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SALES FORECASTING FOR NEW INDUSTRIAL PRODUCTS

by
Jay Edward Klompmaker

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Business Administration)
in The University of Michigan
1973

Doctoral Committee:

Associate Professor H. Paul Root, Chairman
Professor Charles N. Davisson
Assistant Professor William K. Hall
Professor Joseph Martin

DEDICATION

This dissertation is dedicated to my parents, Mr. and Mrs. Edward Klompmaker. Many years of encouragement and stimulation are their contribution to this research.

ACKNOWLEDGMENTS

I would like to thank the members of my dissertation committee for reading and commenting upon my work. A special thank you is due Professor H. Paul Root, my dissertation chairman, for his patience and indulgence. In addition I wish to thank Professor Frederick A. Russ who provided some very valuable suggestions and criticisms on the early drafts of the dissertation. The businessmen who participated in this research are accorded a special thank you for sharing their thoughts and experiences with me; it is unfortunate that they can not be identified by name and given the recognition they deserve. Sue Cheek typed the final draft and acted as a steadying influence when things became most hectic.

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TABLE OF CONTENTS

DEDICATION ii

ACKNOWLEDGMENTS iii

LIST OF TABLES vii

LIST OF ILLUSTRATIONS viii

LIST OF APPENDICES ix

CHAPTER

I. PROBLEM, PAST RESEARCH, AND RESEARCH PLAN 1

Introduction
Background Information on New-Product Sales Forecasts
Characteristics of the new-product sales forecasts
The sales forecasting environment
Statement of the Problem
Past Research
Research Approach

II. THE NEW-PRODUCT DEVELOPMENT PROCESS 47

Introduction
New-Product Development Research Results
Focus of the new-product development process
Problems created by an emphasis on new-product idea generation
Approaches used during the technical development of the product
Approaches used during the market introduction stage
Deliberate use of interdependencies to reduce the risk inherent in the new-product development process
Summary of results related to the new-product development process
Sales Forecasting and the New-Product Development Process
Uses of the new-product sales forecast
Possible consequences of inaccurate new-product sales forecasts
Chapter Summary

III. THE DEVELOPMENT OF A SALES FORECAST 94

Introduction
Approaches Taken to Sales Forecasting
The use of consultants from outside the firm
The use of formal sales forecasting models
The use of test marketing and market research
Incorporation of information into the final sales forecast
Problems encountered using present sales forecasting methods
Chapter Summary

IV. AN APPROACH TO SALES FORECASTING 131

Introduction
Desired Characteristics of an Approach to Sales Forecasting
Literature Review
Model building research
Industrial buying behavior research
Adoption and diffusion research
Integration of research results
An Approach to the Development of Sales Forecasts
Demonstration of the Basic Approach in an Actual Business Situation
Description of the test environment
Collection of the data--the dependent variable
Collection of the data--the predictor variables
Data analysis strategy
Results of the data analysis
Calculation of posterior probabilities and assignment to groups
Discussion of results
Chapter Summary

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS 181

Introduction
Summary of Research Results
Conclusions Drawn from the Results
Recommendations for Future Research
Observations on the research approach employed
Recommendations for research into the new-product development process
Recommendations for research into the sales forecasting process

APPENDIX I 207

APPENDIX II 210

REFERENCES 213

BIBLIOGRAPHY 221

LIST OF TABLES

Table		Page
1-1	The Positions and Responsibilities of the Respondents	16
2-1	Source of the New-Product Idea	53
2-2	Decisions for which Forecasts were Made	85
3-1	The Use of Consultants in Industrial New-Product Sales Forecasting	96
3-2	The Use of Test Marketing and Marketing Research in Industrial New-Product Sales Forecasting	103
3-3	Information Incorporated into the Sales Forecast and Method of Incorporation	116
3-4	Most Difficult Aspects of New-Product Sales Forecast Development	126
4-1	Output from Stepwise Discriminant Analysis	165
4-2	The Predictor Variables by Code Name and Source	173
4-3	Posterior Probabilities of Group Membership for 12 Accounts outside Chicago	174

LIST OF ILLUSTRATIONS

Figure		Page
1-1	Comparison of Growth Curves	6
2-1	Network Diagram of an Illustrative History of a New Product	49
2-2	A New-Product Planning and Control System	51
2-3	Three Initial Families of Technologies and Market Opportunities	77
3-1	Price-Volume Relationship of Various Competing Materials for One Potential Application	108
3-2	Coordination of Material Properties with Application Requirements	109
3-3	Grid Used as an Interview Guide for Survey of Manufacturers	121
4-1	Questionnaire Used to Obtain Information from Salesmen	156
4-2	Classification of 12 Accounts	175

LIST OF APPENDICES

Appendix — Page

I. Interview Guide 207

II. Notes from Meeting at _____ 210

CHAPTER I

PROBLEM, PAST RESEARCH, AND RESEARCH PLAN

1.1 Introduction

The primary objective of this research is to study the development of sales forecasts for new industrial products. More specifically, it is to learn what is needed to improve these forecasts. On one hand, the research is exploratory since it increases our knowledge of (1) the elements of the sales forecasting process for new industrial products and (2) the environment in which these forecasts are made. On the other hand, it is applied since it considers the applicability of using the results from other areas of research to improve the sales forecasting process. For the reader to adequately understand and critically evaluate the results of this research, certain background information is required. That is the purpose of this chapter.

This chapter starts with a description of the characteristics of new-product sales forecasts and of the characteristics of the environment in which these forecasts are made. Next is a section delineating the specific types of problems included for study. Since a number of alternative research objectives could have been selected, the third section, by reviewing the available research literature in the area, defines the reasons for the selection of the chosen objectives. Finally, the last two sections describe the

research methodology employed and the format used in the remainder of the dissertation for the presentation of the results.

1.2 Background Information on New-Product Sales Forecast

1.2.1 Characteristics of the new-product sales forecast

In the Foreword to The National Industrial Conference Board Study, "Forecasting Sales," [10, p. 2] John S. Sinclair, then NICB president, stated:

> Forecasting is a basic and inescapable responsibility of business management. The systematic marshalling of facts and judgment for gauging future company prospects is essential for sound decision-making, planning, and control. Most important of all in this process, for most firms, is the determination of future sales volume.

In a survey of 161 executives who were members of the NICB's Senior Marketing Executives Panel [27, p. 1] one senior marketing executive said that the sales forecast is ". . . the most important piece of data which is presented to management." Another respondent in the same survey described his company's sales forecast as ". . . the basic financial core of our planning effort." The sales forecast is, then, an integral part of the corporate planning process. It is not only a component of the marketing planning process but also serves as a focus for integrative planning [55].

Recent years have shown an increase in the emphasis on new product planning in the overall planning process. A survey conducted by McGraw-Hill [20] found that industry expected 17 per cent of its 1971 sales to be in new products. Those industries which spent the most on research and development also expected the biggest payoff from new products. For example, the aerospace industry, noted for its

research and development expenditures, expected 49 per cent of its 1971 sales to be in new products while the electrical industry, which spends far less for research and development, expected only 24 per cent of its 1971 sales to be in new products. Therefore, new product planning will be of major significance in certain companies' overall integrative planning. As Kotler [14, p. 560] concludes:

> Decision making takes on its most hazardous characteristics in the situation known as new product development and introduction. This is an age in which companies must introduce new products to survive, and yet do so in the knowledge that a substantial number of new products will fail. The costs involved are considerable and alert managements are taking whatever steps will help reduce the risks in the way of organization, professional staffing, marketing research, and model construction.

One would then expect the sales forecasts for new products to be particularly important to these companies.

A major problem for companies making new-product sales forecasts is the fact that, historically, the sales forecasts for new products have been far from satisfactory. In a mail survey of the forecasting practices of 300 leading business firms [24], only 4 per cent of the respondents felt they were doing as well on new products as on established ones. Tull, in his study [72, p. 249], found that ". . . the mean relative error of sales forecasts for sixty-three new products was 65 per cent and the median error 26 per cent."

Reichard [24, p. 205] explains why the forecasts for new products have been particularly troublesome:

> A new-product projection is perhaps the most difficult and challenging task faced by members of the forecasting fraternity. The stakes are larger, yet the chances of hitting the mark are considerably less than in the case of an old established product. A whole variety of unique problems faces the analyst. Almost without exception, they are a lot more difficult to solve--primarily because the amount of information and experience on the item involved is so limited.

It is well known that forecasting the sales of a new product, both before its introduction and in the early stages of its life cycle, is extremely difficult. The task does become easier, however, as market experience is gained. Therefore, the more difficult task is making forecasts before the product has been introduced to the market. Unfortunately, the pre-introduction forecast may well be the most important forecast since the decision to commit funds to the product's introduction will likely be sensitive to this forecast.

It is reasonable to conclude then, based on what has been presented in this section, that the sales forecast can be characterized as an <u>important</u> part of the new-product planning process, particularly to those firms emphasizing new-product development. At the same time the new-product sales forecast can be characterized as one of the most <u>difficult</u> projections which businessmen are called upon to produce. The significance of both of these characteristics of new-product sales forecasts becomes even greater when one considers the nature of the environment in which these projections are normally developed.

1.2.2 The sales forecasting environment

Recent years have seen an increase in computer-oriented, risk-analysis models which are designed to assist the firm in making the new-product introduction decision. Kotler has presented a summary of these methods elsewhere [53]. Since these models generally require more input than previous approaches to the problem, the formulation of the input estimates becomes more important. One of the most important estimates is the sales forecast. In Root's [86, p. 119] study of four firms which were evaluating the use of such a model, one of the

conclusions was that ". . . the perception of the new-product analysis was that of being a gigantic forecasting problem, rather than that of a strategy-choice problem."

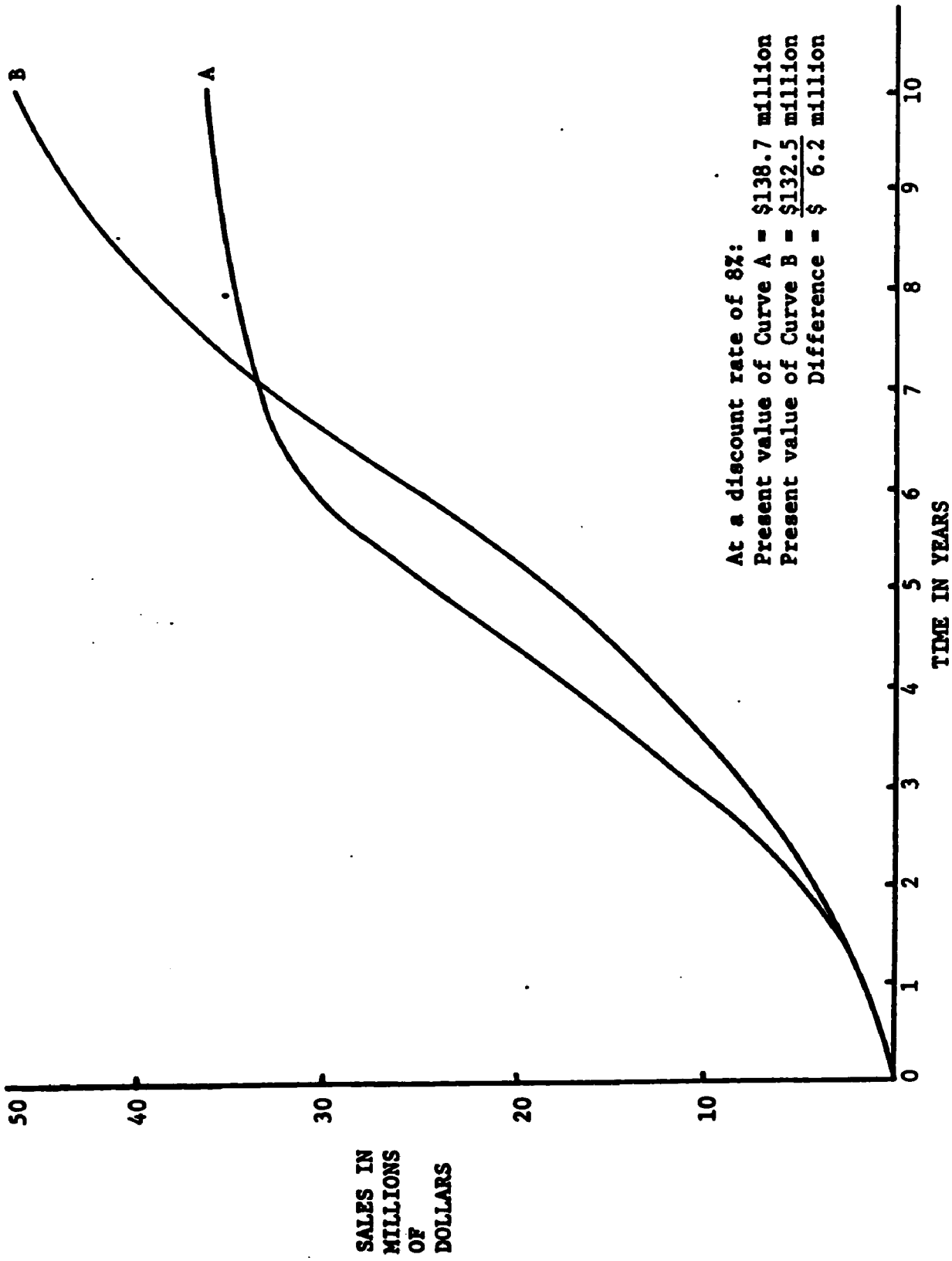
Studies by decision-making theorists show that making a decision is more a process than an act. Hunt [49, p. 85] describes this well when he states:

> . . . business decisions are not made in a few moments by one big brain, but by a lot of smaller brains. . . . These brains, in dealing with business problems, must act in coordination with each other, often over a considerable period of time, usually in a situation that has ways of shifting one's attention from one problem to another, and always in a situation in which an individual's position in the total structure has great influence both on the work that he does and on the way his conclusions are received and used.

Because of this, the sales forecast has to be made in an environment where decisions by others can have an effect on its outcome and its outcome can have an effect on the decisions made by others. An example will help illustrate what is meant by this last sentence.

Imagine a company considering the introduction of a new product. The company will have to make a major investment decision concerning plant, equipment, inventory, etc. The size of the investment will be dependent on both the projected peak demand and the rate at which demand reaches this peak. If the company is using a discounted cash flow model for the investment decision, the timing of the inflows becomes even more important. This is illustrated in Figure 1-1. Note that the expected value of Company B's ten year sales projection is 6.2 million dollars less than the expected value of Company A's ten year sales projection, even though Company B's ultimate expected annual sales are approximately 10 million dollars higher at the end of the projections. This is so because of the early

Figure 1-1.--Comparison of Growth Curves.



growth in sales Company A expects.

Since the risk-analysis model to be employed in the decision process requires an estimate of sales for each year, the marketing department is asked to prepare a formal sales forecast for a new product over the next several years of the planning horizon. They prepare such a forecast based on an assumed price level and an assumed level of marketing effort. The forecast is then presented to the manufacturing engineers who develop requirements for the type and timing of the capital investment based on the forecast they receive.

At this point, considerable man hours and monies have gone into the detailed estimates required. Cost accounting next takes these estimates and makes projections for unit labor costs, coordinates material costs with purchasing, and estimates other required cost figures. Recall that all of these costs are projected on the basis of a production plan prepared on the basis of the sales forecast. With the information they now have, the accounting department can estimate total cost per unit for each year of the planning horizon. If the assumed price cannot support the estimated cost, then the price must be adjusted and the whole cycle begun again.

Organizational interdependencies like those pointed out by the above example are common in the new-product forecasting environment but, in addition, the environment is characterized by uncertainty. In fact, one of the justifications for risk-analysis models is their ability to incorporate uncertainty into the decision process. DeFriece, [42, p. 123] et al., of Sun Oil Company, reported:

> Probabilistic economic analysis gives us a new degree of freedom in communication among the functional parts of the research organization and the business organization as a whole. It allows

> us to better focus, coordinate and integrate the human judgment that is available to us.

Thus, the new-product sales forecasting environment is characterized by organizational interdependencies and uncertainty within the context of a decision process. It is not surprising that the new product sales forecasts which have been generated in this environment have been less than satisfactory. On the other hand it does present a challenging area for research.

1.3 Statement of the Problem

There are several aspects of the overall sales forecasting problem which might be studied. It is possible to study the accuracy of the forecasts without considering how the forecast was developed or what was done with the forecast once it was developed. Theil, in his book Economic Forecasts and Policy [30, p. 15], identifies three main categories into which the analysis of forecasts can be classified:

> First, we have the problem of verification: does the prediction come true? For the interval predictions considered in the preceding section this means: do the intervals cover the actual outcomes with the frequency postulated by the forecaster? For point predictions: is the mean forecasting error indeed zero, or is it true that the outcomes are equally often above and below their predictions? Closely related to this problem is the accuracy analysis of predictions, which is concerned with their empirical variation around the realisations.
>
> . . .
>
> Second, there is the problem of the generation of predictions: what is the basis used by the forecaster when he formulates his plans and expectations? What kind of observations are used, which are the theoretical relationships assumed?
>
> . . .
>
> Third, what is the purpose of the predictions? More specifically: what is their influence on the actual behavior of individuals.

. . .

> One may object that there is still another problem with respect to forecasts, viz., how to make good or even "best" predictions? Contrary to the three problems mentioned above, this one is of the normative type. Its solution depends on the purpose for which the prediction is made, so that the third problem can be said to be preliminary to this.

Tull's research [72], mentioned earlier, studies the first category described by Theil. In contrast to Tull's study, this research focuses primarily on the second category, the generation process itself. It also focuses on the third category, the purpose of the predictions, but only to the extent that the purpose of the forecast may influence the generation process.

It is not possible, however, to fully comprehend the nature of the sales forecasting process without an understanding of the environment in which the forecasts are made. For this reason, even though the primary focus is upon the sales forecasting process, the new-product development process is also studied. It is important to emphasize here that the study of the new-product development process is included to further our understanding of sales forecasting; the results of this research are not intended to be significant contributions to the new-product development literature. Hopefully, the results <u>will</u> contribute significantly to the sales forecasting literature.

But are the two processes, sales forecast generation and new-product development, so interrelated that it is not possible to study the former without understanding the latter? Yes, and for several reasons. First, the sales forecasting process is a sub-process of the new-product development process, as are investment analysis, search

for new products, and allocation of research and development funds. Second, the role of the sales forecast is dependent upon the stage of the new-product development process at which the forecast is required. Typically, the new-product development process is a series of decisions, each of which may require a sales forecast, and it is likely that different decisions require different information. Third, the new-product development process can be dependent upon the outcome of the sales forecasting process. Frequently sales forecasting results will suggest an alteration in the planned new-product development strategy; sales forecasts provide more information than that required for a decision to accept or reject a plan.

There are certain considerations which can alter the specific elements of the sales forecasting task, even though the general nature of the task may be common to many situations. One such consideration is whether the new product is an industrial good or a consumer good. Corey [8, p. 3] has defined industrial marketing as:

> . . . the marketing of goods and services to businesses and other organizations for use in the goods and services which they, in turn, produce. Industrial customers therefore include commercial enterprises, government organizations, and institutions, as opposed to ultimate consumers, that is individuals and family units.

The Industrial Marketing Committee Review Board [50] and others have listed many differences between industrial and consumer marketing. But not all of the differences explain why the approach to forecasting the sales of new industrial products might be different from that used for forecasting the sales of new consumer products.

One important reason for possibly using a different forecasting approach for industrial products than for consumer products is that

the sales of industrial goods are often made direct to the consumer of the product. It is common practice, even for those industrial marketers who use distributors and industrial supply houses as their primary marketing channel, to also employ a sales force which maintains direct contact with the ultimate purchaser. When goods are sold direct, the firm has access to more extensive information about their customers. On the other hand, most consumer goods are sold indirectly through wholesalers and retailers to the ultimate consumer and the producer would be expected to have far less direct knowledge about individual customers.

