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Analysis of the data processing requirements of Darigold Farms, Missoula-Ronan, Montana

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AN ANALYSIS OF THE DATA PROCESSING REQUIREMENTS OF DARIGOLD FARMS, MISSOULA-RONAN, MONTANA

By

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CHAPTER I

INTRODUCTION

Background Information

The focus of the data processing industry has traditionally been toward the application of large scale computer systems to meeting the information system requirements of large corporations and institutions. This situation developed in part because of the large capital investment required to develop and implement a computerized information system and in part because of the very nature of initial computer design. First and second generation computers were huge machines designed specifically to handle large volumes of data for large numbers of transactions and to perform the types of reporting and decision-making functions typical of large corporations.

Improvements in the early stages of this industry were primarily in the areas of speed of operations, storage capacity and areas of application. Price reductions did occur but were most often offset by corresponding increases in system complexity caused by more equipment requirements for increasingly sophisticated applications. In fact, "few of the businesses acquiring these [early] computers had clear cost-based justification for doing so."[1]

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[1]Frederic G. Withington, "Five Generations of Computers," Harvard Business Review, July-August, 1974, p. 99.

In the ten to fifteen years since the early application of computers to the business environment, many different aspects of the data processing industry have undergone vast changes. Hardware has developed from vacuum tubes and magnetic records to large-scale integrated circuits and interactive terminals. Software compilers and input/output control systems were developed and are now being augmented and replaced by multifunction operating systems and communications controllers.

In addition, the functions available on computers have evolved from initial experimental batch applications to a full range of applications and inquire systems including network data collection, remote batch processing, online applications, and data-base management systems. The level of organizational penetration of computer systems has radically changed from the controller's department to operating departments and now involves consolidated, centrally controlled regional or corporate centers with remote terminals in many different locations.[2]

Concurrent with these vast changes in the nature and use of computer systems have been corresponding changes in the effects of electronic data processing on business organizations. Initially, new technicians began appearing in the organization with their own salaries, responsibilities, and behavior problems, and simultaneously the advent of the "fear of automation" among other employees of the organization began. Then followed group proliferation of electronic data processing and a consequent alienation or displacement of some workers and supervisors. A new type of rigidity within the organization resulted from

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[2]Ibid., pp. 100-103.

computerization, but new opportunities also became available. Finally, the centralization of the data processing organization occurred, resulting in division data visible to central management, some division managers alienated, and overall response times within the organization shortened.[3]

Throughout all of this vast and remarkable evolution, data processing managers and other corporate executives of computer-using organizations found it very dificult to keep up with current state-of-the-art. "The net result is that managers are confused and some of them are worried, feeling trapped on an ever-accelerating treadmill with no end in sight."[4] And, of course, the evolution continues. Redistribution and decentralization of data processing functions is beginning, networks of remote terminals connected by communications links are growing, and large-scale integration of computer circuits has recently made possible two new types of hardware capable of expanding the use of electronic data processing into uncounted new areas.

These new types of hardware with their corresponding software operating systems and applications packages are called minicomputers and microcomputers. As yet there is no clear cut definition of either of these new computer systems, and in some instances the two are combined together into one class of computers called small computers or minicomputers. In relation to this discussion the following observation can be made:

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[3]Ibid., pp. 100-103.

[4]Ibid., p. 99.

> A minicomputer costs around $50,000 for a typical business application, and it can do a good deal of the work of computers costing $2,000,000. Stated another way, minis cost approximately one fortieth as much as large computers, but they can do a great deal more than one fortieth of the work.[5]

Two generalizations can be made when relating the use and capabilities of minicomputers to medium and large computers. First, given the substantial price differences indicated, minis are surprisingly close to being as "powerful" as medium or large computers. This has resulted from the continued use of the latest technological advances in minicomputer design, probably because of the much smaller capital investment involved in this design. The other generalization involves the availability of software applications packages for minicomputers. Large machine software is much more advanced, and until recently technological advances in hardware have been the minicomputer manufacturer's prime concern. However, in the past three years substantial investments in software development have been made, and it is becoming possible to use minis as easily as larger machines for many business applications.[6]

In applying this information to the business environment, many in the data processing industry continue to promote the use of computers, even minicomputers, in large-scale business applications. In these cases minicomputers would be used, for instance, as a pivotal link in a communications and control network to handle and regulate the flow of data to and from large computers. However, in the past few years some individuals

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[5]Gerald J. Burnett and Richard L. Nolan, "At Last, Major Roles For Minicomputers," Harvard Business Review, May-June, 1975, p. 149.

[6]Ibid., pp. 149-152.

in the industry have begun to promote the idea of using minicomputers in smaller organizations with a truly wide range of applications.[7]

In any discussion of the use of small computers in small businesses, certain small scale concepts must be clearly defined. First, a "small" computer installation has three basic characteristics: (1) the equipment has a relatively low cost, with an upper limit of $120,000, that often runs less than $50,000; (2) the primary mode of data entry is a keyboard terminal of some type, as opposed to punched cards; and (3) the primary medium of file storage is magnetic disk, as opposed to ledger cards.[8] Second, a "small" business in this context refers to a firm with sales (or revenues) between $1 million and $10 million, employing 25 to 100 persons, and engaged in manufacturing, wholesale distribution, retailing where inventory turnover is high, or in service-oriented activities such as clinics, hospitals, and smaller banks.[9]

Additionally, characteristics of a working, fully implemented small business computer application are somewhat different from most large-scale operations. The following sentence from "Small Computers for Small Businesses" by Marienthal reflects the attitude toward the usual small business computer installation. "Sometimes stashed away in stockrooms, usually given little more attention than the office copier,

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[7]See articles in Selected Bibliography concerning minicomputers in small businesses.

[8]Louis B. Marienthal, "Small Computers for Small Businesses," Datamation, June, 1975, p. 62.

[9]Clyde W. Neu, "The Small EDP Shop," Journal of Systems Management, June, 1976, p. 36.

they do their jobs without the 'support' of dp [data processing] professionals, complicated operating systems, or expensive applications software."[10] The essence of this attitude lies in simplicity of use, configuration, and operation as opposed to the usual complexity associated with the computer system of a large corporation of institution. Once a small business arrives at this stage in the development of its computerized information system, management has seen significant results and can approach further development with ease, confident that the system is economically justified and contributes to sound management of the business.

However, "prior to a decision to automate its data processing functions and develop a management information system, the small company is typically unsophisticated with respect to the capabilities of EDP (electronic data processing) or with respect to the system, personnel, and management requirements of a successful EDP shop. At the time of this decision, some firms may be using a service bureau for selected accounting applications (e.g., payroll, accounts receivable, etc.). An 'in-house' information system may and probably does exist in the small company at this point, but it is fragmented at best and probably based on 'seat of the pants' management."[11] In addition, the manager of the small company may recently have realized that continued growth of his business depends largely on finding or developing a more efficient method of storing and manipulating data than currently exists. However, his first encounter with sales personnel in the data processing industry will

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[10]Marienthal, "Small Computers for Small Businesses," p. 62.

[11]Neu, "The Small EDP Shop," p. 36.

probably introduce him to the "confusion and worries" typical of this rapidly changing industry.

Neu and West both list several risks or problems likely to be encountered by a small company in developing and operating a computerized management information system. These include the selection of equipment with corresponding problems of costs and benefits, resistance of employees to implementation of a computerized system, selection of a manager for the system and delegation of appropriate authority for the associated responsibility, the long term dependence on one individual for systems development, and mechanization without systemization (i.e., simply mechanizing an existing function without first analyzing that function for problems or inefficiencies).[12]

Two alternatives are most often available to small companies that begin a management information system development project. One alternative is to purchase a "turnkey system," a combination of hardware and software that has previously been developed and that must be modified to fit each application. Many times the organization must also be modified to fit the particular structure of the previously developed computer system. The other alternative is to seek outside help in developing a new management information system designed specifically for the company. This outside help can take one of several forms: (1) a systems analyst hired for the development project, (2) a consulting firm specializing in information systems development, or (3) a service bureau that offers

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[12]Neu, "The Small EDP Shop," pp. 37-38; and Glenn M. West, "MIS in Small Companies," Journal of Systems Management, April, 1975, pp. 10-11.

systems development expertise. Any one of these sources of help may be the best in a given situation, depending on the company, company management, and availability of expertise to the company at the beginning of the development project.

A third alternative does exist for some companies in that they may have a current employee, usually with a background in accounting and computer applications, who has the expertise necessary to manage a systems development. However, certain additional risks are involved in this approach, and very few companies either have such personnel or are willing to release them, if they do, from their current tasks to manage the development project.

Purpose and Scope

Regardless of the source of systems expertise, a complete systems development consists of three phases: (1) an analysis of the organization's current information system, (2) the design of a new, computer-based system, and (3) the implementation of the newly designed system. The analysis phase actually includes some design activities that provide management with information with which to make a decision concerning the completion of the development effort. Documentation resulting from this phase is sometimes called a systems proposal. The design phase includes all remaining design activities, such as file and record design and program specifications. The implementation phase includes a test schedule or schedule of activities for the conversion to the new system, a description of the method of conversion, a description of the methods of correcting deficiencies, modifying the system, and reporting program

failures, and a follow-through plan for preparation of a post-conversion system evaluation report.

The purpose of this study was to accomplish the first phase of this process for the dairy business of Darigold Farms with plants in Missoula and Ronan, Montana, providing the type of systems expertise that would be provided by an independent consultant hired by Darigold Farms. The objectives of the study were to: (1) assimilate the information necessary for the design and implementation phases of development and (2) provide this information to the management of Darigold Farms for its use.

The study was divided into five basic steps: (1) the determination of the principal data processing needs and management information requirements of the dairy business of Darigold Farms, (2) the ranking of all data processing needs in terms of their importance to the business relative to their implementation in a computerized system, (3) the determination of what type and form of information was desired by the management of the business, (4) the determination of the general configuration of computer system that would support successful implementation of all principal data processing needs and would provide required management information, and (5) the development of software to demonstrate the current capabilities of electronic data processing methods in one particular area of this dairy's business.

The first step in the study actually encompassed the basic systems analysis. Additionally, in developing a computerized information system for a small business, it is often advisable to implement the various data processing functions in such an order that the expected savings in processing times and production of "better" management information are more

readily apparent.[13] Thus, the second step served to rank the data processing functions in order of their consideration in the implementation phase.

The third step was a design function normally included in the analysis phase to emphasize one of the more important benefits of electronic data processing, "better" and "more useful" management information.[14] Particular emphasis was placed on the types of information that can be provided with a computerized system that cannot currently be provided.

The fourth and fifth steps were design functions but served to provide information that is probably most useful to management of Darigold Farms. The results of the fourth step will allow the management of Darigold Farms to ask informed questions of various hardware vendors concerning their computer systems, while the results of the fifth step served to illustrate the end result management can expect from a completed systems development.

Methodology

The determination of the data processing needs of a specific business is accomplished using the techniques of systems analysis. The methodology used in this study included the various techniques for analyzing information systems outlined in current literature and texts.[15]

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[13]J. Daniel Couger and Lawrence M. Wergin, "Small Company MIS," Infosystems, October, 1974, pp. 30-31.

[14]Craig P. Heard, "Computers in Small Business," Journal of Systems Management, July, 1975, p. 30.

[15]See Selected Bibliography for a thorough listing of available sources.

The management of Darigold Farms agreed to allow an extensive investigation of its organization to take place in support of this research. The following paragraphs outline in some detail the type of systems analysis accomplished in this study.

