A PROCEDURAL GUIDE FOR ESTABLISHING AN ELECTRONIC DATA PROCESSING SYSTEM IN A FOOD SERVICE ORGANIZATION

By

JESSIE STUART BREWER

Bachelor of Science

Mississippi State College for Women

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ELECTRONIC DATA PROCESSING SYSTEM

IN A FOOD SERVICE ORGANIZATION

Thesis Approved:

Helen F. Barbour
Thesis Adviser

Dale D. Grosvenor

N N Durham
Dean of the Graduate College

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CHAPTER I

PURPOSE

The food service industry has developed into a colossal operation in this space age. The enlargement of the industry has developed the need for highly trained and skilled personnel. Management must assume increased responsibility for directing and growth. Demands on the administrative personnel of the food service industry require that more of the non-professional duties be delegated to lower echelons than formerly. This will allow administrative personnel additional time for managerial activities, professional duties and planning.

Observation and past experience in the profession of dietetics has developed great concern in the author for the vast amount of time consumed in non-professional activities. Furthermore, there is decreased time available for the ever expanding need of professional duties. It is this concern that has stimulated the author to explore new methods to eliminate the mis-directed use of the dietitian's time and ability.

The use of electronic data processing shows great possibility in being one of the most efficient systems available at the present time. Technology and equipment today allow many of the clerk-type duties needed for decision-making to be processed quickly and accurately and be readily accessible to management. Industry has put computers to work in many areas, but the food service industry has been slow to adapt and utilize these dynamic machines.

The original objective of this project was to develop a program to allow computers to calculate and print kitchen requisitions from supplied menus and recipes. As the investigation progressed, the author altered this objective to one considered more pertinent and significant. Therefore, it is the purpose of this thesis to develop a guide for establishing an electronic data processing system in a food service organization.

Limitations of the study involve (1), the author's lack of technical knowledge concerning data processing methods (2), the lack of available facilities using data processing equipment in food service related applications for observation and (3), a time factor limiting the investigation of approaches in establishing an electronic data processing system.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The rapid development of the food service industry in the past few years has imposed additional demands on the management of these organizations. The present activities of the personnel affected by this growth have been the subject of several recent investigations.

A study by Lipscomb and Donaldson (68) of activities discharged by directors of dietetics measured the degree of perceived responsibility, authority and delegated authority. Dietitians estimated they delegated authority to assistants in a lesser degree than was their estimated responsibility or authority. The authors concluded, "Delegation of selected technical activities would provide additional time for the director to spend on higher level managerial activities, such as planning, coordination and evaluation" (68, p. 471).

Miller (71) states that as much as five hours daily is spent on clerk type duties by dietitians. Another survey of types of activities therapeutic dietitians perform revealed that 70 per cent of the total working time of 137 dietitians was spent on written (35.4 per cent) and total oral communications (74). Participation in doctor's rounds and research activities involved the smallest percentage of time spent. One-fifth of the total time was determined to be spent in "essential non-productive work activity".

Payne (78) refers to types of criticisms that seem to reflect the lack of creativity in therapeutic dietitians. These criticisms include:

> ... too-rigid routines, too much paperwork, too little real functioning as a member of the medical team and too much mechanical following of orders, too much time spent in activities that should be delegated to non-professional personnel (78, p. 20).

The period since 1950 has been designated as the period of radical change (71). The importance of eliminating the non-professional duties from the dietitians' daily schedule is becoming more significant because of this change. Donaldson states, "Food products, equipment, automation, electronic data processing, teaching machines, cybernation and other new ideas and methods predicted for some vague future are here" (38, p. 357). These factors demand a dietitian's time and ability to investigate, adapt and innovate. More important, the dietitian must make time to cull out inefficiencies in the operation before automation is established. An automated system will freeze communications (34). Therefore, inefficiencies in the operation will be frozen into the system if not eliminated prior to utilization of such a system. Many areas of the food service operation must be standardized before machines and computers can be of value to the dietitian. Foster presents it in this manner, "The computer has arrived as a tool. Sharpening that tool is the present challenge" (49, p. 104).

The use of new methods to eliminate the clerical duties will bring about proper use of the dietitian's education, training and ability. It will also bring about changes in the educational requirements of dietitians in the future, as is recognized by both Ross (83) and Donaldson (38). The latter foresees the person making the decisions as being able to understand all the new things in organization and being able to translate the technology into quality food production.

The following sections of this chapter will endeavor to familiarize the reader with the components of an electronic data-processing system, applications found in industry, hospitals and food service organizations and factors to consider in planning a system. A basic understanding of the materials presented in the literature is necessary to facilitate comprehension of the later chapters.

It is appropriate at this time to clarify the meanings of terms that will be found throughout this paper.

The concept of systems contained herein refers to both internal and external factors of an organization as a whole. The terms "total system" and "totally integrated system" are used synonymously. Various subsystems may operate within a total system, interacting continuously with output for one system providing input for another.

Data processing may be referred to as: (1) automatic data processing (ADP); (2) electronic data processing (EDP); and (3) integrated data processing (IDP).

An Electronic Data-Processing System

An electronic data-processing system is comprised of five basic components: (1) a memory unit, (2) an arithmetic unit, (3) a control unit, (4) a data input unit and (5) a data output unit (51). These mechanical units are of little value without instruction routines for the processor to follow, and personnel to operate and maintain equipment. Also personnel are needed to analyze and set up procedures, prepare instructions, provide input data, utilize reports, review results and supervise the entire operation (52). There are four basic activities involved in an automatic data processing system. These are the development of input, the production of the desired final output, the storage of data at various stages in the system and the performance of arithmetic and control functions within the computer (1).

The development of input requires the collection, conversion and verification of data. The collection of data may be a manual operation such as making punch cards (52). Gregory (51) refers to all facts obtained as "data". He further emphasized that "Facts are the raw material of data processing" (51, p. 3). "Information" refers to particular facts that management needs to know. Data is gathered, manipulated and reported as information results for management decisions. The information may also be retained in the computer for use with other data for further processing.

After the collection of data, it must be arranged in a language that the computer can understand. Before the data can be put into machine language, a clear and concise flow of information must be established. This is accomplished by analyzing the data and developing a flowchart that will represent a schematic over-all process. This process is written in abbreviated form as a "program" and entered into the system. Verification is then necessary to determine if the data is complete, plausible and acceptable to the machine. If the program does not meet any one of the three requirements, the machine will not process it. The program may be complete, plausible and acceptable to the machine but the data entered may be incorrect. Therefore, the data must be verified to eliminate errors in input.

The principle operation in processing data that has been collected, converted to machine language, and verified is rearrangement. This involves classifying data by type and ordering it into sequence without changing the content. Processing is accomplished by computations. This manipulation of data requires facilities capable of controlling operations which follow the prescribed plan, capable of storing data and processing the instructions and capable of performing arithmetical and logical operations.

The memory unit of a storage data-processing unit is used for orderly recording of data so that it is accessible to the machine when needed to complete instructions. The memory unit may be a magnetic drum, a magnetic tape, a matrix of magnetic cores or a combination of any of these. The type of unit will determine the capacity of the memory. The magnetic core is the most widely used (51).

The arithmetic unit of the computer contains the electronic switches, transistors and other essential mechanisms necessary to perform arithmetic computations. These computations are performed on codes for decimal integers.

The control unit is used for directing operations within the computer. It obtains instructions from storage, interprets them and carries out the instruction. This function is accomplished by circuits opening and closing in response to individual instructions.

The output unit uses punch cards, magnetic tape, punched paper tape or a printer. The printer may be used to print data from magnetic tape, punch paper tapes, punch cards or directly from the machine storage onto paper. Instruction and type of machine will determine which of these output methods will be used.

History of Computing

The need and use of devices to speed working with numbers has long been evident. The first aid was the abacus which has been used for thousands of years (87). The abacus is a device that makes use of the bi-quinary number system. The Chinese trained in the use of this simple wooden-peg type apparatus, can out-calculate an operator of a modern calculator. The same bi-quinary number system has been used in developing mechanical computers.

In 1642 the first mechanical computer was built by Pascal and later in 1673, was improved by Leibnitz. A British mathematician named Charles Babbage attempted to develop a large machine in 1812, but due to limited funds the project was not completed. In 1833 he developed the idea for the ancestor of all automatic computers, a machine he called the "Analytical Engine". With this machine it was possible to specify in advance a sequence of operations and the numbers to be used in these operations. Again the expense of the project led to failure in actually developing this machine.

Another step in the development of devices to speed the manipulation of numbers was made by an American, Dr. Herman Hollerith, who patented the punch card in 1889. He developed the card, to be punched by hand and used on a tabulating machine which he invented, to speed the counting of the census in the United States. The 1890 census was completed in one-third the time of the 1880 census, even with a 25 per cent increase in population, by use of this new system. The card used in computing systems today is known as the "Hollerith card".

Babbage's principle of sequential control was used in 1930 for the development of the first modern computer by Dr. Howard Aiken of Harvard University. The machine is commonly known as the Mark I and makes use of electromagnetic relays and punched paper tape. After several years' work the machine was completed in 1944.

The first large electronic computing machine, the Electronic Numerical Integrator and Computer (ENIAC), was completed in 1946 and put into operation at the University of Pennsylvania (88). Its use of vacuum tubes, wherein mechanical inertia was not present, made the high speed of the electronic machine possible. The speed of the electronic pulse in the vacuum tube which performed an arithmetic operation was limited only by the time it took for an electrical transient to settle down. The ENIAC can perform a multiplication in 2.8 milliseconds. The vacuum tubes were later replaced by crystal diodes and more recently by transistors, which enable small, compact, high-speed computers to use less power.

The Univac was the first mass-produced computer and was placed on the market in 1951. The IBM 701 increased the speed of operations and became available in 1953 (88). The Whirlwind I, built by Massachusetts Institute of Technology, has a speed of 0.1 to 0.05 milliseconds per calculation (73). The speed at which these machines could perform was much greater than a human operator's speed in directing the sequence of an operation. Therefore, a method had to be developed so the machine could perform the sequence without human intervention.

Various procedures were tried and presently a set of instructions directing the sequence of operations is entered as a set of coded numbers into the memory of a machine. The control unit of a machine is used to make the selection from the memory of instruction to be used. The results of the instruction are recorded in the memory cell for use in other computations. The memory is capable of storing one character in each cell. Magnetic drums, mercury tanks and electrostatic tubes are used for this function. The memory capacity of a machine was 30,000 words by these methods. This type of storage has been termed "internal storage". Additional data can be obtained from "external storage" on punched paper tapes, punched cards, magnetic tapes or magnetic disks.

Today it is estimated that about 14,500 stored program computers are in use for scientific, engineering and commercial data processing (73). In addition there are thousands of special-purpose computers, electronic card calculators and analog computers in daily use. The U. S. Government uses the majority of all computers and is either directly or indirectly paying for the cost of developing other specialized computers. The development of these special computers is costly, but the military services, who are essentially the only customers at this level, are the causal agents for this special research. As the machines are developed and the cost for production is lowered, the commercial base will be preparing to purchase and put to commercial use the new products. The adaptation pattern of computer use in industry appears to be very uneven. Computers have been readily accepted for some clerical functions but not as readily elsewhere. The high speed at which these machines can produce data creates a threat to clerical help, middle management and top management. The University of Chicago (73) estimates that the new IBM 7090 takes about an hour of computer time to do the equivalent of one million man hours of desk calculator work. It was figured that the machine could do at the cost of one dollar as much calculating as a man could do in a year. The speed differential of larger machines to hand calculating was determined to be ten million to one.

Management has not hesitated to use computers in bookkeeping functions where they can be directly substituted for clerical labor. The use of computers in management functions is viewed as either a threat to middle management or as a boost to the man in the middle. If reorganization to use computers involves by-passing the functions of the middle manager and leaves the decision-making to top management, the threat is real (73). On the other hand, if the middle manager is retrained to care for and feed the computer, the middle man will gain in importance in management functions.

