BUSINESS LOGISTICS SERVICE AS A DETERMINANT IN THE INDUSTRIAL PURCHASE PROCESS

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ABSTRACT

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This research investigates the relevance of business logistics service variables in the industrial purchase process. It is an attempt to provide greater understanding of the role of the logistics component in the marketing mix of a firm of manufacturing industrial installations.

The problem addressed by the research was the identification of market segments where the perceived role of business logistics service in the industrial purchase decision process varied. This entailed the identification of market segments which were significantly different in terms of the importance profiles across several buying criteria or factors, the ability of customers to perceive differences in the performance of suppliers in the market with respect to the buying criteria, and finally the overall preferences of customers relative to their attitudes towards individual suppliers on all criteria.

A two-phase approach was used to investigate the problem. In the first phase, exploratory data was collected to determine the market segmentation dimensions and the criteria used by purchase to select suppliers of the product. The product selected was commercial and industrial air conditioning installations, a part of the industrial plant and

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A two-phase approach was used to investigate the problem. In the first phase, exploratory data was collected to determine the market segmentation dimensions and the criteria used by purchase to select suppliers of the product. The product selected was commercial and industrial air conditioning installations, a part of the industrial plant and

equipment category. The first phase identified a series in the purchase process leading to the ultimate selection of a supplier. The dimensions chosen for segmenting the market were the buying influence centers consisting of contractors and engineers, the job type, the application of equipment, and the product type. All dimensions were investigated in the second phase. A list of nineteen purchase decision making criteria was developed for the second phase.

The validation phase tested several hypotheses about the level of determinance and importance of the supplier selection across market segments delineated along the dimensions identified in the first phase.

A random sample of nearly five hundred contractors and engineers was selected from fifteen major metropolitan areas. The data was collected with a mail questionnaire directed to principal operating officers in contracting and engineering firms. A followup mailing to non-respondents was completed within four weeks of the initial mailing to all sample elements. Using this procedure a response rate of 35 percent was obtained.

A five point importance scale was employed to measure importance of the buying criteria. Attitudes towards suppliers were also measured with a five point scale from 5 - excellent to 1 - poor.

Factor analysis was used initially in the validation phase to reduce the nineteen buying criteria to a more manageable set of variables. The importance ratings on the nineteen criteria were factored across the entire sample. The factor solution was rotated using the varimax method and a combination of variables with significant factor loadings was accomplished using zero-one weighting. Four factors were derived from the analysis and named using the composition variables. These were 1) operating lifetime of equipment, 2) sales service, 3) distribution service, and 4) miscellaneous.

Discriminant analysis was utilized to test the significance of the factor importance profiles across segments. Those dimensions found to be significantly different were 1) contractors versus engineers, 2) job type (contractors only), and 3) product type application (contractors only). Within the engineers group no further breakdown along dimensional lines was significant. The logistics or distribution service factor was found to be most important in differentiating on the contractor-engineer dimension, second most important for job type, and third for the product application group. Distribution service received a high importance rating from the contractor, traditional plan and spec job, and chiller product.

Once the significantly different segments had been identified, they were used as a framework to study the determinance of the four factors listed above in the preferences of customers toward a group of selected suppliers. The four suppliers used in the analysis were those receiving the highest number of overall preference votes. The independent variables were the relative ratings of the individual supplier versus the average rating on each criteria. The dependent variable was the preference versus toward the supplier on an overall basis. In sixteen of the possible twenty combinations of segments and suppliers, a significant difference was found between preferences and non-preferences based on supplier ratings. Distribution service varied in determinance from first to fourth in relationship to the two other factors. The conclusion was drawn that the determinance of the logistics factor in supplier preference varied by market segment and supplier. The ability of suppliers to perform on the various criteria was therefore significantly different enough as perceived by the respondents to make the factor determinant in some segments and not in others.

The results indicate that the ability of suppliers to perform varies by segment and likewise the importance of the purchase decision making factors. The marketer of industrial equipment must therefore investigate his competitive position with respect to logistics service across market segments. Where all suppliers are perceived as competitive but the factor is important, opportunities for increased performance in that segment exist for the supplier who is able to improve his logistical performance. In segments where his performance is not perceived as competitive, he must upgrade to at least the level of the other suppliers if he desires to neutralize their advantage on this factor. If he is unable to do this he may opt to devote his efforts to those segments where he can remain competitive.

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CHAPTER I

RESEARCH OVERVIEW

Introduction

This research deals with the relevance of business logistics variables in the industrial purchase process. It is an attempt to contribute a greater understanding of the role of distribution components in the marketing mix. As such, the subject matter cuts across both the marketing and business logistics management functional areas. Of particular interest is the inclusion of physical distribution service variables in the formulation of marketing strategy for industrial goods.

Strategic market planning consists of "the definition of market targets (or segments) and the composition of a marketing mix."[1] In formulating his market strategy the marketer attempts to realize his firm's overall and market objectives through this two stage process. Stage one consists of identifying as many alternative customer profiles as exist in the market place. These profiles or market segments define the universe of all customers into sub-universes or groups having similar characteristics. The various customer characteristics become dimensions along which these sub-groups may be located for classification. The marketer focuses his effort on one or more of the segments. Stage two consists of varying the elements of the marketing mix over which he has

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[1]Alfred R. Oxenfeldt, "The Formulation of a Market Strategy", Managerial Marketing: Perspectives and Viewpoints, ed. by Eugene J. Kelley and William Lazer, (Homewood, Ill.: Richard D. Irwin, 1967), pp. 98-108.

control to win the market loyalty of customers in the selected target markets or segments. The marketing manager decides how to set levels of the marketing mix elements to most efficiently achieve the firm's market objectives in each market segment.

The strategy of segmentation in the market place

> "represents a rational and more precise adjustment of product and marketing effort to consumer or user requirements. Successful application of the strategy of market segmentation tends to produce depth of market position in the segments that are effectively defined and penetrated."[2]

In pursuing a positive market segmentation strategy the marketing manager identifies all of the relevant segments, chooses those he feels may be cultivated within the scope of the available resources, and tailors his marketing effort to the segments selected. By adjusting his marketing mix to each segment, the manager more effectively concentrates to the needs of the market place.

When the marketing manager adjusts the marketing mix to the segments selected, he specifies the level of the several variables over which he has control. Many lists of these variables have been proposed in the marketing literature. One of the most complete is Borden's from his original conception of the marketing mix.[3] The physical handling

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[2]Wendell R. Smith, "Product Differentiation and Market Segmentation as Alternative Marketing Strategies", Journal of Marketing, Vol. XXI, No. 1, (June, 1956), pp. 3-8.

[3]Neil H. Borden, "The Concept of the Marketing Mix", Journal of Advertising Research, Vol. IV, No. 2, (June, 1964), pp. 2-7.

element includes those activities which are included in the area of study called physical distribution or business logistics (these terms will be considered synonymous). Some authors add the channels of distribution element to this list while others include order handling and processing in defining the set of logistics or distribution activities.[4] These activities create temporal and spacial utility in goods whether they be destined for consumer or industrial market segments. It is the integration of these activities into the marketing mix, which this research addresses.

Problem Background

The physical distribution or business logistics activities are called demand servicing activities by Lewis and Erickson. They comprise one of the two functions of marketing "to obtain demand and service demand".[5] The demand creating activities are those such as product planning, pricing, personal selling, advertising, etc.

In some firms the marketing manager may not have complete control over the PD activities, if he has any at

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[4]For more specific descriptions and definitions to physical distribution refer to: Ronald H. Ballou, Business Logistics Management, (Englewood Cliffs, N.J.: Prentice-Hall, 1973); Donald J. Bowersox, Edward W. Smykay, and Bernard J. LaLonde, Physical Distribution Management, (London: The Macmillian Co., 1968); James L. Heskett, Robert M. Ivie, and Nicholas A. Glaskowsky, Business Logistics, (New York: The Ronald Press, 1964); and James F. Magee, Physical Distribution Systems, (New York: McGraw-Hill, 1967).

[5]Richard J. Lewis and Leo. G. Erickson,"Marketing Functions and Marketing Systems: A Synthesis", Journal of Marketing, Vol. XXXIII, No. 3, (July, 1969), p. 8.

all. However, as Lewis and Erickson also propose, the demand obtaining and demand servicing activities are interrelated in the sense that "the firm's ability to service demand can be used as a demand obtaining force." The degree to which this relationship holds is dependent upon the level of importance that the purchaser places on having a product at the time and place where he wants it and how well the competitors in the market place can meet his needs in this area.

Ballou refers to the end result of logistics activities as customer service.

> "Customer service is a complex collection of demand related factors under the control of the firm, but whose importance in determining supplier patronage is ultimately evaluated by the customer receiving the service."[6]

He further comments that "there is a general lack of research in this area, but researchers have attempted to define the factors that make up customer service."[7]

Customer service may be measured in several different dimensions. Sometimes the availability of inventoried items or in-stock level is measured. Other measurements include time between order placement and receipt of merchandise, out of stock frequency and levels, and percent of customers receiving complete orders in a given time frame -- for example, 48 hours. Although these and many others may be used as measures of customer service it is the manifestation of

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[6]Ballou, p. 96.

[7]*Ibid.*

performing the PD activities as viewed by the buyer which is the only relevant measure of customer service. The customer is not interested in the percent of all orders filled within twenty-four hours when his is not one of them. The frequency with which his personal orders are filled within this time is more relevant to him and more useful in his evaluation of alternate sources of supply. It is these customer services, resulting from the performance of physical distribution activities, that are relevant to the marketing manager.

Ideally, the marketing manager who has control over the specification of the PD activity output should know the responsiveness of customers to varying levels of service. If he could devise a customer service function "that expresses revenue as a function of the customer service factors..."[8] he could readily set the levels of these activities which result in order cycle time, order cycle variability, frequency of back orders, etc. Ballou cites a hypothetical customer service function as:

$$\begin{matrix}\text{Sales Due} \\ \text{to} \\ \text{Customer} \\ \text{Service} \\ \text{(Firm A)}\end{matrix} = \left[\frac{\text{Average Order Cycle Time (A)}}{\text{Competitor Average Order Cycle Time}} + \frac{\text{Order Cycle Variability (A)}}{\text{Competitor Order Cycle Variability}} \right]$$ [9]

This model assumes that the customer faced with a supplier decision which includes logistics services compares each supplier's order cycle time and variability with those of

[8] *Ibid.*, p. 102.

[9] *Ibid.*, p. 103.

that supplier's competition. Sales are partially determined by the ability of each supplier to provide a level of service relative to the market place. This function directly relates the demand servicing activities to the demand obtaining activities.

Realistically, a function such as the above might be different for every customer and product. While tailoring the level of service to each customer would not be profitable to the firm, tailoring the level to specified market segments might be worthwhile. The quantitative measurements necessary to establish a function such as the one illustrated above are at best very difficult to gather. This information is not readily available in even the most data abundant information system of a large firm.

A behavioral rather than a purely mathematical approach to the revenue function is more straight forward and more readily attainable given most firms' data bases and collection capabilities. By determining how the buyer or purchaser perceives the customer service (of PD activities) in his purchase process, a function relating sales or market presence to the various marketing activities can be constructed. More specifically, a purchase decision for an industrial product might be based upon several sets of factors, one of which is the set of supplier and/or product attributes used to evaluate alternative sources of supply. A discussion of this purchase decision making model will appear in Chapter II.

The behavioral approach to a sales function would include information on, 1) the importance of logistics service versus other supplier rating criteria and 2) a measure of how well each supplier meets the various criteria. With this information plus the buyer's expression of overall preference for a supplier, the marketing manager may then select those criteria and services upon which he will put most emphasis in his strategy planning. The most determinant criteria in the purchase decision would be those where a high level of importance is attached and where a significant difference in competitors' performance existed. When coupled with purchase preference information a predictive model of supplier loyalty versus market performance should result. The theoretical basis for this model will be presented in Chapter II.

Problem Statement

The principal problem addressed in this research may be stated as follows:

> How determinant is business logistics service in the process of selecting a supplier of industrial goods?

Of primary interest is whether or not this service is a determinant factor in the selection process. An extension of the problem is to determine the degree to which logistics service is or is not a determinant for each of several market segments. If so, a strategy emphasizing better logistics service in some market segments results.

For industrial products, the solution of the problem entails several subproblem solutions.

These subproblems are as follows:

1) What are the relevant dimensions by which the market may be segmented?
2) Who is (are) the key purchase decision maker(s) for the product in each market segment?
3) What criteria for supplier selection are used by the purchase decision makers?
4) What is the relative importance of logistics service criteria when considered with other marketing and/or product criteria?
5) How do the decision makers rate the performance of competitors?
6) Does the importance rating and competitor rating on the selection criteria vary by market segment?
7) Is the choice of supplier related to the determinant criteria especially the logistics services for each market segment?

The answers to these subproblems should provide insight to the principal problem. A framework that serves as a guide to specifying logistics service levels for market segments will emerge. The factors upon which to concentrate marketing effort for each market segment are brought into focus.

<u>Research Hypothesis</u>

The guiding hypothesis of this research that results from the problem statement is:

market segments may be identified for which business logistics services are of varying degrees of determinance in the industrial purchasing decision.

This general or overall hypothesis was tested in relationship to other selection criteria. Thus a relative indication of determinance was obtained.

Two sub-hypotheses are critical to this overall hypothesis. These are:

1) the relative importance attached to supplier selection criteria varies by market segment, and
2) the performance of competitors in the market relative to the selection criteria varies by both market segment and individual firm.

Furthermore, if a particular selection criteria is highly determinant in the supplier selection process, that criteria is very important to the buyer and a high variation in performance of the competitors is perceived by the buyer. Thus the purchaser's choice preference among suppliers should be related to both the importance of the criteria and the performance of supplier relative to these criteria.

The specific market segmentation dimensions along which the determinance of logistics versus other product selection criteria are expected to vary are discussed in detail in the methodology chapter. These segments are the product application area and the nature of the purchase decision making center, each of which will be expanded further.

Overview of Methodology

Prior to beginning an empirical investigation to verify the research hypothesis, a real market place was selected from which to collect information. Because the primary objectives were to expand understanding of the industrial marketing area, the choice was limited to a product in the raw materials and components sector, the supplies and services sector, or the plant and equipment sector. The general criteria for selecting the product were that a multiple decision making influence structure was present, there were various applications for the product, and information for the study was readily available.

The final selection of a product was in the plant and equipment area. Specifically the marketing process for industrial and commercial air-conditioning equipment was investigated. This product area falls into the mechanical equipment area for commercial and industrial buildings such as offices, stores, hotels, restaurants, warehouses, manufacturing facilities, and similar buildings. There is a dearth of material in the literature upon marketing in the construction area. This research will provide some understanding of the relationships and procedures in this important industry.

Several factors made the market for mechanical equipment (air-conditioning components) attractive for this research. First, a multiplicity of purchasing influences is prevalent in the market. A preliminary investigation indicated that no less than six individuals potentially influence the purchase decision for the selected product. These are the building owner and/or occupant, the architect, the consulting engineer, the general contractor, the mechanical contractor, and the sheet metal contractor. Each of these has a varying influence upon the purchase decision depending upon several factors.

Secondly, a single piece of equipment has many potential applications across various types of installations. This feature yielded some attractive dimensions for segmenting the market as well as a varying set of conditions under which the selected product was purchased.

A limited amount of information was available on the purchase patterns in secondary sources. However trade association contacts were eager to provide background information and contacts with some individuals. A collection of primary survey information was dictated by the relative unavailability of previously published research in this specific area.

The research was conducted in two phases. Phase one had as its objective the collection of information describing the purchase process for the selected products. Its major thrust was to familiarize the researcher with the market and the generation of testable hypotheses. The second phase was designed to verify the hypotheses generated in phase one. Statistical data was collected and analyzed in this phase to test the research hypotheses, and lead to conclusive statements about the market place.

In phase one, a series of personal interviews was conducted with individuals associated with the purchase of industrial and commercial air-conditioning equipment. These interviews were conducted with building owners, architects, engineers and contractors. The interviews yielded a description of the purchase process from the perspective of each interviewee, an enumeration of the criteria used in the supplier selection decision, and classificatory data to group the respondents. The information was collected by utilizing an open-ended question format and general discussion with the interviewee. From the first phase information a structured format for gathering statistical data was constructed.

In phase two a questionnaire was mailed to principals in engineering and contracting firms. The selection of these individuals resulted from the interviews in phase one; the other influence centers were not found to be active in the purchase process. A statistical universe of 800 was enumerated in fifteen metropolitan areas, and a sample was selected from this universe. The primary analysis tool for determining market segmentation relevance was discriminant analysis.

The market was first segmented based on importance ratings for the buying criteria selected in phase one. These ratings were factored to reduce the data set to more manageable proportions. Next, discriminant analysis was utilized to test for differences among segments. After segmentation based on importance ratings, the attitudes of the market place in relation to the ability of selected suppliers to perform was studied. This second stage measured the determinance of the factors in the segments.

Research Limitations

Each piece of research using a specific situation to test general hypotheses carries with it some restrictions and limitations. This research is no exception. To apply the results of this research effort without at minimum considering its limitations could yield erroneous conclusions.

The limitations of this research result from three sources. First, the circumstances surrounding the specific product market in which the study was conducted. Second, the nature of a statistical or probability study such as this; and finally the restrictions of budget and time which constrict the full range of investigation and scope of any study.

Specifically the limitations of this study are---

Only one product area was studied. This resulted primarily from time and budget constraints. The inferences drawn from studying a single part of the entire plant and equipment sector of the industrial goods market will be generalizations. Thus statements about industrial goods marketing are made at the second level of generalization.

A limited geographical coverage was used in the research. While only a small number of metropolitan areas were selected, these include some of the largest markets in the United States. Inference about the total U. S. market for the study product are based upon this group of markets.

The major purchase decision making influences were considered in the study. While these often serve as proxies for other influences in reality, extraneous influences may persist in specific cases. The minor purchase influences are a subject for extension studies.

> A precise quantitative relationship between sales and service levels was not obtained. Once the most determinant criteria are found for each market segment further study would be required to estimate demand elasticities. This was beyond the scope of this research.
>
> Finally, the information obtained in the study was from contact with only part of the total universe. As in all statistical studies, certain cases can be found which are exceptions to generalizations made herein. The validity of the results is tempered with the accuracy of the statistical tools available.

Contributions and Potential Research Extensions

As was stated earlier one objective of this research is a contribution to understanding the relevance of physical distribution services in the industrial purchase process. The results should indicate first whether or not these services represent determinant criteria in selecting a supplier of a specific product and second whether or not the level of determinance varies by market segment.

Although the precise level of service does not result from this type of investigation for any of the criteria, the results serve as a guide to more detailed study of the individual criteria. Where large differences exist between performance levels on a particular criterion, the "best" level in the market place might be used as a target for future marketing effort. Where some criteria are highly determinant and concentration on them is within the scope of the firm's resources, an extension study measuring the demand elasticities and/or trade-offs between criteria would be in order. The segments of the market where this extension research should be conducted are determined.

The question of whether or not the level of physical distribution service should be varied by segment in the plant and equipment sector is reviewed in this research. The results would indicate whether or not a market segmentation strategy is applicable to certain industrial markets.

As extensions of this research beyond measuring the demand elasticities and criteria trade-offs, markets for other types of equipment should be investigated. The format of the investigation used here could be applied in other markets. A more general understanding of industrial market segmentation would result. An extension such as this would provide knowledge of how the determinance of supplier selection criteria might vary across many product marketing situations.

Organization Overview

The remaining chapters will be a detailed discussion of this research. They will deal with the theoretical background and conduct of the investigation.

As background material, Chapter II covers the literature available in both the marketing and business logistics areas of study, which is applicable to the research. This chapter will discuss the behavioral models which form the basis of the investigation, market segmentation, the industrial purchase process (including determinants of supplier selection), and the relationship of physical distribution service to marketing.

Chapter III presents the research methodology in detail. The results of the first phase of the study will be outlined as well as their implication in designing the second phase. Statements of detailed hypotheses, a data collection method and the statistical analysis of phase two data will also be outlined. Additional background literature which relates to the selected methodology will be brought to bear on this study.

Chapter IV reviews the findings dealing with segmentation of the market place for the selected product. The implications for strategic planning resulting from the verification of research hypotheses relating to segmentation of the market place will be discussed in this chapter.

Chapter V summarized the findings related to the attitudes toward suppliers of the study product and their ability to perform with regard to the choice criteria developed in Chapter IV.

Chapter VI reviews the results of the research in light of the existing research. The general conclusions and recommendations for future research are included in this summary chapter.

CHAPTER II

RESEARCH BACKGROUND

Introduction

This chapter presents the theoretical base upon which the research was founded. It reviews the literature pertinent to the accomplishment of the research objective and problems in the previous chapter. The first section deals with models of industrial purchase behavior in the marketing area. The second section discusses the behavioral material which led to the supplier selection measurement methodology utilized. Next a discussion of market segmentation covers perspectives which were used in addressing the research problem. Finally a section which presents thoughts on the interface between marketing and physical distribution services closes the chapter.

Industrial Purchase Behavior Models

Several models of the industrial buying process have been proposed in the marketing literature. While specific applications of the various models have a wide range, some are peculiarly suited for the present research. A great deal of the recent work in this area has been done by Wind, Faris, Robinson, and Webster.[1,2] The model developed by these researchers predominately serves as a guide to the

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[1]Patrick J. Robinson and Charles Faris, Industrial Buying and Creative Marketing, (Boston: Allyn and Bacon, Inc., 1967).

[2]Frederick E. Webster, Jr. and Yoram Wind, Organizational Buying Behavior, (Englewood Cliffs: Prentice-Hall, Inc., 1972).

factors affecting an "organizational" buying decision. Sheth[3] has posited another somewhat analogous model as a result of his work. The prominent features of both models lend themselves well to this research effort; and these will be integrated with the product selected for investigation. The adequacy of the models for describing the realities of the industrial purchase process is beyond the scope of the research. They will, however, provide a set of inputs which serve as guidelines for segmenting markets and identifying differences across the segments.

In proposing their model for simulating the industrial buying process, Wind and Robinson suggest that marketing strategies directed at the buyer "require knowledge of the buyer's behavior ... his decision processes, buying motives, and the relevant forces which affect his behavior."[4] This model breaks the buying process down into a series of phases and outlines a framework for evaluating each phase in various classes of buying problem situations. This framework suggests that a meaningful difference in buying behavior might be found as the decision maker operated at each

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[3]Jagdish N. Sheth, "A Model of Industrial Buyer Behavior", Journal of Marketing, Vol. XXXVII, No. 1, October, 1973), p. 52.

[4]Yoram Wind and Patrick J. Robinson, "Simulation of the Industrial Buying Process", Marketing and the New Science of Planning, ed. by Robert L. King, (Chicago: American Marketing Association, 1968), p. 444.

sequential phase. The phases presented are:

1) Anticipation or recognition of a problem (need) and a general solution.

2) Determination of characteristics and quantity of needed item.

3) Description of characteristics and quantity of needed item.

4) Search for and qualification of potential sources.

5) Evaluation of proposals and selection of suppliers.

6) Selection of an order routine.

7) Performance feedback and evaluation.[5]

Although these phases may not occur in distinctly identifiable steps, they serve as a useful guide in ordering the myriad of decisions made by the industrial buyer. As will be seen in more detail in the report of phase one research results (see Chapter III) the purchase process for the selected product closely parallels this series of buying phases. Principal purchase influencers recognize the process as being multistaged and exhibit varying behavioral characteristics depending upon the phase where they are most influential in decision making.

A more "integrated" version of this model is proposed by Webster and Wind[6] when they identify the classes of factors which influence the purchase decision. This model of

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[5] _Ibid_.

[6] Webster and Wind, p. 27.

organizational behavior is:

$$B = (I, G, O, E)$$

Where the symbols are
B - Buying Behavior
I - Individual Characteristics
G - Group Factors
O - Organizational Factors
E - Environmental Factors

The significance is that multiple sets of factors may influence the purchase decision and can account for observed differences in behavior. These factors potentially determine what criteria might be used in choosing among alternatives at various stages in the purchase process. Once more, phase one results indicated that the buyer of mechanical equipment is influenced in his behavior by many factors which conveniently fall into the above groups. Examples of such factors include the type of building into which equipment is placed, the building owner type, and the contract situation by which the project is operated.

The Wind and Webster organizational model also suggests that meaningful variations in behavior might be accounted for by the three dimensional factors; these being the buying center identity, the nature of the decision process and the buying situation.[7] Organization of an investigation for market segmentation strategy along these dimensions could prove to be fruitful. The buying center is the group of "members of the organization who interact during

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[7]Ibid., p. 110

the buying decision process."[8] The buying center roles are users, influencers, buyers, deciders, and gatekeepers. These roles may be performed by one or more than one individual. It is important that the marketer identify the relationships between the buying center roles and particular individuals within the buying organization. In addition, the individuals and their buying center roles which are most influential in the supplier choice decision must be determined. Finally, the stage in the purchase decision making process where the final decision is "actually" made should be identified. The decision making process integrates the decision making roles and the type of information needed at each stage. In some cases the actual alternatives which are considered in the latter stages of the process are defined at earlier stages, therefore constraining the range at these latter stages. Finally, the nature of the buying situation determines the amount of information needed by decision makers and to some extent the probability of a new supplier being considered. Webster and Wind characterize the buying situation by 1) the newness of the problem, 2) the amount and type of information required, and 3) the number of new alternatives considered.[9] Each individual decision maker may approach the problem differently with respect to the buying situation. As will be illustrated in Chapter III, the key purchasers in the buying

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[8] Ibid., p. 77.

[9] Ibid., p. 115.

process selected for study do approach purchase decisions differently from the standpoint of the buying situation.

In his model of industrial buyer behavior, Sheth also emphasizes various phases of the industrial purchasing process as well as the multiplicity of individual influences on the final purchase decision. He proposes that purchase decision making behavior consists of "the psychological world of the individuals ..., the conditions which precipitate joint decisions among these individuals ..., and the inevitable conflict among the decision makers and its resolution ...."[10] Sheth's model lends some understanding to the interactions among the various role players and individuals as they move through the phases of decision making. Of major significance is the recognition of how conflict resolution leads to a final purchase decision.

According to the Sheth model of industrial buyer behavior, three types of individuals are "continuously involved in different phases of the buying process."[11] These are engineers, purchasing agents, and users. The primary factor accounting for variations in behavioral patterns among these individuals is their expectations. The sources of these variations are the model variables of 1) the background of the individuals, 2) information sources, 3) active search, 4) perceptual distortion, and 5) satisfaction with

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[10] Sheth, p. 27.

[11] *Ibid.*, p. 52.

past purchases. These factors, which influence expectations of how well a supplier can perform relative to various criteria, provide a framework for predicting the determinant supplier selection criteria for a product as the influence level of the decision maker changes in the buying phase. If engineers tend to be highly influential in a particular buying segment, their expectations are relevant for designing market strategies. The engineer's expectations as to which manufacturer's offerings can meet his criteria can constrain the final choice by limiting the number of suppliers who might be specified in his design of a mechanical system or whose product will meet the specifications.

The second factor in Sheth's model, that of joint versus autonomous decision making, is determined by six factors.[12] These are grouped as product specific factors and company specific factors. Product specific factors relate to those connected to putting the product into use. The perceived risk, type of purchase and time pressure determine whether the decision making is predominately performed by a single individual or a group. In the purchase process for mechanical equipment, the risk perceived by contractors and engineers may vary depending upon their relationship with the building owner and the building use. While the product tends to be a one time purchase for some owners, it may be routine for the key decision makers, thus varying the type of

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[12] Ibid., p. 54.

purchase. Time pressure may or may not be a factor to these decision makers. The company specific factors of orientation, size and degree of centralization also are relevant to the problem.

Finally, the process of joint decision making through the resolution of conflicts between individuals is the key concept of the Sheth model. Conflicts between the decision makers result from differential expectations. "What matters most from the organization's viewpoint is how the conflict is resolved."[13] For purposes of this research, the relevant concern is that conflict resolution plays a varying part in the decision making process depending upon the number of individuals influencing the purchase decision and their degree of influence. This concept lends understanding to the role behavior encountered in the various phases of the process. An engineer who specifies certain product configurations has particular expectations relative to a group of suppliers' quality, performance, etc.. On the other hand a contractor more interested in price, delivery, etc. may have a set of divergent expectations. These create a conflict which must be resolved in the final phases of the process or a reiteration might have to take place.

