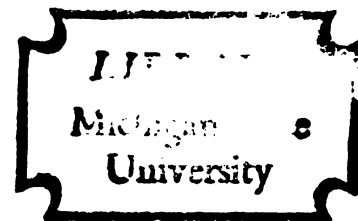


INFORMATION MANAGEMENT FOR SUPERMARKET CHAIN
PRODUCT MIX DECISIONS: A SIMULATION EXPERIMENT

Thesis for the Degree of Ph. D.
MICHIGAN STATE UNIVERSITY
JOHN FREDERICK GRASHOF
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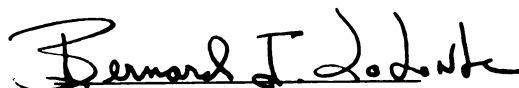
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INFORMATION MANAGEMENT
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SUPERMARKET CHAIN PRODUCT MIX DECISIONS:
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JOHN FREDERICK GRASHOF

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ABSTRACT

INFORMATION MANAGEMENT FOR SUPERMARKET CHAIN PRODUCT MIX DECISIONS: A SIMULATION EXPERIMENT

by John Frederick Grashof

In recent years the number and complexity of product mix decisions in supermarket chains have increased rapidly. The increase is a result of increases in the rate of introduction of new items and in the level of sophistication, affluence, and convenience orientation of consumers. Further, the per cent of sales returned to chains in the form of net profit has decreased despite an increase in the average gross margin per cent earned by chains.

Today supermarket chains use the same product mix decision criteria as were used by the earliest chains. Because of the significant advances in management science and the increased availability of information through data processing, the criteria used by chains should be reevaluated. The purpose of the research was to evaluate the product mix decision process used by chains. The study focused on the source of the buying decision, the criteria used, the information available to the decision maker, and the role of data processing in item selection.

The research was conducted in two phases. The first phase was a series of comprehensive interviews with selected executives in five supermarket chains. The second phase consisted of the development of and experimentation with

three computer simulation models. The simulation models developed were:

- 1) BUYSIM - A computer simulation of an item evaluation process.
- 2) CHAINSIM - A Monte Carlo simulation of the flow of items through a chain system.
- 3) SPACALLO - A linear programming routine to allocate shelf space to items.

The computer models were used in experiments to:

- 1) Determine the effect of alternative decision criteria on the rank of each item in a set of items.
- 2) Identify the degree of similarity among the rankings of an item using the alternative criteria.
- 3) Determine the effect of alternative decision criteria on the operating results of a chain.
- 4) Test the sensitivity of the ranking of an item to variations in the input coefficients.

The results of Phase I of the research were presented in the form of a case study. The results of the case study showed the most widely used criteria for product mix decisions to be:

- 1) Movement
- 2) The promotional program of the supplier
- 3) The gross margin per cent of the item
- 4) The introductory program (for new items)
- 5) The newness of the item (for new items)
- 6) The role of the item in the total mix of items carried by the chain

The results of the experiments with the simulation programs showed:

- 1) The criterion used has a significant effect on the evaluation of an item.
- 2) The rating of an item using movement (the most popular criterion) as the basis for evaluation

is significantly different than the rating using net profit.

- 3) The operating results of a chain are significantly affected by the differing mixes of items resulting from the use of alternative criteria.
- 4) The per cent of available shelf space allocated to individual items varies as the objective of the allocation is changed.
- 5) The ranking of an item is sensitive to minor variations in the price used in the ranking, but is not sensitive to minor variations in the handling costs assigned to the item.

The opportunity exists for chain management to make significant improvements in the product mix decision procedure used by the chain. The research has shown the effect of alternative criteria on the selection of items and that a computer can be used effectively in the decision process. The results can be used by chain management in the reevaluation and improvement of the product mix decision process. The improvement of the item selection process should lead to a better mix of items stocked by the chain and more profitable operations.

INFORMATION MANAGEMENT FOR SUPERMARKET CHAIN
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By

John Frederick Grashof

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1968

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The two other members of the committee, Dr. Gardner Jones of the Department of Accounting and Financial Administration and Dr. E. Jerome McCarthy of the Department of Marketing and

Transportation contributed substantially to the work. Dr. Jones's accounting and financial perspective given to the proposal and early drafts of the chapters aided significantly in the development of the finished project. Dr. McCarthy also contributed significantly to the final form of the research through comments and suggestions.

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CHAPTER I

SUPERMARKET CHAIN BUYING

A PROBLEM AREA

Introduction

The purpose of the research is to develop an improved methodology for product addition and deletion decisions in the supermarket industry. Data which are already available to supermarket management can be combined with available computer technology to improve product selection decisions.

The research is divided into two phases. Phase I consists of a relatively comprehensive interview with five supermarket chains. The chains have been selected using criteria of geography and size to provide a representative sample of the supermarket industry in the United States. During comprehensive field interviews, information relating to new product additions and current product deletions was collected from the cooperating chains. Specifically, data concerning the criteria used, the information used, and committee verses individual decision was collected. A case study analysis has been constructed based on the results of the five interviews.

Phase II of the research uses the information gathered in the field interviews plus other available information to design a computer based model for product decision making. Due to the scope of the problem, the model focuses on one selected department within the typical supermarket operation.

Statement of the Problem

Background

The number and complexity of "what to carry" decisions in supermarkets have increased enormously in the last dozen years. In recent years, American business has been characterized by an increasing number of new products. Few, if any, industries have felt more strongly the impact of new items than the supermarket industry. A great many new items have as their destination the shelves of supermarkets. According to the Super Market Institute the number of items carried by the "average supermarket" has jumped from 3,750 in 1949 to 7,300 in 1965.¹ A more recent study of Super-Valu Stores indicates that the number of items increased from 3,675 items in 1957 to 4,657 items in 1967, a net increase of almost 1,000 items during the ten year periods. A more accurate picture is given by the fact that between 1957 and 1967 a total of 1,588 items were dropped and 2,540 new items were added.² Thus, the total number of item addition or deletion decisions for one chain over a ten year period was 4,098.

In addition to the tremendous growth in the number of items carried by supermarket chains has been a trend toward stabilization of store size. The Supermarket Industry Speaks article referred to above points out that the average number of square feet of selling area increased from 8,500 square

¹ The Supermarket Industry Speaks - 1965 (Chicago: The Super Market Institute, Inc., 1965), p. 18.

² "News Items in the Food Industry," Progressive Grocer, June 1957, p. 59.

feet in 1949 to 15,400 square feet in 1965. However, between 1956 and 1965 the average selling area increased only 2,800 square feet (from 12,000 square feet to 15,400 square feet), which was a relatively small increase considering the number of items that have been added. As indicated in Table 1-1, the average number of items per square foot of store selling area increased from .380 items in 1956 to .545 items in 1965. The increase in the number of items per square foot of selling space has placed additional pressure on the available shelf space in supermarkets.

TABLE 1-1: Number of items per square foot of selling area

year	number of items	floor area	selling area	items per sq. ft.
1949	3750	11,700	8,500	.440
1953	4500	15,600	10,900	.414
1956	4800	17,900	12,600	.380
1959	5800	18,600	13,700	.425
1962	6600	17,900	12,700	.520
1965	7300	18,400	13,400	.545

SOURCE: The Super Market Industry Speaks - 1965, Super Market Institute, 1965, p. 18; and Organization and Competition in Food Retailing, Technical Report #7, National Commission on Food Marketing, June 1966, Table 1-17, p. 17.

The squeeze on shelf space is not the only problem faced by supermarkets. The net profit percentage returned to chains has decreased over the past years despite an increase in gross margin.³ The poor profit margins are the result of increases

³Organization and Competition in Food Retailing, Technical Study #7, National Commission on Food Marketing, June 1966, Appendix Table # 49, p. 543.

in operating expenses. Labor costs are one of the most important causes, though there are other contributing factors. The importance of the low profit problem is illustrated by the fact that the lead story in the first 1968 issue of Supermarket News is specifically directed at increased sales and lower profits.⁴

The space and profit problems are further complicated by increased knowledge of the consumer of what items are available. As stated by Harry Beckner of Jewel Tea Company, "...we must find ways to adjust the merchandise mix to individual consumer requirements by the various neighborhoods within which we operate.

There is no such thing as an average shopper...or an average store...or an average product line. Assortments must be adjusted to reflect shopping patterns in each of our stores."⁵ As many as one half of the items in a store may be carried specifically for a particular neighborhood with the rest of the items standard for all stores. The trend towards customized assortments greatly increases the number and complexity of product mix decisions.

The result of the above factors is that supermarket chains must make a greater number of more complex and more important decisions than ever before. The increased number

⁴"'67 Supermarket Sales Chalk Up Another Advance, But Profit Shrinks Again," Supermarket News, January 1, 1968, pp. 18-19.

⁵"Coming: Customized Assortments," Chain Store Age, November 1966, p. 69.

of decisions is due to the increased number of products available to the stores. The increased complexity is not only due to the increased number of product alternatives available to the stores, but also due to the increased emphasis on having specific assortments for different market areas. The decision is more important than ever due to the squeeze on shelf space and decreasing profit margin.

Scope of the Project

The research is concerned with the two primary decisions relating to product mix. These are 1) the decision to accept or reject a new product which has been offered to the chain, and 2) the decision to delete or retain a product which the chain now stocks. While there are other decisions that must be made concerning products carried by the chain, such as decisions related to space allocation and the selection of items for promotion, the other decisions do not generally alter the content of the mix of products carried by the chain.

The above statement does not imply that decisions such as space allocation and the selection of products for promotion are not important decisions. The space allocation and promotion decisions can have as significant an effect on the profitability of a chain as the decision to stock or not stock an item. However, neither the space allocation nor the promotion selection decision generally alters the content of the mix of products presented to the consumer.

Criteria Used for Product Mix Decisions

The criteria currently being used by supermarket chains for product mix decisions have gradually evolved. Some of the criteria, such as an evaluation of the "newness of the item", are quite subjective. Other criteria are quantitative, such as the introductory allowance by the supplier. The following is a list, not necessarily in order or importance, of the present criteria used by chains for evaluating items considered for addition or deletion.

TABLE 1-2: Supermarket product mix decision criteria

number	criteria
1)	Estimate of sales volume
2)	The supplier's promotional program
3)	Test market data
4)	Unit cost
5)	Unit retail
6)	Unit size
7)	Gross margin
8)	Promotional data
9)	Introductory allowances
10)	Sales of competing items
11)	Gross margin dollars generated per unit time
12)	Newness
13)	Reactions of competitors to the item
14)	Effect on product mix of addition or deletion

SOURCE: Compiled from sets of criteria suggested by Douglas J. Dalrymple, Measuring Merchandising Performance in Department Stores, University Studies in Retail Research, Volume 5, National Retail Merchants Association, New York, 1964, and R. D. Buzzell, U. J. Solomon, and Richard P. Vancil, Product Profitability Measurement and Merchandising Decisions, Division of Research, Harvard University, Boston, Massachusetts, 1965.

While all are important and useful criteria, it is important to note that, with the possible exception of Number 11

(gross margin dollars generated per unit time), none of the criteria implies the use of the firm's data processing system. Number 1 is a subjective estimate based on the buyer's comparison of the new item with similar items or, in the case of the deletion of an item, an estimate based on sales history. Numbers 2 through 10 are facts presented by the salesman or available on the buyer's card. The last three, 12 through 14, are subjective criteria, based on the buyer's experience and "feel for the market".

Several criteria have been suggested for supermarket chain product addition or deletion decisions which do require the use of a firm's information system. The criteria are listed in Table 1-3.

In addition to the listed criteria there have been several product management systems suggested. The two which are most widely known are Merchandise Management Accounting and a capital budgeting approach to merchandise management.⁶

TABLE 1-3: Analytical product mix decision criteria

number	criteria
1)	Return on assets employed
2)	Return on inventory investment
3)	Stock turnover
4)	Direct product profit per item
5)	Direct product profit per unit time
6)	Direct product profit per unit time per unit space
7)	Net profit per item
8)	Net profit per unit time
9)	Net profit per unit time per unit space

SOURCE: Compiled from sets of criteria suggested by Douglas

⁶For discussions of these see: Harvey E. Kappnick, Jr.

J. Dalrymple, Measuring Merchandising Performance in Department Stores, University Studies in Retail Research, Volume 5, National Retail Merchants Association, New York, 1964, and R. D. Buzzell, U. J. Solomon, and Richard F. Vancil, Product Profitability Measurement and Merchandising Decisions, Division of Research, Harvard University, Boston, Massachusetts, 1965.

A third merchandise control system is based on linear programming techniques.⁷ E. L. Salkin, in a Journal of Retailing article, suggested the use of an optimization technique, linear programming, to aid a buyer in making merchandising decisions.

There has been a noticeable trend toward the use of such quantitative criteria and information system technology. The various reasons for the increase appear to be:

- 1) The squeeze on supermarket chain profits caused by increasing operating costs and pressure to lower prices placing premiums on effective decision making.
- 2) The increased number of items per square foot of selling space in the store forced by the increasing number of items demanded by the consumer.
- 3) The increased knowledge of the supermarket operators of the relevant criteria for profitable decision making.
- 4) The increased availability and sophistication of data processing equipment and information retrieval systems.
- 5) The increased sophistication of supermarket chain management with respect to the use of quantitative methods.

⁶(cont) "Merchandise Management Accounting: A New Direction For Retailing" in F. M. Bass, Editor, The Frontiers of Marketing Thought and Science (Chicago: American Marketing Association, 1958) pp. 120-134; Gordon B. Gross, "A Critical Analysis of Merchandise Management Accounting," Journal of Retailing, Volume XXXIV, Spring 1958, pp. 21-29; Richard H. Holton, "A Simplified Capital Budgeting Approach to Merchandise Management," California Management Review, University of California at Berkley, Volume III, #3, Spring 1961, pp. 82-104.

⁷E. Lawrence Salkin, "Linear Programming For Merchandising Decisions," Journal of Retailing, Winter 1964-1965, pp. 37-41.

Research Questions

The research studies the product mix decision process in supermarket chains concentrating on the decision criteria, the information required for these criteria, and the management of this information. The research evaluates the various criteria, indicating which appear most useful, and also evaluates various possible applications of data processing and management information system technology. The following questions have been used to structure the research.

There are two key questions investigated in the present research. The first deals with the available criteria for product addition and deletion decisions.

Question 1: What are the possible criteria for product mix decisions?

Subquestion A: What criteria are supermarket chains now using?

Subquestion B: Are there other criteria that could be used to improve product mix decisions?

Subquestion C: Why are supermarket chains not using the better criteria?

Subquestion D: What combination of criteria will lead to optimal product mix decisions, given the objectives of chains?

The second question is related to the first in that the second question considers the possibility of applying, through data processing, the criteria identified through Question 1. Specifically the second question asks:

Question 2: What use can be made of electronic data processing or management information systems in supermarket chain product mix decisions?

- Subquestion A: Are there any criteria which require, for their application, data processing or information system, technology?
- Subquestion B: What should be the configuration of a supermarket chain's management information system so as to make the system most useful?
- Subquestion C: What routine reports should be generated by the system, to whom should each report be directed, and how frequently should the report be produced so as to make optimal use of the information system for product mix decisions?
- Subquestion D: What routine analysis procedures should be "on call" for the decision maker, what should be the inputs and outputs of the procedures, and how fast must the analyses be performed so as to be of significant help to the decision maker?

Hypotheses

The two key research questions, with the subquestion, listed above provide the general structure for the research. However, to provide specific direction for the research, the following hypotheses were formulated:

- H₀₁: The ranking of items according to various criteria will not vary with changes in the criteria used.⁸
- H₀₂: The per cent of total available shelf space allocated to individual items by a linear program allocation routine will not vary when the objective function is changed from one to another of the following criteria:
- a) Maximize unit sales
 - b) Maximize dollar sales
 - c) Maximize gross margin per cent
 - d) Maximize gross margin dollars
 - e) Maximize dollar contribution

H₀₃: Sensitivity analysis will show that an item's rankings by the BUYSIM routine will not change when the item characteristics of price and handling cost are change.

Each of the three hypotheses is designed to direct the research in a specific area. The first hypotheses provides for an investigation of the effect of various criteria on the profitability of items. The investigation provides for insights into the appropriateness of alternative criteria.

The second hypothesis provides for further investigation of the effect of alternative decision criteria. In particular, the effect of alternative objectives of space allocation, supported by the use of alternative decision criteria helps isolate the consequences of using the various available decision criteria.

The investigation stimulated by hypothesis number three attempts to counter claims by executives of supermarket chains that shelf space allocation and the retail prices of items change so frequently that the application of sophisticated decision criteria is impossible. If the null hypothesis can be rejected then the research will have shown that allocation, handling cost, and price do not affect decisions sufficiently to negate the value of highly quantitative decision criteria such as direct product profit.

Methodology

The research methodology consists of two phases. The first phase is a case study of supermarket chain product addition and deletion compiled from interviews with five supermarket chains. The chains were selected on a judgmental

basis meeting the criteria of geographical distribution, size variation, and general reputation for progressiveness in management practices.

A two day personal depth interview was conducted with each of the five chains to study the buying practices of chains. The interviews concentrated specifically on three aspects of supermarket chain product addition and deletion decisions. The three aspects, presented in the form of questions, were:

- 1) Who makes the product addition and deletion decisions?
- 2) What criteria are used for the addition and deletion decision?
- 3) What information is available to aid the decision maker in adding or deleting items?

Phase II of the research is a computer simulation of a hypothetical supermarket chain and the product mix decision procedures within that chain. To reduce the number of variables and the amount of data required, only one department within the chain will be modeled. In order to make the simulation as useful as possible the department must be one which has a high movement and a rapidly changing product mix. The dog food department has been selected because of:

- 1) Very high turnover of items.
- 2) Rapid growth in the number of items carried by stores.
- 3) Wide variation in the package size (from 2 1/2 ounce cans to 50 pound bags.)
- 4) A wide variety in the kinds of packages (bags, cans and flat packs.)

Rather than model the dog foods department in one store, the simulation models a chain of five stores composed

of the simulated dog food departments. The simulated "stores" model stores serving different neighborhoods; that is, the stores may have different sales volumes, different kinds of customers, are maybe different distances from the warehouse, have different stocking patterns, and different shelf space. The particular design for the simulation covers all relevant details with minimum computation and data storage. The variety of problems that might arise in trying to design and implement an information system for an operating chain should all be present in the design suggested above. The problems can then be noted and solutions proposed.

Once the simulation was programmed various tests and experiments were carried out with the simulation. Some of the experiments were attempts to isolate the "best" criteria for making product mix decisions. Others were attempts to find the "best" configuration for a product mix decision information system. Included in the experiments were tests of the sensitivity of the outputs of the information system to variations in the input.

Limitations

The case study

The primary limitation of the case study is caused by the conscious effort to interview the most progressive supermarket chains. While the effort may have resulted in studying the most advanced decision processes in the industry, the effort may also result in an overstatement of the development of product mix decision processes.

The simulation

One limitation of the simulation results from the lack of resources to do a complete engineering cost analysis to develop product handling, inventory and overhead cost data. The researcher was forced to use the cost data developed and reported by McKinsey and Company.⁹ While developed for a broad range of items, the McKinsey data was not specifically for dog foods. Therefore, the handling costs of dog food items had to be estimated to calculate the direct contribution of each item.

In addition to the lack of completely accurate direct cost data was the problem of the allocation of indirect expenses. One of the criteria evaluated in the research was net profit, which can only be calculated by allocating indirect expenses to individual items. Such allocation is at best arbitrary and therefore subject to discussion.

The debate over the usefulness of direct versus full costing has continued for many years. The discussion generally focuses on the propriety of the allocation of indirect expenses and the alternative bases for the allocation. The purpose of the present research was the evaluation of the alternative criteria for product mix decision making. Thus, the allocation of indirect expenses had to be made even though the accuracy of the net profit figure is subject to some discussion.

⁹"The Economics of Food Distributors," The McKinsey-General Foods Study, General Foods Company, White Plains, New York, October, 1963, pp. 25-38.

A third limitation of the simulation results from the selection of the dog food department. Dog foods were selected because the researcher felt all major problems were represented by the department. However, other departments may have specific problems not encountered in the dog food department.

Contributions

The case study

The supermarket chain interviews, and the case study developed from the records of the interviews could benefit the supermarket industry in several ways.

- 1) The case study identifies the general procedures used by chains for product addition and deletion decisions. The descriptions of the procedures may provide a basis for comparison among chains.
- 2) The identification of the alternative decision formats may suggest methods for improving the flow of item decisions within chains.
- 3) Supermarket chain operators might also derive benefit from the identification of the criteria used for product addition and deletion decisions. The clear statement of the criteria in the case study could lead chain management to re-evaluate the criteria used.
- 4) The summary of industry practice with respect to the application of data processing is also potentially valuable.
 - a) The summary could provide direction for those chains just developing data processing systems.
 - b) The summary could also be used as a benchmark for comparison by other chains now involved in data processing.

- 5) The analysis of the chain buying process provides information on the decision process of managers which, when added to present management theory, may increase understanding of the decision process.

The simulation

The simulation routines and the experiments conducted with the simulations also have many potential benefits.

- 1) The isolation of the information needed for product evaluation using the alternative criteria could aid in selecting the most appropriate criteria for product decisions.
- 2) The identification of the effect of the alternative criteria on item evaluation could be very useful to chains when selecting decision criteria.
- 3) The experiments illustrating the different results obtained from evaluating items using gross margin, contribution, and net profit as criteria may increase supermarket chain manager's awareness of the need to include handling and overhead costs when evaluating items.
- 4) The simulation will provide for tests of the sensitivity of the output of an information system to variations in the input. The results of such tests could be used as guidelines in specifying the inputs to an information system.
- 5) The example of a computerized item evaluation procedure may not only focus managements' attention on the product decision process but it might also be used as a model for any chain wishing to set up a computerized item evaluation system.
- 6) The total requirements of a firm's product mix decision process on the firm's information system, as shown in the simulation of the chain, may lead to additional understanding of the role of an information system.
- 7) The results of the attempts to simulate an actual decision process may lead to greater understanding of the decision process.

- 8) The example of the use of simulation, as a research tool, presented in the study could lead to more widespread acceptance of simulation for research.
- 9) The areas studied in the present research provide possible starting points for future valuable research.

Organization

The remaining sections of the study consist of five chapters, each concentrating on a specific aspect of the research. Chapter Two is a review of the literature. Included in the Chapter are discussions of the contributions of the literature with respect to supermarket chain buying and the methodology employed in the research.

The third chapter is a discussion of the methods now used by supermarket chains to make product mix decisions. Chapter Three discusses the research methodology for the supermarket chain interviews and presents the results of the interviews in the form of a case study.

Chapter Four of the dissertation discusses the computer simulations and the experiments conducted with the simulations. The discussion centers on flow-charts of the simulations which are used to outline the programs.

The fifth chapter is a presentation and analysis of the results of the experiments and tests conducted with the simulation. Chapter Six presents the conclusions drawn from the results presented in Chapter Five. In addition, Chapter Six discusses the implications of the conclusions and makes suggestions for further research based on the findings of the present project.

CHAPTER II

CONTRIBUTIONS FROM THE LITERATURE

Introduction

The research reported in the following chapters draws together knowledge from a variety of disciplines and applies the knowledge to an operating problem in the supermarket industry. Among the disciplines involved in the research are supermarket management, with respect to buying procedures, space allocation and item evaluation and the areas of cost accounting, management theory, simulation, electronic data processing and management information systems, inventory control, sales forecasting and the construction of computer based models.

Rather than attempt an exhaustive study of all literature relevant to the above topics, the following paragraphs will discuss only those selections from the literature that are particularly germane to the research. Specifically, the discussion will focus on supermarket chain buying, considering the source of the buying decision, the criteria employed in the decision, and methodological aspects of the research design. Where possible the discussion will illustrate typical literature relevant to the topics.

Supermarket Chain Buying

The source of the buying decision

The literature which discusses the operations of supermarket chains in the late 1800's and early 1900's is generally

contained within the literature of the broad category of retailing. There is very little literature specifically concerned with retail chains and even less concerned directly with supermarket chains.

Typical of the retailing books of the early period are How to Keep a Store by Samuel H. Terry, Retail Buying, by Clifton C. Field and Retail Selling and Store Management by Paul H. Nystrom.¹ The early literature indicates that "All purchases in the chain are made by the buyer or purchasing agent, as a general rule."² Nystrom indicated the extent of the buyer's power:

"In his buying he is under the direction of the merchandise manager, but, except for limitations as to amounts of money to spend and general suggestion, he is generally given rather a free hand with the injunction from his supervisors to 'make good'."³

While most of the literature of the early 1900's dealt with retailing in general, the comments appear to be directly applicable to supermarket chains. Thus, the product selection decision in early supermarket chains appears to have been made by the buyer. Throughout the years some supermarket chains have continued the practice, For example, Jewel Food Stores in Chicago, one of the most progressive chains in the

¹ Samuel H. Terry, How to Keep a Store (New York: Fowler & Weels Co. Publisher, 1887), Clifton C. Field, Retail Buying, (New York: Harper & Brothers, Publishing, 1917) and Paul H. Nystrom, Retail Selling and Store Management, (New York: D. Appleton & Co., 1916).

² Walter S. Hayward and Percival White, Chain Stores, (New York: McGraw-Hill Book Co., 1925) p. 82.

³ Paul H. Nystrom, op cit.

country, retains a procedure whereby the buyer has complete responsibility for product purchase decisions.⁴

Many supermarket chains, however, have changed the procedure to the point where the buyer "tends now to function as an intermediary in the buying procedure for new products--with final decisions made by a committee."⁵ The buying committee, as it is generally called, now makes the product purchase decision for a majority of the supermarket chains. A 1958 study by Super Market Merchandising found the 86% of those chains containing 30 or more stores used a buying committee.⁶

Exactly when the buying committee replaced the individual buyer as the product decision maker is unknown. In 1929 Godfrey M. Lebhar, then editor-in-chief of Chain Store Age, discussed, as one of the major advantages of chains over independents, the ability of chains to employ "skillful buyers" to take complete charge of the buying operations and do "more intelligent buying."⁷

In 1937, Brisco and Wingate indicated that "in recent years, many stores, particularly of the chain type, have successfully separated the buying and selling functions and have set up a dual merchandising organization. Grocery and

⁴Grocery Buying Policy, Jewel food Stores, Chicago, 1966, p.3.

⁵E. B. Weiss, Winning Chain-Store Distribution for New Products (New York: Doyle, Dane, Bernback, Inc., 1956) p. 14.

⁶"Supermarket Buying Committee," Sales Management, May 1, 1959, p. 107.

⁷Godfrey M. Lebhar, "Chain Store Management Methods" in Trends in Retail Distribution, Daniel Bloomfield (ed.) (New York: The H. W. Wilson Co., 1930) pp. 317-328.

drug chains have one organization to buy and a distinct organization to sell."⁸ The separation of the buying and selling functions was an important change in the structure of supermarket chains in that the change resulted in more specialization and therefore better buying and selling. However, the product mix decision still appears to have been made by an individual rather than a committee.

There were no important changes in the structure of chain buying during the second World War. The buying problem during the war years was obtaining merchandise and soliciting the few items that were introduced rather than screening items. The rationing of most goods during the 1940's presented quite a different problem than that caused by the bombardment of the chains by manufacturers with new items that characterizes chain buying today.

Not until after World War II did chains begin to bring more voices to bear on the selection of new items. Sometime during the ten years between 1945 and 1955 supermarket chains introduced the buying committee. Following the introduction the incidence of chain buying committees continually increased. Table 2-1 presents the results of the 1958 Super Market Merchandising study mentioned earlier. As the Table shows, in "chains"* the incidence of the buying committee in 1958 was between 85% and 90%.

While the incidence of the buying committee is quite high, at least one author questions the actual decision

⁸Norris A. Brisco and John W. Wingate, Buying for Retail Stores (New York: Prentice-Hall, Inc., 1937) p. 68

TABLE 2-1: Size of chain and the incidence of the use of a buying committee

Number of stores in the chain	Buying Committee	
	Yes	No
1-9*	55%	45%
10-29	91%	9%
30 or more	86%	14%

* Groups of stores containing less than 11 stores are not considered chains under the Bureau of Census definition.

SOURCE: "Supermarket Buying Committee", Sales Management, May 1, 1959, p. 107

making role of most buying committees. Neil Borden, Jr. studied the acceptance or rejection of five new items in twenty-six chains. As part of his investigation, Borden studied the buying procedures and the criteria used by the chains.⁹ The conclusion Borden drew from his observation was that "because the committee's decision making role was usually subordinate to that of the buyer, the committee itself had little direct impact on the acceptance or rejection of the products studied."¹⁰

Most literature, however, seems to indicate that buying committees will continue to increase in number and be the most important force in supermarket product addition and deletion decisions for some time to come. For the more routine process of reordering goods, however, modern chains are beginning to employ the services of electronic computers.

⁹Neil H. Borden, Jr., Acceptance of New Food Products by Supermarkets (Boston: Division of Research, Harvard University, 1968) Chapter VII, pp. 194-211

¹⁰Ibid., p. 199

Computer manufacturers, in cooperation with retailers are developing automatic ordering and inventory control routines. Among the more popular of the computer based ordering routines are IBM's IMPACT, NCR's REACT, and Honeywell's PROFIT. These three routines are typical of the systems available today.¹¹

The International Business Machine System is Inventory Management Procedure and Control Techniques (IMPACT). The IMPACT routine assigns probabilities to expected levels of demand and generates a sales forecast. The sales forecast is then used, in conjunction with ordering and inventory costs, physical transportation and inventory limitations, and a desired service level, to determine an order quantity. The procedure is followed for each item and the computer prints a purchase order for each vendor supplying the chain.

The IMPACT routine consists of a series of steps rather than a package of prepared programs which a firm may purchase. The steps outline the kinds of programs needed to implement IMPACT but the specific programs for a chain must be written by or for that chain.

Where the IMPACT routine is designed to be useful at both the wholesale and retail level, REACT (Register Enforced Automatic Control Technique) the National Cash Register system is specifically designed for retail businesses, particularly in the soft goods industries. Further, the REACT system covers a wide variety of store management operations including recording of sales, generating accounts payable, personnel payroll,

¹¹ Much of the material in the following paragraphs is drawn from Inventory Control Systems, an unpublished paper by D. Baumgartner, M. Dodick, J. McCane, J. Mulvehil, J. Przbysz, and T. Renkal, Michigan State University, 1967.

and accounts receivable, in addition to inventory control and merchandise reordering.

REACT depends on a product classification system whereby the item purchased, the supplier, and the salesperson can be recorded on a cash register tape at the time of sale. The cash register tape, either punched or prepared for an optical scanner, is then used as input to a computer. The computer analyzes the data on the tape and generates a series of management reports as well as figuring the payroll and ordering replacement merchandise.

PROFIT (Programmed Reviewing, Ordering and Forecasting Inventory Technique), the computerized inventory control procedure of Honeywell, Incorporated, is more similar to IMPACT than REACT in that PROFIT is concerned primarily with inventory control. The PROFIT routine establishes the level of inventory necessary to provide a preset level of customer service, and then when necessary, proceeds through the steps required to replenish the inventory. The system accomplishes the steps necessary to review inventory records, determines when and how much to order, and then generates the purchase order.

All of the above systems have two major objectives:

- 1) Maintain a preset level of customer service.
- 2) Operate a least-cost ordering-inventory system.

The primary advantage of the systems is their ability to consider a greater number of variables in greater depth than could a buyer. Thus, higher levels of customer service are able to be maintained at lower inventory and ordering costs.

The result is greater consumer satisfaction with greater profit to the chain.

Criteria used for the buying decision

The selection of items to be stocked in a store or chain is a continuing problem. Throughout the years merchants have attempted to develop guidelines to aid in the selection decision. As retailers have increased in sophistication so have the criteria used.

One of the most important criteria over the years, has been the question "what have we sold in the past?" Paul Nystrom suggested, in his chapter "Buying for a Retail Store," that "the first step in determining what and how much to buy is to study the experience of the house."¹² Nystrom further suggested that "every community also is likely to have its own peculiarities or tastes in style" and that the buyer should understand his particular community.¹³ Both of Nystrom's considerations relate to the sales history of a chain.

Field devoted a section of his chapter on "Determining Qualities" to goods sold in grocery stores.¹⁴ Mr. Field suggested that "in buying, the retail grocer either is called upon to stock advertised package brands or to make his selection of such bulk goods, including fruits or vegetables, as the market affords."¹⁵ Interestingly, the same two options are the only

¹² Paul H. Nystrom, op. cit., p. 231.

¹³ Ibid., p. 232.

¹⁴ Clifton C. Field, op. cit., p. 84.

¹⁵ Ibid.

ones open to modern chains. Field further stated that "the old days are past when he (the buyer) selected most merchandise by sample, needing a fine understanding as to quality. In its place a simple laying in of those brands demanded by the consumer has replaced the old system."¹⁶ Table 2-2 is reproduced from Field's text and indicates the qualities suggested as being important for purchasing bulk commodities. Field noted however, that even these items are continually being replaced by branded goods and suggested that in the future all items will be purchased by brand name.

TABLE 2-2: Criteria for purchasing grocery items

	flavor	color	size	mellow- ness	quality of liquid	cooking value
Butter	x	x				
Cheese	x	x		x		
Coffee	x		x			x
Dried fruits	x		x			x
Fish, canned						
salmon	x	x		x	x	
Fruit, canned	x		x	x	x	
Fruit, fresh	x		x	x		
Rice			x			x
Tea	x	x				x
Vegetables,						
baked beans	x		x			
Vegetables,						
canned corn	x		x		x	
Vegetables,						
string-beans	x		x			
Vegetables,						
peas	x		x		x	
Vegetables,						
tomatoes	x		x		x	

SOURCE: Clifton C. Field, Retail Buying, (New York: Harper and Brothers Publishers, 1917), p.87.

The development of sets of criteria for buying continued and by 1925 lists of specific factors to be considered appeared

¹⁶ Ibid.

in retailing texts. Typical of such lists is the following description of information the buyer must have which is reproduced from Retail Buying by Brisco and Wingate:

TABLE 2-3: Information needed by a buyer

number	information
1)	The quantity of stock on hand
2)	The merchandise demanded by customers
3)	The merchandise carried by competitors
4)	The value (quality) of goods
5)	The principles of color and design
6)	The quantity that should be purchased to meet demands
7)	The best concerns from whom to obtain goods
8)	The art of trading and bargaining to get the best possible prices
9)	The procedure in making out a complete order

SOURCE: Norris A. Brisco and John W. Wingate, Retail Buying, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1925) p. 38.

The above list, with few modifications, could have been reproduced from a modern retailing text. The criteria are quite applicable to modern grocery chain buying.

In 1958, William Nigut surveyed executives in fifty leading supermarket chains to determine the criteria used in buying new items. The following factors, presented in the form of questions, are the results of that survey.