An equally important reason for possibly using a different forecasting approach for industrial products is the fact that a small number of firms generally provide a high proportion of the sales of an industrial marketer. Thus each customer can be profitably analyzed in more detail in industrial marketing. Since it is possible that the forecasting approach used for new industrial products could be considerably different from approaches used to forecast the sales of a new consumer product, this research is limited to the study of forecasts for new industrial products.

1.4 Past Research

As outlined earlier, the general problem of new-product sales forecasting is of particular interest to marketing practitioners for two reasons. First, many companies depend heavily on expected payoff from new product introductions and, therefore, are often engaged in the process of generating sales forecasts for various new products. A study of the 200 largest United States corporations [43] found that

a major factor differentiating fast-growing companies from others was their amount of reliance on new products. The study also suggests that new products will increasingly affect growth as competition continues to intensify and the flood of new products shortens the life cycle of existing products. Second, historically, many companies have been dissatisfied with their forecasting ability for new products. The problem of generating satisfactory new-product sales forecasts is both important and difficult to these firms.

One would think that the importance of sales forecasting to the firm and the difficulty of the task would have prompted a great deal of study and research. This is so. It is not difficult to find entire books devoted to the exposition and discussion of sales forecasting techniques [9, 16, 24, 31]. The tools and approaches to the problem discussed in these books, however, are usually for forecasting the sales of existing products to existing markets for both short and long range planning needs. It is also not difficult to find entire books devoted to specific forecasting techniques such as time series forecasting [6, 21]. Again, however, these techniques are usually appropriate for forecasting the sales of existing products to existing markets. In a similar vein, some books [2, 13] have large portions of their content devoted to sales forecasting but these also are usually limited in the same fashion as other books on the subject.

In addition to the many books available on sales forecasting, many articles have also been written on the subject. It is in these that the subject of forecasting the sales of new products is discussed [36, 47, 67, 80]. These articles attack the problem in creative and imaginative ways but, unfortunately, all discuss consumer products.

None have been done specifically for new industrial products. This study is a logical first step to fill this gap in the literature. Only by understanding the nature of the environment for forecasting the sales of new industrial products; only by learning about the techniques presently employed in the process; and only by examining the difficulties encountered using existing methods can one begin to suggest improvements in the methodology. That is the intent here.

In an earlier section, it was suggested that the approaches used to forecast the sales of new consumer goods might be different than the approaches used for industrial goods. For this reason, the study was limited to industrial goods. But there is additional justification for limiting the study to industrial goods; the field of industrial marketing has received less emphasis than consumer marketing by researchers.

In an editorial entitled, "Industrial Marketing and the JMR," [56, p. 109] Elmer Lotshaw, of Owens-Illinois, Inc., stated:

> A perusal of the last six issues of JMR produced only one full-length article, from 63, explicitly concerned with industrial marketing. Perhaps, five other articles had some points interesting for the more intellectual of the researchers, even though they could not be candidates for a required reading list.

Frederick E. Webster, Jr. [79, p. 12] supports this position with these remarks:

> Industrial and institutional marketers have often been urged to base their strategies on careful appraisal of buying behavior within key accounts and in principle market segments. When they search the available literature on buyer behavior, however, they find virtually exclusive emphasis on consumers, not industrial buyers. Research findings and theoretical discussions about consumer behavior often have little relevance for the industrial marketer.

The lack of attention to industrial marketing would be

understandable if it were a relatively unimportant sphere of economic activity. But this is not the case. William J. Stanton [29, p. 157 and 158] has stated well the significance of the industrial market:

> It is estimated that about 50 percent of all manufactured goods are sold to the industrial market. In 1969, this volume of manufactured industrial goods was about $325 billion.
>
> . . .
>
> As large as these figures are, they by no means give the complete picture of the industrial market. They are for manufactured products only. In addition to manufactured products, about 80 percent of all farm products and virtually all minerals and forest and sea products are industrial goods. They are sold to firms for further processing. Industrial farm products and minerals alone would add another $66 billion to the volume of industrial goods marketed.
>
> . . .
>
> The magnitude and complexity of the industrial market may also be shown by the many transactions required in producing and marketing a product. . . . In short, a myriad of industrial products and industrial marketing situations come into play before almost any product, whether it is a consumer or industrial good, reaches its final destination.

He concludes with the statement that ". . . the total sales volume in the industrial market far surpasses total sales to consumers."

The Statement of the Problem section stated that this research is primarily concerned with the second and third categories of forecast analysis identified by Theil [30]. The first category is not explicitly studied for several reasons. First, the verification problem has been studied more than the other two problems associated with forecasting; two of these studies have been cited earlier [24 and 72]. Therefore, the need would seem less pressing for research in this area. Second, this study focuses on decisions and the decision making process. For this reason the generation of forecasts and their purpose, rather than their accuracy, are more compatible with the

intent of the study. Lastly, the author feels that the most compelling reason for studying the accuracy of forecasts would be to determine if, somehow, they might be improved. As Theil observes, this normative problem is preliminary to the third problem he mentions. Accordingly, it is hoped this study will shed light on the important, normative question--can forecasts be made better?

1.5 Research Approach

In order to accomplish the stated overall objectives, it was necessary to establish more operational objectives:

1. To study the forecasting practices of firms introducing new industrial products.
2. To study the sales forecasting environment, that is, the new-product development process in these firms.
3. To examine the extent to which results from other research are capable of providing additional insight for use in the sales forecasting process.

To accomplish the first and second operational objectives, 20 interviews were conducted with people who had the responsibility for the preparation of sales forecasts within their division or firm. Table 1-1 has been prepared to show the positions held by the various persons interviewed. The people included in the table were the primary respondents, that is, the people who provided the researcher with most of the information about each new-product introduction. In all, a total of 39 different people were contacted and, of these, 31 were part of the 21 completed interviews. Often the initial interview was thought to have covered the subject to the researcher's

TABLE 1-1

THE POSITIONS AND RESPONSIBILITIES
OF THE RESPONDENTS

Respondent*	Title of Primary Respondent	Type of Responsibility
J_1	Manager, Business Research Department	Divisional
K_1	Market Research Analyst	Divisional
T_1	Staff Marketing, Planning and Operations	Corporate
K_2	Marketing Manager	Divisional
S_1	Marketing Manager	Divisional
P_1	Market Research Supervisor	Divisional
B_2	Product Manager	Divisional
O_1	Manager-Market Development	Divisional
S_2	Manager-Market Research and Development	Corporate
W_1	Marketing Manager	Divisional
M_1	Market Research Analyst	Divisional
E_1	Manager, Product Planning	Divisional
W_2	Manager, Market and Product Planning	Divisional
D_1	Director of Marketing Services	Divisional
P_2	Director of Commercial Development	Corporate
M_2	Director, Corporate Market Research	Corporate
B_3	General Product Manager	Divisional
S_3	Marketing Specialist	Divisional
L_1	Marketing Specialist	Divisional
B_1	Director-Marketing Research	Corporate
O_2	Technical Director	Divisional

*Each respondent has been identified by a code letter and subscript to prevent identification.

satisfaction but a review of the typed transcripts revealed that further information had to be obtained so additional visits would be arranged. Because of this, 43 separate visits were made to 23 separate divisions of 12 different companies to complete the 21 interviews.

Initial contact was made by telephone or letter to a total of 15 companies and of these, 12 were included in the study, 1 did not reply, 1 did not wish to participate, and 1 felt that the product they wanted to discuss could not be appropriately termed an industrial product and, also, that it was too sensitive to risk a leak in information. The companies, except for one which had annual sales in the $10 million to $20 million range, were all major corporations located in the Midwest. The criteria used for their inclusion in the study was a reputation for introducing new industrial products and a willingness to participate in the study.

The exploratory nature of this research suggested that the interviews be structured only enough to insure comparability between interviews and to permit some tentative generalizations. Further, the emphasis of the research was to be on the generation of predictions instead of the accuracy of the predictions. For these reasons, the method of interviewing chosen was the unstructured-direct interview [11]. An interview guide was employed (see Appendix I) as a mental checklist to insure that the unstructured conversations between the respondent and the researcher covered the points being investigated by the researcher and yet allowed the respondent flexibility in introducing new ideas to the researcher. Each interview covered only one new product introduction and the respondent was assured that his company and product would not be identified since the product discussed was normally in the very early stages of its life cycle and, therefore, sensitive to disclosure.

Even though the unstructured-direct interviewing technique was used, the researcher was seeking specific information from each

interview. An explanation of how the interview guide was used to solicit specific information without structuring the interview, and thus imposing rigidity on the conversation, will help the user of this research understand how these data were collected. It should be understood that the example presented here does not represent any one of the interviews and yet it is typical of nearly all of them; it is purely illustrative and should be treated as such. (The reader may find it helpful to refer to the interview guide included as Appendix I occasionally during this description.)

To put the respondent at ease, he was first asked his name and title, the company name, division, and address, while the researcher recorded the information in the appropriate spaces on the interview guide. He was then asked to describe how he, and the rest of the group he was a member of, fit into the organization of the firm.

During the telephone conversation which was used to schedule the interview, the respondent had been told that the researcher was interested in discussing the development of a particular sales forecast for a particular new product. Therefore, when the researcher asked the respondent to describe the product and to give a brief account of its development, he readily described its inception, any technical difficulties which had been encountered in its development, and the major decision points which had occurred along the way. He ended at the decision point for which the sales forecast he had prepared would be a major input. Accounts of the development of the marketing strategy were less detailed, since many of the products discussed were in the early stages of their development and a

marketing strategy had not been fully developed in as much detail. A target market description, i.e., its size, its composition, the competition, traditional marketing and distribution approaches used, whether the market was a new one or an old one to the firm, etc., was less difficult to obtain and more detailed since the respondent had spent considerable time thinking about these issues. Finally, the respondent was questioned in detail about the use of the sales forecast and its preparation.

All but 5 of the 21 interviews were taped on cassettes, which afforded the researcher great flexibility in perusing and sorting the raw data. Of the 5 respondents who were not taped, only 1 refused to be recorded; for the others taping would not have been practical.

In later chapters of this dissertation--those which discuss the results related to the new-product development process and the sales forecasting process--the interview results are presented as bits and pieces of information gained from individual interviews. The effect is a fragmented presentation of individual interviews grouped according to specific topics. This approach increases the reader's understanding of the researcher's assertions regarding various topics, but it makes it difficult for the reader to understand the context in which some of the statements by the respondents were made.

For this reason the next several pages of this section will present summary descriptions of the status of each new product in the overall new-product development process, the nature of its market, the status of activities of competition, etc. These "situation summaries" are thumbnail sketches of very lengthy, involved processes and they are, for that reason, oversimplified. For example, each situation

summary describes only the major use to which the forecast was put, but there were other uses as well. Formats for each of these situation summaries are identical for ready comparison of one summary with another. The following are the items covered in each situation summary: (1) a description of the product (often done by analogy for the sake of confidentiality), (2) a description of the market(s) for which the new product was intended and the degree of knowledge the introducing firm had of the market(s), (3) a brief history of the new product's development concluding with the decision which was to be made on the basis of the forecast discussed in the interview, and (4) a brief summary of the major uncertainties inherent in the decision which made the forecasting task particularly difficult.

Respondent J_1: This new product was a wider version of a recently introduced, but already established, new product; except for their widths, the two products were identical in form and function. Both were for use in the customers' production process and they were usable for only one production run; after each run they were discarded. (An analogous product is certain types of dies used in the manufacture of metal castings.) With either product the customer could reduce his labor input, but the initial cost of the product was higher than the cost of competing products currently available. The primary advantage of either product over those previously used was the improved quality level attainable in the customers' production process.

While both versions of the product were intended for customers already served by the firm, the newer, wider version was for use on

the largest pieces of the customers' equipment. Thus, even though the same customers were to be introduced to this newer, wider version of the product, a whole new part of the existing market would be opened up.

Since the new product was only a production modification of the already established narrower version, considerable technical development efforts had already gone into its development. Technical personnel of the firm had been working closely with selected customers for over a year, and test marketing was underway in the territory served by one of the firm's sales branches. It was now necessary to decide whether to proceed with full-scale commercialization of the product. Costly revisions to the firm's own production equipment would be required if this new, wider version of the product were to be made on a full-scale production basis.

Because the firm had served the potential customers of this new product for many years, they knew a great deal about them. In addition, the narrower version of the product had already been successfully introduced to the same customers. Therefore, the only major uncertainty facing the firm was the customers' acceptance of the new product for their largest machines; existing products were working well and the advantages of the new product over existing products were less pronounced on the larger equipment.

Respondent K_1: This new product was a plastic material intended for use in high-temperature environments. Its major advantage over existing competitive products was that it was simpler, and thus less costly, for the customer to process. On the other hand, it was more

costly on a per pound basis, and it required tooling which was not required by competitive products. Therefore, high volume usage was necessary for the new product to be competitive.

Delineating the market for this new product was most difficult since it had potential in electronics, as a seal or gasket, as an insulating film, and in a variety of other applications. As a consequence, one of the major problems facing the forecaster was the identification of all potential applications for which the new product could be successfully marketed. The fact that all of the markets which had been identified to that point as potential markets for the product were all markets already served by this division did make the problem somewhat less difficult.

Approximately four years had passed from the time that initial development efforts had begun on the new product. Central Research had initiated the process by developing a particular technological capability, or "technology," with no specific applications in mind. Respondent K_1's division had obtained the product from Central Research for further development aimed at specific potential applications by demonstrating that these potential applications offered the best chance for the product's commercial success. Shortly thereafter, it was concluded that the product could be made for some of these applications at a marketable price; so, preliminary marketing was begun. After working closely with the technical groups of selected customers, one of the division's technical people was given responsibility for marketing the product. Even though existing production facilities were adequate for the next couple of years, it was apparent that they could easily become inadequate in the near future.

Accordingly, the respondent was asked to prepare a forecast of demand for the new product for several years hence.

Besides the uncertainty regarding potential applications for the product referred to in the second paragraph of this situation summary, the respondent was also faced with the problem of recommending a size for the production facility, if and when one was needed. Rough projections of total potential demand indicated that significant economies of scale were possible. Therefore, forecasted levels of demand would directly influence projected production costs. Since the market was price sensitive, production costs, as reflected by the prices charged, directly influenced forecasted levels of demand. The forecaster felt as if he were in an endless, vicious circle.

Respondent K_2: This new product was analogous to a fabric sold to a clothing manufacturer because it too was a raw material used in the manufacture of the customer's product, and because it also became a visible part of the customer's product as purchased by the ultimate consumer. The new material had most of the good features of competing products and yet was moderate in price. Its greatest disadvantage was the customers' tendency to equate it with a competitor's product--even though their physical characteristics were quite dissimilar--which had recently failed miserably when introduced to the same market for which this new product was intended.

The potential market for the new product was totally new and unknown to the firm. It had also been learned that many of the firms in the industry which made up this market were very close-knit. For example, it was not unusual to find people who had worked for several

different firms in the industry and, therefore, had many associations with people in these other firms. This characteristic of the industry made entry by an outsider, even as a supplier, difficult.

Considerable technical development had gone into this new product, and the firm had been working with five potential customers for nearly two years in an attempt to determine and avoid the mistakes made by the competitor who had failed. Although there were no major technical problems remaining, the firm was closely monitoring the product characteristics desired by the market since these characteristics could be readily altered by modifying certain parameters in the product's manufacture. Capacity in the pilot plant was sufficient to meet demand as long as the firm stayed on a test market basis but as soon as full-scale commercialization was decided upon, a new production facility would be required. Management had to decide shortly whether to proceed with commercialization and build the new plant.

Because of the nature of his problem, the respondent felt that there were three major uncertainties facing him: (1) the extent of the association of his product with the previous failure, (2) whether the characteristic nature of the industry made entry as difficult as it seemed, and (3) the acceptance of the product by the ultimate consumer since this would ultimately determine the demand for his product by his potential customers.

Respondent S_1: This new product was a material used in the customer's manufacturing, in much the same way that masking tape is used for painting cars. It was simple from a technical standpoint and yet the firm was experiencing technical difficulties. They were unable to

transfer a successful experience with an application of the product in one firm to similar applications in other firms. Possibly the difficulties were due to the characteristics of the product but they could also have been due to differences in the production processes in different firms. The primary advantage associated with the product was that its use made processing by the customer simpler--not unlike the advantages associated with the use of masking tape--and the cost of labor input was therefore reduced.

The market for this product was large and composed of a bewildering variety of firms--everything from "back-alley" shops to giant manufacturing firms--since the common thread between these firms was the process they employed, rather than the products which they produced. Respondent S_1's firm was particularly interested in the market because it appeared to offer good potential for other new products later. Unfortunately, the firm knew little about marketing to this market and even less about the processing operations used by the firms in the market.

More than ten years had passed since the firm had first considered the introduction of this product. They began by taking it into selected potential accounts to determine its effectiveness in a variety of applications. Some successes occurred but, as described earlier, rarely could these successes be transferred to other firms. Full-scale commercialization of the product had never been justified based on these experiences. Thus, the firm had essentially been test marketing the product for nearly ten years without making a firm decision about the full-scale commercialization of it and considerable monies had been spent in that time. Management felt that it had to

decide whether to introduce the product and, if so, how to market it. The firm could proceed with full-scale direct selling using their own sales force, they could sell through distributors, or they could license another firm to manufacture and market the product and wait for another new product to provide them with a better entry into this market. Two distributors had been given the product on a test basis to learn more about this marketing alternative. Results from this test looked good but the test market still had several months to run.

Knowledge of the market was the major uncertainty then in this case. It hampered technical development efforts and limited the respondent's ability to forecast demand for the new product.

Respondent P_1: This new product was a finishing material used on the interiors of buildings during construction or remodeling. Quality standards were high for these materials because they were a conspicuous part of the finished building, yet each of the approximately twenty competing products had some kind of quality problem associated with it. Although this firm's new product apparently solved all of these quality problems, its cost was also considerably higher than the cost of any of the other materials.

Even though Respondent P_1's firm could readily define and identify the market for this product, they knew little about it; they had no prior experience with this market. This difficulty was increased because, traditionally, in this industry the supplier tailored his material to the individual needs of each customer; it was not at all unusual for a supplier to offer fifteen to twenty different formulations of the same basic material to the less than

fifty firms which made up the industry. Necessarily, then, forecasts were needed for a series of products instead of a single product.

Preliminary technical development of the product had been completed and it was felt, based on this preliminary work, that the product had very marketable technical characteristics--except for its high cost. Before spending any more funds for technical development, the technical group wanted marketing to tell them whether the potential market for the product, and its likelihood of success in that market, were sufficient to justify further expenditures.

The major uncertainty facing Respondent P_1 in his forecasting task was the monetary value placed upon quality: if it was high, the product would succeed; if it wasn't, the product would fail. But this monetary trade-off wasn't made by this firm's customers, it was made by the ultimate consumer--the purchaser of the building--since the additional cost of the material was passed along in the price of the building. Unfortunately, Respondent P_1's firm had had no experience marketing to these ultimate consumers so they knew little about them.

Respondent B_2: This firm produced a raw material basic to many industries. However, their processing operations imparted certain properties to the material which enabled it to withstand extremely hostile application environments, such as high temperatures, corrosive atmospheres, or extreme wear, which, in turn, made their product particularly suited to the needs of the chemical and aerospace industries. Because (1) these two industries were cyclical, (2) there was an excess in the firm's production capacity, and (3) the electronics industry had a need for the special properties of their material, the firm was

considering marketing their product to the electronics industry. This would require significant changes in and additions to the properties of the material, which could only be done through major revisions to their processing operations.

After an extensive investigation of the electronics industry by an internal staff group and by an outside consultant, several conclusions about this potential market were reached: (1) potential volume was large enough that only a small share of the market had to be obtained to justify the requisite capital investment expenditures, (2) meeting the technical requirements of the market was going to be more difficult than was originally thought, and (3) they had a good deal to learn about marketing to this industry.