The combination of these models of industrial purchasing behavior (Webster -- Wind and Sheth) provides a framework from which to investigate some dimensions for

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[13] _Ibid._, p. 55.

segmentation of an industrial product market, specifically mechanical air-conditioning equipment. The roles, degrees of involvement in purchase decision making, and situations in which the individuals are found to varying degrees in the market place suggest dimensions for investigation. Varying marketing strategies aimed at segments delineated along these dimensions would be designed on the basis of the purchase decision making criteria which are most determinant in each segment. In each market segment a measure of which criteria are most relevant or determinant in choosing among the suppliers to that segment is needed. This will lead to a framework by which marketing strategies aimed at each segment are designed. As the amount of influence in the purchase decision making process, their expectations resulting from their roles as decision makers, and the purchase situation is varied; a difference in the pattern of determinant factors should be revealed.

Attitude and Measurement and Brand Preference

It is generally accepted by marketing researchers that attitudes toward various market offerings are closely associated, although in varying degree, with purchase behavior. Rosenberg defined an attitude as "relatively stable affective response to an object."[14] This psychological definition of attitude has been translated into marketing

[14] Milton J. Rosenberg, "Cognitive Structure and Attitudinal Affect", Journal of Abnormal and Social Psychology, Vol. VIII, (November, 1956) p. 367.

as a positive or negative disposition toward a particular product or brand of product. This section will briefly review the basic attitude model proposed by Rosenberg, Fishbein and Sheth as well as some research efforts attempting to apply these models to marketing situations.

In his model of attitude structure, Rosenberg theorized that an attitude was made up on two components related to personal values. He tested the association of these components summed over all relevant values with an overall feeling toward an object. The components of Rosenberg's attitude model were:

1) Value importance (VI) - the relative importance of the stated value in relation to other salient values; and

2) Perceived instrumentality (PI) - the extent to which the stated value was "attained or blocked" by the attitude object.[15]

Thus Rosenberg's model stated that the overall attitude toward an object was a sum of all value importances times the perceived instrumentality or

$$A = \sum_{i=1}^{n} [(VI_i)\ (PI_i)]$$

where A - attitude towards the object

n - number of values

VI_i - value importance of i^{th} value

PI_i - perceived instrumentality of i^{th} value

Rosenberg's research indicated that the sum products of value importance and perceived instrumentality were "significantly

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[15] *Ibid.*, p. 368.

related to attitude position."[16] Thus, a case was made for a two component model of attitude structure toward an object.

The Rosenberg model was tested in a marketing situation by Sheth and Talarzyk.[17] Respondents were asked to rate VI and PI as well as rank preferences for brands based on several attributes. The findings of this research indicated that perceived instrumentality was a "better" surrogate for attitude towards a brand than either value importance alone or perceived instrumentality times value importance. These authors note however that the results may have been confounded by several factors. Particularly, the implicit inclusion either consciously or unconsciously of the importance of an attribute in rating the perceived instrumentality of a specific attribute.[18] Also, the similarity of value importances across products in a class, and the aggregation of purchasers in one group.

This research suggests that perhaps segmenting the study group by such things as product usage patterns, demographics, and purchaser types might explain the low associative properties of the two component model of Rosenberg.

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[16] Ibid., p. 369.

[17] Jagdish N. Sheth and W. Wayne, Talarzyk, "Perceived Instrumentality and Value Importance as Determinants of Attitudes", Journal of Marketing Research, (February, 1972), pp. 6-9.

[18] Ibid.

Bennett and Scott[19] took these factors into consideration when they tested the Rosenberg model in another setting. The market was segmented into two groups who were hypothesized to have differing value importance profiles for similar product attributes. This research held that value importance when used as a weighting factor in fact contributed little to the association of attitude with perceived instrumentality. However when the market was divided by importance profiles, the predictive ability of PI was significantly enhanced. The results of the Bennett and Scott study tend to support a meaningful market segmentation base utilizing the value importance profiles for individual customer types.

Relating these results to the models of industrial purchase behavior suggests that market segments delineated by influence center and the degree of control over purchase decision making by these centers in specific purchasing situations would provide revealing results. While the differentiating variable between segment would be the value importance profiles by product and/or supplier attributes, the divisions could be made on demographic dimensions and characteristics of purchase situations. Brand preference within each segment could be measured in association with perceived instrumentality ratings as Bennett and Scott suggest.

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[19] Peter J. Bennett and Jerome E. Scott, "Cognitive Models of Attitude Structure: 'Value Importance' *is* Important", in *Combined Proceedings: 1971 Spring Conferences*, ed. by Fred C. Allvine, (Chicago: American Marketing Association, 1972)., pp. 346-350.

Bass and Wilkie[20] observed that value importance contributes to predictability for brand preference attitude models. Using the identical data bank as in the Sheth and Talarzyk study, this effort held that both the beliefs and importance scores should be normalized across brands for each consumer.[21] In doing so, Bass and Wilkie found a greatly enhanced predictability in the two component model and additionally in the "beliefs only" model as well. The controversies surrounding the one versus two component model are thoroughly reviewed by these researchers, who conclude that the analytical techniques utilized can have a significant influence on the study results, while a single data set is investigated. Although the controversy has not been decided, a new perspective, that of choice in analytical tools, has been interjected.

While not providing a direct resolution to the controversy, the propositions of Myers and Alpert in their article on determinant buying attitudes perhaps reveals some of the cause for mathematical differences in testing the two model types, (Single and two component). The majority of studies dealing with prediction of brand preference have measured the association of preference ratings with importance scores and instrumentality ratings. As a result one

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[20]Frank M. Bass and William L. Wilkie, "A Comparative Analysis of Attitudinal Predictions of Brand Preference", Journal of Marketing Research, Vol. X, No.3, (August, 1973), pp. 262-269.

[21]Ibid.

might expect high correlations between brand preference and attribute importance scores. However as Myers and Alpert observe the attributes of the product and/or supplier that are most determinant, are not necessarily those which are most important. They refer to attitudes toward each feature of the product or brand which "are most closely related to preference or to actual purchase decisions"[22] as determinant. The most relevant contribution to understanding the relationships of multi-attribute models lies in the observation that although a particular feature may be rated highly on the importance scale, the degree to which all competing brands provide that feature may be perceived as equivalent by the purchaser. If this situation holds for a feature, that feature cannot conceptually be considered as a determinant in the purchase selection or in expressed preference.

This concept also provides some insight into the enhanced predictability of both the one and two component models when the importance and instrumentality scores are normalized before being correlated with purchase preference. Since the measures of importance and instrumentality, in the above studies were summed across attributes or features prior to correlation with brand preference, the determinance variation among the attributes was lost. This suggests either a stepwise or at least multiple variate analysis rather than

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[22]James H. Myers and Mark I. Alpert, "Determinant Buying Attitudes: Meaning and Measurement", Journal of Marketing, Vol. XXXII, No. 4, (October, 1968), pp. 13-20.

an aggregated measure of overall attitude.

Another conceptual matter which needs attention is the relationship between attitude behavior and behavioral intent. While the Rosenberg model deals primarily with the structure of attitudes, two other models namely the Fishbein and Sheth models treat attitudes as part of the model for predicting purchase preferences and/or behaviors. Research studies have been conducted on all three models to test their effectiveness in predicting purchase behavior. Since the expressed behavior is of prime interest to marketers, rather than simply attitudes alone, some discussion must be directed toward how attitudes, whether investigated via a one or two component model, are related to purchase behavior.

In their investigation of the relationships between attitudes, belief, behavior intentions and behavior, Harrell and Bennett[23] found that behavior as measured by a panel diary form of the dependent variable was not highly correlated with preference data. While only a .4 coefficient of correlation resulted, there may have been methodological circumstances which precluded higher values. This research also tested the effectiveness of including normative beliefs

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[23]Gilbert D. Harrell and Peter D. Bennett, "An Evaluation of the Expectancy Value Model of Attitude Measurement for Physician Prescribing Behavior", Journal of Marketing Research, Vol. XI, No. 3, (August, 1974), pp. 269-278.

in the extended version of the Fishbein model. The model tested was

$$B \approx BI = f\left\{ \sum_{i=1}^{n} (B_i a_i W_1) \quad + \quad [(NB)(Mc)]W_2 \right\}$$

where B - Behavior

BI - Behavioral Intent

B_i - Belief About i^{th} Outcome

a_i - Evaluative Aspect of i^{th} Outcome

NB - Normative Belief

Mc - Motivation to Comply with Norms

Wj - Beta Weights

n - Number of Relevant Outcomes

Although more complex than the basic attitude model of Rosenberg, this extended version of the Fishbein model "includes a measure of social consequences."[24] of a particular behavior. While the study found that including the normative factors in the model did not enhance the predictability of brand preference, the authors express caution about excluding these factors from other marketing studies.

The results of the Harrell and Bennett investigation suggest that further research is necessary to determine how closely behavioral intent and actual behavior are in fact related. The authors suggest that situation specific factors might well be the major intervening force between these variables. This would lead to a research design which offers various situations more closely defined by familiar purchase

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[24]Ibid.

circumstances among which the respondent would be allowed to choose. This research recommends the use of behavioral intent as a dependent variable in attitude studies, until more is known about the variables which intervene between behavioral intent and actual behavior. Furthermore a disaggregated form of the model which weights all product and/or supplier attributes individually is recommended for use when studying marketing situations.

A detailed comparison of the Rosenberg and Fishbein models as well as a model proposed by Sheth was conducted by Raju, Bhagat, and Sheth to measure the relative predictability of all three models. This work provides a sound review of the models and accurately outlines a testing criteria scheme. The Sheth model as presented in this research includes four dimensions of behavioral intent toward a particular brand. Behavioral intention is

> "a function of 1) evaluative beliefs about the object's potential to satisfy needs, wants, and desires, 2) perceived social stereotype of the object, 3) predisposition resulting from past satisfaction, and 4) situational influences that the person anticipates will be effective at the time of behavior."[25]

In contrasting the three models with regard to predictive validation, cross-validation, and validity generalization, complete discussion of these criteria may be found

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[25]P.S. Raju, Rabi S. Bhagat, and Jagdish N. Sheth, "Predictive Validation and Cross Validation of the Fishbein, Rosenberg, and Sheth Models of Attitudes", in Advances in Consumer Research, ed. by Mary Jane Schlinger, (Chicago: Association for Consumer Research, 1975), p. 405-425.

in the authors' paper. Generally these forms of validity test the predictability of each specific model across various samples from one or more populations. The conclusions of this research support the inclusion of situation specific components in predicting behavioral intentions. In addition it appears that a disaggregated format in the model again tends to enhance predictability. While this study utilized variates derived from a factor analysis of product related items, the use of a disaggregated form of an attitude model is again indicated. This research also concluded that in all three models, "attitudes were effective predictors of behavioral intentions."[26]

The cited research in general concludes that while not all models perform equally in a specific situation, attitudes toward a purchase object or act may be used as predictors of behavioral intentions. Whether specifically included in a mathematical sense or not, situation specific factors are generally agreed to influence both the purchase intention and purchase behavior. These conclusions strongly suggest designing attitude research which recognize varying situational factors in the purchase decision. These factors may be in the form of applications for the product, circumstances surrounding the purchase act, random unexpected events which change the purchase environment or others relevant to the specific research problem. The evidence of

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[26]Ibid., p. 422.

previous research strongly upholds the inclusion of situation specific variables in a model of behavioral intention.

Market Segmentation

Smith's pioneer work with market segmentation was primarily oriented toward consumer products. As a marketing strategy, segmentation has received wide attention in the marketing literature on consumer goods. On the other hand only a small group of researchers have devoted their efforts toward segmentation of industrial markets. The reasons for this diversity is not documented; however, one viewpoint might render the question moot. Frank, Massy, and Wind maintain that --

> "the choice of segmentation as a marketing strategy for industrial goods and services in a domestic market and both consumer and industrial goods in international markets is predicated on the same assumptions and criteria as segmentation for consumer goods in the domestic market."[27]

The implication is that the principles of designing different strategies tailored to individual market segments, might be equally applicable in both consumer and industrial goods markets. The problem that emerges is therefore not one of finding new ways to plan strategy, but rather new methods of segmenting various types of industrial markets. These authors suggest that segmentation be carried out in a two step process. The first step involves segmenting the organizations (buyers) in the market place according to whether or

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[27]Ronald E. Frank, William F. Massy, and Yoram Wind, Market Segmentation, (Englewood Cliffs: Prentice-Hall, Inc., 1972), p. 91.

not they may or may not use the firm's product. After this "initial screening" a more detailed analysis of the purchase characteristics of potential customers is performed in segmenting the market.

Cardozo in his survey of the literature on industrial market segmentation found "only six sources which carried the concept of segmentation beyond end use and geography."[28] The bases which he found were:

1) The type of buying situation.
2) The phase of the decision process.
3) The primary role of the purchaser and his commitment to it.
4) The purchasing strategies employed by different buyers.
5) The interest of, or problems faced by different industrial buyers.

and 6) The self confidence of particular buyers.[29]

In a later piece of research, Cardozo and Cagley demonstrated that

> "industrial purchasers held clear preferences for types of bidders and bids, responded to the amount and type of risk in the purchase situations, and exhibited identifiable behavior patterns which could form the bases for segmenting industrial markets."[30]

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[28]Richard N. Cardozo, "Segmenting the Industrial Market", in King, p. 433.

[29]*Ibid.*, pp. 433-434.

[30]Richard N. Cardozo and James W. Cagley, "Experimental Study of Industrial Buyer Behavior", *Journal of Marketing Research*, Vol. VIII, No. 3, (August, 1971), p. 32.

What this research suggested was an approach to delineating market segments that did not utilize merely demographic information on buyers such as age, income, education, etc.

A set of situation specific characteristics is recommended by Frank, Massy, and Wind as one choice of segmentation bases for organizational buyers. Borrowing from the Webster and Wind model of organization buyer behavior; these authors suggest such bases as the composition of the buying center; the buying situation; the attitudes, perceptions and preferences of the buyer towards alternate sources of supply; and the determinants of the buying decision.[31] The attitude and decision determinant profiles for market segments delineated by the prior dimensions would serve as a direct link between the target segments and design of market strategies directed to them.

It has been noted above that Bennett and Scott found significantly different value importance profiles for military and industrial users of a product. This would lead to a research design for segmentation which accounted for differences in product use by buyers as suggested by Frank, Massy and Wind. The former study investigated:

> "Whether the structure of the relationship between brand appeal and instrumentality remains the same across segments where there are significant differences in perceived importance of the attributes among the segments."[32]

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[31]Frank, Massy, and Wind, pp. 98-101.

[32]Bennett and Scott, p. 347.

The results indicate that a difference between segments did in fact exist. The observed difference lends support to the proposition that brand preferences are more predicatable by perceived instrumentality scores after segmentation. This would indicate that profiles of preferences, attitudes, and perceptions are relevant bases for segmenting industrial markets. Furthermore within a type of purchaser delineated by demographic variable, several importance and attitude profiles may even exist. By first segmenting on importance or attitude profiles, a strategy might be more accurately designed for the target segments.

Another study of market segmentation, although not in the industrial goods area, also demonstrated the viability of using attitude profiles as segmentation bases. Cunningham and Crissy in their investigation of market segments for foreign and American compact automobiles, found that demographic and socioeconomic variables could effectively be augmented by attitudinal and motivational variables.[33]

Lehmann and O'Shaughnessy were also able to show that different types of buyers attach varying degrees of importance to product and supplier attributes in the act of selecting a supplier of industrial products. While their research was not directly focused on market segmentation, the evidence points toward attribute importance profiles as a

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[33]William H. Cunningham and William J. E. Crissy, "Market Segmentation by Motivation and Attitude", Journal of Marketing Research, Vol. IX, No. 1, (February, 1972), pp. 100-102.

segmentation base. This study concentrates primarily on the purchaser's perception of a product utilization situation. In defining the four product types studied the authors employed a classification scheme which entailed the buyers perception of "problems likely to be encounted if the product is purchased."[34] This study showed both that the importance of several attributes was significantly different across product types and that the two groups of purchasers varied significantly in the amount of importance attached to several attributes by product type.

Existing research, in particular that cited above, indicates that non-demographic bases are viable for segmenting markets for industrial goods. Extensions of this research should attempt to expand the number of types of products, buying influences, and purchase situations. The present research will investigate potential non-demographic segmentation dimensions for a single product type. A set of buying influences and purchase decision making stages will be incorporated with application situations for the selected product, maintaining an equivalent functional use. Attitude and preference profiles for the various market segments after being identified will be compared across segments.

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[34]Donald R. Lehmann and John O'Shaughnessy, "Difference in Attribute Importance for Different Industrial Products", Journal of Marketing, Vol. XXXVIII, No. 2, (April, 1974), pp. 36-42.

Figure 1 summarizes both demographic and non-demographic dimensions for segmenting the industrial market place. When utilizing any of the dimensions an analysis of buying criteria importance profiles should be employed to establish the significance of any single dimension or combination of dimensions for a single market place. A combination of both demographic and non-demographic dimensions might exist for any product market situation. Any dimensions which are therefore relevant based in a difference in importance profiles should be used. In addition combining non-demographic classes with the traditional demographics may lead the researcher to explanations of differences across the latter dimensions. As such, each study of the industrial goods sector must include segmentation dimensions in both cases.

Figure 1

SUMMARY OF SELECTED MARKET SEGMENTATION DIMENSIONS

Demographic	Non-Demographic
Geography	Buying Situation
End Product Use	Product Application
SIC Category	Stage in Purchase Decision Process
Sales Volume	Buying Center Roles
Employment	Risk Level in Purchase
Product Classes	
Position or Title of Buyer	

Physical Distribution and Marketing

Whether termed physical distribution, business logistics, distribution, or materials management, the demand servicing activities referred to by Lewis and Erickson encompass an area of business management which create time and place utility for the products of the firm. Primarily the objective of physical distribution (hereafter referred to as PD) activities is to have the right product at the right place at the right time in the right condition. While appearing as a straight forward charge, the accomplishment of this objective conceivably involves the management of a myriad of activity centers.

The National Council of Physical Distribution Management outlines these activities as

> "...freight transportation, warehousing, material handling, protective packaging, inventory control, plant and warehouse site selection (and site location), order processing, and customer service."[35]

From a marketing perspective it is the cause and result of the importance of the PD activity center which is relevant. As Ballou observes:

> "The activities which are referred to as logistics activities are a consequence of the distance and time gaps between production's location and the point of consumption and the inability or the economic undesirability of having production output respond instantaneously to the needs of the market place."[36]

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[35]Defined by the National Council of Physical Distribution Management as cited in Donald J. Bowersox, Edward W. Smykay, and Bernard J. LaLonde, Physical Distribution Management, (New York: The Macmillian Company, 1968), p. 4.

[36]Ronald H. Ballou, Business Logistics Management, (Englewood Cliffs: Prentice-Hall, Inc., 1973), p. 8.

When viewed in terms of a national sales grid, the spatial and temporal relationships between buyers and the seller become increasingly complex. Thus the orientation of management towards the PD activities can be an important consideration.

Because of the unique nature of PD as an interfact activity between production and marketing, the control placement of the demand servicing functional area can be a perplexing decision for top management. As Schiff states:

> "The logic would suggest that this independent function because of the site of expenditures involved, the uniqueness of its functions, and its significance as a kind of balancing mechanism between manufacturing and marketing particularly as it relates to inventory management, would place it in the organization structure on a level equal to Manufacturing, Marketing, Engineering, and Finance."[37]

According to LaLonde, the perspective of top management will determine where the control of the PD function is placed in the organization. He observes that

> "in a company where top management is primarily financial, the distribution function is often viewed as a means of cost reduction. If marketing or sales predominate, the emphasis is frequently on service capability and demand responsiveness."[38]

The proper organizational posture for PD would appear to be governed by 1) the proportion of total cost accounted for by

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[37]Michael Schiff, Accounting and Control in Physical Distribution Management, (Chicago: The National Council of Physical Distribution Management, Inc., 1972), p. 6.

[38]Bernard J. LaLonde, "Strategies for Organizing Physical Distribution", Transportation and Distribution Management, (January, February, 1974), pp. 21-22.

the performance of PD activities and 2) the relative responsiveness of demand facing the firm to variations in the level of service provided by these activities. The present research is directed towards formulation of suitable groundwork for this latter consideration. If PD services are significant determinants of demand response through brand preference and purchase behavior, the level of service should at minimum be specified by marketing and included in their strategic planning.

Wherever the control of the PD activities is placed in the organization, the knowledge of demand responsiveness of their output is desirable. There are two dimensions measuring the output of these activities which appear to be relevant. As Smykay, Bowersox and LaLonde observe:

> "A firm's physical distribution capability is measured in terms of speed and consistency. ...a fast delivery cycle is of little value to customers unless it is consistently met from one order to the next ...."[39]

One measure of how well PD activities are operating is the time it takes to place a customer's order into his physical possession. This is referred to as order cycle time, and is composed of all the portions occupied in communicating, processing, and transporting the order. Although monitoring the levels of each of those is important from the firm's viewpoint, the customer sees only one result -- the total time from placement to receipt of his order. He is oriented

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[39]Bowersox, Smykay and LaLonde, p. 14.

towards this total time in his evaluation of his supplier.

Another aspect of customer service resulting from PD is the level of stock availability. If an ordered item is not available from inventory or if production capacity is dedicated to another order, the company may be said to be out-of-stock. Failure to provide availability might result in either a back order, a lost sale, or a lost customer. While the affect on demand is merely temporary in the first instance, a lost sale and a lost customer have lasting effects on the demand structure. Both lost revenue and opportunity cost of all marketing activities directed at that customer result.

Some firms establish service standards based on both service time and stock availability. An example of such standards is:

> "1) the system will be designed to provide 95% inventory availability for category A products, 92% inventory for category B products, and 87% for category C products;
>
> 2) desired delivery of all customer orders will be within 48 hours of order placement for 98% of all orders ....[40]

Standards such as these are only a result of information provided by customer contact in the form of marketing research. In estimating service standards, measures that are meaningful to the customer must be utilized. Servicing 98% of all customers within a selected time frame is not relevant to the

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[40] Ibid., p. 41.

single customer. He only sees the service with which his orders are delivered. As a result he measures the service in terms of the number of orders that he personally receives within a given time frame. If he is in the two percent not served 98% of the time, it is probable that he may shift his supplier loyalty.

Several alternative lists of physical distribution services are available in the literature. One which is complete and appears to be customer oriented is proposed by Willett and Stephenson:[41]

1) Order cycles length: The time elapsed between placement of an order and receipt of goods, defined in terms of specific customer's expectations based on a history of orders from a supplier and/or a supplier's guarantee.

2) Consistency of order cycle length: The degree of variation in the lengths of a history of order cycles from a specific supplier to a single customer. This variable is measured in terms of the absolute deviation from the mean of a history of order cycle lengths and/or a supplier's guarantee.

3) Order preparation: The way in which orders are formulated and the medium by which orders are transmitted from customer to supplier.

4) Order accuracy: The degree to which items received conform to the specification of the order.

5) Order condition: The physical condition in which the goods are received.

6) Order size: A service restraint consisting of the minimum size of an acceptable order.

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[41]P. Ronald Stephenson and Ronald P. Willett,"Selling with Physical Distribution Service", Business Horizons, (December, 1968), p. 78.

7) Order frequency: A service restraint consisting of the maximum frequency with which orders can be placed in a given period of time.

8) Billing accuracy: The degree to which billing is accurate with regard to actual order.

9) Billing efficiency: The degree to which the billing procedure facilitates the customer's handling of accounts payable.

10) Back order: The quality of the supplier's procedures for handling back orders.

11) Claims: The quality of the supplier's procedures for handling buyer's claims.

The above authors examined the first three factors, claiming that they are the "most potent in terms of their influence on demand."[42] A study was conducted that measured

1) reorder cycle service times received by retailers on comparable orders

2) retailers ratings of service times, and

3) conditions under which orders were placed.

The results indicated that "ratings of satisfaction with service received were a linear function of service time."[43] A measure of customer response to the time dimension of PD service was established in this research.

Ballou and DeHayes found that consistency of service is more important to customers as a differentiating factor than is pure speed. This study indicated that customers are

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[42] Ibid.

[43] Stephenson and Willett, "Determinants of Buyer Response to Physical Distribution Service", Journal of Marketing Research, Vol. V, No. 3, (August, 1969), p. 279.

inclined only to alter their order size in response to changes in average delivery time.[44] Both of the cited studies indicate that a change in the level of PD service can influence the demand level for a particular product. They do not however study the responsiveness in demand when PD service is varied in relation to other product and/or supplier attributes. Various other factors which made up part of the purchaser's buying criteria are such things as price, quality of products, reputation of the selling firm, service on repair or adjustment for faulty products, etc.. These factors should be included in a study aimed at designing market segmentation strategies. Several other research efforts have attempted to show the relative positions of a general list of product or supplier attributes in terms of importance and determinance. These studies lead to assumptions or hypotheses about the universe of criteria or factors which should be included in the set of variables for an industrial product market.

In his study of the factors which industrial buyers considered most important Klass listed the following:

1) maintaining quality consistent with specifications;
2) on time delivery performance;
3) honest and sincere attitude on the part of the salesman;
4) price;

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[44]Ronald H. Ballou and Daniel W. DeHays, Jr., "Transport Selection by Interfirm Analysis", Transportation and Distribution Management, (June, 1967), pp. 33-40.

5) keeping buyers informed of new product and product development; and

6) effective handling of requests for samples and information.[45]

These factors were considered most important by a general cross section of buyers. The presentation of this research did not however specify the importance ratings by buyer type (e.g. - purchasing agents, managers, engineers, etc.). What is relevant from the research are the relative positions of product quality, delivery, price, and sales related factors. It may be concluded from this work that marketing factors as well as product quality rank among the most important for industrial purchases.

Dickson conducted a study of relative importance of 23 product and supplier related factors rated by purchasing personnel. He concluded that:

> "the ability of potential vendors to meet quality standards and delivery schedules, stand out as the two most critical factors in the vendor selection process."[46]

A similar study by Wind, Green and Robinson found the quality-price ratio and delivery reliability to rank substantially

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[45]Bertrand Klass, "What Factors Affect Industrial Buying Decisions", Industrial Marketing, (May, 1961), p. 34.

[46]Gary W. Dickson, "An Analysis of Vendor Selection Systems and Decisions", Journal of Purchasing, (February, 1966), p. 9.

above all other factors in the vendor selection process.[47] Although this research studied only the importance ratings of ten product and supplier attributes, some important conclusions from a methodological perspective are relevant. The respondents, in addition to being presented with a list of all attributes to rate singly, were also presented with groups of attributes (three (3) at a time). The conclusions from comparing the results were that with a large number of attributes a linear model of the ratings without interaction terms was a good measure of overall performance. When a small number of attributes was presented, the interaction terms were important.[48]

When Bennett and Scott examined the importance of supplier attributes across market segments, they found the ordering to be significantly different between segments. Their research concluded that an analysis "conducted across total markets where there may be inter-segment differences in attribute importance"[49] might seriously affect results. Four-fifths of the most important attributes changed relative positions across the two segments studied. These attributes

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[47]Yoram Wind, Paul E. Green, and Patrick J. Robinson, "The Determinants of Vendor Selection: The Evaluation Function Approach", Journal of Purchasing, (August, 1968), pp. 29-41.

[48]Ibid.

[49]Bennett and Scott, pp. 346-350.

were reliability, non-flammability, quality, and load life.[50] The rating by the total market and the segments of delivery lead time was not specifically reported.

In their study of the importance of product and supplier attributes by product type, Lehmann and O'Shaughnessy also found a variation in the average attribute importance across segments. For two of the four product purchase types, reliability of delivery was ranked most important and fourth most important by the remainder.[51] Price was second, eighth, eighth, and first across all four types. The evidence suggests once more that importance profiles change across segments and further that a PD related factor (delivery reliability) was not only rated highly but changed in rating across the defined product types.

In summary, these studies demonstrated two important points. First, PD services rank highly as important supplier selection criteria in industrial markets; and additionally, that some purchasers consider consistency of delivery more important than delivery time. Secondly, the relative importance may change across segments of the market. The present research attempts to extend the findings of the existing research, in the following ways:

1) Consider more than one element of PD service in relation to other product and supplier attributes; and

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[50] Ibid.