A preliminary investigation was accomplished to determine the goals, objectives, boundaries, interfaces, and information flow activities of the existing information system. This investigation also helped to develop an understanding of the existing system and the current methods of data processing. Each process in the overall system was tested for possible elimination, combination with another process, simplification, or change in sequence. The decision making processes were also tested in much the same way. The system's effectiveness and efficiency was established in terms of: (1) meeting management objectives, (2) providing required management information, (3) requiring clerical and staff time, and (4) generating costs to the firm. The quality of information produced by the existing system was also evaluated.

From the data gathered in the preliminary investigation, the principal data processing needs and management information requirements were determined. These were ranked as to their importance to the organization in terms of implementation. A secondary investigation was then accomplished to discuss results of the analysis to date and to determine the type of management information that should be provided by an "ideal" system.

The end result of this research was the determination of the general configuration of a computer system that would meet Darigold Farms' data processing needs and provide the required information output. Additionally, one of the dairy's data processing functions was programmed

using the BASIC computer language and the AFIT/MBA computer system located at Malmstrom Air Force Base. This software package demonstrated a single process of the system, taking inputs from within the system itself and providing example outputs to management and to other parts of the system, using hypothetical, but realistic, data. As stated previously, this demonstration served to illustrate what could be expected as part of the complete development of a dairy management information system.

CHAPTER II

SYSTEMS ANALYSIS

Description of Current System

The framework for the analysis of an existing management information system may be defined in terms of five points that must be considered. These five points are: (1) the system's environment, (2) the resources of the system, (3) the total system objectives, (4) the components of the system, and (5) the management of the system.[16] This chapter considers to some extent each of these points. However, since this paper has been presented in partial fulfillment of the requirements for the degree of Master of Business Administration, and simultaneously has been intended to provide valuable and useful information to the management of Darigold Farms, the format in which the results of this systems analysis have been presented does not parallel most accepted standards. The analytical procedures followed were the same, but the documentation has been modified to meet the needs of both applications.

System Environment, Resources, and Objectives

Darigold Farms, also called Consolidated Dairies of Lake County, Inc., currently has milk processing plants in Missoula and Ronan, Montana.

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[16]Roger L. Hayen, "The Methodology of Systems Analysis," Proceedings for the Institute on the Development of More Effective Health Manpower Planning, Division of Business and Economic Research, University of Wyoming, August, 1972, pp. 97-103.

The business is organized in the form of a milk and grain producers' cooperative with approximately forty milk members or milk producers. Raw milk in bulk is received from member producers, as well as from other sources in the State of Montana, and numerous packaged milk products are manufactured for distribution and sale within the state. The dairy is operated and regulated under the guidelines specified by the Milk Control Division of The Department of Business Regulations of the State of Montana.

Currently Darigold Farms employs 48 persons in the dairy portion of its business, and in 1975 the dairy business of Darigold Farms consisted of receipt, processing, distribution, and sale of about 18 million pounds of milk amounting to a little under $3.5 million in total revenues.

The overall objectives of the information system of Darigold Farms are: (1) to maintain all pertinent business operations and accounting data, (2) to provide information from that data necessary for successful operation of the business, (3) to report those operations to state regulatory agencies, and (4) to provide accounting reports of the business to applicable federal agencies. In this particular case successful operation of the business is defined in terms of providing and maintaining the best possible savings on revenues to all members of the cooperative. Over the past eight years Darigold Farms has achieved operating margins on total sales of between 1.1 percent and 3.7 percent.

System Components

The reasons for separating the total system into components (or individual data processing functions) are to allow detailed analysis of

the job activities or tasks assigned to individual components and to allow measurement of the performance of each component. Ideally, it would be desirable to analyze the whole system directly, as is done with each component, but this is not feasible. If all system activities could be listed and evaluated in terms of the total system objectives, systems analysis would be greatly facilitated. However, so many variables are usually involved in any system that the whole cannot possibly be considered without subdivision into component parts.[17]

Figure 1 is a flowchart that diagrams the various system components (or data processing functions) and their interrelatedness to one another and illustrates the information flow through the system. As the figure indicates, the flow of information among the various components (denoted by the arrows) is complex, and many of the components actually overlap others in the system. Each of the eight components shown is discussed in some detail with respect to the following points: (1) documents used for data input, (2) data stored on each input document, (3) source of data contained on each input document, (4) frequency with which documents are used, (5) location of storage of each input document (i.e., which plant), (6) output documents produced, and (7) data contained on each output document. All of the data collected in the analysis of the system components has not been included here so as to conserve space, and, again the format of presentation is somewhat more general than would be used in typical systems analysis documentation. However, all essential information has been included.

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[17]Ibid., pp. 100-101.

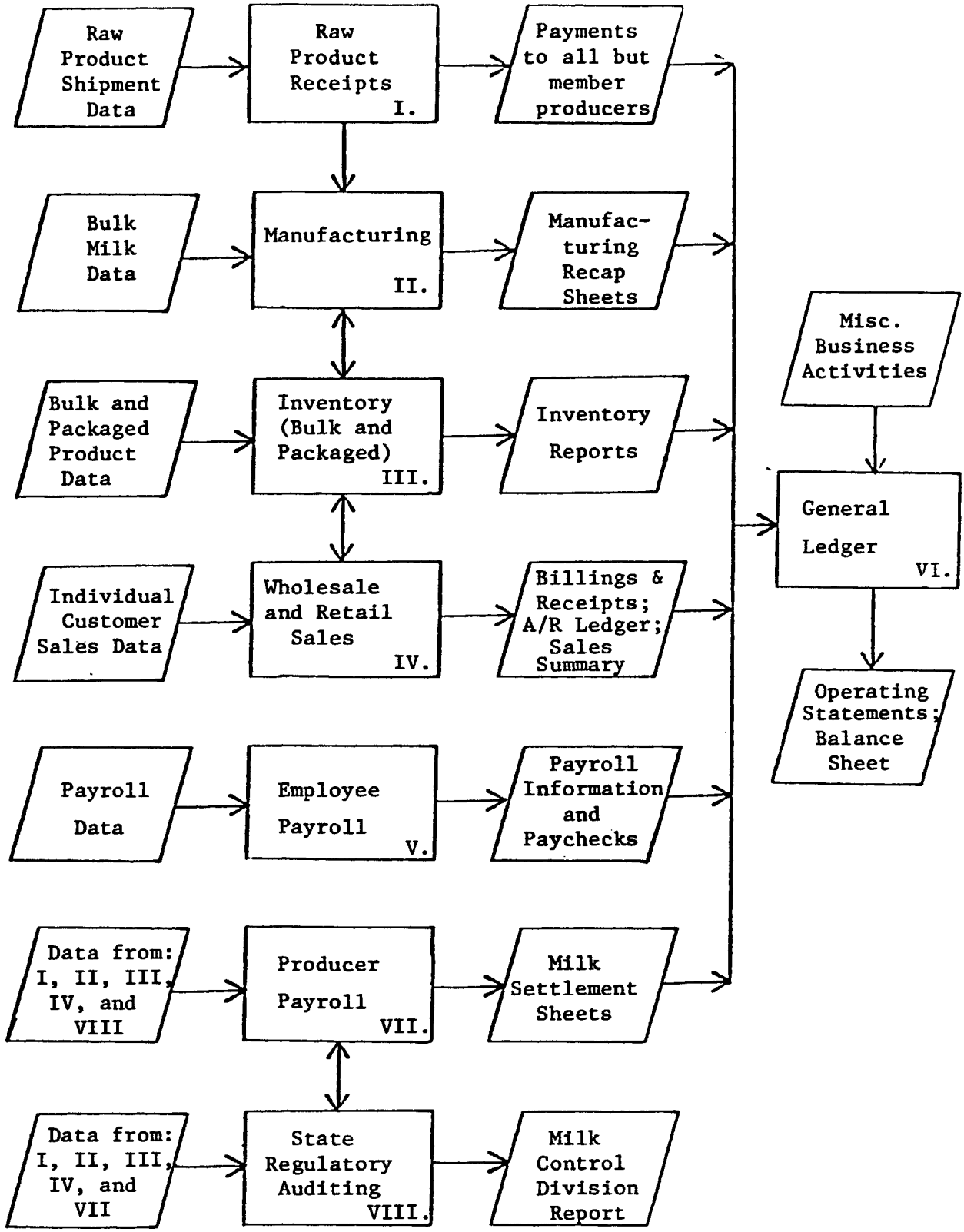

Fig. 1. Flowchart of Existing Information System

Receipts of Raw Products

Bulk quantities of milk products are purchased from various sources in the State of Montana to be used in the manufacture of packaged products for sale. These sources can be classified as Grade A producers (the member producers), Grade B producers, Grade C producers, and other Montana plants. Under each classification the same basic data is recorded concerning each load of milk received. These data include: (1) date received, (2) producer name, (3) origination of load, (4) weight (in pounds), and (5) destination of load. Additionally, a butterfat test (in percent) is recorded for each producer, usually on a bimonthly basis. The first five data are recorded on a Farm Tank or Truck Pickup Sheet at the origination point and transferred to company records when the load is received. The butterfat test is accomplished at the plant when the load is received and recorded in a Butterfat Test Book. Additional data are calculated for each producer from these data, such as daily and monthly totals, average butterfat tests and pounds of butterfat, etc. Also, daily totals of product and butterfat for all producers in a class are calculated. Finally, an overall butterfat test for all Grade A producers is calculated.

Company receipt records, all of which are maintained at the Ronan plant, are updated daily with the basic data as shipments are received. Subsequent calculations are also accomplished at this time. Reports produced from these records vary with class of producer. Bimonthly statements for Grade B and C producers are produced in the form of checks and stubs. These statements include such information as date, pounds of product, butterfat test, pounds of butterfat, total dollars, miscellaneous

deductions (hauling charges, assignments, etc.), price per pound of product at standard butterfat test, and total amount of check. All dairy products are priced at a standard butterfat test, and the price paid to individual producers is modified to that producer's butterfat test from the standard price. The standard price paid for products received from Grade B and C producers is set by the company.

Statements for products received from other Montana plants are produced in much the same fashion and include basically the same information, with the exception of miscellaneous charges or deductions. Statements for Grade A producers are produced monthly and are discussed in more detail later in this chapter. The production of these statements, called Milk Settlement Sheets, is quite involved and is considered a separate system component.

The final record maintained with respect to receipts of raw dairy products identifies raw milk received from Grade A producers and used in the manufacture of cheese and ice cream mix. Additional daily and monthly totals are calculated in this record also, and these items can be used to cross-check data stored in the Grade A producer records. Again, this record is updated daily and is used in the production of the Milk Settlement Sheets for the Grade A producers.

Manufacture of Packaged Products

The manufacture of packaged products constitutes the basic operations of the dairy business of Darigold Farms. Packaged dairy products can be classified into Class I, Class II, and Class III products. Class I products include all fluid milk products such as whole milk, skim milk, low fat milk, chocolate milk, etc. Class II products

include cottage cheese sour cream, and ice cream mix, and Class III products include all other cheese products and butter products. The actual manufacture and pricing of the three classes of milk products is very structured and regulated. Therefore, only a simple explanation is included here to facilitate the following discussion.

Basically, all Class I products must be manufactured from Grade A raw milk. This is received mainly from the Grade A producers and to a much lesser extent from other Montana plants. Grade A raw milk can also be used to manufacture Class II and/or Class III products. Additionally, raw milk received from Grade B producers is used to manufacture some Class II and Class III products. And, the cream received from Grade C producers is used in the manufacture of butter, a Class III product.

Ideally, since Class I milk is normally higher priced than other grades, all Grade A raw milk should be made into Class I products and sold as such. This would provide the largest dollar revenues to the Grade A (member) producers. This is not possible, however, for several reasons. First, the market may not exist for large volumes of fluid milk products. Second, because Class I milk products must have a specified butterfat content and not all Grade A milk has this exact percent of butterfat, some Grade A milk must be used for lower class products. In any event, extremely accurate records must be maintained reflecting the usage of all milk received in terms of the class of milk product manufactured.