TABLE 2-4: Criteria used in buying new items by 50 chains

number	question
1)	Will it return a fair dollar profit in terms of the potential volume and shelf space it will occupy?
2)	Does the consumer want it?
3)	What is its sales potential?
4)	Is there a need for the product?
5)	How will the product be advertised and promoted?
6)	Are there advertising, promotional and/or display allowances available?
7)	Is there a retailer incentive?
8)	Is the product of good quality?
9)	Is it properly and sensibly packaged?
10)	Is the manufacturer reliable?
11)	Does competition have this item?
12)	Was the product market-tested?
13)	Is the product timely-in season?
14)	Is the introduction timely?
15)	Will it help bring new customer traffic to our stores?
16)	How is the product packed?
17)	Does stocking the item conflict with existing company policy?

SOURCE: William Nigut, "Benchmarks for Product Success," Food Business, Volume 6, #10, Oct. 1958, pp. 11-12.

A comparison of Nigut's questions with the list of information needed by a buyer presented by Brisco and Wingate shows the similarity between the 1958 criteria and the criteria suggested in 1925

A more recent study by the Food Trade Marketing Council was reported in the January 1964 issue of Food Business.

Table 2-5 lists the ten most influential factors mentioned by food distributors in their decision to stock or not stock an item. The most important factor listed is a proven demand for the product. As pointed out above, market demand or "the experience of the house" was the factor listed first by both Nystrom and Field in the early 1900's.

TABLE 2-5: Most influential factors in distributors' decisions to stock an item

factors	first choice %	second choice %	third choice %	weighted total*
1) Proven demand for the product.	62.4	17.7	5.6	664
2) Adequate advertising and promotion support.	25.2	44.8	13.9	523
3) Proof that competition is successfully moving item.	2.8	15.7	23.8	188
4) Free merchandise with purchase.	2.8	4.8	10.9	85
5) Advertising allowance.	1.0	5.1	14.2	82
6) Display allowance.	1.4	2.7	12.5	66
7) Case pack commensurate with anticipated movement.	.3	5.1	7.6	56
8) Cash discount.	.7	1.4	6.9	35
9) Does not require excessive amount of display space.	.3	2.0	3.6	26
10) Other (Please Specify).	<u>3.1</u>	<u>.7</u>	<u>1.0</u>	34
Total	100.0	100.0	100.0	

*To keep first, second, and third choice responses in proper perspective, multiplication by 3 has been applied to all first choices, 2 to all second choices, and 1 to all third choices.

SOURCE: Food Business, January 1964, p. 26.

There have been attempts by chains in recent years to adopt somewhat more quantitative criteria for product mix decisions. One of the early examples of such investigations is presented in The Dillon Study.¹⁷ Published in 1960 by Progressive Grocer, a section of The Dillon Study illustrated the use of turnover and return on inventory investment in the evaluation of product groups. As part of the illustration data on turnover and return per dollar invested in inventory were presented for all major product groups.

The importance of various factors on profit

In addition to research on the criteria used by chains to make decisions, there has been research conducted to identify the importance of various factors on profitability. The research has in turn led to suggestions of alternative criteria. One of the criteria that has evolved from such research is direct product profit and direct product profit per unit space per unit time. The work of McKinsey and Company and later Buzzell, et al, has shown gross margin and item sales to be misleading when used as the criteria for product mix decision.¹⁸ The results of their research suggest that the differences in handling, inventory, and selling costs of different items result in different contributions to

¹⁷The Dillon Study, The Editors of Progressive Grocer, New York, 1960, pp. 65-80.

¹⁸See, for example, The McKinsey-General Foods Study: The Economics of Food Distributors, McKinsey and Company, Washington D. C., 1963; The McKinsey Manual of Direct Product Profit, The National Association of Food Chains, 1964; and R. D. Buzzell, W. J. Solomon, and Richard F. Vancil, Product Profitability Measurement and Merchandising Decisions, Division of Research, Harvard University, Soldiers Field, Boston, 1965.

profit, even if the items have the same gross margin and movement. Given the objective of profit, the direct product profit approach of McKinsey and Buzzell would appear to lead to better product mix decisions.

A second attempt to isolate the importance of various factors on the profitability of products was the work done by Dalrymple.¹⁹ While Dalrymple's work involved department stores rather than food stores, the results are of interest because they are, at least in part, transferable and the methodology is directly applicable. Using a stepwise regression of ten variables on the profits of 21 departments in a department store Dalrymple isolated the partial correlation coefficients between the ten variables and the profit of the departments. Table 2-6 summarizes the results of the regression analysis.

¹⁹Douglas J. Dalrymple, Merchandising Decision Models for Department Stores, Marketing and Transportation Paper, Bureau of Business and Economic research, Michigan State University, E. Lansing, Michigan, 1966, and Douglas J. Dalrymple, Measuring Merchandising Performance in Department Stores, University Studies in Retail Research Volume 5, Retail Research Institute, National Retail Merchants Association, New York, 1964.

TABLE 2-6: Stepwise regression of ten variables on profits
(21 departments: 501 monthly observations)

step number	variable entered	multiple		increase in R^2
		R	R^2	
1)	Sales volume	.8047	.6476	.6476
2)	Markdown	.8480	.7191	.0715
3)	Initial markup	.8793	.7732	.0541
4)	Rent	.9018	.8132	.0400
5)	Publicity	.9134	.8343	.0211
6)	Cash discount	.9266	.8586	.0243
7)	Average stock	.9353	.8747	.0162
8)	Transactions	.9417	.8868	.0121
9)	Average sale	.9434	.8900	.0032
10)	Stock turnover	.9435	.8901	.0001

SOURCE: Douglas J. Dalrymple, Merchandising Decision Models for Department Stores, Marketing and Transportation Paper, Bureau of Business and Economic Research, Michigan State University, E. Lansing, Michigan, 1966.

The R^2 of .6476 for the relationship between sales volume and profit lends some support to the retailers' use of the movement of goods as an important criteria to use for product mix decision making. However, the relationship does not appear to be as strong as some chain buyers would hold and thus leads to the conclusion that factors other than movement (sales volume) should be considered.

Integrated buying-merchandising systems

There have been several systems suggested which integrate the buying and merchandising functions. The systems attempt to routinize the buying function, primarily through a mechanistic approach to item selection. The techniques have been designed for department store use buy are mentioned here because the approaches appear, at least on the surface, feasible for grocery chain buying.

The earliest and most well known of the procedures is Merchandise Management Accounting. Merchandise Management Accounting is a technique for selecting merchandise and controlling inventories based on the contribution of individual items to overhead and profit. The technique centers on the ability of stores to identify the marginal cost and profit from handling each item and to identify the item's sales rate. The three factors are then used in the calculation of contribution margin per unit time. Central to the technique is the identification of "cost patterns" for similar items. The "cost patterns" can then be used to develop marginal cost and relieve the store of the problem of identifying the specific costs of handling each item.

When introduced, Merchandise Management Accounting "stirred the imagination of the retail world more than it has been stirred by the introduction of any other new technique in recent years."²⁰ For a period of time following the development of Merchandise Management Accounting by the accounting firm of Arthur Andersen and Company, various journals contained articles discussing the pros and cons of the technique.²¹

²⁰Gordon B. Cross, "A Critical Analysis of Merchandising Management Accounting," The Journal of Retailing, Vol. XXXIV, Spring 1958, p. 21.

²¹See for example M. P. McNair and E. F. May, "Pricing for Profit: A Revolutionary Approach to Retail Accounting," Harvard Business Review, Vol. XXXV, No. 3, May-June 1957; Roger Dickinson, "Marginalism in Retailing: The Lessons of a Failure," Journal of Business, Vol. XXXIX, No. 13, July 1966, pp. 353-358; Peggy Heim, "Merchandise Management Accounting: A Retailing Experiment in Explicit Marginal Calculation," Quarterly Journal of Economics, Vol. LXXVII, No. 4, Nov. 1963, pp. 671-675; and Harvey E. Kapnick, Jr. "Merchandise Management Accounting," in Frank N. Bass (ed.), The Frontiers of Marketing Thought and Science, (Chicago: The American Marketing Association, 1958), pp. 120-134.

Dispite the early interest only a few retailers adopted the system. Several factors contributed to the failure of retailers to adopt Merchandise Management Accounting. First, department stores are traditionally merchandised on a departmental basis, and therefore the results are typically analyzed on a departmental rather than an item basis. Other factors cited are "tradition, resistance to change, unavailability of cost data and unwillingness to provide it, and a lack of understanding" of the technique.²²

A second integrated buying and inventory control procedure that has been suggested employs capital budgeting techniques for item evaluation and control. The method, proposed by Richard H. Holton, uses the concept of contribution-return on inventory investment. Like Merchandise Management Accounting, the capital budgeting approach to merchandising decisions has received very little attention from retailers.²³

Simply stated, the capital budgeting approach suggested by Holton attempts to develop a single index of departmental performance, that is, the contribution. The technique is not, therefore, a direct procedure for improving buying. Rather, through a measure of past performance it will "provide a guide for avoiding really bad decisions and for moving toward the optimum."²⁴

²²Delbert J. Duncan and Charles F. Phillips, Retailing Principles and Methods (Homewood, Ill.: R. D. Irwin, Inc., 1967), p. 687.

²³Richard H. Holton, "A Simplified Capital Budgeting Approach to Merchandise Management," California Management Review, Institute of Business and Economic Research, University of California at Berkeley, Spring 1961, pp. 82-104.

²⁴Ibid.

A third approach to merchandise management is based on the highly quantitative technique of linear programming. Suggested in 1964 by E. L. Salkin, the procedure attempts to optimize the gross margin earned by a department, utilizing the maximization feature of linear programming.²⁵

Using the characteristics of the items and customers, with respect to cost of sales, average age of customers, average income of customers, and turnover, Salkin shows through an example how linear programming would maximize the sales of two skirts, given certain restraints in the form of management goals.

Theoretically there is nothing wrong with the application of linear programming to merchandising decisions. Once the coefficients of the variables are isolated and the restraints specified in quantitative terms, linear programming can find an optimum solution. However, the example presented by Salkin is limited in several ways and probably does not truly represent the technique nor adequately indicate some of the problems associated with its application. First, Salkin was limited, due to the lack of computer facilities, to only four variables. There are certainly many more than four factors that must be considered. Second, the development of accurate coefficients, a prerequisite to an optimal solution, is not discussed in sufficient detail.

The three approaches to integrated buying decisions and inventory control through a systematic procedure discussed

²⁵E. Lawrence Salkin, "Linear Programming for Merchandising Decisions," Journal of Retailing, Winter 1964-1965, pp. 37-41.

above are typical of the attempts of academicians and business practitioners to develop improved methods of merchandise selection and management. The importance of such attempts has been succinctly stated by R. I. Jones of Arthur Andersen in a list of "significant observations":²⁶

- 1) The important decision-making level for retailers is necessarily the individual item and all managerial decisions must be reduced to this level. Consequently, financial and accounting data should be supplied on an individual item basis if that basis will best serve management's needs.
- 2) There is "practically a vacuum" of financial and accounting information at the individual item level since it has been centered around the organizational level of responsibility.
- 3) In view of the situation described in 2) above, retailers have been forced to rely upon the financial information available, that is, percentage relationships of initial markup and expenses to sales price as yardsticks in measuring the results of their merchandising operation. This practice, of course, serves to obscure the variations in cost and profit of individual items and to mislead management.
- 4) Rate of stockturn, although recognized as important by retailers, has never been properly integrated into their financial thinking but instead viewed traditionally in relationship to sales price alone. Since real profit, from an economic point of view, may be properly measured only in terms of earning power on invested capital, the profitability in relation to sales price must be combined with the turnover factor to accomplish this objective.
- 5) Retailers, particularly department stores, have only limited operating expense data with respect to the goods sold and therefore

²⁶R. I. Jones, Merchandise Management Accounting in Practice (Chicago: Arthur Andersen & Co., 1957) pp. 2-9 as listed in Delbert J. Duncan and Charles J. Phillips, op. cit., p. 685.

have generated a concept of "cost" limited to the cost of the goods obtained from the manufacturer. This concept, of course, excludes from "cost" those costs which are incurred in providing essential customer services which are a definite part of the economic value of the ultimate product acquired by the consumer.

Despite the recognized need, however, the literature reports only limited acceptance of the suggested techniques by retailers in general, and almost no acceptance by the supermarket industry. The lack of acceptance is due to a number of factors, some of which have been mentioned above in the discussion of Merchandise Management Accounting. One important reason for the lack of acceptance by retailers, particularly supermarket operators, as reported in the literature has been the inability of the proponents of the techniques to convince the retailers of the value of the techniques.²⁷

Other research on evaluating items

In addition to the research discussed above, most of which is directly related to department stores rather than supermarkets, there has been some amount of research on product management in supermarkets. Although much of the work is directly related to instore operations, particularly shelf space allocation, the results indirectly affect the buying decision and are significant contributions to supermarket management. The following paragraphs describe the most relevant research.

One of the earliest research projects conducted to evaluate the costs and profits of supermarket operations was the

²⁷See for example: Gordon B. Cross, "A Critical Analysis of Merchandising Management Accounting," loc. cit.

"Louisville Grocery Survey". Conducted in 1929 by the United States Department of Commerce, the Louisville Study dealt in part with the "merchandising characteristics of individual products."²⁸

The costs incurred in three categories: 1) maintenance cost, 2) movement costs, and 3) credit costs, were allocated to each item carried. The results of the study indicated that the profitability of individual items varied considerably among different items.

In 1952 the United States Department of Agriculture published a report entitled Better Utilization of Shelf Space in Food Stores. While only indirectly concerned with buying, the results showed that more items with less space per item would result in higher gross profit in food stores.²⁹ The results seemed to indicate that buyers should concentrate on carrying a wide variety of items with each item having a minimum of shelf space.

A second research project directed at the same problem was Progressive Grocer's The Dillon Study.³⁰ The research attempted to show that better profits could be earned through the application of basic merchandising techniques.

²⁸Distribution Cost Studies Number 1, The Louisville Grocery Survey, United States Department of Commerce (Washington, D.C.: Government Printing Office, 1932).

²⁹Hans Pauli and R. W. Hoeker, Better Utilization of Shelf Space in Food Stores, Part I: Relation of Size of Shelf Display, #30, U.S.D.A. Marketing and Facilities Bureau, Washington, D.C., 1952.

³⁰The Dillon Study, The Editors of Progressive Grocer, New York, 1960.

A second Progressive Grocer study, The Colonial Study, also reported the results of attempts to isolate the effect of basic merchandising techniques on sales.³¹ Both the Dillon Study and the Colonial Study showed that the application of basic merchandising principles to buying and store management would result in higher sales. The assumption in both cases is that higher sales would lead to greater profits. However, in no way do the studies prove that the sales-profit assumption is valid.

In November of 1963, shortly after the McKinsey Report on Direct Product Profit, Paul J. Cifrino published what has come to be known as the "Cifrino Space Yield Formula". In a series of articles published in Chain Store Age, first Cifrino and then two of his employees, reported on the space yield formula and the results achieved when the formula was applied to several departments in the stores of the Cifrino chain.³² The Cifrino Space Yield Formula is similar to McKinsey's direct product profit concept in that the formula attempts to evaluate products with a criteria that considers variations in the handling and space cost among items.

There are two basic steps in the calculation of "space yield". The first step is the determination of the "occupancy cost" (the handling and space cost for a product). The second

³¹The Colonial Study, The Editors of Progressive Grocer, New York, March 1964.

³²See for example, Paul J. Cifrino, "Cifrino's Space Yield Formula," Chain Store Age, Nov. 1963, pp. 83-86; John P. DeLuca, "Space Yield Findings on Sauces and Dressings," Chain Store Age, Jan. 1964, p. 69; John P. DeLuca, "Space Yield Findings on Cigarettes," Chain Store Age, Jan. 1965; and P. Kaplan and John P. DeLuca "Space Yield Findings on Canned Meats," Chain Store Age, March 1965.

step is to subtract the "occupancy cost" from the total gross margin dollars generated per week by the product under study. When the difference, the contribution to profit and overhead, is divided by the "exposure area" the result is contribution per unit of "exposure area" (space).

The major weakness, from a product mix decision point of view, of the space yield studies done by Cifrino and his group is that the results are on a department basis rather than a per item basis. From a store operations point of view the department yield is important. However, from the point of view of the buying decision, department information is not nearly as useful as item information. While the department space yield does provide a standard against which particular items might be evaluated, it does not provide a means of directly evaluating particular items.

Summary

The previous paragraphs have discussed the contributions of the literature in four important areas, namely: 1) the source of the buying decision, 2) what criteria are used, 3) integrated buying and inventory control techniques, and 4) individual item evaluation. The discussion has only briefly reviewed each of the areas and has purposely avoided other important areas of chain management, areas not directly related to the current research.

Literature Contributions in Methodology

Introduction

The following paragraphs briefly discuss methodological techniques that are pertinent to the current research. As

with the store operations section, the discussion will indicate what is typical in the literature and will concentrate on the topics particularly relevant to the research. Three topics have been selected for review as follows:

- 1) Electronic data processing in chain management
- 2) Management information systems
- 3) Simulation

Electronic data processing in chain management

The applications of electronic data processing in supermarket management are as varied as the problems and decisions that chains must make. In general, at any point where there is a mass of data to store or handle, or where a mass of data is relevant to a decision, or where there are many decision alternatives, electronic data processing can be of significant value. A comprehensive list of "computer applications for supermarkets" has been compiled by and is presented as Appendix A.

While the computer applications listed in Appendix A include all areas of chain management, several of the applications are directly related to buying. Table 2-7 lists the applications that are particularly relevant to the buying process.

Following the introduction of data processing in supermarket chains, the industry journals contained articles illustrating computers and/or data processing in most of the above applications. For example, in Part II of its series "The Day of the Computer", Food Topics described the specific applications of computers in five warehouse operations, both chain owned and cooperative.³³ The article concentrated on the information

³³"The Day of the Computer, Part II," Food Topics, November, 1964, pp. 9-12, 38-39.

TABLE 2-7: Computer applications in supermarket chain buying

number	application
12	Cost Analysis
13	Coupons - handling, records, analysis of effectiveness
14	Credits - for deal merchandise, for advertising and promotional allowances
16	Deals - evaluation of deals and deal merchandise, effect on sales, etc.
21	Forecasting - seasonal, horizontal, trend, "lumpy" merchandise and its movement
23	Linear Programming
27	Management Strategy Analysis
28	Market Research
31	Order Acknowledgement
32	Order Analysis
33	Overhead Allocation
37	Performance Evaluation - of store, of warehouse, of headquarters operation and of the computer itself
38	Price Analysis
45	Sales Analysis - for management
46	Sales Area Distribution Studies - determination of overstocking, sales forecasts for new stores, new store evaluations, warehouse vs. wholesaler vs. broker vs. drop shipment decisions
47	Sales Quota and Performance Calculation - store by store
54	Warning - of overstocks, out of stocks, deal deadlines, etc.

SOURCE: "The Day of the Computer, Part I", Food Topics, October 1964, pp. 11, 14.

stored by the data processing system of the five operations and how the information was used. Typical of the reports in the article is the discussion of computer applications at the Fleming Company Stores. Cited by the article as one of the most advanced computer systems in the industry, the Fleming system provides for storage of a wide variety of information as indicated in Table 2-8.

TABLE 2-8: Information stored in the Fleming Computer system

number	information
1	Slot number
2	Item code
3	Description
4	Pack and size
5	Cost
6	Per unit selling price for three price zones
7	Newspaper advertising duties
8	Back order quantity
9	Sales for the previous three weeks
10	Weight per item
11	Substitute code
12	Allowable minimum inventory
13	Status code
14	Balance on hand
15	Date of last receipt
16	Year-to-date sales
17	Year-to-date receipts
18	Sales this week
19	Receipts this week
20	Vendor number
21	Orders outstanding
22	Order quantity
23	Tie and high (pallet information)
24	Cubic feet per unit
25	Freight costs per unit
26	Rebate per case
27	Inventory adjustment
28	Beginning inventory for each year
29	Report code
30	Class of item
31	Tax code
32	Buyer number
33	Sort (invoices per department)
34	Department code
35	Warehouse area
36	IGA (member store items)
37	Review day
38	Day advertised
39	Out of stocks
40	Cash discounts
41	Deal pack savings
42	Substitute address

SOURCE: "The Day of the Computer, Part II", Food Topics, November 1964, pp. 9-12, 39.

The tremendous amount of information indicated in Table 2-8 is considered by Fleming to be necessary for a buyer to perform effectively. The information is readily available to the merchandiser (buyer) and is used, together with personal experience, to make buying decisions.

The computer system also performs the distinct, albeit related, inventory control functions through a three stage process. The first stage is "ordering" which calculates how much to order. Using discount structures, available warehouse space, inventory investment, and other variables, the computer calculates the most economical order quantity for each item.

The second inventory control stage is "forecasting" in which the computer uses the past sales history of each item to determine future requirements. The future requirements, together with the quantity on hand and the quantity on order are then used to determine when the item will be needed by the warehouse. Finally, through analysis of vendor lead time and service level (probability of being on time), the computer calculates when the order should be filed and what receiving date should be specified.

The third stage in the inventory control function is "review". The computer automatically reviews the warehouse inventory to determine overstocking and possible out-of-stock conditions. The system then indicates to the buyer any problems that exist and, in cases such as out-of-stock, indicates the corrective action.

The above example illustrates the applications of a large scale computer based data processing system in a large

grocery cooperative. The use of electronic data processing, however, is not limited to large chains. The second example in Food Topic's article describes the data processing system of Good Deal Markets, a thirteen store chain in New Jersey.³⁴ A second example illustrating the application of non-computer punched card electronic data processing systems in small chains, is the discussion of data processing in the 38 store Quality Markets Chain.³⁵ Quality Markets feels that such a system has many advantages including:

- 1) Faster and more detailed store billing
- 2) More efficient warehouse order picking
- 3) Faster warehouse inventory calculation for reporting purposes
- 4) Current and more complete management information to direct attention to problems.³⁶

There is little question that the number of applications for electronic data processing in supermarket chains is increasing. Chains have progressed from such routine applications as payroll and billing to the point where several chains are using computers to order goods automatically from suppliers. An indication of the present day extent of electronic data processing usage is presented in Table 2-9, a summary of the results of a survey of nineteen food chains by This Week Magazine. Other uses of data processing reported by respondents to the This Week survey were "problem solving", "simulation", and "movement and sales analysis."³⁷

³⁴Ibid., p. 11.

³⁵"EDP Improves Distribution Efficiency for Small Grocery Chain," Progressive Grocer, June 1967, pp. 236-238.

³⁶Ibid., p. 236.

³⁷Freedom of Choice, The 12th Biennial Grocery Study by This Week Magazine, New York, 1967 p.22.

TABLE 2-9: Uses of electronic data processing by nineteen food chains

Possible application	per cent using
Inventory control	100
Personnel payroll	93
Accounts payable	53
Re-ordering	73
Store profit and loss statements	20

SOURCE: Freedom of Choice, The 12th Biennial Grocery Study of This Week Magazine, New York, 1967, p. 22

The future of data processing in supermarket chains is as limitless as the imaginations of the men using the tool. One application that indicates the depth to which electronic data processing may penetrate the food retailing industry is Jewel Food Stores' plan to stock stores based on computer analysis of the characteristics of individual items and the customers of particular stores. In a recent Super Market News article Mr. Don Everson, manager of Jewel's data processing and information systems, noted that computers "are now being fed historical accounting data of each individual food store's customer buying pattern."³⁸ Once stored and analyzed, the data will be used by the computer to select items for stores that will specifically meet the desires of the store's customers.

³⁸"EDP Stocking System Ready Soon at Jewel", Supermarket News, April 3, 1967, p. 33

Management Information Systems

Electronic data processing was the first important application of punched card and computer technology. Electronic data processing is, however, only the first step in a series of steps leading to the development of large management information systems. Electronic data processing was expanded into automatic data processing, a procedure whereby the routine data processing functions were performed automatically. The next development was integrated data processing in which "the business is considered as one unit and all basic information from all departments of the business is processed in as many ways as is practical and is then used by all levels of management for planning, execution and control purposes."³⁹

For the purposes of the present research, the concept of a management information system is one step beyond integrated data processing. Where integrated data processing has as its focal point the handling of data in an efficient, economical manner so as to make information available to all areas and levels of management, the focal point of a management information system is the information needs of decision makers. As the following diagram indicates, data processing, be it electronic, automatic or integrated, is only one phase of a program designed to make available to management the information needed for decision making.

³⁹E.J. McCarthy, J.A. McCarthy, and D. Humes, Integrated Data Processing Systems. (New York: John Wiley & Sons, Inc., 1966) p. 10

FIGURE 2-1: A management information system

Data Origination	Data Collection and Preparation	Data Processing	Reports to Management
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SOURCE: R.A. Johnson, F.E. Kast and J.E. Rosenzweig, The Theory and Management of Systems (New York: The McGraw-Hill Book Company, 1967) p. 256

The literature related to management information systems as defined in the present research has developed in the past fifteen years. The bulk of the literature is even more recent with most of the material appearing within the past five years. The literature of management information systems may be broken into two segments. The first segment deals with the technical developments in data processing, particularly innovations in the equipment available. Typical in content and approach of the technical literature are such texts as Introduction to Data Processing by R.R. Arnold, H.C. Hill, and A.V. Nichols, Introduction to Electronic Data Processing Equipment by R.V. Oakford, and Electronic Data Processing: An Introduction by E.W. Martin.⁴⁰ In addition to texts a group of professional and/or technical journals has developed which present articles discussing new technological developments or applications in the field of data processing.⁴¹ While both

⁴⁰R.R. Arnold, H.C. Hill, and A.V. Nichols, Introduction to Data Processing (New York: John Wiley & Sons, Inc., 1966); R.V. Oakland, Introduction to Electronic Data Processing Equipment (New York: McGraw-Hill Book Company, 1962); and E.W. Martin, Electronic Data Processing: An Introduction (Homewood, Illinois: Richard D. Irwin, Inc., 1965)

⁴¹See for example Business Automation, Business Press International, Inc., Elmhurst, Illinois; and The Journal of Data Management, Data Processing Management Association, Mount Morris, Illinois

interesting and important, the technical segment of the literature is not of primary interest in the present research. More important is the second major segment of the literature; the segment which deals with the conceptual problems of information management for decision making.

Many authors have contributed articles on conceptual problems in the use of information systems in business decision making. Most leading business journals, including the Harvard Business Review, the Journal of Marketing, and Management Services have contained articles on information management.⁴²

The major thrust of most articles is either directly concerned with or relates to one or more of the following propositions:

- 1) Business management is becoming more sophisticated with respect to scientific decision making.
- 2) Scientific decision making requires greater amounts of better information.
- 3) Information systems must be developed in order for a business to function effectively.
- 4) The technology is available to develop information systems and managers must avail themselves of the technology.
- 5) An information system can be designed that will link all divisions (both functional and operational) of a firm together.
- 6) An information system can and must be developed for both control of operations and short and long run planning.

⁴²See for example "How to Organize Information Systems," by John Dearden, March-April 1965, pp. 65-73; "What's Ahead in Information Technology," John Diebold, Sept.-Oct. 1965, pp. 76-82; and "How to Build a Marketing Information System," by D. F. Cox and R. E. Goud, May-June 1967, pp. 145-154 all in the Harvard Business Review. See also articles such as Richard E. Sprague "The Browsing Era," Business Automation,

In addition to articles, several textbooks have been written which discuss information systems from a theoretical point of view.⁴³ The work reported in the texts represents several approaches to information systems. For example, Dearden and McFarlan use the opening chapter of their text to classify the various kinds of business information and information systems. The authors list five "important dichotomies of business information":

- 1) Action and nonaction
- 2) Recurring and nonrecurring
- 3) Documentary and non-documentary
- 4) Internal and external
- 5) Historical and future⁴⁴

In addition to the five dichotomies of business information, Dearden and McFarlan identify three major information systems. The three are:

- 1) Financial information system
- 2) Personnel information system
- 3) Logistics information system⁴⁵

Thomas Prince takes a different approach to the theoretical development of management information systems. Prince introduces the information systems approach via a list of three characteristics of business decisions which may be used to categorize the decisions:

⁴³See for example R.A. Johnson, F.E. Kast, and J.E. Rosenweig, The Theory and Management of Systems (New York: McGraw-Hill Book Co., 1967); Adrian M. McDonough, Information Economics and Management Systems (New York: McGraw-Hill Book Co., 1967); T.R. Prince, Information Systems for Management Planning and Control (Homewood, Illinois: Richard D. Irwin, Inc., 1966); and J. Dearden and F.W. McFarlan, Management Information Systems: Text and Cases (Homewood, Illinois: Richard D. Irwin, Inc., 1966).

⁴⁴J. Dearden and F.W. McFarlan, op. cit., p. 6

⁴⁵Ibid., pp. 7-8

- 1) General area that the decision concerns
- 2) The time dimension of the decision process
- 3) Similar requirements⁴⁶ for information in the decision process

Prince then goes on to state:

A group of decisions possessing these three characteristics is the nucleus of an information system. The systems analyst is concerned with tracing all information flows associated with this group of decisions and with the decision-making processes involved, regardless of the organizational boundaries that must be penetrated. This network of information flows that has been traced and charted for each group of related decisions constitutes a system. Since the focus of each network or system is upon "information flows", each network is called an information system.⁴⁷

Prince's text follows many of the basic ideas of general systems theory. Thus, from the point of view of systems theory the Prince text is much more rigorous than the Dearden-McFarlan text.

There are two general conclusions that can be drawn from the literature on management information systems. The first is that information systems are becoming more sophisticated. The systems are becoming better able to supply the necessary information to the decision maker in a useful, timely manner.

The improvement in information systems is a result of two factors. One of the factors is the improvement in the "hardware" and "software" designed to aid data handling, particularly in the areas of collection, processing, and transmission. The other and perhaps the more important factor, is research into decision making. Research aimed at identifying how decision makers actually make decisions and what information

⁴⁶Prince, op. cit., p. 9.

⁴⁷Ibid.

is used to support the decisions is a prerequisite to successful implementation of information technology. Illustrative of the research on decision making and the effect of the results are a number of recent books and articles on logical or quantitative decision making.⁴⁸

The second general conclusion is that there are limits to the amount of automation that can be accomplished in management information systems. John Dearden indicated in an article that there are some information and/or decision making functions which can not be automated. Mr. Dearden further indicated that caution should be used when attempting to automate information systems.⁴⁹

Dearden's comments were in response to what he feels is the unhealthy attitude that automated management control systems, supported by automated information systems, will eventually automate the operational management of a business. There are, of course, persons who would disagree with Dearden and who do feel management information can be automated.⁵⁰ Much of the disagreement, however, may be due to the use of definitions rather than a basic difference in opinion.

⁴⁸See for example Leonard W. Hein, The Quantitative Approach to Managerial Decisions (Englewood Cliffs, N. J.: Prentice-Hall Inc., 1967); Charles H. Kepner and Benjamin B. Tregoe, The Rational Manager (New York: McGraw-Hill Book Co., 1965) and Carl E. Gregory, The Management of Intelligence (New York: The McGraw-Hill Book Co., 1967). See also articles such as Richard E. Sprague, "The Browsing Era," Business Automation, June 1967, pp. 53-55, 70.

⁴⁹John Dearden, "Can Management Information Be Automated?" Harvard Business Review, March-April 1964, p. 128.

⁵⁰Paul E. Konkel, "Management Information Systems Can Be Computerized," Computers & Data Processing, Vol. I, June 1964, pp. 235-236.

Careful consideration of the role of management information would seem to support Dearden's claims. Johnson, Kast and Rosenzweig consider the prime function of data processing (management information systems) to be the development of meaningful information for decision making.⁵¹ Most of the activities performed by data processing, including screening, tabulating and arranging the data collected from day-to-day operations, are carried out to support the development of meaningful managerial information for decision making. Information derived from any source, no matter how sophisticated, is only an aid to decision making; a factor to be used to help management keep better control of the firm's operations and make decisions. The comments of Dearden are not meant to imply, however, that a majority of the information requirements of a firm cannot be fulfilled via a computerized information system.

An indication of the future use of management information systems is described by Richard E. Sprague.⁵² Sprague points out that the role of information systems in the future will be to augment an executive's memory. Thus, the information system will make available to the executive, when he wants it, a vast amount of information which can then be used by the executive in his decision making.

Simulation as a Research Technique

Research which has as its objective the improvement of operating methods in business faces a most difficult task; that

⁵¹R. A. Johnson, F. E. Kast, J. E. Rosenzweig, op. cit., pp. 235-236.

⁵²Richard E. Sprague, "The Browsing Era," Business Automation, June 1967, pp. 53-55, 70.

task being testing suggested improvements. While there is little question that the ultimate test of improvements must be application to operating business entities, such application, particularly during the developmental phases, is often impossible. Operating businesses are rarely willing to permit testing due to the risk of financial loss. Further, the uncontrollability of important variables, such as the activities of competitors, makes testing in an actual business more difficult and can, in fact, adversely affect the results.

Fortunately, the development of the electronic computer presents a feasible alternative to actual business testing, namely simulation. Simulation is a two step process with the first step being the development of a realistic model of an operating system. The second step is the operation of the model. Generally simulation can be accomplished only through the use of electronic computers which are able to manipulate masses of data and account for large numbers of interrelated variables. "In business, simulation means setting up in a digital computer the conditions that describe company operations."⁵³

The advantages of such computer simulations are many. First, simulation permits experiments with a system that would be either too expensive, impractical, or impossible to carry out using the actual system represented by the model. Further, one run of a simulation, a few seconds or minutes of computer time, can portray days, weeks, or even years of operation of the real system. Thus, in a short period of time the long effects of changes in operating procedures can be evaluated.

⁵³Jay W. Forrester, Industrial Dynamics (Cambridge, Massachusetts: The M.I.T. Press, 1961) p. 18.

Highly desirable from a research point of view, the above is obviously impossible in an actual business firm.

There have been several large scale business simulations developed by researchers in the past few years. One of the most well known of these is Jay Forrester's Industrial Dynamics.⁵⁴ Forrester describes the Industrial Dynamics procedure in the following paragraph from the preface:

Industrial dynamics is a way of studying the behavior of industrial systems to show how policies, decisions, structure, and delays are interrelated to influence growth and stability. It integrates the separate functional areas of management--marketing, investment, research, personnel, production, and accounting. Each of these functions is reduced to a common basis by recognizing that any economic or corporate activity consists of flows of money, orders, materials, personnel, and capital equipment. These five flows are integrated by an information network. Industrial dynamics recognizes the critical importance of this information network in giving the system its own dynamic characteristics.⁵⁵

The book then goes into the actual simulation of an industrial system illustrating how and why the different flows are modeled and the results that can be obtained from such a simulation.