[51] Lehmann and O'Shaughnessy, pp. 36-42.

2) Measure the determinance of the various supplier selection criteria, especially those related to PD, across relevant market segments.

The remaining chapters will present a research methodology and the results of an empirical study aimed at extending the existing research in the industrial market segmentation literature. The design will incorporate portions of the industrial behavior models discussed in the beginning of this chapter. The results of a preliminary investigation of a specific product market will be presented from the perspective of these models. Further the research design will utilize the contributions of the research cited above in measuring attitude profiles of market segments in the selected product market.

CHAPTER III

RESEARCH METHODOLOGY

Introduction

Chapter Three presents a research design intended to guide the collection and analysis of empirical information relevant to the role of physical distribution service factors in the industrial purchase decision. A specific industrial market was selected for study which was closely aligned with the characteristics desired for the investigation. These characteristics, as alluded to in the previous chapter, were:

1) A multiplicity of purchase decision making influences;
2) A multi-stage purchase process;
3) A set of purchase decision criteria by which suppliers are evaluated; and
4) A set of various purchase situations.

The market place selected for study was the commercial and industrial air-conditioning industry. As will be discussed below, this industry exhibited the characteristics desired for the study. The research was sponsored by a member of that industry whose identity will not be disclosed. As a result this research was designed to help meet the sponsor's needs as well as the academic interests of the researcher.

The research design consisted of a two phased approach to the problem. To reiterate, the central problem of the research was to identify relevant market segments for an industrial product, and further measure the determinance of physical distribution service factors in the purchase decision for that product. Phase I of the research was an exploratory effort designed to aquaint the researcher with the industry under study, and certify the existence of the desired characteristics (as listed above). The primary focus of Phase I was determination of the relevant buying influencers, a set of purchase situations, a universe of decision making criteria utilized by purchase decision makers, and finally the sequence of events in the purchase process. At the end of Phase I, the findings were compared to the theoretical concepts detailed in Chapter II. The detailed plan of Phase I will be presented below in conjunction with the results of that exploratory effort.

Phase II of the research was an empirical study aimed at verifying the relationships which were hypothesized to exist in the market place. A set of research hypotheses was tested based on Phase II data. These hypotheses, generated as a result of the exploratory findings in the first phase were tested at the end of the second phase. The analysis plan, explained in a later section of this chapter, was basically designed to accomplish two tasks. First, the statistical difference in buying segments was evaluated on the basis of the importance of the selected purchase criteria. The primary tools employed in this analysis were factor analysis. Second, an analysis of the predictability of supplier preferences based on attitudes towards suppliers on the part of purchasers was conducted. The latter analysis also utilized the discriminant analysis technique.

In the sections which follow, the research design and corresponding techniques are presented in detail. The first section presents the design and results of the Phase I exploratory investigation. In the succeeding sections the design of Phase II is outlined. These sections include the sampling design, the construction and administration of the data collection instrument, and an explanation of the data analysis techniques. The results and findings of the Phase II validation study are presented in Chapters IV and V.

Phase I - An Exploratory Study

The first phase of the research was designed to help familiarize the researcher with the market chosen for empirical study. In the process of familiarization, the desired research characteristics were also examined with respect to their existence in the study market. Thus the exploratory phase was to have as its output:

1) the determination of whether or not a multiplicity of purchase influences existed;
2) the identification of the stages which existed in the purchase process;
3) the generation of a universe of supplier selection criteria; and
4) the identification of "typical" purchase situations which might affect supplier choice.

Exploratory Design

Phase I data was collected through a judgemental sample of air-conditioning equipment purchasers in four midwestern cities. These cities were Lansing, Michigan; Detroit, Michigan; Chicago, Illinois; and Dallas, Texas. A selection of respondents was made in each city based on the size of the organization and the perceived familiarity of the respondent organization with the purchase process involving the study market. Personal interviews were conducted with 60 buying organizations in the four cities mentioned above. The organizations interviewed in this phase were:

1) Architectural firms;
2) Consulting Engineering firms;
3) Mechanical Contractors;
4) General Contractors;
5) Sheet Metal Contractors; and
6) Building Owner/Occupants.

These organizations appeared to contain the full range of buying roles as perceived by Webster and Wind in their model of organizational buying behavior. The proposed roles were users, influencers, buyers, deciders, and gatekeepers.[1] Users are the individuals who come in physical contact with the product either through handling in the production process (component parts or raw materials) or through the consumption of the product or its service in the process of their work activity. Influencers are those who may or may not come in direct contact with the product or its service,

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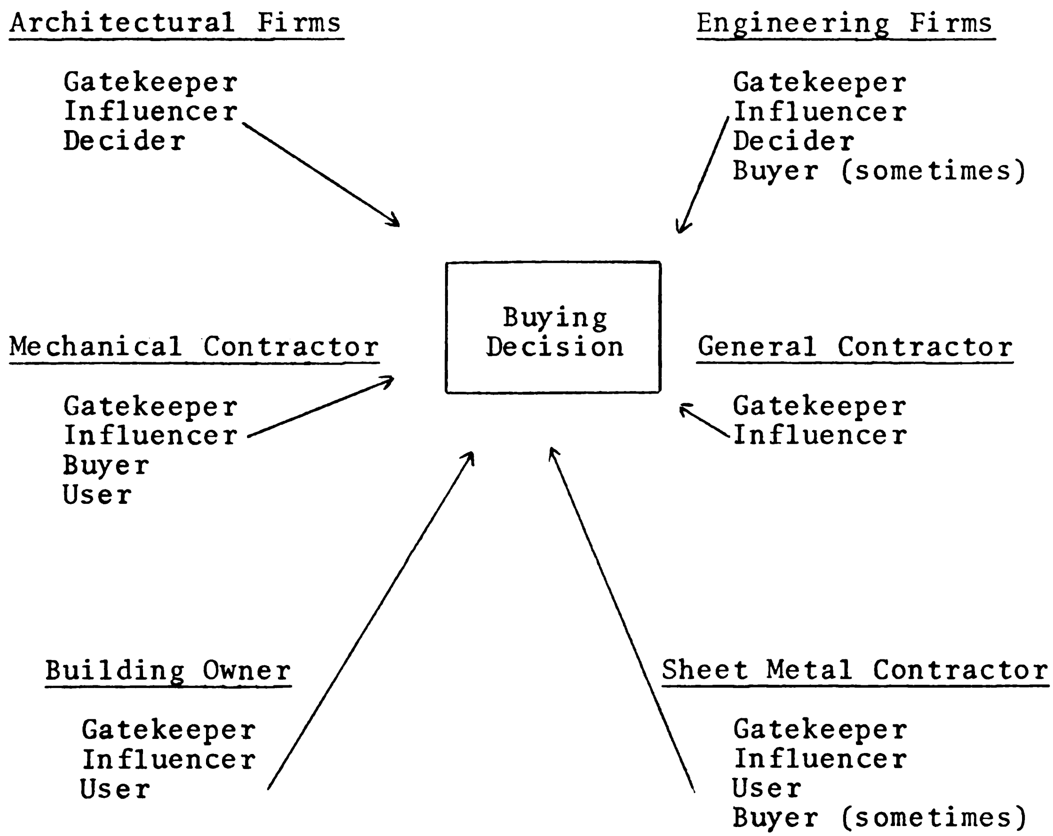
[1]Frederick E. Webster and Yoram Wind, Organizational Buying Behavior, (Englewood Cliffs; Prentice Hall, Inc., 1972), p. 77.

but provide input into the purchase decision making process. Buyers are those who are responsible for making the actual purchase and have the formal authority to represent the buying organization as the purchaser. Deciders make the buying choices in relation to the selection of suppliers and/or alternative sources. Finally, gatekeepers are the controllers of information inflow and outflow between the buying organization and suppliers, both potential and actual. The above models propose that these roles may exist simultaneously within an individual's preoccupation in the buying organization. Thus, a single individual, or organization for that matter, may act in more than one role. For example, the building owner who has A-C equipment installed may be a user, influencer, and decider simultaneously, while he may not perform the actual buying role.

An effort was made in the exploratory phase to identify which roles were predominately performed in each type of organization listed above. Figure 1 presents the buying center role relationships that were believed to exist in the purchase process. As is illustrated, all of the organization types play gatekeeper and influencer roles. The problem in the exploratory phase was to determine which organization had the greatest impact on the final purchase decision. It was also hypothesized that one organization could reflect the buying roles of another through normal interaction in the decision making process. Thus, one organization would tend to represent another in the actual decision. While the

Figure 1

BUYING CENTER ROLES IN A-C PURCHASE PROCESS



purpose of the research was not to determine the interrelationships in the purchase process, some understanding of these was deemed necessary to understand the overall problem. The specific findings with respect to this will be presented in the next section in conjunction with a more detailed explanation of the nature of the interrelationships.

Within each respondent organization, contact was made with a principal operating officer. This individual ranged from the president or owner of the organization to a general manager. It was felt that an individual of this type could accurately represent the organization's role in buying, if not directly reflect his own involvement in the purchase process. In many cases, particularly in smaller organizations, the chief operating officer is also the primary purchasing officer.

Each interviewee was approached in the exploratory phase with a series of open-ended questions about the overall purchase process for the study product group. He was initially informed that the researcher was attempting to understand how purchases of A-C equipment were made. At the beginning of the interview, the individual was asked to describe how purchases were made and how he perceived his role in the overall process. Once he had identified a point where a decision relating to equipment suppliers had to be made, he was asked about the variables which were used to make the decision. The events which followed his decision were then traced. Next, the interviewee was asked to place an importance rating on the selection variables. Finally he was asked to indicate whether or not the importance attached to each variable could vary depending upon the specific job type or application. At this juncture, he was asked to explain the various applications of a single equipment model and how his decision making might vary.

Analysis and Summary of Phase I Data

All interviews conducted in the first phase were content analyzed to develop information for the second or validation phase of the research. Several information items were needed from the phase one content analysis. These were:

1) A description of the purchase process
2) A universe list of the variables or criteria used to make buying decisions
3) A list of equipment applications and/or job types
4) A description of the types of buying organizations involved in the purchase process, and
5) A description of the roles of each buying organization in the process.

Purchase Process and Job Types

The purchase process for the study product was readily perceived to be multistaged. The stages in the process were perceived as separately identifiable by the respondents. While the names of the stages varied somewhat the activities or functions occurring at each stage were nearly identical in all cases. Webster and Wind in their model of organizational buying behavior suggest five stages in the purchase decision making process. To reiterate these stages are

1) identification of need

2) establishing objectives and specifications

3) identifying buying alternatives

4) evaluating alternative buying actions, and

5) selecting the supplier.[2]

From the exploratory interviews seven distinct stages were identified. These stages and the activities taking place at each one are detailed in Table 1. Figure 2 illustrates the similarity between the stages identified in the research and the Webster and Wind model. By comparing the two descriptions it is evident that the market selected for study coincides with the theoretical behavior model from the literature. The seven stage process was utilized in phase two in determining the level of decision making involvement and control by buying group at each stage.

In what might be classified as a "traditional" buying process, the seven stages occur in chronological order with the various buying groups or organizations becoming involved to different degrees in each stage. During this phase most respondents indicated that new job types are evolving in which the patterns of decision making involvement are changing. The primary job type, which most industry respondents term "traditional", is the plan and spec category. This job type follows the seven step process sequentially, with

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[2] Ibid., p. 31.

Table 1

BUYING PROCESS STAGES AND ACTIVITIES

Stage	Activity
1) Building Conception	At this stage the idea for construction is generated consisting of the potential use for the building, the type of occupants, who is to own and finance the building, its approximate size, method of construction, etc.
2) Preliminary Investigation	At this stage, the overall design constraints are usually established. Budget, time horizon for construction, proposed occupancy date, feasibility of construction, preliminary design plans, environmental needs, etc.
3) Design of A-C System Needs	At this stage the engineering parameters which will later determine the size and type of A-C equipment are established. The environmental constraints (temperature and humidity) are converted[3] to system specifications in conjunction with proposed uses of the building.
4) Specification of A-C Equipment	At this stage the exact specifications for A-C equipment are established. These may include ductwork, piping, and air register measurements; pump and fan capacities and ratings; power specifications; and weight and size.

[3]Gilbert A. Churchill, Jr., Marketing Research: Methodological Foundations, (Hinsdale: The Dryden Press, 1976), p. 263.

Table 1 (continued)

Stage	Activity
5) Bid Proposal Solicitation	At this stage the specifications from the preceeding stage are distributed to manufacturers and installers of equipment for bids giving the cost and ability of the supplier and/or installer to accomplish the physical task of placing the system and making it operational.
6) Bid Proposal Evaluation	At this stage the bids received above are reviewed pending selection of a supplier. Ideally the bids are rated in relation to the specifications and needs established in the early stages of the process.
7) Contract Award	At this stage the final selection of the supplier is made and an agreement to purchase signed or a contract let to the specific supplier whose bid was acceptable.

Figure 2

COMPARISON OF STUDY PROCESS AND
WEBSTER AND WIND MODEL

Study		Webster and Wind	
1)	Building Conception	1)	Identification of need
2)	Preliminary Investigation		
3)	Design of A-C System Needs	2)	Establishing objectives and specifications
4)	Specification of A-C Equipment		
5)	Bid Proposal Solicitation	3)	Identifying buying alternatives
6)	Bid Proposal Evaluation	4)	Evaluating alternative buying actions
7)	Contract Award	5)	Selecting the supplier

engineers, architects, and building owner/occupants being involved primarily in stages one through four. In stage five through seven the contractor group typically enters the process, with the engineering group again influencing decisions in stage six. The contractor typically will actually make the equipment purchase and arrange for delivery to the construction site.

Several mentions were made of three "new" job types during the Phase I investigation. These were

1) Negotiated-Team Managed - a job type where the owner, architect, engineer, and contractor form a team and work together through all stages of the purchase process.

2) Design Build - where either the engineer becomes the primary contractor for the job and subcontracts the equipment installation to a specialist contractor or the contractor does his own design work (specification, etc.) and hires an engineering firm to accomplish this task.

3) Owner Prepurchase - where the building owner/occupant specifies (sometimes with the help of an engineer) and purchases equipment and the contractor only provides installation.

Most interviewees expressed the fact that their inputs to the final purchase decision were not the same for all job types. This became the basis for a test of differences in both decision making involvement and importance rating of the buying criteria during the validation phase of the research.

Buying Groups

Several types of organizations were interviewed to determine which ones were most relevant to the decision making process. As stated above these organizations were:

1) Architectural firms;
2) Consulting Engineering firms;
3) Mechanical Contractors;
4) General Contractors;
5) Sheet Metal Contractors; and
6) Building Owner/Occupants.

In questioning all organizational representatives about their involvement in the purchase process for commercial and industrial air-conditioning equipment, the conclusion was reached that mechanical contractors and consulting mechanical engineers (a subset of Group 2) were the most relevant buying groups. The orientation of both architects and building owner/occupants tends to be represented by the engineer group. In the typical working relationship, it is the engineer's function to design, specify and approve all mechanical equipment, including air-conditioning. The architectural firm either employs a full time engineering staff or retains an outside engineering firm to perform the design, specification, and approval functions.

Similarly, the mechanical contractor represents the orientation of both the general contractor and the sheet metal contractor (if one is involved). He is responsible for the installation of any mechanical systems utilized in the building. As such, he may subcontract or work in parallel with related trade contractors such as sheet metal and electrical. The air-conditioning contractor is a specialized form of mechanical contractor who is involved with air-conditioning equipment installation only.

The two primary buying groups which were therefore identified are mechanical contractors and mechanical engineers. Figure 3 illustrates the relationships among all buying groups involved in purchasing. Nearly all interviewees concurred that these two buying groups were the most significant influences in the purchase decision. Several architects, building owner/occupant, and general contractors explicitly stated that an involvement in mechanical systems was relegated to those having practical expertise in that area; specifically these were mechanical engineers and mechanical contractors.

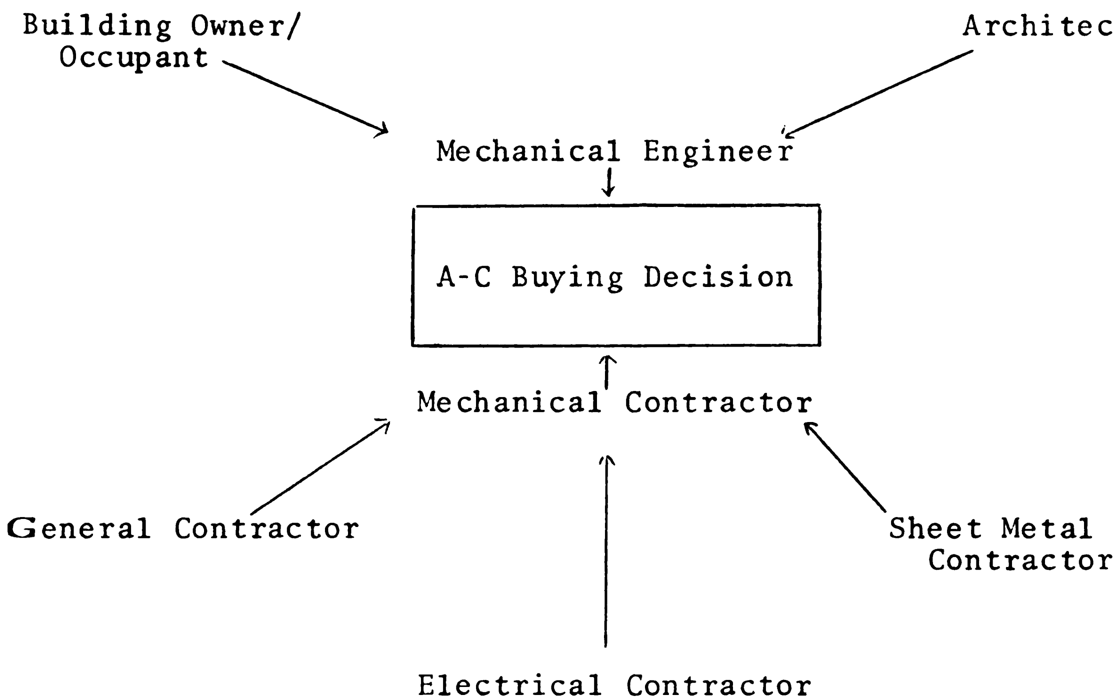
Purchase Decision Criteria

The criteria used by purchase decision makers to evaluate suppliers, were also identified in the preliminary phase of the research. Each individual was asked to list the criteria that he used to evaluate suppliers and equipment. From the analysis of the personal interviews a universe list of criteria was generated.

Each respondent was asked to rank or rate each criteria in terms of its importance to him in making the final decision. Secondly he was also asked if he could rate various suppliers on each of the criteria and if these ratings would be different for each supplier. At this stage nearly all respondents felt confident that they could rate suppliers if asked to do so. Few respondents felt that all suppliers rate equally on the majority of the criteria. The objective of this series of questions to the respondent was the determination of whether or not a multi-attribute model could be applied to the supplier selection process for the study

Figure 3

RELATIONSHIPS OF BUYING GROUPS FOR COMMERCIAL AND INDUSTRIAL AIR-CONDITIONING EQUIPMENT



product. It was concluded that the multi-attribute approach was logical for this form of purchase process.

The criteria listed in Table 2 are those which were mentioned by one or more respondents in the exploratory phase. In Phase II, as is detailed below, a total of 19 criteria were used. These criteria were the result of combining two or more of the original criteria, and eliminating others. The final selection was made by the research sponsor and researcher agreeing on variables of common interest. All of the variables may be grouped into areas. These areas relate to product, sales service, distribution, and cost (first and operating). In the second phase the criteria were grouped statistically through the use of factor analysis.

Research Hypotheses

From the exploratory phase of the research, a set of hypotheses were developed for testing in the second or validation stage. Three research hypotheses were to be tested in this stage. These were:

1) Physical distribution service characteristics are important criteria utilized by purchasers to evaluate suppliers;

2) Suppliers are rated differently in their ability to perform by purchasers and therefore these characteristics are determinants of supplier selection; and

3) The level of determinance varies depending upon the specific purchase situation and buying influence center.

The research was designed to validate these hypotheses with empirical information gathered from the market for commercial and industrial air-conditioning equipment.

Table 2

SUPPLIER SELECTION FACTORS

1. Price-first cost
2. Operating cost
3. Maintenance cost
4. Installation cost
5. Ease of installation
6. Equipment reliability
7. Equipment construction
8. Equipment size
9. Equipment weight
10. Ease of maintenance
11. Life expectancy of equipment
12. Space required for maintenance
13. Noise and vibration level
14. Availability of pre-wired control panels
15. Regular contact by salesman
16. Established relationship with salesman
17. Assistance in design
18. Assistance in startup
19. Assistance in writing specifications
20. Availability of salesman with hours to help with problems
21. Regular catalog updates by personal call by salesman
22. Factory service in first year of operation
23. Availability of parts within 36 to 48 hours
24. Catalog descriptions of equipment specifications
25. Catalog descriptions of installation specifications
26. Delivery time (average)
27. Consistency of delivery on past jobs
28. Delivery expediting capability of manufacturer
29. Back order response of manufacturer
30. Availability of parts and service on a nationwide basis
31. Availability of parts and service in the locality of the project (30 miles)
32. Manufacturer's guarantee or warranty

A series of subhypotheses were also needed for the research. These hypotheses referred to the dimensions along which the determinance of the set of physical distribution service factors was expected to vary. Specifically, the set of subhypotheses was:

> the determinance of physical distribution factors is different for -
>
> 1) mechanical contractors versus engineers (buying influence center
> 2) plan and spec versus design build - team managed jobs (job application)
> 3) commercial versus institutional jobs (job application)
> 4) rooftop versus chiller (product type).

The problem became one of evaluating whether or not a difference existed along any of the above dimensions. If a difference was found (i.e. the level of determinance in each segment varied) the conclusion would be that varying emphasis should be placed upon the logistics service factor depending upon the target market segment. That is to say the strategic plan should recognize differences in market segments and adjust those variables on which differences are significant to each segment.

The research methodology that follows details the study design that was formulated to test the research hypotheses stated above.

Sample Design

The sampling process which provided statistical information for the research consisted of three stages. First, the research population was defined and enumerated. This stage involved a description of the population which led to a determination of who was and who was not a member of the statistical universe. Next, a sampling method was selected. This required the selection of a means to choose a sample from the above universe which was both descriptive of the population and manageable from a size point of view. The determination of sample size was also part of this step. Finally, the population was enumerated and the actual sample was selected. This step also included the collection of personal contacts within sampled buying organizations and current addresses of the organizations. Each step in the sampling process will be discussed below.

Sample Frame

The definition of the sample frame outlines the boundaries of the research population about which inferences may be directly made from the sample information gathered.

For this research the population was defined to include only those individuals who influenced the purchase of a product in this category. The exploratory phase helped define the research population. As described in the previous section, this phase indicated the market for commercial and industrial air-conditioning equipment that fell within the guidelines used to select an industrial product market. That phase also revealed two primary purchase influence centers in the buying process, mechanical contractors and mechanical engineers. In the mechanical contractors group are all firms performing work on any system within a building related to water distribution either for heating or cooling purposes, sanitary systems, or environmental control systems. Mechanical engineers are firms who are primarily involved in the design and specification of the above systems. Within each of these organizations several individuals were identified who influenced the purchase decision. For purposes of the research, an individual within each organization who represented the overall purchase behavior was further identified. The exploratory research revealed that the principal officer of the organization adequately reflected that firm's purchase decision making behavior and process. Only one official in each organization received a data request.

The definition of the sample frame was:

> The principal executive officers of all mechanical contracting and all consulting engineering firms in the United States.

This universe was not totally enumerated prior to the selection of the sample. The justification for this choice will be explained below in the section on sample selection.

Alternative Sampling Methodologies

Many sampling methods are available for use in a research product such as this one. The broad classification of sampling technologies presently used is nonprobability versus probability sampling. Within both of these categories several subclasses of sampling techniques exist. Figure 4 shows the alternative sampling methodologies.[3]

Figure 4

SAMPLING METHODOLOGIES

Sample Designs

- Nonprobability Samples
  - Convenience
  - Judgement
  - Quota
- Probability Samples
  - Simple Random
  - Stratified
    - Proportionate
    - Disproportionate
  - Cluster
    - Systematic
    - Area

Source: Gilbert A. Churchill, Jr., Marketing Research: Methodological Foundations.

Of the two broad alternatives, a probability sampling methodology is the most valuable to the researcher because he can attach an estimate to the sample element that it will be a part of a given population. This allows the researcher to apply statistical methods in estimating and testing hypotheses concerning population variables or parameters.

Two potential sources of error may be present in any sampling plan. These are systematic error and experimental error.[4] Systematic error is the difference between the true population parameter or property (in the case of non-para-

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[3]Gilbert A. Churchill, Jr., Marketing Research: Methodological Foundations, (Hinsdale: The Dryden Press, 1976), p. 263.

[4]Paul E. Green and Donald S. Tull, Research for Marketing Decisions, (Englewood Cliffs: Prentice-Hall, Inc., 1975), p. 213.

metric statistics) which results from the process by which the data pertaining to the population is collected; it is reduced by careful preparation of the research objectives, hypotheses, sampling designs and procedures, analysis and inferences from the analysis. The second error type, experimental or sampling error, results from the selection of a sample which does not accurately reflect the true population parameter. Several methods are available to reduce sampling error. One means is an increase in sample size. This includes more members of the total population and therefore increases the probability that the sample estimate and the parameter will be equal. Another method which aids in reducing experimental error or at least in understanding it, is the use of probability sampling. As shown in Figure 4, the types of probability sampling designs are

1) Simple Random
2) Stratified
3) Clustered

Churchill[5] explains these sampling designs quite extensively. In addition the determination of sample size and methods of simple estimation are also presented. A fourth design exists called multistaged sampling.[6] This design uses a random selection process at more than one level or stage and may include two or more of the above designs. For

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[5]Churchill, pp. 268-297.

[6]Green and Tull, p. 227.

example, in a study gathering data on market segments based on income from the entire United States, several cities might be randomly selected as in a clustered sampling technique, respondents might be stratified by income level, and the sample selected randomly from each income strata.

The sampling design used for this research combined all three of the basic sampling techniques in a multistage plan. Because the research population for the validation phase was defined as all mechanical contracting and consulting engineering firm representatives in the United States, a wide geographic sample had to be selected. Therefore, the sample was drawn from the entire population using a multistage sampling design. Two considerations influenced the design of the sampling plan; the economics of sampling the entire country and the potential variation in attitudes based upon geographical location and organization type (contractor-engineer). It was impossible to identify a particular contractor or engineer with a job application or type prior to contact with the respondent. As a result, job type and application was not included in the sampling design.

To reduce the potential systematic error in the sampling design, the entire population was stratified on the first level by geographic area. The geographic regions selected were

1) the northeast
2) the southeast
3) the midwest
4) the far west.

The justification for geographically stratifying the sample lay in the existence of varying needs and uses of the study product by region.

Within each region a cluster sample of cities was selected. This selection was made on the bases of judgement on the part of the researcher and the sponsor. The cities selected were considered typical markets from two points of view. First, the usage of air-conditioning equipment was considered extensive and the number of users or buyers was large. A total of fifteen cities was selected for the sample. The list of regions and corresponding cities from which the sample was drawn is presented in Table 3.

Table 3

SAMPLING REGIONS AND CORRESPONDING CITIES

Region	City
Northeast	New York, New York
	Boston, Massachusetts
	Washington, D. C.
Southeast	Atlanta, Georgia
	Miami, Florida
	Fort Lauderdale, Florida
Midwest	Chicago, Illinois
	Milwaukee, Wisconsin
	St. Louis, Missouri
	Dallas, Texas
	Fort Worth, Texas
	Houston, Texas
Far West	Phoenix, Arizona
	Los Angeles, California
	San Francisco, California

The subpopulation of all mechanical contractors and engineers in each of the cities listed in Table 3 was enumerated next. Finally a random selection of both mechanical contractors and mechanical engineers was made in each city from the subpopulation listing. Each contractor and each engineer in all four regions was assigned a number. A total sample was selected at random from each region independently. Thus eight independent samples were selected across all four regions and the contractor-engineer groups.