Company manufacturing records are maintained through daily manufacturing reports. All Class I products, Class II cottage cheese, sour cream, and ice cream mix are manufactured in Missoula, while other

Class II ice cream mix and Class III cheese and butter products are manufactured in Ronan. Daily manufacturing reports on these seven groups of products (counting ice cream mix twice) are produced by the production supervisor at the end of each production run, and include such data as date, product numbers and names, total pounds of each product manufactured, and total pounds of butterfat in each product.

These daily reports are posted to monthly summary sheets at the end of each month. Separate summary sheets (six in total) are maintained for Class II sour cream and cottage cheese, Class II ice cream mix (one for each plant), Class III cheese, Class III butter, and Class I fluid milk products. Each of these sheets include the same data items as the daily report, cumulative for the entire month. These monthly summaries are then used to report manufacturing operations and usage of all milk receipts to the state regulatory agency.

Inventory Control

A physical inventory is taken monthly of all packaged milk products and bulk milk in storage at the end of the month. This inventory report includes the following data: month, product numbers, product name (packaged) or class of milk (bulk), total units (packaged only), pounds of product, pounds of butterfat for each product (using standard test figures for packaged products and actual test figures for bulk milk). This report is also used in preparing a monthly report to the Milk Control Division. No crosschecks are currently made against manufacturing and/or sales figures to determine losses of product throughout the month.

In addition to the monthly inventory, a quarterly inventory is

accomplished which accounts for all items of product as well as all other items on hand, such as supplies. This inventory is accomplished mainly for tax considerations and reports much the same data on milk products in inventory.

Sales and Customer Billing

The sales component of this system can be broken down into two subcomponents--retail and wholesale sales. The processes included in each subcomponent are similar; however, differing size and time factors make the consideration of each subcomponent necessary. Retail sales includes sale of packaged milk products to individual customers on a door-to-door basis via six retail routes. Wholesale sales includes sale of packaged and/or bulk milk products to institutional customers such as grocery stores, hospitals, schools, etc. Wholesale sales are also accomplished using routes. In addition, wholesale sales includes the sale of products to "jobbers," independent salesmen operating their own trucks; the sale of products to out-of-state customers in Spokane; and over-the-counter sales at both plants. Each of these additional aspects of wholesale sales is simply considered a "route," and data are recorded in a manner similar to the other four wholesale routes. Retail sales records are maintained in Missoula while wholesale records are split between Missoula and Ronan.

The first step in the sales function is accomplished by the route driver. A Driver Load Sheet is filled out reflecting the various products loaded on the truck on a specific day. This sheet contains the date, driver name, route number, and the number of each product handled that day. Spaces are also available for returns, spoilage,

extra pick-ups, overages, etc. This sheet is turned in at the end of the work day, but nothing is currently done with the data gathered.

As the retail route driver makes deliveries, he completes a Retail Route Sheet which is kept in a Route Book for the entire month. These sheets, one for each of the approximately 1500 retail customers, contain month, route number, customer name, delivery dates, number of each product delivered on each delivery date, and total number of units of each product delivered during the month. The sheets are updated as deliveries are made and totaled at the end of the month.

The Route Book is returned to the plant office at the end of the month, the Retail Route Sheets are posted to sales records, and Retail Customer Statements are produced. These statements are mailed out monthly and include date, customer name and address, product number and quantity of each product purchased, price of each product purchased (standard for all customers), amount due for each product, current month total, balance past due, and total amount due.

At the same time that the retail statements are being produced, a Retail Accounts Receivable (A/R) Ledger is produced. This ledger shows month, route number, customer name, balance past due, credits during month, current charges, total amount due, and an aging schedule. Credits are posted to the current A/R ledger as payments are received from customers, and these as well as the balance past due (if any) are taken from one month to the next in the A/R ledger.

Finally, a Retail Sales Summary Sheet is produced from the Retail Route Sheets. This report reflects month, route number, product numbers and names, quantities sold for each product (separated by route), and total sales dollars for each product (separated by route). This

retail sales summary is then used to produce a total sales summary for each month (discussed later).

As the wholesale route driver makes deliveries, he completes a Daily Wholesale Customer Invoice showing date, route number, invoice number, customer name and address, product number and name, quantity of each product delivered, unit price (not standard--driver specifies price for each customer), total amount for each product, and total amount of order. These invoices are posted daily to produce or update Wholesale Customer Statements, the Wholesale Sales Summary Sheet, and the Wholesale A/R Ledger.

The Wholesale Customer Statement includes customer name and address, date of each delivery, invoice number for each delivery, charges for each delivery, credits received during month, balance brought forward from last statement, and balance due (daily subtotal). These statements are usually sent out monthly to approximately 120 wholesale customers, but can be mailed bimonthly, if desired.

The Wholesale Sales Summary Sheet shows the same basic information as the retail sales summary but is produced daily. Thus, the current totals are for the current day's sales with an additional column showing total units and dollars sold for current month to date. The last day's sheet serves as the monthly Wholesale Sales Summary Sheet. This wholesale sales summary is then used to produce a total sales summary for the month (discussed later).

The Wholesale A/R Ledger reflects exactly the same information as the retail ledger; however, it is updated daily and a slightly different format is used. Also, the aging schedule is done at some later date, usually at the end of the month.

The Total Sales Summary Sheet is prepared monthly from the retail and wholesale sheets. The report shows month, product number and name, sales divisions (retail, wholesale, jobber, total), total units sold by product in each division, total dollar sales by product in each division, and totals of units and dollars for the month in each division. This report is then used in the production of the Milk Control Division Report and in determining amounts paid to Grade A producers.

Employee Payroll

The employee payroll function is accomplished at the Missoula plant for all company employees. A payroll summary report is prepared every two weeks and sent to a commercial service bureau in Missoula. This report includes date, employee name and number, pay code, hours worked (straight and overtime), hourly rate, and a list of one-time deductions by type and amount. These data are gathered from employee files and time cards, and data on Ronan employees are sent to the Missoula plant for submission with the report.

Paychecks are returned from the service bureau to the Missoula plant for dissemination, and a payroll report is sent to the company's accountant for company records.

General Ledger

The general ledger function of Darigold Farms includes the basic accounting recordkeeping operations of the company. Data are maintained on ledger cards for approximately 550 separate accounts divided into the following categories: sales, cost of sales, expenses, and other income and expenses. The ledger is divided approximately in half, and each half is maintained throughout the month at one of the

plants. Each month accounts are figured and balanced for both halves at the Missoula plant office, and a paper adding machine tape is produced showing each account number and corresponding fiscal year-to-date balance. This tape is sent to the commercial service bureau in Missoula where a monthly income statement and balance sheet are produced.

The income statement reflects the following information: account number, account name, current monthly ratio (as a percent of sales), current monthly balance, last year's monthly ratio, last year's monthly balance, the difference between current monthly balance and last year's, current year-to-date ratio, current year-to-date balance, last year's year-to-date ratio, last year's year-to-date balance, and the difference between current year-to-date balance and last year's. The statement also shows total sales, total cost of sales, gross profit, total expenses, net operating profit or loss, total other income and expenses, and net profit or loss each enumerated into the previous ten figures.

The balance sheet is basically a listing of the input tape sent to the service bureau. It shows the account number, account name, and fiscal year-to-date balance in each account.

Producer Payroll

The producer payroll function involves the determination of the amount of money to be paid to each of the Grade A producers for raw milk received. A Milk Settlement Sheet is produced for each Grade A producer from data contained in the following records: Grade A producers receipts records, Class I product sales records, Class II and III product manufacturing records, inventory reports, and records on each producer concerning

miscellaneous deductions (i.e., assignments, advances, assessments, etc.). Additional data concerning the price of Class I milk at the standard butterfat test of 3.5 percent are obtained from the Montana Milk Control Division. By combining these data in various intricate and complex ways and using, among other calculations, a "base plan," a total dollar payment for all milk received from each producer and a net check amount is determined. The actual calculations are not of primary concern here except for the facts that the process is complex, very time consuming, and involves large numbers of data items. In addition, this process is accomplished in conjunction with the final data processing function discussed later.

The Milk Settlement Sheet can be divided into several major sections: a heading, base milk calculations, over base milk calculations, and deductions. The heading shows the producer's name and address and the month for which the Sheet is produced. Base milk calculations reflect the total amount of Class I milk sold in Montana as a percent of the monthly base plan total, priced for base milk at 3.5 percent and at the producer's average butterfat test, and the total amount paid for base milk.

The "base plan" is a device which is designed to stabilize the producer's market by determining in advance approximately how much milk will be purchased from him. This plan applies only to the Grade A producers of Darigold Farms and changes periodically according to market and regulatory conditions. A producer can actually produce and sell any amount of milk he desires, but the "best" price will be paid only for the amount of milk up to the producer's allotted base. The over base milk price is significantly (15-25 percent) less than the base milk price.

Over base milk calculations reflect prices for over base milk at 3.5 percent butterfat and at the producer's average test, and the total amount paid for over base milk. This amount is added to the total payment for base milk, giving total payment for all milk received from that producer for that month.

Next, miscellaneous deductions are removed from the total payment to show amount of the net check, which is included with the Settlement Sheet and sent to the producer. Miscellaneous deductions include stop charges, hauling rates, stock assessments, Milk Control Board assessments, various assignments and advances, and other miscellaneous charges. Some of these charges are fixed, some are variable, and all do not apply to each producer.

Finally, two additional pieces of information are included on the Settlement Sheet. These are the company price for all milk, calculated as the total of all dollars paid out for milk divided by the total amount of milk received from all producers, and the producer's price for all milk produced, calculated as the total payment (before deductions) divided by total amount of milk produced that month by that producer. As stated previously, a copy of the Milk Settlement Sheet and the net check (if any) is mailed to each Grade A producer not later than the fifteenth day of the following month.

One final item should be mentioned here. On about the fifteenth of each month, an advance is sent to each producer for approximately one-half of that month's expected net payment. These advances are simply estimated from past experience and minimal calculations are accomplished. They are, of course, included in the miscellaneous deductions for each producer at the end of the month.

State Regulatory Auditing

Auditing of dairy operations by the state regulatory agency, the Milk Control Division of the Department of Business Regulation, involves the production and submission of a Milk Control Division Report. This report essentially summarizes receipts of all milk and milk products and outlines their utilization for each month. The report is divided into six basic sections as follows: (1) receipts, (2) Class I sales, (3) Class II usage, (4) Class III usage, (5) recap of out-of-state sales, and (6) reconciliation of receipts with utilization.

As stated previously, this report is produced at the same time as the Milk Settlement Sheets, and much of the same data are used in both processes. In addition, data produced and/or maintained by four of the other six system components are used in the production of this report. This report is also quite intricate and involves a significant number of data items in various calculations. A complete description of the process of preparing the Milk Control Division Report would be a project unto itself. Therefore, only a brief summary of its contents is included here to reflect its magnitude and complexity.

The first section of the report summarizes all receipts of milk and milk products from all sources for the month. These sources could include Grade A producers, the dairy's own farm, other Montana sources, out-of-state sources, opening packaged inventory, opening bulk inventory, additives (Class I products only), and reconstituted skim milk. Receipts from all sources are reported in terms of pounds of product and pounds of butterfat.

Class I sales includes the following subsections: packaged sales,

sterile packaged sales, out-of-state sales, bulk and/or packaged sales to other Montana plants, and closing packaged inventory. Packaged sales are reported by product name, units, product pounds, butterfat test, and butterfat pounds. Bulk sales and closing packaged inventory are reported in terms of product pounds and butterfat pounds. Finally, all Class I sales are summarized as total Class I utilization.