Other works on simulation have focused on different industries and different problems and each has added to the knowledge on the uses and techniques of simulation.⁵⁶ The articles and texts form a basis for other work in simulation

⁵⁴Jay W. Forrester, op. cit.

⁵⁵Jay W. Forrester, op. cit., p. vii.

⁵⁶Jay W. Forrester, op. cit.; See also Frederick Balderston and Austin Hoggatt, Simulation of Market Processes (Berkeley, California: Berkeley Institute of Business and Economic Research, University of California, 1962); Charles P. Bonini, Simulation of Information and Decision Systems in the Firm (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1963); and Section III: Application of Simulations: in A. C. Hoggatt and F. E. Balderston (eds) Symposium on Simulation Models: Methodology and Applications to the Behavioral Sciences, (Cincinnati: Southwestern Publishing Co., 1963) pp. 152-250.

but there has been little change in the basic concepts, purposes, and value of simulation.

Summary

The second section of the chapter has described and discussed the contributions of the literature to the methodology and technology used in the research. Three major areas, electronic data processing in chain management, management information systems, and simulation, have been reviewed. With respect to all of the areas, two generalizations are possible:

- 1) The body of literature relevant to the three topics is quite new but is growing rapidly in both breadth and depth.
- 2) The number and complexity of the applications of data processing, management, information systems, and simulation have increased rapidly in the past and will increase even more rapidly in the future.

CHAPTER III

SUPERMARKET CHAIN PRODUCT ADDITION AND DELETION

DECISIONS: A CASE STUDY

Introduction

The logical starting point for any research intended to improve operating procedures in a firm or industry is current firm or industry practice in the area under study. Further, a thorough study of present procedures will provide insights into the strengths and weaknesses of the present methods of operations. The insights should then provide direction for the investigation of possible improvements in the operating methodology. The interviews discussed in the following paragraphs, and the case study compiled from the interviews, investigate and discuss the procedures now used by supermarket chains to make product addition and deletion decisions.

The discussion concentrates on three aspects of the decision process; namely, who makes the decision, what criteria are used by the decision maker, and the nature and sources of the information available to the decision maker. While other factors may be relevant to product mix decisions, the three aspects mentioned above are the most important to the decision process.

The material presented in the following paragraphs is not intended to be an expression of the techniques used by all chains. Rather, the discussion attempts to point out the

general procedures and techniques used, recognizing that each individual chain will have specific adaptations to fit particular needs.

Research Design

The research design selected to guide the interviews used to gather data on current supermarket chains' operations provided for in-depth interviews with a limited number of progressive supermarket chains. Based on the information obtained, a case study of the product addition and deletion procedures was constructed. A composite case study was then written, combining the materials contained in each of the individual case studies.

The Sample

The sample consists of five judgmentally selected supermarket chains. Four general criteria were established to guide the selection of chains to be included in the sample.

The criteria were:

- 1) Each chain must consist of 25 or more stores
- 2) Each chain must be a member of the Super Market Institute
- 3) Each chain should be progressive with respect to:
 - a. the use of electronic data processing
 - b. management policies
 - c. trade innovation and the adoption of improved techniques
- 4) The total sample should:
 - a. provide for broad geographic coverage
 - b. provide for a wide range of sizes with respect to dollar volume and the number of stores

The final selection of stores to be included in the sample was made after consultation with Dr. George Baker, Director of Education of the Super Market Institute and Dr. Bernard J. LaLonde, Coordinator of the Food Marketing Program at Michigan State University. Table 3-1 lists the chains selected with their characteristics.

TABLE 3-1: Some characteristics of the chains included in the case study sample

name	address	number of stores	sales (000) \$
Shopping Bag Stores (Subsidiary of E. F. MacDonald Co., Inc.	1702 S. Del Mar Ave. San Gabriel, California	40	125,000
Stop & Shop, Inc.	393 'D' Street Boston, Massachusetts	143	507,506
Jewel Food Stores	1955 W. North Ave. Melrose Park, Illinois	255	1,060,137
Acme Markets, Inc.	124 N. 14th Street Philadelphia, Pa.	833	1,252,748
The Kroger Co.	1014 Vine Street Cincinnati, Ohio	1,431	2,659,983

SOURCE: The Directory of Super Market Chains, 1965 Edition; The Supermarket News, June 26, 1967 p. 28; and The Fortune Directory, June 15, 1967, p. 32.

The Interviews

Two day depth interviews were conducted at the headquarters of each of the selected chains. At each of the chains three distinct management areas were investigated. The first of the three was the supervisory level. Specifically, the person in charge of the buying activities of the chain,

generally called the head buyer or the head of the grocery department, was interviewed.

The second management area investigated was the operations level. With respect to product addition and deletion decisions, the operating executive is the buyer. Therefore, at each of the chains, interviews were held with two or three buyers.

Finally, at each of the chains, a member of the data processing department, a staff area, was interviewed. The data processing group in most chains is responsible for, among other things, supplying the buyer with much of the information used by the buyer during his normal activities.

Thus, during the course of the interviews, data on the three important aspects of the buying process were gathered. The supervisory personnel supplied information on the buying policies as they affected the buying decisions and described the buying process in general terms. The operating personnel could talk very specifically about the problems they faced, and the steps they took to solve the problems. In addition, the staff department, data processing, which has the responsibility for providing the necessary information to the operating personnel added their views on the buying process.

While the above describes the information gathered via interviews, there were also observations made at each of the chains which provided valuable information. The first of the observations was of the activities of the buying committee, in the chains that used such committees. Wherever feasible, the interviewer attended a meeting of the buying committee. Where

attendance was not possible, in-depth discussions were held with several members of the committee.

The second observation made was of salesman-buyer interviews. Again, wherever feasible, the interviewer sat and watched the presentations of several salesmen to buyers. The observer, in such situations, was able to note exactly how the buyer conducted an interview, what information was exchanged, and how the information was exchanged. The results of the observations could later be compared with the comments of the buyers made during discussions of the buying process. Thus, a more complete picture of the activities of a chain buyer could be formed.

The research design called for the interviews to follow a formal structure. The interviewee would draw a flow-chart of the decision process in his chain. Then, for each decision point within the flow-chart, the interviewee would identify who made the decision, what criteria were used, and what information the decision maker had available for the decision. Appendix B presents a copy of the interview format as originally designed. However, the attempt to structure the interview seemed, in some cases, to cause the interviewee to restrict his discussion of the decision process. Therefore, the formal structure for the interviews was eliminated and a less formal conversational approach was used.

Analysis of the Interviews

The data gathered in the field interviews were drawn together and a case study developed for each chain interviewed. The case studies described the product addition and

and deletion process in each of the chains. While the case studies were designed to report the mechanics of the product decision process, the case studies also attempted to discuss the rationale for the buying procedures. For example, not only did the studies indicate who made the decisions in a particular chain, but the studies also attempted to explain why a particular decision format was used.

The five case studies resulting from the interviews with the five chains were then combined into one case study. The single case study is a general statement of supermarket chain product addition and deletion procedures. Where possible, generalizations have been made concerning the decision process. Where differences exist among the five chains interviewed the differences are noted.

Supermarket Chain Product Addition And Deletion Procedures

Introduction

The mix of products carried by a supermarket chain can be modified in two ways: 1) the addition of new items, and 2) the deletion of items currently carried. The following sections describe, in general, the procedures used by supermarket chains to make addition and deletion decisions.

The Source of the Buying Decision

The new item selection process can be visualized as a screening process whereby the multitude of new items offered to chains are evaluated and the undesirable items screened out. The screening process can take one of three forms.

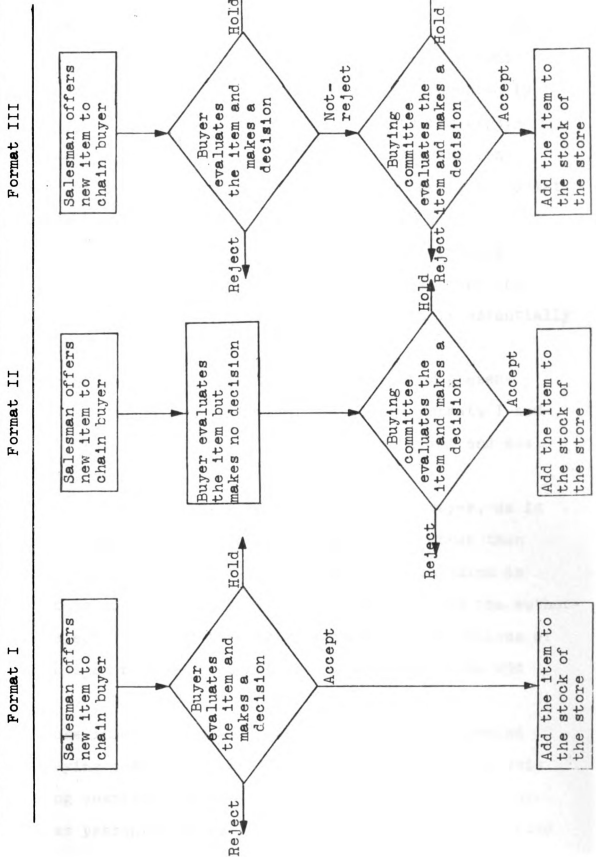
The simplest form is for the buyer to do the complete evaluation and make the accept - reject decision himself. Format I in Figure 3-1 illustrates the process when the buyer makes the decision.

The process begins with a presentation of a new item to a buyer by a salesman or his broker. The new item offer takes place during an interview, generally of about fifteen minutes duration. Chains normally set up specific hours for buyers to interview salesmen, and some have even begun to insist on prearranged appointments.

Following the presentation, the buyer evaluates the item using some set of criteria. (The alternative criteria are discussed in subsequent paragraphs.) When the buyer has completed his evaluation he makes a decision on the item. The three decision alternatives open to the buyer are: 1) to accept the item and add it to the list of items carried by the store, 2) to reject the item, or, in a few instances, 3) hold the item pending further information. Occasionally, part of the additional information desired on an item will be the results of a test of sales of the new item in a few selected stores.

The second decision format is only slightly more complicated. As illustrated in Format II of Figure 3-1, the process is initiated in the same manner as Format I. Following the item presentation the buyer evaluates the item, just as in the first format. However, after the evaluation the second format differs from the first. The buyer, in the second format, makes no decision with respect to the addition

FIGURE 3-1: Three alternative decision formats for product addition



of the item. He merely relays his information on the item and his evaluation with respect to the desirability of the item to the buying committee. The buying committee then considers the item and, using the information presented by the buyer, the buyer's recommendation, and its own experience, makes a decision on the item. The same decision alternatives as available to the buyer under the first format are available to the buying committee.

The third format for addition decision procedures is illustrated in Format III of Figure 3-1. Although the most complicated of the three, the third format is essentially a combination of the first two formats.

The procedure is initiated with a new item presentation to the chain by a salesman just as are Formats I and II. Following the presentation the buyer analyzes and evaluates the item.

Based on his analysis and evaluation the buyer, as in the first format, makes a decision. However, rather than accept or reject, as in the first format, the decision is to reject or not-reject. Thus, while the buyer has the authority to reject items and thereby keep them off the shelves of the chain's stores, he does not have the authority to add items.

Those items the buyer does not reject are presented to the buying committee. Following discussion and analysis the buying committee makes a decision among the same alternatives as presented above. Thus, in chains using the third format, the buyer can reject but can not accept items. The

buying committee can not only reject items, but can also accept items. Table 3-2 summarizes the three decision formats.

TABLE 3-2: The three decision formats

	source of the decision	the possible decision alternatives
Format I	Buyer	Accept, Reject, Hold
Format II	Buying Committee	Accept, Reject, Hold
Format III	1) Buyer 2) Buying Committee	1) Reject, Not-reject 2) Accept, Reject, Hold

While not directly relevant to the buying process, the composition of the buying committee mentioned above is of some interest. There is no set number of persons on the buying committee, with the size varying from as few as three persons to as many as ten. Despite the variety in the number of persons, there are always persons with three types of specialty present. The three specialties are: 1) a supervisor or member of middle management, 2) a buyer, and 3) a field representative or merchandiser. The first type, the manager, will be the head of purchases and/or his assistant or, in some cases, the head grocery buyer. The function of the manager is to direct the meeting, insuring that decisions are made and that such decisions are made carefully.

The functions of the buyer(s) are to present new items, to help in the evaluation of the items, and to vote and thus aid in the decision. While in most chains all buyers are in attendance for the entire meeting, there are some cases

where a buyer attends only long enough to present and vote on his new items. In these cases the buyer participates only in decisions which affect directly the items carried in the product families for which he is responsible.

The third specialty represented on the buying committee is sales. The member may be called a field representative, a merchandiser, or a sales manager but his duties are the same. He will have knowledge of the chain's stores and the problems faced by the stores. In particular, he will be aware of the condition of the various departments in the stores. For example, he must be aware if items have been added to a department without increasing the shelf space allocated to the department and the department is, therefore, overcrowded. Further, just as the buyer concentrates on how and what to buy, the third member of the committee concentrates on how and what to sell. He must be sensitive to the likes and dislikes of the chain's customers. He must be aware of which product areas are increasing in consumer acceptance, which areas are losing consumer acceptance, and what items have been scheduled for special promotions. Based on his background, the third member of the committee acts as a sales advisor, as well as participating in the discussions and voting.

The Criteria Employed

Despite the difference in the format of the buying process indicated above, the criteria used by all chains is nearly the same. While the emphasis may vary slightly from chain to chain, the factors evaluated in reaching a decision on a new item offer do not vary.

There is little question that the most important criteria in all chains is demonstrated consumer demand for an item. If a salesman can prove to the chain that his item will sell and sell well, expanding the market for the product family, then that salesman has assured the acceptance of his item.

However, only rarely, if ever, can the salesman prove consumer demand for his item. After all, the item is supposedly new and thus would not have been in the market where it could prove itself. Therefore, in most instances, the item offered is evaluated on the basis of two other general considerations.

The first general consideration is an attempt to apply the consumer demand criteria mentioned above. It can be roughly stated as "What is our (the chain's) estimate of the consumer demand and sales for this item?" Since the chain can not know beforehand what the demand is going to be, several other criteria are used; criteria that are supposed to be indicative of consumer demand.

The first and foremost of the secondary criteria is the promotional program of the supplier. If the new item is being supported by a large, expensive promotional program, the chain will give a high estimate to the expected level of movement. The chain will be even more favorably impressed if, in addition to a strong national advertising program, a strong advertising program supported by couponing and/or sampling is to be conducted in the chain's local market. Further, chains respond to guaranteed advertising programs rather than programs dependent upon distribution.

A second factor evaluated as part of the estimate of consumer demand for the new item is test market data. A great many new items, particularly those that are product innovations, are test marketed prior to national introduction. The results of such test markets can then be used to estimate the extent to which the new item expanded the demand for a product family rather than merely switch customers within a product family. The data, though generally not directly transferable, can also be used to estimate sales in the chain's local market area.

The third factor used by chains to estimate consumer demand for a new item is the sales history of competing items. As part of the analysis and evaluation of a new item, the buyer extracts from the firm's records the movement history of items in the same product family which the chain now carries. The movement history is then examined to help estimate the expected demand for the new item. Particular attention is given to trends in the sale of the product family and to shifts in sales patterns within the product family.

The fourth factor affecting a chain's estimate of the consumer demand for a new item is the attitude of competition as reflected by the competitive chains that have added the item to their product lines. If all of a chain's competition in a market are carrying an item, that chain is likely to believe it made a mistake in not accepting the item before, that consumer demand for the item does exist, and that they should add it to the list of items now stocked.

The second general consideration chains use in evaluating new items is the effect of the item on the mix of items carried by the chains. If an item is completely new and different, then a chain may well add the item, even if they are unsure of the level of consumer demand for the item. The rationale for such a decision is the desire of chains to present a wide range of items to the consumer. The factors considered when chains evaluate an item under the general consideration of product mix are:

- 1) Unit cost
- 2) Unit retail
- 3) Unit size
- 4) Number of items with which it competes
- 5) Similarities with competing items
- 6) Differences with competing items
- 7) Sales of competing items

There are several other factors, in addition to the above, which chains consider when evaluating a new item. One of the factors is the reputation of the firm offering the product. The chains consider the dependability and reliability of the firm with respect to service, and also consider the firm's reputation for ethical business dealings and successful introduction of new items.

A second factor considered is the gross margin per cent that the manufacturer suggests. Chains, of course, would like all items to have a high gross margin but realize that for some items a high gross margin is impossible. Further, the gross margin on an item tends to decrease with time rather than increase. Thus, a new item which comes in with a low gross margin is not attractive to the chains.

Third on the list of specific factors considered in evaluating new item offerings are the introductory deals and

the promotional allowances available. The opportunity exists for chains to increase profits greatly through careful evaluation of the introductory offers. For example, it might be profitable for a chain to add an item on a promotional basis only, selling the item at a very low price, because of the introductory deal available.

Similarly, the net profit accruing to a chain from carrying an item can be increased if the manufacturer offers a generous promotional allowance. Chains consider such promotional profit during their evaluation of the new items offered.

A fourth factor considered is the quality of the product's handling characteristics. Due to the tremendous expense incurred in handling goods, chains are extremely sensitive to the physical characteristics of goods, and to the method of packing and delivering the goods. Square packages that are easy to stack are much more appreciated by chains than odd shaped bottles. Further, chains are concerned as to whether the case pack seems reasonable given the anticipated level of sales for an item. Chains do not like to have items that sell only 5 units a week come in cases of 48 units. .

Most chains today are becoming sophisticated enough in the technique of materials handling to appreciate the advantages of palletized shipping. Some even go so far as to insist on palletized truck or rail car loads and extract a penalty from manufacturers not complying.

Closely related to the aspect of physical handling characteristics are freight allowances and/or back haul

privileges. Freight allowances are straightforward and need no further discussion. Back haul privileges, on the other hand, are not as usual. Chains generally maintain fleets of trucks for warehouse to store distribution. The delivery of goods to a store is a one way trip with the trucks returning empty. In the instances where empty returning trucks pass within a reasonable distance of a manufacturer's plant or storage warehouse there is a tremendous financial advantage to the chain if the trucks can pick up the goods ordered from the manufacturer and haul the goods back to the chain warehouse. The use of the chain's own trucks in such cases saves the freight on the goods. Some manufacturers allow back haul while others don't. At present the legality of back haul privileges is being questioned by the Federal Trade Commission.¹ However, until ruled illegal, back haul privileges will be a factor in the purchase decisions of chains.

Information Available on New Items

The following few paragraphs will discuss briefly the information presented to the buyer by the salesman. There is other information used in the addition decision but such information is internal to the firm and will be discussed later.

The salesman uses three vehicles to get information to the chain buyer. The first of the three vehicles is the verbal

¹For a discussion of the present position of the Federal Trade Commission with respect to "back haul" privileges, see "F.T.C.: Allowances for 'Back-Haul' Orders are Possibly Illegal," The Marketing News, Semi-monthly newsletter of the American Marketing Association, Volume 1, #7, February 15, 1968, p. 1.

presentation of the salesman to the buyer during the interview. The salesman repeats what is presented in writing and answers a few questions. The fifteen minutes generally allowed for interviews do not provide much time for involved sales presentations.

The second form of communication between the salesman and the buyer is the brochure presented to the buyer by the salesman. Ranging from nothing (the brochures are optional) through one typewritten sheet to extensive multipage promotional pieces prepared by the manufacturer's advertising agency, the brochures again reiterate what is on the "new item form." However, the information is presented via diagrams, charts, pictures, and phraseology designed to "sell" the item.

The third vehicle for the flow of information from the salesman to the buyer is the "new item form". A "new item form" is an information sheet developed by a chain which the salesman must fill out prior to his interview with the buyer. The salesman then presents the new item form generally with samples of the new item to the buyer during the interview. There are spaces on the form for every piece of information the chain deems important and the salesman can supply.

The exact layout of the new item form varies from chain to chain. However, there is little or no variation in the information requested.

Seven general categories of information are requested, each requiring several specific facts. The seven general categories are listed in Table 3-3. Appendix C is an example of a typical "new item form" and illustrates the specific pieces of information requested.

TABLE 3-3: The seven general categories on new item forms

category	information
I	Description of the new item
II	The types and amounts of guarantees on the item
III	The types and amounts of allowances on the item
IV	The types, amounts, and schedules of advertising and sales promotion efforts
V	The competitors stocking the item and the retail price
VI	Shipping information
VII	Store handling information

The Deletion Decision

The discussion will now turn to item deletion decisions, explaining how items are identified for possible deletion, the source of the deletion decision, and what criteria are used. Following the discussion of the item deletion decision, the nature and sources of internal information will be discussed. The order of presentation results from the fact that the internal information is used in both addition and deletion decisions. Thus, the discussion logically follows the discussion of both decisions.

How Items Are Identified for Possible Deletion

The problem of identification of items that should be deleted, or at least considered for deletion, is one of the most serious facing chains today.² The squeeze on shelf space

²Stated by executives of several chains during personal interviews in August 1967.

brought on by the increasing number of new items means that the unprofitable items now stocked must be identified and removed from the shelves of the chain's stores.

Supermarket chains have two procedures for the identification of items that should be considered for deletion. The first procedure requires that for each new item added an item will be dropped, preferably in the same product family. Thus, when a buyer presents a new item he is expected to suggest an item to be deleted. Obviously, since the number of items carried by chains is increasing, the rule is not adhered to 100 per cent. One chain executive estimated that an item was dropped between 25 per cent and 50 per cent of the times a new item was added.³

The second procedure for identifying items to be deleted is a periodic review of all items a chain carries. The review is accomplished in a variety of ways by chains.

One method for the periodic review is for the buyer for each product family to regularly review all items in his section and identify those items he feels should be dropped. The examination may take place weekly or periodically, or it may be continuous with the buyer rotating the product family he examines.

A second method is for the head buyer and/or his assistant to examine all items carried by the chain. Such a review is generally on a periodic basis with the evaluation based on a summary report of each item's performance during the period.

³Suggested during an interview with an executive of a major chain, August 1967.

Items with levels of performance below certain acceptable levels are identified and considered for deletion.

The Source of the Deletion Decision

There are two general approaches to the deletion decision. (In Figure 3-2 the "Format" refers to the Format used for the buying decision as illustrated in Figure 3-1.) Responsibility for the deletion decision depends on the procedure followed by the chain for addition decisions. For chains following the first format (a buyer completely responsible for the addition of new items) the buyer is completely responsible for the deletion decision. While he may consult with his superior concerning the decision, the buyer, since he is generally responsible for the profitability of his product families, assumes the ultimate responsibility for deletion decisions.

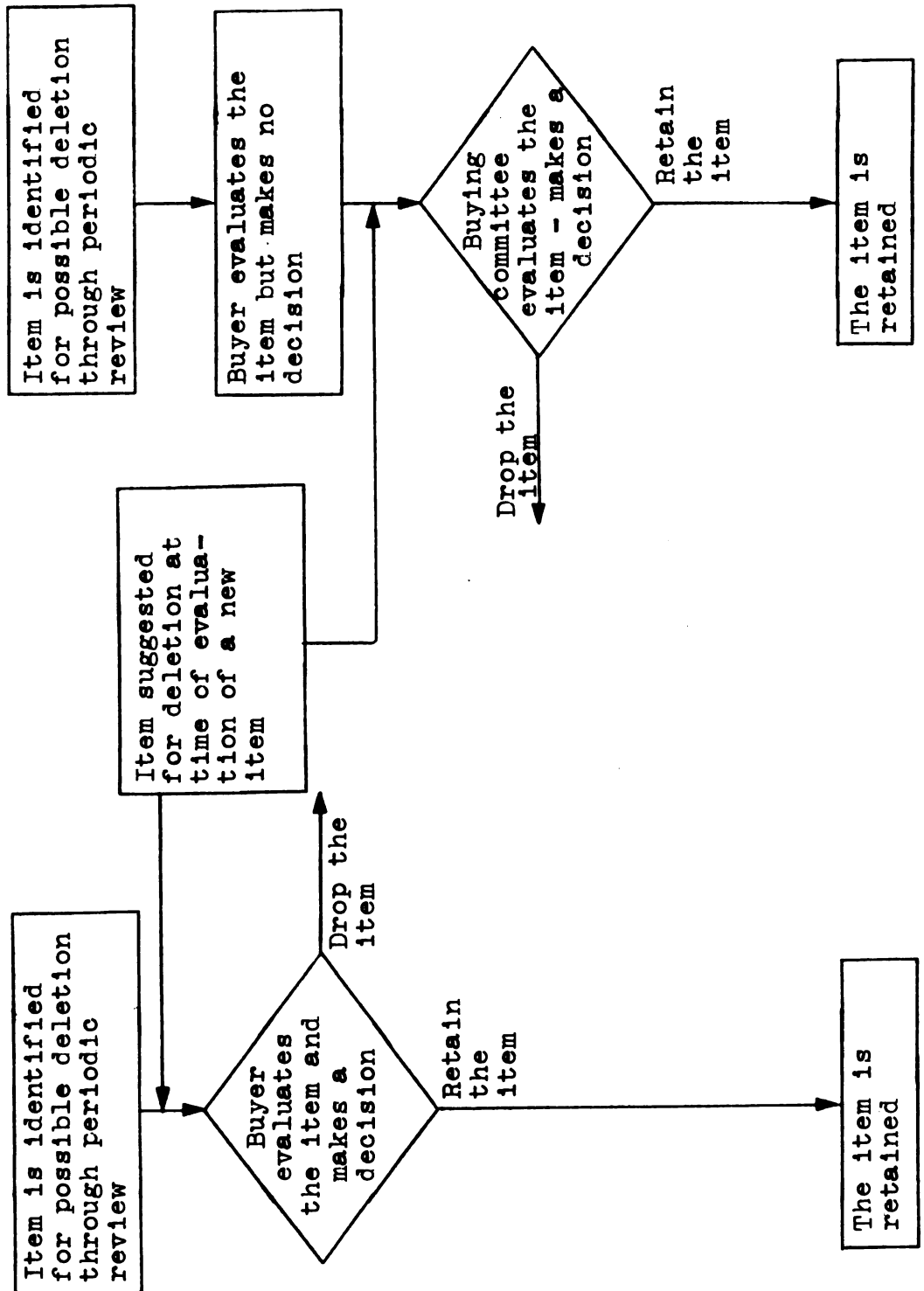
In chains with a buying committee (Formats II and III under the buying decision) the deletion decision is made by the committee. As noted above, when a buyer makes a presentation of a new item he is expected to suggest an item for deletion. In making its decision on the new item the committee will consider the possibility of deleting an item. The deletion decision, however, is not tied to the addition of a new item, but rather is a separate decision, made by a separate vote of the committee, with a majority of the committee carrying the decision.

In addition to presenting new items to the committee, the buyer will also, on occasion, present items he feels should be deleted. Such presentations may be made even if the buyer

FIGURE 3-2: Two alternative decision formats for product deletion

Buying Format I

Buying Formats II & III



is not suggesting a new item to replace the one considered for deletion. The buyer and the committee know that an item that is not generating sufficient profits may be deleted at any time. Part of the rationale behind such a decision is that new items are being constantly added to all product families and therefore, shelf space is always needed.

The Criteria for Deletion Decisions

An important criterion for the addition of a new product is demonstrated consumer demand which results in a high rate of sales for the item. It is, therefore, not surprising that the most important criterion for item deletion is a low rate of sales or lack of movement. The prime factor in the identification of items for possible deletion, as well as the most important criterion used in the decision is lack of demonstrated consumer demand for an item as indicated by a low rate of sales for the item.

Another important criterion is the level of the gross margin of the item. Any item with a particularly low level of gross margin, especially when compared with other items in the same product family, will probably be considered for deletion.

The two factors mentioned above can be combined to provide a third criterion - gross margin dollars generated per unit time. Although generally secondary to movement the gross margin dollars generated per unit time is important because it permits comparisons between dissimilar items in a product family, and in some cases across product families.

For all three of the above criteria many chains consider the trend more important than the absolute level at any point in time. For example, if movement is low but seems to be increasing then the item probably would not be dropped. However, if the movement shows a decline, then even an item with a fairly good level of movement might be considered for deletion.

A fourth criterion used by chains is not as easily applied as those mentioned above. The chains, in their desire to maintain variety on the store's shelves, will hesitate to delete one-of-a-kind items. Most chains feel an obligation to carry as broad a product mix as possible. Thus, an item with slow movement might be "saved" if there are no substitutes for the item. However, items in the one-of-a-kind category are continually appraised and should movement fall to an extremely low level the item would be dropped.

Occasionally an item might be dropped due to a need for shelf space in its product category. Should a chain find an item must be added, probably due to consumer demand for the item, and also find that there was no space on the shelf for the item, the chain might make room for the item by deleting an item now stocked. The item dropped would be the least attractive item, based on the criteria discussed above.

The Nature, Sources and Flows of Internal Information

The buyer's card is an important source of internal information in most supermarket chains. The cards are a set of 5 X 8 index cards, one for each item carried, maintained

by and for the buyer. Not only do the buyers' cards provide a **record** of the activity and actions on an item but also are a **primary** source of decision making information.

Essentially the buyer's card is a perpetual inventory record which is updated weekly for sales and as necessary for receipts of an item. The card contains a record of the total cases shipped from the chain's warehouse to the stores each week, the number of cases ordered and received, and the date of each order and receipt. In addition, the card generally contains notations as to the nature and extent of promotions on items, the current cost and retail, including any changes. The card also contains basic product information such as supplier, size, case pack, case cube, pallet count, and minimum order quantity. From the data contained on the buyer's card, the buyer extracts the information he uses to make addition and deletion decisions.

While the information used most often is the movement of the item, other information is also used. As part of the analysis of new item offers, buyers generally make comparison tables of competing items. Figure 3-3, an example of such a table, shows the information used in the comparison. All the information contained in the table can be extracted from the buyer's card.

Buyers' cards are maintained manually, either by the buyer or his secretary. In addition several chains are storing the same information within their data processing system. At least one chain has gone one step further and reduced the

FIGURE 3-3: A table for item comparison

ITEM	PACK	SIZE	UNIT COST	UNIT RETAIL	GROSS MARGIN	SALES	
						LAST PERIOD	AVERAGE PERIOD

duplication of information by eliminating the buyers' cards. The cards' functions are now performed by reports of the data processing system.

Electronic data processing or management information systems are making important advances with respect to controlling the flow of items through supermarket chains. A good example of such advances is the "short and expedite report". Generated daily, the short and expedite report lists such items as those for which store orders could not be filled due to inadequate stock in the chain's warehouse. Based on the report, buyers can take the necessary steps to correct the deficient inventory problem as are indicated necessary by investigation of the problem.

Very similar to the short and expedite report is the receivings report. Each day data processing prepares a list of all items received in the chain warehouse that day. The list can then be used to eliminate items from the short and expedite report that were received after the report had been generated. The report can also be used to evaluate vendors.

While very useful from a control point of view, the above reports are not product mix decision making information. The application of data processing and information system technology for decision making in supermarket chains is generally behind the control applications. A series of weekly and period summary reports are generated for both control and decision making. The reports are activity summaries for each item containing the basic item data as well as summaries of the cases received and shipped, dollar sales, gross margin per cent, gross margin dollars generated, the inventory level in days supply, and the number of inventory turns. While most of the information is used to evaluate and control performance, much of it also can be used in support of product decisions.

Even though the summary reports mentioned above, and one or two other similar reports can be used in decision making, the main purpose of the reports is control. Buyers make little, if any, direct use of data processing or information systems for product addition and deletion decisions. For example, most chain buyers are aware that certain items sell better in some stores than in others due to the particular customer characteristics. Yet few chains evaluate the mix of items ordered by each store. The technology is available to maintain records of shipments to stores on a per item per store basis. The information made available from such records may be immensely useful in evaluating both new items offered and items being considered for deletion. For example, take a hypothetical 100 store chain. The buyer for beans has suggested for deletion chili beans which are currently moving at the rate of 20 cases per week. The rate

of movement is an average of 1/5 case per store per week. Due to low movement the item might be deleted. Analysis of warehouse-to-store shipments might show, however, that the item was ordered by only ten stores, each store selling an average of two cases per week. The chain-wide average, in the above case, is quite misleading and the chain would probably retain the item for the stores that have the high rate of sales.

Related Uses of Computer Based Information Systems

Many chains have made, in the planning stages at least, improvements in their information systems designed to provide more and better information for decision making. Chains, during the introduction of data processing systems, first applied the systems to routine problems such as payroll, and accounts receivable. With the routine problems solved, chains are now turning to more sophisticated uses of data processing.

One of the uses chains are investigating is computerized evaluation of the customer mix of each store. The results of such evaluation can be used to identify items that have appeal to ethnic, racial, religious, or social groups.

Another example of the proposed use of computer based information systems is the evaluation of promotional deals and announced price changes. When a promotional deal is being discontinued or the cost of an item is being increased it is profitable for chains to stock up on the item at the present lower price. At some point, however, the costs of storage become greater than the savings resulting from the lower purchase price. The computer can easily compare the

the savings and the costs and identify, based on the dollar costs and savings, the optimum quantity to be purchased.

A third use to which chains are contemplating putting their information systems is the evaluation of in-store promotions. End-aisle and similar displays are not only costly to set up and maintain but also take up valuable space. Chains realize the importance of evaluating the costs and returns of such displays and then using the information in planning other promotions.

Summary

The previous paragraphs have discussed the research design used to gather data on the present product addition and deletion decision procedures used by supermarket chains. Based on the data gathered, a case study of the decision process was developed.

The case study illustrated the three general formats for the product addition decision and the two general formats for the deletion decision. In addition, the case study identified the criteria now used in the decisions and the information available to support the decision.

The information presented above has been used as a basis for suggesting improvements in the decision criteria and the flow of information. The following chapters discuss the methodology used to identify and test the suggested improvements, the results of the tests, and the implications of the research for chain management.

CHAPTER IV

RESEARCH DESIGN: THE SIMULATION EXPERIMENTS

Introduction

Phase II of the research project consists of a series of **e**xperiments carried out using three computer routines. The following paragraphs discuss the computer routines and **d**escribe the experiments conducted.

The first section of the chapter discusses the three **c**omputer programs used in the research. The three are:

- 1) CHAINSIM - A computer oriented model of one department of the stores in a chain.
- 2) BUYSIM - A computer model of an item evaluation process which might be used by supermarkets.
- 3) SPACALLO - A linear programming model to allocate store shelf space to individual items.

Flow-charts of CHAINSIM and BUYSIM are presented as appendices.

The second section of the chapter discusses the series of **e**xperiments conducted with the simulation models. The **d**iscussion focuses on the objective of each experiment and the **s**equences of steps taken to reach that objective.