Investigation of this market had taken approximately two years and management felt that it possessed the necessary information to make a decision. If it was decided to go ahead, significant capital expenditures would be required and some of the firm's best technical and marketing people would have to be committed to the project. Existing programs could well be hurt by this transfer of talent.

Whether existing technology could be transferred to these new applications and whether the firm could sell in a totally new market were the major uncertainties.

Respondent O_1: This new product was a machine tool used in the customers' production operations; it combined the features of two products which had been on the market for years. Although the new product wasn't able to do anything that one or both of the existing products couldn't do, it was more convenient to use--which increased

the customer's productivity--and it reduced the customers' inventories of these machine tools to almost half of their existing levels. It cost more than either of the two current products but was less costly than their combined cost. Respondent O_1's firm produced and marketed both of the existing machine tools.

Since this product was intended for the firm's current customers, a great deal was known about the market for the product. This also meant, however, that any problems created by the introduction of this new product could affect the firm's current business with these customers.

Only one step remained in the entire new-product development process for this new machine tool--building an inventory of the new product. At the time that the respondent was asked to prepare a sales forecast for the product, any customer could buy it but only on a special order basis; a part was made only when a firm order had been received. Management felt that this "limited" introduction inhibited the demand for the product and, thus, was impeding the recovery of all of the technical and marketing development funds which had been spent over the previous nine months. If the firm built up an inventory of the product, customers would be able to buy it off-the-shelf and, hopefully, buy more of it. A final sales forecast was requested before the decision was made because the inventory investment that would be required was considerable.

Uncertainty about the decision centered on competition's reaction, the state of the economy and its effects on the market, the increased cost of the product, and the availability of the two separate products which could do everything this single new product could do.

Respondent S_2: This new product was the result of a joint venture between Respondent S_2's firm and another firm. By mixing one firm's basic product with the other's and making some slight technical, although patented, revisions to each, a fungicide suitable for certain agricultural applications was developed. Since neither of the firms wanted to enter the other's business, each would ship their products to other smaller firms--called formulators--who would then do the final mixing, brand and market the product to the ultimate consumer--the farmer. This arrangement created several potential problems. For example, one of the firms might find a way of circumventing the patent protection of the other and then decide to take all of the business rather than just his share. Or one of the firms might find that existing, non-patented products could be altered sufficiently to substitute for the other firm's patented product and accomplish the same thing. It was even possible for the formulators to decide that they wanted to avoid the final mixing and buy the product already mixed instead. Any of these three occurrences would destroy the arrangement as it existed.

The market for the product was made up of about fifty or sixty formulators, all located in the South and Southwest. Total potential volume, if the fungicide was a success, was so large that the total output of the firm's basic product could be increased by several orders of magnitude. Unfortunately, Respondent S_2's firm had had no previous experience with the formulators and therefore had a good deal to learn about the market. The other firm in the joint venture had sold to these formulators for many years.

At the time of the interview, all technical development and

one year of test marketing had been completed. During the test market it became apparent that some of the potential problems described earlier were very real possibilities. Accordingly, the management of Respondent S_2's firm wanted to proceed cautiously before deciding upon full-scale commercialization.

In trying to develop the forecast which management had requested as part of this decision, Respondent S_2 found his major problem to be that of developing the correct assumptions about the future actions of the other firm in the joint venture and of those of the formulators. With these formidable problems facing him, Respondent S_2 was glad that the investment required for full-scale commercialization was small.

Respondent W_1: This new product was a special-alloy material used in the manufacture of jet engines. Although this metal had been used in the production of jet engines before, Respondent W_1's firm was offering it in a physical form never before available in these alloys; this physical form of the alloy had previously been offered only in the more common metals. Technical properties of the metal were enhanced and the amount of machining by the engine manufacturer was reduced with the special-alloy in this form, however, the initial cost of the material was higher than the same alloy in other forms.

The market for the product--all jet engine manufacturers--was readily identifiable and there was an extensive amount of information available about the jet engine industry from trade associations, government sources, other suppliers of the industry, etc. Newness to the market, therefore, did not seem to be a significant consideration

in this case.

Respondent W_1's firm had been manufacturing metals in this form for about thirty years. About 1958, the firm became interested in manufacturing these special-alloy metals using their particular production techniques. Their first, tentative efforts quickly produced half a million dollars in sales per year. To take advantage of the obvious market potential, extensive R/D efforts were begun in 1964. Other firms also became interested and started similar technical efforts at about the same time. In 1968, some of these firms signed an agreement which provided for the exchange of technical information between the signing parties. Up to this point none of the firms had made a serious move into the business because there was still considerable uncertainty about the likelihood of the engine manufacturers substituting this new form of the metal for the existing form, particularly since a major factor in the design of jet engines is safety. Although none of the firms had entered the market on an all-out basis, considerable amounts of money were being spent on technical research without the benefit of any real market analysis. Respondent W_1's firm perceived this problem in their firm and asked W_1 to do a complete market analysis. If the analysis showed that a sound potential market existed for the product, they were prepared to build a new plant, establish a new division of the company, and seek the business in earnest.

The major uncertainty facing Respondent W_1 in the development of the forecast was the willingness of the engine manufacturers to substitute this new form for the older, experience-proven form. The uncertainty took on more importance because the manufacturers would

also be required to have the new product tested in accordance with specifications before it could become a part of an engine; these tests cost slightly over one half million dollars for each engine model tested.

Respondent M_1: This new product was a device designed to be an accessory on large trucks. The product was similar to, and employed technology developed for, another device which the firm produced and marketed to the aerospace industry. A member of the firm's Central Research group had learned of a safety problem encountered frequently by drivers of large trucks; he had learned also that legislation was being considered which would require all large trucks to have a device designed to overcome the safety problem. This new product was designed to be such a device.

Respondent M_1's firm had been manufacturing products for the trucking industry for many years, so they knew the market well. They had the respect of firms in the industry and possessed a reputation for high quality products and good technical service.

The first step in the technical development of the product was initiated by the individual who had conceived the idea originally. He spent a small sum of discretionary R/D funds to assure himself that the technology was, in fact, transferable from the aerospace industry to the trucking industry. Once satisfied that the technology was transferable, he brought the product to the marketing research group for their evaluation concerning the outlay of future technical development funds. The marketing research group was given detailed estimates of the new product's projected performance characteristics; however,

estimates of the cost of the product, and the selling price which would be necessary to cover these costs, were admittedly crude. Extensive additional efforts were required to complete the initial engineering, to develop the tooling required for production, and to gain the total production capability.

Marketing's task was made difficult by three factors. First, they were unable to do test marketing because they did not have a final product. Second, they had to seek information from their customer's customers--the truckers--because the product was only an accessory on trucks and the truckers would establish the demand for the product. Third, they had to predict what form new legislation would take, if and when the legislation was passed.

Respondent E_1: This new product was a basic component of most electronic equipment. Respondent E_1's firm possessed extensive experience manufacturing and marketing highly technical, high-priced, low-volume versions of this basic component. The version they were considering, however, was designed for a specific type of electronic equipment which was produced in large volumes and required low-cost versions of these components.

The market, for which this new version of the basic component was designed, was new to the firm. The firm was unfamiliar with the technical demands placed upon the product when used in this equipment. Also, since the market was composed of only a small number of firms, each potential customer was important to the success of the new product.

A series of versions of the basic component was made on the

same production equipment at the same time. (Respondent E_1 likened it to the simultaneous production of milk and cream.) Tests, which were conducted as one of the last steps in the component's manufacture, were used to assess the technical characteristics of each component on the production line; these technical characteristics, in turn, determined whether the component was a high or low-priced version of the component. Although certain parameters of the production process could be used to alter the levels of various technical characteristics, each production run produced a series of versions of the basic component. Up to the time of the interview, only high-priced, low-volume versions of the component had been sold by the firm. The firm, however, intended to increase production volume considerably, since management felt that the firm would profit from the economies of scale. To achieve increased production, technical discussions were held with a manufacturer of high-volume electronic equipment. These discussions, and the technical modifications to the component which were made on the basis of what was learned in these discussions, were successful and the manufacturer asked Respondent E_1's firm for a commitment to supply the production needs of the component for the next model year. To make such a commitment, additional production equipment would be needed and several technical problems would have to be resolved. Additionally, increased attention would have to be given to other manufacturers of this electronic equipment because Respondent E_1's firm was not a price leader and had to sell quality. To do this, their customers' designs had to specify the higher levels of quality which they were able to provide. If a cheaper, lower-quality, competitive product became a part of a customer's design, it would be

very difficult for Respondent E_1's firm to obtain a share of that customer's business. Therefore, if the firm made the commitment to this manufacturer, it had to stay abreast of market developments.

The major uncertainties facing the firm in this decision were: (1) the actions of their competitors in this market and (2) whether the firm was technically ready to provide components to this market.

Respondent W_2: This new product was an hydraulic model of a mechanical device found in most powered vehicles. Although the hydraulic model performed the same functions as the mechanical version, it was able to perform some of these functions better in certain vehicles. Conversely, in other vehicles it was only as good, or not quite as good, as the mechanical model. The initial cost of the hydraulic model was higher than that of the mechanical version; there was little difference in their costs of operation.

Delineating the market for this new product was not difficult--the potential market was all manufacturers of certain types of powered vehicles. Nearly all of these manufacturers were already customers of Respondent W_2's firm.

Technical development of this new product had started as far back as 1903, but serious development only began in 1965 when certain technical problems were overcome. By that time the basic concept of the new product was sound, but development for the particular technical demands required by each of the various potential applications had just begun. Since the applications of the new product varied considerably, the technical development still required was extensive. In addition, a commitment by the firm to enter even one of the market

segments would require a considerable outlay for additional production equipment. Marketing was asked to review the potential for the new product and make recommendations concerning the market segment to pursue initially. Based on these recommendations, plans would be made to add additional production capacity.

The major uncertainty facing the marketing group in their task was the selection of a market segment; poor selection could seriously hamper the growth rate of the new product and lead to failure. The designated market would depend on factors such as: (1) the ability of the new product to function appropriately in that application, (2) the willingness of firms in that industry to adopt a new, higher-priced device, and (3) the willingness of these firms' customers to adopt the device.

Respondent D_1: This new product was a stylized version of a functional component of automobiles. Automobile manufacturers covered existing, less stylish versions of the component with a decorative metal plate to improve the appearance of the automobile. The new product combined the features and functions of the functional component and the decorative plate.

Since Respondent D_1's firm was one of the major suppliers of the existing version of the functional component, they had extensive knowledge of the market for this new product. The market, in terms of the number of customers, was small—specifically, four major automobile manufacturers. Each of these companies could adopt the new product only by making it standard in the entire production of one of the thirty to fifty models in their product line. Since all of the

companies made this adoption decision at the same time for all of their models each year, demand was expected to grow in large increments.

All technical development had been completed at the time of the interview. Respondent D_1 was asked to prepare a sales forecast for the product because each increment in demand would necessitate additional production equipment. Production and engineering needed to know when additional production equipment would be required since considerable time and money would be spent before the additional equipment would be available for use.

Forecasting demand which increases in large, incremental steps is a very difficult task since errors can be very large. Making the forecasting task even more difficult was the fact that the demand for the new product was entirely derived demand; the only reason the automobile companies would add the new product to any one of their models would be to enhance their ability to sell that model. Thus, the respondent had not only to forecast the demand for the product by the car buyer, but was required also to predict the ability of his firm's salesmen to convince the automobile companies that this demand existed and needed satisfaction.

Respondent P_2: This new product was a nylon material with a unique set of technical characteristics. Although most of these characteristics were improvements over the characteristics of existing nylons, some were drawbacks. A particular disadvantage was that the new material was more costly than other nylons.

At the time of the interview, only two uses of the material

had been identified in which the material's properties and cost were compatible with the demands placed upon it. Respondent P_2 was confident that other applications which afforded the material a good likelihood of commercial success also existed, but only the two aforementioned uses had been discovered. Neither of these two markets had been served previously by this firm so the market was not only poorly delineated at the time of the interview, but the market which had been determined was virtually unknown to the firm.

The material had been developed originally in the firm's exploratory research group. Utilization of materials which the firm already manufactured was the impetus for the initial interest in the new product. Once the research group was satisfied that the material could be made, they began visiting research groups of potential customers to determine which markets offered the best opportunity for the product's commercial success. After the two applications mentioned earlier had been found, and after marketing had generated some preliminary, crude estimates of demand in these two applications, management decided that the product was a candidate for final technical development, e.g., tailoring the product to meet the needs of each individual application. Since no real market analysis had been made on the product's potential market up to that point--even though large sums of money had been spent on its early development--and since a new production facility would be required, the respondent was asked to perform a detailed market analysis.

At the time the respondent was asked to perform this analysis, only one company had actually begun to incorporate the new product into its production. The respondent felt, therefore, that the first

step in the analysis ought to be a total reexamination of all potential applications, both from the standpoint of the product's technical feasibility and its economic feasibility. The reexamination of potential applications was the major uncertainty facing Respondent P_2 in his task.

Respondent M_2: This new product was a container made of paperboard which had previously been made of aluminum. Respondent M_2's firm, a manufacturer of paperboard containers, had a limited product line because the inherent technical characteristics of paperboard limited the uses of these containers. A new manufacturing process altered some of these characteristics enough to allow the use of paperboard containers in hostile environments, such as high temperatures. Containers made in this way were particularly suited for certain applications because the paperboard containers were less expensive than aluminum containers.

The firms which made up the market for these new containers were customers of Respondent M_2's firm. Although the firm's experience with the market was an advantage, it was possible that, if the new containers created major problems for these customers, sales of the firm's existing products could be seriously affected.

Three years prior to the time of the interview, the R/D group in Respondent M_2's firm had obtained a license to study the new manufacturing technique from the Swedish firm which had developed the process. Three other U.S. firms had also entered into similar agreements with the Swedish firm. The license was renewed each year by the R/D group so that technical development could continue.

Management felt that, in spite of the potential deleterious consequences, the firm should bring the new containers to market to recover the sizable investment they had made in the three preceding years in licensing fees and technical development. If this course of action was not advisable, then management felt that the license should not be renewed and that technical development should be halted. Respondent M_2 was asked to prepare a complete market analysis for the new containers since very little market analysis had been done previously.

The major uncertainties facing the respondent in his task were: (1) whether the product was technically capable of performing its functions and (2) whether the firm's customers were willing to use paperboard containers in hostile environments. Underlying his uncertainty was his concern about the potentially damaging effects on the firm's existing business if the container failed to perform as expected.

Respondent B_3: This new product was a device used by practitioners in one field of health care for the application of prophylactic substances. With the device, application took half as long and was more thorough than applications using existing apparatus. Even though the new product's price was higher than that of existing devices, its time-saving feature justified its use on purely economic grounds.

The firm had been serving the particular field of health care for which the new product was intended since the firm's beginning. Literally thousands of items for this market made up the firm's product line.

The firm first learned of the new product in January, 1971, when its inventor approached the firm with his idea. All of the technical development had been completed and the product was ready for market introduction. On the basis of very rough estimates of the new product's sales potential, the firm's management signed a contract with the inventor containing these clauses: (1) if the firm did not introduce the product within a set period of time, it would pay the inventor ten thousand dollars, (2) if the firm introduced the product, the inventor received a fixed percentage of each dollar of sales, and (3) if sales did not reach an established minimum level within two years after introduction, the inventor could dissolve the contract. The marketing department estimated that the product would require a minimum annual promotional budget of fifty thousand dollars. Late in 1972, management asked Respondent B_3 to prepare a detailed sales forecast for the new product to determine whether to go ahead with the introduction of the product or to pay the inventor ten thousand dollars.

Since the firm's customers were notoriously poor businessmen, it was possible that the customers would not appreciate the product's lower total cost; they might only consider the product's higher initial cost and disregard the cost savings available from the use of the product. A second difficulty was that the proper use of the device required a demonstration. This could impede the new product's adoption because the salesman's time with a customer was usually limited.

Respondent S_3: This new product was a totally new type of truck

engine. Because this firm's product line consisted of a series of models of conventional truck engines, the new product could potentially replace the firm's entire product line.

The firm knew the market for truck engines very well. They had acquired an extensive knowledge of the truck manufacturing industry from many years of service to the industry. During this period they had also earned a reputation as a manufacturer of high-quality engines.

Development of the firm's new engine began in the 1950's. By the late 1960's, four other engine manufacturers were actively developing their own versions. Each firm continued the development of its own version of the engine because, if one firm were to introduce the engine, there was a distinct possibility that the entire market would eventually convert to the new engine and the market for the old engine would disappear. Respondent S_3's firm had spent millions of dollars in technical development funds on the project over a period of years. During this time, several sales forecasts had been generated but funds for development continued to be committed as long as the replacement of old engines with the new engine remained technically feasible.

Less than a year prior to the interview with Respondent S_3, one competitor had introduced their version of the new engine on a limited basis. More importantly, this competitor had developed a complete sales and service system for the new engine. Before the establishment of the competitor's system, Respondent S_3's firm had the best sales and service system in the industry; now the advantage was gone. Because of actions like these by competitors, Respondent S_3's

firm had to decide soon whether to introduce their version, even if only on a limited basis. A major expenditure (several million dollars) for a new plant and production equipment would be required if market introduction were to be undertaken. In anticipation of this investment decision, management asked the respondent to prepare a new sales forecast for the engine.

The major uncertainties faced by Respondent S_3 were: (1) the receptivity of truckers to the new engine and (2) whether the firm's service system could handle the problems which were certain to arise shortly after the engine's introduction.

Respondent L_1: This firm manufactured a series of models of a basic mechanical device for heavy vehicles. This new product was the next generation of the firm's current product line.

Since the new product was intended for the firm's current customers, a great deal was known about the new product's market. Previous new-product introductions by the firm to the same market had gone well, and the firm had gained a reputation for only bringing new products to market after extensive testing and development.

A study done in 1968 on the new product line concluded that a new production facility should be built and recommended that it be built large enough to accommodate all of the manufacturing equipment required to produce expected demand in 1975. The equipment was added as sales levels increased over time. By late 1970, there were major equipment purchases scheduled so management requested an updated version of the sales forecast for the new product line. Two years had passed since the original forecast and considerable market

experience had been gained in that time. Since the total investment for plant and equipment was over fifty million dollars, management insisted that each decision incorporate the best currently available data.

Since another person had generated a similar forecast two years earlier, Respondent L_1, in the development of this current forecast, was most uncertain about (1) the assumptions used in the derivation of the previous forecast and (2) whether conditions had changed enough in the intervening two years to render some of these assumptions invalid.

Respondents T_1 and B_1: (These respondents did not choose to discuss a specific new product; instead they talked about their firms' general approach to new-product development and sales forecasting.)

Respondent O_2: Respondent O_2, who was the Technical Director of a firm studied in another interview, was included in the interview schedule because he allocated funds to the initial technical development of new products. According to several respondents these allocations were often made in their firms with little market analysis. The researcher interviewed Respondent O_2 to verify the accuracy of these statements. Respondent O_2 willingly discussed at length how he made these decisions.

In summary, the research approach used to accomplish the first and second operational objectives can be described as an "abbreviated case study" approach. Traditionally, case studies have been done with a limited number of firms--three or four--over an extended period of

time, i.e., two years. Alternatively, rather than using the case study approach a survey might have been conducted of a large number of firms. Compromising, this researcher chose an approach between these extremes; the problems and the promise of the approach are discussed in the last chapter.

Research objective three, to examine the extent to which results from other research are capable of providing additional insight for use in the sales forecasting process, was accomplished by proposing a general approach for the incorporation of information into the sales forecasting process. A basic proposition upon which the approach was based was that there exists in the introducing firm information relevant to the development of the sales forecast which is not being utilized. Due to the absence of data, it was not possible to test the approach in an actual sales forecasting situation. However, it was possible to examine the basic approach in a closely related situation, the projection of test marketing data to predict the results obtainable from full-scale market introduction. Considerably more detail about the development of the technique and its application to a particular problem is presented in Chapter IV.