Managing with Electronic Data Processing in Industry

The computer has become one of the most revolutionary tools available to industry in the last twenty years. It has been used to obtain greater efficiency in clerical duties, to expedite accounting procedures, to lower inventory levels, to better competitive positions and other management reporting activities. A new area of computer uses is advancing in the management of the business industry.

Higginson (60) conducted a survey of companies in the United States industry that had 1,000 or more employees. Information for the research was obtained by mailing a four page questionnaire to the presidents of 988 companies requesting information concerning EDP in their organizations. Detailed letters or questionnaires enabling 288 companies to be included in the survey were returned. The participating companies owned, rented, or leased approximately 13 per cent of the computers in the United States.

The companies were asked to state their EDP objectives in an attempt to determine what data processing meant to them. Only 112 companies presented goals that were measurable. Others (117) referred to their objectives in terms of applications and about 15 per cent gave broad nonmeasurable objectives. One-half of the measurable objectives presented were financial and over one-fifth related to information objectives. The goals listed by these companies were as follows:

	No. of companies
Improved clerical savings	45
Reduced data-processing costs	32
Lower administrative or overall costs	20
Better service to customers	17
Greater timeliness of information	17
Increased speed of information	13
Improved accuracy of information	11
Greater efficiency	11
Higher contribution to profits	9
Fewer employees	6
Higher productivity	4
Additional information	3
Reduced clerical effort	2
Reduced inventory	1
Higher inventory turnover	1
Improved sales	1

(60, p. 32-33)

Higginson discovered that only one-fourth of these objectives had been set in terms of corporate needs and the rest for clerical or departmental needs. His conclusion was that data-processing executives did not consider the computer as a management tool.

The question regarding applications planned for in the future indicated a greater concern for management needs. More specifically, the questionnaire revealed that executives planned to use EDP for management information systems, management planning and control, reports and operating systems. Others stressed planning and control, while a few were interested in integrated, information or total systems. Only 18 companies stated operations research and problem solving as their future targets. The author was concerned that the use of computers for "decision making" was seldom mentioned. The major problem of companies setting appropriate EDP objectives was stressed by only one executive. He said:

> Probably the reason that we have not made more use of our computers is that there has been a certain haziness about our objectives. Most of our decisions to date have been intuitive. Either because of ignorance or skepticism on the part of management regarding what can be done with computers, they are not being used for the important areas of our business (60, p. 34).

Information has become an important factor in the new concept of systems in conducting business. Forrester described an organization as a "system which has six interconnected networks: personnel, money, materials, orders, capital equipment, and information"(60, p. 37). General Foods Corporation uses previous activities as information, whereas, Lever Brothers Company initiates action with EDP, and uses it for management reporting and problem solving. Therefore, information can be defined as a reflection of action. It can be a summary of past actions, or action that needs follow-up or control, and to initiate future action. Information flows upward in the form of reports and downward as instructions or directives, or outwardly to customers and stockholders.

Computers can process masses of data and provide instantaneous information. This is an important factor in being able to obtain better control and for planning applications in industry. The survey points out that routine clerical applications are in common use and do save money for the companies, but the executives expressed the fact that they were interested in making money, not saving it. Therefore, planning and control applications are of more concern to competitive industry. Applications of computer information by the companies participating in the survey show the common use of clerical routines. Sales analysis and inventory control are gaining attention as the following frequency list indicates:

	No. of companies
Payroll	247
Sales analysis	235
Inventory control	211
Billing and invoicing	195
General accounting	197
Accounts receivable	183
Cost accounting	188
Accounts payable	152
Personnel	136
Production control	133
Production planning	128
Shipping-distribution	106
Sales planning	95
Purchasing-ordering	89

(60, p. 38)

Information is not the only important function of EDP. An EDP system can provide services to both management and to customers. General Electric Company provides their divisions and departments with consulting services. The computer can also be used to coordinate departments. Information from all departments can be compiled into a single integrated system. This integrated system allows the departments to realize their part in the whole organization. EDP can be used in developing budgets, standards for administrative executives and to help measure these standards, therefore, performing another control function.

Service to customers is provided by immediate information of product availability and delivery. EDP allows the sales force more time for customer satisfaction by relieving them of administrative details. Lever Brothers Company has drawn together corporate functions that effect customer service. Among them are sales forecasting, production scheduling, warehouse replenishment, order processing, warehousing and shipping.

Hospital Use of Electronic Data Processing

Hospitals have been slow in adopting the use of the computer, possibly due to their unique organizational structure. Gradually hospitals are beginning to realize the abilities of the machine and the possibilities of its use in areas undreamed of in the past. Many of the larger hospitals are now using data processing equipment in the traditional business applications of payroll and accounting. At present, several hospitals are experimenting with various applications of EDP in areas from research in life sciences to bedside care of patients.

A recent report in the Army Times (61) gave an account of four research projects under study by top-level medical officials that could lead to the use of bedside computers in hospitals. The computers could be used as bedside monitors that would keep a continuous check on vital life signs, such as temperature, pulse, respiration and heart condition. The failure or down swing in any one of the vital signs would cause a light to flash at the nurse's station. Other uses of the system mentioned were to help plan menus and special diets, to help doctors diagnose illnesses and to prescribe medicines. In helping to diagnose illnesses, the computer would be fed symptoms of the patient and the machine would compare this input with thousands of medical case histories that have been stored in its memory and print out a list of illnesses that might be indicated by the symptoms. The list would be in order of probability. It would be the final responsibility of the doctor's professional judgment to make the diagnosis. The system would also be used to keep medical histories of patients readily accessible to a medical officer at nearly any fixed medical facility, reducing the possibility of lost records in the frequent moves of service personnel. The system would provide nurse's stations with keyboard units that would enable nurses to order prescriptions from hospital pharmacies by punching letters on the keyboard. The medicines would be delivered through pneumatic tubes back to the nurse's station.

Pilot studies at Tulane University Medical School in New Orleans (85) have recorded information and stored it in computers for use in statistical studies. Information pertinent to the medical history of the patients is checked on a form designed for easy reference by the physician. This check sheet is used to prepare the punched cards for the input data to be stored in the computer. Clinical information is checked on marked sense cards and stored on digital magnetic tape for further reference. This information can be retrieved for study by having the computer challenge the records containing a given set of conditions, extract information and array it in the proper format for analysis. The information can be reorganized under a subject heading for clinical use, for study of medical terminology, to detect trends in the incidence of infectious disease, to study the effects of investigational drugs and environmental factors or to study other major health subjects.

The bacteriology laboratory at the University of Illinois Research and Educational Hospitals (28) developed a method for using the computer to prepare the monthly report of over 2900 specimens tested per month. A data processing center was already operating in the administrative area, therefore, offering a speedy and accurate method for computing the information needed. Clerical personnel was used to prepare the data and reports, leaving the medical technologists free for laboratory duties. Punch cards were used with a coding system developed to record the necessary data. Data from the monthly tabulation produced the following information:

1. Number of specimens processed.
2. Processing cost for these specimens.
3. Total number of specimens processed for each ward or clinic.
4. Processing cost for the specimens for each ward or clinic (28, p. 92).

The laboratory staff indicated that the use of the computer made comparisons between time periods more valid due to standardized methods needed to obtain and count the data. Minimization of human errors and variables in judgment were advantageous also. The increased data available facilitated its use for clinical investigation as well as establishing a correlation between work volume and costs.

The Health Sciences Computer Facility at the University of California, Los Angeles (94) uses two data processing systems to provide computing support for basic medical research and as a base of applied computer research in biology and medicine. The speed, memory capacity, and accuracy of the digital computer makes clinical data readily accessible to the medical staff. A panel of physicians and medical scientists stated a few examples of the current use of the computing facility at UCLA as follows:

> Significant new knowledge is being provided on the organization of brain systems during sleep, fatigue, prolonged darkness and other conditions.
>
> Complex biochemical experiments now conducted in the laboratory may one day be performed more rapidly, precisely, and economically with computer assistance. Chemical responses of blood to various factors in surgery are simulated and analyzed by the computer in one project.
>
> Huge masses of medical data can be analyzed. In one effort the computer is a principal tool in a Los Angeles heart study aimed at discovering causes associated with heart disease and conditions which keep people free of heart trouble.
>
> The facility serves as a research tool aimed at developing a hospital-wide system of automated record handling, storage, and retrieval. This project involves development of a computer-stored "thesaurus" of disease conditions for automatic coding of disease (94, p. 87).

Review of literature reveals most hospitals are applying data processing in a particular area and for a specific function such as research, accounting, or to reduce clerical activities. The Children's Hospital, Akron, Ohio (25) is developing a prototype communications and information network for computerized hospitals of the future. A two year feasibility study began early in 1961. The entire hospital was evaluated. The study indicated a need for either systematization or automation. It was found that about 40 per cent of the nurse's time was spent doing clerical work and that duplication of effort by personnel resulted from a lack of a single source of information. Another problem was "the inability to insure an acceptable degree of accuracy when transcribing or transmitting information, making dosage conversions or other computations, and when preparing medical documentation" (26, p. 71).

The system was narrowed after the study from the original "grandiose" system of solving most of the communication problems in a hospital, by eliminating systems being used and studied at other hospitals (25). The accounting and business applications will be incorporated after the information system is operational and processed during slow hours, therefore, becoming a by-product of the system. Time clock recorders will be used for payroll purposes to eliminate key punching of employee hours. The time clock is connected directly to the computer eliminating many clerical functions previously used.

Manual entry units and output printers are located at the seven nurses' stations, seven other ancillary departments and at the admitting office. The basic data for each patient is key-punched and fed into the computer by a card reader at the admitting office. The input-output units are in direct communication with the computer complex. Two disk packs of two million digit capacity are used instead of tape due to the need of near-instantaneous retrieval of stored data. The computer has a clocking system that calls into action more than 150 automatic functions for inpatients and 50 more for outpatient activities. An example of what the call schedule list will provide the nursing unit terminals between the hours of 6 A.M. and 6:38 A.M. is as follows:

> Time-date notification
> Formula feeding schedule
> Medication not reported -- reminder, 6 A.M.
> Medication schedule, 7 A.M.
> Lab regular schedule
> Kitchen requirements
> Dietary breakfast
> Shift medication not reported -- reminder
> (25, p. 118)

In addition to these functions, approximately 160 other application programs are used for patient activities. The nurse's station has a loose-leaf detailed instruction book for reference for easy conversion of orders into computer language. The nurse can report, order and query by way of the entry keyboard of the terminal. Appropriate numbers are entered across the 12 rows of keys, the output printer types out the message, and the nurse verifies it. If the message is correct a transmission key is depressed to start the cycle of computer activity.

Test runs of ten-day periods have been conducted to "debug" the programs. Education of personnel was an important factor, but did not prove to be a major obstacle. It was found that a range of eight hours was needed to learn to use the loose-leaf instructional manual, and that confidence and speed of the operators were gained after a period of three or four days. It was determined that personnel reaction was very favorable. The study pointed to a number of omissions in conventional communications not noted previously. Although further research and evaluation was found to be necessary, the assistant administrator concluded:

> Successes thus far indicate that systems approaches such as this will one day be utilized in all hospitals -- either time-shared or others or self-contained within the institution (25, p. 120).