The population enumeration in each city was supplemented with listings from two trade journals which survey member activity on an annual basis. The two publications are Engineering News Record and DE Journal. These supplied additional firm names that did not appear in the telephone directory. Engineering News Record annually enumerates the levels of sales activity (billings) of the top 500 design-engineering firms in the United States. This listing served as a cross check of the coverage of the telephone directory listings. DE Journal lists the top 200 mechanical contracting firms in the United States on the basis of billings. For both groups (contractors and engineers) any firms listed in either publication which were located in or near the fourteen cities and not included in the directory listings were included in the population. Very few cases were found where this condition existed, however.

The cross check did provide a verification of the adequacy of the telephone directory method of population enumeration for this type of study. An alternate method commonly utilized in developing population enumerations is trade associations such as local mechanical contractors' associations and professional engineering societies. One drawback exists in using these sources. Not all firms belong to these groups in all cities. Most mechanical contractors' organizations exist for the primary purpose of negotiating in trade union matters for example. Thus non-trade union shops do not typically become members. In some cities, particularly those in Texas and the south, many non-union shops exist. Therefore those sources were ruled out for use in developing population lists.

Sample Size, Selection, and Response

Methods of Sample Size Determination

As with sampling design, several methods are available for determining sample size. The considerations in sample size computation are twofold:

1) the statiscal accuracy of the sample should be optimized by balancing the cost of sampling against the cost of poor information

2) the economics of sampling must fall within the budgetary constraints of the research.

A balance between the above considerations is necessary in any practical marketing research application. As the need for statistical accuracy becomes greater, the cost of information rises while the cost of wrong decision falls. Conversely, the value of the information gained through increasing accuracy may be readily outstripped by the cost of providing that accuracy.

Tull and Hawkins[7] suggest three specifications which

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[7]Donald S. Tull and Del I Hawkins, Marketing Research, (New York: Macmillian Publishing Company, 1976), p. 186.

must be made prior to determining sample size. These are:

1) the allowable error

2) the level of confidence

and 3) a measure or estimate of the standard deviation of population.

Once these specifications are made, the sample size required to either estimate parameters or test hypotheses may be determined via a mathematical formula. The appropriate choice is determined by the importance of the statistic being estimated in relationship to the success or failure of the research. Since most research involves several variables and statistics, the one which either is most critical or that appears most often might be chosen.

A third method of sample size determination exists, which does not directly involve the use of probability or estimates of population parameters. When cross-tabulation of data is a part of the data analysis, the number of categories and level of cross tabular analysis may easily require a sample size larger than that needed with the probability techniques referred to above. Several "rules of thumb" exist for determining the appropriate sample size for cross-tabular analysis. The lower limit seems to be five elements per cell in at least eighty percent of the cells.[8] This is suggested as the lower limit when using a chi-square test on nominally

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[8] Sidney Siegal, Nonparametric Statistics: For the Behavioral Sciences, (New York: The McGraw-Hill Book Company, Inc., 1956), p. 178.

scaled data. On the other hand, if parametric statistics are to be compiled means or percentages for example, the lower limit of the cell sizes may be as large as 50 elements. The larger sample size per cell is suggested when utilizing the normal approximation to estimate probabilities.

Considering these limits, a minimum cell size of thirty elements would serve as a guide to determining sample size for analyses involving both parametric and non-parametric statistics. Several authors suggest a sample size of 30 as the threshold for moving from the sampling distribution of the non-parametric statistic to the normal probability distribution for statistical analysis.[9] The cell size referred to here is the expected cell frequency for cross tabulation.

Sample Size Determination

The sample size for this research was determined by the latter approach. The cross-tabular sample size estimation method was used. One objective of the analysis was to compare responses across several segments in the market. Specifically, the responses of contractors versus engineers for plan and spec versus design build team managed, commercial versus institutional, and chiller versus rooftop applications were desired. If all dimensions were compared simultaneously, a total of 960 (2 X 2 X 2 X 2 X 2 X 30) elements

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[9]See Sidney Siegel, Non-Parametric Statistics; William Mendenhall, Introduction to Probability and Statistics, and Dick A. Leabo, Basic Statistics.

would have been necessary in the sample. Since the total population of interest in the sample frame was less than the required size for a five level comparison, the decision was made to reduce the number of simultaneous comparisons. The final sample size for the study was set at a minimum of 120, 30 per cell in four cells, a two by two classification comparison. Given equal prior probabilities of group membership, this minimum fell within the constraints of the methodology discussed above.

Sample Selection

The actual selection of the sample was accomplished through a step-wise process. After the minimum sample size was determined, an enumeration of the population was done to determine the proportion of the sample that would come from each geographic and organizational strata.

Since it was recognized that the response rate for mail interviews usually runs between 20 and 40 percent,[10] more than 120 questionnaries had to be placed in the field. A conservative estimate of the expected response rate was set at 25 percent. With this figure, at least 480 questionnaires had to be placed into the field. Table 4 shows the total mailing in each region by mechanical contractor and engineer and the response rate of usable returns.

The slight difference in percentage of mailings over total population versus the target percentage (480/882)

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[10]Green and Tull, p. 152.

resulted from the inadequacy of some addresses for population elements and total failure to reach the remaining twelve elements. Only 468 mail interviews were attempted. As shown in Table 4, the response rate was significantly higher than expected, yielding a total usable sample size which was larger than the minimum established.

Table 4

BREAKDOWN OF POPULATION AND SAMPLE SIZE BY REGION (BY CONTRACTOR AND ENGINEER)

Region	Population Size		Mailing		Usable Responses	
	MC	E	MC	E	MC	E
Northeast	111	189	62	68	20	27
Southeast	78	102	34	46	14	13
Midwest	148	106	88	62	26	18
Pacific	80	68	52	56	29	19
Total	417	465	236	232	89 (37.7%)	77 (33.2%)

To select and contact the potential respondents, the population was enumerated city by city in each region. A number was assigned to each organization. The organizations were then chosen randomly until the needed size was selected in each region for both groupings (contractors and engineers). Once the organizations were chosen, a personal contact was established in each one. Two methods were utilized for this information. The field sales force of the sponsor provided the bulk of the personal contacts and the remainder were made through trade publications or local association rosters where available. The names of the chief executive officers of all sample organizations were successfully obtained by these methods.

Three mailings were made to generate the total response. An initial mailing was made to all selected recipients. After a two week period, a second mailing was made to those organizations selected but not responding to the initial mailing. A coding system was used to determine the organizations which had not responded. A third and final mailing was made three weeks after the second mailing, only to those organizations which had persisted in not responding.

After the final mailing, many non-respondents were contacted by telephone concerning the interview. The purpose of this follow-up was to determine either the potential respondent's intent or reason for non-response. Many questionnaires which were returned either totally or partially unanswered provided a means of determining the reasons for non-response. The primary reason appeared to be the time and detail required to complete the questionnaire. Several unanswered, but returned, questionnaires carried comments about the length of the instrument. In balance many usable responses also carried comments on the length and detail. These returns were roughly equally divided in terms of positive and negative positions. Several respondents commented (a few by personal letter) on the completeness and depth of the research and offered further assistance if needed. The conclusion after reviewing all comments was that no unusual bias resulting from the length or subject matter effected the response rate. By most standards, the response rate would be considered "typical" for a mail interview format.

Data Collection Instrument

Two areas had to be considered in designing the data collection instrument for the study. First, the media for collecting the data had to be chosen and second, the general question type was selected. Each of these areas will be treated in turn.

A survey format was initially chosen for data collection as opposed to either observation or a true experimental design. Since the attitudes and preferences of "professional" purchasers were being sought, the survey method was deemed adequate. The preliminary investigation indicated that officials of purchasing organizations were able to readily express both the buying process and purchase criteria. The problems associated with survey bias such as inability and unwillingness of the respondent to express his attitudes appeared to be absent in Phase I.

The next choice regarding the instrument concerned the media. Each of the three basic media, personal, telephone and mail interviews were considered. While each type has its own advantages and disadvantages, the research objectives and data content needs were the determining factor in the choice process. Prior to the final media decision a subjective test of each was conducted by the researcher. The primary data collection effort was centered around the rating of both criteria importances and evaluation of suppliers.

As stated in a previous section an extensive list of supplier selection criteria emerged from the Phase I investigation (See Table 2). Since the set of criteria was the focal point of the study, it was necessary to design the data collection technique around this section. Several personal and telephone interviews were conducted as a test to determine the feasibility of collecting importance ratings of the buying criteria and attitudes of how well nine competitors in the market place rated in relationship to the same criteria. In both personal and telephone interviews presenting the list of criteria to the respondent was found to be extremely difficult if not impossible in some cases. After obtaining his impressions on the first several criteria and suppliers, he often would need the entire list or a portion of the list repeated. This process was very time consuming and the respondent rapidly lost interest. During a personal interview, the respondent could be handed a list of both criteria and manufacturers, however the data recording process became extremely mechanical and could have been accomplished as well without personal contact. The economics of personal interviews were also a drawback.

On the positive side, both personal and telephone interviews potentially made the data collection effort more personal for the respondent. The personalization of the interview format helped motivate some individuals to respond. However this advantage did not outweigh the disadvantages presented above. Another potential advantage of both telephone and personal interviews is flexibility both in question wording and ordering. With the amount and type of data that was needed for the research, flexibility did not prove to be a desirable characteristic. The control lost over ordered responses to the questions was a critical factor from the perspective of statistical accuracy in the succeeding analysis.

Mail was selected as the data collection media for the research. The choice was influenced primarily by the considerations discussed above. Due to the large volume of information needed, the hard copy provided in mail and personalization through a personally signed and addressed cover letter was selected. Both the cover letter and questionnaire are reproduced in Appendix I.

No incentive, monetary or otherwise, was used with the questionnaires. Although some studies[11] show increased response rates with monetary incentives, it was concluded that an incentive should not be used in this data collection effort. Since the information was collected under the cover of Michigan State University, an incentive was deemed inappropriate. While the effect of using a non-incentive program could not be measured, the response rate was not atypical for a mail questionnaire.

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[11]See Paul L. Erdos, Professional Mail Surveys, (New York: The McGraw-Hill Book Company, 1970), pp. 94-100.

Another concern in designing the data collection instrument was the type of questions to utilize. The importance rating of each buying criterion and the attitude of the respondent with respect to how well various suppliers were rated on that criteria was needed. Several methodologies are available to measure this information, including ordered ranking of criteria and suppliers, semantic differential and attitude scales, and sorting techniques. Of the three types, attitude and ranking scales were chosen as the most viable for the study. The choice was determined by two major variables, the total time and space required for the respondent to completely provide the data and the relative ease with which the respondent could understand the questions and relate his attitudes.

Ranking methods provide measures of how various objects are related to each other on an ordered scale. Some problems are inherent in rank ordering methods which preclude the use of some statistical analyses as well as the ability of the respondent to supply accurate information. First, respondents cannot indicate the degree of difference between objects being compared. Only the relative position is indicated. If several are perceived as equal, the ranking method is also ineffective. Secondly, respondents cannot handle a large number of objects with ranking methods.

Methods of sorting and/or paired comparisons are another means of studying buying criteria and brand preference. In a sorting technique such as the Q-Sort, the respondent creates a scale value by placing statements in piles, along an interval scale. Another sorting method requires the respondent to create pairwise comparisons of brands which are most similar in one or more characteristics to those which are least similar. Both methods are extremely difficult to execute in a mail interview format. They also are extremely time consuming for the respondent and because they are not often utilized in research, many if not most respondents require extensive instructions on how the process operates.

The alternative chosen for this research was the equal appearing interval scale. The specific questions utilized are illustrated on the questionnaire reproduced in Appendix I. Five point interval scales were used both to measure importance ratings of buying criteria and attitudes toward suppliers. Because the second section of the questionnaire was the most critical portion the question types used were most important. The remaining section contained questions similar in format to those in section two to maintain continuity for the respondent.

Debate continues over the appropriate number of scale points to be used in marketing research. Jacoby and Matell maintain that reliability and validity of attitude scales are not substantially affected by the number of points or categories on a scale. They infer that dichotomous or trichotomous scales may be used in scoring or recording attitudinal data after the respondent has expressed his feelings on "an instrument that provides for the measurement of direction and several degrees of intensity."[12] Lehman and Hulbert[13] contend that increasing the number of scale points reduces rounding error when measuring attitudes and individual as opposed to group behavior. They suggest that a minimum of five points should be used. The controversy if it does in fact exist seems to lie in the trade off between the ability of the respondent to express his true feeling along a continuum and his ability to truly differentiate between points on a scale. Hulbert[14] in his review of several marketing research efforts found a mean of six to ten points being used. However, he also cites situations where a respondent was unable to comprehend a scale with more than ten points. The range would therefore be from two to ten scale points.

Looking at the problem from the perspective of the respondent and his problem of expressing his true feeling the minimum number of points necessary might be determined. He may have an extreme feeling in either a positive or negative direction, this locates the end points of the scale. If he is indifferent and perceives the scale as a continuum from

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[12] Jacob Jacoby and Michael S. Mattell, "Three Point Scales are Good Enough", Journal of Marketing Research, Vol. VIII, No. 4, (November, 1971), pp. 495-500.

[13] Donald R. Lehmann and James Hulbert, "Are Three Point Scales Always Good Enough", Journal of Marketing Research, Vol. IX, No. 4, (November, 1972), pp. 444-446.

[14] James Hulbert, "Information Processing Capacity and Attitude Measurement", Journal of Marketing Research, Vol. XII, No. 1, (February, 1975), pp. 104-106.

positive to negative, he requires an intermediate point placed near the midpoint. So far three scale points are necessitated. If he is not indifferent, but he also does not have an extremely positive or negative feeling, he needs two more intermediate points. One point is halfway between indifferent and positive and the other halfway between indifferent and negative. Thus it would appear that most respondents should be provided with a minimum of five points to express their true feelings. For this research, a five point scale format was selected for use in measuring both attitudes and importance ratings.

Data Analysis Techniques

The primary focus of the research was the analysis of group differences of buying criteria importance and determinance. As stated in the section dealing with research hypotheses, the analysis of differences was to be conducted along several dimensions. To review, these dimensions were:

1) mechanical contractors versus engineers (buying influence center)
2) plan and spec versus design build team managed job types (job application)
3) commercial versus institutional jobs (job application)
4) rooftop versus chiller (product group).

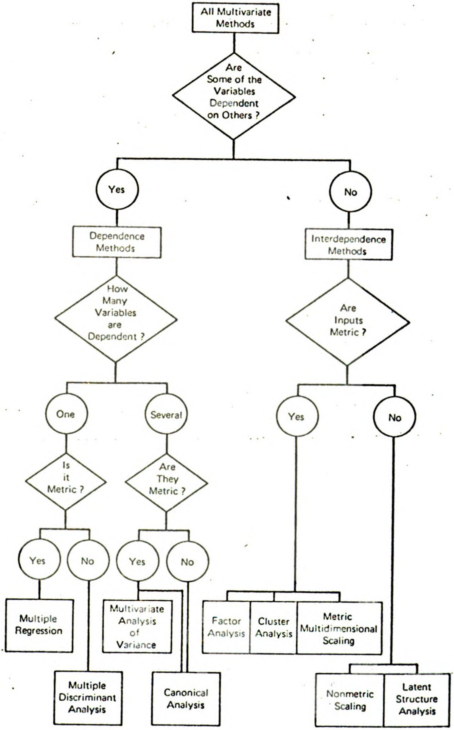
The analysis plan was designed to identify group differences along these dimensions. Each dimension was analyzed independently in the following sequence. First, a comparison between mechanical contractors and engineers was made. If the difference in buying criteria importance was found to be significant the entire sample group was to be split on this dimension. Next each subgroup was analyzed along the job application dimension and the product group dimensions. The objective of this part of the plan was to identify the variables or criteria upon which the groups differed to the greatest extent with respect to importance ratings. In addition, whether or not the between group differences were statistically significant also had to be known.

If there was a significant difference on importance ratings between two or more subgroups, the next step was the identification of the variables which determined supplier choice. Since the data collection instrument asked respondents to indicate the supplier (or suppliers) from which they would purchase the product, the dependent variable for evaluating determinance was the mention of a supplier name.

Several statistical techniques are available to analyze group differences in marketing research. The selection of the proper technique is dependent upon the characteristics of the variables under study. Figure 5 is an example of one decision tree which might be used to select the statistical methodology. Because the relationships of all selected criteria were to be studied simultaneously a multivariate statistical methodology was chosen as opposed to a univariate or bivariate technique. The level of measurement attained in the data and the specification of the independent and

Figure 5

CLASSIFICATION OF MULTIVARIATE METHODS



dependent variables for analysis were the two controlling factors in selecting statistical technique.

Table 5 summarizes the characteristics of the various levels of measurement for statistical analysis. The proper or desired level of measurement is determined by the data collection method and instrument. Whether the nominal, ordinal, or interval scaling level is reached is determined by the design of the questions and the underlying assumptions of the researcher with respect to interpretation of the scales by the respondent. In the study, an equal appearing interval scale was used to collect both importance ratings and attitudes towards suppliers. Both the importance ratings and attitudes were considered the independent or predictor variables. These variables were considered to be intervally scaled. The dependent variable in the first part of the analysis was the group to which each respondent belonged (contractor-engineer, etc.). The second part of the analysis used supplier mentions versus nonmentions as the dependent or criterion variable. Both dependent variables were therefore assumed to be nominally scaled. With this information and the decision framework illustrated in Figure 5, the primary statistical analysis technique was selected. Following the steps through the framework, the decision was made to utilize discriminant analysis for evaluating the group differences based upon both importance ratings and attitudes. The next section will explain this technique and explain its application in this research.

Table 5

SUMMARY OF LEVEL OF MEASUREMENT

Level of Measurement	Operations Allowed	Statistics
Nominal	Equivalence	Mode Frequency Dist. Chi-square
Ordinal	Equivalence Ordered Relationships (rankings) Greater than/ Less than	Median Percentile Rank Correlation
Interval	Equivalence Ordered Relat. Arithmetic Oper. addition subtraction multiplication division	Mean Variance (std. deviation) Product Moment Correlation
Ratio	Equivalence Ordered Relat. Arithmetic Ratio of Two Scale Values Absolute Zero Point	Geometric Mean Coefficient of Variation

Discriminant Analysis Applications

Discriminant analysis is a technique used to evaluate classifications of observations into groups. As applied to marketing research, the purpose of discriminant analysis (DA) is to study group differences based on the observation of several variables. The use of DA is two fold. First it may be used to predict group membership based on a set of observations on known group membership. In this process, a set of observations are taken on individuals whose membership is known, and subsequently individuals whose group membership is unknown are classified based on the same set of observations. A second use of DA is the study of group differences based on a set of observations. This use evaluates the importance of various observations in distinguishing between the groups. As such it is predictive in the sense that it may be used to classify unknown individuals, but greater emphasis is placed upon whether or not the observations can discriminate among groups and which ones are most effective. The objective of the latter approach is to identify the variables which are the discriminating variables.

The use of DA for marketing research has been rather limited. However, several studies have used the technique to study users versus non-users of a brand, good versus bad credit risks, adopters versus non-adopters, and readers versus non-readers. For the most part these studies used demographic characteristics to predict group membership.

Massy[15] used socioeconomic variables to predict FM station selection. He found that the DA approach could be used to identify dissimilarities in station audiences. Sweeny and Reizenstein[16] used a combination of store attribute variables, customer shopping variables, and customer demographic variables to predict preferences for store types. They successfully discriminated groups with roughly one-half of the original twenty variables. Lehman and O'Shaughnessy[17] determined the attributes which were most important in differentiating between industrial buyers in the United States and Great Britain. Finally, Scott and Bennett[18] clustered buyer types with DA, on the basis of product attribute importance ratings. They suggest that buyers should be clustered on the bases of attribute importance prior to evaluating attitudes toward suppliers.

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[15]William F. Massy, "Discriminant Analysis of Audience Characteristics", Journal of Advertising Research, Vol. V, (March, 1965), pp. 39-48.

[16]Daniel J. Sweeny and Richard C. Reizenstein, "Developing Retail Market Segmentation Strategy for a Women's Specialty Store Using Multiple Discriminant Analysis", in Proceedings, Fall Conference, American Marketing Association, 1971, pp. 466-472.

[17]Donald R. Lehmann and John O'Shaughnessy, "Difference in Attribute Importance for Different Industrial Products", Journal of Marketing, Vol. XXXVIII, No. 2, (April, 1974), pp. 36-42.

[18]Jerome E. Scott and Peter D. Bennett, "Cognitive Models of Attitude Structure: 'Value Importance is Important'", in Proceedings, Fall Conference, American Marketing Association, 1971, pp. 346-350.

DA seems to be a viable methodology to use in evaluating the importance of individual product and/or supplier attributes in determining the results of the purchase decision. In the next section, the foundations of discriminant analysis as a statistical technique will be discussed.

Discriminant Analysis - Statistical Foundations

Assuming that systematic differences exist among groups, discriminant analysis develops a decision rule, based on observations of several variables, to classify individuals into one of two or more mutually exclusive groups. If a single variable could be used to predict group membership there would be no need for a technique like discriminant analysis. However, one variable is usually not adequate for prediction. If no variables are available to predict membership, a simple probability or chance model might be used to predict membership. The objective of discriminant analysis as a formal technique is to improve the level of predictability over the chance model.

In order to predict group membership, a single variable is needed to simplify the decision process. Given a value of the discriminator or predictor variables, the resulting value of the criterion (dependent) variable is used to classify an individual. To create the criterior variable, a linear combination of the predictor variables is specified. This combination takes the form

$Y - a_b + a_i x_i$

or $Y = a_b + a_i x_i + a_2 x_2 + a_3 x_3 + \ldots a_n x_n$

Where

Y - criterion variable

a_b - constant

a_i - predictor variable weights

and

x_i - predictor variables

The technique attempts to find the linear combination (places values on a_i) such that the equation is better than the chance model for predicting group membership.

To accomplish an efficient prediction the weight are found such that the ratio of

$$\frac{\text{between group variation - } Y}{\text{within group variation - } Y}$$

is maximized. The mathematical scope of this manipulation will not be presented here. Several sources[19] give detailed explanations of the process. The mathematics involve manipulation of the cross product matrices of the independent variables. Green and Tull[20] present a straightforward approach which uses the cross product matrix to generate a series of simultaneous equations whose unknowns are the

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[19]See; Cooley and Lohnes, Multivariate Data Analysis; Maurice M. Tatsuoka, Multivariate Analysis; and Ben W. Bolch and Cliff J. Huang, Multivariate Statistical Methods for Business and Economics; for mathematical explanations of the discriminant analysis technique.

[20]Green and Tull, p. 450.

discriminant coefficients.

Once the values of the discriminant coefficients have been determined, two analyses follow. One evaluates the ability of the function truly to differentiate the groups based on the prediction variables. The other studies the relative importance of each prediction variable in discriminating. These analyses will be dealt with separately.

To evaluate the ability of the function to discriminate group membership, a confusion matrix is constructed. Figure 6 shows the format of a matrix for a two group analysis. In the evaluation, a value for each member of the sample based on the values of the prediction variables for that individual. The values are then used to place the individual into a predicted group. Some methods calculate the probability membership in each group and assign the individual to the group with the highest probability. Other methods find the mean value of the criterion variable (Y) for each group and establish a midpoint (in the case of a two-group analysis) between the values referred to as group centroids. Assignment is based on the position of an individual's discriminant score (value of function) relative to the midpoint. With either method the number of correctly classified individuals becomes the statistic for evaluating the worth of the discriminant function. Since both the known and predicted group memberships are readily found, the percent of individuals correctly classified may be computed. This percentage is then evaluated through the formula

$$t = \frac{Pcc - Pec}{\sqrt{\frac{PecQec}{n}}}$$

where t - Student's-t statistic

Pcc - Percent correctly classified

Pec - Percent expected by chance (equal to 1/number of groups assuming equal probabilities of membership)

Pec - 1 - Pec

n - Total sample size (Groups 1 and 2)

The critical value of t is found in a Student's-t distribution with a degrees of freedom at the selected alpha level (the probability of judging the null hypothesis false when in fact it is true).

Figure 6

CONFUSION MATRIX FOR TWO-GROUP DISCRIMINANT ANALYSIS

Predicted Membership

Actual Membership	Group 1	Group 2	
Group 1	n_{11}	n_{12}	N_1
Group 2	n_{21}	n_{22}	N_2

$$\%\ \text{correctly classified} = \frac{n_{11} + n_{22}}{N_1 + N_2}$$

Morrison[21] poses two criteria for testing the proportion of individuals correctly classified. He suggests using either the proportional chance criterion or the maximum chance criterion. The hypothesis is tested by setting up a critical value based on either of these criterion and checking the proportion correctly classified against it. If the test proportion is larger than the criterion, the function is said to discriminate between the groups. The only decision involved is the selection of either the proportional or maximum criterion, and this depends upon whether the objective is to study both groups or maximize the proportion correctly classified.

The second type of evaluation used with discriminant analysis is determining the predictor variables that serve as the "best" discriminators. The objective is to decide which variables are most important in distinguishing between one group versus the other (or all others in the case of n-group analysis). As in multiple regression the variable with the highest function coefficient is judged most important in discriminating. Before this judgement is made however, the coefficients must be standardized to account for both measurement units and variation. The correction is accomplished by adjusting the coefficients through multiplication of each one by the sample standard deviation (across all groups) for

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[21]Donald G. Morrison, "On the Interpretation of discriminant Analysis", Journal of Marketing Research, Vol. VI, No. 2, (May, 1969), pp. 156-163.

each independent variable.[22] Only after the adjustment is made can the relative importance of the variables in the function be judged. Both positive and negative signs normally appear in the function, whether the raw or standardized coefficients are used. These signs merely indicate the directional nature of the coefficient and are dropped when evaluating the relative importance of the variables.

Several assumptions are associated with the use of discriminant analysis. These are

1) the predictor variables are intervally scaled
2) the subgroups in the population (subpopulations) are mutually exclusive and exhaustive
3) the variables are normally distributed
4) the subpopulations (subgroups) from which the samples are drawn are multi-variate normal with common (identical) covariance matrices which are unknown
5) the costs of misclassification are equal for all subgroups
6) for most analyses, the probability of group membership is equal across all groups.

The assumptions are similar to those of other multivariate parametric analyses. While it is possible to statistically prove whether or not the assumptions are all met, that proof might require an exhaustive analysis. What is most important is the realization that the assumptions are present and a logical explanation of whether or not they may be reasonably considered to exist in the data used for the analysis.

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[22] *Ibid.*, p. 159.

An upward bias problem may be present in discriminant analysis when testing the significance of the function in differentiating between groups. As Frank, Massy, and Morrison[23] point out, the ability of the function to discriminate may be misinterpreted when it is evaluated with the same data used to generate the function. This problem is also inherent in multiple or even simple regression. The above authors suggest two methods of measuring the bias. One entails partitioning the sample into two halves, the first to generate the function and the second to evaluate how well the function discriminates. A second method would use the entire data set to generate the function which would then be tested with a randomly generated set of values the result of which would help estimate the level of bias which existed. The latter alternative is recommended when the sample size is too small to be halved. Both techniques minimize the bias by eliminating the condition where identical data sets are used to generate and evaluate the discriminant function. The purpose of this study includes both the determination of which variables are important in differentiating among group and how significantly the groups differ. It is recognized that an upward bias problem exists in evaluating the worth of the function in discriminating with the identical data used to

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[23]Ronald E. Frank, William F. Massy, and Donald E. Morrison, "Bias in Multiple Discriminant Analysis", Journal of Marketing Research, Vol. II, No. 3, (August, 1965), pp. 250-258.

generate it. The problems inherent in over biasing are outweighed by the fact that if only half of the sample is used to generate the function a reduction in the accuracy of the discriminant coefficients in demonstrating the relative importance of the predictor variables results. Since the discriminant technique has no real means of estimating the coefficients in the population from the sample data, the only alternative seems to be reducing the sampling error by including the maximum number of sample elements possible in the analysis. Therefore, the problem of upward bias will be treated as a limitation in the results rather than being analyzed and nullifying part of the data set.

Another problem also exists in discriminant analysis when a large set of predictor variables is included in the analysis. If the correlations between several of the variables are high, the predictive power of the function as well as the evaluation of variable importance is hampered.[24] One method of relieving this problem is by factor scores for individuals to predict group membership. Not only is this an attractive alternative from the above point of view, but it makes the interpretation of group differences easier due to the lesser number of resulting predictor variables. A brief explanation of factor analysis and the particular technique selected for this research follows.