Class II and Class III usage sections include product pounds and butterfat pounds used in manufacturing for various Class II and III products, exported bulk sales, and other Montana plant bulk sales. The section on recap of out-of-state sales summarizes product pounds and butterfat pounds of Class II and Class III out-of-state bulk and/or packaged sales.

Finally, the reconciliation of receipts with utilization summarizes all receipts and utilization enumerated previously, and contains subsections for overage or shrinkage. Thus, every drop of milk received should be accounted for within a certain allowable degree of error.

System Management

System management encompasses the generation of plans for the system, setting of component goals, allocation of resources, and controlling of the system's performance.[18] The critical aspect in this process is planning for changes in the system. Unless the system is allowed to grow and expand, and this growth and expansion is effectively managed, the system will stagnate or evolve into an unworkable monstrosity.

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[18]Ibid., pp. 100-101.

The data processing system studied in this project has been growing and expanding in the past few years under very effective management. Recent expansion of the dairy business, however, has caused this system to become overburdened and has caused some important management analysis to be foregone in favor of accomplishing the more basic tasks of recordkeeping. Planning for changes is now being accomplished, as evidenced by the subject of this paper, and the finalization of these plans should provide the framework within which long term expansion and growth can be accompanied by effective system management.

Ranking of Data Processing Functions

Traditional approaches to computerization of small company data processing functions usually emphasize the early implementation of such administrative functions as customer billing, general ledger, and other accounting applications. In some cases these approaches are warranted because of the lack of valid accounting information available to management and because of limited cash flow due to poor billing methods. However, in other cases the initial implementation of "lifestream activities," activities concerned with the actual operations of the company, would actually produce much more sizable returns and benefits and would support continued computerization of additional functions.[19]

In the case of the dairy business of Darigold Farms an even more envolved situation exists. As can be seen from Figure 1 (page 16) and from the previous discussion of system components, six of the eight data

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[19]Couger and Wergin, "Small Company MIS," pp. 30-31.

processing functions involved are considerably interdependent. At the same time the other two, somewhat independent, components (employee payroll and general ledger) are already computerized to some extent using a commercial service bureau.

Computerization of one or two of the interdependent functions would barely begin the development of a viable management information system. On the other hand, computerization of the general ledger and employee payroll functions first would result in the least possible savings and benefits in terms of dollars and man-hours. It would seem, then, that in order to utilize a computer system most effectively in this application, a systematic implementation of at least four of the six interdependent functions, and ultimately all eight components, would be the best approach. This implementation would involve building a central data base to be accessed by each of the various system components (Figure 2) and would allow whatever additional analysis and reporting that is desired by management.

It is possible, of course, to computerize one or more system components without developing the type of information system mentioned above. A Darigold Farms study of employee occupation with various office activities done in May, 1975, indicates that the vast majority of office time is spent accomplishing the various sales activities. This seems reasonable due to the "lifestream" character of the sales function to this business. The other functions in order of time spent on each are: receipts, general ledger, producer payroll, employee payroll, inventory, state regulatory auditing, and manufacturing. In addition, it could be possible to prepare the producer payroll and Milk Control Division Report via computer while having only sales and receipts functions implemented.

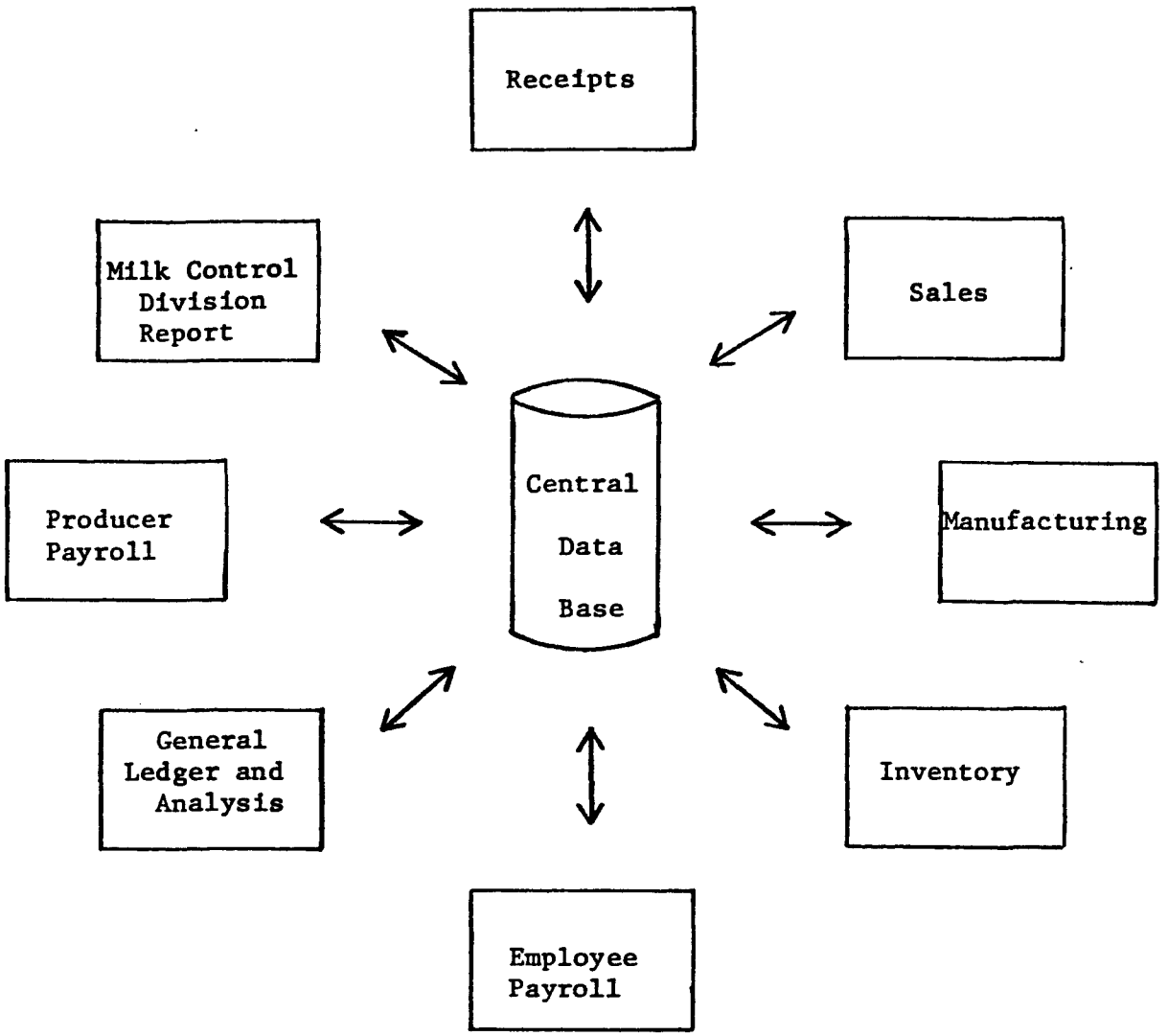

Fig. 2. Information System with Central Data Base

The data stored in inventory and manufacturing processes and required to produce reports could be handled manually.

In considering all the above information, it would seem necessary to begin any implementation of a computerized system with the sales function, followed closely by the receipts function. A start with these components will allow the development of a central data base to begin. As additional components are added, the data base can be expanded until data are available to produce all required reports and accomplish all desired analysis.

It should be noted at this point that, since the producer payroll and state regulatory auditing functions depend on data from each other and virtually all other components, the computerization of these functions should be very nearly simultaneous. Implementation beginning with sales and receipts, moving to general ledger and employee payroll and then to producer payroll and the auditing report would be a viable alternative to complete computerization. Inventory and manufacturing functions would remain manual until further computerization is possible.

In summary, then, the most desirable priority of component implementation into a computerized management information system is as follows: sales, receipts, general ledger, employee payroll, producer payroll, state regulatory auditing, manufacturing, and inventory. Careful implementation of any portion of the system components listed above should provide significant returns and benefits to the company directly proportional to the speed and efficiency of implementation.

Evaluation of Current System and Improvements Possible Through Computerization

Various methods and techniques exist by which an information system can be evaluated. However, one of the more complete and thorough approaches is described in Information Systems Analysis by M. J. Alexander.[20] The initial step in this approach, as discussed in Chapter I of this paper, includes testing each process in the system for possible elimination, combination with another process, simplification, or change in sequence. Next, the system's efficiency and effectiveness must be established in terms of various measures. Finally, the quality of information produced by the system is evaluated.

In testing the various processes that comprise the components of the current system, it was found that the great majority of these activities require very little simplification, and no changes in sequence, elimination, or combination. Each process currently includes the gathering of the minimum amount of data required for use by management. In fact, additional data should be gathered in some processes. Some parts of the receipts records could possibly be combined and simplified; however, machine aid would be required to accomplish this effectively. Obviously, many of the activities would be much simpler when processed with the aid of a computer.

The only processes where a large amount of simplification could be helpful are those over which the company has little control. These

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[20] M. J. Alexander, Information Systems Analysis, (Palo Alto: Science Research Associates, Inc., 1974), Chapter 7.

processes include state regulatory auditing, producer payroll as affected by Milk Control Division regulations, and out-of-state sales. The problems occurring in out-of-state sales arise when required pricing data are late in arriving. This causes estimates to be used in reports and subsequent modifications to reported information to be made after deadlines are past and reports have been filed.

The efficiency and effectiveness of the current system can be evaluated in terms of meeting management objectives, providing required management information, requiring clerical and staff time, and generating costs to the firm. Each of these factors is considered in some detail in the following paragraphs. In addition, suggested improvements possible through computerization of the various system components are outlined.

The total system objectives were stated in Chapter I as (1) maintaining all pertinent business operations and accounting data, (2) providing information from that data necessary for successful operation of the business, (3) reporting those operations to state regulatory agencies, and (4) providing accounting reports of the business to applicable federal agencies. Each of the data processing functions of the system contribute to meeting these objectives, some more than others. Pertinent data are stored and available under the current system and reports to outside agencies in state and federal government are ultimately produced. However, the accuracy and timeliness of state reports are occasionally substandard.

In addition, some relatively serious problems do currently exist in the area of providing required management information. Usable information in the form of reports and analyses of the various aspects of the business are scarce at the present time, and much of management's time

is spent in converting available data into usable information. This problem area is discussed in more detail in later paragraphs.

Under the present system a substantial amount of clerical and staff time is spent accomplishing activities in the receipts and sales areas. As a result activities in other functional areas are delayed, only partially accomplished, or not accomplished at all. Areas affected in this manner include inventory and management analyses of operating data from the manufacturing and general ledger functions. Additionally, reports to outside agencies may be delayed due to the amount of time required to conclude a month's sales transactions.

The costs associated with the existing information system include both explicit and implicit costs. The explicit costs are the monthly costs for the commercial service bureau (approximately $200 per month), the maintenance costs for the data processing equipment currently in use[21] (approximately $125 per month), the depreciation expense of the equipment, and salaries of employees involved in the manual preparation of data for the firm. Implicit costs include opportunity costs associated with inventory shortages or overages, losses of inventory due to lack of complete inventory control, and other business losses due to imcomplete or unusable management information. This last area could include such possibilities as declining productivity, waste in manufacturing, rising costs not accompanied by corresponding changes in prices or investigation of the reasons for the rising costs, other cost accounting considerations, and other miscellaneous expenses.

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[21]The NCR 395 machine being used was purchased for $7,500. However, only maintenance and depreciation expenses continue to be incurred.

In general the management information provided by the existing information system is of reasonably good quality. However, most of this information, gathered for use in the producer payroll and state auditing functions, is in the form of aggregated data. Further reduction and alternate combinations of this data must be accomplished by hand and take considerable time. Because of this time requirement much of the information desired by management is never available, or becomes available too late to be useful.