There are a great many hospitals that are too small to afford a self-contained data processing system due to finances, talent, or a wide scope of applications. Several articles have revealed various approaches to solving this problem. One answer may be the shared automatic data processing facility. The banking industry has been successful in this area as have been some hospitals. One or more hospitals join in developing and establishing a single data processing center with one operating and planning staff. Many advantages are realized such as reductions in labor, more timely and accurate information, improvement in financial systems, elimination of clerical duties by professional personnel, and assistance in managing and planning. Pacholski (77) has listed additional advantages of professional, administrative and operational functions as follows:

> Use of a computer system by any participating hospital regardless of size.
> High caliber personnel to staff the centralized facility, and more of them than any individual hospital could afford.
> Use of more sophisticated systems and techniques that could not be developed individually by a hospital.
> Sharing of the best administrative and management techniques.
> Preparation of comparative reports and analyses permitting performance evaluation.
> Expansion of centralization to additional susceptible areas and functions.

> Release of sorely needed hospital space for other use (77, p. 56).

Pacholski further lists 13 separate areas or organizations that are studying the feasibility of shared data processing systems.

A single machine installation and a unified staff have served the Fairfax Hospital and the Alexandria Hospital in the Washington, D. C. area since 1962 (37). An estimated $25,000 per year has been saved by the project. A third hospital requested to join the system and plans were initiated to incorporate this new hospital into the system by January 1966.

An independent staff was established called the management services division and placed under the direction of an assistant administrator. This staff is reponsible for the development of all new systems and procedures and for review and control of the existing system. They are responsible for the training and indoctrination of all hospital employees of both hospitals. Staffs of both hospitals share in the policing of the systems. The plans for the third hospital include utilization of a consolidated systems staff, also.

The twelve hospitals of the Sisters of the Third Order of St. Francis have found the use of electronic data processing for accounting, gratifying (62). Prior to 1956, only one hospital had an accounting staff. A general ledger was maintained at Peoria, Illinois and monthly reports were sent in from each of the twelve hospitals. As the public became more conscious of the cost of hospitals, a need emerged for an accounting staff at each hospital. This need was fulfilled by the development of a central accounting and administration office with one controller. Data processing was required to process the accounting data rapidly to provide meaningful data to each hospital. The central accounting system required the development of a handbook and manual on procedures for reporting the information for processing to obtain uniformity from the twelve units.

Hospitals that cannot afford a self-containing data processing unit, and are not in a situation that lends itself to a shared data processing system, may find aid outside the hospital. Service bureaus have been established in some areas that sell computer time to industry, businesses and organizations such as the hospital. Mount Sinai Hospital of Chicago (12) utilized such a bureau. A biweekly payroll for 1300 personnel is processed at a data processing bureau. The bureaus' ability can be utilized to solve single problems for a hospital. The hospital may use this service as the first step toward a more integrated data processing program of their own, or more specific applications may be the objective of such services. Baum has stated three major advantages of using a service bureau as:

1. A hospital can enjoy the benefits of automation even though it has no installation of its own.
2. A hospital gains valuable experience for the day when it expands its use of such equipment, whether this develops from its own installation or through more elaborate service bureau or community hospital computer center applications.
3. The hospital can utilize less time than they can afford if they owned their own machines (12, p. 51).

The availability of service bureaus, of shared systems and of self-containing systems has not been sufficient to make data processing a common application in hospitals to date. In 1962 the Division of Research of the American Hospital Association conducted a survey to determine the use of data processing applications by the hospital members (50). Results determined only 7 per cent of the 7000 registered hospitals maintained data processing applications. Only 39 of the 7 per cent reported the use of computers. Approximately one-half of the hospitals using data processing equipment used outside equipment to tabulate records. The major application of the equipment was for bookkeeping purposes. It was found that larger hospitals were more likely to utilize data processing equipment than were small hospitals. One of every three federal government-controlled hospitals utilized data processing equipment with large voluntary hospitals being the next largest user (5.7 per cent). The overall reaction to data processing for hospital record keeping was favorable. The main complaint was due to general mechanical difficulties with the equipment. The number of completely dissatisfied members was only 2 per cent, as compared to 33 per cent that were completely satisfied.

Food Service Application of Electronic Data Processing

The application of electronic data processing in food services did not appear in the literature until 1960. The Methodist Hospital in Indianapolis initiated the use of punch card processing of menus. The patients on regular diets checked their own menus, whereas, the dietitians visited the patients on modified diets and checked the menus for these patients. It was reported that increased patient satisfaction was gained by the use of selective menus and resulted in reduced food waste, increased portion control and increased accuracy in food orders (82).

The use of punch cards for inventory control in food service first appeared in 1961. Tatge (89) described the system as a card file. A card is punched for each item purchased and placed in one of

24 categories of food items. When the kitchen orders an item, the corresponding card is pulled from the file and run through an accounting machine to obtain an accurate expenditure record for each classification of food. The percentage of total food cost is also calculated for each food group.

Tatge also discussed the use of data processing to determine labor efficiency. Labor cost was distributed into 14 categories according to areas of work. The man hours expenditure on various tasks were calculated and costed.

Punch cards were used for selective menus as in the Methodist Hospital in Indianapolis. The menus were printed in the center of the card and marked by the patients with special pencils. A carbon-sensitive machine read the marks and punched holes related to the menu at a speed of 100 cards per minute. A sorter arranged the cards according to foods selected and a tally of each item was obtained. The cards were then rearranged by the sorter in order of patients to be served. The sorter operated at the speed of 400 cards per minute for each card column or food item.

The use of electronic data processing in food service applications became more prevalent in the literature in 1962. Nutritional analysis, nutritional research, tallying of selective menus and costing of foods seemed to be the most significant applications. The use spread to analysis and control of food costs, menu planning, inventory control and arrangement simulations.

Hayes, Abraham and Careres (58) described the use of computers in epidemiologic dietary studies. To gain appropriate use of computers for such studies an exceptionally large volume of data should be evident, the processing operation should be repetitive and lengthy, complex statistics or extensive classification are involved or speed must be essential in the analysis of data. The epidemiology studies of cardiovascular diseases meet these requirements. The initial dietary data was collected by interview, food records, or self-administered questionnaires and converted into quantitative dietary data by computer. Operating instructions and a food composition table were stored in the computer for use when input consumption data required computation. The results were printed reports or output tapes as specified by the investigator.

The use of computers in the epidemiologic studies revealed three distinct advantages. Improved comparability of different studies were possible by eliminating the shortcuts taken previously, due to volume of data collected. The second advantage was the application of new approaches in analyzing data such as determining the time of food ingestion as well as the total nutrient intake. Another advantage was the effective storage of data on punched cards or tape that could be easily manipulated for future studies.

Tullis, Lawson and Williams (93) discuss the use of the digital computer for calculating dietary data by the "short form". The short form of nutritional composition of food includes fifty-one categories, fifty two if alcohol is included. Analysis is usually calculated for twelve nutrients or greater if special interest items are included such as type of fatty acids present. The two-dimensional array resulting from the food categories and nutrients evaluated, provided 624 derived items. The authors expressed the problem in mathematical terms as follows:

> ...the basic procedure represents the multiplication of a vector, the components of which are the amounts of food ingested, by a matrix, the elements of which are the numerical values in the food composition tables. The resulting matrix product is a vector representing the desired nutritional factors (93, p. 384).

The dietitians estimate the quantity consumed by the subjects, using food models as a guide, and record it on a form that corresponds to the punch cards of the 52 categories of food. The input cards are punched accordingly. The computer contains a program that will make the necessary computations and punch or print out the results as directed. A master deck of 52 cards containing the nutritional data for the 52 food categories are read into the machine and stored in the memory cell for future reference. To obtain the nutritional analysis of a subject, the cards prepared from the food consumption report are fed into the machine, the program is activated and in a few seconds the results that have been computed are punched on output cards or printed as directed. The output cards can be used further in summaries, correlations and statistical evaluations. The output for a subject contains a summary of the daily nutrient intake, the average daily intake, and National Research Council recommendations for easy reference.

Electronic data processing has been helpful in evaluating dietary surveys conducted in earlier periods as well as more recent investigations. The surveys are used to characterize and differentiate eating habits and nutrient intake of individual and group diets. Nutritionists from the Louisiana State Board of Health in New Orleans use the system to gather data for a dietary-atherosclerosis investigation (55). The investigators not only sought to characterize and differentiate diets and dietary habits by the use of more accurate and standardized methods for assessing dietary data enabled by computer use, but also thought it possible to identify new trends by the longitudinal studies.

The data processing system is programed to compute thirty-six chemical components and thirty-two interrelationships of the diets. The system is flexible and can process data for homogeneous or heterogenous individuals or groups. Correction factors for census and time are included in the system to allow comparisons. When proper correction factors are applied, the system indicates the average food eaten as a daily average gram weight.

The system is developed to provide proper maintenance of the nutrient table as revised analysis is available or new foods added. Another provision is the double checking of calculations to detect printing, clerical, and card-punching errors. A special character was devised to represent missing nutrient data so that the percentage calculation would be for known nutrients only. This was also valuable in the statistical analysis by utilization of the confidence levels produced by the special characters, because constituents with nutrient values known at or above the 75 per cent level were included to obtain means, minimum and maximum values, standard deviation and standard error of the nutrient analyzed.

The utilization of electronic data processing equipment for calculation of nutritive values for epidemilogical research has provided more accurate, immediate, and consistent results. The system has enabled the calculation of individual items to be evaluated. The statisticians in the Consumer and Food Economics Research Division of the United States Department of Agriculture have prepared a deck of cards to facilitate the use of EDP in nutritional analysis. The nutritive values of foods according to the USDA Home and Garden Bulletin No. 72, (1960), titled Nutritive Value of Foods, have been used for the cards. Most of the values are for ready-to-eat forms of food. A manual was prepared to accompany the cards to describe the method of computing the nutritive values with the cards. Another deck of cards for institutional use was prepared for "as purchased foods" corresponding to Handbook No. 8, Composition of Foods--Raw, Processed, Prepared (29). The cards were revised based on the 1963 revision of Agriculture Handbook No. 8 and include values of the edible portion of 100 gram portions as well as 1 pound food as purchased. The data was recorded on magnetic tape also. The USDA Home and Garden Bulletin No. 72 was revised in 1964 and the new data applied to update the corresponding deck of cards. At this time, the instruction manual was revised and can be used for either of the two decks of revised cards (75).

Nutritional analysis of research is not the only application of electronic data processing in the food service industry. The main objective of menu planning is to develop a palatable, attractive and acceptable menu that is nutritionally adequate. Electronic computing equipment is an excellent tool for evaluating menus for nutritive value. The Veterans Administration has established a system for evaluating the menus of its hospitals throughout an area, at a central data processing center. Brisbane (22) reported that the use of computers at the Data Processing Center in Los Angeles makes it possible to calculate the nutritive value of menus of 170 VA hospitals in the Western section of the country. The process has attained both accurate and standardized source figures of food composition in addition to relieving the hospital dietitians of this clerical task. Both regular and modified menus are analyzed for 14 nutrients for both daily and weekly averages. The USDA punch cards have been adapted for use in the system. The system has proven satisfactory as the mechanics are easily understood and accepted by the dietitians.

A survey of 15 hospitals in the three states of California, Maryland and Ohio led Hartman to make this statement:

> Data-processing equipment still is expensive, and in spite of the fact that value is recognized, the cost and difficulties encountered in programing have prohibited its use. The hospitals represented in this survey plan to release dietary personnel from the time consuming clerical duties and manual calculations of nutrient value of diets; ideally they should provide more patient contact for these persons, thus increasing patient satisfaction through visible personal attention to their needs and wishes (57, p. 168).

The use of computers should not be restricted to the evaluation of menus, the tallying of food orders from diets and for nutritional analysis. Clithero, an IBM representative, announced the following:

> With the advent of high speed computers and a mathematical technique known as linear programming, we can examine all combinations of food items, based on nutritive value, availability, and price and calculate a menu that will meet all requirements at the least possible cost (30, p. 451).

He further explains that a set of "shadow prices", which indicates how much the item costs to add or exclude, can be produced. The computer compares each food item with every other item giving the item's true value relationship to the finished menu. Some of the important results of computer menu planning are quality control, least cost and purchasing guidance.