CHAPTER II

THE NEW-PRODUCT DEVELOPMENT PROCESS

2.1 Introduction

In order to study the sales forecasting practices of the participating firms, it was also necessary to study the context in which the forecasts were made and were used--that is, the new-product development process--since interrelationships exist between the two processes. This chapter presents the results which concern primarily the new-product development process, and the next chapter presents the findings about the development of the sales forecast. While the results pertaining to each of the two processes are thus separated in this dissertation, the reader is reminded that strong interrelationships do exist between them and that the separation is done only for clarity of presentation.

Beginning the chapter is a section which describes the focus of the new-product development process in the firms studied, and the next section discusses the problems created by this focus. Following this are descriptions of a series of approaches used by the respondents' firms to resolve these problems at different stages of the development process. A summary section concludes this portion of the chapter with a synthesis of the results presented up to that point.

To here in the chapter, emphasis is on the new-product development process, and the effects this process has on the generation

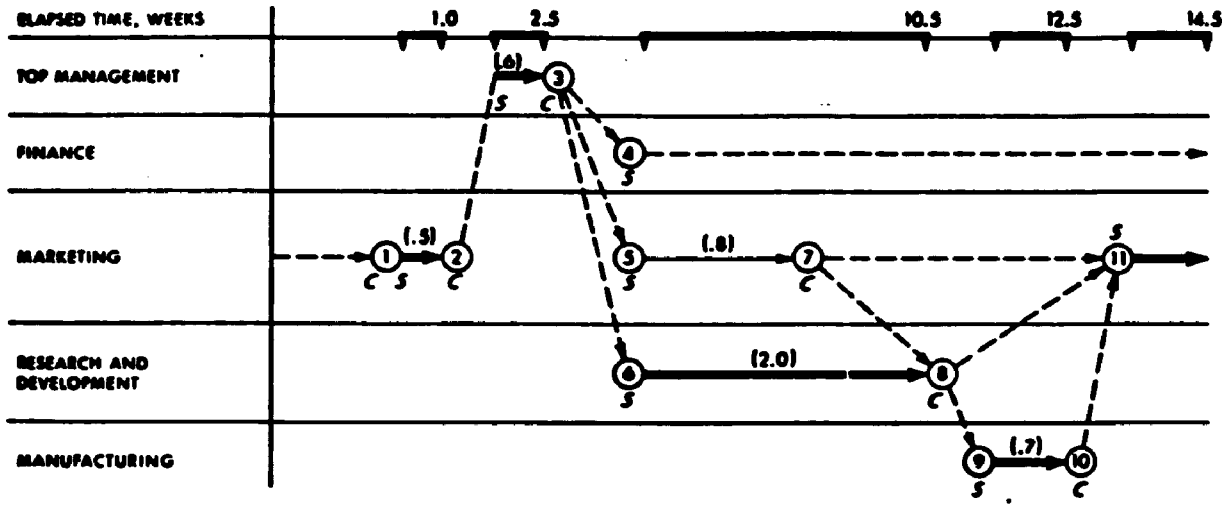
of the sales forecast either are implicit in the discussion or are simply stated; results from the research are not used to confirm the assertions about the interrelationship of the two processes. In the remainder of the chapter, however, results from the interviews are used to show (1) that there is a series of forecasts produced during the development process and (2) that the accuracy of the forecasts can affect the development process in several ways. By using the results of the interviews to develop these two points, the assertion that the two processes are intimately interrelated is strengthened.

2.2 New-Product Development Research Results

2.2.1 Focus of the new-product development process

In the literature on the new-product development process, the first step in the process is normally viewed as the discovery and identification of a new customer need. Figure 2-1, taken from New-Product Decisions: an Analytical Approach by Edgar A. Pessemier, illustrates this well. It should be noted that the first step in the process illustrated by the network analysis diagram in the figure is ". . . continuing market audit discovers a new customer need, starts proposal preparation." The proposal is then the basis for subsequent market investigation and technical investigation. The various succeeding budgetary, investigative, and evaluative steps in the suggested new-product development process then emanate from these basic, preliminary steps.

The approach to new-product development described in the previous paragraph is an outgrowth of what is now termed the marketing concept. Edward J. Green [46, p. 7-3] has defined this concept as



① Continuing market audit discovers a new customer need, starts proposal preparation.
② Marketing completes the new-product proposal.
③ Top management approves the study proposal.
④ Finance records budget and starts budgetary controls.
⑤ Marketing starts preliminary market investigation.
⑥ Research and development starts preliminary technical investigation.
⑦ Preliminary market investigation is completed.
⑧ Preliminary technical investigation is completed.
⑨ Manufacturing starts preliminary cost study.
⑩ Preliminary manufacturing cost study is completed.
⑪ Marketing, in cooperation with research and development and manufacturing, starts general evaluation of new product.
⑫ New-product committee completes general evaluations and submits recommendations.

Figure 2-1.--Network Diagram of an Illustrative History of a New Product.

> . . . a way of life in which all resources of an organization are mobilized to create, stimulate, and satisfy the customer at a profit.

But this has not always been the approach to marketing. Buzzell, [7, p. 51], et al., point out:

> The concept of customer satisfaction as the basis for marketing activity is often referred to as the 'modern' marketing concept. We can digress briefly to point out that this concept has not always prevailed as a philosophy of business conduct, nor is it universally applied today. The most common alternative, sometimes called the 'old' marketing concept, views the product as the focal point of business activity.

That the more traditional view has still a great many proponents--at least in the area of new-product planning--is evident from a study conducted by Booz, Allen & Hamilton, Inc. [17]. Their experience in examining the approach to new-product planning in several hundred companies is summarized in the basic approach illustrated by Figure 2-2. Here the initial stage in the process is the exploration of new-product ideas. Although this approach incorporates feedback from the marketing information system at the very early stages of the process, accent is placed on screening new-product ideas rather than discovering and identifying customer needs.

B. Charles Ames [33, pp. 101 and 102], in discussing why the industrial marketers he studied failed to fit the more modern concept of marketing planning, offered the following as an explanation:

> . . . the marketing department must also plan around the constraints imposed by other functions, since marketing simply does not control the factors that make or break performance in the marketplace. In the industrial world, marketing success depends largely on the activities of other functions, such as engineering, manufacturing, and technical service. This means, in turn, that changes in marketing strategy are likely to be based on product design, cost, or service innovations.

Based on Ames' observations it would be reasonable to expect

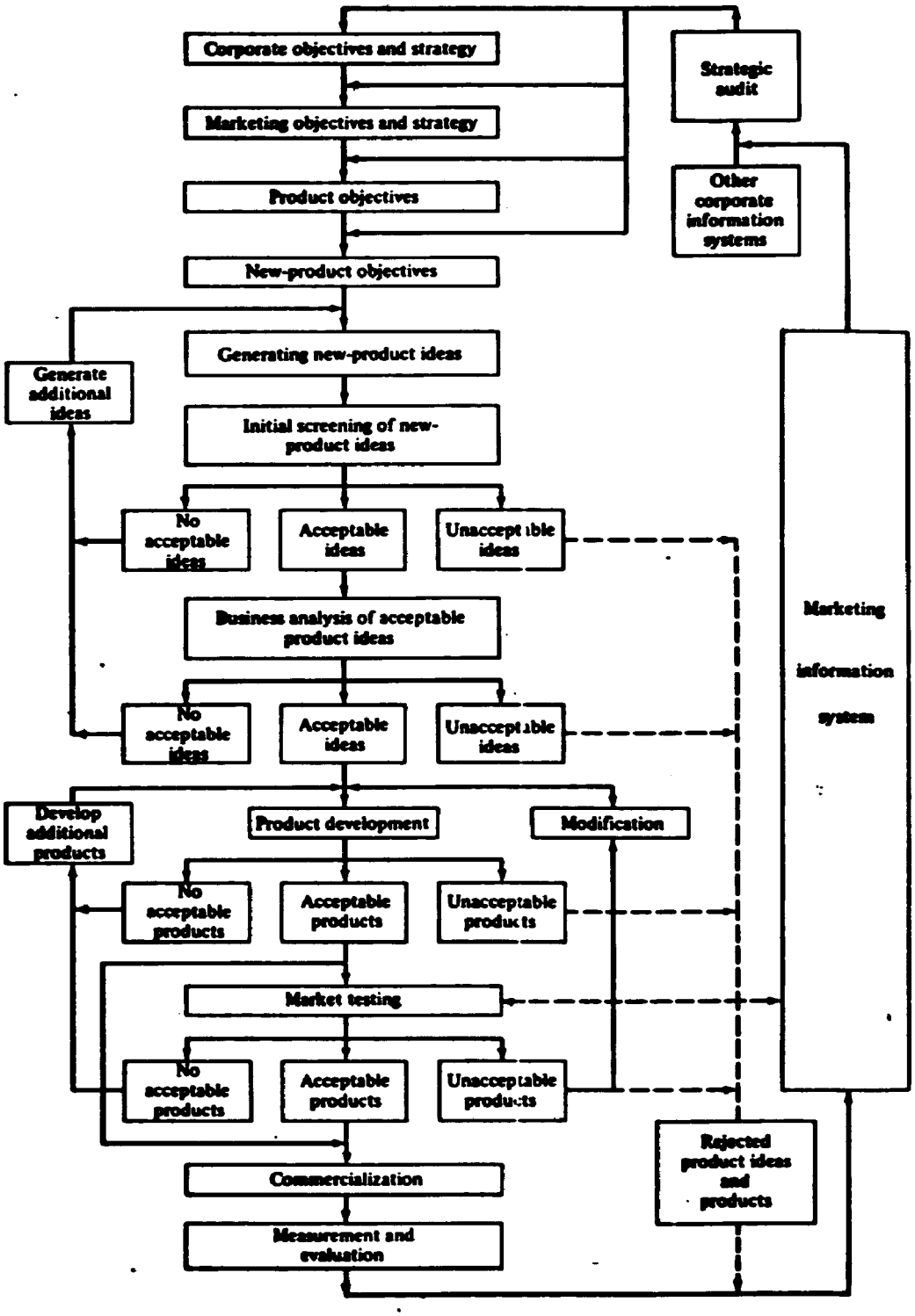


Figure 2-2.--A New-Product Planning and Control System

the firms participating in this study to have a strong product orientation. Contrary to what the quotation by Buzzell et al., implies, the approach used by the firms in Ames' study is not necessarily at odds with the 'modern' marketing concept. Rather it means that firms employing this approach to new-product development utilize several sources of new-product ideas, only one of which is the customer. John J. Corson [40] identifies several sources of innovation both inside and outside the firm. Inside the company, innovation can come from the top, from below, and from staff. From outside the company, two major sources of innovation are customers--especially the government--and the firm's credit sources.

As expected, the focus of the new-product development process in the firms studied was on the technical development of the product; primary emphasis was upon developing the product and then evaluating its potential in the market. Table 2-1 shows the source of the product idea for each of the new products studied for which it was possible to identify a source.

In only four cases out of eighteen did the idea for, or instigation of, the research emanate from a customer or the marketing department. In ten cases the product's inception occurred in one of the technical departments of the firm, one new product came from an outside inventor who approached the management with a licensing proposal, one came from another firm suggesting a joint venture, and two were by-products from other products already produced by the firm. Thus, fourteen of the eighteen products did not come, at least directly, from information gained from customers.

Respondent J_1, commenting on the source of new-product ideas,

TABLE 2-1

SOURCE OF THE NEW-PRODUCT IDEA

New-Product Idea Source	Number of Products
Research lab	3
Product lab	3
Central research	3
Marketing department	2
Spinoff	2
Customer	2
Another firm	1
Engineering	1
Outside inventor	1

described how his division spends fifteen percent of its technical budget on research for "creating" new products. That is, technical efforts are expended in his division on relatively fundamental research even though the company has a corporate research and development group whose very purpose is just that. Respondent O_2, the Technical Director of another division in the same company, described how he frees several people from his product development group to pursue any ideas they may have about possible new products. And yet, both O_2's group and J_1's technical group are supposed to direct their efforts to further developing new product concepts emanating from Central R/D and preparing them for commercialization. But the desire for new product ideas is so strong in this company that both of these

groups feel they must also pursue them.

In discussing new-product development with Respondent O_2, the researcher asked why so few of the products he had discussed in his interviews with respondents had arisen from specific needs identified in the market. The essence of O_2's response was the following:

> In order to get a truly new product--one which will yield the 10% after tax return-on-investment his company is seeking--two things are needed:
>
> 1. Unique technical capability
> 2. Need
>
> Without either of these one is left either with no product at all or simply a "me-too" product. Those products which are developed on the basis of an identifiable market need result in a 1 or 2% ROI--not 10 or 11%. If the need is there and can be readily identified, the chances are that someone else is also working on that problem's solution. On the other hand, if a unique technical capability is developed and then a need for this capability is identified, the company has a considerable competitive advantage.

A point similar to that of the Technical Director is made in a confidential document, which the researcher was allowed to peruse, describing the establishment of the Advanced Products Division in Respondent B_1's firm. This manuscript states:

> . . . basic to the approach to be taken by the Advanced Products Division will be the concept of identifying the timely convergence of technical capability and marketing requirements. Successful utilization of currently available technology depends upon the ability to precisely match the investment in its commercialization (product development) with the emergence of a firm expanding market. To invest too soon in product development will result in program failure in an economic sense in that an adequate return-on-investment will not be achieved within a reasonable time. Too-late an investment in product development may result in program failure by missing the prime portion of the market.

Summarizing then, most of the ideas for the new products studied did not come from customers. Rather, emphasis in these firms was on the development, or discovery, of new-product ideas from a

variety of sources, with the firms' own technical groups the major source.

But, as was stated earlier, it should not be assumed that the firms in the study disregard the modern marketing concept. To the contrary, it will be shown shortly that the firms realize that their emphasis on new-product idea generation can reduce input from customers, or potential customers, into the new-product development process and they therefore take steps to actively involve customers in the development process.

It has not been the intent of the discussion here to show that the view held by many, and illustrated by Pessemier's diagram, is naive. It would be unreasonable to assume that these authors feel that all new product ideas start with an identification of customer needs. The intent of this section has been to show how the new-product development process was initiated in the firms studied. Clearly, the nature of the development process could well be dependent upon its origins. Moreover, because of the interrelationships between the two, the nature of the sales forecasting process could also be affected by the same influences. It is important, then, for the reader to recognize this emphasis on new-product idea generation so that he can fully appreciate further observations made by the researcher concerning the new-product development process.

2.2.2 Problems created by an emphasis on new-product idea generation

One result of the focus on developing new product ideas and concepts is a chronology of events wherein a large sum of money can be spent on development prior to any real market assessment. That this

is so is apparent in the following exchange between the researcher and Respondent P_2:

Respondent: I completed this project which was a pre-development analysis. We had done enough work up to this time so that we could get some idea of what we wanted to do with the product line. From this point on then we started very active development to try and develop the product line to make it profitable.

Researcher: Had much money been spent at that point or not?

Respondent: Quite a bit of money had been spent on it.

Researcher: Was it the kind of money that you find in research where they say, 'Look, we're budgeting research at so many dollars a year so go ahead and do something with it.' Was that the kind of money that had been spent prior to that time?

Respondent: Mostly. Up until this point the Research Director just had to justify what he was doing. There was a certain set amount of money that he had to work with.

Researcher: He didn't really do any sales forecasting then?

Respondent: No.

Respondent L_1 said that his company makes no extensive market assessment until an appropriation request is prepared for management's approval. However, for management to approve such a request management insists that the technical people involved with the project be able to assure them that the project is technically sound; without such an assurance management will only approve requests for R/D funds.

In all, at least seven of the companies included in this study had spent R/D or development funds prior to any real market analysis. Respondent W_1 summarized his company's actions in this regard when he said, "People were spending a lot of money and they had no idea of what they were getting for their money." He undoubtedly overstates the case and yet his words illustrate well the danger inherent in the

approach which is followed by a majority of the companies studied--an emphasis on idea and concept generation in the new-product development process.

The second major problem identified with an emphasis on new-product idea generation was the problem of coordination within the organization developing the product. Several of the respondents, i.e., Respondents J_1, K_2, P_1, O_1, E_1, and S_3, made reference to the problem of coordinating the activities of people from diverse backgrounds and groups in such a way that the development process culminated in the successful commercialization of the new product. Donald A. Schon [28, p. 92] describes this problem well:

> The process of invention requires mutual determination of need and technology. But in the large, articulated corporation, the job of determining technology has been separated, by specialization of function, from the job of determining need. There are now departments of marketing and technology. Each specializes in its job. Each has developed a profession around its job. Each tends to be willing to answer only the questions that fall within its professional specialty: to do otherwise would be nonprofessional. As a result, it is difficult to locate a commitment to innovation. Each department says to the other, "Give me what you have done and I'll tell you whether or not it is feasible from the point of view of my specialty." Professionalism serves as a barrier to co-operative inquiry and as a defense against blame from the top for failure. But since questions of need cannot be answered without assumptions about technology, and vice-versa, each department finds itself performing as an amateur in the professional specialty of the other.

Some of the approaches employed by the firms studied to resolve the problems described in this section at various stages of the new-product development process are discussed in the next three sections.

2.2.3 Approaches used during the technical development of the product

As mentioned in the previous section, several of the firms studied were aware that they were often expending considerable time, effort, and money on the technical development of their product prior to any real market analysis. But even though this problem was recognized, none of the respondents spoke of ways that they had found to resolve the problem; they treated the problem as something to be lived with. On the other hand, they did recognize, and attempt to resolve, the problem of coordination mentioned earlier.

One approach to the problem of coordination is the revision of the organization of the firm. The literature in recent years has devoted considerable attention to new-venture management groups [54 and 68]. These are groups charged with the responsibility for overseeing the development of a new product through the early stages of its life cycle. Once the product is capable of supporting itself it is turned over to an existing division, or a new division is created.

Respondent B_1 estimated that in his company, which has a new-venture management group, approximately six of the more than thirty divisions in the firm were outgrowths of the successful commercialization of a new product. To understand the basic function of their new-venture management group, read the following excerpt from the confidential document referred to earlier in this chapter which acted as the charter for this group:

> The Advanced Products Division will identify, evaluate, and implement into a profitable new business, those promising new technologies, new product areas or prototypes, or spinoffs and fallouts, which are outside the immediate interest and existing plans and capability of any existing divisions or subsidiaries; yet are consistent with the Corporate objectives.

. . .

> The long term performance of the Advanced Products Division will be judged on its ability to select programs for implementation by the division and its ability to bring these programs to an early stage of profitability.

In all, however, only three of the twelve companies in this study had a new-venture management group in their corporate organization. Even so, it should not be concluded that the remaining firms were unconcerned about the problem of coordination. Quite the contrary. They simply took different steps to resolve the problem. Three of these approaches to the problem of coordination will be briefly described.

Respondent S_1's firm, in an effort to instill in their technical personnel an awareness of market needs and the importance of these needs to the success of a new product, encourages their technical people to become pseudo-entrepreneurs. In the words of the respondent:

> This goes way back to the entrepreneurship philosophy of the company. You invent something and you're capable of taking it all the way through, including the marketing. You've got a chance to become a division and that lab man can work his way up through project to department to division and vice-president. (Company name) has always encouraged that lab guy to get out in the field.

. . .

> Consequently, (company name) may be going back and trying to instill in the development people this marketing capability by letting them go in the field as the product is being developed--to the customer--and they keep coming back with this flow of information as to what . . . they may know what they have to do, not so much by the customer telling them, but by their own intuition when they get out there and they see.