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[24]Churchill, p. 531.

Factor Analysis

The purpose of factor analysis is the reduction of a large number of observations to a smaller and more manageable set. A family of factor analytic techniques exist which all operate on the assumption the set of underlying factors for which several observations might be surrogates, exists in the process being studied. The objective of all factor analytic techniques is the generation of linear combinations of variables which reduce the number of total dimensions of the variable set (independent variables) while preserving the original relationships in the data. The methods of factor analysis are the ways in which the coefficients of each linear combination are determined.[25] For each factor a set of weights is determined for the equation

$$F_j = a_{i,j}s + a_{2,j}x_2 + a_{3,j}x_3 + \cdots + a_{n,j}x_n$$

where F_j - j^{th} factor

$a_{i,j}$ - Factor weight for i^{th} variable and j^{th} factor

x_i - i^{th} variable in original data set.

One mathematical procedure in factor analysis uses the correlation matrix between variables to derive principal factors.[26] This method actually factors the correlation matrix rather than the original data set itself. Two methods

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[25]Green and Tull, p. 529.

[26]Ibid., pp. 535-541.

may be used.[27] First, principal factors using communalities (the proportion of variance accounted for by common factors) in the diagonal of the correlation matrix; and second principal components setting the diagonal values to unity. The first method was chosen for this research.

The principal factors are extracted from the correlation matrix such that the first factor accounts for the greatest amount of variance in the original variable set. The second and successive factors are selected such that they are uncorrelated with the previous factor and account for the next largest proportion of variance. Although a discussion of how the number of factors is determined is beyond the scope of this discussion, the procedure performs matrix manipulations on the correlation matrix until the last component or factor accounts for at least the total variance of a single variable.[28]

Once the principal factors have been found an intermediate step is performed which computes the correlation between the principal factors and the individual variables. These correlations are the factor loadings.[29] The factor loadings tell the researcher which variables are highly correlated with which factors. This aids in interpreting and

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[27]Richard L. Gorsuch, Factor Analysis, (Philadelphia; W. B. Saunders Company, 1974), pp. 85-92.

[28]Norman H. Nie, et al, Statistical Package for the Social Sciences, (New York: McGraw-Hill Book Company, 1975), p. 479.

[29]Green and Tull, p. 531.

naming the factors. The problem with the principal factor loading as they result from the above procedure is that one variable may load highly, be correlated with more than one factor. The set of methods for overcoming this interpretative problem is referred to as principal factor rotation. The objective of this process is to simplify the interpretation by rotating the axes describing the loading of the variables on the factors such that each variable loads highly on some factors and has near zero or zero loading (correlation) on others.

Several rotational schemes are available for performing this simplification step. The selection is based upon the research objectives. A broad classification of rotations is specified by orthogonal or oblique rotations. To simplify the explanation the axes are simply graphical scales illustrating the correlation of factors and variables. Orthogonal rotations maintain uncorrelated factors while oblique rotations allow some correlation between factors to result. Graphically on orthogonal rotation maintains a perpendicular relationship between factors. Oblique rotations result in factors being graphically represented in relationships which are at angles other than perpendicular. The former class, orthogonal rotations, is most often used due to simple interpretation.

Within each class several rotational methods are present. In orthogonal rotation quartimax, varimax, and equimax rotations are commonly used.[30] Quartimax rotation attempts to simplify the factor structure to the point where a variable loads highly on one factor, on near zero on others. Varimax, on the other hand, attempts to rotate the factor such that several variables load highly and others load near zero on each factor. The third, equimax, attempts to achieve the best of both situations. In cases where R factoring is used (factoring observations) and the description of underlying factors is the objective, the varimax criteria is the most popular of the three. That criteria was used in this research.

Once the rotated factor loading matrix is determined, the factors can be named and utilized in further analysis. The naming of factors is an arbitrary process based on the researchers judgement. Often the name is a combination or summary of the variables which load highly on the factor.

The naming of the factors is not as important however as their use in further analysis. Since the purpose of factor analysis is to simplify the original data set without substantial information loss, the knowledge gained from the technique used most be put to use. Usually factor scores are developed for each individual which are combinations of the original variables. These combinations are then used for an analysis of individual, group, or other differences, or to predict some phenonmenon. A decision rule must be established concerning how the original data is to be combined to

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[30]Nie, et al, pp. 484-485.

produce factor scores. Actually factor scores are estimated since the factors themselves rarely account for the total variance in the original variables. Gorsuch[31] presents several methods for estimating factor scores. One method often used is a zero-one weighting system. All variables are given a weight of zero or one depending upon their loading on the factor. A commonly used critical loading is .60. All variables loading greater than or equal to .60 are included and all other excluded. The factor score on each factor for each individual is simply the sum of the raw variable values for those variables with high loadings. This method makes the computation simple and assumes that all variables included in a factor are equally weighted. All variables which do not have high loadings on any factor may either be dropped from further analysis or lumped into a miscellaneous factor. If the objective is to use a set of uncorrelated variables in further analysis the latter alternative is chosen. This was the case in this research.

Factor Analysis of Importance Scores

The first analysis step applied a factor analysis to the importance scores for the set of buying criteria used in purchase decision making. (See Section II of the questionnaire - Appendix I). The importance ratings on the nineteen criteria were factor analyzed for the entire sample. No separate groupings were used in this step.

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[31] Gorsuch, pp. 231-239.

The purpose of this step was twofold. First, the reduction of the nineteen buying criteria to a set of buying factors was sought in using the technique. Second, if a set of factors was found which retained the original information in the data, while explaining or accounting for a large proportion of the total variance, the problem of covariance among independent variables used in the subsequent discriminant analysis would be relieved. The factor analytic technique was used in a data reduction rather than in a predictive mode in the research analysis plan.

As discussed above, several techniques in factor analysis may be performed. Principal components analysis was chosen for this analysis to provide a set of factors derived from the correlation matrix of the buying criteria. This correlation matrix is shown in Chapter Four - Table 5. The correlation coefficients between the independent variables indicate which sets of variables potentially may become factors. The final combination and number of factors is determined by the proportion of variance explained by the factors and the eigenvalue. The eigenvalue is the amount of variance explained by the factor and in the SPSS factor analysis package is set to 1.0 as default.[32] The variance accounted for by each factor is found by summing the squared loadings of all variables on the factor. To reiterate, the factor loading is the correlation between the variable and

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[32]Nie, et al, p. 479.

the factor. Factors accounting for a variance of less than 1 are not included in the analysis. Stated another way if a factor does not account for a proportion of variance equal to or greater than

$$\frac{\text{critical eigenvalue} = 1}{\text{number of variables}},$$

it is not included. This criteria may be altered if necessary, however.

Another method of determining the number of factors is through the use of the percentage of total variance accounted for by the factors.[33] This may be determined by the researcher and is directly related to the eigenvalue by summing the proportion of total variance represented by the actual eigenvalue divided by the number of variables. Comparing these methods when twenty original variables are included in the analysis and the critical eigenvalue of 1.0 is involved, approximately 95 percent of the variance will be explained by the factors which remain.

Another set of summary statistics of importance in the factor analysis sequence are the communalities of the variables. These indicate the percent of total variance in each variable that is explained by the common factors. These sequentially replace the values in the diagonal of the correlation matrix during the analysis. The final communality estimates are then evaluated to measure the variance

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[33] Ibid.

explained by the factors. The communalities are calculated by summing the squared loading for all factors across each variable. In the SPSS routine, the estimate of the communalities, eigenvalues, and factor loadings are presented both before and after factor rotation. The post rotation statistics are the more important for an analytical summary.

Computer Data Analysis Tools

The bulk of the statistical analysis was accomplished with the use of the Statistical Package for the Social Sciences (SPSS). This package allows the researcher to perform many types of parametric statistical analyses on a common data set. The mathematical procedures used in the SPSS package are adapted from popular references in the social science literature and have been utilized in several fields for analysis. The package allows for several options in handling missing data in a survey, as well as a wide range of statistics in most routines. It was assumed that SPSS was free of gross methodological errors.

The data from the research questionnaire was coded and recorded in computerized form for use with SPSS. Two verification steps were used in the coding process. To eliminate excess error data was recorded onto card images directly from the questionnaire. After coding a random sample of questionnaires was selected for verification. This was in addition to a recheck of each case (questionnaire) while coding. The card image coding was then permanently recorded on computer cards. A verification (mechanical) step was also performed in the keypunching process. This process was designed to reduce or eliminate any mechanical errors in the analysis resulting from transfer of data from the form where the respondent recorded it to the actual analysis algorithm in the computerized SPSS package. Each analysis was cross checked with similar analyses to certify that the correct number of respondents were being included as group members as the successive runs through the package were completed.

Summary of Research Design

A step by step process was used to analyze the research data. First, the importance scores for all buying criteria were factored across all respondents. This step served to reduce the covariance problem encountered in using a large variable set for discriminant analysis. Factor scores for each respondent were developed as linear combinations of the importance ratings. A zero-one weighting procedure was used to develop the factor scores.

Once factor scores for all respondents were developed from the importance ratings, discriminant analysis was employed to evaluate differences between groups on the buying criteria importance ratings. The analysis looked at the contractor-engineer dimension first for a significant difference. Next the plan and spec versus design build-team managed job types were evaluated in both the contractor and engineer groups. The job type and product type dimensions were also evaluated.

Once dimensions were identified where significant differences existed, a second level discriminant analysis was conducted for buyers versus non-buyers of three selected suppliers. These second level analyses were only conducted in groupings where significant differences based on importance ratings were found in the first level analysis.

Chapter IV presents the results of the factor analysis of importance scores and the discriminant analysis of segments based on the factor importance scores. The significance of the differences in segments based on factor importance is discussed in that chapter.

Chapter V examines the significance of the factors as determinants in the buying process. The overall preference of respondents is studied in relation to the ratings of suppliers on the buying factors.

CHAPTER IV

ANALYSIS OF MARKET SEGMENTS

Introduction

Chapter IV presents, in detail, the research findings related to the analysis of differences among segments of the market for the study product. The importance scores for the buying criteria are used to develop a profile for the various segments which are significantly different from each other. Chapter V uses the market segments derived in the present chapter and analyzes the determinant criteria for supplier choice.

To reiterate the methodology set forth in the previous chapter, the steps in the total analysis process are:

1) Factor analyze the entire data sample based on importance ratings for the buying criteria

2) Evaluate the statistical significance of group differences using discriminant analysis based on factor scores developed in Step 1

3) For all groups found to contain significant differences in Step 2, use discriminant analysis to determine the determinant factors in purchase preferences.

The first two steps are covered in Chapter IV and the third in Chapter V. The managerial implications and conclusions will be presented with the findings.

Step One - Factor Analysis

Table 1 presents the eigenvalues and percent of explained variation following the varimax rotation chosen for the present research. To summarize the varimax rotation, the factors are rotated orthogonally to a solution where some variables load highly on each factor and others load highly on each factor and others load near zero. By examining the information presented in Table 1, it is noted that 92.3 percent of the total variation in the original data is accounted for in factors one, two, and three. Factor four may be considered a miscellaneous factor explaining the remaining variance in the data. The composition of the factors (variables which are highly correlated with the factors) is explained below under the factor loading discussion. Of importance at this point is the fact that three underlying factors account for over ninety percent of the total variance in the data.

Table 1

EIGENVALUES AND PERCENT OF VARIATION EXPLAINED AFTER VARIMAX ROTATION OF IMPORTANCE RATINGS

Factor	Eigenvalue	Percent of Variation	Cumulative Percent Variation
1	4.627	47.4%	47.4%
2	2.731	28.0	75.4
3	1.652	16.9	92.3
4	.747	7.7	100.0

Table 2 presents the final estimated communalities for the nineteen importance variables. As discussed above, the communality is the variance in each variable accounted for by the common factors, one through four. By examining the communalities the potential variables are determined for which the minimum amount of information is lost in reducing the number of predictors from nineteen to four. Several of

Table 2

COMMUNALITIES OF ORIGINAL VARIABLES IN FACTOR ANALYSIS

Variable	Name	Communality
1	Price-First Cost	0.16973
2	Operating and Maintenance Cost	0.54875
3	Reliability-Life Expectancy	0.71678
4	Ease of Installation	0.87990
5	Ease of Maintenance	0.65978
6	Size, Weight, and Construction of Equipment	0.27249
7	Noise and Vibration Levels	0.34017
8	Delivery Time	0.57638
9	Consistency of Delivery	0.82368
10	Delivery Expediting Capability	0.81932
11	Local Availability of Parts and Service	0.53836
12	Regular Contact by Salesman	0.61385
13	Long Term Established Contact	0.62948
14	Salesman's Assistance	0.22924
15	Regular Catalog Updates	0.44443
16	Availability of Salesman	0.42848
17	Availability at Full Line	0.26157
18	Factory Service Support	0.47539
19	Catalog Descriptions	0.32903

the original variables have a high percentage of variation explained.

The factor loading matrix shown in Table 3 is used to determine which variables are combined to estimate the factor scores from the original data. As stated in Chapter III (Research Methodology) a factor score is a linear combination of the original variables of the form

$$F_i = w_1x_1 + w_2x_2 + w_3x_3 \ldots\ldots + w_nx_n$$

where F_i - i^{th} factor score for sample element

w_1 to n - weight of j^{th} variable

x_1 to n - raw score on j^{th} variable.

A factor score is calculated for each member of the sample with the four new variables. The weights used in computing factor scores are zero or one depending upon the factor loading of the variable. The weights are determined by a simple decision rule:

weight = 1 if factor loading $\geq .60$

weight = 0 if factor loading $< .60$

The factors are named by studying the variables which load highly on each factor or those which have weights of one. By examining Table 3, the four factors might be named operating and/or equipment lifetime, sales service distribution service, and miscellaneous, respectively. Thirteen of the nineteen original variables are included in the factors. The remaining six variables have variances which are not accounted for by the factors to be included in the

Table 3

FACTOR LOADING MATRIX FOR IMPORTANCE RATING AFTER VARIMAX ROTATION

Variable Number	Variable Name	Factors			
		Factor 1	Factor 2	Factor 3	Factor 4
1.	Price-First Cost	-0.32156	-0.04184	0.24199	0.07759
2.	Operating Maintenance Cost	0.71999	0.06775	-0.12285	0.10336
3.	Equipment Reliability	0.83515	-0.02045	-0.09087	0.10308
4.	Ease of Installation	-0.07496	0.05694	0.45165	0.81673
5.	Ease of Maintenance	0.66210	0.20886	0.06156	0.41711
6.	Size, Weight, and Construction	0.18183	0.21422	0.12109	0.42294
7.	Noise and Vibration	0.36154	0.19893	-0.01035	0.41204
8.	Delivery Time	-0.12217	0.03600	0.73096	0.16083
9.	Consistency of Delivery	0.06019	0.10997	0.89762	0.04729
10.	Delivery Expediting Capability	0.03775	0.18450	0.86998	0.16427
11.	Local Availability Parts and Service	0.65214	0.24966	0.20954	0.08263
12.	Regular Contact by Sales Force	-0.03575	0.77740	0.02804	0.08618
13.	Long Term Sales Contact	-0.12060	0.78184	0.03897	0.04632
14.	Sales Assistance	0.18945	0.37679	0.20431	0.09814
15.	Regular Catalog Updates	0.27044	0.60610	-0.04584	0.04283
16.	Availability of Sales Help	0.16841	0.60234	0.13762	0.13554
17.	Availability of Full Line	0.26050	0.40065	0.06604	0.16980
18.	Factory Service Support	0.65122	0.21838	0.05747	0.01773
19.	Catalog Descriptions	0.31642	0.46735	0.07120	0.07362

computation of factor score estimates. These variables are:

1) Price-first cost
2) Size, weight and construction
3) Noise and vibration
4) Sales assistance
5) Availability of full line
6) Catalog descriptions.

All six of the variables listed above are confounded with all four factors.

Of particular relevance is the fact that the price-first cost variable did not load highly on any one factor. An examination of the mean importance ratings and the correlation matrix, and the communalities is necessary to help explain this phenomenon as well as that observed with the remaining five variables. Table 4 presents the aggregate importance ratings for the entire sample.

Price-first cost appears to be an important criteria in the choice process, thus the confounding of the variable is not a result of unimportance and therefore a random relationship to other variables on the part of the respondents' ratings. In fact price-first cost is rated as second in importance by the entire sample. On the other hand, the variation in this criteria rating is not well explained by the factors. The communality of price-first cost is only .16973 (See Table 2). The correlation matrix indicates that this criteria is not highly correlated with any other criteria (Table 5). The highest coefficient is -.31, the other

Table 4

MEAN IMPORTANCE RATING FOR
NINETEEN BUYING CRITERIA

Criteria	Mean Importance Rating
Price-First Cost	3.96
Operating Maintenance Cost	3.95
Equipment Reliability	4.21
Ease of Installation	3.71
Ease of Maintenance	3.67
Size, Weight, and Construction	2.89
Noise and Vibration	3.93
Delivery Time	3.64
Consistency of Delivery	3.73
Delivery Expediting Capability	3.46
Local Availability of Parts and Service	3.94
Regular Contact by Sales Force	3.20
Long Term Sales Contact	3.10
Sales Assistance	3.23
Regular Catalog Updates	3.26
Availability of Sales Help	3.93
Availability of Full Line	3.05
Factory Service Support	3.78
Catalog Descriptions	3.61

Table 5

CORRELATION COEFFICIENTS FOR CRITERIA IMPORTANCE RATINGS

	1	2	3	4	5	6	7	8	9	10
1	1.00	-0.16	-0.31	0.22	-0.19	-0.02	-0.15	0.26	0.14	0.21
2	-0.16	1.00	0.69	-0.06	0.55	0.19	0.32	-0.15	-0.08	-0.00
3	-0.31	0.69	1.00	0.00	0.57	0.15	0.33	-0.12	-0.02	-0.04
4	0.22	-0.06	0.00	1.00	0.34	0.40	0.27	0.48	0.42	0.51
5	-0.19	0.55	0.57	0.34	1.00	0.30	0.47	0.01	0.16	0.18
6	-0.02	0.19	0.15	0.40	0.30	1.00	0.33	0.08	0.17	0.26
7	-0.15	0.32	0.33	0.27	0.47	0.33	1.00	0.07	0.06	0.10
8	0.26	-0.15	-0.12	0.48	0.01	0.08	0.07	1.00	0.67	0.66
9	0.14	-0.08	-0.02	0.42	0.16	0.17	0.06	0.67	1.00	0.82
10	0.21	-0.00	-0.04	0.51	0.18	0.26	0.10	0.66	0.82	1.00
11	-0.15	0.42	0.51	0.12	0.53	0.23	0.32	0.08	0.24	0.26
12	-0.01	0.06	0.01	0.14	0.17	0.14	0.19	0.06	0.13	0.18
13	0.09	-0.01	-0.07	0.09	0.08	0.21	0.11	0.10	0.11	0.16
14	0.04	0.16	0.14	0.18	0.28	0.16	0.13	0.11	0.22	0.28
15	-0.13	0.28	0.19	-0.01	0.35	0.18	0.27	-0.00	0.02	0.12
16	-0.09	0.09	0.06	0.19	0.34	0.19	0.27	0.10	0.21	0.24
17	-0.02	0.22	0.19	0.18	0.29	0.20	0.25	0.03	0.10	0.17
18	-0.16	0.46	0.53	0.01	0.46	0.18	0.25	-0.01	0.10	0.07
19	-0.19	0.20	0.25	0.16	0.29	0.24	0.13	0.06	0.12	0.15

Table 5

CORRELATION COEFFICIENTS FOR CRITERIA IMPORTANCE RATINGS - (continued)

	11	12	13	14	15	16	17	18	19
1	-0.15	-0.01	0.09	0.04	-0.13	-0.09	-0.02	-0.16	-0.19
2	0.42	0.06	-0.01	0.16	0.28	0.09	0.22	0.46	0.20
3	0.51	0.01	-0.07	0.14	0.19	0.06	0.19	0.53	0.25
4	0.12	0.14	0.09	0.18	-0.01	0.19	0.18	0.01	0.16
5	0.53	0.17	0.08	0.28	0.35	0.34	0.29	0.46	0.29
6	0.23	0.14	0.21	0.16	0.18	0.19	0.20	0.18	0.24
7	0.32	0.19	0.11	0.13	0.27	0.27	0.25	0.25	0.13
8	0.08	0.06	0.10	0.11	-0.00	0.10	0.03	-0.01	0.06
9	0.24	0.13	0.11	0.22	0.02	0.21	0.10	0.10	0.12
10	0.26	0.18	0.16	0.28	0.12	0.24	0.17	0.07	0.15
11	1.00	0.16	0.09	0.31	0.28	0.32	0.31	0.51	0.38
12	0.16	1.00	0.65	0.27	0.46	0.48	0.29	0.08	0.36
13	0.09	0.65	1.00	0.31	0.44	0.40	0.27	0.10	0.34
14	0.31	0.27	0.31	1.00	0.23	0.40	0.26	0.22	0.12
15	0.28	0.46	0.44	0.23	1.00	0.39	0.32	0.27	0.40
16	0.32	0.48	0.40	0.40	0.39	1.00	0.31	0.27	0.34
17	0.31	0.29	0.27	0.26	0.32	0.31	1.00	0.29	0.29
18	0.51	0.08	0.10	0.22	0.27	0.27	0.29	1.00	0.41
19	0.38	0.36	0.34	0.12	0.40	0.34	0.29	0.41	1.00

Note: Variable names same as Table 3

criterion variable being equipment reliability. The second highest correlation coefficient is .26 that being with delivery time.

While price-first cost is on one hand an important criteria, but is related to several other variables both directly and inversely, the results indicate that price is considered in conjunction with several other variables. There does not appear to be any clearly singular relationship with any other criteria. As a result it may be concluded that price is a mitigating factor in the choice process. As a result the price variable is not highly correlated with a single factor.

Recalling that the purpose of factor analysis is data reduction with minimal information loss, the inclusion of only those variables which are highly correlated with the underlying factors needs some explanation. Principal components analysis yields a new set of variables for which the most variation exists from one sample member to another. In creating linear combinations, it is those variables containing the largest amount of variance explained by the factors, which are of interest to a researcher.

The value of factor analysis to this research was the reduction in the total number of independent variables used to predict group membership in segments of the market. Table 6 presents a summary of the four factors derived in step one of the research analysis and the variable names included in each factor with weights of one.

Table 6

VARIABLES LOADING HIGHER THAN .60 ON FACTORS

Factor 1	Factor 2	Factor 3	Factor 4
Operating and Maintenance Cost	Regular Contact	Delivery Time	Ease of Instal- lation
Equipment Reliability	Long Term Contact	Consistency of Delivery	
Ease of Main- tenance	Regular Catalog Updates	Delivery Expedi- ting Capability	
Local Avail- ability Parts and Service	Availability Sales Help		
Factory Service Support			

Once the composition of the factors was determined, factor scores were used as inputs for the discriminant analysis phase of the research. The factor scores and factor composition was utilized in two areas. First, segments of the sample were delineated using the factor importance ratings. Second, the supplier ratings on the factors were used to predict purchase preferences within the identified segments. The following section discusses the results, the first of these analysis steps.

Analysis of Segment Differences Based on Factor Importance

In this analysis step, the discriminant analysis technique was used to evaluate the differences between segments. The factor scores for all group members on each factor were used as independent or predictor variables in the analysis and group membership was the dependent variable. As stated in the Research Methodology chapter, groups were analyzed two at a time according to the tree diagram shown in Figure 1. At the first level mechanical contractors versus engineers were studied. In the second level analysis job-type, equipment application, and products were evaluated within each of the above groups. This sequence resulted from the hypothesis that the greatest difference in importance ratings was expected in the contractor-engineer breakdown.

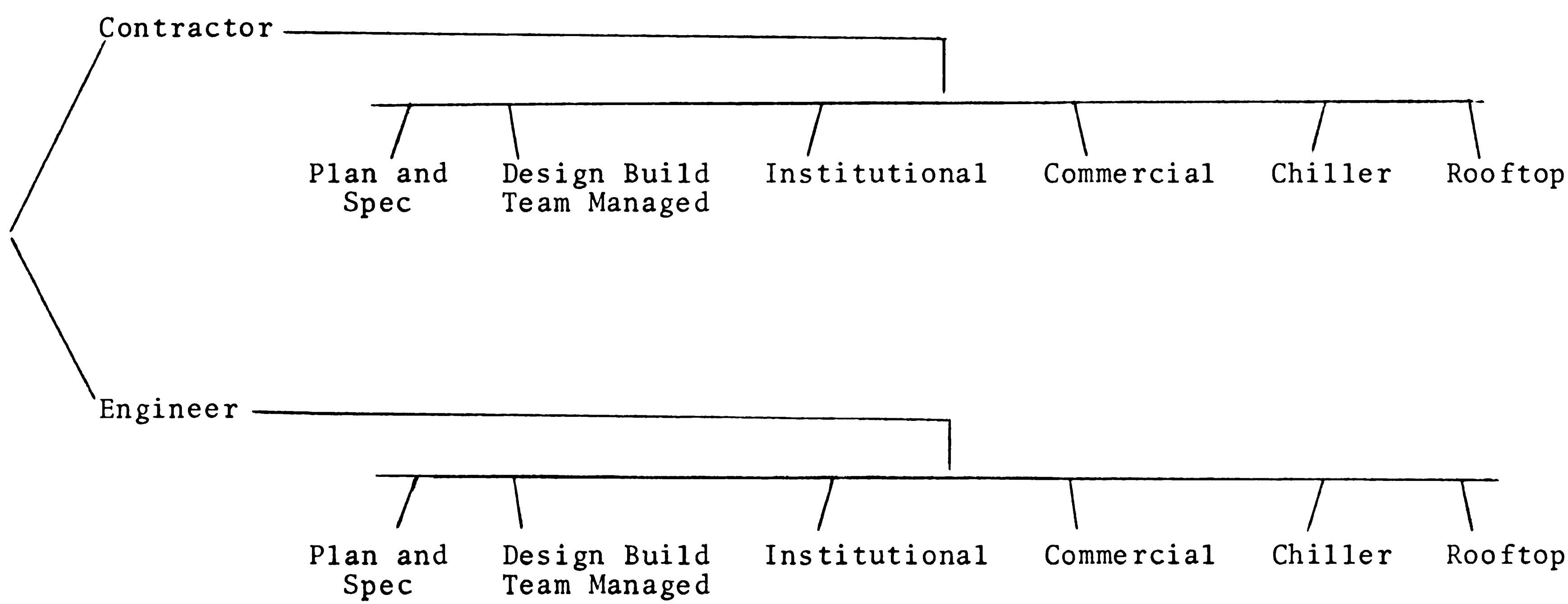
Group Assignment

A method for assigning the sample elements to the groups outlined above was designed into the data collection instrument. Each questionnaire was coded prior to mailing to indicate whether the respondent was a mechanical contractor or engineer. This was necessary since identical questionnaires were mailed to both groups.

A process of self-placement was used to group the respondents into job type and job-application categories. As may be noted on the questionnaire (see Appendix I) each respondent was asked to choose a combination of job type and application. Further, each was instructed to answer the section on importance and supplier ratings in terms of his selection. The reason for using this methodology hinged on the lack of information as to what job types and applications were predominately accomplished within any one respondent's organization. Thus each respondent could not be asked about a specific type and application due to the fact that no prior knowledge of his familiarity with that combination could be

Figure 1

ANALYSIS SEQUENCE FOR FACTOR IMPORTANCE RATINGS



assumed. The risk of sample size deterioration due to an improper job combination respondent match, resulting in a nonresponse, was therefore minimized.

Discriminant Analysis of Factor Importance Scores

As stated in the Research Methodology chapter, discriminant analysis was used to evaluate differences among groups based on factor importance scores. To reiterate, the factor scores for each respondent were computed as linear combinations of the importance ratings for the nineteen buying criteria variables. These combinations were the independent variables in the analysis and the group assignment was the dependent variable.

The first level discriminant analysis evaluated the difference between the mechanical contractor and mechanical engineer groups. The mean raw factor scores for both groups are presented in Table 7 with the standard deviations. The sample sizes for each group are also given in this table. A one-way analysis of variance test was also conducted on each variable to determine significant difference between groups on each variable considered individually. The results of this test are also shown in Table 7.