Balintfy* of New Orleans has just such a program in operation (3). The system is designed to take the many variables that a dietitian considers in planning a menu, process these variables by use of a "bounded integer programming algorithm" developed by Dr. Balintfy and his associates, and make decisions on foods to be included in the menu. The system reduces food costs by 25 to 30 per cent and may be used for any hospital with 15 beds or more. The dietitian can accept or reject any menu item included in the diet or insert another item. The computer will then make necessary adjustments to meet all requirements programmed.

The pilot study for the computer planned menu was conducted at Touro Infirmary in New Orleans (38). Information was collected on food prices, recipes of menu items, and patients' preferences. This information was used as input information for the menu-planning program. Another source of data used for input information was the nutrient composition of foods. The food-price information was converted into cost per serving of each menu item. The storage of the food-price data allowed updating as necessary. The Recommended Daily Dietary Allowances of the National Research Council were stored on tape for future use in the program. The nutrient composition of the food items

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were recorded in 100 gram portions.

Recipes for the menu items described the item and listed the ingredients with quantities in 100 gram units for one serving. The information about the food item was used to determine the nutrient value and cost of each food item included in the recipe. These values and cost were tabulated to obtain the total nutrient value and cost of the menu item. This figure was converted into a single cost per serving. The size of the portion was determined by the hospital dietitians and was subject to change if desired.

A questionnaire was distributed to the patients to obtain the preference frequency of each menu item. The questionnaire queried the patients on meals previously eaten as to how they like each item on the menu and how frequently they would like the item to appear on the menu. The results from the questionnaire were then statistically analyzed by the computer. The analysis showed how many meals should separate the food item before it appeared on the menu again. This information was used in the program for menu planning. Once a food item appeared on the menu, it could not be considered again until the proper number of meals had been planned.

The four sets of informational data used as input for the menu-planning program were the original objectives of the program to be satisfied. Balintfy and his associates had to develop a complicated mathematical program to meet the set objectives.

The IBM 1410 computer was used to program the menus in the original study at Touro Infirmary. The program took no more than 40 seconds to produce a menu that was the lowest cost per nutrient requirements stated. The menu was printed out for the dietitian to review and accept or reject. If the reviewer desired to make a substitution for one of the menu items produced by the computer, it could be typed on the console typewriter input-output machine used with the system. The computer would then recalculate the menu and produce the new menu with nutrients and cost tabulated. It also produced the percentage amount of nutrients in excess of the requirements stated in the program.

The computer menu was compared with menus prepared by experts to determine its advantages and disadvantages. The cost of the computer-produced menus were 27 cents a day less and did not fluctuate in cost from day to day as greatly as the menus of the experts' did. The nutritional comparisons showed the menus of the experts' met the total 14 day requirements, but did not meet daily requirements as did the computer-planned menus. The investigator concluded from these comparisons, that the computer could produce a less expensive menu that met nutritional requirements daily. The stability of daily expenses could be regulated more easily and the constant meeting of nutritional requirements daily would be especially significant concerning certain nutrients such as vitamin C and the body-building amino acids that cannot be stored from day to day. Another advantage stated was the additional time the dietitian could have for other vital aspects of the job such as supervising the preparation and handling of food, visiting of the patients, and investigation into special nutritional problems of the patients.

The primary objectives of other institutions may not be to obtain the lowest cost menu that meets all nutritional requirements. Other objectives may be defined and programmed. The objectives may be to offer a wide variety of menu items irrespective of cost, a highly palatible menu at moderate cost, or any other combination of objectives. Dr. Balintfy noted that this requirement of having to define and state the objectives of the institution before programming for computer menu-planning was in itself an advantage in encouraging management to recognize and define their objectives (6).

The institution must structure a menu plan, collect the menu's items and recipes and categorize the items into classes such as appetizers, entrees and such. In planning a non-selective menu, each category must supply one menu item to the day's menu. The items selected would then be suppressed for a predetermined number of days so as to maximize the combination of items during this period.

After the institution has established its objectives and structured its menu plan to meet the established objectives, data must be collected and organized for computer utilization. Balintfy classifies this data into two groups:

> that already available in the Institutions' files (recipes, prices, nutrients) and that which may have to be collected (production feasibility and popularity data which points to frequency, preference and acceptance ratings) (6, p. 102).

The processing of this basic data was described in detail by Balintfy and Balintfy (4). The basic information required for the processing is available in most institutions as food purchasing records, recipe files and nutrient composition tables such as the USDA Handbook No. 8. The logical steps of computation for the processing of records of menu items are as follows:

> (i) determine the amount of each ingredient in one (or a given number of) servings of a menu item, (ii) multiply these quantities with the unit price of the corresponding foods and accumulate the products obtaining the food cost per serving, and (iii) multiply the quantities of each ingredient with each of the corresponding nutrient composition per serving (4, p. 5).

Unfortunately, in the three sources terminology for names of foods and their measure are not standardized. Another problem encountered in the processing of the data was the state of the food listed in the three sources. The purchase invoices usually list the foods in the "as purchased" state, whereas the recipe may list the quantity in the "edible portion".

The first step in preparing the data for processing is to code the food items and develop standard terminology for the food names. Establishing standard measures for the three sources is much more difficult and may require endless computations. The Tulane project converted all measures into 100-gram units and used this standard as the basis for all conversion factors. The transformation of the food from the "as purchased" state to the "edible portion" required the calculation of three separate yields. The quantity of food in the "as purchased" state was represented by q_o. The food listed on the recipe was symbolized by q_1 and the completely transformed food appearing in the nutrient tables was denoted by q_3. The q_2 was used for the quantity yield after cooking. Yield factors were calculated for each process as the food passed from the raw state to the "edible portion" by using the formulas $y_1 = q_1/q_o$, $y_2 = q_2/q_1$ and $y_3 = q_3/q_2$. These yield factors were used to calculate the equivalence relationship of each step in processing. This relationship was necessary to determine the nutrient content and cost in each of the three sources of data.

The basic data and the conversion and yield factors are provided the computer to make the necessary computations. The output information was punched on cards and the original data was stored on tape. A master tape was prepared from the input tapes and stored for further use.

A nutrient card was prepared for each food item. The card contained the code number of the food item and its nutrients obtained from the USDA Handbook No. 8. When the computer read these cards, nutrient composition per 100 grams of each of the food items were computed and stored on tape.

Price data cards were punched with raw food cost that was used by the computer to convert the price of each food item into cents per 100 grams of "edible portion". The cards contained the following information:

1. Name of food item
2. Code number of the food item
3. Unit code - identifies the unit (pound, gallon, case, etc.) of the food as it was purchased. (For example, Unit Code 1 corresponds to pound.)
4. A.P. price (in dollars) per unit
5. Yield factor
6. Conversion factor (4, p. 8)

A tape was prepared from the output of the computations of the price data and contained the names, code numbers and prices of the food items. This information was stored in numerical order.

The need for two cards to provide necessary data for the recipe input was recognized. One card was used as a "title card" and the second card listed the ingredients included in the recipe. Information included in the title card was as follows:

1. Menu Item Code Number
2. Name of Menu Item
3. Code for Source of Recipe
4. Total Number of Ingredients required for the recipe.
5. Total Number of Servings obtained from the recipe (4, p. 9).

The second card listing the ingredients contained the following information:

1. Menu Item Code Number
2. Name of the Ingredient
3. Food Item Code Number (corresponding to the numbers on the Price and Nutrient Tapes)
4. Yield Factor
5. Quantity of the Ingredient (in pounds, quarts, etc.) as called for in the recipe for the number of servings specified
6. Conversion Factor
7. Card Number Identification (4, p. 9)

The list of ingredients were stored on tape for one serving and the quantity of ingredients were given in 100-gram units.

The three tapes containing the nutrient data, the price data, and the recipe data were used as input information to calculate the cost of nutrient composition of each menu item. All input data was stored in 100-gram of "edible portion" units. The output for the cost of nutrient composition was for a single serving portion. The output data was stored on a fourth tape, titled "Menu Item Master Tape".

Balintfy and Balintfy (4) recognized several methods for obtaining information to measure food acceptance. Food acceptance may be measured from data collected by tallying selections made from selective menus, by determining a frequency rating or a preference rating from data collected by use of questionnaires or by analysis of cost. A separation rating was determined by using the median of the frequency ratings and was determined by the authors to be the most significant. The selection rating was considered the most reliable but limited by the availability of a variety of items from which to select. The separation rating was used as the input data in the study at Tulane.

The main interest of the pilot study was the utilization of computers in menu planning, but for experimental purposes, related information was also processed (4). The experimental design assured that a card was punched for each patient upon admission with general information about the patient. A "Master Diet Card" was originated by reproducing necessary information from the admission card. Additional information such as the ward number, bed number and diet code was contained on the card. Diet changes could be made on the ward by the means of mark sensing by the nursing personnel. These cards were used as source data to produce an up-to-date "Diet Sheet" for each ward and to pre-punch "Menu Cards" for each patient to make selections for the following day.

The menu was printed on the "Menu Card". On the reverse side of the card a questionnaire was printed for use in opinion sampling by combining the selection ratings with the frequency ratings. A preference rating scale was also on the card, but was not used. The cards were distributed to patients to make their selections by marking the desired items. After collecting the cards, they were processed through a reproducer and a sorter to obtain dietary information for future processing.

A tally of food items were obtained from the cards by machine. An important function of the computer at this stage was to make proper selections for cards that had not been marked by following the diet code on the card. The output information not only contained the total number of servings checked, but also the unit cost and total cost of each menu item selected. This information was obtained from the use of the "Menu Item Master Tape" in processing. Other information obtained from the tallying process was median frequency ratings of items selected and nutrient content and cost of the menu selected by each patient. All output was punched on cards for easy access for later use in statistical analysis, in addition to the print-out sheet for immediate review.

Balintfy and Nebel conducted a later experiment using the technique of computer-assisted menu planning (5). A group of dietitians were asked to plan economical, non-selective menus for seven consecutive days. They were supplied with a list of 200 menu items that were categorized into fifteen classes, such as appetizer, entree, cereal, starch, vegetable, salad and desserts. Three methods of menu planning were analyzed and compared to determine the effect of various factors on the computer-assisted menus. The first method consisted of menus planned without the assistance of the computer. The dietitians had the assistance of the computer for the second method and the third method was a random selection by the computer of a menu item from each of the fifteen classes.

Factors affecting the menu planning were the completeness of dietary information supplied to the dietitians, the difference in planning one week's menu or two and the effect of menu display. One-half of the dietitians received complete dietary information, while the others did not. The subjects were instructed to plan a week's menu to meet daily nutritional requirements at a moderate cost using the 200 menu items. Upon completion of this phase of the experiment, the dietitians visited Tulane University to prepare the computer-assisted menus. Complete dietary information was available for this method. One-half of the group planned menus for the first week while the other half planned menus for the second week. Eight of the dietitians had the menus typed on the input-output typewriter and the other eight had their menus printed out on a printing device fifteen feet away.

The computer calculated a day's menu and printed it out for the dietitian's approval. If the menu was approved, the computer was instructed to compute the next day's menu. If the dietitian did not approve the menu, she was free to type in a new menu item to replace the one she did not find satisfactory. The computer would recalculate the diet, make adjustments and print out the revised menu. This process would continue until the menu was approved and the computer was instructed to continue with the following day's menu. The sixteen dietitians were not instructed in technique of methodology in selecting substitutions for the disapproved menus. Only the eight dietitians who were supplied complete dietary information for the unassisted menus were familiar with this factor to assist in making selections for the computer assisted menus. A control group of two dietitians were given complete information, instructed as to the process of making selections and practiced with the computer to gain experience.