A second example of a company's efforts to involve technical people with the realities of the market involved the development of a

new material which had been originally developed by Central Research for general use. No specific applications were necessarily considered; it simply was a material with unusual and, what appeared to be, attractive properties. Respondent K_1's division "placed their bid" for the product and were awarded it for further development. After some further developmental monies had been spent to convince the division's technical people that the product could be employed in several specific applications, the decision was made to proceed with market development. The first step in market development was to send the technical people in the division who had been involved with the technical development of the product to potential customers for the material. Their mission was to work closely with the technical people in a small number of potential accounts to develop the product further in accordance with the needs expressed by these selected customers. Shortly after this stage one of the technical people was assigned to the marketing staff of the division to continue to work with the further marketing of the product.

A third company, that of Respondent P_2, maintained similar contacts between its technical personnel and technical groups in the customers' organizations. P_2 put it this way:

> . . . the research people were working with (customer's name) research people. They very often have research-to-research contacts. (Customer's name) was working on this process and they needed some help from people who knew something about (the process). So they got together and samples went back and forth. There was enough activity between the two research departments that we knew that it was a good bet that we had something.

Prior to this statement he had described how his firm had acquired their knowledge of the process he was referring to:

> . . . in basic research we have a group called Exploratory Research. They do nothing but work in just . . . exploring ideas of one kind or another that are just . . . really not very related with our current business. We like to keep them as related as we can. We like to have some sort of tie with the kind of business that we're in but they have more latitude in the Exploratory Research Department than all the rest of the groups in research.

The accounts of the product development approaches employed by six of the firms in the study, which were presented in the last several paragraphs, emphasize an effort on the part of these companies to incorporate the essence of the marketing concept into the technical groups involved with the development of the product at the earliest stages of the overall new-product development process. Three of the firms had used new-venture management groups to act as a coordinating agency both between various groups in their firms and between these various groups and their potential customers. The other three firms made sure that their people who were involved with the technical development of the product received a good deal of exposure to potential customers. This helped coordinate the activities of their technical groups both with their potential customers and with the marketing groups in their own organizations.

Besides efforts taken during the technical development stage, some of the firms studied also sought to resolve the problems identified in Section 2.2.2 by taking action at the market introduction stage of the process. These actions will be described in the next section.

2.2.4 Approaches used during the market introduction stage

Mark Hanan [48, p. 45] in commenting on the marketing problems to be encountered in the introduction of a new product said:

> Yet marketing strategy appears to be the main chance for new business success. Certainly it incurs the lion's share of cost. In a report on 'Technological Innovation: Its Environment and Management,' a panel of electronic, transportation, communications, and chemical executives noted an interesting paradox about their product innovations: only 5% to 10% of innovative costs were attributable to R/D; the other 90% were incurred in planning for market entry.

Efforts aimed at improving the marketing aspects of the new-product development process in the firms studied focused on minimizing the chance of aborting full-scale market introductions.

Respondents Q_2, M_2, B_1, and K_1 specifically mentioned the use of checklists to avoid the introduction of products to the market when the product was not yet ready for market introduction. Checklists as described in the literature [1, 12, and 23] are used primarily as a basis for eliminating bad products or holding up the introduction of a potentially good product which requires further technical development before it can be successfully introduced. All four of the respondents employing checklists described a similar use of them in their organizations. They were not used to provide a measure of the product's potential for commercial success, only as a screen to prevent inappropriate or premature introductions.

In addition to checklists, some of the firms introduced their products in a fashion such that an unsuccessful product could be detected as soon as possible and with a minimum of expense. As an example of one of these marketing strategies, note the steps taken by Respondent J_1's firm in what is described as their "four-step program."

Step one in this program is "laboratory involvement." In the first step only technical people work closely with accounts in the

field who are potential users of the new product. The intent here is to insure against technical problems with the product which might be overlooked without intimate customer involvement. Step two in the program is initiated with the first actual sale of the product to a customer. At this point the laboratory begins to receive limited assistance from marketing and technical service personnel. The initiation of test marketing in one branch of the sales department's several branches is the initiation of the third step. Dealer involvement is still severely limited in step three. Instead the firm's own sales force, which normally sells to dealers, is selling direct to accounts in one geographic area, however, the dealer is receiving his normal commission. Step four is still geographically limited introduction but the dealerships are assuming their normal marketing role. Only after step four is satisfactorily completed are inventories filled and full-scale market introduction accomplished.

Respondent K_1's firm employs a similar strategy. Their efforts are directed at obtaining both market reaction and technical reaction, that is the reaction of technical personnel in the organizations of potential customers, at the same time. This is done during the test marketing phase of their step-by-step introduction process. Test marketing in this firm is the technical development of the product with significant customer involvement so that a potentially bad product can be abandoned early, before large sums are spent on its introduction. Objections to the new product's characteristics by either the customers' buyers or by the customers' technical people can be reason for a termination decision for one of this firm's new products.

Respondent P_2's firm maintained "marketing-types" in their

technical organization to participate in the test marketing phase of the new-product development process. Note the following conversation which occurred between the researcher and the respondent:

> Respondent: We don't call it test marketing. A test market is primarily a consumer term. We call this market development.
>
> Researcher: You're going into customer plants with something . . .
>
> Respondent: That's right. 'Try this! Use it and see if it works in your process.' Try to build up usage like that. The people that do this are rather uniquely equipped. They have sales ability and yet they generally have more of a technical, scientific background and frequently MBA's.

Respondent J_1 summarized the marketing approach typified by the three approaches described in the last several paragraphs well when he said:

> It's a conservative set-up so you can back out at each point. You haven't damaged yourself. By the time you're to that fourth step, you should know whether you have a product or not.

The last several sections have been discussions about the sources of new-product conceptualizations, the technical development of that idea into a viable product, and the introduction of that product into the marketplace. The reason for presenting these results has been to illustrate the manner in which the firms participating in this study reduce some of the risks involved in the new-product development process. Rather than passively reacting to these risks by trying to decide whether they should be accepted or rejected, the firms have developed aggressive, active approaches which result in risk reduction. Risks are altered rather than accepted or rejected.

Scott Cunningham [41, p. 84] has described perceived risk as ". . . the perceived <u>certainty</u> of a given event happening and the

consequences involved if the event should happen." In Cunningham's model, then, risk can be altered either through efforts directed at altering the consequences of the possible outcomes or through efforts directed at changing the possibility of each of their occurrences. For example, those firms in this study which spent money on basic research to assure themselves of a continual flow of new product ideas and new technical capabilities to meet the ever changing demands of their markets were essentially reducing the possibility that a need would be identified in the market to which they were unable to quickly respond. Similarly the reason several of the firms encouraged heavy involvement with customers by their technical personnel early in the development process was to reduce the likelihood that a product would be brought to market which had technical characteristics inconsistent with those required by the potential customers. On the other hand, the costs, or negative consequences, of terminating a new product introduction could be reduced if the conservative, step-by-step market introduction approach employed by other firms in the study was used instead of a more aggressive approach.

2.2.5 Deliberate use of interdependencies to reduce the risk inherent in the new-product development process

The various approaches employed by the firms in this study to the development of new products affect the development of the associated sales forecasts. However, before proceeding to a discussion of these effects (which is the purpose of the next section), it will be shown how some of the firms use interdependencies to reduce the risk inherent in the new-product development process.

All of the methods of risk reduction discussed up to this point focused on a particular product and its chances for success in a specified market. Efforts were focused on fulfilling a particular market need and on assuring parity between technical offerings and technical requirements. These approaches did not utilize the inter-dependencies inherent in many of the activities and products of the firm.

Just what does this last statement mean? Marketers have long recognized that the addition of certain new products to their total array of product offerings may affect the sales of their existing products or, at least, certain products in their line. Glen Urban [73] has developed a new-product investment analysis model specifically designed to incorporate these product interdependency effects.

Respondent T_1's firm tries to develop and market new products which exploit interdependencies between products. They call the approach their "razor and razor blade" philosophy. It is their desire to develop new products which are like razors, that is, products which consume other products made by the company. Thus, the company can expect continual sales beyond the initial sales for their new product because the consummable supplies which they produce will need to be continually replenished.

Other examples of product line interdependency effects, similar to those cited in the previous paragraph, could be drawn from this research but this is the more traditional treatment of product interdependencies. What is of more interest are some of the more specific interdependency effects which were revealed. Some of these were natural results of the particular situation and others were

deliberately introduced into the decision.

With regard to the former type of interdependency effects, that is, those which were natural results of the situation, it is important to understand their nature and how they affected the new-product development process. In Respondent S_3's case, the new product which was being considered, and evaluated with regard to its potential, was a product which could ultimately replace the firm's entire product line; it was an entirely new, radical approach to accomplishing the same function presently performed by their existing product. Not only would their present product be outmoded, but their field sales personnel would have to be retrained, their entire service organization would need new skills and technical capabilities, and, worst of all, their entire production facility would need major revamping. It was possible that the introduction of this new product would have as great an effect on this firm and its industry as the jet engine had on the aircraft engine industry--perhaps even more. But still management felt that they had to proceed with the development of the product because of what could happen if their competition successfully developed and marketed the new product while they did nothing. In the words of S_3, the negative consequences--no matter how remote their likelihood of occurrence--were so awesome that it became a "no-choice" decision; management felt they simply had to continue to invest funds into the new-product's development. But in spite of this feeling, management was still reticent to introduce a product which could require as much change in the organization and the physical facilities as this new product. In the words of the respondent:

> . . . I really feel that the reason they (his division) grabbed it was not so much to bring this baby forth but I think that there was an inherent, subconscious desire on the part of some people to make the baby germinate a little while longer and not let it be a threat to the already established (existing product).
>
> . . .
>
> . . . We played around with it in minor degrees and we finally got some people in, some engineering people from some (the new product) oriented organizations, and they were not about to let the thing sit on the back burner. They brought it to the foreground. They caught up on some of the technology, some of the metallurgy, and this kind of thing, always with the party line that it wouldn't be a threat to the (existing product), it would be a complement to it or a supplement to it. . . . it finally got to the point where the thing was no longer sitting on the back burner.

In the situation faced by Respondent O_1's firm, the new product being evaluated was essentially a composite of two of their existing products. That is, the new product could do the same things that each of two of their existing products could do while providing additional advantages over the two existing products such as decreased inventory expenses for the customer. It also performed some of the functions of the existing products more effectively. It was possible, however, to approximate this new product by using a combination of two of the existing products. The decision management faced is evident in this statement by the respondent:

> It's possible that if competition came out with it first that the customer would buy that one from competition and then the only thing that we would have to market would sit in inventory. Now the possibility is that only one of the things that we have in inventory will sit idle. The other choice is that the only two that we have will sit because we don't have this new product. We don't sell anything.

The respondent essentially saw this as a "no-choice" decision. The choice in this decision, and in the previously described decision, was one in which the costs of product and market development were so

small in comparison to the opportunity costs of not having the product, if and when the market demanded it, that the decision was seen as a foregone conclusion. This does not mean, however, that the firms responded in an aggressive, offensive manner. Rather, the approach they took was essentially defensive and conservative. If conditions at some later point in time were such that the demand for the product did not materialize, or that there were insurmountable technical difficulties involved in the product's development, or some other difficulty were encountered, then the firm could terminate the development of the new product at minimal total expense to the firm.

Both of the situations described above involved the ultimate product interdependency effect, that is, the possible total substitution of a product or product line. The effect of this ultimate product interdependency effect upon the new-product development process was extraordinary, the decision-maker felt he had little choice. He had to proceed and the only control he felt he could retain was upon how he proceeded.

There were other situations where the interdependencies present in the decision situation were also a natural result of the circumstances surrounding the decision but the decision-maker felt that he had more control over the process than in the two previous situations. Perhaps the best example of one such situation is Respondent J_1's case in which the new product was simply a wider version of one of their existing products. Although the simple widening of an existing product may not appear to be a very significant innovation, it was. The new product ran on totally different pieces of the customers' equipment than the existing product and thus an entirely

new market was opened to the firm. Previously, only competing processes and procedures could be accommodated on these larger pieces of equipment. With the new, wider version, a completely new process, which had been developed and successfully marketed by the respondent's firm, could be used on the customers' larger machines. To make the new, wider version the firm had to invest considerable monies in revamping their own production machinery. Much of their equipment had to be widened by ten inches. But in so doing the firm also increased the capacity of their plant for producing ten-inch wide models of the existing product since the smaller models were made several at a time and then cut to their appropriate width. Therefore, even though the decision was whether to add a new model to the firm's existing product line, the decision was structured such that the decision would have--no matter how the new product turned out--positive effects on other models in the line. The respondent referred to this interdependency effect, which he felt was relatively common in his particular firm, as the "piggyback effect" since the decision to go ahead carried with it advantages related to other areas of their business in addition to those related to the new product itself.

An analogous case was described by Respondent E_1. His firm was considering the introduction of a new product which was going to require a considerable investment in production equipment. Fortunately, some of the equipment to be purchased could also be used in other parts of their existing production facility if the market for the new product failed to materialize as expected. On the other hand, other pieces in the new production line would not have applicability in any other processes in the plant. Owing to this, some of

the equipment, that which possessed commonality between several processes, was purchased early and the remainder, that which could be used only in the production of the new product, was not purchased until the last possible moment. The firm wanted the passage of time to resolve as much uncertainty as possible about the potential for success of the new product before they would go ahead with the purchase of the equipment which could only be used to produce the new product.

The point of these last two examples is that interdependencies which are natural results of the particular decision situation can be such that the negative consequences are reduced or the positive consequences increased or both. In either case, the risk is reduced because the consequences are altered.

There are occasions, however, where such interdependencies do not exist and the success or failure of only the new product can determine whether or not the decision to go ahead was a prudent one. Occasions such as these are viewed with trepidation by the firm since there are no alternatives to pursue if the new product does not prove to be successful. The following is taken from the interview with Respondent S_1:

> The product was not made on existing equipment so we had to spend some money.
>
> . . .
>
> We look at any investment in equipment that only turns out one particular thing as being a critical investment. If you're going to make a specific product on a specific kind of machine, then it's critical.

The concern expressed by this respondent was that his company was going to be stuck with a piece of equipment of little value to them

if the new product's demand failed to materialize.

Another respondent, Respondent P_2, was concerned about his firm's new product because only one customer had purchased it up to that time. Again there was concern expressed over the lack of alternatives available. Note the following quote by the respondent:

> . . . the way we have it projected here it's mostly the one company, (customer's name), and this is why it's still not over the hump yet because any product line with just one customer, even though it's very successful, is not really on sound ground.

Both of the last two respondents referred to their situations as critical because of the lack of alternatives. The basic feeling in this regard is similar to the military strategy axiom that one doesn't attack without previously prepared positions to which one can withdraw. The interesting thing about this reaction--at least with regard to the new-product development process--is not so much that it exists but, instead, how some firms have learned to utilize interdependencies as an integral part of their new-product development strategy. They consciously introduce product interdependencies into the new-product development process so that the risks involved in the process are reduced. This is done in a number of ways and to describe each of these approaches illustrations will be taken from the interviews.

One of the most straightforward approaches to deliberately providing for product interdependencies is to introduce new products which open up whole new areas of business to the firm. Rather than introduce new products to its traditional markets, the firm develops new products which open up new markets. In so doing, the firm increases the potential return from many of the activities which are

a part of the new-product development process. While the firms' technical and marketing groups are learning about the new market's requirements for the particular product under investigation, they are also learning a great deal about other possible areas of interest to the firm in this new market. Thus, some of the costs of market investigation can be spread over a series of potential new products instead of just one. On the other hand, the potential returns from the new-product development process are also increased. If the new product is a success in the new market, the likelihood of introducing other new products successfully to the market is also increased. Respondent S_1 described this approach in this way:

> . . . if you're looking at this as a new product among several others, you can get along here. You can take care of it by hook or crook. But if you really have a going product and a going business and you're in a brand new market area, . . . you can see how that opens up other things. I mean, if I'm in there selling this, I'm going to be looking around. This is a whole new business opportunity. Right now it's a product; we're trying to make it into a business.

Respondent O_1 described a similar approach taken by his firm:

> We invested in capacity in terms of new machines but it was not because of that alone. It was more because of a strong desire to get into the hardware business itself. Not because of that specific product. We had a strong intention of going into that part of the business so we didn't have that kind of decision to make but we did have a decision to make as to whether that was the right product to go to the marketplace with.

Several of the respondents also described approaches which utilized technology transfer to effect product interdependencies. Richard N. Foster [45, p. 111] has defined technology transfer as "the process of employing a technology for a purpose other than that for which it was developed." Respondent J_1 described something he called the applied Product Concept as the process of deriving new

products out of old concepts through original thinking. The basic idea is to develop new, marketable products with virtually no further technical development expense. Because of this approach it is not unusual in this firm to see the same basic product being sold to several diverse markets.

Respondent M_1 described how his firm utilized technologies developed for projects in their Aerospace Division in commercial applications:

> Our Aerospace Division uses a lot of advanced technology. They will turn around and see what other sorts of applications they have for them, disregarding whether or not a market exists for it. In other words, they're just seeing what else they could use it for.

This concept, or partially developed commercial product, is then brought to the attention of the marketing groups in the various divisions or to the attention of the venture management group in the firm. If one of these groups is interested in the product, they assume responsibility for it and oversee its further technical and market development. It is possible then for several commercial products to proceed forth from the same aerospace technology.

Essentially then, the approaches utilizing technology transfer simply amount to getting "more mileage" out of technical development funds already spent. Two of the firms studied did something similar to this but different in one important respect: these two firms considered, and tried to incorporate, the advantages of technology transfer in their new-product development processes even before the technologies were developed. They <u>deliberately</u> developed technologies which could result in several new products to several markets rather than trying to develop specific products.

In one of the two firms mentioned in the previous paragraph, Respondent T_1's, the technical efforts are directed at developing "technologies" rather than products. A weaving technology, or a bonding technology, or a chemical technology is developed, not so much because this technology is required to produce a specific new product, but because with this new technology several new products can be made. Rather than just one division becoming interested in the particular development, several might. With this technology in mind, the marketing personnel in the various divisions can actively seek applications. These are the ten or eleven percent return-on-investment products the Technical Director was referring to earlier in this chapter.

The second of the two firms, Respondent B_1's, introduced a new product using a modular approach. First, the firm developed the basic core technology of a whole family of products which resulted in the basic product module. Then they developed other technical capabilities which resulted in other modules which could be readily attached to the basic module and produce a new product attractive to another market. By continuing to develop modules, it was possible to produce new products for new markets by combining modules. Although this approach is difficult, if not impossible, to use with many items, it does illustrate how a basic core technology resulted in a family of products. Respondent B_1 defined his "family of programs concept" as ". . . developing a long-range marketing and technology base in a broad area which holds promise to be a major business area." Next they take this concept one step further and try to orient their technical development efforts to "program families" which utilize

overlapping technologies. That is, they work on program families which can borrow the technology from other program families. By doing this, the core technology of a particular program family is not only utilized to develop the various new products in that particular program family but it is also instrumental in the development of the various new products in one or more other program families. This total approach is illustrated in Figure 2-3. The following quote from the confidential document referred to earlier in this chapter describes this figure well:

> As illustrated, the areas intentionally overlap and have in common certain technologies which are basic to the success of the intersecting areas. . . . A review of the other specific and common technologies indicates that (company name) Research Laboratories has a core of technologies which will provide the initial critical mass to allow the Advanced Products Division to exploit the three areas indicated.