As can be noted from the table, a significant difference of the mean factor importance ratings was found for all four factors between the contract and engineer groups. The results of the discriminant analysis test are presented in Tables 8 and 9. Table 8 contains both the standardized and unstandardized discriminant function coefficients. The standardized coefficients are used in evaluating the relative importance of the factors in differentiating between groups and the unstandardized coefficients are used to predict group membership based on the discriminant function for the confusion matrix. This matrix is shown in Table 9.

Table 7

MEAN FACTOR IMPORTANCE SCORES AND TESTS OF DIFFERENCE FOR CONTRACTORS VERSUS ENGINEERS

Factor	Group: Contractors	Group: Engineers	F[b] Ratio	S/NS[c]
Operating Lifetime	22.27a (5.31)	24.01 (3.48)	6.08	S
Sales Service	12.72 (3.89)	14.13 (3.28)	6.26	S
Distribution Service	11.70 (2.90)	9.41 (3.15)	21.96	S
Miscellaneous	3.91 (0.92)	3.39 (0.92)	13.34	S
n =	90	77		

Note: a) Values in ( ) are standard deviations
b) Critical value of F for 1 and 165 degrees of freedom ($\alpha = .05$) = 3.91
c) Significant (S), Non-significant (NS)

Examining the standardized coefficients reveals that the order or importance in differentiating between groups is:

1) Distribution Service,
2) Operating Lifetime,
3) Miscellaneous, and
4) Sales Service.

Table 8

STANDARDIZED AND UNSTANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS FOR CONTRACTORS VERSUS ENGINEERS

Factor	Standardized Coefficients	Unstandardized Coefficients
Operating Lifetime	0.570	0.123
Sales Service	0.395	0.107
Distribution Service	-0.625	-0.195
Miscellaneous	-0.481	-0.504
Constant[a]		-0.333

Note: a) A constant term appears in only the unstandardized discriminant function.

The signs on the coefficients are directional in nature and not related to the relative factor importance. They do however indicate which groups place greater total importance on each factor. To evaluate which factors the individual groups feel are most important, the centroids of each group (as denoted by the dependent variable) must be determined. The group centroid is the linear combination of the group means on each independent variable computed using the unstandardized discriminant coefficients. The centroids for contractor group was -.487 and for engineer group .570. Thus, the factors with negative coefficients are considered to be more important in the purchase decision for contractors. High importance scores on these factors tend to place a respondent near the negative end of the continuum, where the contractor centroid is located. Contractors feel that distribution service is most important, while engineers feel that the operating lifetime factor is most important.

Table 9

CONFUSION MATRIX OF CORRECTLY CLASSIFIED RESPONDENTS ON FACTOR IMPORTANCE RATINGS MECHANICAL CONTRACTOR VERSUS ENGINEERS

		Predicted Group	
Actual Group	n	Contractors	Engineers
Contractors	90	65 (72.2%)[a]	25 (27.8%)
Engineers	77	21 (27.3%)	56 (72.7%)
Totals	167	86	81

Percent Correctly Classified = 72.46%

Note: a) Percentages are row percentages of correctly and incorrectly classified respondents

b) Percent correctly classified = $\frac{65 + 56}{167}$

The confusion matrix of correctly versus incorrectly classified respondents based on the function (see coefficients in Table 6) is shown in Table 7. The data from the confusion matrix is used to evaluate the overall statistical significance of the function in terms of its ability to distinguish among groups. The percent correctly classified by the function versus those who would be classified by chance is compared in a student's t test (see Chapter 3, Research Methodology). The t value is calculated as

$$t = \frac{Pcc - Pec}{\sqrt{\frac{PecQec}{n}}}$$

where Pcc - percent correctly classified by discriminant function

Pec - percent correctly classified by chance

Qec - 1 - Pec

n - total sample size

The Student's t statistic for the discriminant function used to differentiate between contractors' and engineers' factor importance scores was

$$t = \frac{.7246 - .5000}{\sqrt{\frac{.5(.5)}{167}}}$$

The critical value of t for 166 degrees of freedom is 1.96 (α = .05), therefore, the function was determined to differentiate between the groups better than chance. It may then be said that the factor importance profiles of contractors and engineers are in fact different. The contractor-engineer dimension was therefore determined to be significant in terms of buying criteria importance scores. Thus the hypotheses that contractors and engineers are significantly different in terms of their importance profiles was found to be true.

The results suggest that the contractors who represent the buying center role of users and influencers in the decision process are different than engineers with respect to distribution service or logistics service and secondly operating lifetime than engineers when alternative suppliers are evaluated. This observation might be explained by the fact the contractors are primarily involved in the installation of industrial and commercial equipment and do not generally concern themselves with the operation of the equipment after installation. The contractor typically must stand behind the installation for a shorter time period than the designing engineer. This period is usually one year. Conversely, engineers represent the interests of the building owner and/or occupant and as such tend to be more concerned with long term interests as the users of the service provided by the quipment. They are not involved in the actual scheduling of the installation and as such are not as concerned with the logistics of placing the equipment at the job site as the contractor. This would suggest that in marketing a product, such as that investigated in this research, the logistical service factors and the ability to provide acceptable service in this area is highly important to contractors. As an influencer in the purchase process, the contractor might then be most concerned with this factor than engineers. This would suggest that the parameters used to set the level of service in the logistics area would be best estimated by the contractors. The close tie between the logistics factor variables and price also suggests that contractors in general might be willing to trade off (either up or down) price against the provision of logistics service. If the ability of alternative suppliers to provide acceptable service is sufficiently different, the logistics service factor may be highly determinant in the purchase process.

Second Level Analysis of Importance Ratings

After a significant difference in factor importance was found along the contractor engineer dimension, a second level set of discriminant analyses was conducted within each group (contractor and engineer) to determine whether or not differences existed along the job type application and product dimensions. The steps in each analysis were similar to those above with the object being the determination of segments which were significantly different in terms of value importance of the buying factors.

Each dimension with both the contractor and engineer groups will be analyzed and discussed independently. First the plan and spec versus design build job type will be examined. Next, the commercial versus institutional application, followed by the chiller versus rooftop product type will be analyzed.

Tables 10 through 12 present the results of the analysis of difference in the contractor group between plan and spec (traditional bid review) job types and design build team managed job types. The hypothesis tested is that a difference in overall factor importance profiles exists between these groups. Referring to Table 12 a significant difference was found to exist between the two sub-groups as differentiated by the discriminant function. The order of importance of the factors in discriminating was:

1) Sales Service,
2) Distribution Service,
3) Operating Lifetime, and
4) Miscellaneous

Table 10

MEAN FACTOR IMPORTANCE SCORES AND TESTS OF DIFFERENCE FOR PLAN AND SPEC VERSUS DESIGN BUILD-TEAM MANAGED JOBS (CONTRACTORS)

Factor	Group: Plan and Spec	Group: Design Build-Team Managed	F[b] Ratio	S/NS
Operating Lifetime	21.81 (6.52)[a]	22.64 (3.90)	0.53	NS
Sales Service	13.81 (4.39)	11.76 (3.16)	6.42	S
Distribution Service	12.30 (3.17)	11.09 (2.56)	3.91	NS
Miscellaneous	3.93 (1.03)	3.91 (0.82)	0.00	NS
n =	43	45		

Note: a) Values in ( ) are standard deviations
b) Critical value of F for 1 and 86 degrees of freedom (α = .05) = 3.97

Table 11

STANDARDIZED AND UNSTANDARDIZED
DISCRIMINANT FUNCTION COEFFICIENTS FOR
PLAN AND SPEC VERSUS DESIGN BUILD-TEAM
MANAGED JOBS (CONTRACTORS)

Factor	Standardized Coefficients	Unstandardized Coefficients
Operating Lifetime	0.570	0.107
Sales Service	-0.730	-0.186
Distribution Service	-0.617	-0.211
Miscellaneous	0.328	0.355
Constant[a]		1.063

Note: a) A constant term appears in only the unstandardized discriminant function.

b) Centroids Plan and Spec -0.37
Design Build-Team Managed 0.35

Table 12

CONFUSION MATRIX OF CORRECTLY CLASSIFIED
RESPONDENTS ON FACTOR IMPORTANCE RATINGS
PLAN AND SPEC VERSUS DESIGN BUILD TEAM MANAGED JOBS
(CONTRACTORS)

Actual Group	n	Predicted Group: Plan and Spec	Predicted Group: Design Build Team Managed
Plan and Spec	43	31 (72.1%)[a]	12 (27.9%)
Design Build-Team Managed	45	12 (26.7%)	33 (73.3%)

Percent Correctly Classified[b] = 72.73%

$t = 4.26$[c] (Significant at $\alpha = .05$)

Note:
a) Percentages are row percentages of correctly and incorrectly classified respondents
b) Same as Table 9
c) See text.

Examining the directional nature of the factor coefficients, indicates that sales service and distribution service seem to be more important to the contractor involved in plan and spec jobs than in design build-team managed jobs. This may in part be due to the fact that contractors involved in the prior job type are not working as closely with supplier sales people prior to the letting of bids for the product. Their involvement is limited at the earlier stages of the buying process and thus they are more dependent upon information from the salesperson as well as being influenced by their relationships with him. Contractors feel that the operating lifetime factor is more important in the design build-team managed area. This is perhaps due to the involvement of the contractor in the design and specification phases of the purchase process. Being more responsible for the specification of equipment in the design phase, the contractor feels these considerations are more important than if an engineer designs the system and the contractor act as an installer. The distribution service factor is more important to the contractor involved in a plan and spec job where he does not have other concerns such as design and operation of the system. On design build-team managed jobs the contractor performs a role more like the engineer during early phases of the purchase process.

Tables 13 through 15 analyze the engineers group along the job type dimension. The hypothesis that the factor importance profile were different for engineers involved in plan and spec versus design build-team managed jobs was determined to be false in this analysis. No real difference between job type factor importance profiles existed. A discussion of the relative importance of the factors in differentiating is therefore unnecessary.

Engineers do not have different factor importance profiles across job types. The role of influencers and the representation of the owner in both job types is similar. In addition, difference in importance was found for any singular factor. The segmentation dimension across job types will not be considered in the analysis of determinant factors.

Table 13

MEAN FACTOR IMPORTANCE SCORES AND TESTS OF DIFFERENCE FOR PLAN AND SPEC VERSUS DESIGN BUILD-TEAM MANAGED JOBS (ENGINEERS)

	Group		F[b] Ratio	S/NS
Factor	Plan and Spec	Design Build-Team Managed		
Operating Lifetime	23.81 (3.59)[a]	24.50 (3.20)	0.53	NS
Sales Service	13.98 (3.31)	14.61 (3.35)	0.49	NS
Distribution Service	9.31 (3.07)	9.89 (3.34)	0.47	NS
Miscellaneous	3.33 (0.82)	3.50 (1.15)	0.49	NS
n =	58	18		

Note: a) Values in ( ) are standard deviations
b) Critical value of F for 1 and 74 degrees of freedom ($\alpha = .05$) = 3.99

Table 14

STANDARDIZED AND UNSTANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS FOR PLAN AND SPEC VERSUS DESIGN BUILD-TEAM MANAGED JOBS (ENGINEERS)

Factor	Standardized Coefficients	Unstandardized Coefficients
Operating Lifetime	-0.199	-0.057
Sales Service	-0.510	-0.154
Distribution Service	-0.432	-0.138
Miscellaneous	-0.276	-0.304
Constant[a]		5.877

Note: a) Same as Table 11
b) Centroids Plan and Spec 0.06
Design Build-Team Managed -0.21

Table 15

CONFUSION MATRIX OF CORRECTLY CLASSIFIED
RESPONDENTS ON FACTOR IMPORTANCE RATINGS
PLAN AND SPEC VERSUS DESIGN BUILD-TEAM MANAGED JOBS
(ENGINEERS)

		Predicted Group	
Actual Group	n	Plan and Spec	Design Build Team Managed
Plan and Spec	58	29 (50.0%) [a]	29 (50.0%)
Design Build-Team Managed	18	10 (55.6%)	8 (44.4%)

Percent Correctly Classified[b] = 48.68%

$t = .23$[c] (Non-significant at $\alpha = .05$)

Note: a), b), and c) Same as Table 12

The difference between commercial and institutional job application factor importance profiles for contractors is analyzed in Tables 16 through 18. No individual factor differences were found as shown in Table 16. In Table 18, the test of the ability of the discriminant function to differentiate between the groups indicates only a marginally significant difference. It was concluded that there was difference in factor importance profiles for contractors across job applications on commercial and institutional buildings. A discussion of the relative importance of the factor is therefore not relevant in this dimension.

Table 16

MEAN FACTOR IMPORTANCE SCORES AND TESTS OF DIFFERENCE FOR INSTITUTIONAL VERSUS COMMERCIAL JOB APPLICATIONS (CONTRACTORS)

Factor	Group		F[b] Ratio	S/NS
	Institutional	Commercial		
Operating Lifetime	22.45 (6.44)[a]	22.45 (4.64)	0.11	NS
Sales Service	12.00 (4.07)	13.16 (3.76)	1.83	NS
Distribution Service	11.94 (3.13)	11.56 (2.80)	0.33	NS
Miscellaneous	3.88 (1.10)	3.96 (0.83)	0.12	NS
n =	32	55		

Notes: a) Values in ( ) are standard deviations
b) Critical value of F and 1 and 85 degrees of freedom (α = .05) = 3.98

Table 17

STANDARDIZED AND UNSTANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS FOR INSTITUTIONAL VERSUS COMMERCIAL JOB APPLICATIONS (CONTRACTORS)

Factor	Standardized Coefficients	Unstandardized Coefficients
Operating Lifetime	0.031	.006
Sales Service	1.010	0.259
Distribution	-1.027	-0.353
Miscellaneous	0.388	0.417
Constant[(a)]		-0.945

Note: a) Same as Table 11
b) Centroids Institutional -0.294
Commercial 0.171

Table 18

CONFUSION MATRIX OF CORRECTLY CLASSIFIED
RESPONDENTS ON FACTOR IMPORTANCE RATINGS
INSTITUTIONAL VERSUS COMMERCIAL JOB APPLICATIONS
(CONTRACTORS)

		Predicted Group	
Actual Group	n	Institutional	Commercial
Institutional	32	21 (65.6%)[a]	11 (34.4%)
Commercial	55	23 (41.8%)	32 (58.2%)

Percent Correctly Classified[b] = 60.92%

t = 2.04[c] Significant at α = .05
Non-Significant at α = .01

Note: a), b), and c) Same as Table 12

Apparently contractors place the same importance on the factors regardless of the job application. This results from the fact that they do not view their buying roles and responsibilities differently for commercial as opposed to institutional job applications.

Similarly, when the difference between institutional and commercial job applications was tested for the engineers group, the test of the discriminant function to significantly differentiate failed. Tables 19 through 21 present the results of this test. No significant differences exist between the groups for any of the individual factors. Once more the order of the factors in the discriminant function is meaningless from an interpretive standpoint. Engineers again do not perceive their role as different depending upon the job application and further do not indicate that a different importance level be placed on the factors in one versus the other application.

The results of both dimensional tests of job type and application indicate that the engineers group should not be segmented on the basis of the situation in which the product is to be used. This suggests a strategy uniformly applied to the segments where engineers are significant influencers in the purchase process.

Tables 22 through 24 present the test of whether contractors have different factor importance profiles depending upon the product application. Although none of the individual factors had significantly different importance ratings (see Table 22), when considered simultaneously with the discriminant analysis technique, the groups were found to be different.

Table 19

MEAN FACTOR IMPORTANCE SCORES AND TESTS OF DIFFERENCE FOR INSTITUTIONAL VERSUS COMMERCIAL JOB APPLICATIONS (ENGINEERS)

Factor	Group: Institutional	Group: Commercial	$F^{(b)}$ Ratio	S/NS
Operating Lifetime	24.36 (2.68)[a]	23.50 (4.12)	1.12	NS
Sales Service	14.03 (3.18)	14.39 (3.37)	0.23	NS
Distribution	9.47 (3.39)	9.34 (2.98)	0.03	NS
Miscellaneous	3.36 (0.80)	3.39 (1.05)	0.24	NS
n =	36	38		

Note: a) Values in ( ) are standard deviations
b) Critical value of F for 1 and 72 degrees of freedom ($\alpha = .05$) = 3.99

Table 24 shows the result of the confusion matrix test of the ability of the function to significantly differentiate the groups.

Table 20

STANDARDIZED AND UNSTANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS FOR INSTITUTIONAL VERSUS COMMERCIAL JOB APPLICATIONS (ENGINEERS)

Factor	Standardized Coefficients	Unstandardized Coefficients
Operating Lifetime	1.301	0.372
Sales Service	-0.684	-0.209
Distribution Service	0.106	0.033
Miscellaneous	-0.770	-0.826
Constant[(a)]		-3.438

Note: a) Same as Table 11
b) Centroids Institutional 0.220
Commercial -0.209

Table 21

CONFUSION MATRIX OF CORRECTLY CLASSIFIED RESPONDENTS ON FACTOR IMPORTANCE RATINGS INSTITUTIONAL VERSUS COMMERCIAL JOB APPLICATIONS (ENGINEERS)

Actual Group	N	Predicted Group: Institutional	Predicted Group: Commercial
Institutional	36	21 (58.3%)[a]	15 (41.7%)
Commercial	38	15 (39.5%)	23 (60.5%)

Percent Correctly Classified[b] = 59.46

t = 1.62[c] Non-significant at $\alpha = .05$

Note: a), b), and c) Same as Table 12

The order of importance of the factors in discriminating was:

1) Miscellaneous,
2) Operating Lifetime,
3) Distribution Service, and
4) Sales Service.

For the chiller and rooftop applications, contractors are most different in terms of the importance placed upon the miscellaneous factor. Referring back to Table 3 (Factor Loadings), the criterion most highly correlated with this factor is ease of installation. In addition, the other criteria also correlated with this factor (although not highly) are ease of maintenance, size, weight, and construction, and noise and vibration. These criteria are product design related and are directly related to the difference between the two product types studied.

Referring to the group centroids (Table 23) and the directions of the coefficients (Table 22) the miscellaneous, the operating lifetime, and the sales service factors are more important to contractors for the rooftop product. This may result from the fact that the rooftop unit is not as highly engineered as the chiller. Contractors recognizing this fact may put more emphasis on product related characteristics. Another explanation is related to the scheduling problems associated with the chiller product installation as opposed to the rooftop product. Typically, the chiller (a component of a central station system) must be installed prior to the completion of the structural closure of construction. As a result, the timing of the arrival is critical to contractors in chiller applications. If the construction schedule calls for closing the mechanical equipment section of the building on a specified date and the equipment has not arrived at the job site, the contractor may have to bear the cost of reopening the structure for equipment placement.

Table 22

MEAN FACTOR IMPORTANCE SCORES AND TESTS OF DIFFERENCE FOR CHILLER VERSUS ROOFTOP APPLICATIONS (CONTRACTORS)

	Group		F[b] Ratio	S/NS
Factor	Chiller	Rooftop		
Operating Lifetime	21.88 (5.58)[a]	23.21 (4.76)	1.19	NS
Sales Service	12.58 (4.15)	13.07 (3.32)	0.30	NS
Distribution	11.58 (3.05)	11.96 (2.63)	0.33	NS
Miscellaneous	3.83 (0.97)	4.11 (0.83)	1.69	NS
n =	59	28		

Note: a) Values in ( ) are standard deviations
b) Critical value of F for 1 and 85 degrees of freedom (α = .05) = 3.95

Table 23

STANDARDIZED AND UNSTANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS FOR CHILLER VERSUS ROOFTOP APPLICATIONS (CONTRACTORS)

Factor	Standardized Coefficients	Unstandardized Coefficients
Operating Lifetime	-0.479	-0.090
Sales Service	-0.062	-0.016
Distribution Service	0.330	0.113
Miscellaneous	-0.843	-0.906
Constant[(a)]		4.432

Note: a) Same as Table 11
b) Centroids Chiller 0.108
Rooftop -0.227

Table 24

CONFUSION MATRIX OF CORRECTLY CLASSIFIED RESPONDENTS ON FACTOR IMPORTANCE RATINGS CHILLER VERSUS ROOFTOP APPLICATIONS (CONTRACTORS)

Actual Group	n	Predicted Group Chiller	Predicted Group Rooftop
Chiller	59	36 (61.0%)[a]	23 (39.0%)
Rooftop	28	11 (39.3%)	17 (60.7%)

Percent Correctly Classified[b] = 60.92%

t = 2.03[c] Significant at $\alpha = .05$

Note: a), b), and c) Same as Table 12

On a rooftop application, the scheduling problems are not as critical since the equipment does not have to be placed prior to structural completion. In fact, it may not be necessary or practical to place the equipment until full completion of the structure. What is however important in both cases is the scheduling of handling equipment to install the product. While this is also a costly venture, if the delivery is not accomplished according to schedule, the level is not as great as that above. Thus the strategic plan must stress the efficient performance of the logistics function for both products, but most emphasis on consistency must be placed on delivery of the chiller product.

The last hypothesis to be tested was that a difference existed in the engineers group for importance profiles for chiller and rooftop product types. Tables 25 through 27 present the results of this test. As in the other engineer subgroups (plan and spec versus design build-team managed and commercial versus institutional) no significant difference was found between the groups. Table 27 indicates that the discriminant function could not significantly differentiate between the groups. The importance of the factors in differentiating is therefore once more meaningless for this group.

Engineers appear to have similar factor importance profiles across job types and applications and across product applications. This would suggest that the same strategy for marketing both products to engineers for all applications.

The emphasis to engineers should be upon operating lifetime of the products and the sales-service factors. Their concerns are not typically involved with either scheduling the installation or the installation itself. Rather, they are most concerned with the overall design factors and variables relating to the operation of the equipment once installed. This does not appear to vary by application.

Table 25

MEAN FACTOR IMPORTANCE SCORES AND TESTS
OF DIFFERENCE FOR CHILLER VERSUS ROOFTOP APPLICATIONS
(ENGINEERS)

	Group		$F^{(b)}$ Ratio	S/NS
Factor	Chiller	Rooftop		
Operating Lifetime	24.18 (3.09)[(a)]	23.16 (4.50)	1.21	NS
Sales Service	14.33 (3.43)	13.89 (2.79)	0.24	NS
Distribution	9.60 (3.10)	8.84 (3.37)	0.81	NS
Miscellaneous	3.38 (0.91)	3.37 (1.01)	0.01	NS
n =	55	19		

Note a) Values in ( ) are standard deviations
b) Critical value of F for 1 and 72 degrees of freedom ($\alpha = .05$) = 3.99

Table 26

STANDARDIZED AND UNSTANDARDIZED
DISCRIMINANT FUNCTION COEFFICIENTS FOR
CHILLER VERSUS ROOFTOP APPLICATIONS
(ENGINEERS)

Factor	Standardized Coefficients	Unstandardized Coefficients
Operating Lifetime	-0.999	-0.286
Sales Service	0.036	0.011
Distribution Service	-0.628	-0.198
Miscellaneous	0.812	0.925
Constant[a]		5.415

Note: a) Same as Table 11
b) Centroids Chiller -0.109
Rooftop 0.316

Table 27

CONFUSION MATRIX OF CORRECTLY CLASSIFIED RESPONDENTS ON FACTOR IMPORTANCE RATINGS CHILLER VERSUS ROOFTOP APPLICATIONS (ENGINEERS)

Actual Group	n	Predicted Group Chiller	Predicted Group Rooftop
Chiller	55	31 (56.4%)[a]	24 (43.6%)
Rooftop	19	10 (52.6%)	9 (47.4%)

Percent Correctly Classified[b] = 54.05%

t = .696[c] Non-significant at $\alpha = .05$

Note: a), b), and c) Same as Table 12

Summary of Segments Based on Factor Importance

Figure 2 summarizes the categories in which significant differences were found based on factor importance scores. The analysis plan called for two levels; first, an overall comparison between buying influence centers (contractors and engineers); and second, between job types, job applications, and equipment types within the influencer groups. As shown in Figure 2, a significant difference was found at the first level and differences were found in the contractor group in two of the three second level breakdowns.

Figure 2

SUMMARY OF SIGNIFICANT AND NON-SIGNIFICANT DIFFERENCES FOR GROUPS BASED ON FACTOR IMPORTANCE SCORES

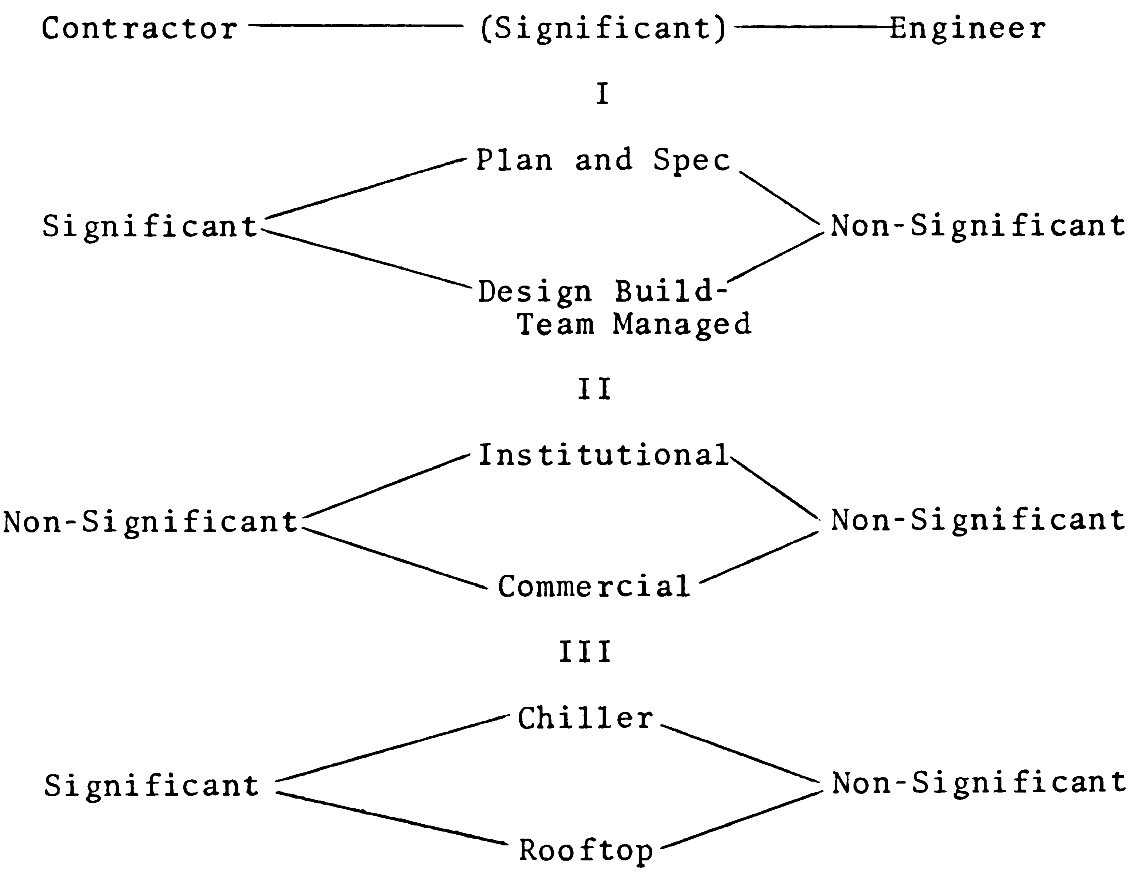


Figure 3 indicates the ranking of factors in order of their relative importance in discriminating among groups on the basis of factor importance scores. The ranking is based on the size of the standardized discriminant function coefficients (See Tables 7 through 27).

The results indicate that three dimensions are significant for segmenting the buying influencers for the study product. These are:

1) Contractor versus Engineer

2) Contractor - Plan and Spec versus Design Build-Team Managed

3) Contractor - Chiller versus Rooftop.

It appears that for the contractor group both the job type and product type are viewed differently in terms of the factor importance profiles in the purchase process. This suggests that the emphasis upon the logistics factor might be varied by segment.

Chapter V will analyze the degree of variation across selected suppliers in each of the above segmental groups. The determinance of the factors within segments will be developed in that chapter.