The simulation model of a supermarket chain developed for the present research is presented as a test of the **m**ethodology. The purpose for the development of the model was to **s**how that a simulation model could be built and used to test **h**ypotheses concerning the operations of a supermarket chain

and to illustrate the techniques that might be used to build such a simulation. Thus, the model was limited to not more than five stores, no more than sixty items, no more than twenty suppliers, and built using the characteristics of one department in the dry groceries section of a supermarket. The model could be expanded, however, to model all the non-perishable departments of a store and a chain with as many stores as desired. The only limitation would be the physical limitations of the computer facilities used.

The Simulation Programs

CHAINSIM: A Computerized Chain

CHAINSIM is a computer based simulation model of a supermarket chain. The model begins with a set of randomly generated customers and traces the operations of the chain to provide for and control the flow of goods. The primary function of the CHAINSIM program is to trace the flow of goods through the chain system.

The simulation models the flow of goods through one department of the dry groceries section of the stores in a chain. While the program could model any of the several dry groceries departments, the specific input data used in the present research are from the dog food department.

In order to provide flexibility in the CHAINSIM routine, the chain and item characteristics are specified as input to the program. Table 4-1 presents the input data to the program.

The input data used in the present research was gathered with the cooperation of several chains operating in the Detroit,

TABLE 4-1: Input data for CHAINSIM

number	description	source
1)	The number of stores in the chain.	Set by researcher.
2)	The number of simulated years.	Set by researcher.
3)	The number of items carried by the stores.	Developed from the actual number of items carried by a national chain.
4)	The number of suppliers selling to the chain.	The actual number of suppliers of the items carried by a national chain.
5)	The probability that a customer will accept a second choice item.	Set by researcher.
6)	Initial value for random number generator.	Set by researcher.
7*)	The number of customers to shop each store.	Set by researcher.
8*)	The quantity of each item on the shelves of each store.	Set by researcher.
9*)	The market share of each item in each store.	Developed from the actual sales histories of the dog food items of a national chain.
10*)	The maximum quantity of an item that may be on the store shelves.	Developed by observation in the store of a national chain.
11*)	A second choice item for each item carried.	Set by researcher.
12*)	The store order days.	Set by researcher.
13)	The coefficients for the exponential smoothing forecasting routine.	Set by researcher.
14)	Initial trend factor for the forecasting routine.	Developed from the sales histories of 76 pet food items over a 52 week period in an actual chain.
15)	Initial seasonal factor for the forecasting routine.	Same as 14).
16)	The lead time for each supplier.	Set by researcher.
17)	Identification of the items carried by each supplier.	Extracted from the records of a national chain.
18)	Item data including: case pack, case cost, case retail, handling cost, initial inventory.	Extracted from the buyers' cards for the items under study.

*May be different for each store in the chain if so desired.

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Michigan area. In particular, the number of items carried by the chain and the characteristics of the items including supplier, cost, retail, and case pack, were extracted from the order book of one chain. The market share of each of the items was derived from the movement history of the items. The maximum shelf quantity of each item was determined by observation of the actual quantities on the shelf in a store.

The data needed for the exponentially smoothed seasonal and trend adjusted sales forecast were developed from the weekly sales records of one chain. The sales history of seventy-six pet food items for a period of fifty-two weeks was decomposed into trend and seasonal parts through a linear regression analysis on the computer of the University of Detroit. The program returns not only the slope of the regression line (the trend factor) but also the residuals (the differences between the observed value and the values computed from the trend equation). The residuals are, therefore, a seasonal factor (assuming zero random error) for each of the fifty-two weeks. The fifty-two week year was then transformed into thirteen four-week periods, in order to smooth out the effect of such factors as weekly promotions. The seasonal factor for each of the periods was assumed to be the arithmetic average of the seasonal factors of the four weeks that constitute the period. The trend factor determined by the linear decomposition of the sales history data is 0.36612. The seasonal factors for each of the thirteen periods are presented in Table 4-2.

The handling costs associated with the items in the

TABLE 4-2: Seasonal indices for pet food

period	average residual	seasonal index
1	0.70196	100.70196
2	0.16838	100.16838
3	0.11836	100.11836
4	2.82060	102.82060
5	-6.39289	93.60711
6	-3.37712	96.62288
7	-4.72980	95.27020
8	9.78266	109.78266
9	9.54183	109.54183
10	-0.54183	99.45817
11	-0.59371	90.40629
12	-9.38381	90.61619
13	0.96765	100.96765

SOURCE: Calculated from the weekly item sales histories for fifty-two weeks of seventy-six pet food items carried by a chain operating in Detroit, Michigan.

Simulation were estimated from the costs compiled by McKinsey and Company.¹ While not developed specifically for dog foods, the McKinsey data are the most recent estimates of the costs of handling dry grocery items. The costs are accepted by the industry and can be applied to items other than the ones specifically studied by McKinsey.

The factors of case pack, type of container, and size of container were used to apply the McKinsey data to dog food. For example, canned dog food items packed in cases of twenty-four were assigned the handling cost of canned fruit (\$0.79). Canned dog food items packed in cases of forty-eight were assigned the handling cost of canned soup

¹"The Economics of Food Distributors," McKinsey-General Foods Study (White Plains, New York: General Foods Corporation, October, 1963).

(\$0.74) as developed by McKinsey. Estimates for the other dog food items were developed from the costs of items similar in package size and case pack studied by McKinsey. Table 4-3 presents the various types of dog food items, the comparable item studied by McKinsey, and the handling cost.

Exclusive of the input and output sections, the CHAINSIM program consists of five activity routines. See Appendix D for a flow chart of the CHAINSIM program. The first activity routine is generation of store-to-customer sales. Using Monte Carlo simulation techniques, the program generates a preset number of customers per day for each store.² A random number between 0 and 100 is generated by a random number generator. The random number (customer) is then matched with a particular item. A cumulative market share is calculated by sequentially adding the market share of each item. The cumulative market share is the device used by the routine to match the random number with an item.

To illustrate, suppose the random number generated was 20.2347. The computer compares the random number with the market share of the first item. If the market share of the first item is less than 20.2347 the computer would add the market share of the second item to that of the first. Again the computer would compare the random number with the market share, using as market share the cumulative total of the

²Monte Carlo simulation techniques are experimental sampling techniques that can be used to model processes which are essentially probabilistic. For an introduction to the concept of Monte Carlo simulations see Ronald E. Frank and Paul E. Green, Quantitative Methods in Marketing (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967) pp. 89-95.

TABLE 4-3: The various types of pet food packages
and the McKinsey handling costs
associated with the items

item	comparable McKinsey item	handling cost (dollars)
1 pound can (Case pack 24)	canned fruit	0.79
(Case pack 48)	canned soup	0.74
1 pound 10 ounce canned dog food	coffee	0.86
36 ounce package of semi-moist	flour	0.51
72 ounce package of semi-moist	detergent	0.77
2 pound box	detergent	0.77
5 pound bag	flour	0.51
10 pound bag	detergent	0.77
25 pound bag	cereal	1.17

market shares of the first and second items. If the cumulative total market share is greater than the random number (20.2347) then the computer would recognize the second item as the selection of the customer in question. If the cumulative market share was less than 20.2347, the computer would calculate a new cumulative market share by adding the market share of the third item to the cumulative market share of the first and second. The procedure outlined above continues until the cumulative market share is equal to or greater than the random number. When the cumulative market share becomes equal to or greater than the random number generated, the computer uses as the item to be purchased the last item added

to obtain the cumulative market share.

Once the computer has identified the item the customer wishes to purchase, the store shelf inventory is checked to determine if the item is available on the store's shelves. If the store has the item on the shelf the purchase is recorded and the computer recycles to the next customer.

If the item selected by the customer is not on the shelf of the store, the computer generates a second random number. The number generated is compared with a preset number indicating the probability that the customer will accept a second choice item. If the customer will accept a second choice item, the second choice item is identified using the original selection of the customer. For every item carried, a second choice item is read as input data with the storage address of the item based on the number of the first choice item. Again the shelf inventory is checked, now for the second choice item. The program recycles to the next customer if the item is not on the shelf. If the item is available it records the purchase and then recycles to the next customer. The customer generation procedure is repeated until a preset number of customers have been processed for each store.

The second activity routine generates the store-to-warehouse order. Several assumptions concerning the operating procedures and policies of the chain had to be made to develop the store order routine. The assumptions are:

- 1) The "chain" follows a Store Labor and Inventory Management program whereby the stores will only order an item when a full case will fit on the shelf.

- 2) The stores may order one, two, or three days per week. The specific store order days are preset for each store in the model.
- 3) Goods ordered on one day are received the following day. For further detail, see the description of the warehouse and store inventory adjustment routine.

Each simulated day, following the generation of the customers for each store, the computer checks to see if that day is a store order day for the store in question. If today is not a store order day for the store in question, the computer checks successive stores until a store that orders today is identified or all stores have been checked.

When the computer identifies a store that orders today, the computer generates a store order. For each item carried by the store, the computer checks to determine if a case of the item will fit on the store's shelves. The space available is determined by comparing the case pack of the item with the difference between a preset maximum allowable quantity of the item and the quantity of the item now on the store's shelves. If one or more cases of the item will fit on the shelves, the item and proper quantity are placed on the store order. The computer then proceeds to the next item until all items carried by the store have been checked. If the available space is not sufficient to accept a full case of the item the computer simply proceeds to the next item.

The third activity routine simulates the shipment of product from the chain warehouse to the stores. Each day, for each store, the computer checks whether the previous day was a store order day. If not, the computer continues to the next section of the program.

However, for the day-store combinations on which the store ordered merchandise the previous day, the computer must update the warehouse and store shelf inventories. For each item carried by the chain, the computer checks to see if the item was ordered by any store. If an item was not ordered by any store the computer proceeds to the next item.

When the computer locates an item that was ordered by one or more of the stores, a check is made to determine if the warehouse inventory is sufficient to fill the total orders from all stores for the item. If the warehouse inventory is sufficient to fill all store orders, the quantity of the item ordered by each store is subtracted from the warehouse inventory and added to the shelf inventory of that store.

If the warehouse inventory is not sufficient to fill the total orders for an item, the available warehouse inventory is allocated to the stores on a percentage basis. The per cent of the total amount ordered of each item contributed by the order of each store is calculated. The available warehouse inventory is multiplied by the per cent contribution of each store to determine the number of cases of each item shipped to each store. The shipment to each store is then subtracted from the warehouse inventory and added to the store's shelf inventory.

The final daily activity routine adjusts the warehouse inventory for the items received at the warehouse. The computer checks a file listing, for each day, the items to be received by the warehouse. For each item listed, the computer updates the warehouse inventory for the number of cases to be received.

The four activity routines are completed for each day the chain operates. At the end of each day the computer generates a set of daily reports as described in Table 4-4. At the end of every sixth day, the end of a week of simulated activity the computer goes through the fifth activity routine--the sales forecast and warehouse order routine.

The simulation uses a trend and seasonally adjusted exponentially smoothed sales forecasting procedure.³ Based on the forecasted sales for the present week, the actual sales for the present week, a seasonal factor, and a trend factor, the routine generates, for each item, a sales forecast for the following week. Once generated, the forecast is adjusted by the expected level of inventory based on present inventory and expected sales to determine the proper order quantity.

Once the order quantity for each item has been calculated, the date on which the item will be received by the warehouse is calculated. The receiving date is the lead time of the supplier adjusted by a service level factor. For each supplier the probability that the shipment will be one and two days late, on time, and one and two days early is specified. A random number is then generated by the computer. The random number is matched with the service level probability to determine the adjustment, if any to be made in the supplier's lead time. The adjustment is used to calculate the actual receiving date and the quantity of each item to be received are stored in the warehouse receivings file. When sufficient time has

³For a discussion of the forecasting technique see Peter R. Winters, "Forecasting Sales by Exponentially Weighted Moving averages " Mathematical Models and Methods in Marketing, Frank M. Bass, et al (ed) (Homewood, Ill.: R.D. Irwin, Inc., 1961) p.482

TABLE 4-4: The output reports generated by CHAINSIM

frequency	title and description
Daily	Case Shipments of Item to Stores - Indicates the number of cases of each item shipped, by store, during each day.
Daily	Short and Expedite Report - Indicates for items shorted the number of cases each store was shorted.
Daily	Warehouse Receipts - Indicates the quantity of items received by the warehouse on each day.
Weekly	Warehouse-to-Supplier Order - Indicates for each supplier the quantity of each item ordered.
Weekly	Overstock in Inventory - Indicates items for which the level of inventory was greater than the forecasted sales.
Weekly	Warehouse-to-Store Weekly Case Shipments - Summarizes the week's shipments of each item to each store.
Weekly	Buyer's Weekly Shipment and Inventory Report - Summarizes, for each item, the weekly case shipments, dollar sales, gross margin dollars generated, gross margin per cent achieved, the warehouse inventory.
Weekly	Weekly Product Category Summary Report - Presents summary data, by product category, on the number of items carried, the number of cases sold, the gross margin dollars generated, and the average gross margin per cent achieved.
Periodically	Item Summary for the Period - Indicates for each item the cases shipped, the dollar sales, the gross margin dollars generated, the gross margin per cent, and the average cases shipped per week.
Periodically	Period Operating Statement by Category - Generates net profit for each product category; Also presents last period's operating statement.

passed to reach the actual receiving date, the warehouse inventory is adjusted by the quantity received as indicated in the description of activity routine number four.

The five activity routines described above constitute the major sections of the CHAINSIM program. In addition to the input, as described previously, and the above activity routines, the program routinely generates a series of daily, weekly and period reports. Table 4-5 lists the reports, specifying the frequency, title, and the information contained in each report.

BUYSIM: Computerized Item Ranking

The second of the three computer routines is a model of an item evaluation process which might be followed by supermarket chain buyers. (See Appendix E for a flowchart of the BUYSIM program.) The program can be used to rank items currently stocked or to compare new item offers with currently stocked items. Thus, the routine can be used to evaluate items for both addition and deletion decisions.

The inputs to the BUYSIM program are presented in Table 4-5. With the information given in the table the computer automatically calculates the values necessary to rank the items according to seven decision criteria.

If the program is being used to evaluate new items, the first step is to estimate the level of unit sales for the new item. The basis of the estimate is the average weekly unit sales of the currently stocked items selected for comparison. The estimate is then adjusted by the test market data, and

TABLE 4-5: Data input to BUYSIM

number	description	source
1)	Item number and name	Set by researcher
2)	Case pack	Records of a national chain
3)	Case cost	Records of a national chain
4)	Case retail	Records of a national chain
5)	Gross margin dollars per case	Item 4 minus item 3
6)	Gross margin per cent	Records of a national chain
7)	Handling cost per case	Adapted from McKinsey data
8)	Four weeks unit sales	Records of a national chain
9*)	Test market data	Set by researcher
10*)	Rating of the intro- ductory program	Set by researcher
11*)	Rating of the national advertising program	Set by researcher
12*)	Rating of the local advertising program	Set by researcher
13*)	Rating of the com- petitors' reaction	Set by researcher
14*)	List of items for comparison	Set by researcher
15)	Number of items to be ranked	Set by researcher
16*)	Number of new items to be ranked	Set by researcher

*Information needed only if the program is to be used to rank new items.

the ratings of the introductory program, the national advertising program, the local advertising program, and competitive reaction to the item. Appendix F presents an example of a "New Item Evaluation Form" that would be filled out by a buyer to provide the necessary input to the program. Following calculation, the estimated movement of the new item is used by the computer to calculate the information necessary to rank the items.

When the program is not being used to evaluate new

item offers, but rather is being used to rank only items now stocked, the above section of the program is skipped. The computer proceeds directly to the calculation of the values for the criteria. Of the seven criteria used in ranking the items, five must be calculated. Table 4-6 lists the criteria used in the BUYSIM program.

TABLE 4-6: Criteria used to rank items in the BUYSIM program

number	criteria
1)	Movement (in units) per week
2)*	Gross dollar sales per week
3)	Gross margin per cent
4)*	Gross margin dollars generated per week
5)*	Dollar contribution per week
6)*	Net profit generated per week
7)*	Weighted summary ranking

*The values for the criteria must be calculated by the program using the rate of movement and the item characteristics.

Once the necessary values for the above criteria are calculated, the BUYSIM program calls a subroutine to sort and rank the items in descending order. The items under consideration are first ranked according to each of the first six criteria listed above. Then, a weighted summary value is calculated for each item. The rank each item received according to each criteria is subtracted from the total number of items plus one. The values for each item are then added across all criteria. When the summary values have been calculated the items are ranked according to the weighted summary values.

The output of the BUYSIM program is a table listing each item evaluated. (See Appendix G for examples of the output table of BUYSIM.) For each item evaluated the table indicates the value and the ranking of the item according to the criteria, and the weighted summary ranking.

SPACALLO: Linear Programming Allocation of Shelf Space

The SPACALLO program uses the optimization characteristics of linear programming to allocate available shelf space to individual items, given a predetermined management goal. The program is not intended to solve space allocation problems, but rather, to illustrate the impact of alternative decision criteria on item evaluation. Rather than design a linear program routine specifically for the present research, the computer's library linear programming routine is used.

The input to the routine consists of item data, a set of constraints and an objective function. The item data needed are:

- 1) The width of one facing of the item.
- 2) The number of units in one facing.
- 3) The number of facings per case of the item.
- 4) The relationship between a change₄ of one facing and the sales of the item.⁴

The constraints imposed on the solution are:

- 1) A maximum number of cases of each item that may be stocked.
- 2) The total linear shelf feet required for the items may not exceed a preset maximum.

⁴While there is little concrete evidence that additional facings of an item result in higher sales volume for that item, many supermarket operators feel that additional space will in fact sell more of an item. Research in the area provides conflicting results. See for example Keith K. Cox, The Relationship Between Shelf Space and Product Sales (Austin, Texas, 1964)

The criterion (objective) function may be changed for various runs of the program. In particular, the program may be used to allocate shelf space so as to maximize:

- 1) Unit sales
- 2) Dollar sales
- 3) Gross margin per cent
- 4) Gross margin dollars
- 5) Dollar contribution

Thus, the criterion function must be adopted to the particular problem being solved.

As output, the routine will specify the number of facings that should be given to each item. The output will also include the value of the objective criteria.

The Simulation Experiments

Introduction

The sets of experiments described in the following paragraphs are designed to provide the data necessary to test the hypotheses listed in Chapter One. The description is presented in two sections with each section designed to provide data on a particular aspect of the hypotheses. The two sections are:

- 1) Identification of the Effect of Alternative Decision Criteria on Item Evaluation.

⁴(cont) However, a research report by the U.S. Department of Agriculture did find that for seventeen canned fruits and vegetables each additional facing increased sales by ten per cent. The ten per cent value reported by the Department of Agriculture was used as the sales response to additional space coefficient for the present research. For some items, such as twenty-five pound bags of dry dog food, the coefficient was adjusted. See Hans Pauli and R. W. Hoecker, Better Utilization of Selling Space in Food Stores: Part I, Relation of Size of Shelf Display to Sales of Canned Fruits and Vegetables, U.S.D.A. Marketing and Facilities Bureau, Marketing Research Report #30 (Washington, D.C.: U.S. Government Printing Office, 1952).

- 2) Sensitivity Analysis of the Effect of Minor Fluctuations in the Input Data on Item Decisions.

Identification of the effect of alternative decision criteria on item evaluation

The first set of experiments is designed to identify the impact of the use of various decision criteria. The hypothesis to be tested by the results of the first set of experiments is:

H_{01} : The ranking of each item in a set of items will not change when the criteria used for the ranking is changed.

Both the BUYSIM and the CHAINSIM programs, as well as an analysis routine, are used in the experiments.

The first step is to categorize the dog food items and place each item in one of four product families. The four product families are:

- 1) Canned ration type dog food
- 2) Canned all-meat type dog food
- 3) Dry (meal) type dog food
- 4) Semi-moist dog food

The next step in the experiment is to make four runs of the BUYSIM program, using as input for each run all the items in one product family. After each run the rankings of items using the alternative decision criteria are compared. If the comparison of the rankings shows that the rankings vary using the alternative decision criteria then the results will have provided evidence that the particular items selected by a chain are dependent on the criteria used in the selection process.

Item data are available on fifty-two dog food items stocked by the Detroit Division of a national food chain. Table 4-7 presents the product family categorization of the fifty-two items.

TABLE 4-7: Product family categorization of 52 dog food items

product family	total number of items	number of items used in CHAINSIM*
Canned ration type dog food	12	9
All meat and gourmet	14	10
Semi-moist dog food	12	9
Dry meal dog food	<u>14</u>	<u>10</u>
Total	52	38

*Approximately 75% of the total number of items.

A computer program was written to analyze the results of the rankings of the items by the BUYSIM program. The problem computes the sum of the absolute differences in the ranking of each item by each pair of criteria. The pair of criteria with the smallest sum of absolute differences in rankings is defined as the pair that is most similar. The pair with the highest sum of absolute differences is defined as the least similar pair.

Further analysis of the rankings is conducted using Kendall's Coefficient of Concordance. Kendall's statistic answers the question, "How much do these rank orders tend to agree, or show 'concordance'?"⁵ The statistic is a ratio of

⁵William L. Hays, Statistics for Psychologists (New York: Holt Rinehart and Winston, 1963) pp. 656-658.

the observed amount of variance in the rank sums and the maximum possible variance in the rank sums.

The output from the second step in the experiment, the item rankings generated by BUYSIM, is used as the input data for the third step. The top seventy-five per cent of the items in each of the four product families, as determined by the item rankings, are used as the items stocked by the stores in the CHAINSIM program. Since the output of BUYSIM provides seven rankings of the items, seven different sets of items are generated to make up seven different departments. Thus, seven runs of the CHAINSIM routine must be made.

In order to provide for comparability among the results of the seven runs of CHAINSIM, the same store characteristics and input data on the items are used. Further, the same set of customers are generated by using the same number to initialize the random number generator. Therefore, any differences observed in the output of the CHAINSIM routine from the seven runs must be due to the different set of items stocked in the department.

A second experiment designed to show the effect of alternative decision criteria uses the SPACALLO program. The hypothesis tested by the results of the experiments with the SPACALLO program is:

- H_{02} : The per cent of total available shelf space allocated to individual items by a linear program allocation routine will not vary when the objective function is changed from one to another of the following criteria:
- a) Maximize unit sales
 - b) Maximize dollar sales

- c) Maximize gross margin per cent
- d) Maximize gross margin dollars
- e) Maximize dollar contribution

A dog food department with sixty linear feet of shelf space is assumed. The mix of items stocked and a minimum space allocation to each item is also assumed. The space required for the minimum allocation of all products is forty linear feet or two-thirds of the total available space. The linear programming routine then determines the optimum allocation of the remaining twenty linear feet of space in the department.

The amount of shelf space allocated to each item by the five runs, as specified by the hypothesis, is then compared. If the space allocations vary, the variations provide further evidence that alternative decision criteria, as manifested in various management goals, result in the emphasis (or selection) of different items. In addition, evidence is provided on the specific effect of various management goals on the operating results of a chain.

The sensitivity of item rankings to variations in the input data

During the interviews with chain executives reported in Chapter Three of the dissertation, several of the executives indicated that they felt highly quantitative item evaluation or item evaluation by computer was impractical. Their reason was that price and the shelf space devoted to individual items changed so frequently that accuracy could not be achieved. To guide an investigation into the correctness of opinion of the chain executives the following general hypothesis was

formulated:

- H_{03} : Sensitivity analysis will show that an item's ranking by the BUYSIM routine will not change when the item characteristics of price and handling cost are changed.

To provide greater structure to the research, the following more specific hypotheses were formulated.

- H_{03-a} : The ranking of an item by the BUYSIM routine will not change when the price of the item is increased by five, ten, and fifteen per cent.

- H_{03-b} : The ranking of an item by the BUYSIM routine will not change when the handling cost of the item is increased by five, ten and fifteen per cent.

- H_{03-c} : The ranking of an item by the BUYSIM routine will not change when the price of the item is decreased by five, ten and fifteen per cent.

- H_{03-d} : The ranking of an item by the BUYSIM routine will not change when the handling cost of the item is decreased by five, ten, and fifteen per cent.

The hypotheses are tested by selecting an item in one of the product families and submitting twelve runs of the BUYSIM routine to the computer. Two product families, the canned ration type dog food family and the canned all meat family, have been selected for examination so that results could be obtained for more than one set of goods.

For each product family the item selected was that item given the median weighted summary ranking by BUYSIM. The median item was selected so that the ranking of the item when the data is changed could either increase or decrease. Table 4-8 indicates the set of experiments carried out to

test the sensitivity of the rankings to variations in the input data.

TABLE 4-8: Experiments performed as part of the sensitivity analysis

number	experiment
1)	Price increased 5%
2)	Price increased 10%
3)	Price increased 15%
4)	Handling cost increased 5%
5)	Handling cost increased 10%
6)	Handling cost increased 15%
7)	Price decreased 5%
8)	Price decreased 10%
9)	Price decreased 15%
10)	Handling cost decreased 5%
11)	Handling cost decreased 10%
12)	Handling cost decreased 15%

Evaluation of the hypotheses

Each of the hypotheses listed above is evaluated using the results of the computer simulation experiments. The first hypothesis is rejected if more than three items are assigned different ranks by each pair of criteria.

The second hypothesis is rejected if the space allocated to more than ten items changes significantly when the objective function is changed. Minor variations in the space allocated to an item should be ignored because the total space used by the department under each of the objectives may be different.

The subhypotheses under hypothesis three are evaluated as pairs - one pair relating to price variations and one pair relating to handling cost variations. The pairs of hypotheses

are rejected when the rank of an item changes according to three or more criteria for each ten per cent variation in price or handling cost.

Definitions

- 1) Computer model - A mathematical model or simulation which is specifically designed to utilize an electronic computer in the solution or operation of the model.
- 2) Decision Criteria - The factors evaluated in reaching a decision.
- 3) Direct Profit - The amount of money remaining after the cost of goods sold and the direct expenses have been subtracted from dollar sales.
- 4) Handling Costs - All costs associated with the physical movement of an item through the physical distribution system of a chain. Included are the warehouse costs, the cost of shelf space, and ringing-up and bagging the item.
- 5) Indirect Costs - All costs associated with the sale of an item which cannot be traced directly to the item. Such costs include the operating expenses of the central headquarters and the division headquarters.
- 6) Information Management - All activities related to selecting the kinds and amounts of information necessary at the several decision points within a firm and providing for the steps necessary to make the required information available.
- 7) Information System - An organized structure composed of data collection, transmission, and analysis devices and the personnel through which data is collected, analyzed, and turned into timely, relevant information for decision making.
- 8) Product Mix - The assortment of goods that is presented to the customers of a store.
- 9) Product Mix Decision - Any decision which relates to the content of the product mix. There are essentially two decisions which affect the content of the product mix of a store: 1) the decision to add a new item and 2) the decision to delete an item now stocked.
- 10) Quantitative Decision Criteria - Decision criteria for which quantitative or numerical decision rules can be developed.

- 11) Simulation - The description of a real world system or organism through the use of mathematical models of the actions of the components of the system and the interaction of the components. Generally, though not necessarily, such models are designed for operation on an electronic computer.
- 12) Subjective Decision Criteria - Decision criteria for which quantitative or numerical decision rules cannot be developed.
- 13) Supermarket - A complete, departmentalized food store with sales of over one million dollars per year and at least the dry grocery section completely self-service.
- 14) Supermarket Chain - A group of eleven or more supermarkets operating regionally under the same management.

Summary

The computer programs and the experiments described in the above paragraphs had two major purposes. The first purpose was to illustrate that simulation could be used effectively to study the operations of supermarket chains and that computer technology could be used in the everyday operations of a chain.

The second major purpose was to investigate and develop evidence concerning the effect of alternative decision criteria on the evaluation of items. The investigation included identification of the effect of the use of seven alternative decision criteria, the effect of the criteria on the amount of space optimally allocated to individual items, and preliminary evidence on the effect of item selection on the operating results of a chain. Also included was a set of experiments designed to test the sensitivity of item rankings to variations in the input data. The results of the experiments are presented in the following chapter.

CHAPTER V

FINDINGS

Introduction

The results of the experiments with the computer routines are discussed in the following paragraphs. The discussion is centered on the hypotheses presented earlier and presents the results obtained from each of the experiments. Tables are presented in the text and in the Appendix to facilitate the discussion.

Findings Relative to Hypothesis I

The first hypothesis

H_{01} : The ranking of each item in a set of items will not change when the criterion used for the ranking is changed.

was investigated through the use of the BUYSIM program. Each item in four product families was ranked according to seven criteria. The criteria used are listed in Table 4-5 and the rankings appear in Appendix G.

Examination of the item rankings presented in Appendix G shows that the rank of items does change when the criteria used for the evaluation are changed. One measure of the extent of the effect of the variation of the criteria on the ranking of items is the number of times each pair of criteria agree on the rank assigned to the items. While the measure does not consider the variation in rankings, but rather considers only the fact of agreement or non-agreement, the measure

does provide for some useful insight into the criteria. Table 5-1 presents data on the number of times each possible pair of criteria agreed on the ranking of all fifty-two items. For example, the first pair of criteria, movement and dollar sales, gave the same rank to thirteen of the fifty-two items.

TABLE 5-1: The 21 possible combinations of the seven decision criteria and the number of times each pair agreed on the rankings of the 52 items

number	pair	number of times
1)	Movement and Dollar Sales	13
2)	Movement and Gross Margin Per Cent	3
3)	Movement and Gross Margin Dollars	7
4)	Movement and Dollar Contribution	2
5)	Movement and Net Profit	1
6)	Movement and Summary	11
7)	Dollar Sales and Gross Margin Per Cent	0
8)	Dollar Sales and Gross Margin Dollars	9
9)	Dollar Sales and Dollar Contribution	2
10)	Dollar Sales and Net Profit	1
11)	Dollar Sales and Summary	6
12)	Gross Margin Per Cent and Gross Margin Dollars	7
13)	Gross Margin Per Cent and Dollar Contribution	6
14)	Gross Margin Per Cent and Net Profit	3
15)	Gross Margin Per Cent and Summary	3
16)	Gross Margin Dollars and Dollar Contribution	5
17)	Gross Margin Dollars and Net Profit	0
18)	Gross Margin Dollars and Summary	18
19)	Dollar Contribution and Net Profit	15
20)	Dollar Contribution and Summary	13
21)	Net Profit and Summary	2
Average Number of Agreements		6.05

The data presented in Table 5-1 show that the number of times a pair of criteria agreed on the ranking of the items is low. The highest number of agreements was eighteen as scored

by gross margin dollars and the summary with dollar contribution and net profit second with fifteen agreements. Two of the pairs, dollar sales with gross margin per cent and gross margin dollars with net profit, scored zero agreements. The average number of time a pair agreed on the rankings of items was 6.05 out of a possible score of fifty-two.

An overall estimate of the level of agreement among the criteria is provided by Kendall's coefficient of concordance.¹ The statistic

$$W = \frac{\text{observed variance of the rank sums}}{\text{maximum possible variance of the rank sums}}$$

was computed for each of the four product groups. The values of the statistic, and the average value, are presented in Table 5-2.

TABLE 5-2: Kendall's coefficient of concordance for four product families

product family	value of the statistic
Canned Ration	0.264735
All Meat	0.243776
Semi Moist	0.042100
Dry Meal	<u>0.106885</u>
Average	0.164374

The values of the Kendall statistic are not subject to a test of significance by comparison with table values as would be the case with a statistic such as Chi Square. However, some interpretation is possible. The statistic, by definition, can assume values between zero and one. If there is no agreement at all among the criteria the value of the

¹Wm. L. Hays, Statistics for Psychologists (New York: Holt, Rinehart and Winston, 1963) pp. 656-658

statistic would be zero and if the criteria agreed completely the value of the statistic would be one. The low values in the Table indicate, therefore, a low level of agreement or "concordance".

Although the agreement or non-agreement between pairs of criteria is interesting and useful, a better understanding of the alternative criteria requires analysis of the amount of variation in the rankings. To analyze the amount of variation in the rankings of the items by the various criteria a computer program was written to compute the sum of the absolute differences in the rankings of the items according to the alternative criteria. For example, the first item scored a rank of five according to movement and one according to gross dollar sales. The absolute difference in the ranks is four. The second item scored a nine according to movement and a nine according to gross dollar sales for an absolute difference of zero. The sum of the two absolute differences is then four. The absolute difference in the rank is computed for all items and for all pairs of criteria. The sum is computed by adding the absolute difference in the rank given each item by each pair of criteria. The results of the calculation of the sums of the absolute differences in the ranks of the items are presented in Table 5-3. The results can be used to identify the degree of similarity in the rankings of the items.

Similarity, for the present research, is defined in terms of the sum of the absolute difference in the rankings.

TABLE 5-3: The sum of the absolute difference in the rank given each item in a product family by each possible pair of decision criteria

pair number	description of pair	canned ration	all meat	semi- moist	dry meal	average of 4 product families
1)	Movement and Dollar Sales	28	10	28	75	35.25
2)	Movement and Gross Margin Per Cent	38	85	41	72	59.00
3)	Movement and Gross Margin Dollars	26	38	30	75	42.25
4)	Movement and Dollar Contribution	50	90	44	69	63.25
5)	Movement and Net Profit	62	98	58	69	71.75
6)	Movement and Summary	30	59	19	51	39.75
7)	Dollar Sales and Gross Margin Per Cent	52	81	37	87	64.25
8)	Dollar Sales and Gross Margin Dollars	24	36	18	40	29.50
9)	Dollar Sales and Dollar Contribution	44	88	62	86	70.00
10)	Dollar Sales and Net Profit	72	96	66	94	57.00
11)	Dollar Sales and Summary	34	57	23	78	48.00
12)	Gross Margin Per Cent and Gross Margin Dollars	28	51	29	53	40.25
13)	Gross Margin Per Cent and Dollar Contribution	26	27	39	41	33.25
14)	Gross Margin Per Cent and Net Profit	34	39	41	37	37.75
15)	Gross Margin Per Cent and Summary	20	34	32	31	29.25
16)	Gross Margin Dollars and Dollar Contribution	32	60	50	78	55.00
17)	Gross Margin Dollars and Net Profit	58	74	58	86	69.00
18)	Gross Margin Dollars and Summary	12	21	13	54	25.00
19)	Dollar Contribution and Net Profit	30	20	24	14	22.00
20)	Dollar Contribution and Summary	20	41	39	30	32.50
21)	Net Profit and Summary	46	59	53	44	50.50

The lower the sum the greater the similarity attributed to the pair of criteria. According to the data presented in Table 5-3 the pair of criteria showing the greatest similarity is "dollar contribution and net profit" with an average sum of absolute differences over the four product categories of 22.00. The pair of criteria showing the least similarity is "movement and net profit" with an average sum of absolute differences of 71.75. The results of the analysis of the sum of the absolute differences in rankings agree with the results of the analysis of the number of times each pair of criteria agreed on the ranking of items. In both cases dollar contribution and net profit are among the most similar and in both cases movement and net profit are among the least similar.