As an aid to understanding this approach, an hypothetical example is presented here. By developing a technological capability in ultrasonic sensing and in precision measurement, a firm is in a position to develop and market a series of products for use in laboratories and quality control. The development of a capability in mechanical controls, when combined with their capability in precision measurement, would further enable this firm to exploit the demand for automated graphics equipment. Lastly, a combination of the ultrasonic sensing technology with the mechanical controls capability would be the technical foundation for the development of a whole family of new products to serve the process controls industry. In this example, then, various combinations of three technological capabilities result in three "program families." This example is oversimplified because in B_1's firm a larger number of technological capabilities would

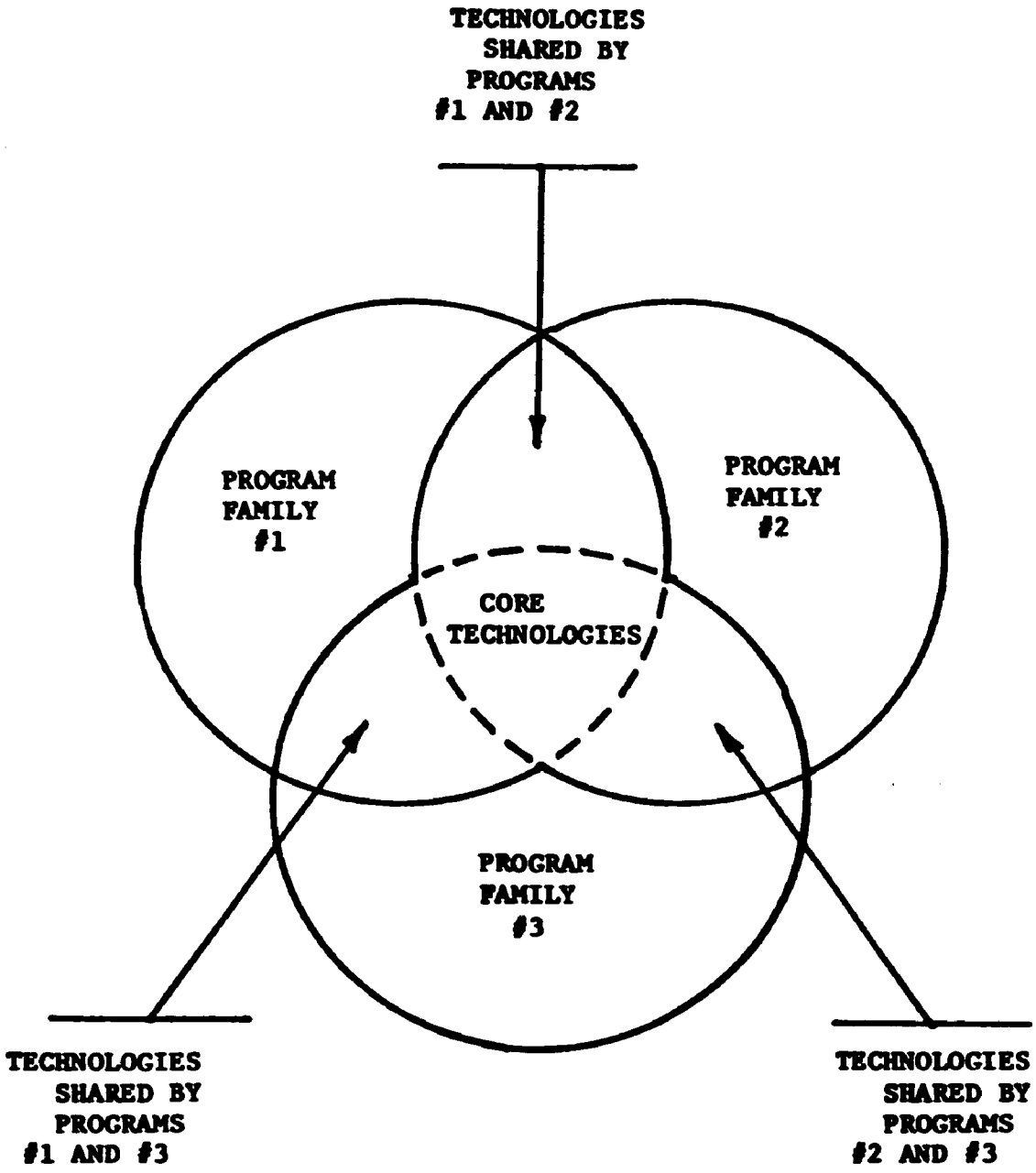


Figure 2-3.--Three Initial Families of Technologies and Market Opportunities.

normally be required to produce three program families. Yet, even though this example is contrived and oversimplified, it does convey the essence of the approach to new-product development employed by this firm.

It is the firm's contention that this approach helps answer two of their most basic concerns about the new-product development process. Both of these concerns involve ways of reducing the negative consequences associated with unsuccessful new-product introductions:

1. How to market a variety of product areas without investing in the development of a sales marketing force for each new product area.

2. How to produce a variety of product areas without accumulating a variety of specialized production facilities and without commitment of extensive fixed resources early in the product areas' development cycle.

2.2.6 Summary of results related to the new-product development process

The concept of the new-product development process for new industrial products which emerges from this research is not necessarily contrary to the model described in the available literature. In fact, much of what was observed in this study supports and clarifies much of what has been said about the new-product development process.

The most apparent area of agreement involves the issue of organizing for new-product development. There seems to be a general concern with this problem in the firms studied and three of the companies do employ venture management groups, an organizational practice which has received extensive treatment in the literature. Where such groups were not formed, efforts were made by the firms to

overcome the problems of coordinating the efforts of diverse groups and people by altering the organization. For example, Respondent K_1's firm assigned technical personnel to the marketing department to follow the new product through the development process. Another firm, that of Respondent S_1, made it possible for an idea to grow all the way into a separate division of the company.

A second area of agreement is that a very conservative approach to new-product development is followed by the firms in the study. Checklists, test marketing, and new-product introduction programs run in well-defined phases are outward manifestations of this concern over the risks involved in the new-product development process.

Lastly, the firms studied are very cognizant of product interdependency effects although, more than likely, not in those terms. Also, they may not necessarily include these product interdependency effects in the quantitative assessments associated with their investment analyses. But this does not mean that they are not conscious of the presence of these effects and their potential--both advantageous and disadvantageous. Recall the respondents' descriptions of product line considerations and the way in which some of the decisions were made simpler due to interdependencies between various pieces of production equipment. Also recall the manner in which the respondents viewed the introduction decision as critical when it involved the possible substitution of their existing product line. The awareness of the presence of product interdependency effects is strong; the treatment of these effects in the subsequent investment analysis may not necessarily coincide with some of the more sophisticated, recommended treatments found in the literature [73].

More important, however, than the results which confirmed previous findings concerning the new-product development process are those findings in this research which lent new insight into the process. Although they have been described in detail in earlier sections of this chapter they are summarized here.

The first finding which lends new insight is not necessarily contrary to previous findings. In fact, it confirms an earlier Booz, Allen & Hamilton, Inc. study [17]. This is the finding that the focus of the new-product development process is upon the development of new product ideas. This, at first glance, appears to be contrary to the modern marketing concept which emphasizes the identification and satisfaction of customer needs as the first step in the process. But this is not what was observed. Even though the firms studied emphasized the development of product ideas, they took several approaches to the organization of the firm to assure that customer needs and wants were made an integral part of the development process. These organizational approaches did not necessarily take the form of separate new-product development groups. Rather, in several cases, there was a concerted effort to create an environment wherein all of the people involved in the process were exposed to customer involvement. The details of these approaches to the organization of the firm are not as important as the fact that the firms strived for more customer involvement by their people during the developmental process. It was recognized that an emphasis on idea generation could result in an inattention to the demands of the marketplace and efforts were expended to insure that this inattention did not become a reality.

Emphasis upon the generation of new-product ideas also created

another apparent problem. In several cases considerable monies and time had been spent on product development before any significant market analysis had been performed. Some of the firms tried to remedy this omission by involving their technical personnel with the customer during the earliest stages of the new-product development process. In so doing, the firm hoped to instill in some of their technical people a recognition of the need for early market analysis. But even in the firms taking these precautions, the tendency to spend technical development funds prior to market analysis was present and observed. It is not clear from this research how the decisions were made to spend these funds.

Lastly, one of the most interesting observations emanating from this study was the specific manner in which some of the firms deliberately considered product interdependencies in making the new-product decision so that overall risk in the decision was reduced. The simplest approach observed for doing this was to introduce products which opened new markets and business opportunities to the firm. Using this approach, some of the costs of market investigation are shared by a series of products instead of a single product, and the potential returns are greater because of the increased number of opportunities. Another approach which was observed was to deliberately strengthen product interdependencies by creating a technology transfer to reduce the costs of research and development for subsequent new products.

The most sophisticated approach involved the actual planning for technology transfer by the careful choice of product lines which were chosen for development, or the careful choice of certain

technologies for development by the technical groups. The criteria for the selection of these product lines or technologies was, basically, that overlap existed between them and that a number of core technologies would result from the overall program. These core technologies could then be subsequently used to support a wide variety of new products. This latter approach was observed in only two of the twelve firms studied but seemed to be the logical extension of some of the simpler, less sophisticated approaches taken by several of the other firms.

There may be a tendency to conclude, on the basis of the results presented thus far in this chapter, that the need for accurate new-product sales forecasts is diminished if the decision-maker effectively controls the risks involved in the decision by taking some of the steps discussed in earlier sections of this chapter. It seems only logical that if the risks associated with a particular decision are reduced, the need for an accurate prediction of the future is also reduced. But this is not necessarily so and this is not borne out by the results obtained in this research. If the sales forecast for a new product is only used as the basis for a go/no-go decision on market introduction, then it is logical to conclude that the need for an accurate sales forecast is lessened. As the consequences of the go/no-go, market introduction decisions are diminished, the interest in, and desire for, accurate predictions are also diminished; forecasts are still required, but their accuracy requirements are lessened. But since the approaches to new-product development observed in this research result in a decision process--that is, a whole series of decisions rather than a single decision made at a

single point in time--the use of the sales forecast is quite different than that use associated with a sales forecast made for the single go/no-go decision.

It is helpful to reexamine the concept of the new-product development process which emerges from this research and its effects on the sales forecasts required throughout the process. At the risk of both oversimplification and overgeneralization, it may be said that the new-product development process in the firms studied has the following characteristics: (1) initially in the process, efforts are focused on the generation of new-product ideas and (2) this focus creates problems for the firm which the firm attempts to resolve (a) by improving coordination between the marketing and technical groups, (b) by employing various approaches to market introduction, and (c) by utilizing a number of different approaches to risk reduction. Essentially, the firm proceeds deliberately and methodically through the entire process, altering the risks inherent in the process whenever possible. What effects, however, does this basic approach to new-product development have on the requirements for the associated sales forecasts? First, since it <u>is</u> a process, a series of forecasts, rather than a single forecast, is required. Second, the requirements placed upon each of these forecasts differ by the stage in the process at which the forecast is used, the nature of the decision to be made on the basis of the forecast, etc. Third, since a series of forecasts are made throughout the process, the forecast can be used to alter the very nature of the new-product development process. If just a single forecast were employed during the process, it would only be used as the basis for a go/no-go decision; it would not be used to alter the

process, it would either stop the process or allow it to proceed to completion. The sales forecast as used by the firms in this study, in effect, becomes an integral part of the development process and contributes to the success or failure of that process.

2.3 Sales Forecasting and the New-Product Development Process

To lend support to the conclusion made in the previous section of this chapter, that the sales forecasts becomes an integral part of the new-product development process and contributes to the success or failure of that process, it is necessary to present two separate series of results drawn from this research. The first of these concerns how the forecast is used by the decision-maker and where in the decision process it is used. The second series of results pertains to what can happen if the decisions are wrong. Neither of these series of results, as will be seen, directly resolves the basic issue: does the success of the new-product development process, in some sense, depend on the sales forecast? However, it will be possible to assess the reasonableness of the researcher's assertions after a review of the two series of results upon which the researcher based his conclusion.

2.3.1 Uses of the new-product sales forecast

Table 2-2 summarizes the purposes for which the various forecasts studied were developed. Note that a whole variety of decisions were made on the basis of the sales forecasts. Of the eighteen sales forecasts studied and for which it was possible to definitely identify and describe the nature of the decision, eight of the decisions

TABLE 2-2

DECISIONS FOR WHICH FORECASTS WERE MADE

Decision	Number of Products
Whether to build a new plant.	5
Whether to purchase production equipment.	3
Whether to spend more money for development.	3
Whether to renew a technical licensing agreement.	2
Whether to introduce the product.	2
How large to build the plant.	1
Whether to invest in inventory for full-scale production.	1
Customer wanted a commitment for their production plans.	1

involved the purchase of production equipment or facilities. Another was to decide how large the new plant should be. Therefore, half of the decisions were fixed facility investment decisions. Is it not only reasonable to assume that these were not preliminary, go/no-go introduction decisions but instead were only one of a whole series of decisions in an overall decision process? Another decision which was similar to these was the decision to invest in the inventories required for full-scale commercialization. Again it is only reasonable to assume that a series of decisions preceded this decision. Another five of the decisions involved the issue of whether to provide further technical development funds or whether to renew licenses required for further technical development. These are isolated decisions, ones which are not sufficient to fully commit the

organization to the introduction of the new product. Therefore, it is reasonable in these cases also to assume that a series of decisions were made as part of an overall decision process. The remaining three decisions, as they were described in the interviews, might have been the isolated, go/no-go type decisions. It is not possible to tell for certain but in all three cases the ensuing discussion led the researcher to believe that in these cases also there was a series of decisions made and not a single isolated decision.

Support for the researcher's contention that the forecasts were part of a decision process made up of a series of decisions is also provided by statements made by some of the respondents which explicitly bear upon this issue. As Respondent J_1 put it:

> There were various forecasts made at various stages of the product's development, by all kinds of people, from technical types at the early stages to marketing types at the later stages.

This same point is also made in the following exchange between Respondent K_2 and his assistant discussing their new-product forecasts:

> Respondent K_2: Bill's made forecasts every year . . . twice a year . . . three times a year, for nine years, haven't you Bill?
>
> Assistant: Yes. With this market changing as it has in the last three years you always made a forecast to see what potential you have because the potential changes. Plus when you're building a new product, where can it fit? This had to be decided. Where does it fit?

That the new-product decision is a process or series of decisions is not surprising based on what has been presented in the literature, what has been presented here, and what was presented in

the situation summaries in Chapter I. But it is important to understand that the sales forecasts are a part of this decision process in order to understand the researcher's assertion that the process itself and the forecasts are intimately interrelated. Without examining the decision process in detail, one would expect each forecast that was made, as a part of the whole series of forecasts required by the process, to simply build on all of the succeeding forecasts. Each would become more detailed and accurate as time passed and more information was included. This is so to some extent, but that is not where the matter ends. Conditions change with the passage of time, prior assumptions prove to be invalid, and other things occur which prevent this simple "building-on" approach for the refinement of earlier sales forecasts. For example, in the last quotation cited, Respondent K_2 was making forecasts and the decision had not yet been made as to which market the new product would serve. It was still possible to alter the technical characteristics of the product in such a way that it could serve any one of several markets. In fact, the forecasts were also used to help resolve this very basic issue.

Respondent S_1 said he used the forecast to decide "what marketing strategy to use." He was confident that the sales growth would be largely determined by which strategy he chose and he was using the sales forecast to help resolve this question. And, yet, subsequent sales forecasts would be largely dependent on how this issue was resolved.

Respondent O_1 also talked about the effects the process could have on the sales forecasts themselves, specifically, the possibility of using a build-on approach for subsequent forecasts:

> The place that it (the build-on approach to forecasting) falls apart, if it does, is where one of the things that you learned between forecasts three and four may negate what you assumed--some of those assumptions made back between two and three. It may not be just a building-on of information. It may cut off one of the legs from one of the assumptions that you made earlier. Then it changes it.

Another way in which the new-product development process can have a direct influence upon the sales forecast is by limiting sales of the product. This is often the case when test marketing is used in the new-product development process. Rather than releasing the new product to the entire market, it is given only limited distribution so that various questions about the product can be answered before full-scale introduction is begun. It is possible for this limited distribution to actually limit the sales of the product in the early years of its life cycle but it is felt that this approach minimizes the chances of an early termination decision and thus results in greater sales of the product over the entire period of its life cycle. In one instance studied, the test marketing restricted initial sales to such an extent that the laboratory facility for producing the new product had sufficient capacity to satisfy the new product's entire demand.

In three instances the new-product development process resulted in new products which had a market potential so great, when compared to their costs of development, that the sales forecast was virtually unnecessary; the forecast only had to provide a rough indication of the size of the market potential. The effect this had on the sales forecasting process was a reorientation. The need for an accurate assessment of the size of the market in these cases was not nearly so important as the need for an accurate assessment of the firm's ability to identify and satisfy the market's specific needs. Respondent B_2

described such a situation in these words:

> What you really get down to is this: The share of the market that we see we need to get to satisfy our plan is so tiny that the total market movement, we feel, is just not going to make that much of an influence. In other words, if we're seeking to start out from zero and get one-half of one percent in the share of the market over five years, even though that market fluctuates wildly, we feel that that's going to be a lesser determinant of our success than our ability to make technical and marketing and sales efforts successful.

Additional justification for the researcher's position that the sales forecast and the new-product development process are intimately interrelated is provided by a series of statements by respondents making that very point. Respondent L_1, describing the modus operandi of his firm which is very similar to that detailed in Chapter I of this dissertation, put it this way:

> We're at a disadvantage when we're doing a forecast because we can only assume a price. Once we come up with a forecast and the manufacturing estimates are made, it goes to the accounting department and they say: 'This is our volume, these are our costs, this is what we've got to sell it at to breakeven in a certain period of time.'

Others described similar approaches in their firms but it is not necessary to recount them all. But Respondent O_1 talked about a use of sales forecasts by his firm which was somewhat different than others:

> We said: 'Here's what we think we can sell of this kind of product. Here's about what it will be marketed for in terms of a price.' Then you meet with people like engineering and sales people and you come up with a design. Then you get a little closer to market introduction and you get down to the actual prints--the specifics--and trial in the field to see how it runs. If it functions properly. Then you again forecast and you get tuned in a little closer to the economy. . . . Then we take the results of the tests and see if we have to make some product modifications. We then begin to map out a plan to introduce it to the marketplace.

Note how the forecast is an integral part of the process. It not only

provides the basic information as to whether to go on but it also provides information about how to proceed, the validity of previous assumptions about market needs and desires, and so on.

The last quotation in the previous paragraph is the closest thing to direct support for the researcher's contention that the new-product development process is interdependent with the sales forecast. The sales forecast helps to define the steps to be taken in the process. But this one statement by one respondent is not sufficient justification, even though the whole series of results and quotations prior to it in this section of the chapter also imply similar uses of the forecast, for the researcher's conclusion. Accordingly, the remainder of this chapter will briefly report on the feelings of several respondents as to what can occur if the forecasts are off their mark. It is felt that these results will lend further support to the conclusion that the sales forecast becomes an integral part of the new-product development process and contributes to the success or failure of that process.

2.3.2 Possible consequences of inaccurate new-product sales forecasts

Respondent J_1 said this about what could happen if his sales forecast were inaccurate:

> . . . we had two new-product situations where we went national too quickly and we got burned on them.

Respondent J_1 also said that the problem with the failure of one of their new products was poor management by the sales department of the test marketing program.

Respondent S_1 talked about the danger of alienating the people

in the company's distribution network in this bit of conversation:

> I don't want to go out and set up a network of distributors with our brand name product and have it fail. I don't think they should be subject to that. We should test our product and know that it can be sold before we go out and put it in all these places.
>
> . . .
>
> I think it hurts if you kill a product. If you're on a test and you find that you've got some things wrong, you can go back and change them. But if you go out on a full-blown program and you have these problems, you're going to get it so far back in the guy's trunk that you'll never get it back out again.

Respondent E_1 talked about the importance of timing:

> If you deliver a product that is not a price leader, you should be first or second. If you've got a labor rate that is higher than your competitor's, the only way you can do it is to sell them quality. In order to sell them quality, you have to be in there first and then let the other man fail. If the other man gets designed in, you'll never get an opportunity to prove your quality. We have to have technology going for us or we don't sell. We're not price competitive.