Figure 3

SUMMARY OF RELATIVE IMPORTANCE OF FACTORS IN DISCRIMINATING BETWEEN GROUPS

Contractor vs. Engineer	Contractor: Plan and Spec vs. Design Build-Team Managed	Contractor: Chiller vs. Rooftop
Distribution Service	Sales Service	Miscellaneous
Operating Lifetime	Distribution Service	Operating Lifetime
Miscellaneous	Operating Lifetime	Distribution Service
Sales Service	Miscellaneous	Sales Service

CHAPTER V

RATINGS OF SUPPLIERS WITHIN MARKET SEGMENTS

Introduction

Chapter V presents the analysis of the attitudes towards selected suppliers of the study product. The determinance of the four supplier selection factors is examined with respect to loyalty towards each supplier.

The four factors derived in Chapter Four are utilized in the analysis. The respondents in the study were asked to rate each of nine selected suppliers on each of the nineteen purchase decision criteria. Linear combinations of the relative rating of each supplier were used as the predictor or independent variables for discriminant analysis.

The analysis was conducted within the segments developed in Chapter IV. The entire sample was split into these sub-groups.

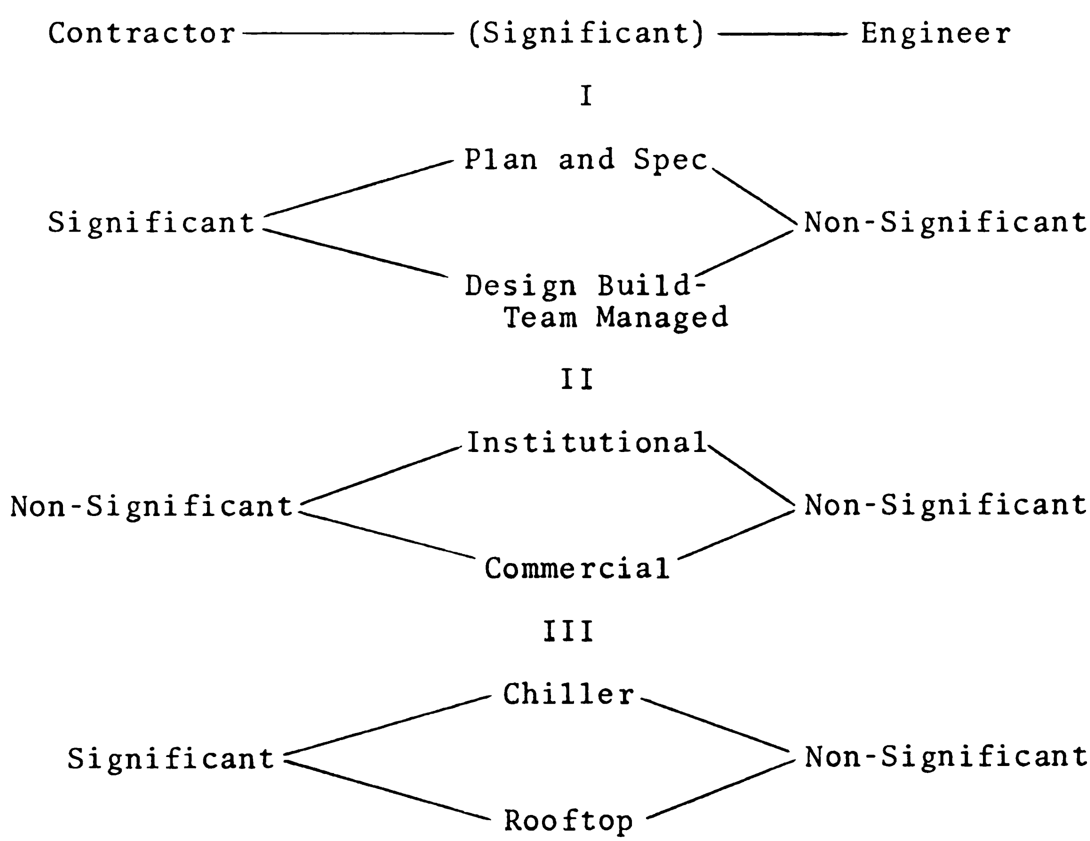
Supplier Ratings within Segments

Once the entire sample was split into groups based on the importance rating of the buying criteria, an analysis of supplier ratings was conducted in each group. The groups used were those which were found to have significantly different importance profiles in the first step of the analysis. Figure 1 shows the groups where differences were found to be significant.

The second step of the analysis used the discriminant analysis technique. The independent variables were the ratings for selected suppliers on each buying factor, while the dependent variable was the mention versus non-mention of the supplier, in question one, part three of the questionnaire (see Appendix I). The steps in the discriminant analysis used in this chapter are similar to those in the previous chapter. The objective of this analysis step was the identification of the factors which are determinant in the actual purchase decision.

Figure 1

SUMMARY OF SIGNIFICANT AND NON-SIGNIFICANT DIFFERENCES FOR GROUPS BASED ON FACTOR IMPORTANCE SCORES



In computing the values of the independent variables, a conversion was made from the raw supplier ratings to a relative rating. Each respondent was asked to rate all suppliers on all criteria. For each respondent, an average supplier rating was computed across all rated suppliers for each criterion variable. The relative rating was found by subtracting the average rating from the actual rating. This procedure was used to adjust for a respondent who rated all suppliers identically and thus indicated no difference among them on a given variable. If this were the case, he would see no difference among them and thus the variable would not be determinant in his decision. If the respondent rated all suppliers differently, some high and others below average on one factor, that factor could be considered to be determinant in the purchase decision. The factors which are most important in the discriminant function are then most determinant in the purchase decision. The order of determinance was therefore developed from the discriminant function. Recall from the discussion in Chapter III the standardized discriminant function coefficients are used to evaluate the importance of the independent variables in differentiating between groups. The higher the value (absolute) of the coefficient relative to the others the more important was the variable in differentiating. This implies that the variable accounts for the greatest variation between the groups. If the variable is highly important in differentiating between preferences and non-preferences toward a supplier, then that variable may be assumed to be determinant in the preference function. Since the independent variables in each analysis of supplier preference versus non-preference were the relative ratings on only the supplier in question, this technique was valuable in indicating the individual determinance of each variable to each respondent.

Factor ratings were the actual values used as independent variables in this analysis step. As such, they were computed in a manner similar to that used for factor importance ratings. After the individual ratings of all suppliers by each respondent were converted to relative ratings, the factor ratings were computed by summing the relative ratings of the variables which loaded highly on each factor (see Chapter III). The weights used in this summation were zero and one as in the factor importance analysis. If a respondent rated a given supplier below average and several others above, the score on that variable would then be negative for that supplier. Whether the composite factor rating was positive or negative depended upon the relative ratings of the supplier on each variable loading on the factor.

Finally, some respondents did not rate all suppliers. Any supplier who was not rated on a given variable was treated as a missing case and assigned a value equal to the mean of all other variables. If all ratings are missing for a given respondent on a supplier, that case is dropped from the analysis, but included in the classification phase by substituting mean values for each variable.

The four suppliers selected for analysis were those which received the greatest number of respondent ratings. Table 1 presents the frequency of supplier mentions by segment.

Table 1

FREQUENCY OF SUPPLIER MENTIONS BY SEGMENT

	Segment				
Supplier	Plan and Spec	DBTM	Chiller	Rooftop	
A	28	29	42	15	56
B	30	26	40	16	53
C	1	3	4	0	12
D	11	11	17	5	27
E	3	4	0	7	7
F	6	3	4	5	4
G	4	4	0	5	5
H	2	1	2	1	2
I	1	0	1	1	2
J	0	0	0	0	1

Two hypotheses were tested in the analysis of supplier preference within each group. First, that the discriminant functions significantly differentiate between mentions and non-mentions of a supplier. Second, that the business logistics factor varied in importance in the function depending upon the segment. The discussion which follows presents the results and implications of the analyses across all significant segments. Some analyses were not conducted due to the small sample size in either the mentions or non-mention category. These are indicated in each analysis as "no response". The analyses in each segment follow.

In the contractor-plan and spec segment, only one supplier mention - non-mention analysis was significant. Table 2 presents the summary information for this segment. As may be noted for Suppliers A and B the discriminant function did not significantly differentiate between groups. For Supplier C the sample size was too small for analysis. Finally, the discriminant function was significant in differentiating mentions versus non-mentions. The order of importance of the factors was:

1) Distribution Service
2) Miscellaneous
3) Sales Service
4) Operating Lifetime

Contractors evaluating this supplier indicate that the distribution service factor is most important in selecting the supplier. By examining both the directional nature of the coefficients and the centroids, indicates that above average ratings on the distribution service factor tend to be significant in determining the choice of Supplier D. As such the conclusion is drawn that logistics service is indeed a determinant factor for this supplier by contractors in plan and spec jobs.

Table 2

DISCRIMINANT ANALYSES OF SUPPLIER MENTIONS VS. NON-MENTIONS
CONTRACTOR - PLAN AND SPEC JOBS

Supplier	Standardized Discriminant Function Coefficients[a]	Means of Factor Ratings: Mentions	Means of Factor Ratings: Non-Mentions	Group Centroids	n	Percent Correctly Classified t-value
A	-1.051	2.35	-0.93			
	0.458	2.42	0.37	-0.371	29	65.12%
	-0.011	0.57	-1.11	0.908	14	t =1.983(NS)[b]
	-0.373	0.41	-0.01			
B	-0.191	2.89	1.31			
	-0.486	4.25	1.90	-0.192	30	65.12%
	0.003	0.92	0.38	0.632	13	t =1.983(NS)
	-0.556	0.33	-0.08			
C	No Analysis for this Supplier - No Response					
D	0.041	1.12	-1.00			
	0.312	0.89	-1.71	-0.741	11	79.07%
	-0.875	0.66	-0.86	0.297	32	t =3.81 (S)
	-0.580	0.20	-0.23			

Note: a) Order of Coefficients is as follows (reading down)
Operating Lifetime
Sales Service
Distribution Service
Miscellaneous

b) S - Significant
NS - Non-Significant

The remaining analyses, being found non-significant are also of some interest. Supplier A ratings by mentioners and non-mentioners appear to be quite different, while the function is non-significant. The significance of the functions was rejected marginally in the analysis. Thus it appears that a fine line may exist between preference and non-preference for these suppliers.

Table 3 presents a summary of the results of the analysis of supplier preference data for the contractor design build-team managed sector. The results of the analyses in this segment appear to be more clear cut than in the previous segment. All four discriminant function were found significant. Referring to the table, the position of the distribution service factor is second for Supplier B and third for Suppliers A, C, and D. In three cases the directional nature of the coefficients and the group centroids indicate that respondents having a preference for the supplier rate that supplier above average on the factor. Those preferring D rate the supplier below average on the distribution service factor.

The results support the hypothesis of a significant difference between mentions and non-mentions of a supplier. The position of the logistics factor indicates that in this segment the factor is moderately determinant in the purchase choice process.

The determinance of the distribution service factor in contractor-chiller application segment is analyzed in

Table 3

DISCRIMINANT ANALYSES OF SUPPLIER MENTIONS VS. NON-MENTIONS
CONTRACTOR - DESIGN BUILD-TEAM MANAGED JOBS

Supplier	Standardized Discriminant Function Coefficients[a]	Means of Factor Ratings		Group Centroids	n	Percent Correctly Classified
		Mentions	Non-Mentions			t-value
A	-0.651	3.42	-0.16			
	-0.310	3.55	-0.54	-0.354	33	80.00%
	-0.287	1.00	-0.57	1.028	12	t =2.68 (S)[b]
	0.002	0.24	-0.22			
B	1.018	2.72	0.12			
	0.100	3.63	1.55	0.470	27	71.11%
	0.405	0.46	0.45	-0.647	18	t =2.83 (S)
	0.020	0.12	-0.08			
C	-0.162	-0.28	-2.02			
	-0.915	1.76	-2.06	-1.362	4	84.44%
	-0.316	0.13	-1.51	0.272	41	t =4.62 (S)
	0.460	0.13	0.01			
D	0.536	2.92	0.06			
	1.023	2.62	-2.23	1.047	11	82.22%
	-0.391	0.51	-0.26	-0.410	34	t =4.32 (S)
	-0.354	0.48	-0.08			

Note: Same as Table 2

Table 4. All four selected supplier preference functions were found to be significant. As in the preceding analyses, the position of the factor varied by supplier - second, third, first, and fourth for Suppliers A, B, C, and D respectively. The signs of the coefficients once more indicate that those preferring the selected supplier rate him above average on the distribution service factor. The factor was moderately determinant in this segment.

Table 5 presents the results of the analyses of supplier preference and factor determinance in the contractor-rooftop segment. In this segment there was not adequate response for Supplier C, thus that analysis was not conducted. For all three others there was a significant difference in the preferences for each. The discriminant functions were significant in their ability to differentiate. The position of the distribution factor was third, second, and second for Suppliers A, B, and D respectively. The results coincide with the importance ratings which differentiate the segment from the contractor-chiller segment. Therefore, considering the combination of importance in segmentation and in determining supplier preference the factor is a significant determinant in the purchase process in this segment.

The final segment analyzed for the determinance of the distribution service factor was the engineers group. Table 6 presents the results of these analyses. The ability of the discriminant functions to differentiate between preferences and non-preferences for each supplier was found to

Table 4

DISCRIMINANT ANALYSES OF SUPPLIER MENTIONS VS. NON-MENTIONS
CONTRACTOR - CHILLER APPLICATIONS

Supplier	Standardized Discriminant Function Coefficients[a]	Means of Factor Ratings: Mentions	Means of Factor Ratings: Non-Mentions	Group Centroids	n	Percent Correctly Classified: t-value
A	-0.163	2.52	0.43			
	-0.655	2.77	-0.71	-0.255	44	71.93%
	-0.480	0.81	-0.52	1.021	13	t =3.31 (S)[b]
	-0.002	0.37	-0.07			
B	-0.357	2.38	0.23			
	-0.631	3.86	0.67	-0.302	41	64.91%
	-0.189	0.74	0.16	0.805	16	t =2.25 (S)
	-0.135	0.18	-0.23			
C	0.199	0.49	-1.61			
	-0.633	2.67	-1.54	-1.370	5	94.74%
	-0.735	0.88	-1.58	0.238	52	t =6.75 (S)
	0.021	0.47	-0.03			
D	-0.116	1.92	0.28			
	-0.761	1.35	-1.40	-0.577	17	70.18%
	-0.051	0.37	-0.29	0.256	40	t =3.05 (S)
	-0.181	0.30	-0.10			

Notes: Same as Table 2

Table 5

DISCRIMINANT ANALYSES OF SUPPLIER MENTIONS VS. NON-MENTIONS
CONTRACTOR - ROOFTOPS

Supplier	Standardized Discriminant Function Coefficients[a]	Means of Factor Ratings: Mentions	Means of Factor Ratings: Non-Mentions	Group Centroids	n	Percent Correctly Classified / t-value
A	-1.262	4.07	-1.73			
	0.390	3.94	0.36	-0.635	16	85.71%
	-0.152	0.41	-1.22	0.917	12	t =2.73 (S)[b]
	0.127	0.23	-0.18			
B	0.783	3.72	0.10			
	-0.130	3.66	2.17	0.660	15	82.14%
	-0.536	0.36	0.57	-0.880	13	t =3.40 (S)
	0.519	0.39	-0.11			
C	No Analysis for this Supplier - No Response					
D	0.545	2.44	-1.28			
	0.977	2.90	-3.12	1.255	5	89.29%
	-0.677	1.07	-0.72	-0.418	23	t =4.16 (S)
	0.044	0.48	-0.28			

Notes: Same as Table 2

Table 6

DISCRIMINANT ANALYSIS OF SUPPLIER MENTIONS VS. NON-MENTIONS
ENGINEERS

Supplier	Standardized Discriminant Function Coefficients[a]	Means of Factor Ratings: Mentions	Means of Factor Ratings: Non-Mentions	Group Centroids	n	Percent Correctly Classified: t-value
A	1.317	2.88	1.54			
	-0.763	3.52	3.54	0.190	56	64.00%
	-0.071	1.06	0.81	-0.470	19	t =2.42 (S)[b]
	-0.047	0.24	0.02			
B	-0.250	2.25	0.88			
	0.992	4.11	0.80	0.285	53	63.01%
	-0.341	0.06	0.58	-0.703	20	t =2.22 (S)
	0.315	0.20	-0.01			
C	-0.196	-0.39	-1.92			
	-0.147	0.90	-0.80	-0.567	12	78.67%
	-0.254	0.12	-0.77	0.170	63	t =4.97 (S)
	-0.552	0.24	-0.20			
D	0.843	1.68	-0.48			
	0.351	1.44	-0.93	0.489	27	66.67%
	-0.203	0.50	-0.21	-0.216	48	t =2.89 (S)
	0.086	0.13	-0.06			

Notes: Same as Table 2

be significant. The position of the distribution service factors in the discriminant functions for engineers was fourth, second, second, and third for Suppliers A, B, C, and D respectively.

Noting the signs of the discriminant function coefficients and the centroids, the place of the distribution service factor is different than in previously studied segments. For three of the four suppliers, an above average rating on the distribution factor is associated with non-preference rather than preference. These suppliers are A, B and D. This indicates that even though the engineers groups recognizes distribution service provided by some suppliers is above average, other considerations are more important in the determination of their supplier preference.

Summary of Ratings and Factor Determinance

Once all analyses of supplier preference were conducted in each segment, the relative determinance of the distribution service factor could be studied in those groups. Figure 2 indicates the groups and suppliers where significant differences were found between mention and non-mention of suppliers based on supplier factor ratings. In all except two groups, where the cells had sample members, the discriminant function significantly differentiated between preferences and non-preferences for the four selected suppliers.

The position of the distribution service factor in all groups and for all suppliers varied from most to least important. Since the independent variables were scaled on

Figure 2

SUMMARY OF SIGNIFICANT AND NON-SIGNIFICANT FUNCTIONS AND RELATIVE IMPORTANCE OF FACTORS
SEGMENT

Supplier	Contractors PS	DBTM	CHILL.	RT	
A	NS[a] 1,2,4,3[b]	S 1,2,3,4	S 2,3,1,4	S 1,2,3,4	S 1,2,3,4
B	NS 4,2,1,3	S 1,3,2,4	S 2,1,3,4	S 1,3,4,2	S 2,3,4,1
C	No Response	S 2,4,3,1	S 3,2,1,4	No Response	S 4,3,1,2
D	S 3,4,2,1	S 2,1,3,4	S 2,4,1,3	S 2,3,1,4	S 1,2,3,4

Notes: a) S - Significant NS - Non-Significant
Order of factors in discriminant function
Codes - 1 - Operating Lifetime, 2 - Sales Service
3 - Distribution Service, 4 - Miscellaneous

ex - Contractor-Plan and Spec, Supplier D the order of importance is Distribution Service, Miscellaneous, Sales Service, and Operating Lifetime.

the basis of the respondent's relative comparison of suppliers on each variable, the importance of the factor in the discriminant function is a direct indication of the determinance of the factor in the purchase decision.

Table 7 summarizes the importance ranks of the factor in the discriminant function across all suppliers and all segments. As may be seen by inspection of this matrix, the level of determinance of the various factors varies by market segment. While the factor of interest in this research is most frequently second or third, there were two segments where the factor was first and one fourth. The results indicate that the level of determinance of the distribution or logistics service factor does vary by market segment.

Table 7

FREQUENCY OF IMPORTANCE RANKS IN DISCRIMINANT FUNCTIONS FOR PURCHASE FACTORS BASED ON SUPPLIER RATINGS (EXCLUDING NON-SIGNIFICANT AND EMPTY CELLS)

	Rank in Function			
	1st	2nd	3rd	4th
1. Operating Lifetime	6	2	5	3
2. Sales Service	7	5	2	2
3. Distribution Service	2	6	7	1
4. Miscellaneous	1	3	2	10

The implications of these results lead to a design of a marketing strategy which might emphasize the ability of the supplier to provide acceptable service, as well as a plan to actually provide a specified service level. Buyers do perceive a difference across suppliers in their ability to provide an above average level of service. This perception then determines in combination with the other decision factors, the buyers overall preference for a given supplier.

From a marketing strategy perspective, the supplier who wants to influence purchase preference should stress the distribution factor. In some segments where little perceived difference exists in the ability of suppliers to provide adequate service, opportunities may exist for one supplier to gain a competitive edge over the others by providing a higher level of service. This strategy would be particularly beneficial in those segments where the importance placed on the factor is also great. In other segments where the supplier has below average service he should bring his service level up to at least average or above in order to remain competitive. How far above average he should go again depends upon the importance level attached to the factor in the segment.

Considering the engineer group of purchase decision influencers, the level of importance attached to the distribution service factor is only moderate. This leads to the conclusion that to raise the perceived level of service above average might not prove beneficial. However in the contractor plan and spec and chiller segments, where the level of importance of the factor is high and the determinance of the factor is also significant every effort should be made to both design a high level of service into the system and to convince purchasers that the ability of the supplier to provide this service is above average.

This supplier must identify the segments in which his performance is below average and develop a strategy to improve in those segments. As may be noted in Figure 2, the determinance of the distribution service factor varies not only by segment but by manufacturer. This indicates that each supplier may have to determine his own relational model of the determinance of the various factors. His inability to provide competitive service levels may be overcome by better performance than competing suppliers on other factors. As a result, his rating on only one factor cannot be independently considered. The level of determinance of one factor is related to all other factors and as such the purchaser will trade off performance in one area against another. This may in part explain why the importance of the distribution service factor varies by supplier within a given segment.

In planning his marketing effort a supplier may then effect purchase preference in two ways. First he may adjust the levels of the determinant factor such that he is competitively superior to other suppliers. This must be done particularly with factors rated as highly important by purchasers. Second, if the competitive level of the factor is already high, the supplier must then raise his service level to equal the competitors and thereby neutralize the determinant effect. Once neutralized, the supplier then works from a position of strength in the other factors.

The primary implication for an individual supplier is therefore that the market must be segmented to identify significantly different importance profiles. Once the various factor importance profiles have been determined, the performance of the supplier in relationship to competition on all buying factors should next be determined within each segment. It is the level of importance in conjunction with the relative rating that determines the final purchase preference.

CHAPTER VI

RESEARCH CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Introduction

Chapter VI discusses the conclusions of this research in relation to existing research as they relate to industrial marketing. The limitations of the research are presented followed by some suggested paths for future investigations of the relevance of logistics system service in the industrial buying decision.

General Conclusions

As stated in Chapter II (Research Background) several studies have identified logistics or distribution service as an important variable in the industrial buying decision. Klass[1]; Dickson[2]; Wind, Green, and Robinson[3]; and Lehmann and O'Shaughnessy[4] found that some form of delivery and/or distribution service was rated as very important in a list of industrial buying decision making criteria. All of the cited studies investigated the importance of the factor to a single

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[1]Bertrand Klass, "What Factors Affect Industrial Buying Decisions", Industrial Marketing, (May, 1961), pp. 33-40.

[2]Gary W. Dickson, "An Analysis of Vendor Selection Systems and Decision", Journal of Purchasing, (February, 1966), p. 9.

[3]Yoram Wind, Paul E. Green, and Patrick J. Robinson, "The Determinants of Vendor Selection: The Evaluation Function Approach". Journal of Purchasing, (August, 1968), pp. 29-41.

[4]Donald R. Lehmann and John O'Shaughnessy, Difference in Attribute Importance for Different Industrial Products", Journal of Marketing, Vol. XXVIII, No. 2, (April, 1974), pp. 36-42.

group of industrial buying personnel. These individuals were primarily formal purchasing officers. These studies are reviewed in Chapter II (Research Methodology).

As Bennett and Scott[5] suggest, the entire market must first be segmented on the basis of attribute importance. Once this step is accomplished and the importance profiles isolated, the evaluation of suppliers may take place. But added to this, the actual evaluation of suppliers' ability to provide acceptable levels of performance must also be analyzed. It is not the absolute level of performance but the relative level to other suppliers that causes a purchase criteria or attribute to be determinant as Myers and Alpert[6] suggest.

To reiterate the hypotheses developed in Chapter III, the research was designed to test whether or not:

1) business logistics service is an important criteria used by industrial purchasers to evaluate suppliers;

2) suppliers are rated differently in their ability to provide some level of service or performance of the criteria, therefore making the criteria determinant; and

3) the level of determinance varies by market segment.

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[5]Peter J. Bennett and Jerome E. Scott, "Cognitive Models of Attitude Structure: 'Value Importance' _is_ Important", in _Combined Proceedings: 1971 Spring Conferences_, edited by Fred C. Allvine, (Chicago: American Marketing Association, 1972), pp. 346-350.

[6]James H. Myers and Mark I. Alpert, "Determinant Buying Attitudes: Meaning and Measurement", _Journal of Marketing_, Vol. XXXII, No. 4, (October, 1968), pp. 13-20.

The results indicate that not only is the business logistics service factor important but the importance level varies by purchase influence center and market segment. The level of importance was different within the purchase influencer dimension as delineated by the contractor-engineer breakdown. The engineer tends to be more concerned with long run product performance criteria while the contractor is more concerned with installation of the equipment.

The importance does not appear to change across purchase situations and product applications when presented to engineers. Their role as a representative of product user interests appear to be unchanged from the operating lifetime characteristics including operating and maintenance cost, service and parts availability, and service support. Contractors on the other hand seem to change their importance ratings depending upon equipment application and their involvement in the job type. Where the job characteristics involve potentially costly scheduling error possibilities their rating of the importance of logistics service is higher than in jobs where these problems are not as important.

Perreault and Russ[7] recognized that the general purchasing environment had an effect on the relative importance of physical distribution service in the industrial purchasing

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[7]William D. Perreault, Jr. and Fredrick A. Ross, Physical Distribution Service in Industrial Purchase Decisions", <u>Journal of Marketing</u>, Vol. XXXX, No. 2, (April, 1976), pp. 3-10.

decision. They grouped respondents on the basis of importance ratings of eight buying criteria including distribution service. While several patterns were observed which were significantly different, the position of the physical distribution service variable remained constant. It is difficult to ascertain how the purchase situations were delineated, but the entire sample was of purchasing agents for various products. One conclusion drawn from this study was that many purchasing agents are insensitive to poor service and a minor number are sensitive to poor service. The present research has helped identify which segments of the industrial installation market for air conditioning equipment are sensitive to service. The identification of two purchase influence centers has also added to this area. Those influencers whose roles are different in terms of the application of the product and their representation in the buying center have different sensitivities to the level of service as evidenced by the combination of importance ratings and individual supplier ratings on the various buying criteria. The evidence points to the fact that the purchase situation is just as important as the product in delineating market segments where logistics service must be adjusted to a competitive level.

The interrelationships among the members of the buying center also determine which factors must receive attention. Tables 1 and 2 present the analysis of the various levels of decision making control by both contractors and engineers within the job types studied in the research. The

Table 1

LEVEL OF PURCHASE DECISION MAKING CONTROL ON SEVEN STAGES
BY JOB TYPE - CONTRACTORS

Stage in Process	Plan and Spec	Negotiated/ Team-Managed	Design-Build	Owner Prepurchase	F	S/NS
1. Conception of Building	1.477	2.541	2.895	1.566	24.359	S
2. Preliminary Investigation	1.636	2.919	3.333	1.615	37.132	S
3. Design of A/C System Needs	1.705	3.378	4.253	2.135	79.959	S
4. Specification of Equipment	1.784	3.486	4.293	2.058	75.321	S
5. Solicitation of Bids for Equipment	3.750	4,338	4.560	2.038	54.833	S
6. Evaluation of Bids for Equipment	4.034	4.216	4.587	1.923	60.717	S
7. Purchase Ordering of Equipment	4.057	4.187	4.547	1.887	63.839	S

Coding : 5 - Total Control, 3 - Some Control, 1 - No Control.