Current management information provided by the existing system includes monthly operating statements (with no analysis), an aged A/R ledger for both plants, the Milk Control Division Report, daily cash flow report, monthly manufacturing recap sheets, monthly and quarterly inventory reports, a quarterly cost analysis report, and a payroll report reflecting hours worked in various stages of operations. All of this information is reported for the current period only with little or no comparison to previous periods.

The types of information desired by management include operating statements with analysis of losses on specific product items or groups of products and profitability analysis comparing current year-to-date figures to previous year-to-date figures. Also, a payroll report should be provided with analysis of productivity by job areas, as well as an inventory analysis of shrinkages in various categories and a detailed accounting of product pounds from receipt through manufacturing to sales or usage. Finally, a detailed cost analysis should be produced providing a cost per item monthly by cost categories, and a profit and loss analysis by route and/or method of delivery (i.e., retail, wholesale, jobber). Of course,

as this information is provided to management, further refinements will be desired and additional information will be required.

As an overall evaluation of the existing information system of Darigold Farms, it can be stated that the successful and conscientious accomplishment of current data processing functions meets stated management objectives by providing minimally adequate management information using a moderate amount of time while generating reasonable explicit costs. However, expansion of current system components to handle an expanding business operation and to attempt to provide desired management information will result either in greater explicit costs (i.e., salaries or equipment) or in greater implicit costs.

Computerization of at least a portion of the information system of Darigold Farms will provide several types of improvements. First, a significant time saving will result, if a computer system is used to perform as many of the repetitious mathematical calculations involved in various activities as is possible. This time saving will free existing employees from tedious activities and allow them to accomplish other needed work. Additionally, substantial expansion of business operations can take place without the addition of clerical employees, if data are stored and manipulated and reports produced by computer.

Also, improvement of the existing system to include much of the additional analysis and production of management information discussed previously can only be feasible through computerization. Additional or current staff employees may be capable of providing this improvement, but not as timely or as flexibly as a computer system nor with as little effect on other system components.

Finally, the expansion of certain system components, such as inventory and manufacturing, to include detailed control and analysis will require additional data gathering activities. The vehicles for gathering this data already exist; they need only to be employed in different, more detailed ways. Employee time will be required to accomplish this data gathering process, possible without adding employees due to time savings previously mentioned. And, the detailed analysis can only be effectively and efficiently accomplished using a computer system organized around a central data base.

CHAPTER III

COMPUTER SYSTEM CONFIGURATION

Introduction

This chapter describes the general configuration of a computer system designed to support successful implementation of all principal Darigold Farms data processing functions and to provide required management information. The basic system requirements for central processing, internal and external storage, data preparation and entry, and report generation are described under the headings: Hardware and Software.

The term, hardware, as used in the computer industry and in this paper, pertains to the computer and computer-related equipment that make up a computer system. This can include the central processing unit, which is the portion of a computer housing the basic operating instructions and main memory; terminals of various types; printers of various types; magnetic disk drives; magnetic tape drives; card or paper tape readers/punches; etc.

Software, on the other hand, refers to the programs developed for specific applications. These programs, when coupled with the basic operating instructions (also considered software), perform the various functions and activities of the system components. The following two sections describe the basic hardware and software requirements of a computer system capable of supporting the information system of Darigold Farms.

Hardware

General Information

Any computer system designed for a business application such as the one under study has a certain basic set of parameters. These parameters describe the absolute minimum computer system configuration possible. Lacking one of these parameters, a configuration will not provide a workable system. At the same time, the choice of a particular piece of hardware to fulfill these basic requirements is quite varied.

The basic requirements for any business computer system include: a central processing unit with a specified amount of main memory, some form of auxiliary storage medium, and one or more input/output devices. The central processing unit (CPU) is actually the "brains" of a computer and is sometimes referred to as the computer "main frame." All computer operations and calculations are performed in the CPU through the basic operating instructions and programs. The CPU contains the main memory (also called core or core memory) of the computer and is available in various sizes or amounts.

Computer memory, as well as storage, is usually described in terms of units called "bytes," composed of a specified number of smaller units called "bits." A byte usually contains 8 bits. While some storage and memory are described in terms of a combination of bytes, called "words," this unit will not be used here.

Main memory is usually purchased from a computer vendor as an integral part of the CPU. Main memory can be purchased in varying amounts, usually in multiples of 4,096 bytes (commonly referred to as "4K" bytes, a "K" being 1,024 bytes). However, many computer vendors offer CPU's with

only a few specified amounts of main memory and changes to these specified amounts can increase the price of the CPU.

Auxiliary storage refers to one of the many peripheral devices that can be attached to the computer main frame. Most business applications involve storage of a tremendous amount of data. Even though a certain amount of storage is available as main memory, the total amount of storage required would cause the price of a computer system to be astronomical if only main memory were used. Therefore, most computer systems contain some sort of auxiliary storage which can be either "online" or "offline." Offline storage refers to punched cards, paper tape, or computer printouts, while online storage refers to one of the magnetic media available--disks, tapes, drums, etc.

Amounts of online auxiliary storage are usually measured in millions of bytes, called megabytes (Mb). Magnetic disks, for example, are available in sizes from 2 Mb to 200 Mb with prices ranging accordingly.[22] Offline storage of current operating data is not really feasible in a business application. However, offline storage of historical records is frequently done, usually employing computer printouts, since this requires no additional equipment such as card reader/punch or paper tape reader/punch. Also, printouts can be interpreted without the aid of the computer, allowing access to historical records without disrupting daily computer operations.

Input/output (I/O) devices are available in various sizes, speeds, and designs, and are classified according to function. Some

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[22]Donald Mattson, "Understanding Media," Computer Decisions, March 1976, pp. 44-46.

common I/O devices are: readers/punches, terminals, and printers. Business applications traditionally have employed punched cards for input, requiring card punches and a card reader. However, more recent applications have employed terminals as data entry devices, where data is typed via a keyboard directly onto a magnetic medium or into main memory.

Terminals are usually of two types: teletypewriters and cathode ray tubes (CRTs). Teletypewriters record whatever is typed on the keyboard on paper, while CRTs display the keyed data on a screen (similar to a television screen) and retain no printed copy of the data. Terminals are rated according to their printing speed, usually in characters per second (cps). Speeds vary, but are usually found to be in the range of 30 to 75 cps.

The other I/O device usually included in the basic business system configuration is a printer which operates at a higher speed than most terminals. Printers can also be purchased with varying printing speeds, usually rated in lines per minute (lpm). While a teletypewriter could be used for output, the increased speed of line printers (with speeds up to several hundred lines per minute) coupled with the ability of producing output while simultaneously entering data at a terminal makes a line printer a reasonable and cost effective device.

Specific Recommendations

The computer system configuration of Darigold Farms should include some combination of the basic system parameters mentioned above. However, the exact configuration will depend on the extent to which the information system is computerized. Various possibilities do exist, as described in Chapter II; however, the optimum approach would involve computerizing all

principal data processing needs, providing the best return on investment and the most valuable management information.

This optimum configuration should include the initial computerization of the sales and receipts functions, followed shortly by the computerization of employee payroll and general ledger functions. Once these processes are operating satisfactorily, the producer payroll and state auditing functions should be implemented. These last two processes would require data from the remaining manual processes: manufacturing and inventory. The initial hardware configuration should also provide the capability of expansion to include computerization of manufacturing and inventory functions at some future time.

The hardware required to allow the development of this system configuration should include the following items: (1) a CPU containing at least 16K bytes of main memory, expandable to at least 32K bytes, (2) an auxiliary storage medium in the form of magnetic disks containing approximately 5 Mb (megabytes) of simultaneous online storage, (3) a printer (possibly as part of the online terminal) capable of using 132-column width paper and printing at least 60 lines per minute or 75 characters per second, (4) an online terminal (preferably a teletypewriter) with a print speed of no less than 30 cps, (5) one additional terminal capable of preparing data offline in some machine-readable form (e.g., on diskette, magnetic tape, etc.), and (6) an interface device capable of transferring the data prepared offline to online auxiliary storage.

The requirement for the last two items in the hardware list arises from two factors. First, the sales and receipts functions are currently separated, one function being accomplished at each plant. Second, even if the data gathered for both functions were consolidated

at one plant, a single keyboard operator would simply be unable to enter and process the enormous daily volume of data involved. This is the basis for one of the most common problems in business computer applications--the data entry "bottleneck."

The only feasible alternative to the configuration outlined above would be one that required two online terminals. In this way, two operators would be able to enter data directly into auxiliary storage for processing. However, this approach would increase hardware and software costs significantly.

The hardware of a small business computer system will cost between $25,000 and $50,000, if purchased. Monthly lease costs for a one-year renewable lease will be between $700 and $1,500. The lower end of the price range reflects a configuration with one online terminal, no line printer, no offline terminal or interface, 16K bytes of main memory, and approximately 2.4 Mb of online auxiliary storage. The upper end of the price range reflects a configuration with one online terminal, a 120 lpm line printer, an offline terminal and interface hardware, 32K bytes of main memory, and up to 10 Mb of online auxiliary storage. The optimum system configuration outlined previously would lie in the upper portion of this price range.

Software

General Information

The software required to support the development of the information system of Darigold Farms includes two basic components: the operating system and the applications programs. The operating system, or set of basic operating instructions, is unique to each type of computer system

and is purchased with the CPU. The applications programs are unique to the business, however.

Two principal types of operating systems are available for this type of business application: real-time systems and batch systems. Real-time operating systems are usually more complex and expensive than batch systems but allow user interaction with the computer in the form of "question-and-answer" programs. These types of programs are valuable in maintaining perpetual inventories, in supporting order entry applications, or in providing immediate response management information. Batch operating systems, being less complex, are easier to use and are less expensive. However, since all processing is done in "batches," response time for information produced is longer than with a real-time system.

Recently, some computer vendors have begun to offer a simplified real-time operating system, which allows interactive programming but which also allows batch processing. This type of operating system is ideally suited to the business environment and to Darigold Farms in particular.

Some applications programs can be purchased from computer vendors for such processes as employee payroll, general ledger, A/R ledger, and some customer billing functions. However, many of these programs must be modified in some way to apply to specific applications.

In addition, programs to accomplish the data processing functions unique to this application must be developed. Efficient program development and integrated implementation of all system programs must be emphasized, if the computer-based information system is to be successfully developed. These two activities, comprising the major portion of the design phase of an information systems development project, can best

be accomplished by someone with expertise in this area working jointly with company management. Independent consultants usually are the best choice, since neither the individual small company nor the computer vendor has the personnel available at a reasonable cost.

Finally, in order to allow the development of unique applications programs for the proposed information system, a language compiler must be obtained as part of the operating system. Various business-oriented languages are available for this purpose, and the specific language obtained again depends on the computer vendor chosen. Each vendor has a particular computer language available with its minicomputer equipment and all of these languages are equally reliable. However, some languages may be more familiar to those involved with the development, operation, and maintenance of the system software, and this should be taken into consideration.

Specific Recommendations

In addition to evaluating the hardware offered by various computer vendors, Darigold Farms should evaluate the operating systems available. Capabilities differ with each system, and operating characteristics and limitations are of significant importance to the development of a workable system.

Darigold Farms should also analyze any applications programs available from vendors and determine the ease and costs of modifying those programs to its specific applications. Finally, a suitable programming language should be included with the operating system that is compatible with the types of data processing functions involved. Any one of the following languages would be suitable for this system:

BASIC-PLUS, FORTRAN, RPG, COBOL (in one of its many forms), or one of the new unstructured English-based languages.

Software costs will vary significantly with the computer vendor. Also, operating systems and language compilers are only offered on a lease basis. This is to the user's advantage, however, because the system and compiler are kept up-to-date by the vendor. Applications programs can either be purchased or leased, depending on the specific circumstances of their development. In any case, software costs should be specifically delineated by each computer vendor for evaluation by management of Darigold Farms.