Menus were planned by the computer, unassisted, for a guide line in the study. Menus were selected at random from each of the three methods of menu planning and presented to a panel of dietary experts to judge the acceptability of the menus. The menus were presented in a uniform manner without cost and nutritional data or identification. A five-point scale was used to rank the degree of acceptance according to the combination of the menu as a whole.

The computer-assisted menus were significantly lower in cost than the unassisted menus. On the other hand, the unassisted menus were higher in nutritional value than were the computer-assisted menus. There was a greater variance in the daily nutrient level of the unassisted menus than in the computer-assisted menus.

The panelists preferred the menus written by the dietitians, but were generally pleased with the menus produced with the assistance of the computer. Experience proved valuable in obtaining lower cost menus with the computer-assisted menu planning method, but the availability of dietary information showed no significant effect on the cost. The type of display was significant and supports the "on-line man-machine system" design with remote control terminals. The investigators concluded that "... computer assisted menu planning is capable of producing menus that are acceptable to patients"...and at a lower cost (5, p. 13).

The computer-planned menus the dietitians worked with consisted of three meals a day for each day of the two weeks planned during the experiment. The nutritional requirements were satisfied for each meal at a minimum cost and with the variety objectives satisfied. Since all requirements have to be met for each meal before another can be considered, each meal becomes a stage of planning.

In developing the computer programs for menu planning the defined objectives had to be expressed in mathematical models. Linear programming methods allowed these models to be formulated for making necessary decisions in menu-planning. Linear programming is defined as "a mathematical optimization technique concerned with the most efficient allocation of limited resources to meet specific objectives" (8, p. 2).

The mathematical model is described as follows:

> ... a formal statement about the relationships characterizing the 'constraints' imposed upon a decision maker by given conditions, and the 'activities' or choices which he might consider or 'program' [used in the sense of planning, not as a set of instructions as used for computer programs] in order to attain the optimum value of his 'objective function' by a participation 'solution' of the problem (8, p. 2).

The program used for the experiment with the dietitians optimized minimum cost with nutrient and variety requirements acting as constraints. The fact that these objectives were met for each meal before proceeding to the next meal required several stages of mathematical models to fulfil the ultimate objective of a completed menu. Dr. Balintfy and his associates labeled this problem the "Multistage Model for Non-selective Menus" (38, p. 20).

Other models developed at Tulane are the "Singlestage Model for Non-selective Menus", "Multistage Models for Selective Menus", and "Singlestage Models for Selective Menus" (7, p. 8-11). The singlestage model for non-selective menus produced a list of menu items for the entire period designated, such as two weeks or a month. The model was designed to optimize the main objective while staying within the constraints for the total period. However, a new set of constraints was needed to meet the variety objective. Dr. Balintfy developed a "bounded variable linear programming problem" for the solution. The solution also produced valuable managerial information by giving a reduced cost figure for each menu item listed. This figure indicated the increased (if positive) or decreased (if negative) cost of the menu by allowing the menu item to appear more times than stated in the constraints. The singlestage output was a list of menu items and the number of times each menu item could be used, but was not a completed menu. It had to be arranged into meals by the dietitian.

Multistage models for selective menus could utilize the random meal selection method or the random menu item selection method. Both methods had disadvantages. The random meal selection method produced two separate complete meals from which the selection was made. The menu items could not be interchanged and the cost was not minimized to the fullest, because only expected values could be included in the constraints. Each meal did meet the required nutrients given.

The random menu item selection method gave a choice of menu items from each category of food. However, the objective to meet nutritional requirements was an economically unfeasible task. The Tulane investigators formulated the cost and nutritional requirements in terms of probability. The two objectives were expected to be higher in this method of menu planning.

The same results could be expected for singlestage models for selective menus. Nutritional requirements could not be guaranteed for daily menus and the total cost was expected to be much greater than in the non-selective menus.

Dr. Balintfy has programs for other food service operations. Most of his investigations thus far have been in menu development. A total informational system for food service requires inventory control, requisitioning foods and other related items for the kitchen, purchases from the vendor, employee scheduling, and many other functions. Only one total system being planned for operation could be found in the literature.

The University of Florida Hospital is constructing a design for a total dietary system (45). The objectives of the design are to monitor and control all dietary functions. These functions include recipe development and menu planning which are the input information for the system. Other functions dependent upon the first two functions are tabulation, purchasing, inventory control and work scheduling.

Unlike the Tulane study, the University of Florida plans a selective menu. The selections will be tabulated and the results used for the requisitioning of food supplies and for data in determining food preferences. Inventory control methods will be used for purchasing. A stock level will be maintained and ordering will be initiated automatically when the system indicates an item is below the level established. Work assignments, facilities and equipment, nutritional adequacy and patient satisfaction are all dependent on the menu and recipes, so are instrumental in their development.

The hospital is in the intermediate stage of changing from conventional methods of monitoring and control to automatic data processing of these functions. The flow process has been developed as it will be used with automation, but the actual processes are being conducted manually at this stage.

The University of Florida Hospital has estimated a projected savings of six to eight cents per patient day by using computer planned menus in place of the hand-calculated menus. A total of 1,156 patient days of regular menus served in a two year period is the "break even" point for the cost of computer written menus. Fellers and Gue express this as a "surprisingly low" number and feel that it may indicate the feasibility of computer planned menus for most hospitals with computer equipment available (43, p. 27).

Tulane's experts expressed a much lower cost for computer time per menu. Depending on the size of the computer, an estimate of one dollar per menu was given (6). Balintfy and Blackburn further stated:

> Cost analysis shows that hospitals with more than 400 beds can justify the installation of a medium-sized computer solely on the basis of menu planning economy -- even if the machine is idle 90 per cent of the time! (6, p. 102).

The difference in non-selective and selective menus could account for part of the variance in cost calculated at each institution. Florida University Hospital boasts of a highly efficient manual method of menu planning in effect at present that could account for additional variance.

Osteno, Moy and Donaldson (76) and Knickrehm (63) have studied the use of computers in simulation techniques. It was determined to be an effective method of studying experimental models through manipulation of numbers or symbols. This would provide management with quantitative data for making decisions concerning proposed plans that were tested by computer simulation.

Planning for an Electronic Data Processing System

Planning for an electronic data processing system is an important factor in determining the success of the system. Vignali (96) noted from reviews of Federal installations of automatic data processing that a direct relationship existed between the success of data processing and the degree of planning and study that preceded equipment selection and installation. Results of poor planning were evident in "...misuse and under-utilization of equipment, unnecessary rentals, incomplete programs, and other deficiencies (96, p. 55). The rapid technological changes in computers have made this a greater challenge. Vignali listed ten consequences caused by inadequate planning in developing an automatic data processing system. These are given below:

1. Insufficient management review and control of A.D.P. activities, resulting in uncoordinated and incomplete studies.
2. Lack of objectivity in the performance of the study, which sought to justify decisions previously made.
3. Inadequate analyses of data processing requirements, which led to selection of equipment not suited to agencies' needs.
4. Costs underestimated.
5. Failure to purify data converted to A.D.P., causing inaccuracies in the data processing.
6. Installation and acceptance of equipment before programming was completed sufficiently to initiate a satisfactory level of operation, resulting in high rental payments and low utilization of equipment.
7. Improper use of auxiliary equipment, limiting computer capacity.
8. Selection of equipment on the basis of its immediate availability, rather than on its ability to perform the agencys' workload, sometimes necessitating early and costly equipment changes.
9. Ineffective use of new equipment, due to lack

of system improvements.

10. Excessive rental payments, which resulted when both the old and new equipment were operated simultaneously for long periods (96, p. 55).

Cummins (34) observed the fundamental contribution of the information system to be the discipline involved in the preparation of an automated communications system. He contended that human defenses complicate the problem of bringing technical relationships into practical harmony. He further emphasized the importance of culling out inefficiencies before starting the system, because an automated information system would freeze communications.

Bennett (69) recognized the importance of human acceptance involved in making a change from manual processing to electronic processing of data, by declaring that nothing scares the uninformed worker more than the advent of automation. His suggestions are as follows:

> Don't let employees discover automation plans through rumor; let them hear of the firm's computer intentions through an official announcement that states accurately and simply what's being considered and what workers' future roles will be (69, p. 2).

This policy can prevent or dispel the gross misconceptions that are created in workers' minds by changes. Bennett further states that active distrust of the computer can destroy the effectiveness of an automated system.

Some authorities (21) recommend telling personnel of thoughts about automation before the feasibility study begins. This recommendation is based on the theory that it is better to tell the employees rather than letting them find out by rumors. But most authorities agree that the personnel should be told no later than immediately after the decision to automate has been made. They should be reassured that the change will make their jobs easier. Continued education, reorientation and reassurance are recommended by data processing people.

Planning is necessary in all stages of the system. These stages are preparation, selection, installation and operation of the equipment. The following information should be provided by an adequate study:

1. Disclose areas for improvements, whether the decision is for changing or for continuing the old system.
2. Determine present and future needs for data processing and information requirements.
3. Enumerate the expected economic and other benefits to be derived from the proposed system.
4. Provide knowledge of available electronic equipment and methods.
5. Determine estimated costs in personnel, time and money.
6. Consider internal control and audit trial requirements to provide accuracy and ability to reconstruct data.
7. Provide for selection and training for personnel, programming and testing, preparing the physical site and selecting the organization location for the computer installation.
8. Provide for data cleanup where necessary (96, p. 56).

The "feasibility study" is the first step in collecting the information needed to make decisions about automating. Wertz defines the feasibility study as "a detailed analysis of the technical and economic practicability of using automatic data processing" (97, p. 59). A carefully thought-out plan for the investigation should be developed and should consist of six basic steps. These steps are listed as follows:

> ...(1) organizing the study effort; (2) surveying data processing objectives and requirements; (3) investigating feasibility; (4) specifying and selecting a data processing system; (5) detailed systems planning and programing; and (6) converting to an ADP system (97, p. 60).

Wertz considers the first step as establishing a committee, represented by all departments of the organization, to review all possibilities of data processing. The committee should know the meaning and potentials of data processing and develop the goals of the system.

A study group should be assigned the detailed investigation and analysis. The individuals of this group should understand the organization and should be familiar with methods of analyzing adminstrative problems.

Education and training in data processing should continue during the initial study. Visits to installations using ADP should be arranged.

General goals should be established and used as working guidelines throughout the program. The goals should be substantiated by more specific statements of actions required to fulfill the goals. Each activity of the organization should be queried as to its purpose, procedure and relation to the total organization. This information can then be used to determine costs and effectiveness of the activity in meeting operational and administrative needs of management.

The results of the investigation of the study group can then be used to determine data processing approaches to meet the defined objectives of the committee. Costs, advantages and disadvantages should be presented for both systems to determine if the program should or should not continue.

Wertz gives suggestions of definitive statements that should be developed by the committee as a formal charter, if the decision is to continue the program. These suggestions are given below:

1. Objectives to be achieved in the data processing program.

2. Functional areas to be considered.
3. Approaches to processing to be investigated.
4. Commitments of financial and human resources to the program.
5. Expectation of financial gain and cost of the program.
6. Organizational structure of the program.
7. Over-all schedule of the program's activities specifying items in the program requiring decisions (97, p. 61).

Wentz discusses specific tasks that should be accomplished with the advanced feasibility study. Reviewing the study goals with top management should be a continuing effort. A detailed analysis of the present data processing activities is necessary before the designing of the process can be developed for automatic data processing. To fulfill this requirement, samples of forms, reports and other documents must be collected and a "procedure flow chart" prepared to reveal the volume of each used, the number of persons required to handle each operation and total man-hours expended in the process. The origin of source data and the termination of results should be noted as this is vital information to both systems.