Respondent S_3 also talked about the timing of the introduction of the new product:

> About halfway through the time of the Stanford study, (competitor's name) started running around the country setting up an industrial marketing system that has already handled a number of (new product) training sessions. So what they didn't have, what to us was a competitive advantage before, now is going to net out as neutral. By the time that we are there with a product, they will have built the marketing and distribution system to support their product which is already on the market.

Other problems which can be encountered, according to the respondents, are losing the impetus of the introductory sales program, inability to fill initial orders if forecasts are low, and missing an opportunity to dominate a market by failing to get into the business far enough ahead of competition.

The point of reporting what various respondents felt could occur is to illustrate how these expressed feelings support the conclusion by the researcher that the forecast is part of the new-product development process and has an effect on that process. The respondents did not simply talk about the forecast turning out to be too high and then trying to make the best of a bad decision. Instead they talked in terms of timing, in terms of management problems, in terms of impetus and so on. These are process-related terms.

2.4 Chapter Summary

The industrial new-product development process focuses its emphasis on the creation and refinement of new-product ideas. This focus is such that several areas of the firm feel compelled to take part in it. A result of this emphasis on idea generation is an inherent danger that the needs and desires of the potential consumers of these new products will be neglected. To minimize this danger, the firm takes steps, primarily relating to the organization of the firm, to actively integrate the information obtainable from potential customers into the development process. Further, the risk resultant from this process due to the emphasis on idea generation compels the firm to bring the product to market in a series of well-planned, carefully conceived steps which enable the decision-maker to become actively engaged in the reduction of the risk. He proceeds as a risk adjuster rather than as a risk accepter or as a risk rejecter. Because of this approach to the development of new products, the role of the sales forecast is changed from that of a source of information upon which go/no-go decisions are made to one of an integral part of

the process. More than simple prognostications about the size of the potential market are required; information about the market, and how the development process alters that information, is required.

CHAPTER III

THE DEVELOPMENT OF A SALES FORECAST

3.1 Introduction

Stress was placed on the close interrelationship of the new-product development process and the sales forecasting process in the previous chapter of this dissertation. In this context it was not necessary to examine the various components of the sales forecasting process in detail. All that was needed was a general reference to the overall process and how it related to the new-product development process. However, this general, overall treatment is not sufficient for a thorough discussion of the results of this research which deal specifically with the sales forecasting process as it exists in the firms which participated in this study. In fact, it is inappropriate. Clarity and understanding of the sales forecasting process can only be achieved by breaking down the process into various components and presenting a separate discussion of the various results pertaining to each of these components.

There is a danger in separating the presentation of the results pertaining to each of the various components that the reader will assume, because the components are treated separately, that each component is independent of the rest of the components and unrelated to them. Nothing could be further from the truth; each of the various components are interrelated and each does exert influence on the

others. It is only for clarity of presentation that the discussion of these results is structured in this way.

Presentation of the results relating to sales forecasting is divided into the following components: (1) the use of consultants, (2) the use of models, (3) the use of test marketing and market research, and (4) the incorporation of information into the final sales forecast. Following this is a section discussing the various problems encountered by the firms in the preparation of their sales forecasts. A chapter summary section is then included to bring the various results together.

3.2 Approaches Taken to Sales Forecasting

The discussion of the various approaches taken by the firms studied to the sales forecasting problem has been broken down into the various components of the process for reasons explained in the introductory section of this chapter. The first of these concerns the relatively infrequent use of outside consultants.

3.2.1 The use of consultants from outside the firm

Table 3-1 has been constructed to show the various ways in which outside consultants were used to assist in the development of the sales forecast. It is interesting to note in Table 3-1 that only seven of the nineteen respondents indicated that outside consultants had been employed in the sales forecasting process for their new products. This would not be difficult to understand if the sales forecasting problem were an inconsequential, minor problem but it has been shown to be both difficult and important. Why then would well

over half of the firms studied fail to use all available resources in the solution of the problem? Might it be because the problem really isn't that difficult? Or that it really isn't that important? Both of these possibilities are remote based on what has been presented in earlier sections of this dissertation. What then explains this failure to utilize consultants?

TABLE 3-1

THE USE OF CONSULTANTS IN INDUSTRIAL NEW-PRODUCT SALES FORECASTING

Respondent	Use of Consultant
K_1	Used to get total potential figures and price information of existing, competitive materials.
B_2	Used to get total market demand and cost and price information of competition.
W_1	Used to get forecasts of demand for customers' products which could utilize this new product.
D_1	Used to get forecasts of demand for customers' products which could utilize this new product.
P_2	Used basically for technical development based on consultant's knowledge of market.
S_3	Used to get total potential demand and for technological forecast.
L_1	Used to get total potential demand.

A very plausible explanation is that the firms felt that the consultants were, in fact, incapable of providing much additional insight. Partial support for this contention is found in the fact that the consultants were used, in every case cited, to assist in the

development of total potential figures for the new product. Never was the consultant used to develop estimates for the growth rate or the share of the market the firm would ultimately retain. A good reason for not using outside consultants to develop estimates of either the growth rate or market share is that both are influenced by decisions made by the introducing firm. Accordingly, consultants would be expected to experience considerable difficulty making either of these estimates.

The previous paragraph showed that consultants were never used to estimate either growth rate or market share and for understandable reasons. Still, seven of the nineteen firms did employ outside consultants to develop total potential figures. If all the markets had been new to the firms, the use of consultants would have been understandable. But only Respondents B_2, W_1, and P_2 were introducing products to markets with which they had had little or no previous experience; the other four respondents had had considerable experience with the markets they were studying.

Why then were outside consultants used? This question can best be answered by examining <u>how</u> they were used by the firms. Respondents K_1 and B_2 used the consultant primarily as an access device to competitive cost and price information, information which would have been either very difficult for them to obtain from their competitors--or potential competitors--or which might have tended to prematurely "tip their hand" and thus dull the surprise effects of the introduction of their new products. For Respondents W_1 and D_1, the consultant provided necessary assistance in the development of total potential figures by providing information about the demand for their

customers' products which used the new products as either a component or a raw material. Here again the consultant provided assistance by obtaining sensitive information which the introducing firms might not have been able to obtain. Each of the other three uses of a consultant involved expertise which the introducing firm lacked. For Respondent L_1 this was market research expertise, and for Respondents P_2 and S_3 it was technical development and technological forecasting expertise.

Summarizing then with regard to the use of consultants, they were used primarily to provide information about the total potential demand for the new products and they were not used to provide estimates of the growth rate or ultimate market share. The reason they were used was that the firm introducing the product could not readily obtain the information, due either to the nature of the particular situation or to a lack of particular expertise. The consultants were primarily supplemental participants in the forecasting process; the essence of the forecasts were developed by the firms themselves. It is clear that the firms studied felt that outside consultants could only play a limited role in the development of the sales forecasts for their particular new products; it was up to the firm to develop the forecast. How they did this is the subject of the next several sections.

3.2.2 The use of formal sales forecasting models

A formal sales forecasting model is defined here as one in which the operations performed upon the input data are explicit and well-defined. Using this definition as a guide, it was found that formal sales forecasting models for new industrial products were

virtually nonexistent in the firms studied. Only three of the nineteen forecasting processes studied included what might be called formal models. In all other cases it was impossible to specify how the various input data were integrated into the final sales forecast. And even in those cases where a formal model was employed, the model was only used to derive a specific portion of the final sales forecast. For example, Respondent O_1 used a computer model to analyze sales data, from potential customers of the new product, and inventory information to extrapolate estimates of the usage rate of the new product by each customer.

The other two respondents who used formal models used approaches which were very similar to one another. Respondent W_2 used a basic grid which combined estimates of the technical capability of the new product to meet the specific needs of specified market segments with estimates of the receptivity of that market segment to the innovation to derive an overall estimate of the likelihood of successfully marketing the new product to each of several market segments. This was then combined with historical sales data to develop the total potential demand for the new product in each market segment. Mathematically this model can be expressed as follows:

$$L_i = t_i r_i$$

where L_i = likelihood of successfully marketing the new product to market segment i.

t_i = capability of the product to meet the technical requirements of market segment i. (t_i ranges in value from 0 to 1.)

r_i = receptivity of market segment i to the innovation. (r_i ranges in value from 0 to 1.)

Then $S = \sum_{i=1}^{n} L_i D_i$

where S = total sales potential for the new product.

D_i = demand for that type of product historically in market segment i.

Respondent L_1 used a basic grid to segment his market two ways. Each cell in the grid represented a specific market segment, defined on two separate market segmentation criteria. To illustrate, consider the following simple, hypothetical example. If the two segmentation criteria were end use and quality and the values for each of these were heavy-duty and light-duty and high-quality and low-quality respectively, then the cells, or market segments, would be heavy-duty, high-quality; heavy-duty, low-quality; light-duty, high-quality; and light-duty, low-quality. Estimates of the penetration rate for the new product--that is, the percentage of the sales of the existing products, which the new product was designed to replace, that would be converted to the sales of the new product--for each value of each of the two segmentation criteria were then obtained. By multiplying the two estimated penetration rates for each cell, the total expected penetration rate for that particular market segment represented by a particular cell in the matrix was obtained. This was then applied to historical sales data for each cell, i.e., market segment, to give an estimate of the total potential sales obtainable from a particular segment. The following is a mathematical formulation of this model:

$$P_{ij} = P_{1i}P_{2j}$$

where P_{ij} = total expected penetration rate for market segment ij.

P_{1i} = estimated penetration rate of market segment i when the segments are developed on the basis of criterion 1.

P_{2j} = estimated penetration rate of market segment j when the segments are developed on the basis of criterion 2.

Then $$S = \sum_{i=1}^{m} \sum_{j=1}^{n} P_{ij}D_{ij}$$

where S = total sales potential for the new product.

D_{ij} = demand for that type of product historically in market segment ij.

It should be noted that each of the three formal models described in this section provided only information which was input to the final forecast; the formal model did not provide a final forecast. Second, note that the formal models were not comprehensive models of the potential market. Rather, they were basically computational devices for handling data, based on specific assumptions about the structure of the potential market. Third, note that all three of the models discussed here provided only information related to total potential demand, they were not used to estimate either the growth rate or the market share. In summary, there appears to be a need for research related to the development of comprehensive sales forecasting models for new industrial products.

Since the environment of the sales forecasting process for new industrial products is characterized by complexity, it is useful to note how the respondents reacted to the complexity.

3.2.3 The use of test marketing and market research

The previous chapter described how the various firms restructured the new-product development process in such a way that they were able to, in a sense, alter the uncertainties and consequences inherent in the process. This, in turn, affected the requirements for the new-product sales forecast. It could be said that the firms took positive steps intended to alter the situation in such a manner that they were more capable--or at least more comfortable--in dealing with it. To a certain extent this is what was done with the sales forecasting process. Since it was difficult to structure the problem to include existing, available information about the future of the new product in such a way that the most effective use was made of this information--that is, develop a formal model of the environment which could be used to process the data--the next best thing was to obtain additional information about the future.

Table 3-2 has been constructed to illustrate the nature of the test marketing and marketing research, which are both techniques for obtaining information about the future, undertaken by the firms in this study to assist them in the development of their prognostications about the future of their new products. Note that thirteen of the nineteen sales forecasting processes studied included either marketing research or test marketing. It is reasonable then to state that it was common practice for the participants in this study to

TABLE 3-2

THE USE OF TEST MARKETING AND MARKETING RESEARCH IN INDUSTRIAL NEW-PRODUCT SALES FORECASTING

Respondent	Test Marketing or Marketing Research Done
J_1	Test marketed the product to about 30 accounts out of a total of about 40,000.
K_1	Test marketed the product to just a "few" customers.
K_2	Test marketed the product to 5 accounts out of a total of about 700.
S_1	Test marketed the product with 2 distributors out of a potential 200 or 300 distributors.
B_2	Had consultant do test marketing.
O_1	Test marketed to the entire market. Only difference from national marketing was items were made to order; they were not available "off-the-shelf."
W_1	Employed a consultant to do market research on his customers' future demand. Also did something similar himself.
M_1	Talked to a "small sampling of his major customers."
P_2	Did market research in the form of a survey and test marketed to the extent that they tried to get adoption by one or two accounts before going national.
M_2	Test marketed with a few accounts.
S_3	Stanford Research was employed to do an extensive market survey.
L_1	Did market research to forecast his customers' sales.
B_1	Did market research by surveying a sample of accounts.

include test marketing or marketing research in the sales forecasting process. Eight of the firms did some sort of test marketing and six did some kind of market research. (The reason the total of these is fourteen instead of thirteen is that Respondent P_2 did both test marketing and marketing research.)

Let us examine these results relating to the use of test marketing and marketing research by the firms studied. First, test marketing. Generally, test marketing is not used to forecast growth rate, especially for industrial products. Since the growth rate for new industrial products is normally slow, the period of time covered by the early growth portion of their product life cycle is quite long. Therefore, test marketing is a very poor way of predicting growth rate--too much time is required. With regard to market share, it would be unreasonable to expect to accurately predict ultimate market share on the basis of the small number of firms that were typically included in the described test markets. In all cases where test marketing was used, with the exception of Respondent O_1's case, the number of customers included in the test market was very, very small compared to the total number of potential customers. (Respondent O_1's firm marketed their new product nationally during their test marketing phase but only made it available as a made-to-order item; it could not be bought off-the-shelf during test marketing.) It is more reasonable to conclude that the test markets conducted by the firms in this study were used to obtain information from selected customers about the relative economic benefits to the customer of the new product and about the technical performance of the new product in specific environments. This information is primarily related to the total potential

demand for the new product in selected market segments.

In every case where marketing research was used, the objective of the research was to determine the level of sales of the potential accounts. That is, since the new product which was being considered for market introduction was to become either a raw material in, or a component of, the potential customer's product, it was necessary to know the level of sales of the customers' products in order to determine the total potential market for the new product. Often this information was not readily available from the literature, or the potential customers were reluctant to divulge it because they considered it sensitive and proprietary information. Respondents S_3, L_1, and W_1 used outside consultants to help them with their marketing research, partially because of the latter reason. In all cases, however, market research of some nature was necessary to get an accurate indication of the total potential demand for the new product.

Summarizing, it is reasonable to conclude that the results of the test marketing and of the market research were no more than input to the final forecast. It is known, based on the interviews, that the market research and the test marketing concentrated only on the total potential figures; they were not used to assess either the growth rate or the market share.

To this point in this chapter it has been shown that the firms in the study utilized various approaches for gathering information about the future of the new products in which they were interested. In some cases outside consultants were employed to gather specific information about the new product's chances of success. In several firms, test marketing or market research was employed. Yet even though

test marketing was done, and even though market research was done, and even though outside consultants were used, it was still left for the firm to incorporate the additional information obtained with other information, both objective and subjective and already existent in the firm, in such a way that a final sales forecast was derived. How this was done varied from one firm to the next. The next section of this chapter will describe several of the approaches to the incorporation of information into the sales forecast and will develop conclusions concerning these approaches.

3.2.4 Incorporation of information into the final sales forecast

In order to clearly show the variety of forms which the sales forecasting process itself can take, detailed descriptions of how several of the forecasts discussed in this study were developed will be provided.

The forecasting approaches employed by seven of the nineteen firms studied will be described first. These approaches, while quite dissimilar in specific details of the process, are quite similar in their general, overall approach to the sales forecasting problem. Nine other firms also employed similar overall approaches to the problem but they will not be discussed for the sake of brevity and because the seven approaches included are quite typical of the range of approaches employed by these firms. Therefore, descriptions of the process in each of the nine firms would provide little, if any, additional information. The remaining three of the nineteen firms studied used approaches which were similar to one another but were unique when compared to the process in the other sixteen firms. For

this reason each of these three processes will be described in detail, followed by a discussion of the differences between these three and the remaining sixteen.

Respondent J_1 described his approach to the development of the sales forecast for his new product. He was asked, "How did you come up with that forecast?" His reply was:

> Subjectively, I put a lot of thought into it. It may not be that it was precisely backed up by data all along the line but I did have these data available for (two similar products). I knew what levels they were running at and I knew what kind of market we were going to have with the (new product). And I know what kind of price tag we had on it so I knew it couldn't be up to the magnitude of that. (Pointing to another product's historical sales curve.) That gave me an upper limit to work with. And I did know what the acceptance was of (competitor's product) in the marketplace from an article. I interpreted that to come out with about 50,000 units per month. So if they could do that much with the kind of bad record they have in our marketplace--they just don't do anything right from a marketing standpoint. Their products are okay; it's just that they screw things up terribly. So this is a 50,000 units per month estimation. That's got to be the floor; we've got to be able to do better than that with our polished sales force. Somewhere in between there is the true volume and I established it at 70,000. It took a lot of soul searching to come up with the rationale. I was fortunate enough to have two limits, and I was able to resolve that it would be above one limit and below the other one. And I did have an explanation that somebody could put a degree of credence to so they did follow that.

In essence what he did was look at two historical sales curves for existing products: one which was the maximum sales success he could expect for the new product and another which was the worst he could reasonably expect. He then subjectively drew the projected sales curve for his new product between these two historical sales curves taking into account various factors such as technical considerations, willingness of the potential customers to innovate, compatibility of the new product with the customers' processes, and so on.

Respondent K_1 described how he developed the sales forecast

for the new product he had worked with. Since the product was a basic material, there were several potential markets where the new product could be applied. The following is a paraphrased description of the steps he took in developing the sales forecast for <u>each</u> potential application:

> The first thing I did was to try to get something I call Total Potential or the absolute ceiling estimate. In this stage of the process I used a consultant to help me develop this information. What we did was to try to develop a price-volume relationship for the various competing materials. That is, we plotted the volume actually sold annually for each competing material versus the price per pound of each material. (See Figure 3-1.)
>
> . . .
>
> The next step was to try to determine what percent of this was available to (new product's name). To determine this I really only considered the material's performance characteristics and its price. This then lowered the line although I was sure this was still not a reasonable potential for the material. It was a potential in a very gross sense.

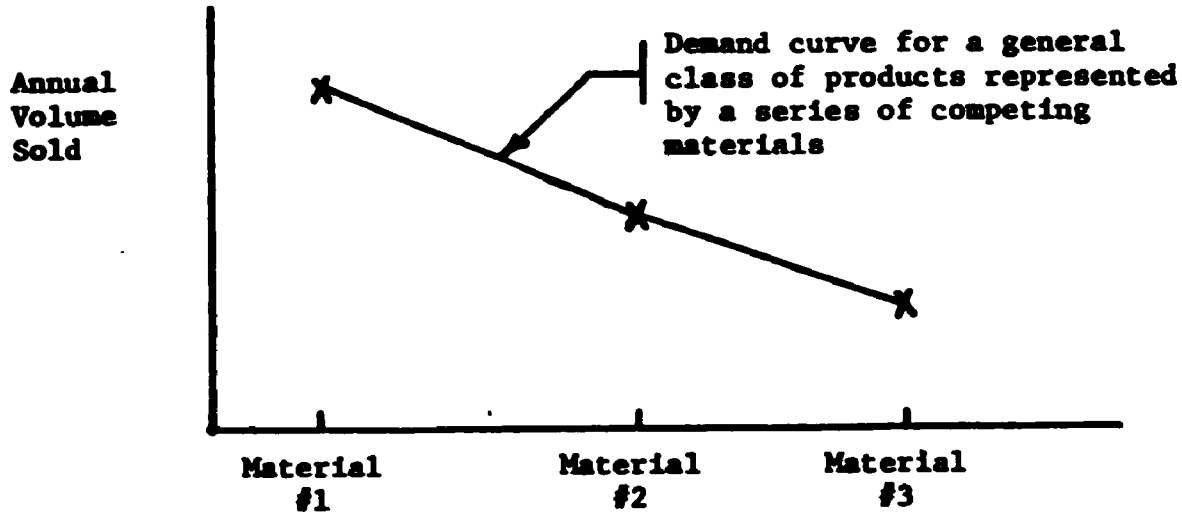


Figure 3-1.--Price-Volume Relationship of Various Competing Materials for One Potential Application.