CHAPTER IV

DEMONSTRATION PROGRAM DESIGN

Introduction and Assumptions

This chapter contains the basic elements of a systems design and serves to illustrate the end result that can be expected from a completed systems development of the management information system of Darigold Farms. Software was developed to demonstrate the current capabilities of electronic data processing methods in handling one particular area of this dairy's business. The area chosen for demonstration was the retail sales subcomponent. Care was taken to insure that current business methods used by Darigold Farms were followed, and the resulting package of programs parallels these methods quite explicitly. However, certain modifications and assumptions were made to facilitate the development of programs and data files for one specific data processing function isolated from the overall system. These modifications and assumptions simply allowed the demonstration programs to be developed outside the system environment and should not reflect on the possibility of a full-scale systems development.

First, it was assumed that the computer system available at the University of Montana AFIT/MBA Program Computer Center is similar to that which would be available for use by Darigold Farms personnel. Thus, all programs were designed around available hardware and software. The

BASIC computer language was used, since it is most easily adapted to business applications. Hardware used by the demonstration programs included a 30 cps teletypewriter, a 60 lpm line printer, a CPU containing 48K bytes of main memory, and a removable disk containing 2.4 megabytes of online auxiliary storage.

Second, the size of data files and certain program parameters was modified to allow relatively fast debugging, testing, and implementation of the demonstration programs. The number of retail products available was limited to twenty and the number of retail customers was limited to fifty. Also, only three retail routes were included. These numbers correspond to the approximately seventy-five products, fifteen hundred retail customers, and six retail routes in the actual retail sales subcomponent of the Darigold Farms system.

Third, only those product and customer data required for current period retail sales functions were designed into the data files. No historical sales data were included nor were any other data required for additional analysis or management reports. Again, this allowed relatively fast debugging, testing, and implementation of the programs and resulted from the separation of this one subcomponent from the overall system. However, in the next two sections, File Descriptions and Program Specifications, expansion of the demonstration package to include processing of other system components is described.

Finally, all data contained in customer and product files are hypothetical, but realistic. This includes price data of retail products. However, retail product descriptions were based on actual retail products currently offered by Darigold Farms.

File Descriptions

Two basic sets of data files were designed for the Darigold Farms retail sales demonstration programs: customer-related data files and product-related data files. All customer-related data were stored in a single Customer Master File containing fifty records, one for each customer. Each record of this file was divided into thirteen data fields. The record layout of the Retail Sales Customer Master File is shown in Figure 3.

Field #1 (the first three spaces) of each record contains the customer number. This three-digit number is the "key" to each Customer Master File record. In other words, it is unique to each record and allows the programs (and ultimately the computer operator) access to a customer's data via that number. Fields 2, 3, and 4 contain the customer name, street address, and city, state, and zip, respectively. Each is thirty-two spaces or characters wide.

Field #4 of each record contains a one-digit number specifying an active or inactive customer record. A "1" is stored, if the customer record is "active;" a "0" is stored, if the customer record is "inactive." An "active" customer record is one that contains a positive balance due or positive total current purchases at the end of the month. This "flag" is used in several programs and will be discussed further in the next section.

Field #6 contains a one-digit number specifying a customer record in which the customer's account is "over 120 days past due." This "flag" is also discussed further in the next section.

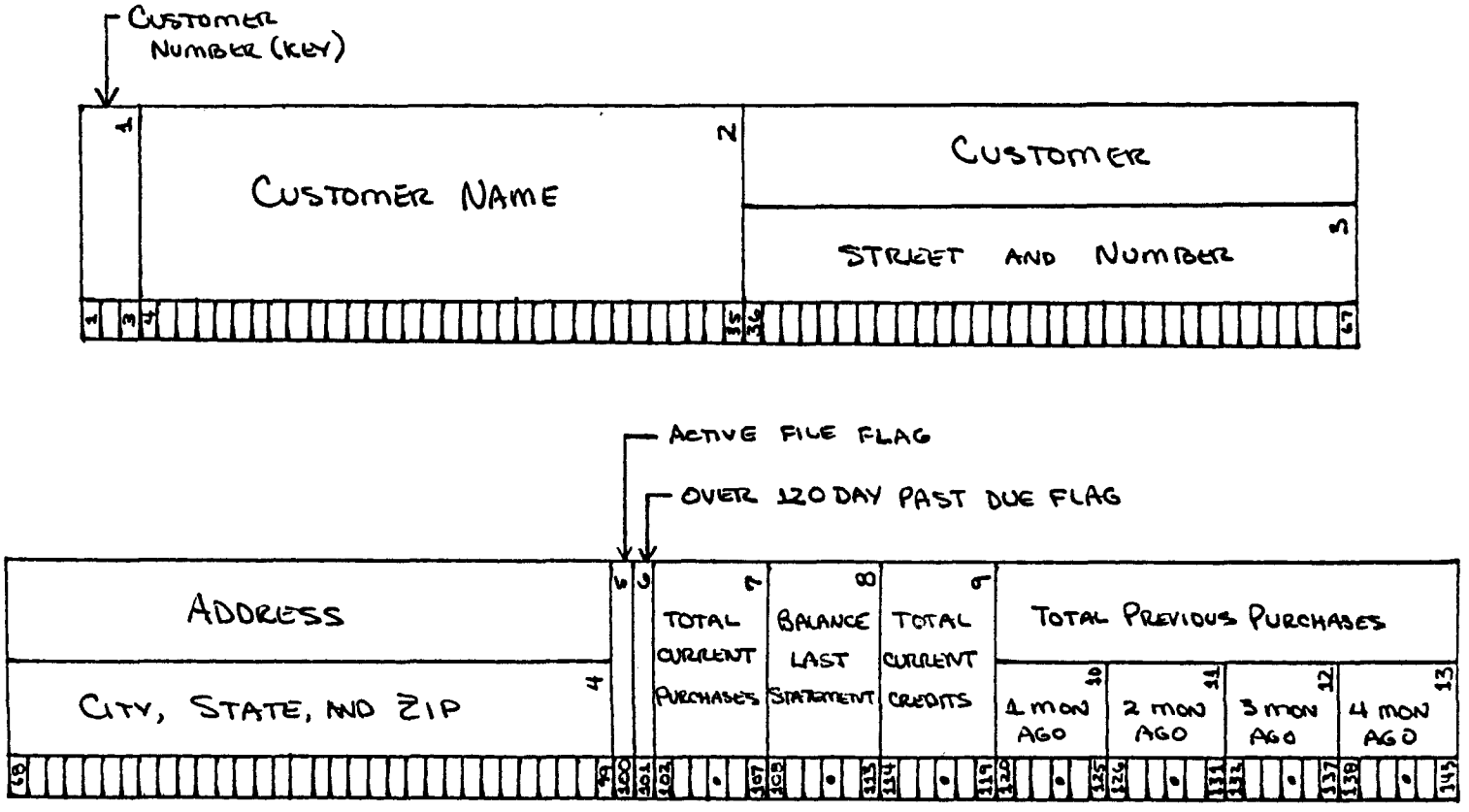

Fig. 3. Record Layout of Retail Sales Customer Master File

Fields 7, 8, and 9 of each record contain total current purchases, balance last statement, and total current credits, respectively. Each of these fields is six spaces wide, but has a decimal point specified within the field. This effectively limits the size of each number to $999.99; however, this size limitation is not invariable. It was specifically chosen in this case to conserve storage space and could be set to any reasonable value, as required.

Fields 10, 11, 12, and 13 contain total previous purchases and could be separated from the master file and stored in a history file, if desired. However, in this case the data stored in these fields are used in current period calculations rather than as reference data for non-current periods (as are history file data) and should remain in the Customer Master File. These fields, again, are six spaces wide and include a specified decimal point. Thus, the size limitation mentioned above applies here also.

Product-related data were stored in two product data files--a master file and a work file--each containing twenty records, one for each product. Each record of the master file was divided into three data fields, and each record of the work file was divided into four data fields. The record layouts of the Retail Sales Product Master File and Retail Sales Product Work File are shown in Figures 4 and 5, respectively.

Field #1 of each record in both product files contains the product number. This two-digit number is the "key" to each Product Master and Work File record. Field #2 of each Product Master File record contains a 32-character product description, and Field #3 contains the retail price of the product. Field #3 is 5 spaces wide and contains

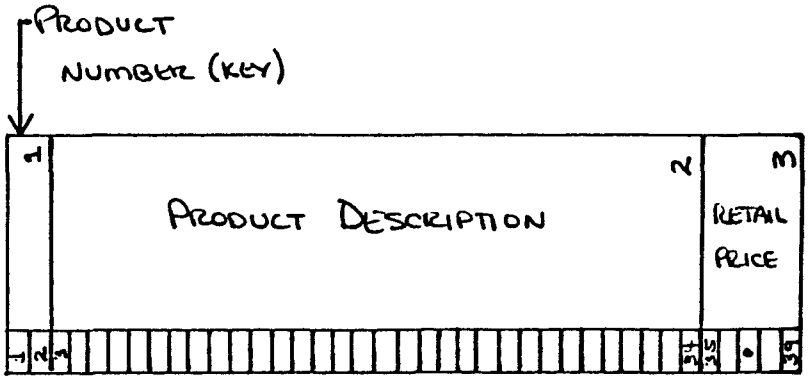

Fig. 4. Record Layout of Retail Sales Product Master File

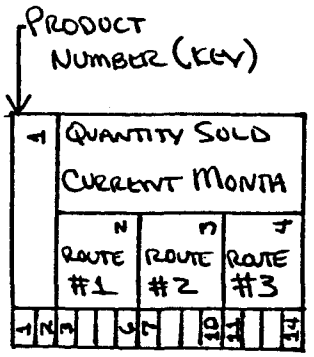

Fig. 5. Record Layout of Retail Sales Product Work File

a specified decimal point. Thus, the size limitation on retail price is $99.99. Again, this could be specified to any reasonable size, as required.

Fields 2, 3, and 4 of the Product Work File contain quantity of product sold in the current month on Route #1, #2, and #3, respectively. This work file provides the data for a special summary report as discussed in the next section.

Expansion of the two sets of files discussed above to include additional data required for processing of other system components would be a very simple task. By adding just one more data field to each Customer Master File record specifying "type of account," all wholesale customers could be added. The addition of two more data fields specifying "total purchases year-to-date" and "total purchases last year" would allow additional sales analysis and reporting.

No additional data fields are required in the Product Master File records to allow wholesale sales processing. (The "retail price" field would, of course, be changed to "price.") A completely new file, a Product History File, containing sales history by month and route (both wholesale and retail) for each product would allow even more sales analysis and reporting. Inventory-related data fields added to the Product Master File records would allow inventory tracking and analysis and reporting of inventory and manufacturing processes.

Completely different sets of data files would be required, of course, to allow processing of other system components such as raw product receipts or employee payroll. However, it is quite evident that very little expansion of the customer and product data files designed for this demonstration would be necessary to allow computerized processing

of three system components instead of one-half of one component.

Program Specifications

This section of a systems design document usually contains detailed specifications of each program to be developed. The specifications are instructions to the programmer from the analyst or designer explicitly outlining the programming to be done. In this case, however, the specification of the demonstration programs have been extremely simplified, and only general specifications have been included.

Figure 6 shows a functional breakdown of the Darigold Farms retail sales component. This decomposition of functions is called a "hierarchy" and is part of a design process called HIPO, an acronym for Hierarchical Input, Process, and Output.[23] In addition to the hierarchy, each second level function shown in Figure 6 would normally be diagrammed using an IPO, a figure specifying the input, process, and output of each function. Again, these have not been included here, since they are of relatively little importance to the subject of this paper.