Interviews with operating management can attain specific information needs and suggestions for system improvements. It is probable that many reports required in the conventional system will not be necessary with the automated system due to integrated reports produced and the immediate availability of information. On the other hand, certain reports not economically feasible in the conventional system may be of value and can be obtained inexpensively and immediately with the proposed system. These interviews can also help to educate the managers in the philosophy and techniques of automatic data processing. The understanding and acceptance of the proposal at this level can be invaluable in the transformation from one system to the other.

A rough design of several systems should be prepared to include layout of inputs, outputs and files, flow charts of the overall system and a narrative description of the system including volumes of data and assumptions made. Costs analysis of each system with advantages and disadvantages should accompany the design. This information is used in making the selection of the system design best suited to meet the objectives of top management.

Upon the decision to proceed to an automated data processing system, a manual containing organizational background and needs and specifications for the desired system should be prepared. This manual will be used by competitive bidders or vendors selected to secure proposals for the desired system. The proposals received should be evaluated carefully to determine if they meet the stated specifications, that the costs and assumptions are correct and that it meets the requirements of the organization. Selections should be made on the results of the evaluation.

Contract negotiation should precede and should include test time provided by the vendor, programming assistance, delivery schedule, conversion assistance, availability of back-up equipment and maintenance. Legal assistance should be obtained before signing the contract.

CHAPTER III

PROCEDURE

In previous experience as a dietitian in the production and service area of food service, the investigator observed the excess time spent on preparation of cook's worksheets and kitchen requisitions by supervisory personnel. The initial objective of this project was to develop a program to allow computers to calculate and print the kitchen requisitions, thus eliminating this clerical duty from the supervisor's schedule and thereby creating additional time for supervision of personnel and quality food production.

In order to accomplish this objective, personal interviews were arranged with persons familiar with computer programming and correspondence was sent to persons known to be using, or planning to use, computers in food related projects. Classes in computer programming were attended and operating computer centers were visited. The ordering procedures of a conventional type system were observed in a university resident hall food service organization.

Dr. Robert Morrison, Professor of Mathematics and Statistics at Oklahoma State University, was consulted to obtain information needed to write a program for computer-calculated kitchen requisitions. He was further queried as to the procedure to obtain programming assistance and computer time. The investigator requested recommendations for study that would be helpful in preparation for the programming task.

Organizations using computers in a food service activity were contacted by way of correspondence. Correspondence with Helen Brisbane, Consulting Dietitian for the Department of Data Management of the Veterans Administration, was initiated to acquire information concerning the utilization of electronic data processing equipment by the Veterans Administration for their hospital food service activities. Suggestions for further research in this area were requested.

Communications were established with Dr. Joseph Balintfy, Associate Professor of Operational Research and principal investigator of the computer-planned menus at Tulane University in New Orleans. Information relating to the research being conducted with computer applications in food service operations was requested. The correspondence further included questions concerning problems encountered in establishing a computer system in food service, limitations and acceptability of the system by professional staff, employees and clientele.

Information regarding studies at the University of Florida on the planning and control functions of dietary management by electronic data processing was requested from John Fellers, Assistant Director of Shands Teaching Hospital, in charge of supportive services. Query was also made of limitations and special problems encountered, special need for further study and future plans for computer applications.

Correspondence was sent to Colonel Mary Lipscomb, Chief of the Army Medical Specialist Corp and past Chief of the Dietitian Section of the Corp, and Lt. Colonel Katharine Manchester, Chief of Food Service Division, at Walter Reed General Hospital and past Chief of Dietitian Section of the Corp. Both were questioned as to plans for future computer utilization in the food service division of army hospitals. Specific questions regarding delays in establishing electronic data processing systems were included. Personal contact was made as a follow-up of the earlier correspondence.

Other letters of inquiry were mailed requesting similar information. Professional journals were used to obtain names and addresses of persons using computers in food service activities and research.

Time was spent with Mary Barnes, Food Purchasing Agent, Resident Hall Food Service, Oklahoma State University, to observe the purchasing procedures of a decentralized university resident hall food service organization. Food requisitions from outlying resident hall kitchens to the main purchasing office were noted. The requisitions were followed through compilation, ordering, receiving and costing of the items. Two of the resident halls were visited to examine the process of accumulating information necessary to complete the food requisitions. Menu planning, inventory control, cost accounting and employee scheduling were also noted.

Classes in computer programming were attended by the investigator to acquire additional knowledge in this area. Both Cobol and Fortran computer orientated languages were studied.

A visit was arranged to tour a wholesale food company that was using electronic data processing equipment to process orders from vendors. Methods, arrangement, procedure and machines were of special interest to the investigator.

Arrangement was made to visit with Dr. Balintfy, at the Computer Research Center, Tulane University in New Orleans. Each member of the research team contributed time to the investigator to explain the research problems, development, methods and future plans. Each member was interviewed as to his role in the study.

CHAPTER IV

RESULTS AND DISCUSSION

The initial objective of this project was to develop a program to allow computers to calculate and print kitchen requisitions. Personal interviews with persons familiar with computer programming were arranged and correspondence was established with persons using, or planning to use, computers in food service activities. Computer programming classes were attended and operating computer centers were visited. The ordering procedures of a conventional type system were observed in a food service organization.

Early in the investigational stage of this study, the author consulted with Dr. Robert Morrison (72), Professor of Mathematics and Statistics at Oklahoma State University. The purpose of this consultation was to obtain a clear understanding of programming techniques and to receive advice for preparation for the development of the program. Dr. Morrison described the problem as being solvable by a linear programming technique. This technique requires advanced mathematical application to state the problem in a form that can be programmed for computer calculation. He further identified the problem as being a time consuming task and requiring more mathematical background than was possessed by the investigator. It was suggested that the problem could be stated and programmed with the assistance of an experienced programmer, but there was a shortage of programmers on campus and other arrangements would have to be made.

Correspondence with Helen Brisbane (23), Consulting Dietitian for the Department of Data Management of the Veterans Administration, revealed several important factors. See appendix. Data processing has been utilized in the food service operations in the Veterans Administration hospitals since 1955. The first application was in classifying receipts from purchase orders into the proper food groups. Specified conversion factors were used to calculate poundage and cost, which were totaled and accumulated until the end of a report period.

Nutrient values have been calculated for their menus on a daily and weekly basis since 1962. Each hospital may submit regular and modified diets to be calculated twice a year.

In 1964, reports to higher management were automated. These reports included rations earned, compliance with ration pattern standards, food cost per ration and productivity per non-professional employee. The reports are presented to station and higher management. The information was used to plan or change menus and to control budget allowances. Management also used the information in preparation of future budgets for both subsistence and personnel and in judging the effectiveness of various levels of management.

The consultant remarked on the common application of data processing in bookkeeping functions, but contended there are more sophisticated uses to come in the future. This is emphasized in her statement, "The application of operational research techniques will reveal information not now known, considered or felt obtainable" (23). One of the limitations recognized at present is the ability to quantify personal judgments and emotions.

Linear programming has provided a technique to produce automatic food requisitions and menus. The lack of a common coding system for subsistence items, incomplete nutritional tables for raw and cooked foods and recipes standardized more than are now considered standard by most institutions are factors delaying the utilization of this technique to the fullest. Uniform recipe coding schemes, data representing true preference ratings and valid frequency information need to be developed for reliable input data for this type of application. The standardized recipe for computer use should include not only the nutrients and cost stated in machine usable form, but should also contain color and texture of the product, preparation time, type of employee and equipment needed.

Tasks such as data collection, preparation of master data for the computer and devising the problem to be solved requires much time before the program is usable. The Veterans Administration data processing system is considered to be the most advanced application in the industry. The reader should note the dates these processes became effective and the time required to prepare for each stage of the system. The problems encountered by the Veterans Administration should be recognized as common factors to be considered by any food service organization. Brisbane (23) declared the benefits of automation would be realized only with continued use of the applications or by solving some very mathematically complex problem that was practically insolvable by manual means.

Dr. Joseph Balintfy (9), Associate Professor of Operations Research at Tulane University, was written requesting details of his research with computer-planned menus. In answer to this request, four research papers describing the experiments with computer assisted menu planning, the processing of dietary information by computer and the mathematical foundations required for menu-planning were forwarded to the author (7, 5, 8, 4). These papers offered invaluable material consisting of data that is necessary for input in the system, methods and limitations in collecting this data, arrangement and flow of the data through processing and the basic development of mathematical models used in the programming. The contents of the papers are described more fully elsewhere in this presentation.

A letter and research report was sent in response to the investigator's request for information from John Fellers (46), Assistant Director, Shands Teaching Hospital of the University of Florida. See appendix. The research report described the operations research and systems analysis being conducted at the University Hospital (43). The dietary system, as planned for a total computer system, was explicated. The research and future plans were discussed. Pertinent information contained in the report is presented in the Review of Literature of this paper.

Fellers stated in his letter that the groundwork for the research began as early as 1958. From this early planning, systems and management procedures were developed. The complication of the hospital operation was regarded as being greater than the average hospital and possibly fifty times more so than a commercial type cafeteria. Formulas initiated for computer management of such a system could possibly be adapted to less complicated types of food service.

This hospital food service is only at the intermediate stage of a total data processing system for planning and controlling dietary functions. Again the time in preparation for transformation to an automated system should be noted.

The Chief of the Army Medical Specialist Corp, Colonel Mary Lipscomb (66), stated two basic problems resulting in delay of computer applications in army hospital food service. The first problem is the lack of standardized recipes that are the source data for production. No other data would be valid until the recipes are accurate. When valid data is available, program development for production control, requisitions and accounting can be pursued. The second problem stated by Lipscomb, is the shortage of programmers.

Lt. Colonel Katharine Manchester (70), Chief of Food Service Division, Walter Reed General Hospital, described the method of standardized recipe development. This is being accomplished by ingredient room control. The recipe will be calculated for the number of servings required and all ingredients will be weighed and issued from the control room. Preparation instructions will accompany the ingredients for each menu item. A production chart will list employee and preparation starting time. This process will require accurate data for measuring and issuing ingredients and for scheduling production. Recipes standardized for this function will contain reliable data for computer use.

The resident hall food service ordering procedures were observed at Oklahoma State University to familiarize the author with factors that are similar and different with that of a hospital food service operation. Consideration was originally given to the possibility of using one of the resident hall food service units in a pilot study to test a computerized program of calculating requisitions.

The Resident Hall Food Purchasing Agent, Mary Barnes (11), contributed much time to explain the process of receiving orders from each of the food units, how these orders are consolidated, the process of contacting vendors for bids or price quotations and ordering. The product is usually delivered by the vendor directly to the individual food unit for storage. The invoices are forwarded by the food unit to the Central Food Purchasing Office for verification and record entry.

Each year before the opening of the fall term of school, the dietitians and food managers from each food unit join the purchasing agent in a can cutting procedure for checking the quality of each product available for purchase. Results of this session are used as a guide for the purchasing agent throughout the year. Current price quotations and acceptability ratings of products are factors considered as part of the decision-making and purchasing process.

Ordering procedures in the production units were of major importance in the investigation. Particular areas of interest were the recipes and menus, since this is the basic data necessary for ordering. Two food units were visited to observe the process of completing kitchen requisitions and initiating orders through the Central Food Purchasing Office.

Each unit is operated independently of every other unit. Menus are written in each unit and recipe files are maintained separately.

Recipes are standardized to meet the needs of the unit. Therefore, a compilation of recipes from each of the units would show great variation of ingredients in a particular menu item. An example such as Bean Salad would clarify the point. Bean Salad in one unit may contain seven ingredients of varying amounts whereas, Bean Salad in another unit may contain only five ingredients. The standardized recipes in each unit did not contain sufficient information for data processing.

Menus are written in each unit. One of the units visited used a cycle menu while the other unit did not. The unit with the cycle menu made adjustments for current use when the kitchen requisitions were written. The use of individual menus by each of the eight units resulted in a greater number of items being ordered through The Central Food Purchasing Office and in smaller quantities. The campus did have a central bakery from which the units could order from a rotating variety of products.