The findings show the effect of alternative criteria on the evaluation of an item. Further, the findings indicate the amount of similarity between pairs of criteria.

Findings Relative to Hypothesis II

The second technique employed in the research to identify the effect of alternative decision criteria is based on the concept that the selection of the decision criteria depends on the goals that management sets for a firm. The maximization feature of linear programming was used to test the effect of alternative management goals, on the allocation of shelf space to items.

The experiment was designed to provide evidence to test the hypothesis that:

H_{02} : The per cent of total available shelf space

allocated to individual items by a linear programming allocation routine will not vary when the objective function is changed from one to another of the following management goals:

- a) Maximize unit sales
- b) Maximize dollar sales
- c) Maximize gross margin per cent
- d) Maximize gross margin dollars
- e) Maximize dollar contribution

The results of the experiment are presented in Table 5-4.

In the Table the values which are underlined indicate values which are significantly different from the value in the preceding column. Thus, the values represent significant differences in the per cent of shelf space allocated to items as the basis of allocation was changed. For example, when the maximization goal was changed from unit sales to dollar sales the space allocated shifted only 0.05 per cent which is insignificant. However, when the maximization goal was changed from dollar sales to gross margin per cent the space allocated changed significantly from 1.42 per cent to 0.34 per cent.

Table 5-5 presents a summary of the changes indicating the pairs of criteria which produce significantly different shelf space allocations. As indicated in the Table, shifting from one to another of six pairs of maximization goals caused a significant change in the per cent of space allocated. However, for four of the pairs a shift from one to another produced no significant change in the per cent of shelf space allocated to the item.

TABLE 5-4: The per cent of shelf space allocated to items
by a linear programming allocation of shelf space
using five maximization objectives

item description	maximization objectives				
	Unit Sales	Dollar Sales	Gross Margin Per Cent	Gross Margin Dollars	Dollar Contribution
03041 KLRAT DG FOOD	0.52	0.54	0.51	0.53	0.52
03051 KLRAT STEW PK	1.37	1.42	0.34	0.35	0.35
03061 KLRAT DG FOOD	1.48	1.55	0.36	1.18	0.38
05031 VET DG FD LIVR	0.52	1.96	1.01	1.95	1.92
05041 VET DG FD CHKN	1.88	1.96	1.86	1.95	1.92
05051 VET DG FD 11b	0.52	0.54	1.86	0.53	0.52
05061 VET DG FD 1-10	1.48	1.55	0.36	1.54	1.51
07041 RIVAL DG FD	0.52	0.54	1.86	1.95	1.92
07051 RIVAL DG FD BEEF	1.48	1.55	1.47	1.54	1.51
08011 DASH DOG FOOD	2.20	2.29	2.17	2.28	2.24
11011 STREAK DG FOOD	0.52	0.54	0.51	0.53	1.92
12011 STRONGHEART DG FD	0.52	0.54	0.51	0.53	1.92
07012 RIVAL BURG + GVV	1.88	1.96	0.51	1.95	1.92
07022 RIVAL MXD GRILLE	1.88	1.96	0.51	1.95	1.92
07032 RIVAL CKN CROQ	1.88	1.96	0.51	1.95	0.52
09012 ALPO LAMB	1.88	1.96	1.86	1.95	1.92
09022 ALPO SCRAMBLE	1.88	1.96	1.86	1.95	1.92
09032 ALPO MTBL + GVV	1.88	0.54	1.86	0.53	1.92
09042 ALPO HORSMT DG FD	0.52	0.54	1.86	0.53	1.92
09052 ALPO LIVER DG FD	0.52	0.54	1.86	0.53	1.92
09062 ALPO CNK BF	0.52	0.54	1.86	0.53	0.52
09072 ALPO CHICKEN	0.52	0.54	1.86	0.53	1.92
09082 ALPO CHPD BF	1.88	1.92	0.51	1.95	0.52
10012 KAL KAN CHKN	1.88	1.96	1.86	1.95	1.92
10022 KAL KAN CNK BF	1.88	0.54	1.86	1.95	1.92
10032 KAL KAN STEW	1.88	1.96	1.86	0.53	0.52
02033 GAINES PRIME 2	2.99	3.13	2.96	3.10	1.69
02043 GAINES PRIME 4	5.39	3.13	2.96	3.10	3.06
02053 PRIME VARIETY	2.43	2.53	2.39	2.51	2.48
02063 GAINES BURG 72	2.78	2.90	2.75	2.88	2.84
02093 GAINES BURG 36	1.85	1.93	1.83	1.92	1.89
02103 G BURG LIVER	1.85	1.93	1.83	1.92	1.89
02113 G BURG CHKN	1.85	1.93	1.83	1.92	1.89
03013 KLRAT SPEC CUTS	2.79	2.91	2.76	2.90	0.82
03033 KLRAT BURG 36	3.68	3.80	3.59	3.76	3.72
03023 KLRAT BURG 72	2.57	2.68	2.54	2.65	2.61
06013 TOP CHOICE 36	3.14	3.27	3.10	3.75	3.20

TABLE 5-4: continued

item description	maximization objectives				
	Unit Sales	Dollar Sales	Gross Margin Per Cent	Gross Margin Dollars	Dollar Contribution
06023 TOP CHOICE 72	2.99	3.13	2.96	3.10	3.06
01014 PUR PUP CHOW	2.06	2.16	2.04	2.14	2.11
01024 PUR DOG CHOW 2	2.90	3.02	2.86	3.00	2.96
01034 PUR DOG CHOW 5	2.28	2.38	2.26	2.36	2.33
01044 PUR DOG CHOW 10	2.28	2.38	2.26	2.36	2.33
01054 PUR DOG CHOW 25	2.73	2.85	2.71	2.83	2.80
02014 GAINES DG BITS	1.48	1.55	1.47	1.54	1.51
02024 GAINES DOG BISC	1.48	1.55	1.47	1.54	1.51
02074 GAINES MEAL	1.82	1.90	1.80	1.89	1.86
02084 GAINES DOG FOOD	2.73	2.85	2.71	2.83	2.80
04014 GRAVY TRAIN 5	2.28	2.38	2.26	2.36	2.33
04024 GRAVY TRAIN 10	2.28	2.38	2.26	2.36	2.33
04034 GRAVY TRAIN 25	2.73	2.85	2.71	2.83	2.80
05014 VETS DG FD 5	2.28	2.38	2.26	2.36	2.33
05024 VETS DG FD 25	2.73	2.85	2.71	2.83	2.80

Note: Minor variations in the per cent of the shelf space allocated to an item by the various criteria should be ignored as they result from minor differences in the total space occupied by the department. The values in the Table are expressed as the per cent of linear shelf space available in the department.

Findings Relative to Hypothesis III

The results of the experiments conducted to test the third hypothesis

H₀₃: Sensitivity analysis will show that an item's ranking by the BUYSIM routine will not change when the item characteristics of price and handling cost are varied.

are presented in Table 5-6. The Table presents the rankings

TABLE 5-5: The alternative pairs of maximization objectives and whether or not each pair indicated significant changes in the space allocated to items*

	unit sales	gross dollar sales	gross margin per cent	gross margin dollars	dollar contribution
unit sales	X	NO	YES	NO	YES
gross dollar sales		X	YES	NO	YES
gross margin per cent			X	YES	NO
gross margin dollars				X	YES
dollar contribution					X

* "YES" indicates that the per cent of space allocated to items changed significantly when the maximization objective was changed from one to the other of the pair. "NO" indicates that the per cent of space allocated to items did not change when the maximization objective was changed.

of a selected item according to the seven criteria as the input coefficients are changed by five, ten and fifteen per cent.

The data presented in Table 5-6 indicates conflicting results. When the price of an item is altered by as little as five per cent the ranking of the item changes significantly. However, when the handling costs of the item are altered very little change in the ranking of the item results. Part of the explanation is that a change in the price affects all the other factors except movement. However, a change in the handling costs changes only the dollar contribution and the net profit. Even for dollar contribution and net profit, the ranking of the item was affected more by the variations in the price of the item than by variations in the handling cost.

TABLE 5-6: The ranking of a selected canned ration and all meat type dog food according to seven criteria when the input coefficients are varied

Per Cent of Original Price	movement	gross dollar sales		gross margin per cent		gross margin dollars per week		dollar contri- bution per week		net profit generated per week		weighted summary**
		1*	2*	1	2	1	2	1	2	1	2	
0.85	3	5	13	12	14	12	14	12	10	11	7	12 13
0.90	3	5	13	10	14	6	14	11	8	11	7	6 12
0.95	3	4	13	6	13	5	12	10	8	10	6	6 9
1.00	3	3	13	4	8	3	12	4	8	8	6	6 7
1.05	3	3	12	2	5	1	10	1	4	4	5	4 7
1.10	3	3	12	1	4	1	8	1	1	1	2	1 3
1.15	3	3	12	1	3	1	7	1	1	1	1	1 2
Per Cent of Original Handling Cost												
0.85	3	3	13	4	8	3	12	2	8	7	5	6 7
0.90	3	3	13	4	8	3	12	3	8	7	5	6 7
0.95	3	3	13	4	8	3	12	4	8	7	5	6 7
1.00	3	3	13	4	8	3	12	4	8	8	6	6 7
1.05	3	3	13	4	8	3	12	6	8	9	6	6 7
1.10	3	3	13	4	8	3	12	7	8	9	6	6 7
1.15	3	3	13	4	8	3	12	9	8	10	6	6 7

* The number 1 designates the data for canned ration dog food and the number 2 designates the data for all meat dog food.

**The Weighted Summary is calculated by subtracting the rank of each item according to each criterion from the number of items plus one and summing across all the first six criteria. The values thus obtained are ranked from high to low.

Other Results

An additional set of experiments was conducted to further illustrate the effect of alternative criteria on item evaluation and to project the effect to the operating results of the chain. Using the results of the rankings of the items in each of the four product categories seven different dog food departments were developed. The top seventy-five per cent of the items in each of the four product categories as determined from the rankings according to the seven criteria were selected as the items to constitute the departments. The departments thus developed were submitted as input data to analysis by the CHAINSIM program.

The seven runs of the CHAINSIM program provided the results presented in Table 5-7. The Table presents the operating results obtained during the last of thirteen periods of simulated activity. The results show the effect of alternative decision criteria on the operating results of a chain.

Figure 5-1 is an example of the operating statement generated by CHAINSIM. The operating statement presented is for the department selected using movement as the decision criterion. The results are the same for both periods because the model has settled down to the point where the variables have stabilized. Further, the results are based on one thousand customers per day shopping in the stores of the chain. Therefore, the set of random numbers generated becomes quite uniform and the distribution of products purchased by the customers is nearly constant.

TABLE 5-7: Operating statements for Period 13 of thirteen periods of simulated activity for departments selected according to seven decision criteria*

	criteria						
	movement	gross dollar sales	gross margin per cent	gross margin dollars	dollar contribution	net profit	weighted summary
GROSS SALES	4058.72	4507.65	4136.16	4478.56	3392.32	3357.56	4051.68
COST OF GOODS SOLD	3664.80	4116.64	3706.72	4027.20	3008.80	2970.24	3681.12
GROSS MARGIN	393.92	391.01	429.44	451.36	383.52	387.52	370.56
HANDLING COSTS	565.84	760.32	670.88	754.88	447.60	422.24	623.12
DIRECT CONTRIBUTION TO OVERHEAD AND PROFIT	-171.92	-369.31	-241.44	-303.52	-64.08	-34.72	-252.56
ALLOCATED INDIRECT EXPENSES	405.87	450.77	413.62	447.86	339.23	335.78	405.17
NET PROFIT BEFORE TAXES	-577.79	-820.08	-655.06	-751.38	-403.31	-370.50	-657.73

* Note: The negative net profits are a function of the exceptionally low price level in the Detroit market. However, the fact that handling costs and indirect expenses constitute a major part of the sales dollar is not limited to the Detroit market.

FIGURE 5-1: An example of the operating statement generated by CHAINSIM

PERIOD OPERATING STATEMENT BY CATEGORY
 PERIOD 13 YEAR 1
 PET FOOD

LAST PERIOD

SALES	4058.72	4058.72
COST OF GOODS SOLD	3664.80	3664.80
GROSS MARGIN	393.92	393.92
EXPENSES		
HANDLING COSTS	565.84	565.84
DIRECT PROFIT CONTRIBUTION,	-171.92	-171.92
OTHER EXPENSES		
ADMINISTRATIVE EXPENSE	89.29	89.29
RENT AND REAL ESTATE	73.06	73.06
ADVERTISING AND PROMOTION	44.65	44.65
OVERHEAD	198.88	198.88
TOTAL OTHER EXPENSES	405.87	405.87
NET PROFIT BEFORE TAXES	-577.79	-577.79

Summary

Chapter Five has presented and briefly discussed the results of the experiments conducted using the simulation programs. The first experiment used the BUYSIM program to rank pet food items according to seven alternative criteria. The rankings and the analysis of the rankings indicate that the alternative criteria do have a significant effect on the evaluation or ranking of an item.

The results of the rankings of the items were then submitted as input to the CHAINSIM routine to determine the effect of the different rankings resulting from the use of the various criteria on the operating results of the chain. Again, the results varied indicating that different criteria which result in the selection of different items will cause variation in the profit accruing to the chain.

Based on the concept that the goals of management and the decision criteria employed by a chain are interrelated, the affect of alternative management goals on shelf space allocation was investigated. The results showed clearly that management goals, and therefore the decision criteria used, do affect the emphasis placed on various items.

The final set of experiments was designed to evaluate the sensitivity of the ranking of an item to variation in the price and handling cost of the item. The results showed that the ranking of an item was extremely sensitive to variations in the price. However, minor variations in the handling cost of the item had little or no effect.

The conclusions and implications of the results presented above are discussed in Chapter Six. In addition, suggestions for further research, based on the present project, are presented.

CHAPTER VI

CONCLUSIONS AND IMPLICATIONS

Introduction

The final chapter of the dissertation is subdivided into three sections. The first section presents the conclusions on the hypotheses that result from the findings presented in Chapter Five. The second section of the Chapter discusses the implications of the research. The particular elements of the product mix decision are discussed at length. The last section of the Chapter presents some suggestions for further research based on the present project.

Conclusions Relative to Hypotheses

The first hypothesis was:

H_{01} : The ranking of each item in a set of items will not change when the criterion used for the ranking is changed.

The results of the ranking of the items in four product families presented in Appendix G and the data presented in Table 5-1 provide sufficient evidence to reject the hypothesis. As indicated in Table 5-1, the highest number of items ranked the same by any pair of criteria was eighteen. Thus, thirty-four items were given different ranks by the pair of criteria which showed the highest level of agreement. The criteria established for the rejection of the hypothesis was that if more than three items were assigned different ranks by each

pair of criteria the hypothesis would be rejected. Since the fewest number of differences was thirty-four the hypothesis is rejected and the alternative hypothesis

H_{A1} : The ranking of each item in a set of items will, in general, change when the criterion used for the ranking is changed

is accepted.

The results of the allocation of available shelf space using the SPACALLO linear programming routine were used to test the hypothesis that

H_{02} : The per cent of total available shelf space allocated to individual items by a linear program allocation routine will not vary when the objective function is changed from one to another of the following criteria:

- a) Maximize unit sales
- b) Maximize dollar sales
- c) Maximize gross margin per cent
- d) Maximize gross margin dollars
- e) Maximize dollar contribution.

The data used to test the hypothesis are presented in Table 5-5 and summarized in Table 5-6. The hypothesis is rejected when the ranking of more than ten items changed significantly from one criterion to another. Table 6-1 lists the possible pairs of criteria and indicates whether or not the hypothesis can be rejected for the pair. As indicated in Table 6-1 the hypothesis can be rejected for six pairs of criteria but is accepted for four pairs of criteria. The conclusion is then, that some pairs of criteria give similar rankings to items while other pairs of criteria give different rankings to items.

TABLE 6-1: Summary of the results of the tests of Hypothesis II: The pairs of maximization goals and acceptance or rejection of the hypothesis.

pair number	description of pair	acceptance or rejection
1	Unit sales and dollar sales	Accept
2	Unit sales and gross margin per cent	Reject
3	Unit sales and gross margin dollars	Accept
4	Unit sales and dollar contribution	Reject
5	Dollar sales and gross margin per cent	Reject
6	Dollar sales and gross margin dollars	Accept
7	Dollar sales and dollar contribution	Reject
8	Gross margin per cent and gross margin dollars	Reject
9	Gross margin per cent and dollar contribution	Accept
10	Gross margin dollars and dollar contribution	Reject

The third hypothesis was subdivided into four sub-hypotheses. The four are:

- H_{03-a} : The ranking of an item by the BUYSIM routine will not change when the price of the item is increased by five, ten, and fifteen per cent.
- H_{03-b} : The ranking of an item by the BUYSIM routine will not change when the handling costs of the item are increased by five, ten, and fifteen per cent.
- H_{03-c} : The ranking of an item by the BUYSIM routine will not change when the price of the items is decreased by five, ten, and fifteen per cent.
- H_{03-d} : The ranking of an item by the BUYSIM routine will not change when the handling costs of the item are decreased by five, ten, and fifteen per cent.

The data presented in Table 5-7 was used to test the sub-hypotheses. Based on the criteria established in Chapter

Four, the two subhypotheses related to variations in the price of an item are rejected. However, the two subhypotheses related to variations in the handling costs are accepted.

General Conclusions

In addition to the specific conclusions regarding the hypotheses presented above, several general conclusions may be drawn from the present research. The present research has focused on the evaluation of the alternative criteria for product addition and deletion decisions. The project has investigated the decision process in the literature, the industry, and through experiments with computer simulations. Based on the investigation conclusions can be drawn on the sources of the information, the location of the decision, and the criteria to be used.

The most useful source of product mix decision information are the records of the chain. In particular, detailed records of the sales, costs, and profits associated with the sale of each item provide the best basis for item decisions. For new items the records of the chain can be used to provide data on comparable items. For the new item, the source of the information must be the new item form completed by the manufacturer. The new item form is presently used but can be improved by providing more specific detailed information on the promotional programs of the manufacturer.

The research has identified three possible locations of the product decision within the structure of the firm; namely 1) the buyer only, 2) all decisions made by the buying

committee, and 3) a combination of the buyer and the buying committee making the decision. When the three alternative formats are evaluated according to the criteria of efficiency and control, the third format, a combination of the buyer and the buying committee, appears to be the most useful.

The alternative criteria available to the chain for product mix decisions fall into two categories - quantitative and qualitative or subjective. The most appropriate quantitative decision criteria appears to be the net profit per unit time generated by the item, assuming that the goal of the firm is the maximization of net profit. The second most useful criteria appears to be the direct dollar contribution of the item to the chain. The subjective criteria used are "newness" for new items and the role of the item in the mix of items carried by the chain for other items. Both of the subjective criteria lack research support for their use but appear to be highly thought of by supermarket executives. The use of such criteria can only be for items that would be rejected using the quantitative criteria and even then should be done with care.

A final general conclusion is that supermarket chain management could make a great deal more use of computer technology in the decision process. The present research has suggested the use of a computer to perform the item evaluation tasks generally performed by the buyers and the buying committee. Once the computer has made the evaluation the buyer and/or the buying committee could use the evaluations to make the product decision. By removing the computation from the hands

of the buyer, such a system would reduce the subjectivity in the evaluation and also provide more time for creative management.

Major Conclusions

The most important conclusion of the present research is that the item addition and deletion decisions of supermarket chains are often hastily made using inappropriate, incomplete, and sometimes inaccurate information. The decisions regarding the mix of items carried by the chain are among the most important decisions a chain makes. Yet the decisions are often made in two or three minutes and at least one buyer has said that, "On practically all products I can decide which way I feel within 30 seconds..."¹ The results of the present research have shown that the criteria used by chains may not lead to the greatest profit for the chain. The research has further shown why and how additional information can be used.

The overall decision process is illustrated in Figure 6-1. In the Figure the inputs to the decision process, the criteria used, and the bases for performance evaluation are presented.

The sections following Figure 6-1 present detailed conclusions concerning the elements of the decision process based on the present research, the literature, and industry data.

¹A comment of a buyer for a large chain as reported in Neil H. Borden, Jr., Acceptance of New Food Products by Supermarkets (Boston: Division of Research, Harvard Business School, 1968) p. 204

FIGURE 6-1: A supermarket chain item decision process

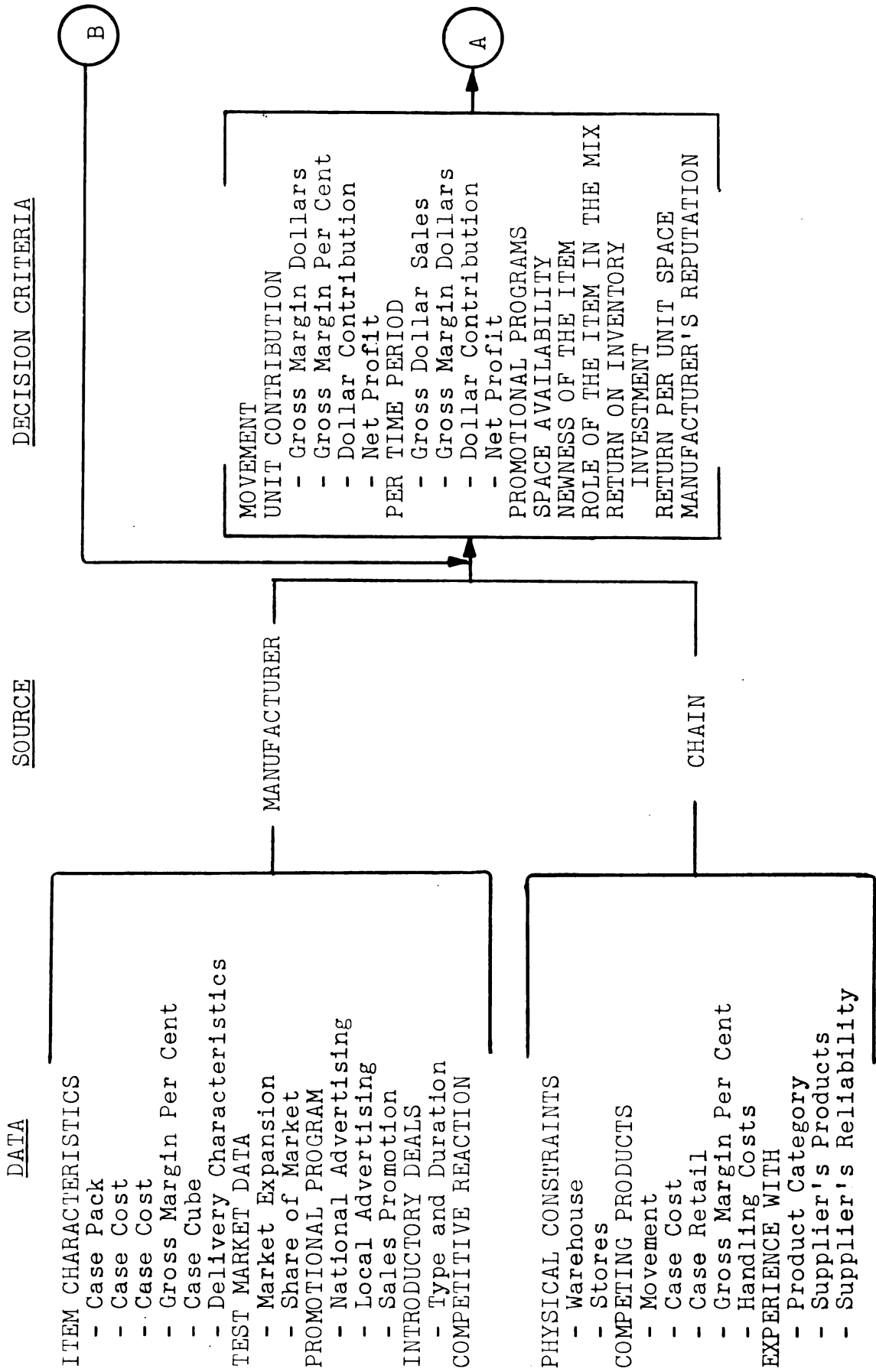
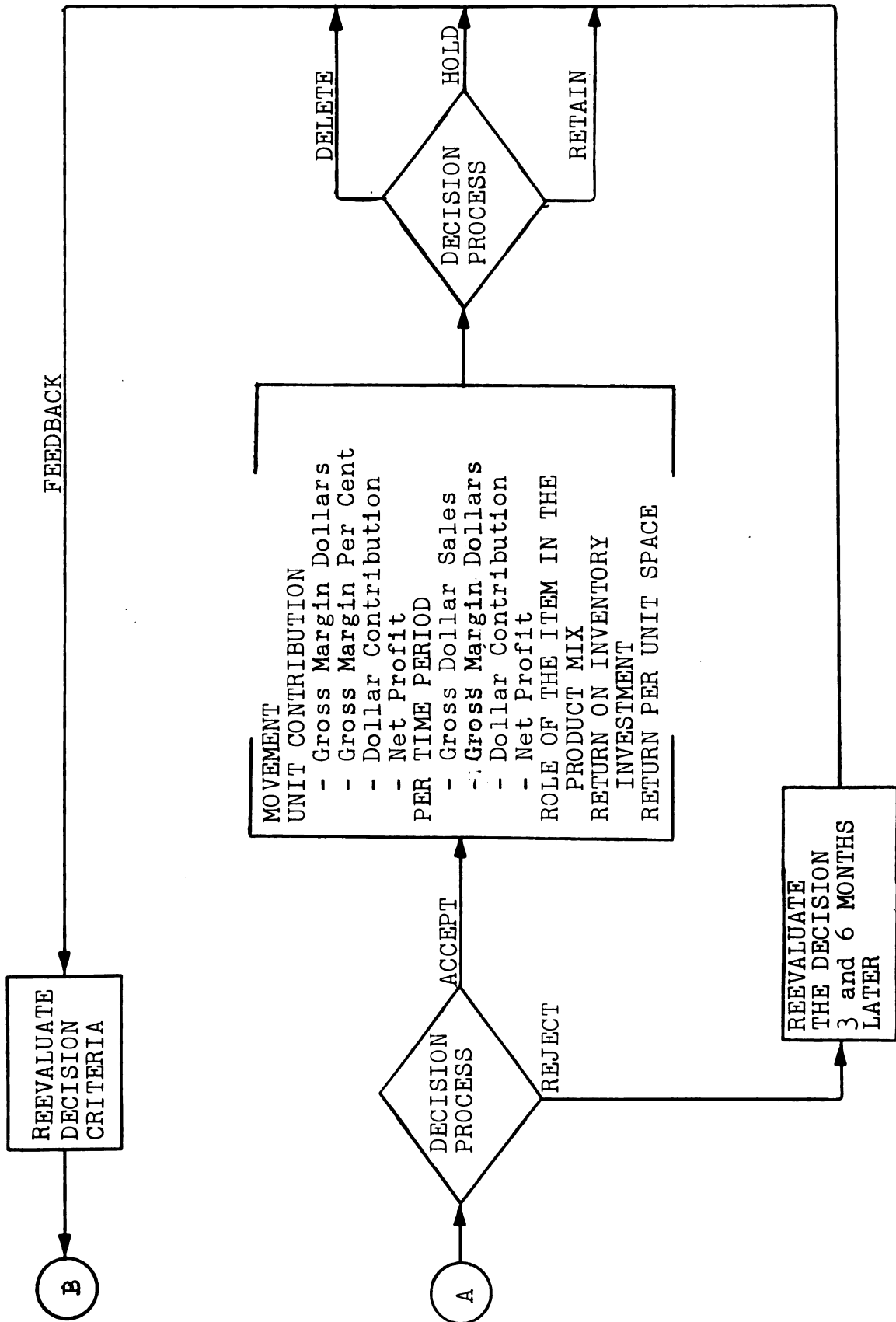


FIGURE 6-1: continued



Elements of the Product Mix Decision

Types of information required

The specific items of information required for decision making in a chain depends on the criteria employed in the decision process. Whether the item is a new item or one currently stocked is also important in determining the information needed. Table 6-2 is a summary of the data needed for the evaluation of items using the criteria now employed by chains.

TABLE 6-2: The data needed for product mix decisions

new items	items currently stocked
Movement of comparable items*	Unit cost of the item
Test market data on the item*	Unit retail price of the item
Data on the introductory program of the supplier*	Unit sales of the item by day or week
Data on the national advertising program of the supplier*	Unit handling cost of the item
Data on the local advertising program of the supplier*	Unit overhead expenses of the item
Data on the reactions of our competitors to the item*	
Unit cost of the item	
Unit retail price of the item	
Unit handling cost of the item	
Unit overhead expenses of the item	

* These data are required to provide an estimate of the rate of unit sales of the new item. It is possible to estimate unit sales even though a chain does not have all of these data, but the more accurate data available the more accurate will be the estimate of the movement of the new item.

The quality of the data indicated above could be improved considerably. Test market data should be documented, perhaps by a cooperative agency developed by the chains. Further, test market data should be translated into a chains local marketing area. For example, data on a test market conducted in

Syracuse, New York must be translated to the Los Angeles area before the results of the test market would be meaningful to a chain operating in the Los Angeles area.

Another area in which the quality of the information could be improved is the data on the promotional programs of the suppliers. At present the data is presented in the form of schedules of advertisements in newspapers and magazines and the schedules and number of shows or spots on television and radio. While interesting, such information is not really useful. The important facts about an advertising campaign are not the individual parts that make-up the campaign but rather the total impact of the campaign. Such data as the range, frequency, and gross rating points of the campaign would be much more valuable than the fact that the supplier was going to run a series of nine advertisements in four consumer magazines.

Sources of the information required

The data on the movement of the comparable items can be extracted from the records of the chain after the buyer has decided which items will compete with the new item to be evaluated. The data on the handling costs and the indirect or overhead expenses should be available from a table that has been previously developed by the chain. For each type of item or each set of item characteristics a chain should develop standard overhead costs. Such costs would then be available when a new item was being evaluated.

All the data needed for the evaluation of items now stocked by the chain are available from the records of the chain. The data other than the handling costs and the estimated indirect expenses would be available from the buyers' cards. The data on handling costs and the indirect expenses should be available from the tables mentioned above.

The structure of the decision process

As presented in Chapter III of the dissertation, chains follow one of three alternative formats for the decision process. The three formats are:

- 1) The buyer makes all product addition and deletion decisions.
- 2) The buyer evaluates the items but makes no decision. Rather, all decisions are made by a buying committee.
- 3) The buyer evaluates all items and makes a decision to reject all items clearly unacceptable to the chain. All acceptance and deletion decisions are made by the buying committee.

Based on the material in Chapter III the conclusion of the present research is that the third format would be best for most chains. The selection is based on the results of the evaluation of the control and efficiency of the decision process under the three formats.

A buyer makes all decisions

The first format is quite efficient since only one person is involved in the decision process. Further, the format provides for a high degree of flexibility and the decision maker has the ability to respond quickly when necessary. However, there is little provision for control in the decision

process. The experience and ability of only one person, the buyer, is brought to bear on the decision. No matter how good the buyer is, more experience and ability can be brought to bear on the decision by a committee. Further, a single person is more likely to be affected by emotional reactions to a product and/or a salesman and less likely to make rational decisions than is a group of experienced supermarket personnel.

A committee makes all the decisions

The second format, where all item decisions are made by a committee, sacrifices efficiency for what could be a great deal more control. Unfortunately, the control aspect is often missing and the procedure introduces delay into the decision process.

The lack of efficiency stems from the fact that all items must be reviewed by the committee. There are a number of items offered to a chain that could be rejected by the buyer using a preset group of decision rules. Screening out such items before presentation to the buying committee would greatly reduce the number of decisions that the committee has to make.

If the process of evaluation and decision on all items by the committee resulted in a very high degree of control or on extremely good decisions, the lack of efficiency could be justified. Unfortunately, the quality of the decisions may, in some instances, be decreased by the requirement that all items must be reviewed by the committee. The number of new items and items suggested for deletion and must be evaluated each week by a chain is large. Since the buying committee is

in session for only a limited amount of time each week, the amount of time spend on each decision is partially a function of the number of items to be evaluated. If the number of decisions were reduced, each decision could receive more time.

A combination decision process

The third decision format provides for efficiency by having the buyer screen out such items as are clearly unacceptable to the chain. The buyer only presents to the committee those items he feels are acceptable or about which he is in doubt. The committee then decides the fate of the items.

Both the control and the efficiency of the third format can be improved through the use of an item evaluation sheet which would be duplicated and distributed to all members of the committee prior to the meeting of the committee. Such a sheet would force the buyer to collect all relevant data and summarize his position which would saved meeting time.

The sheet would contain a record of all items evaluated by the buyer, the information used in the evaluation, and the results of the evaluation. For those items rejected, the buyer would present his reasons. If the other members of the committee disagreed with the buyer or for some other reason wanted the item discussed at the meeting, that item could be presented at the meeting.

For those items not rejected by the buyer, the other members of the committee could study the data presented and formulate the questions or points to be discussed at the

meeting. Not only would such a procedure result in more efficient use of meeting time, but more importantly, the items discussed would receive a closer scrutiny.

The use of a pre-meeting fact sheet on items to be discussed will be of value only if all members of the committee seriously consider the information on the sheet prior to the meeting. Unfortunately, in some chains where such an information sheet is now used, the members of the committee do not always examine the sheet prior to the meeting. In such cases not only is any possible benefit of the sheet lost, but the cost involved in reproducing and distributing the sheet is wasted.

Objective criteria for product mix decisions

There are three distinct sets of criteria for product mix decisions that are often used by chain management. The first set consists of individual pieces of information which can be used to evaluate items. Included in the set are:

- 1) Movement (For new items the value would be an estimate of movement based on the movement of comparable items, the introductory programs of the supplier, and the promotional programs which will support the items.)
- 2) Dollar sales per period of time
- 3) Unit gross margin dollars
- 5) Gross margin dollars generated per unit time
- 6) Direct dollar contribution per unit time
- 7) Unit dollar contribution
- 8) Net profit dollars generated per unit time
- 9) Unit net profit dollars

Without knowledge of the objective of management, a statement of the best decision criteria is impossible. Under the assumption that the objective of the chain is the maximization of net profit, the best criterion is item net profit per unit time. Net profit is calculated by subtracting the direct expenses of carrying an item and a share of the indirect expenses allocated to the item on some basis selected by management from the gross margin dollars generated by the item. Since chains must select among alternative items to decide in which to invest limited shelf space and capital, the selection of items using net profit will maximize the net profit of the chain. Were a chain to have an objective other than maximum net profit, the decision criteria would have to be modified so as to agree with the objective.

A few general statements regarding decision criteria are possible however. First, any criteria used should provide for a measure of both rate of sale and return to the chain. Unless a chain has as its objective to establish and maintain the highest rate of unit sales possible, the criterion of movement would not be appropriate. Movement, in and of itself, does not give any indication of the value of an item to a chain.