It should be noted, however, that each of the four second level functions in Figure 6 is accomplished by one of the demonstration programs developed. These programs are considered the main processing programs. In addition, five utility programs were developed to accomplish certain ancillary functions required of the demonstration package.

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[23]Martha Nyvall Jones, "HIPO For Developing Specifications," Datamation, March, 1976, pp. 112-122.

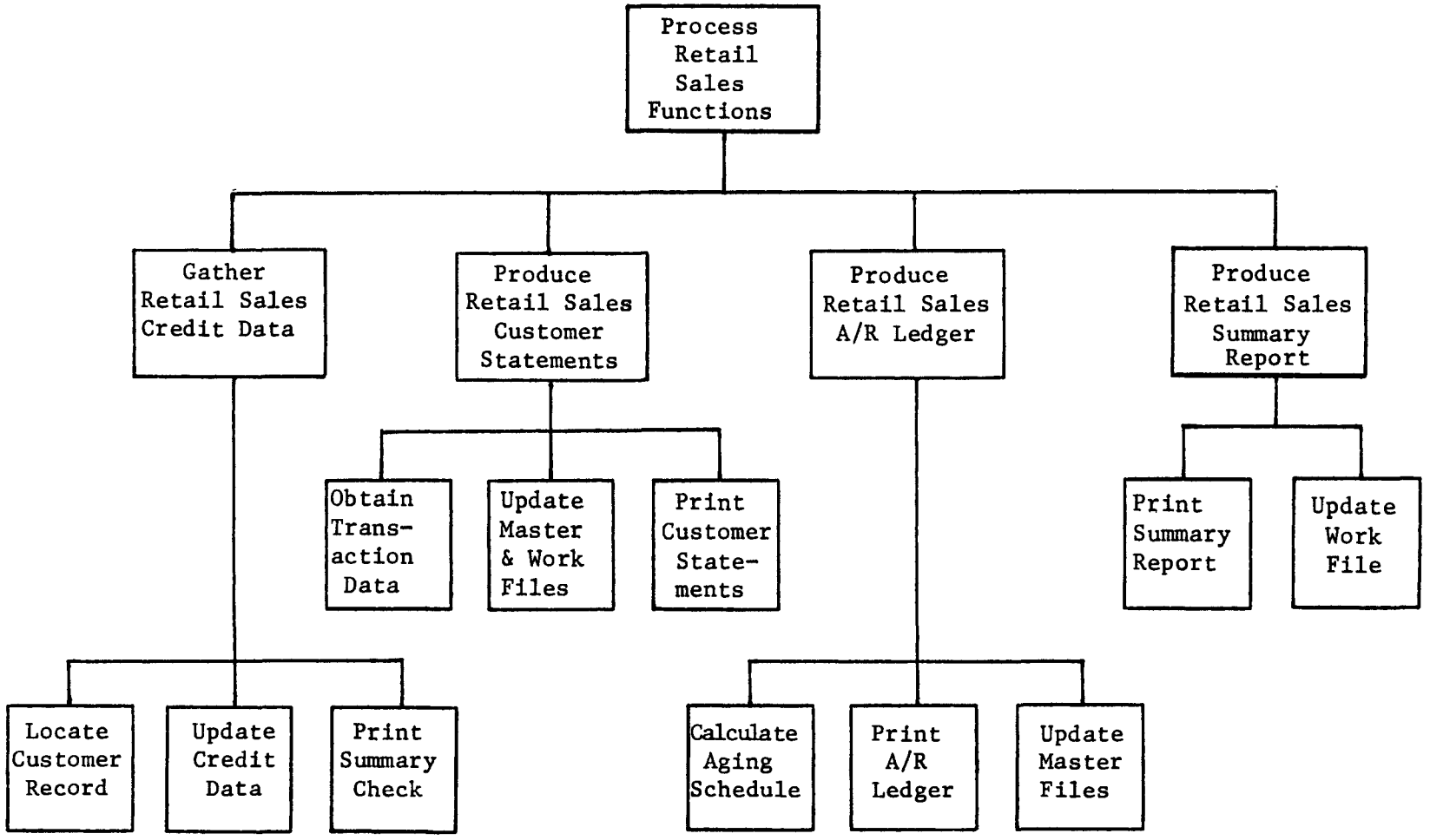

Fig. 6. Hierarchy of Functions in Retail Sales Subcomponent

The following is a listing of the nine programs developed for the demonstration of the Darigold Farms retail sales functions and a brief description of their uses:

1. RSCLD - creates the Retail Sales Customer Master File.
2. RSPLD - creates the Retail Sales Product Master and Work Files.
3. RSCEDT - allows editing of the Retail Sales Customer Master Files.
4. RSPEDT - allows editing of the Retail Sales Product Master and Work Files.
5. RSCRDT - allows updating of current credit data.
6. RSSTMT - produces the Retail Sales customer statements and updates master and work files.
7. RSARLD - produces the Retail Sales A/R Ledger and updates master files.
8. RSSRPT - produces the Retail Sales Summary Report and updates work files.
9. RSLBLS - prints mailing labels for all customer statements produced by RSSTMT.

Expansion of the several programs discussed above to include additional processing of other system components would, again, be a very simple task. All of the expansions noted in the previous section would require minimal additional programming. In fact, some expansions would simply require changes in a few program parameters. However, as noted before, expansion into completely different components would require completely new sets of programs.

User Documentation

General Information

User documentation is usually comprised of a user's manual explaining the operation of a system of programs. This user's manual should be very thorough and greatly detailed to insure that any and all operations to be accomplished with the system are fully explained, and any operational problems encountered are easily solved. The user's manual should contain sections describing: (1) the overall system, (2) how to create the data files, (3) how to maintain the system, and (4) how to execute each output-producing program. Forms and reports designs should be included as well as system security and privacy considerations. Mechanisms should be established and described whereby additions and modifications can be made to the system and design problems can be reported and solved. All of this should be available upon completion of the implementation phase of the systems development project.

For the purposes of this paper, however, only a general explanation of the use of each program has been included along with some sample computer output from the four main processing programs. In addition, a sample of the one input form used for processing customer statements has been included.

Use of Programs

The first two programs, RSCLD and RSPLD, actually create the data files on the computer disk and allow the initial customer and product data to be loaded or entered into these files. These two programs should only be executed once, since subsequent executions will destroy

data files previously created. For extremely large data files the loading function of RSCLD and RSPLD would be separated into two additional programs allowing multiple executions for entering all of the initial data. However, in this case this was not necessary because the data files were relatively small.

The next two programs, RSCEDT and RSPEDT, allow editing operations to be carried out on the various fields in each record of the customer and product data files. The edit options available with either program include: (1) adding new customers or products, (2) deleting old customers or products, (3) querying individual customer or product records, or (4) changing data in existing customer or product records. During the debugging and testing processes of the implementation phase these programs would be extremely useful. Also, in normal operations these programs allow management the opportunity to query records in search of specific information, as well as provide mechanisms for the expansion and contraction of the dairy's retail business. Of course, RSCEDT and RSPEDT also allow for the correction of operator mistakes which can occur during the execution of the main processing programs.

RSCRDT, the credit update program, allows the posting of current period credits (in the form of payments or returns) to customer records. These credits are normally received and posted by Darigold Farms personnel daily throughout a given month. RSCRDT, then, can be executed as often as necessary to keep current credits updated. At the end of each execution, RSCRDT prints a summary of the total number and amount of credits posted during that execution. This provides a quick, but accurate, verification to the operator.

Once all current credits have been posted (the cut off date is usually the 25th of the month), the retail sales customer statements can be produced using RSSTMT; one statement is produced for each "active" record. The operator receives the Retail Route Books from the route drivers containing the customer Route Sheets in route order. A sample Route Sheet is shown in the next subsection. From these sheets the operator enters current transactions in the form "product number, quantity" for each customer's purchases. RSSTMT processes customer statements in route order also, allowing the operator to begin with the first customer in the first route, stop anywhere in the middle, and begin again where necessary. Finally, master files and product work files are updated with current transaction data for later use.

As soon as all retail customer statements are prepared satisfactorily, RSARLD can be executed to produce the Retail Sales A/R Ledger and an optional listing of all accounts over 120 days past due, which uses the "over 120 days past due flag." Sample output produced by RSSTMT and RSARLD is included in the next subsection. Finally, current transaction data are deleted and master files are further updated by RSARLD, preparing them for the next month's processing.

The last of the main processing programs is RSSRPT, which produces the Retail Sales Summary Report. The use of this report is described in Chapter II, and sample output is shown in the next subsection. At the end of this program all product work file data are deleted in preparation for the next month's processing.

The last program in this demonstration package is RSLBLS, which prints mailing labels for customer statements. Using the "active file flag," RSLBLS prints a mailing label for each statement produced by RSSTMT.

Each of the programs in this package is extremely simple to execute and contains instructions and "prompts" for the operator in the form of questions or requests. (For a sample see Figure 8 in the next subsection.) This approach to program design is extremely effective, when the programs are to be used by an operator unfamiliar with the operation of a computer. In addition, each program contains numerous checks and "failsafes" to help prevent inadvertent operator mistakes during execution. These checks range from a reminder to the operator to insure that the proper paper is in the line printer before continuing execution, to summary totals printed at the end of execution to enable the operator to verify input data.

Sample Input Form and Output

The following pages contain samples of the Retail Sales Customer Route Sheet currently used by Darigold Farms (Figure 7), sample teletypewriter output from RSCRDT (Figure 8), and sample line printer output from RSSTMT, RSARLD, and RSSRPT (Figures 9, 10, 11, and 12, respectively). Teletypewriter output for RSSTMT, RSARLD, and RSSRPT is quite similar to that shown for RSCRDT. Therefore, this output has not been included here. It should be noted that the current transaction data samples shown in Figures 8 and 9 correspond to the appropriate customer entry in Figure 10. It should also be noted that Figure 7 shows an actual form currently being used by Darigold Farms, and product numbers will not necessarily correspond to those on sample output from the demonstration programs.

Darigold Farms

2600 S. Third Street - Missoula, Montana 59801
(406) 543-5165

Route Sheet

For

When remitting detach top section and return with payment.

	1 2	3 4	5 6	7 8	9 10	11 12	13 14	15 16	17 18	19 20	21 22	23 24	25 26	27 28	29 30	31	TOTAL	AMOUNT	
1 ½ Gal. Homo.																			
2 ½ Gal. Skim																			
3 ½ Gal. 2%																			
5 Qt. Homo.																			
6 Qt. Skim																			
7 Qt. Choc.																			
8 Qt. B.M.																			
11 Pt. ½ & ½																			
12 Pt. Whip																			
13 ½ Pt. Whip																			
24 Pt. CCH.																			
35 Butter																			
36 Eggs																			
38 Qt. Orange																			
44 ½ Gal. Ice Cream																			
	1 2	3 4	5 6	7 8	9 10	11 12	13 14	15 16	17 18	19 20	21 22	23 24	25 26	27 28	29 30	31			
																	Total This Month	$	
																	Unpaid Balance	$	
																	Total Due	$	

Statement for

Prompt payment is appreciated as your routeman does not receive his commission until this statement is paid.

THANK YOU. We're happy to serve you.