A storeroom in each unit allowed a relatively large inventory of food items to be on hand. A running inventory card system was kept in each unit. When the kitchen requisition was completed by using the menus and recipes, the items were issued from the unit's storeroom. Staple and frequently used items were ordered through The Central Food Purchasing Office by a modified stock-level and past usage method. Physical inventory count was taken and balanced with the running inventory cards each month. A copy of the inventory was forwarded to the Central Food Purchasing Office.

The raw food and labor cost of each day's menu was calculated in each food unit. After the items appearing on the kitchen requisition were issued, it was forwarded to the dietitian's office for crediting on the inventory cards and for costing. The cost of the issues were transferred to a storeroom inventory record. This record indicated inventory brought forward, receipts, issues and balance for the day.

The food cost for the day was transferred to a cost summary sheet that also contained figures for gross sales for the day, labor cost and customer count. The percentage of food and labor cost was calculated separately and entered on the sheet for ready analysis. A daily and a total to date summary was recorded.

Other records were kept in each unit such as breakdown of cash, student tickets, employee meals and snack bar customers. Employee schedules were planned and the hours costed for each unit. This process was quite tedious due to ten or more wage scales used. A large number of accounting and clerical type duties were performed in each unit. To consolidate these functions for computer use would require extensive study and standardization of procedures among the units.

In the earlier stages of this investigation, classes were attended to learn how to write computer programs by use of the Cobol language. The description of the course indicated this language to be a business-oriented one. The author decided this was the form of communication that was most applicable to the food service industry. The vocabulary of the language, command statements and format for writing a program by use of the Cobol language was taught in this class. However, the problems were stated and the students were instructed to write programs which allow the computer to solve the problems.

As the investigation continued, it became apparent that the programs written for food service operations were in Fortran, a scientific-engineering language, rather than Cobol. Enrollment in a course in which elements of computer programming were taught familiarized the student with machine language and later with the higher-level Fortran language. Programs could be written for stated problems, but the author soon realized that the preliminary step needed in developing a computer program was in the definition of the problem and the statement of it in mathematical terms before it can be programmed with one of the languages.

It was determined that a visit to a business in a related field in which electronic data processing equipment was used, would be helpful in understanding certain applications of the machines. A wholesale company that sold food and supplies to Oklahoma State University was selected for this observation. This company used electronic data processing equipment to compile, cost and print invoices to customers. The present machines had been in operation for ten years, but were soon to be replaced by a newer system.

Codes were composed for each of the items handled in the business transactions of the company. When a shipment of goods was received by the company, a card was punched for each unit with the code of the item, the unit cost, date of arrival and other information vital to the company. These cards were sorted by machine and filed by categories and code numbers. Cards were collected manually from the files to correspond with orders received from customers. There was a card for each unit of each item requisitioned. Price quotations agreed upon by the salesman and vendee would be punched into the cards before sorting, compiling and printing of the invoices. Leader cards containing the customer's name and address preceded the item cards. The machine printed the name and address of the customer, total number of units ordered with unit and total price given for each item and total price of the order. The printing was accomplished in tripilicate. One copy was delivered to the customer with the items, another was used by the issuing section of the wholesaler and the third copy was retained in the office for accounting purposes.

The company was in the preparation stage of installing newer and more efficient equipment. Information needed and establishment of information fields on the data cards was a responsibility of the management. Assistance was to be obtained from the machine company in the actual programming and installation of the system.

The management of the wholesale company was well satisfied with the savings in labor and time resulting from the use of machines for this portion of data processing. They anticipated additional savings in both areas and wider applications with the installation of the new system.

The author made arrangements with Dr. Balintfy (9), principal investigator of computer-planned menus, to visit the research center in New Orleans. The Professor and his staff contributed three days of time to orientate the visitor to the results and plans of the research program. Dr. Balintfy shared his finding's freely with the author and gave much valuable insight into the capabilities of a computer system in a food service organization. He discussed the author's plans for study, offered suggestions and outlined problems and limitations that could be encountered. He further scheduled time with each of his staff members to explain in detail the various areas of research and preparation that was necessary for each phase of the experiment. He expressed a sincere desire for food service administrators to become aware of the possibilities of electronic data processing in management of their organizations.

The single-stage computer-planned menu was explained by Alma Hammett (54), Program Co-ordinator. Samples of the output data were used to demonstrate the information provided a dietitian for completion of daily menus. The information supplied by this type of program could be of great value in the routine task of planning menus within the budget of the organization. Not only would the menu optimize the food items within the given constraints, but would supply data to show what effect each item could have on the total cost if any of the stated constraints were modified.

The single-stage menu gave a listing of menu items to be used in forming the meal pattern for the programmed period. The program supplied a number of items in each category to correspond to the requirements for the category. For example, fourteen breakfast appetizers would be listed to satisfy the requirement of a two-week menu. The fourteen appetizers would not necessarily all be different, but would not appear more times than the frequency rating constraint allowed. The dietitian would have to arrange the items listed into the meal patterns. The results would be an average, nutritionally adequate menu at minimum cost for the period programmed.

Ralph Blackburn (19), Assistant Project Director, explained the techniques of developing the multi-stage computer-planned menu. This method of menu planning produces a completed menu with each meal meeting nutritional requirements at a minimum cost. The construct of this program is such that a large amount of machine storage space is necessary. An IBM 7044 was utilized with disk storage allowing for immediate retrieval of information without interfering with other programs in process. A 1050 console input-output machine was used for "on-line" adjustments of the menu. The menu was printed out for acceptance and gave instructions for entries if not accepted. The machine would recalculate the menu with the new entry and print out the revised menu, price and per cent of surplus nutrients. A dataphone was also connected to this unit to facilitate dialing of others directly to the computer at the research center. Another university was conducting a computer-planned menu class by way of this method as an experiment. The advantages of this system used for a large organization with satellite units were obvious.

The sample multi-stage planned menu was evidence of the importance of additional and valid information needed on standardized recipes. The additional information such as color of the predominant food in a menu item, consistency, temperature and other factors considered important in menu planning must be available to include such constraints in the program. In conventional menu-planning these factors are considered by the person drafting the menu. The computer cannot "think" and must have available for reference the data to be considered. Therefore, these factors must be expressed in "machine readable" form on the recipes for use as input data for menu planning.

Webb Evans (42), Research Dietitian, U. S. Public Health Service

Hospital in New Orleans, worked with the Tulane research group and was consulted as to methods of collecting appropriate data for the recipes. Collecting valid data and devising a mode to express the results in a form useable by the computer was not an easy task. It is significant to note that approximately two years were spent in assembling four hundred recipes containing sufficient and accurate data for the pilot study.

A questionnaire was distributed to patients of the U. S. Public Health Service Hospital to evaluate how often certain foods and menu items would be accepted. The results of this questionnaire were analyzed to determine frequency data to be included on the recipe and used as constraints in the program.

Other complications develop in assigning preference ratings to menu items when a selective menu is utilized. There are many variables to be considered when an item is offered with a combination of other foods. A high rate of selection may be noted when a popular menu item if offered with an unpopular item, but a lower rating will result for the same item when offered with an equally preferred menu item. A method of statistical analysis was formulated by Dr. Balintfy in an effort to quantify preferences for use in selective menus. This data was being analyzed at the time of the author's visit.

Dr. Laszlo Kovacs (64), a mathematician on the research team, explained the significance of knowing higher mathematics and statistics in solving problems to be programmed for computer calculations. The objective of a situation must be defined and raw data supplied for input. The mathematician then develops a linear program to satisfy the objective.

The author learned that many other programs had been written by the research group, including the printing of kitchen requisitions from the menu and recipe data. The practicality of using these programs will not be real until more extensive data has been collected and validated.

Results of the information compiled from the various sources discussed conveyed to the investigator the basic need for guidance of food service personnel in establishing an electronic data processing system. Programs are available to perform many of the operations desired by food service management, but the lack of valid source data has delayed and prevented the wide use of these programs to date. Therefore, the following outline is to give the interested manager a guide in organizing, studying and determining the needs of his operation before adopting an electronic data processing system. The outline is not prepared as an inclusive guide, but is designed to direct the reader to a point where he will be able to formulate, evaluate and proceed in the most efficient manner to meet the objectives of his organization.

Procedural Guide for Establishing an Electronic Data Processing System in a Food Service Organization

Establishing an electronic data processing system requires careful and skillful planning from the time the idea originates until the system is installed and is in complete operation. Even then, continuous analysis of the processing and planning for broader application should follow. The manner in which the initial investigation is conducted may have an effect upon the acceptance of the change by the personnel, the time it takes to make the system productive, the cost of the investigation and the effectiveness of the system as a whole.

The first decision is to be made by management. Management must decide if it is interested in investigating the feasibility of changing to electronic data processing or if it is satisfied with the present system of processing data. If the decision is to investigate the change, management should organize a meeting of department heads to announce the decision and to seek their support, ideas and suggestions.

Director of the Study

A member of the staff should be appointed to direct the investigation. The appointee should understand the objectives of the organization, should be familiar with each department, should know methods of systems analysis and should possess good relationship with the other staff members.

The position of the director of the study should appear on the organizational chart in line with the heads of the department. The director should function as a liason officer between each section and should be directly responsible to the head of the organization.

The director should be supported by technical advisors and analysts. In a large organization, the director should be assigned these support personnel as a full-time work force. In smaller units, this support may be obtained outside the organization from service bureaus or private consultants. It is essential to assign the director as full time because of the duties required. If the study required a long period of time, the early analysis might be outdated before time for the final decisions to be made.

The director must prepare for the task ahead. It is likely this person will not be a specialist in electronic data processing, therefore, time must be spent in researching the literature, visiting installations using electronic data processing equipment and possibly attending classes. A familiarization with computer capabilities is necessary to help the director train personnel, to be able to communicate with programmers and electronic equipment salesmen and to relate the activities of the organization to them.

All personnel of the organization should be informed of the study and assured of their jobs, with emphasis on how the system will help them. Periodically, the personnel should be informed of the progress of the study and be reassured of their jobs. The staff should be trained in analysis of present procedures. Each department head should conduct the analysis of his departments and collect the required source data. The director should serve as advisor and coordinator.

Objectives of the System

Overall objectives of the study should be established immediately at the beginning. The director needs to keep the head of the organization informed as to progress made toward these objectives. Each department head should establish the system objectives for the department under his management. The director should advise the staff to assure that the objectives for the whole organization are being accomplished. An example of objectives which each department could have is as follows:

1. Food Purchasing Department: Automatic inventory control functions, including costing issues, adding receipts, automatic purchase requisition print-out and periodic inventory and cost print-out.

2. Food Production Department: Computer planned menus, automatic kitchen requisition print-out, employee scheduling and increasing or decreasing recipes to desired quantity with current cost per serving.

3. Therapeutic Department: Nutrient scanning process for printing out foods high or low in the nutrient stated, analyzing the nutritional value of a diet consumed and checking nutritional adequacy of modified diets.

4. Food Administrator's Office: Equipment inventory and depreciation schedule, equipment repairs and expense, simulations of proposed operations, other reports using "management by exception" techniques and cost accounting procedures.

The objectives of each department should be utilized to develop the overall objectives of the total system.

Standard Terminology

Standard terminology should be established early in the investigation and adhered to by all departments throughout the study.

Methods of Analysis

The method of analyzing each department's activities must be determined. The department heads and supervisors, who will be in direct charge of the data collection for the analysis, should be instructed as to the mechanics of the method of analysis and data collection. Each activity should be analyzed to determine how and why the activity is necessary, the time required to perform the action and the cost involved. When this data is collected, the director should develop a total analysis. This analysis should be studied and feasibility of the use of electronic data processing methods determined.