Similarly, a measure of per unit return of an item tells very little about the actual value of an item to a chain. Without some indication of the rate of sales of an item the total return to the chain is not available. Thus, any criterion which presents only a measure of the rate of

sales or the per unit profit cannot be an effective criterion for product mix decision making.

Measures of performance as criteria

The second set of criteria available to supermarket chain managers consists of a group of measures of performance. Measures of performance are essentially indices or ratios developed from the operating results of the chain. The measures of performance that have been suggested for item evaluation are:

- 1) Return on assets employed
- 2) Return on inventory investment
- 3) Stock turnover
- 4) Direct product profit per unit space
- 5) Net profit per unit space

The first two measures of performance are attempts to apply standard return on investment criteria to item evaluation. The four indicators of return which would be appropriate are:

- 1) Gross dollar sales
- 2) Gross margin dollars generated
- 3) Direct profit dollars generated
- 4) Net profit generated

The selection of the indicator of return to be used by a chain depends on the objectives of the chain. If the objective is the maximization of net profit, then the return which should be used is net profit.

The major problem with the use of return on assets employed or inventory investment is that an accurate measure of assets employed or inventory investment is difficult to develop. For most situations the most appropriate measure of assets employed would be the cost of the store level

facilities devoted to the item. The cost of the assets employed then becomes the same as the space cost of the item and the measure becomes equivalent to number 5 - net profit per unit space.

The use of return on inventory investment as a measure of the performance has an additional drawback. That is, the indicated level of performance depends not only on the level of performance of the item but also on the level of performance of the chain with respect to inventory control. Thus, were a chain to use return on inventory investment to evaluate items the level of inventory investment used should be either a minimum level of inventory required to support adequately the item or a "standard" level of inventory based on the rate of sale of the item. The use of either of the two suggested indicators of inventory investment would remove the performance of the chain's inventory control system from the measure of performance. Thus, the measure would more accurately measure the level of performance of the item.

Stock turnover is a very useful measure of performance for the inventory control system but is not appropriate for measuring the level of performance of an item. The components of stock turnover are the movement of the item and the average level of inventory. As pointed out above, movement, without a measure of the per unit profit of an item, is not a good criterion. Further, the average level of inventory is not a good measure of the performance of an item since the inventory level is dependent on the inventory control system not the item's performance.

Direct product profit per unit space and net profit per unit space are the two most useful measures of performance. Both direct product profit and net profit are based on the rate of sales of the item and a measure of the return to the chain. Further, since one of the major constraints on the operations of a chain is the fixed amount of store space available, the use of space in the evaluation of items is quite appropriate.

The major weakness of measures of performance for item evaluation is that such measures are relative rather than absolute measures. The measures or ratios developed are meaningful only when compared with similar measures for other items. Thus, measures of performance are useful for comparing items but are not appropriate for evaluating individual items.

Newness as a criterion for product mix decisions

In addition to the quantitative criteria discussed above, chains often employ two highly subjective criteria in product mix decisions. The first subjective criterion deals with the concept of the "newness" of the item and is used in the evaluation of new item offers. The use of the criterion is based on the assumption that chains must present an image of being modern and up-to-date to consumers. Thus, an item which was the first of its kind on the market would probably be accepted by many chains, particularly if the item were being supported by a high level of consumer promotion.

It would seem that if a chain has as its objective maximization of profits, all items, including new items,

should be evaluated by the same criteria. New items do occupy shelf space that could be used by other items and thus incur the same costs for shelf space. In addition, the new item will incur other costs related to adding the item to the product line of the chain. Thus, rather than a lower level of net profit, new items probably should be responsible for a higher level of profit.

The role of an item in the mix of products carried by the chain as a criterion

The second important subjective criteria used by chains is the role of an item in the total mix of items stocked by the stores of the chain. The basis for the use of the criterion is the assumption that if a customer is not satisfied by the mix of items carried by a chain she will switch to another store. A chain would, therefore, lose the profit of the customer on all items she might purchase. Chains use the above assumption as justification for adding otherwise unacceptable items.

Unfortunately, there is little or no research evidence to support or disprove the assumption that a consumer will switch stores if her present store does not carry an item she desires. If a consumer would not switch simply because an item she desired was not available there would seem to be little justification for adding an unprofitable item, even if the item were the only one of its kind.

Cost and profit allocation problems and procedures

One of the most difficult problems connected with the evaluation of items for product mix decisions is the effect

of stocking one item on the sale and resulting profit of other items stocked by the store. The problem is closely related to the decision to stock an item to enhance the attractiveness of the store to consumers. As indicated above, many chains stock items which are deemed necessary to present a broad range of items to consumers. Further, some very slow moving items are stocked because there is a very low level but consistent demand for the items. When evaluating the profit of such items it is necessary to consider not only the profit generated by the item, but also the profit generated by other items sold to the consumers who purchase the slow moving items.

One approach to the determination of the indirect profit generated by an item would be to develop a measure of the total profit of the "market basket" of items purchased by consumers who purchase each item. The total profit could then be multiplied by the probability that the consumer would switch stores if the item she desired was not available. The result would be the profit lost from not stocking the item. The profit gained by stocking the item would be the total profit of the "market basket" of goods purchased less the profit generated if the item were not stocked. Included in the measure must be some provision for the fact that some consumers would accept a substitute item rather than switch stores.

The development of item handling costs

There are two difficult problems associated with the development of the direct product profit per item and the net

profit per item. The first of the problems is the development of the handling costs of items. McKinsey and Company have demonstrated that it is feasible to develop the direct costs associated with stocking an item. The development of handling costs is neither simple nor inexpensive. The most accurate approach to the problem is through the use of engineering studies conducted by industrial engineers. Through the use of data compiled by time and motion studies, industrial engineers can develop accurate measures of the cost of handling individual items. The use of the engineering study approach is quite expensive. However, the results of the research presented in the dissertation indicate that extreme accuracy in handling costs is not necessary for effective evaluation of items. Therefore, less expensive estimating procedures can be used to develop estimates of the handling costs of individual items.

A second factor which serves to reduce the problem is that the handling costs of many items will be the same. The problem is to identify the factors which cause the handling costs of items to be different.² Once the factors have been identified, the costs of groups of items can be developed. Among the factors which should be considered are:

- 1) Case pack
- 2) Type of container

²For a discussion of the approach see: Frank H. Mossman, Distribution Cost and Revenue Analysis: A new Approach, Bureau of Business and Economic Research, College of Business and Public Service, Michigan State University, East Lansing, Michigan, 1962.

- 3) Size of container
- 4) Cubic space occupied by one unit
- 5) Rate of unit sales of the item

For example, the handling costs of most canned soup would be the same since the case pack, size of container, and other factors are the same. Thus, handling costs need to be developed for only one type of soup.

The development of indirect expenses

The development of net profit on items requires an estimate of the indirect expenses that should be charged to each item. The estimate can be developed by allocating the total indirect expenses of the chain to each item carried. There are several bases of allocation available to a chain including:

- 1) Per cent of unit sales
- 2) Per cent of dollar sales
- 3) Per cent of available space occupied by the item

Little or no research evidence is available to aid in selecting the allocation factor. However, the most suitable basis of allocation appears to be per cent of available space. An important factor in the cost of selling an item is the cost of the space occupied by the item. Thus, the space occupied by the item appears to be quite appropriate.

A second basis that would seem appropriate is the per cent of unit sales. The number of units of a particular item that must be handled has a significant effect on the cost of the item. Further, the per cent of units sold would be much easier to develop and use than the per cent of shelf space occupied by the item. Therefore, unless research should show

that the per cent space is a much better basis of allocation than the per cent of unit sales, per cent of unit sales could be used.

Implications

The general implication of the above conclusions is that in order to improve their profit position chains can and must reevaluate the product mix decision procedure used. Not only must the decision process itself be studied, but the criteria used and the information available to the decision maker must be evaluated. The following paragraphs discuss the elements of the product mix decision process and indicate the implications of the present research on the various elements.

Elements of the Product Mix Decision

Type and source of information required

The present research has concluded that the decision criteria used by chains often do not lead to the most profitable selection of items. A prerequisite to the application of improved decision criteria is the availability of improved information. Improvements should be made in both the external and internal information a chain has available.

The external information

One of the areas in which chains should improve the external information used is the information provided on new items. Specific detailed information should be demanded on the range, frequency, and gross rating points of national and

local advertising. The market expansion and share of market data resulting from test markets should be translated into the local market area of a chain. Further, chains should, on a cooperative basis, set up an agency to document test market results.

Chains should also become familiar with other types of external data. In particular, chains should have available data on the trends in consumers' purchasing patterns, incomes, and population shifts in age distribution and location. Such information would be most useful if broken into racial, religious, ethnic and socio-economic groupings.

The above information is available from several sources. The United States government, through the census and other studies, develops a great deal of information. Further, chains should make more use of the several trade associations, universities, and independent research groups which publish the results of research. For example, Sales Management's Survey of Buying Power contains detailed information on the expenditure patterns of the American consumer.

Internal information

In order to provide better internal information for product mix decisions chains should examine the nature and flows of information within the structure of the firm. Chains should first strengthen and improve the existing information. For example, warehouse shipment data should, as soon as feasible, be replaced with sales data generated at store level. Store level data would be more accurate for shorter periods of

time, such as a week. Further, the evaluation of such activities as special promotions, end-aisle displays, and advertising would be improved.

While the hardware to provide such data is available, it is expensive. Therefore, it may be some time before store level collection of sales data is a reality. During the interim, chains should have warehouse shipment data by item on a weekly basis for store groups. The stores of a chain should be grouped so that stores serving similar racial, religious, ethnic and social groups are identified and may be treated as a group.

Another type of internal information that should be developed by chains relates to the development of measures of profit. The research has shown that the criterion of gross margin does not necessarily lead to maximum profits. The indication of the research is that dollar contribution and/or net profit are better criteria. To calculate dollar contribution chains need data on the direct expenses (handling costs) of items. Chains should develop tables of the handling costs of items. The most promising approach to the task is the development of costs according to item characteristics such as case pack, weight, cub, item size, type of package, shape of package, value of the item, and the rate of sales. The information can be developed through engineering studies, but the research has shown that estimating procedures can be used wherever possible.

To develop net profit chains must also have data on the amount of indirect expenses that should be charged to an

item. Using the same item characteristics as for direct expenses, chains should develop tables of the indirect expenses that should be charged to items. The most important problem in developing such a table is the decision regarding the basis of allocation regarding the proper allocation of expenses to items. Chains should evaluate the alternative bases of allocation available and select the basis most appropriate for their chain.

In addition to the above information chains can use data processing to develop useful information for decision making. The application of data processing to product mix decision making are discussed later.

The structure of the product mix decision

Chains should reevaluate the structure of the decision process within the chain organization. Two criteria should be used in the evaluation. The first, control, while closely related to the criteria used, is also affected by the structure of the decision process. The aspect of control deals with:

- 1) The ability of the process to screen out new items that should not be stocked.
- 2) The ability of the process to provide for the addition of those new items that should be stocked.
- 3) The ability of the process to identify and delete those items that should be deleted from the list of items now carried by the chain.

The second criteria is efficiency. There are two factors which should be considered; 1) the ability to react and make decisions when necessary and 2) the cost of the process in terms of both dollars expended and man-hours required.

The decision structure should be able to provide for the accurate evaluation of items, reacting as fast as necessary with as little cost and manpower expended as possible. The research concluded that a combination of the buyer making reject - non-reject decisions and the buying committee making reject - accept decisions would be appropriate for most chains. However, each chain will have to consider its own situation, including the experience of the personnel available, to determine the structure most appropriate for its particular situation.

The criteria used for the product mix decision

There is little question that one of the most important factors in the product mix decision is the set of criteria used for the decision. The present research has shown that the various criteria available to chains result in the selection of different sets of items. The rate of introduction of new items continues to increase so chains will have to make more and more decisions. Thus, the criteria used by the chain will become even more important.

Chains must continually evaluate and reevaluate the criteria used for product mix decisions. As the squeeze on shelf space increases and as the expenses of the chains increase, the pressure on profits will increase. To guard its profit position, a chain will have to make better decisions regarding which items to stock. Further, the selection of items to promote either actively through advertising or passively through increased shelf space, will become more important.

Chains should evaluate the criteria used for both the selection of new items and the deletion of current items should be examined. In addition, chains should also examine the criteria used for the selection of items to promote. The evaluation of the criteria should be based on the goals and objectives of the chain. Once the goals have been specified, the chains are in a position to select the criteria that will best lead to the attainment of the goals.

The Application of Computers to the Decision Process

Simulation

One of the most important application of computers is based on the ability of researchers to develop models of supermarket chain operations and utilize electronic computers to simulate the activities of the chain. Such simulations have a wide variety of uses. One important use is research into the various factors surrounding the product mix decision. For example, such simulations can be used effectively to test the alternative results of the selection of items using various decision criteria. The simulation can also be used to project the effect of various promotions on the sales and profits of the chain.

Simulation can also be used in routine product decision making. For example, in the evaluation of alternative items, a simulation can be used to evaluate the strength of alternative product mixes. By simulating the results of using various possible mixes of items chains can better evaluate alternative configurations of the mix of products offered to

the consumer.

One step beyond the simulation of the product evaluation process is the simulation of the total product mix decision process. While the identification of the proper decision rules for such a simulation is difficult, the problem can be solved by modeling the decision process used by the chain. Howard and Morgenroth have described the development of such a model of the executive decision process.³ Rather than attempt to develop ideal decision rules, such a model programs the logic of the decision as now accomplished by the decision maker. The model, when built, can be tested by comparing the output of the decision model with the actual decisions made by the executives. Experimentation with the model can then provide for insights into the decision process, the effect of variations in the decision process and could be used to make the actual decisions for the chain.

Routine and Exception Reporting

One of the most valuable uses of a computer in product mix decision making is the evaluation of items. As indicated by the BUYSIM program developed as part of the present research, a computer can be used to evaluate items according to a variety of criteria. Not only would such evaluation provide more information for product selection decisions through evaluation on a set of criteria rather than one criterion, but the use of a computer would also relieve the buyer of the

³John A. Howard and William M. Morgenroth, "Information Processing Model of Executive Decision," Management Science, Volume 14, No. 7, March, 1968, pp. 416-428.

routine of the evaluation. Thus, the buyer would have more time to devote to the aspects of the decision process that cannot, at present, be computerized. For example, the buyer could devote more time to the investigation of the specific characteristics of the purchasers of individual items and the customer mix of individual stores.

A second important use of the computer is the reporting or identification of items that should be considered for deletion. A chain could set up a series of decision rules which a computer could use to evaluate each item. Once a period, probably at the end, the evaluation program would evaluate each item carried by the chain. On an exception basis the computer would identify, based on the preset decision rules, the items which should be considered for deletion.

A computer can also be used in other ways to support the chain buyer.⁴ For example, in most chains the buyer receives each day a short and expedite report and a list of the items received in the warehouse. When he receives the reports the buyer must compare the lists to determine the items on the short and expedite report that were received in the warehouse and are, therefore, no longer out of stock. A computer could easily compare the two lists and delete from the short and expedite report such items as were received in the warehouse. Further, for the items remaining on the short and expedite report, the computer could list not only the item, but how long

⁴See Appendix A for a comprehensive list of the possible uses of a computer to support the buyer.

the item had been out of stock, the date of the next expected shipment, and which, if any, item could be substituted for the out of stock item.

The performance of new items once accepted by the chain is of extreme importance. Even items that appear to be excellent may fail after a brief initial period. A computer can be used effectively to monitor the performance of new items. For a period of three to six months after a new item is added to the mix of items carried by the chain the computer could evaluate the new item to determine whether the level of performance was meeting a minimum acceptable level. On an exception basis the computer could report the items that were not performing as expected.

The Product Mix Decision and Retail Information Systems

A retail information system encompasses all the information necessary to plan operate and control a retail business. Included in such a system would be essential operating data such as payroll, accounts receivable, accounts payable, and product control data. In particular, the product control information includes all the information on the flow of items through the chain system.

The process starts with the development of a sales forecast for each item. From the sales forecast an order quantity is determined and an order generated. The information system also monitors the inventory level of each item in the chain warehouse and on the store shelves. The system accounts for all merchandise received as well as the sales of the items via warehouse shipments to the stores.

Ideally, the retail information system of a chain would provide the necessary information for planning such activities as promotions. For example, the information system should provide the necessary information for management to identify the most effective types of promotions. Further, the system should provide data on the most effective mix of items to be promoted.

One of the most important segments of the retail information system is the segment devoted to the planning and evaluation of the mix of items carried by the chain. The segment provides the information necessary to make decisions concerning the addition and deletion of items from the mix of products stocked by the chain.

Table 6-2 lists the data needed to evaluate items. The data is the input to the system. To the data must be added the constraints or decision rules under which the chain wishes to operate. The combination of the data and the decision rules is the data which the information system uses to evaluate items.

The output of the product mix decision segment of the information system consists of two types of reports. The first type of report is the result of the item evaluation process. Data on a specific set of items is input to the evaluation process, the items are evaluated and the process reports the results of the evaluation. The report could either be in the form of a ranking of the items selected for evaluation or in the form of specific values for a set of criteria. Perhaps the process would be most useful if both the values and the rank were reported.

The second type of report consists of an exception report indicating the items now carried by the chain that should be considered for deletion. The report would be generated at periodic intervals, probably to coincide with the fiscal periods of the chain.

Included in the report would be not only the identification of the item but also the information needed to make the deletion decision. One possible set of such information would include:

- 1) The movement of the item
- 2) The gross margin per cent of the item
- 3) The direct profit and net profit generated by the item

In addition to the information on the item to be considered for deletion, the report would also contain the same information on the items that compete with the item. Such information would provide a basis of comparison to further aid in making the deletion decision.

The primary advantage of the development of a product mix decision information system is the such a system should lead to greater control of the mix of items carried by the chain. The improved control will have several advantages. One of the advantages is that the mix of products carried by the chain will better meet the needs of consumers. For example, one development in the information system will be the inclusion of data on the matching of items to customer characteristics. Items which appeal to specific racial, ethnic or religious groups will be identified and stocked only in stores where the customer mix contains persons with the appropriate characteristics.

A second advantage will be that chains will better evaluate the items stocked by the stores of the chain with respect to the contribution of the item to the profit of the chain. Items which do not contribute to the profit of the chain will be identified and deleted. Such deletion will be particularly important for items which have a relatively low rate of sales.

Both of the above factors contribute to the most important advantage resulting from the development of an effective product mix information system. That advantage is the competitive advantage a chain can achieve over the other chains that do not develop such an information system. Not only will the short run profits of the chain be increased by the elimination of items which do not contribute to profits but more importantly the long run profits of the chain will be increased. The increase will result from the fact that the mix of items offered by the chain will be superior to the mix of items offered by other chains. Thus, the chain will attract and keep the customers of other chains in addition to satisfying its present customers better.

Integration of information systems for management decision making

During the development of the information system for product mix decision a chain must be aware of the need to have the product mix decision information system be compatible with the total information system of the chain. Prior to developing the product mix decision information system a chain should delineate the parameters of the total information

system. The primary factor to be considered is the configuration of contents of a central data bank which would contain all the basic data needed by the chain.

While the product mix decision information system would utilize only a limited amount of the data stored in the data bank, the development of the system must not preclude the compilation and storage of any data necessary for the total information system. In particular, the above requirement implies that the format of the storage of all data be developed. Further, the data necessary for the total system should be stored even though the total information system is not fully developed.

Suggestions for Further Research

As a result of the present research several areas for further research can be identified. The first such area is the effect of decision criteria on the operating results of the chain. The results of the seven runs of the CHAINSIM program reported in Chapter Five indicate the use of alternative decision criteria can affect the operating results of the chain. The results indicate that additional research to further identify and better delineate the effects of alternative criteria could lead to a better understanding of the alternative criteria. The increased understanding should lead to a more informed selection of the decision criteria that a chain might use.

A second area for further research is concerned with the best criteria for the evaluation of the mix of items carried

by a chain. The present research has identified the fact that the mix of items carried by the chain has an effect on the profit of the chain. However, the project did not focus on the question of the evaluation of the mix of items to be carried by a chain. In addition to evaluating items on an individual basis, the research pointed out that chains do evaluate, albeit subjectively, the role of individual items in the total mix of items offered to the consumer. Such analysis and evaluation should be removed from the realm of subjective evaluation and placed in the province of informed, analytical evaluation. The implication of the suggestion is that the cross-elasticities of demand for each item with all other items carried by a chain must be identified. While such a task is probably beyond the immediate ability of researchers, there are methods available to begin the task.

A third area in which a great deal of important research could be conducted deals with the identification of the factors which cause a consumer to remain loyal to a store and the factors which cause a consumer to switch stores. The primary justification of many chains for the addition and/or retention of slow moving or unprofitable items is that such items are necessary to present a broad range of products so as to retain consumers. Research evidence to either support or refute the assumption would be immensely valuable.

Closely related to the third area is the effect of the gain or loss of a consumer on the profit of a chain. If one is to evaluate accurately the consequences of a decision not to stock an item, then one must know the effect on the profit

of not stocking the item. The effect on the profit of the chain will be the expected value of the loss of a customer times the number of customers that would be lost by not stocking the item. The data on the loss of profit from the loss of a customer would be useful also in evaluating the effect of out of stock conditions which might cause a customer to shop elsewhere.

Another area for research is the identification of the best method for estimating the sales of a new item. One of the suggestions based on the results of the present research was that chains should evaluate new items with the same criteria as items that are currently stocked. In order to do such evaluation chains must be able to identify the factors that are important in estimating the movement of new items. Further, chains must have the knowledge necessary to apply the estimating technique and know how the information should be used.

A sixth area for further research is the development of handling cost on items. McKinsey and Company have made a beginning with the development of the handling costs for sixteen items in the dry grocery area. However, the dry grocery section of a supermarket may contain several thousand items. The development of handling costs on all items is a necessary prerequisite to the application of net profit as an accurate criteria for item evaluation.

It is unlikely that handling costs will have to be developed for every item in a store since, for many groups of items, the handling costs of all items in the group will

be the same. For example, the handling costs of all canned soups are probably the same. Research is needed to identify the items which may be grouped together because of similar handling costs.

A seventh area for important research is the determination of the most appropriate basis of allocation of indirect expenses to items. The allocation is necessary to develop the net profit of an item. Yet, as pointed out earlier, no research based information is available to guide chains in the selection of a basis of allocation.

A final area for particularly useful research deals with the sensitivity of item evaluations to variations or imperfections in the data. The present project showed that for the items evaluated variations in price were significant in terms of their effect on the ranking of an item while variations in the handling costs of the item did not appear to be as important. Further research into the effect of variations in the data on the evaluation of items could not only aid in the development of better data for item decisions but could also help further isolate the impact of alternative criteria on item rankings.

APPENDIX A

Applications of Computers in the Food Industry

1. Data Processing Applications
 - a. Sales invoicing (store shipments)
 - b. Sales Analysis
 - c. Accounts Receivable
 - d. Inventory Adjustments Analysis
 - e. Retail "going in gross"
 - f. Purchase Order Writing
 - g. Quarterly Velocity Turnover Report
 - h. Summary of Item Analysis, Inventory and Sales
 - i. Accounts Payable
 - j. Financial Statements
 - k. Retail Bill-out Control
 - l. Accounting for Retail Stores
2. Delivery Analysis
 - a. Cost per Fleet Unit
 - b. Rated Delivery Payload
 - c. Driver Performance
 - d. Backhauls and Inbound Receiving on Company Trucks
 - e. Budgets and Variance Comparisons
3. Warehouse Performance
 - a. Cost per Case
 - b. Tons and Cases per Man-hour
 - c. Projected Tonnage and Case Movement by Selection Area
4. Payrolls
 - a. Retail - Corporate
 - b. Retail - Independent
 - c. Concentration of Purchases by Retailers - Semi-annual
5. Other Applications
 - a. Net Profit
 - b. Net Profit by Product Item
6. Decision Formulations
 - a. Where to Store Merchandise in Warehouse
 - b. Scheduling of Inbound Truck Receiving
 - c. Weight and Cube on Outbound Deliveries
 - d. Minimal Economic Level to Stock of an Item
 - e. Minimal Supplier Case Allowance to Order and Stock Excess Stock
 - f. When to Discontinue an Item
 - g. Return on Investment
 - h. Profit Planning, Volume-Cost Analysis
 - i. Rebate and Allowance Analysis to Retailers

7. Item Movement Analysis
 - a. Seasonal Order Patterns
 - b. Specialty Orders
 - c. Effect of Advertising on the Sale of Items
 - d. Discontinued Item Analysis and Review
8. New Stores
 - a. Prebudget and Labor Control Analysis
 - b. Item Movement by Various Store Volume Categories
 - 1) Most Profitable Store
 - 2) "Loss" Stores
 - 3) New Stores
9. Automatic Distribution
 - a. Weekly Advertised Items
 - b. New Items
 - c. New Stores
10. Inventory
 - a. Daily Adjustments Analysis
 - b. Physical Counts vs. IBM Control Counts
 - c. Warehouse, Office, and Delivery Errors
 - d. Central Billing on Retail Shipments
11. Budget Variance From Actual
 - a. Warehouse
 - b. Retail (corporate)
 - c. Dividends
 - d. Stockholdings
 - e. Proxy Votes and Stockholder Votes
12. Advertising Income
 - a. Suppliers
 - b. Retailers (independent)
 - c. Property, Equipment, and Depreciation
 - d. Prebudget of Retail Meat, Produce, Bakery, and Other Perishables -- Sales and Labor
13. Sales per Man-hour
 - a. Warehouse (wholesale)
 - b. Retail
 - c. Rating Advertising Income to Purchases by Suppliers
 - d. Merchandising Cost/Sell Audit and Equalization (Warehouse Profit Control)

14. Merchandise Variances
 - a. Count and Recount
 - b. "Cents Off" Deals
 - c. Advances
 - d. Declines
 - e. Off Label Deals
15. Inbound Freight Costs
 - a. Freight Register
 - b. Expected to Arrive Date Compared to Actual
 - c. Inbound Freight and Routing Cost
 - d. Freight Claims
16. Period End Accounting
 - a. Unmatched Receivings
 - b. Unmatched Invoices
 - c. Fixed Entries (Rent, Depreciation, Etc.)
17. Marketing Analysis
 - a. Sales Quotas by Sales Counselors, Stores and Territory
 - b. Sales Comparison With Past Performance and Quotas
 - c. EVTOP Verification of Quantities to Buy
18. Out-of-stock Report
 - a. Total Cases and Dollars Ordered but not Shipped
 - b. "Out" by Reason Code
19. Retailer Returns - Allowances
 - a. Cases, Dollars and Returns
 - b. Warehouse Scratch-off Analysis¹

¹Charles P. Kreichelt and Michael J. Roach, The Role of Data Processing in the Food Industry, Food Marketing Paper #3 (East Lansing, Michigan: Food Marketing Program, Michigan State University, 1967) Mimeographed

APPENDIX B

Interview Format:
Supermarket Chain Interviews

INFORMATION MANAGEMENT FOR SUPER MARKET CHAIN
PRODUCT MIX DECISIONS: A SIMULATION EXPERIMENT

OPERATING EXECUTIVE'S
FIELD INTERVIEW FORMAT

CHAIN_____	ORIGINAL CONTACT_____
ADDRESS_____	PERSON INTERVIEW_____
_____	TITLE_____
DATE_____	FUNCTION_____
TIME_____	_____

START THE INTERVIEW WITH A PREFACE COVERING THE FOLLOWING:

- 1) Who I am and where I am studying.
- 2) General statement of my dissertation topic area and research methodology. (Give a copy of summary statement.)
- 3) Why I am interviewing chains.
- 4) What I hope to gain from the interviews.

OPERATING EXECUTIVE

- 1) The first thing I would like to do is draw a flow chart of your organization's decision process for NATIONAL BRAND manufacturer's products. (note: Show the example "Information System".)

TIME
DAY

1

PRODUCT
OFFERING
BY
SUPPLIER

POINTS IN DECISION FLOW-CHART
NATIONAL BRAND

BLOCK NUMBER	DECISION MADE	WHO MAKES DECISION OR EVALUATES PRODUCT	CRITERIA USED	WHAT INFORMATION DOES PERSON HAVE AVAILABLE	WHAT ARE THE SOURCES OF THIS INFORMATION
-----------------	------------------	---	------------------	---	--

POINTS IN DECISION FLOW-CHART
NATIONAL BRAND (CON'T)

BLOCK NUMBER	DECISION MADE	WHO MAKE THE DECISION OR EVALUATES ITEM	CRITERIA USED	WHAT INFORMATION IS AVAILABLE	SOURCES OF THE INFORMATION
-----------------	------------------	---	------------------	----------------------------------	----------------------------------

2. Now I would like to do the same thing for the private label brands you carry.

TIME
DAY
1

POINTS IN FLOW-CHART
PRIVATE BRAND

BLOCK NUMBER	DECISION MADE	WHO MAKES THE DECISION OR EVALUATES ITEM	CRITERIA USED	WHAT INFORMATION DOES PERSON HAVE AVAILABLE	SOURCES OF THE INFORMATION
-----------------	------------------	--	------------------	---	----------------------------------

POINTS IN FLOW-CHART
PRIVATE BRANDS (CON'T)

BLOCK NUMBER	DECISION MADE	WHO MAKES THE DECISION OR EVALUATE ITEM	CRITERIA USED	WHAT INFORMATION DOES THE PERSON HAVE AVAILABLE	SOURCES OF THE INFORMATION
-----------------	------------------	---	------------------	---	----------------------------------

3. Now I would like you to forget about corporate restrictions, time and money limitations, or even what you think is feasible or realistic. I want you to draw a flow-chart of your ideal product mix decision system. In other words, if you could have any information that you wanted, and could organize it in any way that you wanted, how would you make product mix decisions?

TIME

DAY

1

BLOCK NUMBER	DECISION MADE	WHO MAKES THE DECISION OR EVALUATES THE ITEM	CRITERIA USED	WHAT INFORMATION DOES PERSON HAVE AVAILABLE	SOURCES OF THE INFORMATION
-----------------	------------------	---	---------------	---	----------------------------------

POINTS IN DECISION PROCESS
IDEALIZED SYSTEM (CON'T)

BLOCK NUMBER	DECISION MADE	WHO MAKES THE DECISION OR EVALUATES ITEM	CRITERIA USED	WHAT INFORMATION DOES PERSON HAVE AVAILABLE	SOURCES OF THE INFORMATION
-----------------	------------------	--	------------------	---	----------------------------------

1. What factors do you think affect the cost of stocking and selling an item?
2. How much autonomy is granted the individual store manager with respect to the items carried by each store, and how much control is retained by the district headquarters? How is retained by the central headquarters?
3. Any other points?