Darigold Farms Missoula, Montana
Ronan, Montana

Fig. 7. Retail Sales Customer Route Sheet

```
RUN RSCRDT

     ***** DARIGOLD FARMS MANAGEMENT INFORMATION SYSTEM *****
           ** RETAIL SALES CREDIT UPDATE PROGRAM **

DESCRIPTION:
THIS PROGRAM ALLOWS UPDATING OF CURRENT CREDITS DURING THE
MONTH BY POSTING CHECKS OR OTHER CREDITS AS THEY ARE RECEIVED.
PLEASE FOLLOW ALL INSTRUCTIONS EXACTLY AS THEY APPEAR.


********** ENTER THE CUSTOMER'S NUMBER       ? 122

CUSTOMER # 122 :  MARCIA K. FELLER

IS THIS THE CORRECT CUSTOMER (YES OR NO)? YES

ENTER THE CREDIT AMOUNT ($) TO BE POSTED.              ? 5.66

IS THIS THE FIRST CREDIT POSTED TO THIS
CUSTOMER'S ACCOUNT THIS MONTH (YES OR NO)? YES

ANOTHER CUSTOMER (YES OR NO)? YES


********** ENTER THE CUSTOMER'S NUMBER       ? 201

CUSTOMER # 201 :  RUSSELL C. BOTTS

IS THIS THE CORRECT CUSTOMER (YES OR NO)? NO


********** ENTER THE CUSTOMER'S NUMBER       ? 202

CUSTOMER # 202 :  DONALD S. COTTON

IS THIS THE CORRECT CUSTOMER (YES OR NO)? YES

ENTER THE CREDIT AMOUNT ($) TO BE POSTED.              ? 7.20

IS THIS THE FIRST CREDIT POSTED TO THIS
CUSTOMER'S ACCOUNT THIS MONTH (YES OR NO)? NO

ANOTHER CUSTOMER (YES OR NO)? NO


********** SUMMARY OF THIS EXECUTION:
                                                       -------

     2 CREDITS POSTED, TOTALING                        $12.86

          ***** END OF PROGRAM *****

READY
```

Fig. 8. Sample Output From Retail Sales Credit Update Program

RETAIL CUSTOMER STATEMENT FROM:

******* DARIGOLD FARMS *******
**** 2600 S. THIRD STREET ****
** MISSOULA, MONTANA 59801 **
******* (406) 543-5165 *******

MARCIA K. FELLER # 122
1407 7TH ST. S.
GREAT FALLS, MT. 59401

STATEMENT AS OF: 30-JUN-76 AMOUNT PAID: $----------

PROD NO.	QUAN.	PRICE	AMOUNT	TOTAL THIS MONTH	ARREARS	TOTAL DUE
0	0	$0.01	$0.10			
2	2	$0.88	$1.76			
12	5	$1.25	$6.25			
				$8.11	$10.00	$18.11

THIS STATEMENT IS DUE NOW

0	FINANCE CHARGE	1	HOMO 1/2 GAL
2	2% 1/2 GAL	3	HOMO QT
4	2% QT	5	CHOCOLATE QT
6	1/2 & 1/2 PT	7	HOMO 1/2 PT
11	COTTAGE CHEESE PT	12	MILD CHEDDAR CHEESE
13	SHARP CHEDDAR CHEESE	14	SOUR CREAM PT
15	BUTTER 1 LB	16	ICE CREAM QTS
17	ICE CREAM 1/2 GALS		

STATEMENT AS OF: 30-JUN-76

THANK YOU. WE'RE HAPPY TO SERVE YOU.

ARREARS MUST BE PAID WITHIN TEN DAYS OR DELIVERIES WILL BE SUSPENDED.
FINANCE CHARGE IS 1% PER MONTH ON BALANCE OVER 30 DAYS.

***** DARIGOLD FARMS MISSOULA, MONTANA *****

Fig. 9. Sample Retail Sales Customer Statement

PAGE 1

DARIGOLD FARMS
RETAIL SALES ACCOUNTS RECEIVABLE (A/R) LEDGER
FOR MONTH ENDING 30-JUN-76

***** CUSTOMER ***** NO.	NAME	BAL LAST STATEMENT	CURRENT CREDITS	CURRENT PURCHASES	AMOUNT DUE	TOTAL ARREARS	***** AGING SCHEDULE ***** 30 - 60	60 - 90	90 - 120	OVER 120
101	JOHN W. ARMSTRONG	$10.01	$10.01	$13.32	$13.32	$0.00	$0.00	$0.00	$0.00	$0.00
102	CHARLES E. AUSTIN	$8.83	$8.83	$10.19	$10.19	$0.00	$0.00	$0.00	$0.00	$0.00
110	JOHN R. COULTER	$11.31	$11.31	$9.38	$9.38	$0.00	$0.00	$0.00	$0.00	$0.00
120	ROBERT W. DEAN	$11.96	$11.96	$11.57	$11.57	$0.00	$0.00	$0.00	$0.00	$0.00
121	JOHN K. FANNON	$25.10	$15.10	$16.99	$26.99	$10.00	$10.00	$0.00	$0.00	$0.00
122	MARCIA K. FELLER	$15.66	$5.66	$8.11	$18.11	$10.00	$3.52	$1.76	$4.72	$0.00
130	SHELBY G. GOODMAN	$9.18	$9.18	$13.68	$13.68	$0.00	$0.00	$0.00	$0.00	$0.00
140	BRUCE D. GUILMAIN	$32.76	$12.76	$14.10	$34.10	$20.00	$5.76	$7.92	$6.32	$0.00
150	SHERMAN L. IVERSON	$24.51	$14.51	$12.61	$22.61	$10.00	$10.00	$0.00	$0.00	$0.00
202	DONALD S. COTTON	$7.20	$7.20	$10.19	$10.19	$0.00	$0.00	$0.00	$0.00	$0.00
210	KEITH H. ERB	$12.74	$12.74	$12.74	$12.74	$0.00	$0.00	$0.00	$0.00	$0.00
215	AUGUST W. ISAKSON	$13.80	$5.80	$0.08	$8.08	$8.00	$3.70	$0.10	$3.97	$0.23
225	JAMES S. KYLE	$32.23	$12.23	$21.07	$41.07	$20.00	$9.51	$7.72	$2.77	$0.00
226	JOHN W. NIXON	$18.28	$8.28	$15.91	$25.91	$10.00	$10.00	$0.00	$0.00	$0.00
230	ANN OWENS	$21.87	$6.87	$6.50	$21.50	$15.00	$6.50	$5.05	$3.44	$0.00
231	PATRICK L. RYAN	$15.21	$15.21	$16.07	$16.07	$0.00	$0.00	$0.00	$0.00	$0.00
240	JOHN L. SAUNDERS	$10.01	$10.01	$10.01	$10.01	$0.00	$0.00	$0.00	$0.00	$0.00
250	GEORGE A. SWANSON	$44.66	$14.66	$14.66	$44.66	$30.00	$4.66	$5.89	$9.94	$9.51
301	CLYDE A. BONDE	$10.94	$10.94	$10.94	$10.94	$0.00	$0.00	$0.00	$0.00	$0.00
310	THOMAS S. EASTMAN	$13.80	$13.80	$13.80	$13.80	$0.00	$0.00	$0.00	$0.00	$0.00
320	STANLEY W. HAAS	$13.71	$13.71	$14.59	$14.59	$0.00	$0.00	$0.00	$0.00	$0.00
330	CAROLE HENDERSON	$13.38	$13.38	$14.24	$14.24	$0.00	$0.00	$0.00	$0.00	$0.00
345	TERRY D. JENSEN	$-1.25CR	$0.00	$0.00	$-1.25CR	$0.00	$0.00	$0.00	$0.00	$0.00

Fig. 10. Sample Retail Sales Accounts Receivable Ledger

PAGE 2

DARIGOLD FARMS
RETAIL SALES ACCOUNTS RECEIVABLE (A/R) LEDGER
FOR MONTH ENDING 30-JUN-76

***** CUSTOMER ***** NO.	NAME	BAL LAST STATEMENT	CURRENT CREDITS	CURRENT PURCHASES	AMOUNT DUE	TOTAL ARREARS	***** AGING SCHEDULE ***** 30 - 60	60 - 90	90 - 120	OVER 120
350	DANIEL H. KRAFT	$13.95	$13.95	$14.85	$14.85	$0.00	$0.00	$0.00	$0.00	$0.00
360	COLE K. LOVETT	$8.39	$8.39	$7.20	$7.20	$0.00	$0.00	$0.00	$0.00	$0.00
370	ROBERT E. LYONS	$33.49	$13.49	$24.88	$44.88	$20.00	$20.00	$0.00	$0.00	$0.00
375	MAUREEN MANSFIELD	$13.03	$13.03	$13.78	$13.78	$0.00	$0.00	$0.00	$0.00	$0.00
380	STUART B. MCCRACKEN	$9.56	$9.56	$11.41	$11.41	$0.00	$0.00	$0.00	$0.00	$0.00
TOTALS		$454.32	$302.57	$342.87	$494.62	$153.00	$83.65	$28.44	$31.16	$9.74
PERCENT OF ARREARS						100 %	54.6 %	18.5 %	20.3 %	6.3 %

Fig. 10. (Continued)

PAGE 1

DARIGOLD FARMS
RETAIL SALES ACCOUNTS OVER 120 DAYS PAST DUE
FOR MONTH ENDING 30-JUN-76

***** CUSTOMER ***** NO.	NAME	BAL LAST STATEMENT	CURRENT CREDITS	CURRENT PURCHASES	AMOUNT DUE	TOTAL ARREARS	***** AGING SCHEDULE ***** 30 - 60	60 - 90	90 - 120	OVER 120
215	AUGUST W. ISAKSON	$13.80	$5.80	$0.08	$8.08	$8.00	$3.70	$0.10	$3.97	$0.23
250	GEORGE A. SWANSON	$44.66	$14.66	$14.66	$44.66	$30.00	$4.66	$5.89	$9.94	$9.51
TOTALS		$58.46	$20.46	$14.74	$52.74	$38.00	$8.36	$5.99	$13.91	$9.74

Fig. 11. Sample Listing of Retail Sales Accounts Over 120 Days Past Due

DARIGOLD FARMS
RETAIL SALES SUMMARY REPORT
FOR MONTH ENDING 30-JUN-76

***** PRODUCT ***** NO.	DESCRIPTION	RETAIL PRICE	ROUTE #1 QUAN	ROUTE #1 AMOUNT	ROUTE #2 QUAN	ROUTE #2 AMOUNT	ROUTE #3 QUAN	ROUTE #3 AMOUNT	TOTAL QUAN	TOTAL AMOUNT
1	HOMO 1/2 GAL	$0.90	27	$24.30	26	$23.40	21	$18.90	74	$66.60
2	2% 1/2 GAL	$0.88	15	$13.20	21	$18.48	19	$16.72	55	$48.40
3	HOMO QT	$0.47	10	$4.70	13	$6.11	8	$3.76	31	$14.57
4	2% QT	$0.46	8	$3.68	0	$0.00	8	$3.68	16	$7.36
5	CHOCOLATE QT	$0.48	23	$11.04	5	$2.40	19	$9.12	47	$22.56
6	1/2 & 1/2 PT	$0.46	5	$2.30	4	$1.84	8	$3.68	17	$7.82
7	HOMO 1/2 PT	$0.15	0	$0.00	0	$0.00	0	$0.00	0	$0.00
11	COTTAGE CHEESE PT	$0.75	12	$9.00	15	$11.25	28	$21.00	55	$41.25
12	MILD CHEDDAR CHEESE	$1.25	10	$12.50	10	$12.50	9	$11.25	29	$36.25
13	SHARP CHEDDAR CHEESE	$1.49	2	$2.98	5	$7.45	5	$7.45	12	$17.88
14	SOUR CREAM PT	$0.86	4	$3.44	4	$3.44	6	$5.16	14	$12.04
15	BUTTER 1 LB	$1.29	11	$14.19	7	$9.03	14	$18.06	32	$41.28
16	ICE CREAM QTS	$0.65	7	$4.55	7	$4.55	3	$1.95	17	$11.05
17	ICE CREAM 1/2 GALS	$1.19	3	$3.57	5	$5.95	4	$4.76	12	$14.28
TOTALS			137	$109.45	122	$106.40	152	$125.49	411	$341.34

Fig. 12. Sample Retail Sales Summary Report

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