Table 2

LEVEL OF PURCHASE DECISION MAKING CONTROL ON SEVEN STAGES
BY JOB TYPE
GROUP - MECHANICAL ENGINEERS

Stage in Process	Plan and Spec	Negotiated/ Team-Managed	Design-Build	Owner Prepurchase	F	S/NS
1. Conception of Building	3.289	3.404	2.889	3.000	1.427	NS
2. Preliminary Investigation	3.773	3.696	3.139	3.297	2.921	NS
3. Design of A/C System Needs	4.293	4.000	3.743	3.595	4.325	S
4. Specification of Equipment	4.307	3.783	3.361	3.324	9.300	S
5. Solicitation of Bids for Equipment	2.773	2.804	2.833	2.676	0.092	NS
6. Evaluation of Bids for Equipment	3.307	3.065	2.778	3.162	1.348	NS
7. Purchase Ordering of Equipment	1.944	2.304	2.206	2.162	0.726	NS

Coding: 5 - Total Control, 3 - Some Control, 1 - No Control data for these tables was derived in section one of the data collection instrument. The level of decision making control shared by engineers and contractors at various stages of the purchase process changes in composition with job type. In the plan and spec job category (traditional method) the engineer has primary control over the preliminary phases where needs are determined and alternatives specified. The contractor has more control in the latter stages where the alternatives are narrowed down to the final selection. Moving to the next two job types (Design Build and Team Managed) contractors and engineers trade some decision making control in earlier stages of the process. Contractors become more involved in the purchase decision process earlier. It is at these stages where alternative suppliers are specified.

The main implication of these findings is that in the job types where contractors become involved in selection of alternatives at early stages, the determinance and importance of the logistics service factor becomes relevant not only for specifying the final supplier but also for determining the feasible alternatives. Thus the higher level of importance placed on the delivery factor, combined with the experience of the contractor with various suppliers may either exclude or include a specific supplier from consideration as alternative. Once the alternatives have been determined the final choice is constrained. As a result, the evaluation of the determinance of the logistics service factor as well as all other factors is not adequate when conducted with only a single purchase decision making influencer. When the decision makers who consider logistics service a determinant get involved in the earlier stages of the decision making process the attitudes of engineers may be affected. As a result the provision of adequate or competitive service may have to be stressed to both groups in these latter segments. Thus the marketer of industrial equipment must identify several variables in designing his strategy. These are:

1) The key purchase decision making influencers in the buying process;
2) The buying factors which are important in the process;
3) The segments of the market which have significantly different buying factor importance profiles; and
4) The determinance of the buying factors for various market segments.

He must then work from a position of strength where his capability to provide competitive levels of logistics service in the market segments where this factor is determinant.

Research Limitations

The conclusions drawn in this research have some limitations. These are in the areas of product specificity, selection of the research population and sample frame, and finally the scope of the study in relation to the full range of purchasing influencers and product applications.

A single product category was the subject of the investigation in this research. As such, generalizing the results to other product types might be approached with some caution. The nature of the relationships and identification of segmentation dimensions may vary from product to product. A product in the plant and equipment category, specified in the design stages of a building and installed by a specialty contractor such as that studied here would fit in the framework readily. The roles of the engineer and contractor are not necessarily similar for component parts, raw materials, supplies, and accessories as subgroups of the industrial product markets. As such similar studies need to be conducted in these areas.

The research population included a nationwide cross section of contractors and engineers. The sample for the research was selected from fifteen major U. S. cities. Those metropolitan areas bypassed in the sample may have characteristics which are different than the research population. The conclusions should not technically be extended beyond the fifteen city area. However, these cities are the largest concentrations of population and industrial activity. They are furthermore representative of the geographic areas where they are located. No substantial error is therefore expected in making inferences to the entire U. S. population of contractors and engineers.

Finally, the investigation was limited to the two major influence centers - contractors and engineers. Several other potential influences in the purchase decision were assumed to be represented by these groups. It should not be concluded that these groups are the sole influences. Some information flows from other groups directly related to these. A third highly important group whose input was not solicited was the owners and occupants group. This group consumes the service of the product, but has little direct influence in the purchase decision process. These individuals need to be investigated further for their potential influences and corresponding results in terms of marketing strategy and success.

Recommendations for Future Research

Although this research has hopefully made some contribution to how the business logistics service factor fits into an industrial purchase decision, many areas exist for further research.

Initially the area of actual service measurement across market segments and suppliers needs to be developed further. The statistical relationship between real service levels and overall performance of suppliers in terms of sales, market share, or profits is yet to be evaluated fully. The parameters of the actual service time and variation, frequency of failure, and related service components need to be evaluated within market segments in relation to the perceived service level as well.

Both the level of tolerance and the conditions surrounding the reaction to failures in the system to provide consistent service or deliver complete orders, remain open for investigation. The frequency with which the promised delivery schedule is not met and the change of preference from one supplier to another is another relationship which needs investigation. How many times can the system fail to provide acceptable performance before a customer switches to another supplier permanently. Finally, a methodology for estimating the current level of service which is acceptable needs development. This research has identified the fact that service performance is not only perceived differently in various segments, but has also established it as a determinant purchase criteria which should be studied further with respect to its quantitative nature.

The trade-offs between the level of logistics service and the composition of the service mix must also be studied. How much additional cost will be borne by the customer to affect faster delivery time and less variation in delivery remains unstudied. These are separate issues which need further investigation. Evidence exists that the absolute time is not as important as the variability (see Chapter II). The customer may simply readjust his schedule to reflect the absolute time. However, variability is another matter. Whether or not he views the reduction of variability as a responsibility of the supplier in his normal performance or as something which he is willing to substantially reduce by paying for better service is still the question at hand.

The second trade off question involves product quality and delivery performance. Is the quality reputation of a supplier sufficient enough to overcome poor delivery service. The research indicates that quality is determinant in preferences toward some suppliers and not others within the same importance profile, thus other factors where little difference exists between suppliers are non-determinant. Conversely, how far above the average level of logistics service must a supplier perform in order to overcome a low quality image.

Finally, the interaction between members of the buying center needs further investigation. The information transferred from one member to another concerning the service level may be investigated more fully. To what degree does the experience of one member of the buying center with a given supplier effect the preference of other buying center members. In addition other influencers such as product users, owners, architects, and other contractors should be studied with respect to their inputs to the buying center. A more clear-cut distinction is needed for the members of the buying center and their roles in various purchase situations.

APPENDIX

SECTION II

THIS SECTION DEALS WITH YOUR FEELINGS REGARDING FACTORS THAT MAY BE INVOLVED WHEN YOU SPECIFY OR PURCHASE INDUSTRIAL OR COMMERCIAL AIR CONDITIONING EQUIPMENT.

NOTE: PLEASE ANSWER THE QUESTIONS IN THIS SECTION IN TERMS OF THE JOB YOU SELECTED ON THE LAST PAGE.

FIRST,

Scale	
5	EXTREMELY IMPORTANT
4	
3	SOMEWHAT IMPORTANT
2	
1	NOT IMPORTANT

PLEASE INDICATE THE RELATIVE IMPORTANCE OF EACH OF THE FACTORS LISTED BELOW IN YOUR SPECIFYING OR PURCHASE DECISION MAKING. THE IMPORTANCE RATING IS TO BE BASED ON THE SCALE TO THE LEFT. SEVERAL FACTORS MAY BE OF APPROXIMATELY EQUAL IMPORTANCE, THEREFORE THE SAME RATING NUMBER MAY BE USED FOR MORE THAN ONE FACTOR.

NEXT,

PLEASE RATE EACH OF THE FOLLOWING COMPANIES ON THE FACTORS LISTED BELOW ACCORDING TO THE SCALE ON THE RIGHT. YOU MAY USE THE SAME RATING FOR MORE THAN ONE COMPANY, IF YOU FEEL THAT THIS IS APPLICABLE. NOTE: RATE ALL COMPANIES UNLESS YOU HAVE ABSOLUTELY NO INFORMATION ON A PARTICULAR ONE.

Scale	
5	EXCELLENT
4	
3	AVERAGE
2	
1	POOR

IMPORTANCE RATING	FACTOR	CARRIER	CHRYSLER	FEDDERS	LENNOX	MCQUAY	NESBITT	TRANE	WESTINGHOUSE	YORK
___	PRICE - FIRST COST	___	___	___	___	___	___	___	___	___
___	OPERATING AND MAINTENANCE COST	___	___	___	___	___	___	___	___	___
___	RELIABILITY - LIFE EXPECTANCY	___	___	___	___	___	___	___	___	___
___	EASE OF INSTALLATION	___	___	___	___	___	___	___	___	___
___	EASE OF MAINTENANCE	___	___	___	___	___	___	___	___	___
___	SIZE WEIGHT AND CONSTRUCTION OF EQUIPMENT	___	___	___	___	___	___	___	___	___
___	NOISE AND VIBRATION LEVELS	___	___	___	___	___	___	___	___	___
___	DELIVERY TIME	___	___	___	___	___	___	___	___	___
___	CONSISTENCY OF DELIVERY (VARIABILITY OF ACTUAL FROM PROMISED)	___	___	___	___	___	___	___	___	___
___	DELIVERY EXPEDITING CAPABILITY	___	___	___	___	___	___	___	___	___
___	LOCAL AVAILABILITY OF PARTS AND SERVICE	___	___	___	___	___	___	___	___	___
___	REGULAR CONTACT BY SALESMAN OR ENGINEER	___	___	___	___	___	___	___	___	___
___	LONG TERM ESTABLISHED CONTACT WITH SALESMAN OR ENGINEER	___	___	___	___	___	___	___	___	___
___	SALESMAN'S OR ENGINEER'S ASSISTANCE IN STARTUP, DESIGN, AND/OR SPEC WRITING	___	___	___	___	___	___	___	___	___
___	REGULAR CATALOG UPDATES BY PERSONAL SALES CALL	___	___	___	___	___	___	___	___	___
___	AVAILABILITY OF SALESMAN OR ENGINEER TO HELP WITH PROBLEMS OR ANSWER QUESTIONS	___	___	___	___	___	___	___	___	___
___	AVAILABILITY OF FULL LINE OF A-C SYSTEM COMPONENTS	___	___	___	___	___	___	___	___	___
___	FACTORY SERVICE SUPPORT OVER EQUIPMENT LIFETIME	___	___	___	___	___	___	___	___	___
___	CATALOG DESCRIPTIONS OF OPERATING AND INSTALLATION SPECIFICATIONS	___	___	___	___	___	___	___	___	___

1. WHICH MANUFACTURER'S EQUIPMENT LISTED BELOW WOULD YOU SPECIFY OR BUY FOR THE SPECIFIC JOB THAT YOU SELECTED ON PAGE 1. PLEASE CHECK THE ONE MANUFACTURER, OR IF THERE ARE TWO OR MORE WHICH YOU ABSOLUTELY FEEL ARE EQUAL, PLEASE CHECK THOSE THAT YOU WOULD SPECIFY OR BUY.

CARRIER..........____
CHRYSLER.........____
FEDDERS..........____
LENNOX...........____
MCQUAY...........____
NESBITT..................____
TRANE....................____
WESTINGHOUSE.............____
YORK.....................____
OTHER(please specify)
____________________.....____

2. IN THE PAST YEAR, APPROXIMATELY WHAT PERCENTAGE OF ALL JOBS DONE BY YOUR FIRM INCLUDED INDUSTRIAL OR COMMERCIAL AIR CONDITIONING EQUIPMENT FROM THE MANUFACTURERS LISTED BELOW.

CARRIER............____%
CHRYSLER...........____%
FEDDERS............____%
LENNOX.............____%
MCQUAY.............____%
NESBITT............____%
TRANE..............____%
WESTINGHOUSE.......____%
YORK...............____%
OTHER (specify)
________________.____%
TOTAL..............100 %

SECTION III

THIS SECTION DEALS WITH YOUR THOUGHTS ON ALTERNATES TO THE MANUFACTURERS NAMED IN THE MECHANICAL SPECIFICATIONS FOR AN INDUSTRIAL OR COMMERCIAL AIR CONDITIONING JOB.

1. HOW IMPORTANT IS IT THAT INDUSTRIAL OR COMMERCIAL EQUIPMENT BE PURCHASED FROM A MANUFACTURER NAMED IN THE SPECIFICATIONS? (please check the importance along the scale)

EXTREMELY IMPORTANT ___ ___ ___ ___ ___ NOT IMPORTANT

2. HOW OFTEN ARE SPECIFICATIONS WRITTEN SUCH THAT THEY ARE CLOSED TO ANY BUT THE NAMED MANUFACTURER?

ALWAYS ___ ___ ___ ___ ___ NEVER

3. HOW OFTEN IS A MANUFACTURER SUBMITTED OTHER THAN ONE NAMED IN THE SPECIFICATIONS?

ALWAYS ___ ___ ___ ___ ___ NEVER

4. FOR THE JOB SELECTION MADE IN SECTION ONE HOW LIKELY IS IT THAT AN ALTERNATE WILL BE APPROVED FOR ANY OF THE REASONS LISTED BELOW? (please check the appropriate point on the scale)

	EXTREMELY LIKELY				EXTREMELY UNLIKELY
BETTER PRICE THAN THE NAMED MANUFACTURER..............	___	___	___	___	___
BETTER PAST DELIVERY PERFORMANCE THAN THE NAMED MANUFACTURER....................................	___	___	___	___	___
BETTER PROMISED DELIVERY DATE THAN THE NAMED MANUFACTURER....................................	___	___	___	___	___
BETTER RELIABILITY THAN THE NAMED MANUFACTURER'S EQUIPMENT....................................	___	___	___	___	___
BETTER SERVICE THAN THE NAMED MANUFACTURER............	___	___	___	___	___
OTHER (please specify)________________________.....	___	___	___	___	___

5. HOW OFTEN ARE ALTERNATES APPROVED?(please check the appropriate point on the scale)

ALWAYS ___ ___ ___ ___ ___ NEVER

SECTION IV

THIS SECTION DEALS WITH GENERAL INFORMATION ON YOUR FIRM'S BUSINESS.

1. IN WHICH OF THE BUILDING TYPES LISTED BELOW, DID YOUR FIRM WORK WITH AIR CONDITIONING EQUIPMENT DURING THE PAST TWO YEARS? (please check all that apply) IF YOU SPECIALIZE IN A PARTICULAR TYPE OF BUILDING PLEASE DOUBLE CHECK.

OFFICE BUILDINGS (3 STORIES OR LESS)....._____
OFFICE BUILDINGS (MORE THAN 3 STORIES)..._____
STORES (DEPARTMENT)....................._____
STORES (SMALL RETAIL)..................._____
SHOPPING CENTERS......................._____
RESTAURANTS..........................._____
BANKS................................._____
NURSING AND/OR CONVALESCENT HOMES......._____
HOSPITALS AND/OR HEALTH CARE FACILITIES.._____

ELEMENTARY AND/OR SECONDARY SCHOOLS......_____
COLLEGE BUILDINGS......................._____
RECREATIONAL BUILDINGS.................._____
RELIGIOUS BUILDINGS....................._____
INDUSTRIAL BUILDINGS...................._____
APARTMENTS (3 STORIES OR LESS).........._____
APARTMENTS (MORE THAN 3 STORIES)........._____
OTHER (please specify)
______________________________....._____

2. IS YOUR FIRM OR WAS IT EVER A FRANCHISED OR AUTHORIZED DEALER FOR INDUSTRIAL OR COMMERCIAL AIR CONDITIONING EQUIPMENT?

NO ☐ YES ☐

3. IF YOU ARE OR WERE EVER AN AUTHORIZED OR FRANCHISED DEALER, WITH WHICH MANUFACTURER(S) ARE (WERE) YOU ASSOCIATED?

____

____

4. WHAT IS THE GEOGRAPHICAL EXTENT OF YOUR FIRM'S BUSINESS? (please check the widest area that applies)

LOCAL..............._____
STATEWIDE.........._____
REGIONAL..........._____
NATIONWIDE........._____
INTERNATIONAL......._____

5. APPROXIMATELY WHAT WERE YOUR FIRM'S TOTAL BILLINGS LAST YEAR? $__________________

6. WHAT IS YOUR POSITION OR TITLE IN THE FIRM? ______________________________

THANK YOU FOR YOUR HELP WITH THIS SURVEY. PLEASE RETURN AT YOUR EARLIEST CONVENIENCE IN THE ENCLOSED ENVELOPE

SECTION I

THIS SECTION DEALS WITH YOUR ROLE IN THE PURCHASE PROCESS FOR INDUSTRIAL OR COMMERCIAL AIR CONDITIONING EQUIPMENT. OF INTEREST IS THE AMOUNT OF CONTROL YOU FEEL THAT YOU HAVE OVER DECISIONS MADE AT VARIOUS STAGES IN THE PURCHASE PROCESS.

1. WHAT PERCENTAGE OF ALL JOBS DONE BY YOUR FIRM FALL INTO THE CATEGORIES LISTED BELOW?

PLAN AND SPEC..........................._____%
NEGOTIATED/TEAM MANAGED................._____%
DESIGN BUILD............................_____%
OWNER PREPURCHASE......................._____%
TOTAL....... 100 %

2. IN THE NEXT FIVE YEARS, WHAT DO YOU FORSEE HAPPENING TO THE PERCENTAGE OF JOBS IN EACH CATEGORY? (Please check the appropriate trend)

	More than now	About the same	Less than now
PLAN AND SPEC	____	____	____
NEGOTIATED/TEAM MANAGED	____	____	____
DESIGN BUILD	____	____	____
OWNER PREPURCHASE	____	____	____

3. USING THE SCALE PRESENTED BELOW, PLEASE INDICATE HOW MUCH CONTROL YOU HAVE OVER PURCHASE DECISION MAKING.

5 TOTAL CONTROL
4
3 SOME CONTROL
2
1 NO CONTROL

PLEASE INDICATE THE AMOUNT OF CONTROL YOU HAVE OVER DECISIONS MADE AT EACH STAGE IN THE PROCESS AS LISTED BELOW. USE THE SCALE AT THE LEFT TO INDICATE THE AMOUNT FOR EACH JOB TYPE. YOU MAY USE THE SAME NUMBER AT MORE THAN ONE STAGE IF YOU FEEL THIS IS APPLICABLE.

Stage in Process	PLAN AND SPEC	NEGOTIATED/ TEAM MANAGED	DESIGN BUILD	OWNER PREPURCHASE
CONCEPTION OF BUILDING	____	____	____	____
PRELIMINARY INVESTIGATION	____	____	____	____
DESIGN OF A-C SYSTEM NEEDS	____	____	____	____
SPECIFICATION OF EQUIPMENT	____	____	____	____
SOLICITATION OF BIDS FOR EQUIPMENT	____	____	____	____
EVALUATION OF BIDS FOR EQUIPMENT	____	____	____	____
PURCHASE ORDERING OF EQUIPMENT	____	____	____	____

4. SEVERAL APPLICATIONS FOR INDUSTRIAL OR COMMERCIAL AIR CONDITIONING EQUIPMENT ARE LISTED BELOW. PLEASE SELECT A SPECIFIC APPLICATION WITH WHICH YOU ARE FAMILIAR. ALSO PLEASE INDICATE THE JOB TYPE AS LISTED ABOVE (PLAN AND SPEC, NEGOTIATED/TEAM MANAGED, DESIGN BUILD, OR OWNER PREPURCHASE)

	YOUR SELECTION	JOB TYPE
- A CHILLER FOR A HOSPITAL	____	__________
- A CHILLER FOR A MULTI-STORY OFFICE BUILDING OR STORE TO BE OCCUPIED BY THE OWNER	____	__________
- ROOFTOPS FOR A SCHOOL, POST OFFICE, ETC.	____	__________
- ROOFTOPS FOR A SHOPPING CENTER	____	__________
- A CHILLER FOR A MULTI-STORY BUILDING CONSTRUCTED FOR A SPECULATIVE OWNER	____	__________
- ROOFTOPS FOR A RESTAURANT, BRANCH BANK, STORE, OR SMALL OFFICE BUILDING	____	__________
- A COMPUTER ROOM AIR CONDITIONING SYSTEM	____	__________

PLEASE ANSWER THE QUESTIONS IN THE NEXT SECTION IN TERMS OF THE JOB THAT YOU SELECTED ABOVE.

BIBLIOGRAPHY

BIBLIOGRAPHY

Articles and Periodicals

Ballou, Ronald H. and DeHays, Daniel W., Jr., "Transport Selection by Interfirm Analysis", Transportation and Distribution Management, (June, 1967), pp. 33-40.

Bass, Frank M., and Wilkie, William L., "A Comparative Analysis of Attitudinal Predictions of Brand Preference", Journal of Marketing Research, Vol. X, No. 3, (August, 1973), pp. 262-269.

Bennet, Peter J. and Scott, Jerome, E., "Cognitive Models of Attitude Structure: 'Value Importance' is Important", in Combined Proceedings: 1971 Spring Conferences, ed. by Fred C. Allvine, (Chicago: American Marketing Association, 1972)., pp. 346-350.

Borden, Neil H., "The Concept of the Marketing Mix", Journal of Advertising Research, Vol. IV, No. 2, (June, 1964), pp. 2-7.

Cardozo, Richard N., "Segmenting the Industrial Market", in King, William R., ed., Marketing and the New Science of Planning.

________., and Cagley, James W., "Experimental Study of Industrial Buyer Behavior", Journal of Marketing Research, Vol. VIII, No. 3, (August, 1971), p. 32.

Cunningham, William H., and Crissy, William J. E., "Market Segmentation by Motivation and Attitude", Journal of Marketing Research, Vol. IX, No. 1, (February, 1972), pp. 100-102.

Dickson, Gary W., "An Analysis of Vendor Selection Systems and Decisions", Journal of Purchasing, (February, 1966), p. 9.

Frank, Ronald E., Massy, William F., and Morrison, Donald G., "Bias in Multiple Discriminant Analysis", Journal of Marketing Research, Vol. II, (August, 1965), pp. 250-258.

Harrell, Gilbert D., and Bennett, Peter D., "An Evaluation of the Expectancy Value Model of Attitude Measurement for Physician Presctibing Behavior", Journal of Marketing Research, Vol. XI, No. 3, (August, 1974), pp. 269-278.

Hulbert, James. "Information Processing Capacity and Attitude Measurement", Journal of Marketing Research, Vol. XII, No. 1, (February, 1975), pp. 104-106.

________., and Lehmann, Donald R., "Are Three Point Scales Always Good Enough", Journal of Marketing Research, Vol. IX, No. 4, (November, 1972), pp. 444-446.

Jacoby, Jacob, and Mattell, Michael S., "Three Point Scales are Good Enough", Journal of Marketing Research, Vol. VIII, No. 4, (November, 1971), pp. 495-500.

Klass, Bertrand, "What Factors Affect Industrial Buying Decisions", Industrial Marketing, (May, 1961), p. 34.

LaLonde, Bernard Jo, "Strategies for Organizing Physical Distribution", Transportation and Distribution Management, (January, February, 1974), pp. 21-22.

Lehmann, Donald R., and O'Shaughessy, John, "Difference in Attribute Importance for Different Industrial Products", Journal of Marketing, Vol. XXXVIII, No. 2, (April, 1974), pp. 36-42.

Lewis, Richard J., and Erickson, Leo G., "Marketing Functions and Marketing Systems" A Synthesis", Journal of Marketing, Vol. XXXIII, No. 3, (July, 1969), p. 8.

Massey, William, F., "Discriminant Analysis of Audience Characteristics", Journal of Advertising Research, Vol. V, (March, 1965), pp. 39-48.

Morrison, Donald G., "On the Interpretation of Discriminant Analysis", Journal of Marketing Research, Vol. VI, No. 2, (May, 1969), pp. 156-163.

Myers, James H., and Alpert, Mark I., "Determinant Buying Attitudes: Meaning and Measurement", Journal of Marketing, Vol. XXXII, No. 4, (October, 1968), pp. 13-20.

Perreault, William D., Jr., and Russ, Fredrick A., "Physical Distribution Service in Industrial Purchase Decisions", Journal of Marketing, Vol. XXXX, No. 2, (April, 1976), pp. 3-10.

Raju, P. S., Bhagat, Rabi S., and Sheth, Jagdish N., "Predictive Validation and Cross Validation of the Fishbein, Rosenberg, and Sheth Models of Attitudes", in _Advances in Consumer Research_, ed. by Mary Jane Schlinger, (Chicago: Association for Consumer Research, 1975), pp. 405-425.

Rosenberg, Milton J., "Cognitive Structure and Attitudinal Affect", _Journal of Abnormal and Social Psychology_, Vol. VIII, (November, 1956), p. 367.

Sheth, Jagdish N., "A Model of Industrial Buyer Behavior", _Journal of Marketing_, Vol. XXXVII, No. (October, 1973), p. 52.

_________., and Talarzyk, W. Wayne, "Perceived Instrumentality and Value Importance as Determinants of Attitudes", _Journal of Marketing Research_, Vol. XX, No. 1, (February, 1972), pp. 6-9.

Smith, Wendell R., "Product Differentiation and Market Segmentation as Alternative Marketing Strategies", _Journal of Marketing_, Vol. XXI, No. 1, (June, 1956), pp. 3-8.

Stephenson, P. Ronald, and Willett, Ronald P., "Selling with Physical Distribution Service", _Business Horizons_, (December, 1968), p. 78.

_________., "Determinants of Buyer Response to Physical Distribution Service", _Journal of Marketing Research_, (August, 1969), p. 279.

Sweeny, Daniel J., and Reizenstein, Richard C., "Developing Retail Market Segmentation Strategy for a Women's Specialty Store Using Multiple Discriminant Analysis", in _Proceedings_, Fall Conference, American Marketing Association, 1971, pp. 466-472.

Wind, Yoram, and Robinson, Patrick J., "Simulation the Industrial Buying Process", _Marketing and the New Science of Planning_, (Chicago: American Marketing Association, 1968), p. 444.

_________., Green, Paul E., and Robinson, Patrick J., "The Determinants of Vendor Selection: The Evaluation Function Approach", _Journal of Purchasing_, (August, 1968), pp. 29-41.

Books

Ballou, Ronald H., Business Logistics Management, (Englewood Cliffs: Prentice-Hall, Inc., 1973).

Bolch, Ben W., and Huang, Cliff J., Multivariate Statistical Methods for Business and Economics, (Englewood Cliffs: Prentice-Hall, Inc., 1974.

Bowersox, Donald J., Smykay, Edward W., and LaLonde, Bernard J., Physical Distribution Management, (London: The Macmillian Co., 1968).

Churchill, Gilbert A., Jr., Marketing Research: Methodological Foundations, (Hinsdale: The Dryden Press, 1976).

Cooley, William W., and Lohnes, Paul R., Multivariate Data Analysis, (New York: Wiley, 1971).

Erdos, Paul L., Professional Mail Surveys, (New York: The McGraw-Hill Book Company, 1970).

Heskett, James L., Ivie, Robert M., and Glaskowsky, Nicholas A., Business Logistics, (New York: The Ronald Press, 1964)

Frank, Ronald E., Massy, William F., and Wind, Yoram, Market Segmentation, (Englewood Cliffs: Prentice-Hall, Inc., 1972).

Gorsuch, Richard L., Factor Analysis, (Philadelphia: W.B. Saunders Company, 1974).

Green, Paul E. and Tull, Donald S., Research for Marketing Decisions, (Englewood Cliffs: Prentice-Hall, Inc., 1975).

Kelley, Eugene J., and Lazer, William, eds., Managerial Marketing: Perspectives and Viewpoints, (Homewood, Ill.: Richard D. Irwin Co., 1967).

Leabo, Dick A., Basic Statistics, (Homewood, Ill.: Richard D. Irwin, Inc., 1972).

Magee, James F.,Physical Distribution Systems, (New York: McGraw-Hill, 1967)

Mendenhall, William, Introduction to Probability and Statistics, (Belmont, California: Wadsworth Publishing Company, Inc., 1972).

Nie, Norman H., et al, Statistical Package for the Social Sciences, (New York: McGraw-Hill Book Company, 1975).

Robinson, Patrick J., and Faris, Charles, Industrial Buying and Creative Marketing, (Boston: Allyn and Bacon, Inc.).

Schiff, Michael, Accounting and Control in Physical Distribution Management, (Chicago: The National Council of Physical Distribution Management, Inc., 1972).

Siegal, Sidney, Nonparametric Statistics: For the Behavioral Sciences, (New York: The McGraw-Hill Book Company, Inc., 1956).

Tatsuoka, Maurice M., Multivariate Analysis, (New York: Wiley, 1971).

Tull, Donald S., and Hawkins, Del I., Marketing Research, (New York: Macmillian Publishing Company, 1976).

Webster, Fredrick E., and Wind, Yoram, Organizational Buying Behavior, (Englewood Cliffs: Prentice-Hall, Inc., 1972).