APPENDIX C

A Typical "New Item Form"

NEW PRODUCT INFORMATION

NEW ITEM

Name of Item and Brand	Pack	Item Size	☐ Tin ☐ Glass ☐ Cel. ☐ Other	Cost/Case	F.O.B.	Freight/Case
Name of Item and Brand	Pack	Item Size	Palletized ☐ Yes ☐ No	Cost/Case	F.O.B.	Freight/Case
Name of Item and Brand	Pack	Item Size	☐ Tin ☐ Glass ☐ Cel. ☐ Other	Cost/Case	F.O.B.	Freight/Case
Name of Item and Brand	Pack	Item Size	Palletized ☐ Yes ☐ No	Cost/Case	F.O.B.	Freight/Case
Name of Item and Brand	Pack	Item Size	☐ Tin ☐ Glass ☐ Cel. ☐ Other	Cost/Case	F.O.B.	Freight/Case
Name of Item and Brand	Pack	Item Size	Palletized ☐ Yes ☐ No	Cost/Case	F.O.B.	Freight/Case
Manufacturer	Address		City & State	Phone	Financial Rating	
Represented by:	Address		City & State	Phone	Salesman	
Date Item Available	Cash Discounts	Case Weight	Case Cube Size	Total Case Cost	No. of Samples	

GUARANTEES

of Sale	of Product	Conformance with F.D.A.	Price Protection Policy	Interval--Order to Delivery
Product Liability Insurance By:		Dollar Amount of Liability	Covers Vendor ☐ Yes ☐ No	

ALLOWANCES

Display Allowance	Swells	Labels	Quantity Discounts
Advertising Allowance	Promotional	Other	

Introductory Offer:	Consignment ☐ Yes ☐ No
---------------------	---

PRODUCER'S ADVERTISING	DATES	MERCHANDISE DISPLAYS	SALES AIDS
Papers		☐ Floor	☐ Circulars
Radio		☐ Shelf Extension	☐ Window Banners
TV		☐ Basket	☐ Store Signs
Magazines		☐ End	☐ Overwire Banners
Coupons		☐ Other	☐ End Display
Demonstration			

MAJOR RETAILERS NOW STOCKING ITEM	Fair Traded ☐ Yes ☐ No	Suggested Retail Price \$	% Profit	RETAIL PRICE (Show Each Retailers Price)	APPROX. MOVEMENT
Alpha Beta					
Food Giant					
Lucky					
Market Basket					
Ralphs					
Safeway					
Others					

SHIPPING INFORMATION

How Shipped	Point of Origin	Min./Max. Shipment	Routing or Delivery	Terms of Delivery
Unitized Load ☐ Yes ☐ No Slip Sheet ☐ Yes ☐ No Pallet (Wooden) ☐ Yes ☐ No Type of Service ☐ Rail ☐ Truck				
If "delivered" and we elect to pick up this merchandise with our own trucks what hauling end/or handling allowance will be made ☐ cwt. ☐ case				

STORE HANDLING

Tear Strip Cases ☐ Yes ☐ No	Spot for Retail Prices ☐ Yes ☐ No	Merchandise Prepriced ☐ Yes ☐ No	Shelf Stocking ☐ Yes ☐ No
--	--	---	--

VENDOR	All above information is accurate and complete; all promotional, advertising and other allowances and benefits herein contained are being actually offered on proportionally equal terms to all other customers of the seller competing with the purchase.
Signed	Date

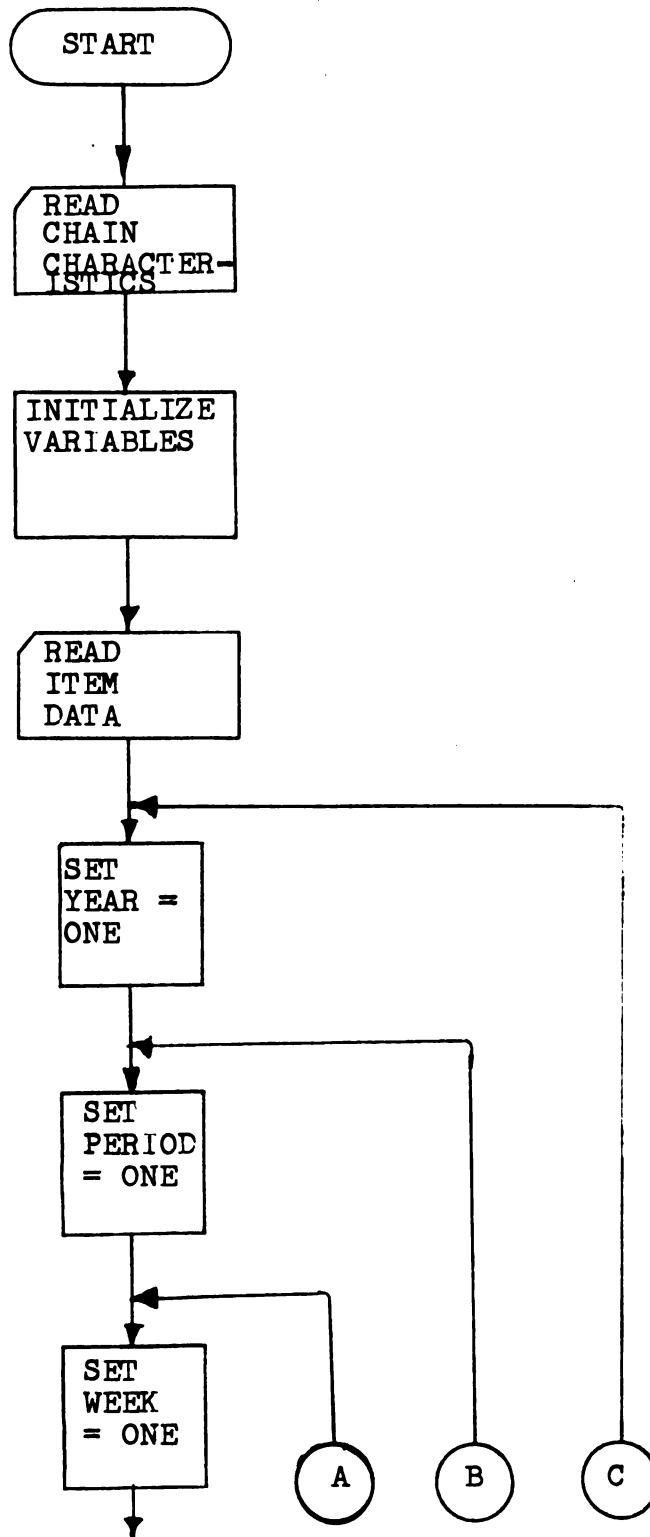
FOR BUYER USE ONLY

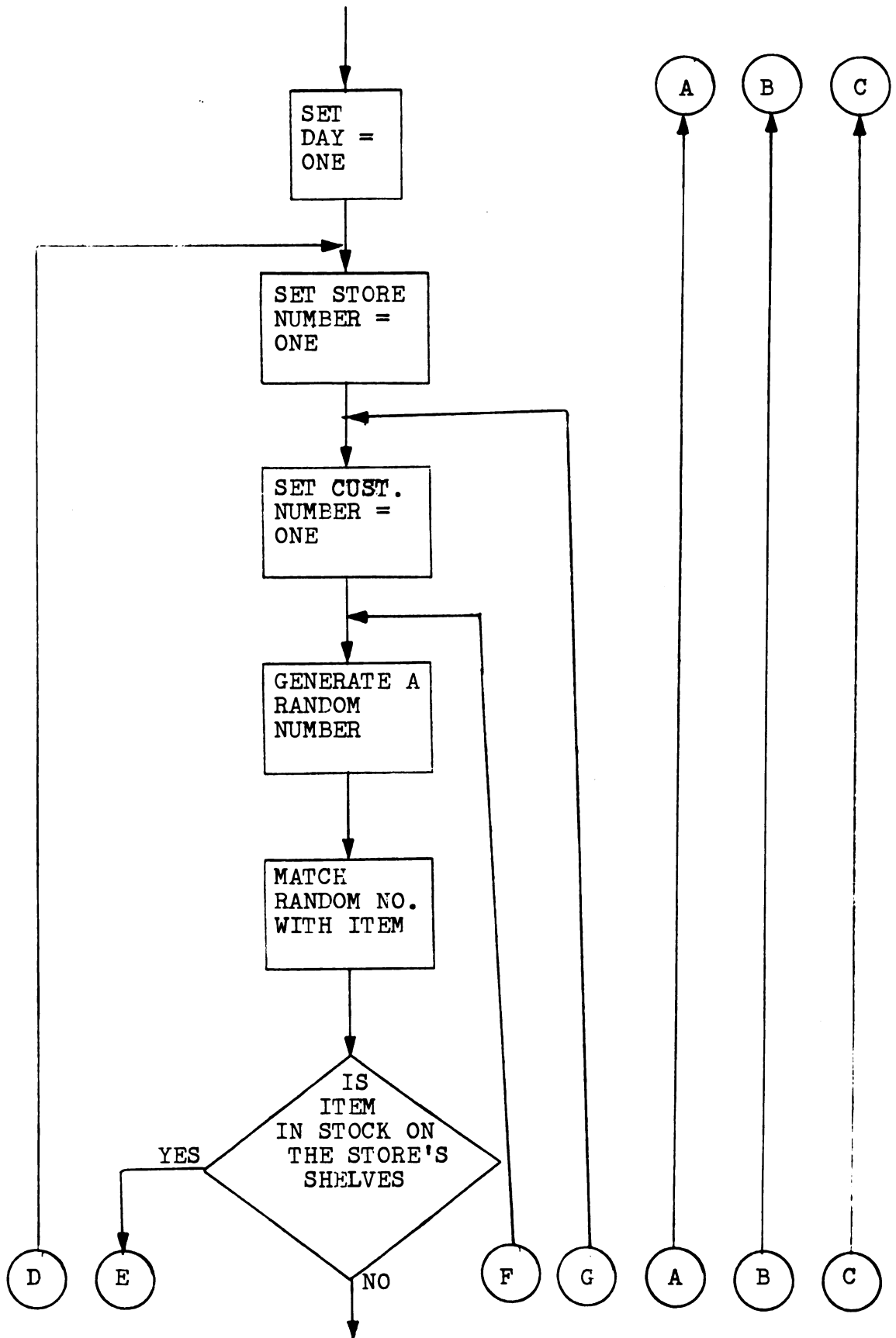
COMPETITIVE ITEMS	SUGGESTED DISCONTINUED ITEMS

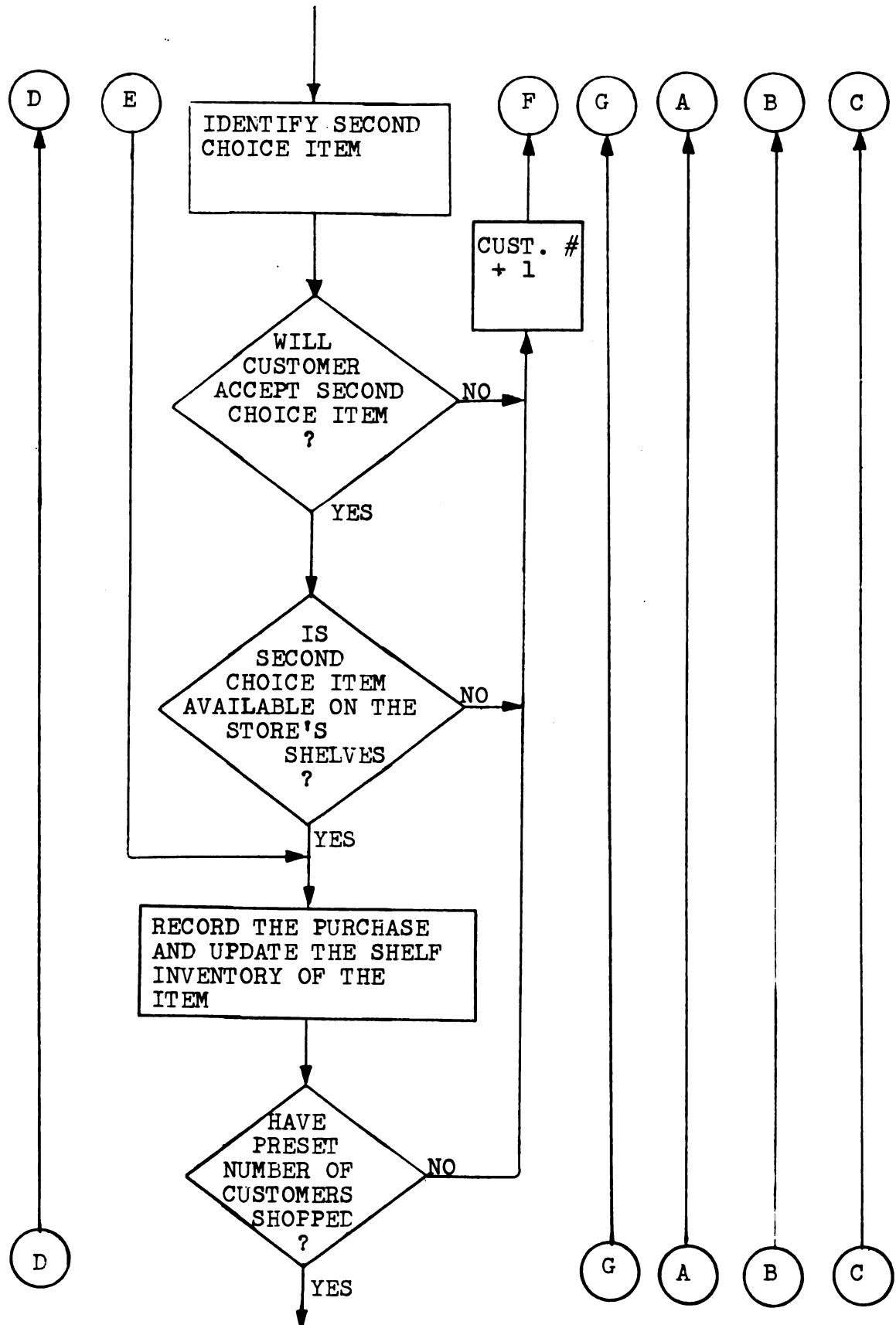
APPENDIX D
Flow-Chart of CHAINSIM

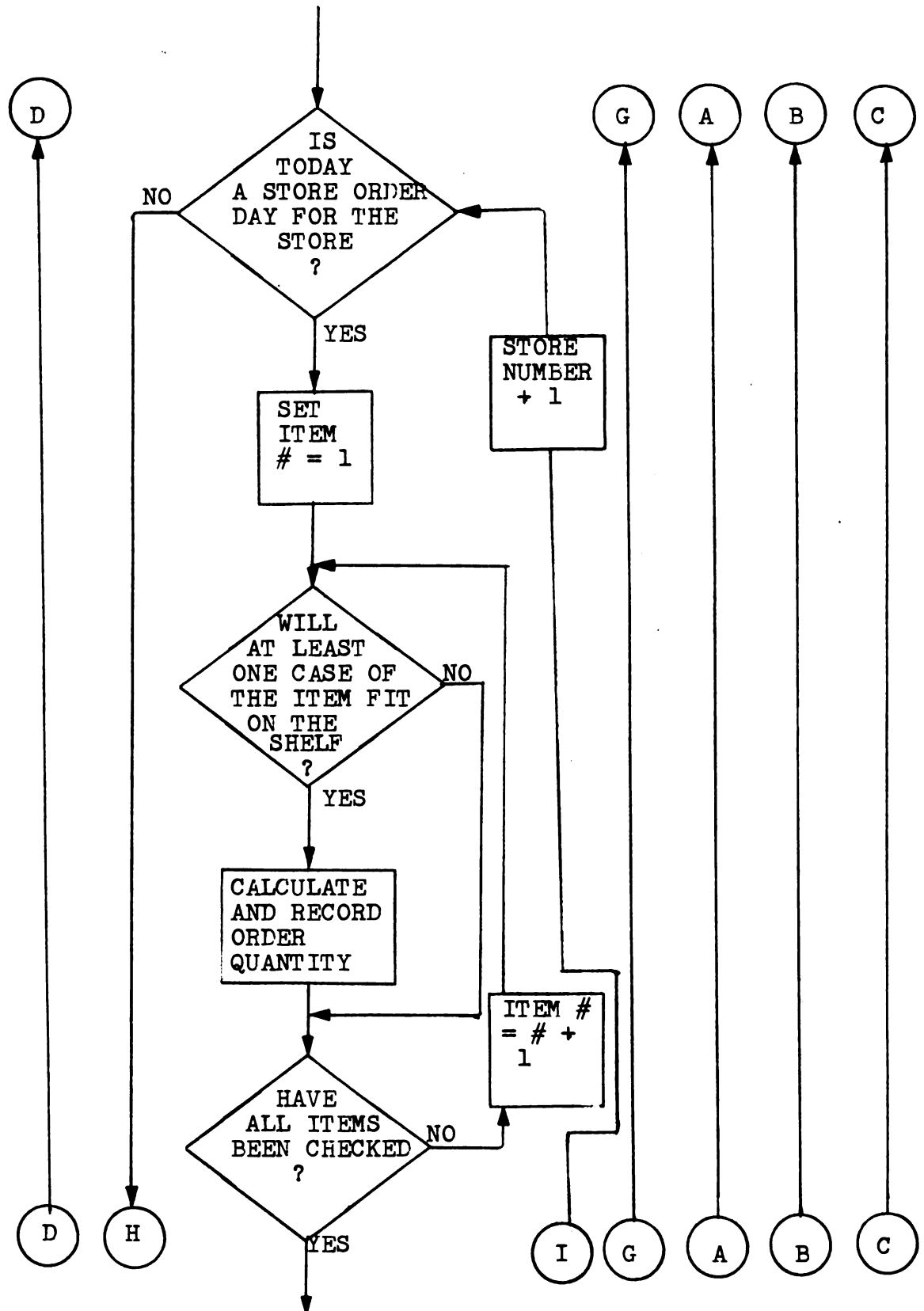
APPENDIX D: Flow-Chart of the CHAINSIM program