One method of analyzing the data processing activities of a department is to take each form, report or document and prepare a flowchart for it. The quantity used should be recorded. The chart should begin with the origin of the form and flow through each process in which it is involved. Time and number of people required at each step should be noted. The flowchart should picture the flow of the processing of each document. Analysis should then be made to determine if it is the most effective processing, the cost of processing, the number of people involved and possible computer adaptation of it.

These flowcharts with the results of the analysis can be used in establishing new flowcharts of data processed automatically, if it is decided to automate. If not, they can be used to improve the conventional system by determining the most efficient flow of the data manually.

Time Schedule

A time schedule should be established and goals set for each stage of the investigation. Periodic progress reports should be forwarded to the director, who in turn, will keep management informed.

The Decision

After the preliminary study is completed and the needs and costs of the present system determined, investigation should be made into various electronic data processing systems in order to make a comparison with the manual system. Cost is not the only factor to consider;

increased efficiency, increased availability of data for decision-making and other factors are to be evaluated. Management should use the analysis of data collected to make the decision concerning the establishment of electronic data processing.

If the decision is to maintain the present system, updating of analysis and re-evaluation of the two systems should be considered at a later date. The decision to automate the processing of data will require further study, training, planning, preparing and changing.

Continuation of the Study

At this point of the investigation, the director should consult with each of the staff members and develop a detailed plan of action. The objectives of each department should be firmly established so as to provide a guide for data collection and computer programming.

Input and Output Requirements

Output requirements must be determined in order to establish needs for raw data input. The collection of the input data should begin immediately because of the time required to collect the data. Other installations and organizations may have available valid input data or methods of obtaining it that could be utilized.

Program Development

The input and output requirements should be established to facilitate the preparation of the computer programs. The programs should be "debugged" prior to actual operations. Programs may be obtained from other sources and adapted for the specific operation and objectives.

Education of Personnel

Training of personnel should include the procedures of processing the data and the operation and first echelon maintenance of the machines. When the equipment is installed, the programs should be ready and reliable, the input data should be valid and the personnel should be prepared and ready to make the change easily. The change should go smoothly and immediately begin processing data efficiently. Insufficient preparation for the actual operation can result in higher cost per unit output due to inefficiency and idle time.

The planning, evaluating and reviewing of the methods does not discontinue with installation and operation. Continual review will keep management informed of efficiency and allow for adjustments when necessary. Periodic evaluation will reassure management of savings resulting from automation or cause investigations in search for reasons of decreased savings. Continued planning will increase efficiency and savings and develop broader machine applications.

CHAPTER V

SUMMARY AND CONCLUSIONS

Observation during past experiences created great concern in the author for the amount of time professional and supervisory personnel expend on clerical-type duties. The applications of electronic data processing were studied in an effort to envision the possibilities of a total information system in food service organizations.

The review of literature revealed many applications of an electronic data processing system in industry. These included not only the common cost accounting procedures, but many operations providing control and planning information for management decisions.

Hospitals using electronic data processing in some area were reviewed to determine what information is obtained from these applications that could be utilized as input data for food service activities, but one hospital reviewed showed insight into the capabilities of a total system. The total system concept allows data collected for one function to be used for every other related activity, thus eliminating duplication of data collection throughout the hospital.

Reports concerning applications of data processing in food service management are scarce in the literature. Computers have been found to be very helpful in nutrition research because of the speed with which they can calculate and manipulate data. A few instances were found where food service organizations were using computers for control, but little use was found in planning. Most of the control functions were related to the common cost accounting procedures. Studies were being conducted on inventory control by computers, menu-planning, nutritional evaluation and various other activities. Only one food service organization was developing a total data processing system.

Planning for an electronic data processing system is an important procedure that directly effects the success of the system. All stages of the system development such as preparation, selection, installation and operation requires careful planning. Other factors that may effect the degree of success of a new system are the attitudes of the personnel, the validity of the source data and the correlation between the established objectives of the system and what management actually expected from it.

Personal correspondence and interviews were conducted with persons using or planning to use computers in food service and related activities. Computer programming classes were attended and installations using computers were visited. Food requisitioning procedures of a university resident hall food service organization were observed in hopes of relating the manual processes to an automated processing of the data.

The investigation revealed the complexity of developing an electronic data processing system. The planning stage of the development is of great significance and should be directed and coordinated by one that understands the objectives and activities of the organization. The director of the feasibility study should also be knowledgeable in methods analysis and in computer applications and approaches.

The collection of valid source data is time consuming, but essential to the effectiveness of the system. Availability of all necessary source data is limited at present. Reliable expression of preference data, food processing loss and temperature, color and consistency of foods for machine comprehension are representative of this limited availability of data. Other problem areas of valid data collection are standardized measures of "as purchased" food and quantities stated on recipes.

An electronic data processing system cannot be effective until the valid data is collected. Therefore, this collection of data should begin early in the investigational stage of the system development. If the feasibility study should prove an electronic data processing system to be unjustifiable, the research and data collection should result in increased accuracy from the data collected and in increased efficiency resulting from analysis of the flow process of the organization with the conventional system.

The importance of data collection and methods analysis in the success of a system was recognized by the author. Also, the lack of understanding and knowledge of computer applications by food service administrators was realized. These two factors influenced the decision to develop a procedural guide for establishing an electronic data processing system in a food service organization. Limited time and sources available resulted in a generalized guide for the first stages of establishing a system. It is also believed by the author that as one becomes knowledgeable in the objectives of the organization and in computer applications, detailed procedures would be developed for the specific organizational needs. Therefore, this guide is to give assistance in the preliminary stages of an automated system development.

Conclusions derived from this investigation include: (a) computers can be a valuable tool in food service management; (b) applications should include not only accounting procedures, but also inventory control, menu planning, simulations, production and employee scheduling and other management functions; (c) planning should be for a total system to minimize data collection and processing duplication, although activating actual operations should be allowed in stages; (d) it is not necessary for the food service administrator to know how to write computer programs, although applications of electronic data processing should be understood; (e) a food service administrator who understands the objectives of the organization, should direct the preliminary investigations, the development of flowcharts and data collection; (f) data processing experts should be consulted for technical advice, for computer programming and systems analysis; (g) review of the objectives of the system and accomplishment of these objectives should be conducted continuously.

Further research is needed in the areas of data collection and computer applications. The need for development of a reliable measure of food preference is immediate. Research in the area of food processing is needed to develop processing loss tables. Effective methods of conditioning of personnel for changes to automation should prove to be an interesting and helpful investigation. There are many other areas of study that should be explored. Computers are becoming a necessary tool in management of all businesses and industries in this period of electronic revolution.

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APPENDIX

VETERANS ADMINISTRATION
DEPARTMENT OF DATA MANAGEMENT
WASHINGTON 25, D. C.

YOUR FILE REFERENCE:

IN REPLY REFER TO:

November 30, 1965

Miss Jessie S. Brewer
Graduate Student
Dept. of Food, Nutrition and Institution Adm.
Oklahoma State University
Still Water, Oklahoma

Dear Miss Brewer:

The Veterans Administration has been using data processing in its food service operations since 1955. The first application classifies receipts from purchase orders or equivalent papers into proper food group, applies specified conversion factors, calculates poundage and costs, and accumulates totals until the end of a report period.

Since 1962 computers have calculated the nutrient values of a week's menus on a daily and weekly basis. Regular and as many modified diets as each hospital cares to submit are calculated twice a year.

Reports to higher management were automated in 1964. Dietetic Service earned rations, compliance with ration pattern standards, food costs per ration, and productivity per non-professional employee are segments compiled and provided for station and higher management.

Menu plans are made or changed and current budget allowances controlled as immediate uses of the information provided by data processing. Future budgeting allowances for subsistence and personnel, changes in ration pattern allowances for medical or other patient reasons, and judgements about the effectiveness of various levels of management are other uses made of the reports, derived as a result of data processing.

The more common bookkeeping type of applications of data processing for food services are now quite commonly automated. There is no end in sight, however, for more sophisticated uses. The application of operational research techniques will reveal information not now known, considered or felt obtainable. The ability to quantify personal judgements or emotions is one difficulty often met in food service problems, however, this is not all that remains to be solved.

Linear Programming is one technique being researched by several groups at the present time to provide automatic food requisitions and/or menus. Inability to apply the technique to the fullest, immediately, is due largely to lack of a common coding system for subsistence items, incomplete nutritional tables for raw and cooked foods, and recipes more standardized than what are now considered standard by most institutions. There are futher needs for uniform recipe coding schemes, good data to denote food preference ratings and verified frequency data with which an item can appear in a stated period of time. Other than cost and nutriements stated in computer usable form, recipe characteristics need to include color and texture of the product, preparation time, type of employee, and equipment necessary.

The main problem for you will be deciding on where your main interest is, then limiting the phase of the problem you wish to research. Originally devising the method of attack with a programmer, collecting data, and preparation of master data for use by the computer are slow and time consuming tasks. Benefits of automation come only with continued use of the application or solving some very mathematically complex problem practically unsolvable by manual mears.

If after you have decided upon your project we can be of assistance or when your thesis is completed we whould certainly appreciate hearing from you again.

Sincerely,

Helen M. Brisbane
Consulting Dietitian

TEACHING HOSPITAL AND CLINICS
THE J. HILLIS MILLER HEALTH CENTER
UNIVERSITY OF FLORIDA
GAINESVILLE, 32603

June 16, 1966

PHONE: 376-3211
AREA CODE 305

Mr. Jessie S. Brewer
822 N. Jefferson Street
Stillwater, Oklahoma 74074

Dear Mr. Brewer:

You will find enclosed a copy of a research presentation that we made in San Francisco last summer on some of the work that we are doing in EDP management.

Much of the ground work for this research began as early as 1958. Systems and management procedures for handling diets have been developed from this early planning. You will note that the operation is much more complicated than the average hospital and perhaps some fifty times more complicated than a commercial type cafeteria. By working out the formula for initiating computer management in this type of operation, it is then possible (if economical), to adapt these methods to less complicated types of food service.

Certainly you have selected an interesting subject for your thesis.

Very truly yours,

John D. Fellers
Assistant Director
Shands Teaching Hospital
In Charge of Supportive
Services

JDF/bik

Enclosure

VITA

Jessie Stuart Brewer

Candidate for the Degree of

Master of Science

Thesis: A PROCEDURAL GUIDE FOR ESTABLISHING AN ELECTRONIC DATA PROCESSING SYSTEM IN A FOOD SERVICE ORGANIZATION

Major Field: Food, Nutrition and Institution Administration

Biographical:

Personal Data: Born in Coffeeville, Mississippi, March 31, 1938, the daughter of John Madison and Mary Olive Brewer.

Education: Attended first five years of grade school in Coffeeville, Mississippi; attended the 6th through 8th grades at Lizzie Horn Elementary School, Grenada, Mississippi; graduated from John Rundle High School, Grenada, Mississippi in 1956; received the Bachelor of Science degree with a major in Home Economics, specializing in Foods and Nutrition from Mississippi State College for Women in May, 1960; completed requirements for the Master of Science Degree at Oklahoma State University, August, 1966.

Professional experience: Enlisted in the Women's Army Corp as a student in dietetics in December, 1959; received an honorable discharge from the Women's Army Corp in August, 1960; commissioned in the Army Medical Specialist Corp as a Second Lieutenant in August, 1960 and now holds the rank of Captain; served as dietitian at Walter Reed General Hospital, Washington, D. C. from September, 1961 to March, 1963; stationed at Tripler General Hospital, Oahu, Hawaii as dietitian from April, 1963 to August, 1965; member of the American Dietetic Association; member of Phi Upsilon Omicron, honorary Home Economics Fraternity; member of Gamma Sigma Epsilon, honorary Chemistry Fraternity.