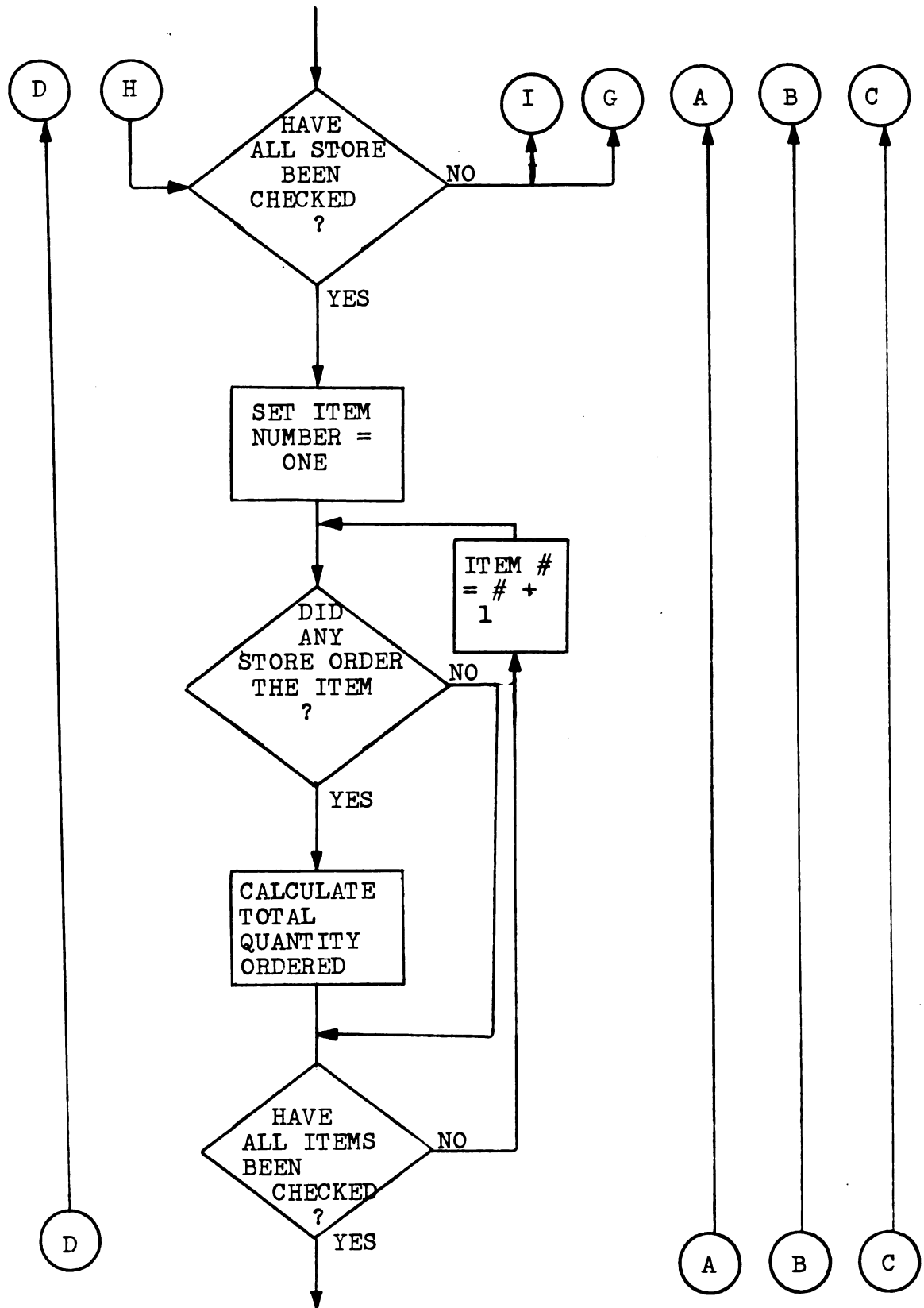
Page 1 of 9

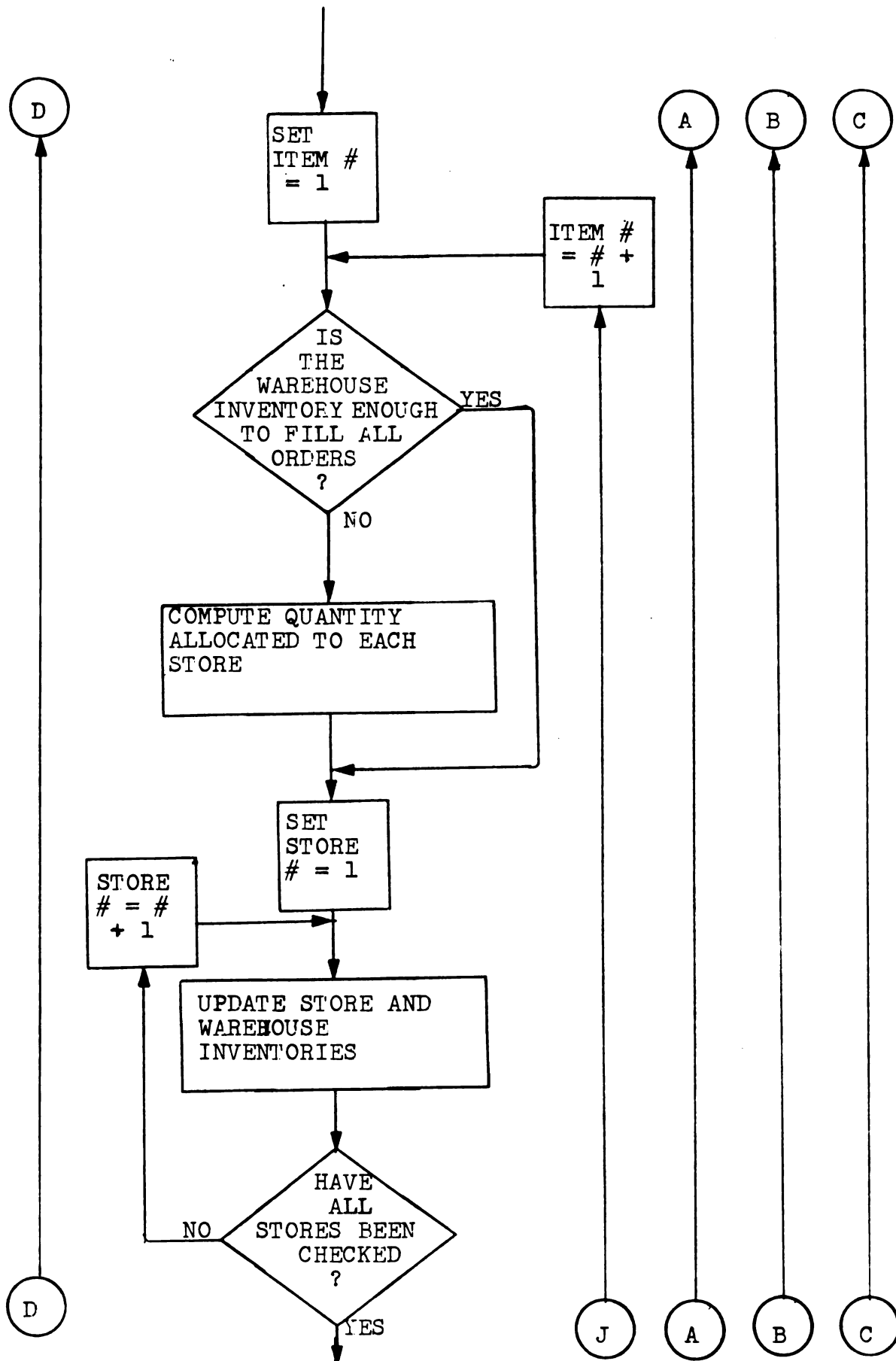


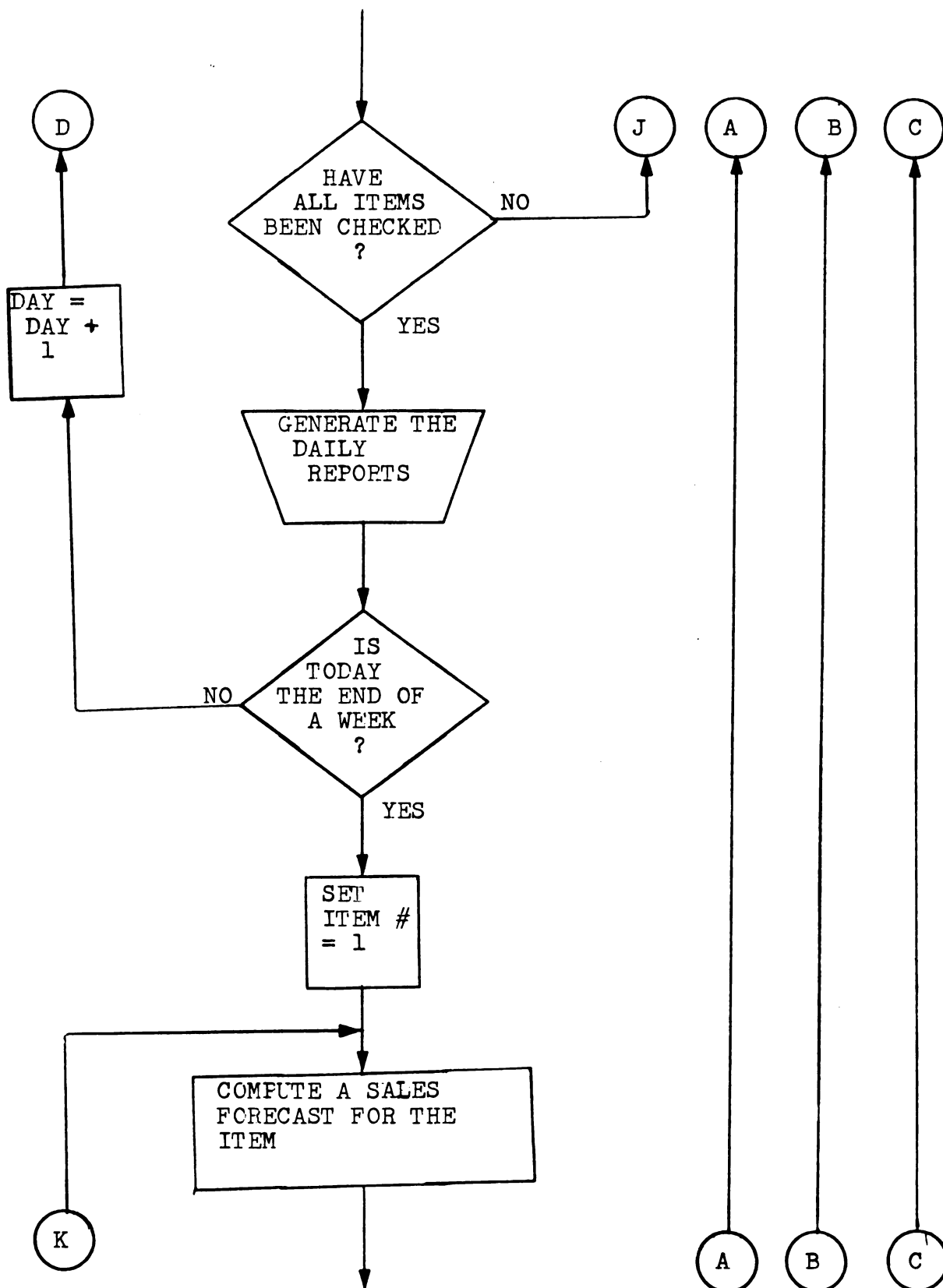


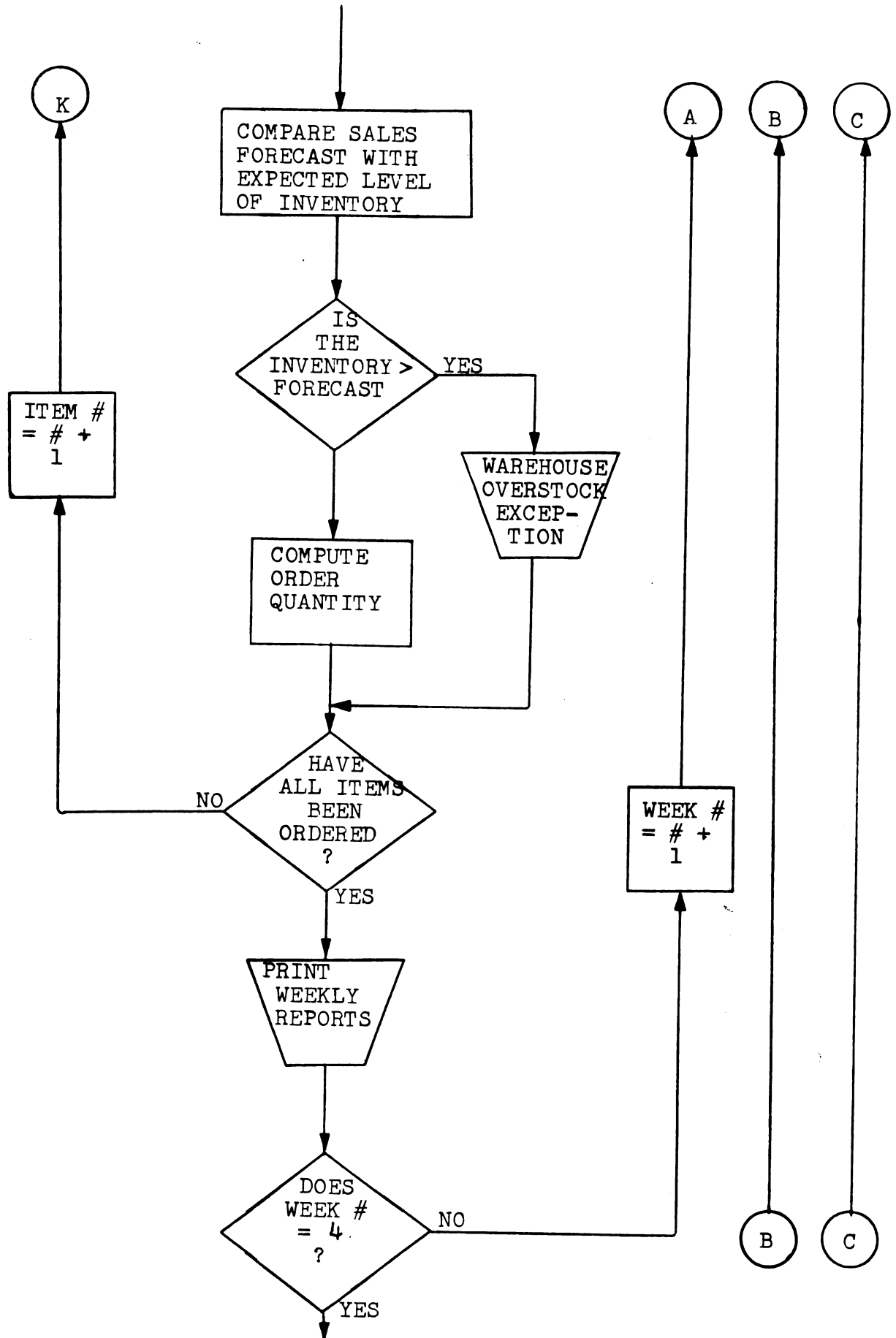


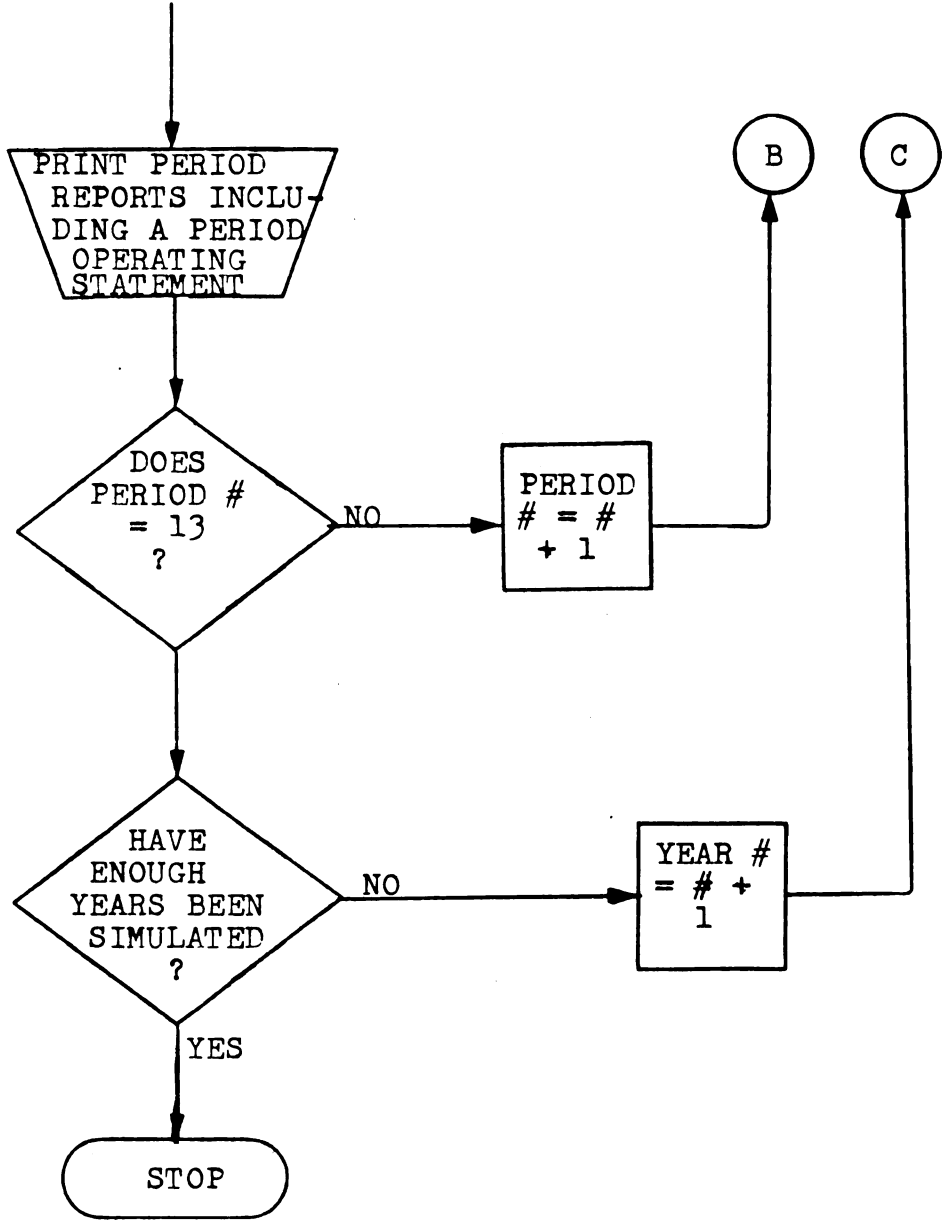












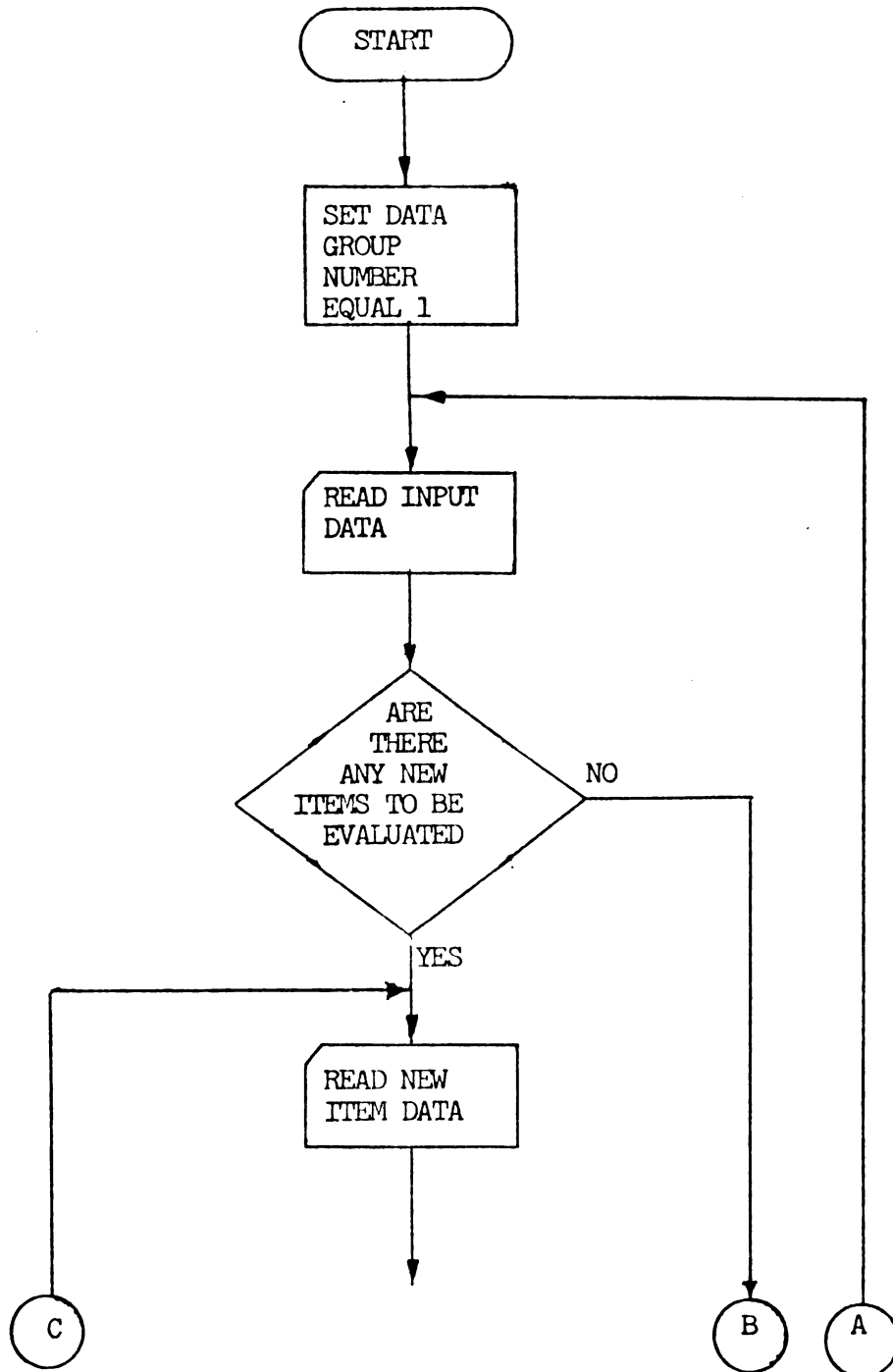
APPENDIX E

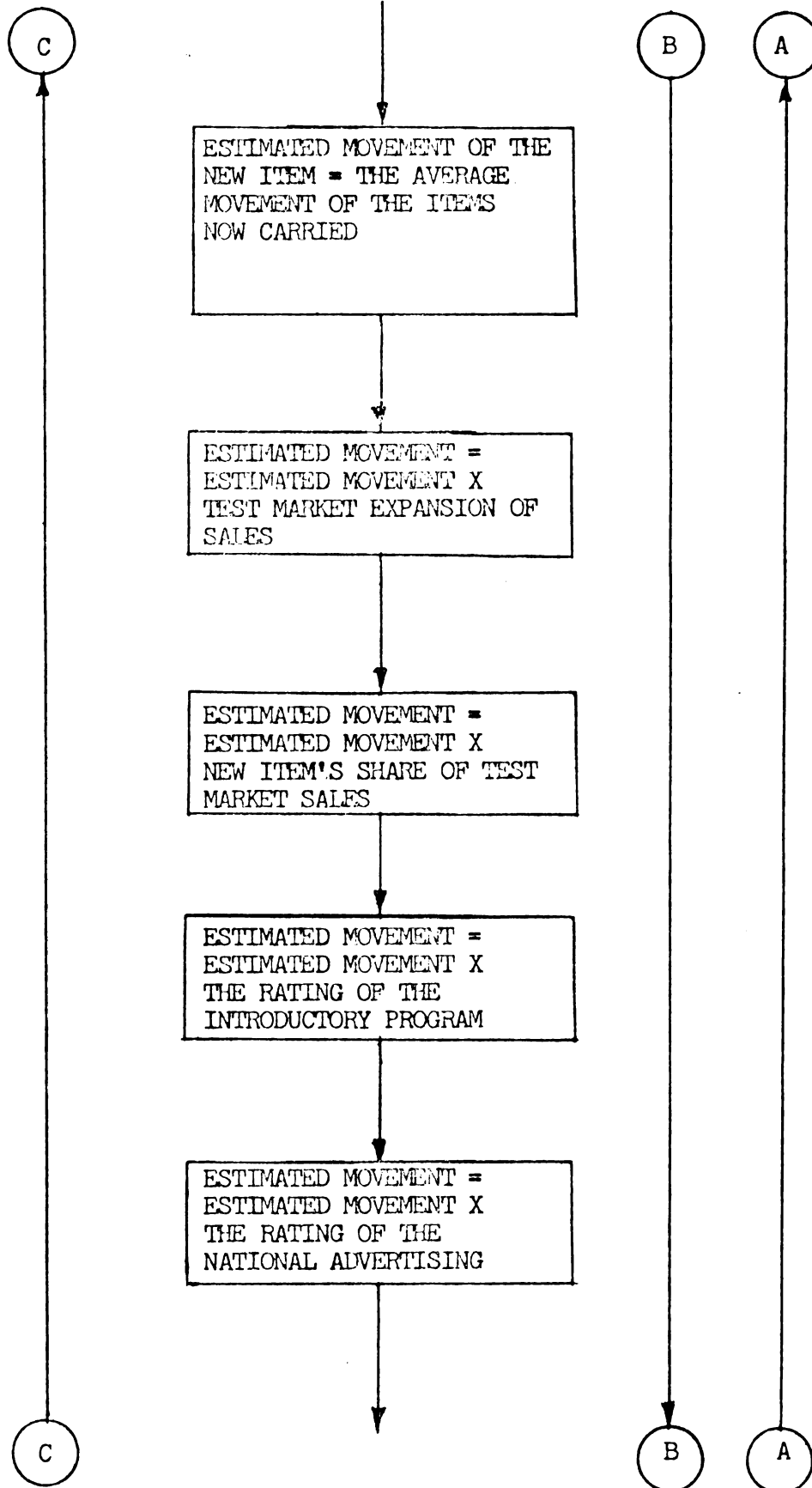
Flow-Chart of BUYSIM

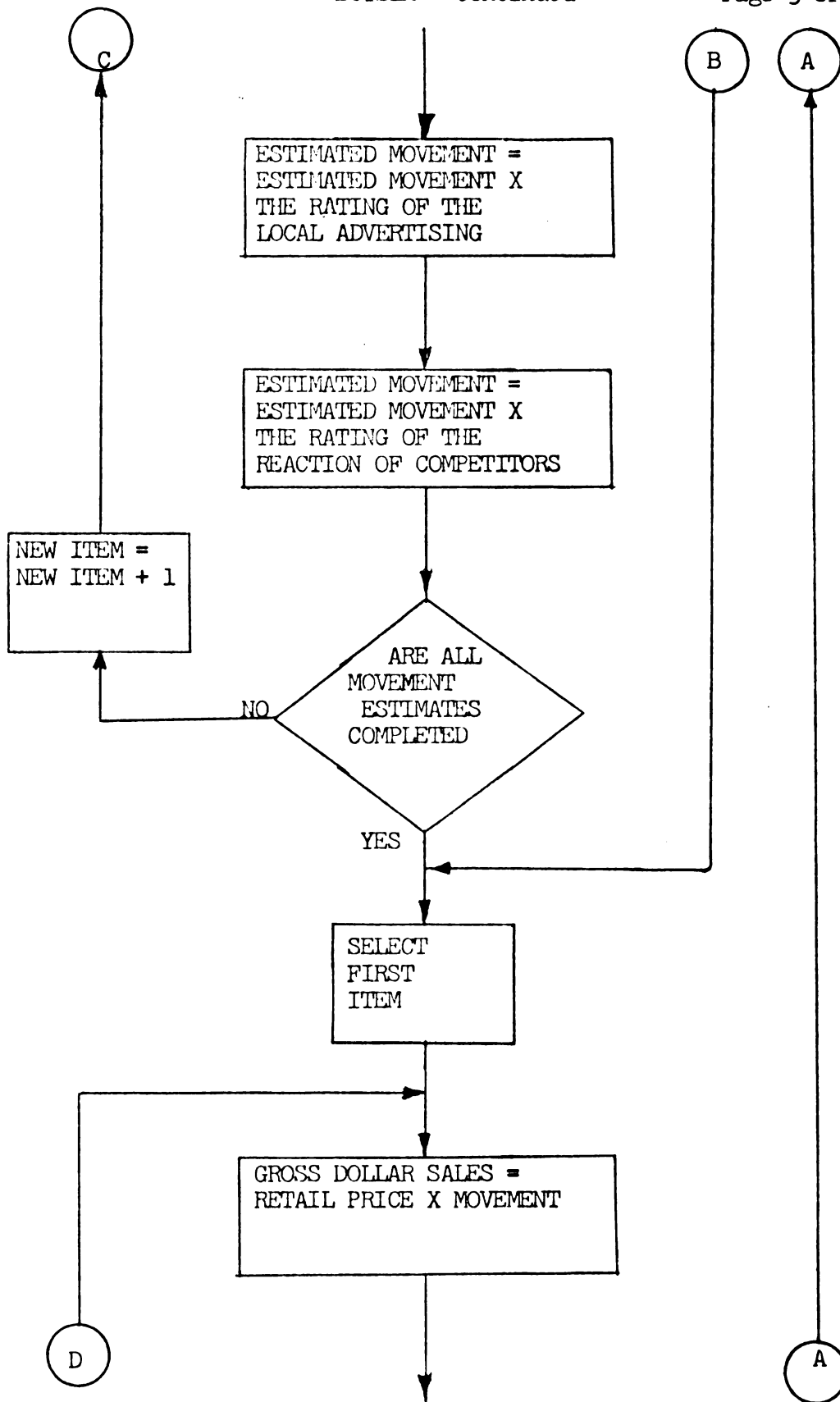
APPENDIX E

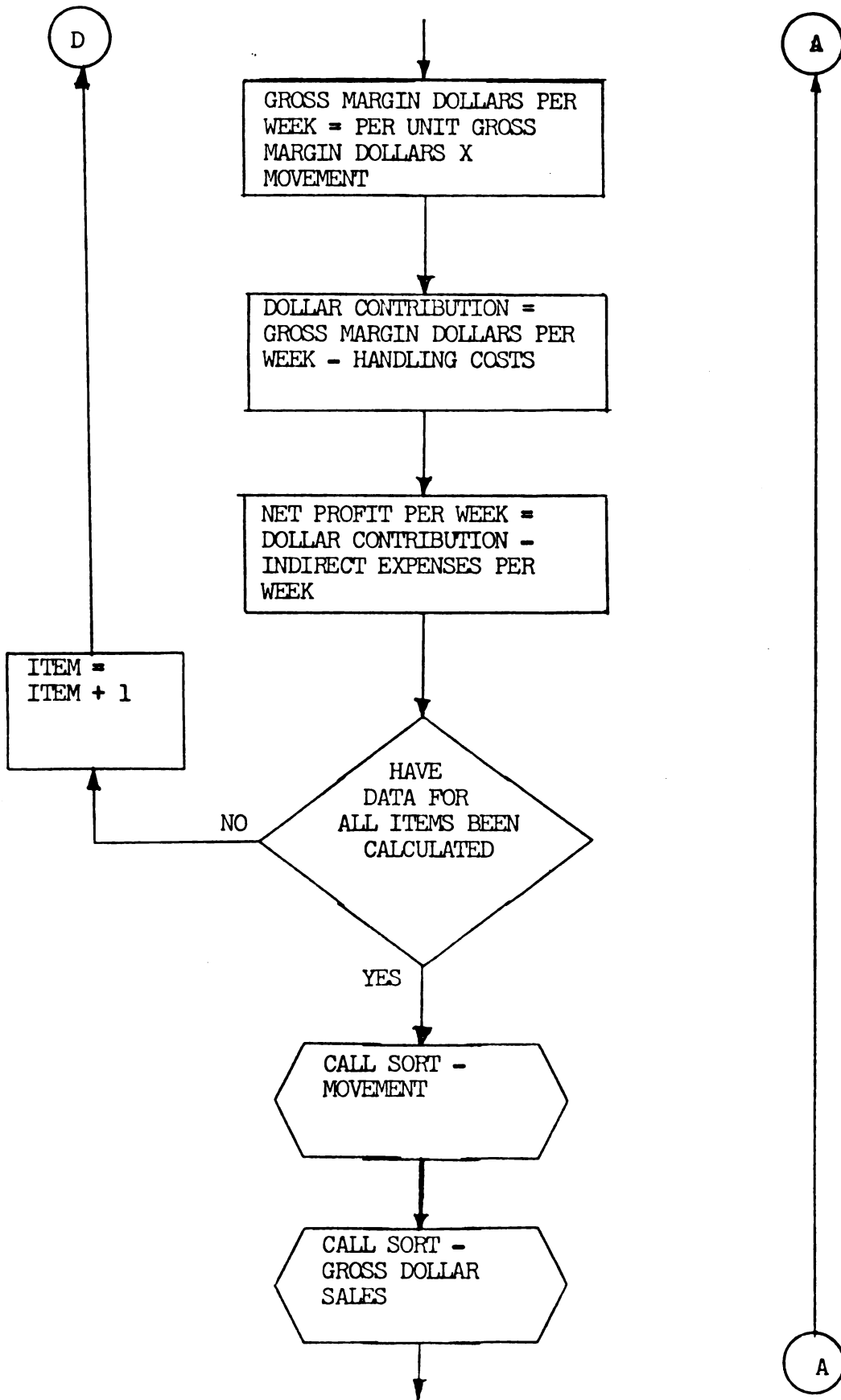
FLOW-CHART OF "BUYSIM"

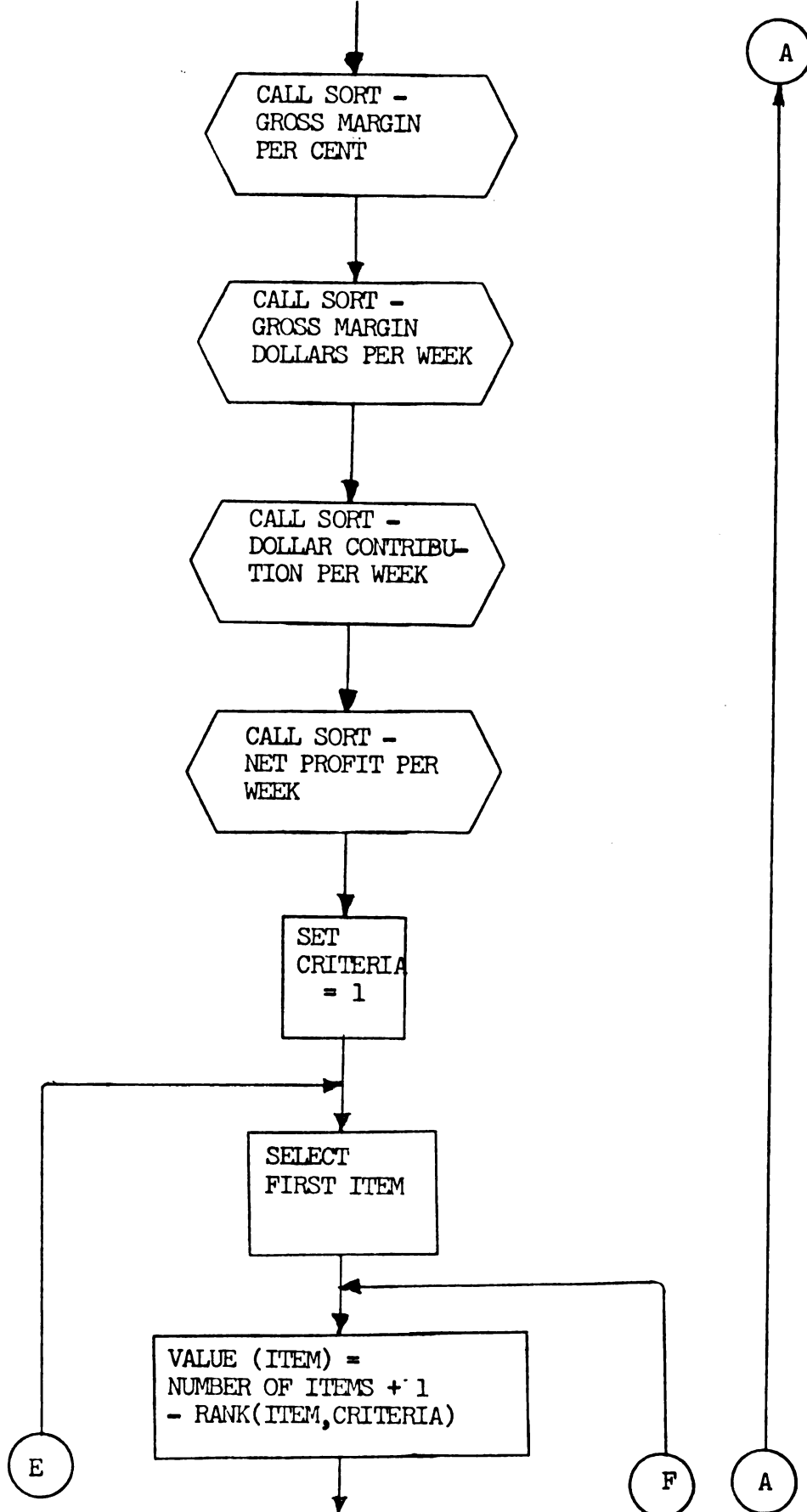
Page 1 of 7

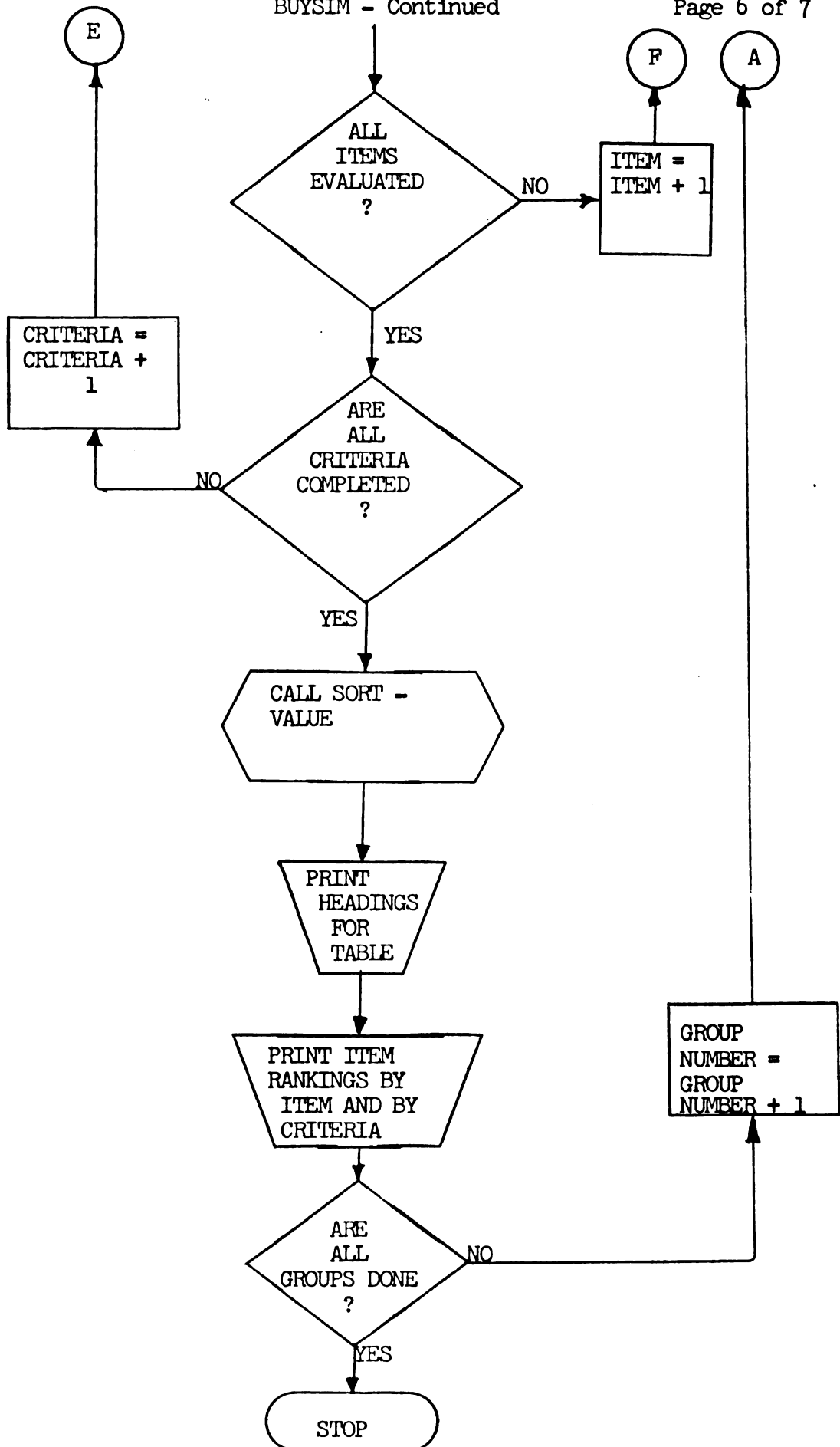


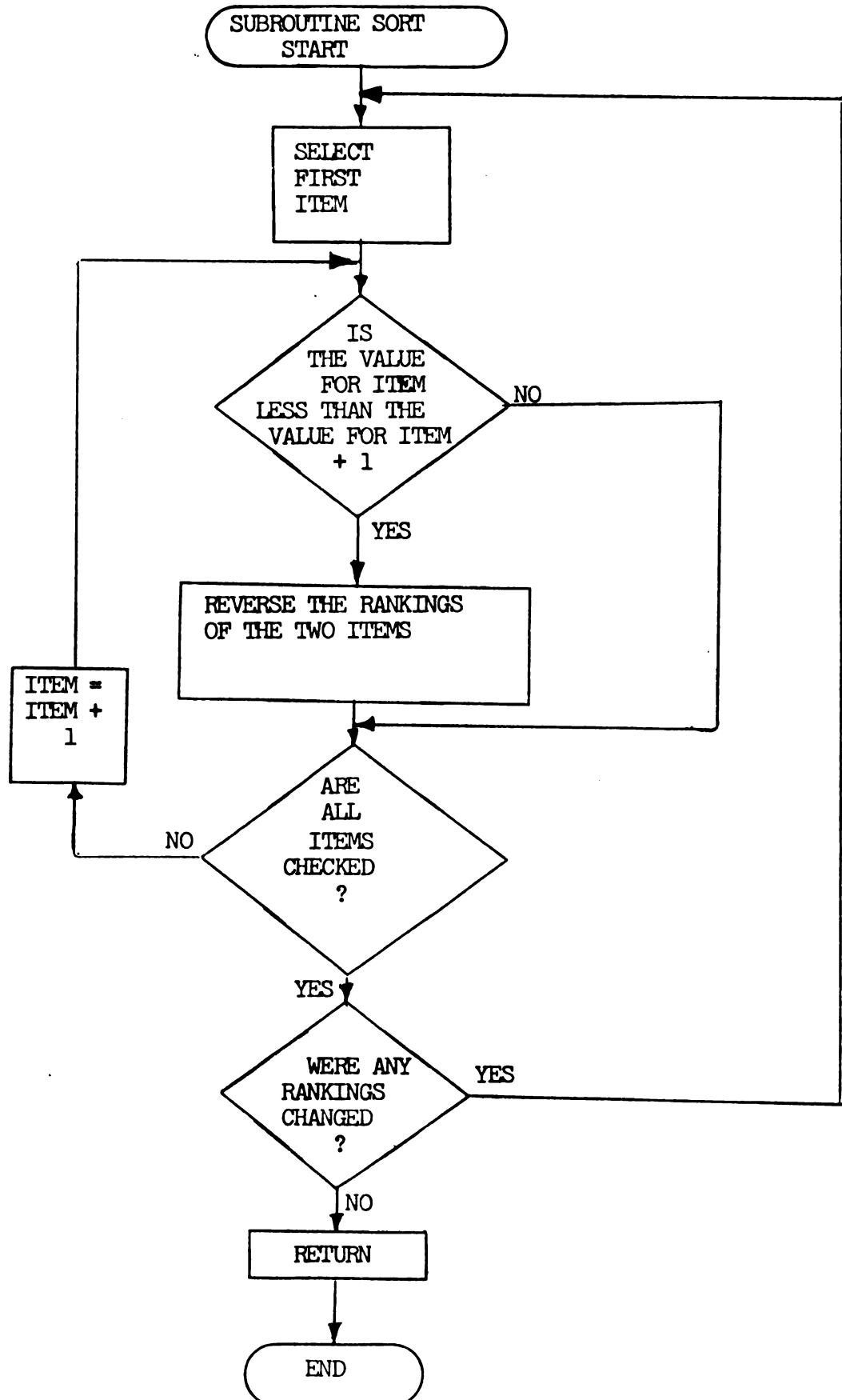












APPENDIX F

NEW ITEM EVALUATION FORM

ITEM NAME _____ CASE COST _____ CASE RETAIL _____
 SUPPLIER _____ ITEM NO. _____ CASE PACK _____
 MANUFACTURER _____ GROSS MARGIN \$ _____ % _____ SIZE _____

TEST MARKET DATA
 EXPANSION OF MARKET _____ SHARE OF MARKET _____

INTRODUCTORY PROGRAM

ACTIVITY	PROGRAM RATING
1. Couponing _____	1. Excellent _____ (1.20)
2. Sampling _____	2. Strong _____ (1.10)
3. Cents-off _____	3. Average _____ (1.00)
4. 2-for _____	4. Weak _____ (0.90)
5. Other _____	5. Poor/None _____ (0.80)

MEDIA	GROSS RATING POINTS	NATIONAL ADVERTISING RATING	GUARANTEED	
			YES	NO
TV	_____	1. Excellent	1.30	1.00
Radio	_____	2. Strong	1.20	0.90
Magazines	_____	3. Good	1.10	0.80
Newspapers	_____	4. Average	1.00	0.70
Other	_____	5. Fair	0.90	0.60
TOTAL	_____	6. Weak	0.80	0.50
		7. Poor-None	0.70	0.40

MEDIA	TOTAL SPOTS	LOCAL ADVERTISING PER WK.	RATING	GUARANTEED	
				YES	NO
TV	_____	_____	1. Excellent	1.30	1.10
Radio	_____	_____	2. Strong	1.20	1.00
Newspaper	_____	_____	3. Good	1.10	0.90
Other	_____	_____	4. Average	1.00	0.80
			5. Fair	0.90	0.70
SUMMARY: Reach _____; Frequency _____			6. Weak	0.80	0.60
			7. Poor/None	0.70	0.50

COMPETITIVE REACTION
 NUMBER OF COMPETITORS CARRYING
 1. ____ (0.90); 2. ____ (0.95); 3. ____ (1.00); 4. ____ (1.05); 5. ____ (1.10)

ITEMS FOR COMPARISON					
ITEM	DESCRIPTION	CASE PACK	CASE COST	CASE RETAIL	MOVEMENT

APPENDIX G

Item Rankings According to
Seven Criteria for Four Types of
Dog Food

ITEM RANKINGS - CANNED RATION

ITEM DESCRIPTION	MOVEMENT (UNITS)	GROSS DOLLAR SALES	GROSS MARGIN PER CENT	GROSS MARGIN DOLLARS PER WEEK	DOLLAR CONTRIBUTION PER WEEK	NET PROFIT GENERATED PER WEEK	WEIGHTED SUMMARY RANKING
03041 KL RAT DG FOOD	7332.0 5	1173.12 1	.17 4	157.33 1	44.29 1	-73.01 9	1
03051 KL RAT STEW PK	2142.0 9	417.69 9	.22 1	91.92 5	21.42 2	-20.34 2	4
03061 KL RAT DS FOOD	2082.0 11	534.38 7	.15 6	87.61 6	19.08 3	-34.35 4	5
05031 VET DG FD LIVR	3528.0 6	343.98 10	.12 7	49.98 8	-4.41 9	-38.80 6	8
05041 VET DS FD CHKN	2892.0 7	281.97 11	.12 7	40.97 10	-3.61 8	-31.81 3	8
05051 VET DS FD 1L3	7776.0 4	758.16 4	.12 7	110.16 4	-9.72 10	-85.53 10	6
05061 VET DG FD 1-10	2112.0 10	184.80 12	.18 3	33.00 11	.44 7	-18.04 1	7
07041 RIVAL DS FD	8508.0 2	1106.04 2	.07 11	51.40 7	-79.76 12	-190.36 12	8
07051 RIVAL DS FD 3F	1605.0 12	593.85 6	.06 12	32.10 12	-54.83 11	-114.22 11	12
08011 DASH DGS FOOD	2532.0 8	430.44 8	.10 10	44.31 9	5.27 6	-37.76 5	8
11011 STREAK DG FOOD	9012.0 1	720.96 5	.21 2	148.32 2	9.38 5	-62.70 7	2
12011 STRONGHEART OF	7848.0 3	784.80 3	.17 4	130.80 3	9.81 4	-68.67 8	3

ITEM RANKINGS - ALL MEAT

ITEM DESCRIPTION	MOVEMENT (UNITS)	GROSS DOLLAR SALES	GROSS MARGIN PER CENT	GROSS MARGIN DOLLARS PER WEEK	DOLLAR CONTRIBUTION PER WEEK	NET PROFIT GENERATED PER WEEK	WEIGHTED SUMMARY RANKING					
07012 RIVAL BURG+JVVY	1782.0	338.58	9	.21	3	71.28	5	12.62	2	-21.23	4	2
07022 RIVAL MXD GRIL	1608.0	393.96	6	.14	4	48.91	7	-4.02	7	-43.41	7	7
07032 RIVAL CHKN CRN	1344.0	262.08	11	.25	1	57.68	6	13.44	1	-12.76	2	2
09012 ALPO LAMB OF	366.0	98.82	14	.08	10	8.08	13	-3.96	6	-13.84	3	12
09022 ALPO SCRAMBLE	906.0	226.50	13	.09	8	20.76	12	-9.06	8	-31.71	6	12
09032 ALPO MTHL +JVVY	1254.0	313.50	10	.12	5	41.80	9	.52	5	-30.82	5	9
09042 ALPO HORSMT DF	4698.0	1174.50	3	.09	8	107.66	3	-46.98	11	-164.43	11	5
09052 ALPO LIVER DF	4362.0	1177.74	2	.08	10	96.32	4	-47.25	12	-165.02	12	8
09062 ALPO CNK BEEF	8826.0	2206.50	1	.10	7	183.87	1	-106.64	13	-327.29	14	4
09072 ALPO CHICKEN	3354.0	838.50	4	.11	6	111.80	2	1.39	4	-82.45	10	1
09082 ALPO CHPU BEEF	930.0	232.50	12	.23	2	42.62	8	12.01	3	-11.23	1	5
10012 KAL KAN CHKN	1926.0	365.94	8	.07	12	24.87	11	-38.52	9	-75.11	8	11
10022 KAL KAN CNK BF	3252.0	616.52	5	.00	14	.00	14	-107.04	14	-168.69	13	14
10032 KAL KAN STEW	2016.0	393.04	7	.07	12	26.04	10	-40.32	10	-78.62	9	10

ITEM RANKINGS - DRY MEAL

ITEM DESCRIPTION	MOVEMENT (UNITS)	GROSS DOLLAR SALES	GROSS MARGIN PER CENT	GROSS MARGIN DOLLARS PER WEEK	DOLLAR CONTRIBUTION PER WEEK	NET PROFIT GENERATED PER WEEK	WEIGHTED SUMMARY RANKING
01014 PUR PUP CHOW	720.0 8	352.80 12	.15 1	52.80 8	6.60 2	-28.68 2	3
01024 PUR DGS CHOW 2	693.0 9	256.41 13	.12 3	30.03 11	-14.43 6	-40.07 4	7
01034 PUR DG CHOW 5	1555.0 1	1041.85 5	.02 12	18.66 13	-60.64 9	-164.83 10	9
01044 PUR DG CHOW 10	816.2 7	1101.93 3	.11 6	119.17 3	35.91 1	-74.27 6	1
01054 PUR DGS CHOW 25	829.5 6	2380.66 1	.03 9	157.60 1	-327.65 14	-565.71 14	6
02014 GAINES DG BITS	684.0 10	253.08 14	.12 3	30.78 10	1.71 4	-23.59 1	5
02024 GAINES DG BISC	981.0 5	362.97 11	.12 3	44.14 9	2.45 3	-33.84 3	4
02074 GAINES MEAL	1262.5 3	845.87 8	.02 12	18.93 12	-78.27 10	-162.86 9	11
02084 GAINES DGS FOOD	470.0 11	1348.90 2	.03 9	89.30 4	-185.65 13	-320.54 13	10
04014 GRAVY TRAIN 5	1100.0 4	737.00 9	.02 12	16.50 14	-39.60 8	-113.30 7	11
04024 GRAVY TRAIN 10	420.0 12	567.00 10	.10 7	61.32 7	-3.36 5	-50.06 5	7
04034 GRAVY TRAIN 25	357.5 14	1026.02 6	.03 9	67.92 6	-141.21 11	-243.81 11	14
05014 VETS DGS FD 5	1555.0 1	979.65 7	.13 2	120.51 2	-29.15 7	-127.12 8	2
05024 VETS DGS FD 25	410.5 13	1063.19 4	.08 8	88.25 5	-151.88 12	-258.20 12	11

ITEM RANKINGS - SEMI-MOIST

ITEM DESCRIPTION	MOVEMENT (UNITS)	GROSS DOLLAR SALES	GROSS MARGIN PER CENT	GROSS MARGIN DOLLARS PER WEEK	DOLLAR CONTRIBUTION PER WEEK	NET PROFIT GENERATED PER WEEK	WEIGHTED SUMMARY RANKING
02033 GAINES PRIME 2	603.0 8	524.61 9	.14 1	72.36 3	33.65 2	-18.79 1	2
02043 GAINES PRIME 4	878.0 3	1308.22 1	.06 5	72.43 2	-12.07 8	-142.89 12	3
02053 PRIME VARIETY	927.0 2	732.33 5	.05 7	37.08 6	-22.40 12	-95.53 9	6
02063 GAINES BURG 72	728.0 6	1084.72 2	.06 5	60.06 4	-10.01 7	-118.48 11	4
02093 GAINES BURG 36	819.0 5	647.01 7	.05 7	25.93 10	-8.87 5	-73.57 6	5
02103 G BURG LIVER	393.0 11	310.47 11	.05 7	15.72 11	-.98 4	-32.02 3	11
02113 G BURG CHICKN	303.0 12	239.37 12	.05 7	12.12 12	-.75 3	-24.59 2	12
03013 KL RAT SPEC CUT	1386.0 1	956.34 3	.11 2	101.64 1	60.63 1	-34.99 4	1
03033 KL RAT BURG 36	876.0 4	692.04 6	.05 7	35.04 7	-12.41 9	-81.61 8	6
03023 KL RAT BURG 72	571.5 9	851.53 4	.07 3	46.67 5	-20.95 11	-106.10 10	8
06013 TOP CHOICE 36	554.0 7	516.66 10	.05 7	26.16 9	-9.26 6	-60.93 5	9
06023 TOP CHOICE 72	417.0 10	521.33 8	.07 3	34.05 8	-15.29 10	-77.42 7	10

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