. . .

In order to develop a more realistic potential figure I conducted what I call the Market Research stage. Here I actually tried to consider the needs of the various specific applications within the general application for which I was developing the forecast. I also considered the general economic conditions in the various industries we hoped to serve, the political aspects of introducing a new material into each specific application and so on. To assist me at this stage I tried to develop tables like the one shown below. (See Figure 3-2.)

. . .

I developed a table like this for each competing material and this helped me see where (new product's name) had the best chance of taking some business. Actually this helped me in both the second and third steps. I look at the second step as the establishment of the credibility of my estimates and the third step as a screening step. Actually, they are both very closely related.

. . .

The fourth and final step was to determine a Realistic Sales figure. I try to get this figure in more than one way to increase the credibility of the estimate. I looked at specific end uses and compared the numbers I got there to the numbers I got by looking at the total market curve at different prices. I felt safer than if I had done it only one way.

	Specific Applications		
Properties of Material	#1	#2	#3
Inert		X	X
Friction		X	X
Insulator	X		
Temperature	X	X	X

Figure 3-2.--Coordination of Material Properties with Application Requirements.

A third respondent, Respondent K_2, described a similar but less sophisticated approach to sales forecasting. This respondent's new product was a raw material component of his customers' product. The essence of his description of the steps he took follows:

> We looked at the market and determined that we would need to get both some of the (customers' product) now using (a competitive material) and some of those using (another competitive material). By multiplying the 550 million units of (the customers' product) produced annually by so many square feet of material per unit, we got the total potential. To forecast our sales for 1971 we simply forecast our pilot plant capacity because we knew even our test marketing supply was going to be limited by this capacity. However, the decision to build a larger plant was made on the assumption that we could get 10% of the total potential market. By setting a lower limit on the price of (customers' product) that would incorporate our new material, we got our actual total potential. Then by looking at various penetration rates, such as 10, 15, 20 and 25%, we could determine what was needed. When we checked with one of our distributors, he confirmed the fact that we could get 10% of the total potential. In fact, he felt 20% was more likely.

Respondent O_1 used much the same approach as Respondent K_2 except that he forecasted sales for his entire new product line:

> We looked at the total market for (class of products), whether they used a clamp or a pin or anything. (It should be understood by the reader that the new product discussed here combined the advantages of both clamp and pin types. It could also do anything either of these could do plus some other things.)
>
> . . .
>
> Next we looked at the forecast for this type product and usage rates for this type product--history as well as forecasts. Although the forecasts weren't broken down into pin-type and clamp-type, we were able to get a pretty good split from the marketplace.
>
> . . .
>
> Next we looked at our ability to substitute this new product for other existing products and directed our sales activity at substituting this one for competitive products, not ours. That's what we did first. We said: There are so many for this type demanded and we can easily replace that one. There are so many demanded for this type and we can replace it. Etc.

. . .

> Next we said: What are the chances of people in today's economy investing with no real advantage at the outset? This product was more expensive. This was a factor in it. What was the chance of getting somebody to invest at equal cost, even if they were equal? Not very good because people were not after productivity at the time. They had available capacity in most plants.

. . .

> Another thing which affected the way that we forecasted was the fact that we had a small share of the total market. These three (his two main competitors and his firm inclusive) had 80 or 85% of the market but we were number three. This meant that we had a pretty good block of business out there that we could go out and hurt people in and not hurt ourselves as much with the substitution effect. So that was important for us to know.

. . .

> Finally then what we said was: This part of the total is what's actually available to us. We think we can increase our market share by ten percent. We then took ten percent of the total available and that was our forecast.

Respondent S_2 summarized his approach, which was very similar to those already described, in the following manner: (The reader will note that S_2 describes his general approach to forecasting by talking about imaginary product introductions.)

> Suppose you're going to come out with a new fabric softener. You can go to the literature and immediately find out approximately how much fabric softener is sold in the U.S. There are probably five different sources. Or if you're going to come out with a new planter box treatment that incorporates a new insecticide, or a new release, or whatever, you can find out how much corn is planted. You know from experience approximately how much planter box treatment they put in with the corn, and you know from experience approximately what percent of the people planting corn use the planter box treatment. So that's your potential market. Then you'd have to guess, of course, as to what you're going to get of it.

Respondent P_2 described an approach similar to those already presented except that it possessed some peculiarities of its own. The researcher asked P_2, "How did you go about doing that (developing

the sales forecast)?"

> It was a rather complicated thing. The first thing that we did, of course, was to do a market survey, a market study. The reason that it was so complicated was that it was a product line that had never been produced before by anybody. We just had to think up possible applications that . . . we could identify only one or two applications.
>
> . . .
>
> We knew for sure, number one, that it could make an effective (type of product). Now that's not saying that it was for sure going to go and solve all their problems but we could make them with the stuff. Second thing we were sure of was that it was a good (another type product) so that we thought it's a pretty good chance that we would be able to get other business in that general field. Those were really the only two things that we knew. There were several other things, just looking at the properties. Being flexible and clear we felt there were possibilities in (several other applications). What we had to do then was figure out the size of each of these general markets. And then from that what portion of these large markets we might have a shot at with something like this. We also had to pare it down further by saying: Okay, if we have a shot at this, what sort of a percentage of that do we think we'll actually get and that was our sales forecast.

P_2 indicated that the market study he had performed primarily consisted of library research but it also included sending people into the field and sending letters to key customers asking them for information. This stage of the research resulted in a figure for the maximum amount available in each of several potential applications or market segments. This did not mean that all of this was actually potential for this particular product. The particular properties of the product would make it unsuitable for some of this potential so the actual market potential for the new product in each of these market segments was something less than this total amount.

It is interesting to note how P_2 described how he obtained the actual market potential for each market segment. The following is a quotation in response to the question: how did you get your market

potentials?

> Different ways. For example, here, number one was just a guesstimate; just put down five percent of the market size. What else do you do? Number two, we back this up by saying that we feel it will get a certain portion of this part of the market. And numbers three, four and five, twenty-five percent probability of success times market size equals market potential on that particular one. The next two, we had to put something down, so we just put it down.

But even this step did not result in the final forecast. It was still necessary to incorporate two other considerations affecting each of these market segments. The respondent described these two considerations with these words:

> Technically we didn't know whether we could do them and economically we didn't know whether we could do them. So these two factors had not been plugged in yet. Suppose that you take every single one of these market potentials and you say: Okay, we have a fifty percent chance, or even a ten percent chance, of getting each one of these. You can add up quite a sizable market potential if you can think up enough of these categories. And you might look at it and say: That's great. That justifies it. Except with only a ten percent probability in each one of them, it makes the whole thing look pretty slim. So you really have to discount all of these things when you're making a market projection. And the only thing that I can say is that it just kind of is by the seat-of-the-pants.

The seventh respondent, Respondent B_3, gave this description of his approach to the sales forecasting problem:

> The first thing I did was take some government statistics, which I could validate with some (trade association) statistics, concerning the number of (potential customers) using the (technique which required this type of product), the number of (customers each of his customers had), and the percentage of (his customers) who were using (his type of product). I applied these numbers to the total (potential customer) population. This then gave me the total number of applications per year which was 12,000,000. I learned from another source that a trade association was saying about 12,500,000 per year. Adding five percent to my figure gave 12,600,000 per year so I felt confident about that number. I also had to break this number down into three sizes for the different size (applications), and into trays and inserts since some (customers) used trays and others used inserts. To get our share of this total market, I

> concluded that only about fifty percent would use trays so the total potential market would be about 6,000,000. I felt that in about two or three years we would have about fifty percent of this market so I decided about twenty percent the first year.

The reader is reminded that the seven sales forecasting processes briefly described in the last several pages of this chapter are representative of the approaches employed by sixteen of the nineteen firms studied. Before proceeding to a description of the sales forecasting processes in the remaining three firms, it is well to make some observations about those already presented.

There are two ways in which generalizations can be made about the basic approach used by the sixteen firms mentioned and represented by the techniques employed by seven of these sixteen firms. The first way this can be done is by comparison with the approach described by Lippitt. He [16, p. 84] states that usually the approach to forecasting the sales of new products:

> . . . involves estimation of total industry sales of the new product, then company share of the market, and thus company sales. . . . Customer characteristics, producers' actions, and competitive interactions are the core of the analysis.

This is basically how these sixteen firms attacked the problem. Their approach was to develop a gross, total potential figure initially and then apply growth and market share estimates to this potential to get the actual sales forecast.

Lippitt's description then goes into considerable detail as to how judgments and assumptions about customer characteristics, producers' actions, and competitive interactions can, and should, be made a part of the sales forecasting process. However, it is not explicit how all of these various factors can be actually integrated into the process. Lippitt feels that this is the task of a formal model.

Unfortunately, even though sixteen of the nineteen approaches studied were basically the same as the sales forecasting approach described by Lippitt, only two of the sixteen were using anything that could reasonably be called a formal model. Even then, neither of these were anything at all like the formal model Lippitt suggests. It would appear that the firms were using an approach which made it difficult to incorporate information about customer characteristics, producers' actions, and competitive interactions.

The second way to develop general conclusions about the basic sales forecasting approach utilized by these sixteen firms is to examine individually each of the stages inherent in the process. Specifically, the approach used by each of these seven respondents can be divided into a stage in which the forecaster attempts to estimate a factor which can be termed total potential, that is, the total amount which will be available to the new product, and another stage in which the forecaster makes judgments about the market share and the growth rate. If one examines then the information which was incorporated by each forecaster at each of these two stages of the forecast, and also how this information was incorporated, one can gain further insight into the limitations of the basic approach utilized by each of these firms.

Table 3-3 is an admittedly crude attempt to summarize <u>what</u> information was incorporated by each forecaster at each of the two stages of the forecasting process, and <u>how</u> this information was incorporated. The reader should note the difference between the type of information which was used to develop the total potential part of the forecast as compared to the information which was used to

TABLE 3-3

INFORMATION INCORPORATED INTO THE SALES FORECAST AND METHOD OF INCORPORATION

Respondent	Information incorporated at potential stage and how incorporated	Information incorporated at share and growth stage and how incorporated
J_1	Information: Data about his other products, price of his new product, data on competitor's product sales. How: Directly.	Information: Technical considerations, willingness of customers to innovate, compatibility of new product, etc. How: "Subjectively." "I put a lot of thought into it." ". . . a lot of soul searching."
K_1	Information: Consultant, price-volume relationships, new product's performance characteristics and price. How: (Not clear from interview.)	Information: Needs of various applications, general economic conditions, political aspects. How: Table shown in Figure 3-2 and by taking more than one approach.
K_2	Information: Number of (customers' product) produced annually and square feet of material per (customers' product). How: Directly by multiplication.	Information: Price of (customers' product) and opinion of distributor. How: (Not clear from interview.)

TABLE 3-3.--Continued.

Respondent	Information incorporated at potential stage and how incorporated	Information incorporated at share and growth stage and how incorporated
O_1	Information: Government data, trade association data, usage rates, ratio of pin to clamp types.	Information: Price, people not after productivity, small share of market, customer attitudes toward new product.
	How: Directly.	How: "Come up with a number . . ."
S_2	Information: Literature, U.S. sales, five sources, amount of corn planted, percent using planter box treatment, etc.	Information: (Not stated in interview.)
	How: Directly.	How: "Then you'd have to guess of course, as to what you're going to get of it."
P_2	Information: Market survey, library research, units made per year, ratings as to potential application.	Information: (Not stated in interview.)
	How: Directly.	How: ". . . just a guesstimate." ". . . we feel it will get . . ." ". . . we had to put something down, so we just put it down." "Well, it's judgment." "And the only thing that I can say is that it just kind of is by the seat-of-the-pants."

TABLE 3-3.--Continued.

Respondent	Information incorporated at potential stage and how incorporated	Information incorporated at share and growth stage and how incorporated
B_3	Information: Government statistics, trade association data, etc. How: Directly.	Information: (Not stated in interview.) How: "I felt that in about two or three years . . ." "I decided about . . ." "I came up with twenty percent because, historically, our company has gotten about ten percent of the market in the first year after introduction."

determine the market share and growth rate. Basically, the former information was "hard," or primarily objective data. It is the type of information which can easily be quantified, if it already isn't. On the other hand, the information which was incorporated at the growth and share stage was much more subjective and much less quantifiable. In some instances, the respondent did not even describe the information he had incorporated at this stage. The types of data incorporated at each of the two stages are very dissimilar.

The methods used to incorporate the information into the sales forecast at each of the two stages were also quite dissimilar. For the potential stage, the information was almost always of such a nature that it could be directly incorporated into the process. In most cases the respondent did not even have to describe how he had incorporated the information since the method of incorporation was obvious. Conversely, the method for incorporating the information into the growth and share stage was very difficult for the respondents to describe. Very obscure phrases were normally used to describe how it was done.

The conclusion that is reached upon analysis of Table 3-3 is that the forecasters in developing total potential for their new product have "hard," objective data which can be readily incorporated into the sales forecasting process. However, in deriving their estimates of market share and growth rate they have far less objective information and they have difficulty describing how this information is, or can be, incorporated into the sales forecasting process. Whether they experience difficulty incorporating this information into

the sales forecasting process because of the nature of the information itself or because of some other reason can not be determined from the results of this research. That they do experience difficulty can be determined and the conclusion is that they experience real difficulties.

Thus, the conclusion that is reached about the basic sales forecasting technique utilized by sixteen of the nineteen firms studied is the same whether it is formed by comparison with the approach described by Lippitt or by an examination of the information incorporated, and the means by which this information is incorporated, at two distinct stages in the process. The conclusion is that the firms experience real difficulty trying to incorporate subjective information about customer characteristics, producers' actions, and competitive interactions into the sales forecasting process. These difficulties occur primarily in the formation of the estimates of market share and growth rate.

The remaining three firms studied utilized sales forecasting techniques which were similar to one another but were basically different from those used by the other sixteen firms. Even so these three techniques possessed some similarities to the other sixteen also. Before proceeding to a discussion of these basic differences and similarities, it is necessary to describe briefly each of these three approaches to the sales forecasting problem.

The first of these three, Respondent W_1, went into some detail about the approach he used. His new product was a new material to be used in the manufacture of a highly technical product.

I first called the Bureau of the Census and other similar organizations to see if anybody could tell me how many pounds of (the material which his new product would replace) were presently being shipped annually. I couldn't get an answer. I next started looking for my own data. By going to (Defense Department installation), I was able to obtain the material specifications for all of the (models of his customers' product) in use at the time. This wasn't complete, but it was extensive. By looking at the array of models, the various components in each, and the material specifications for each of the various components, I was able to piece together about twenty percent of the puzzle. That is, what is the present usage?

. . .

I next decided to conduct a survey of manufacturers (his customers). The guide I used for the interview looked like a grid (see Figure 3-3). In each cell of this matrix, I tried to find the premachined weight, the finished weight, and the material type. I contacted the people in both purchasing and production engineering at (a list of his customers). I was able to complete the grid to my satisfaction.

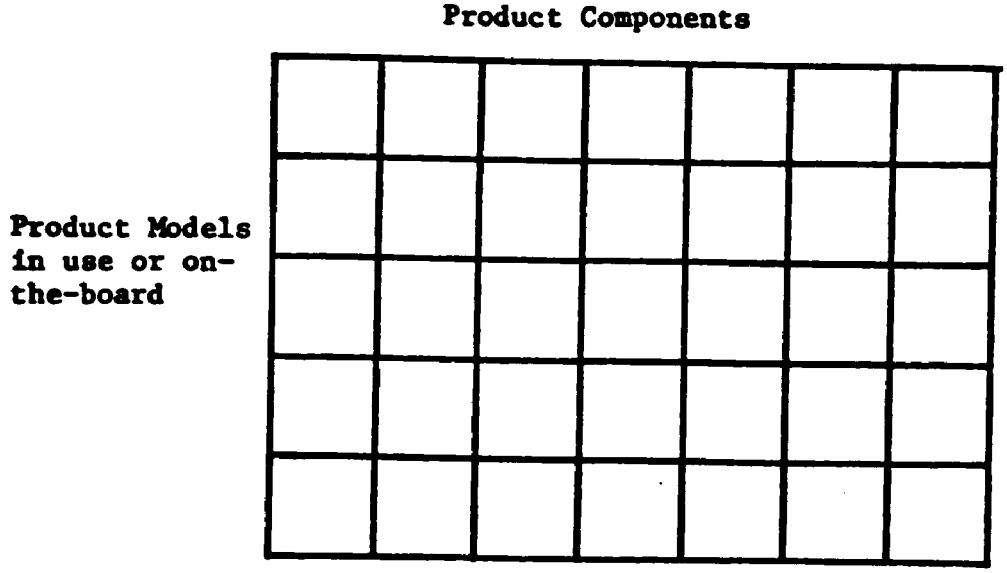


Figure 3-3.--Grid Used as an Interview Guide for Survey of Manufacturers.

. . .

> The next thing I had to do was estimate the number of units of each model which would be produced each year for the next several years. I went to a consulting firm in New England which had just finished a five-year forecast for (customers' product) production. The period covered by the forecast was 1967 to 1972 so I doctored it a bit to get the period beyond 1972 by incorporating my own feelings and some information I had obtained from one of the manufacturers. Since we were only interested in (certain materials), I projected the total potential market for (certain materials) in both cast and wrought form. (These are both forms which would be replaced by their new form of the same metal.) Next by looking at the price of (their new product) versus the price of these and by examining the technical capabilities of these materials in (their new product) form, I determined an estimate for the total market which could reasonably be expected to convert to (their new form). I then set a three year sales objective for the period 1971 through 1973 which was a portion of this total market.

. . .

> In setting these objectives, I looked at each individual account, and tried to assess their propensity to use (their new form) from (his company). In fact, I went so far as to look at each individual component of each individual (customer's product) model.

Respondent B_2 had the task of developing a sales forecast for a new material also. Unfortunately, it is difficult to reconstruct from the conversation a nice, neat description of the approach he used. It is possible, however, to look at several bits of conversation and get a general feeling for his basic approach. There is enough information available to support the generalizations to be made shortly about these last three sales forecasting approaches.

> We had some consultants make a study for us on what they thought the market would be and how fast (their form of metal) metallurgy would . . . what would be the demand for it and what might it grow to.

. . .

> We backed into it by talking to some of the users of the material and tried to . . . where we could get them to . . . in many cases they were quite open, combining this with our own guesstimates of what share of the market they represented.

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(new product) will undoubtedly weigh more heavily in one vocation than in another.

. . .

When the market segments had been identified, the size of each segment was calculated and forecast through 1975. The next step was determining the (new product) penetration into each market segment for each year to be forecasted and applying the penetration to the number of units in the segment to determine the predicted (new product) sales in that segment.

. . .

Having thus defined the potential markets for the (new product) and having made the initial segmentation, penetration rates were determined for each of the segments.

. . .

(One particular) segment was further divided into vocational categories and (models) and was handled in a different way. Each vocation and (model) category was rated on a scale from 0 to 10, based on its applicability and merits with regard to the (new product); the higher the rating, the more favorable that vocation or (model) is toward the (new product). Each vocation and (model) was rated on this basis for each year, 1971-1975. Using these ratings, the penetration percentage for each vocational category was calculated by taking the product of the ratings for the use and (model) that determine that vocation.

. . .

The sales of each of the segments were then totalled, and the result was the Five-Year (new product) Sales Forecast.

The basic similarity between the approaches used by these last three firms with the approaches used by the other sixteen firms is the information incorporated at each stage of the process and the manner in which this information is incorporated. Based on the material contained in Table 3-3, the conclusion was reached that the information utilized to develop estimates of total potential was "hard," objective data which can be directly incorporated into the sales forecasting process. On the other hand, the estimates of market share and growth

rate are based on far less objective data which are more difficult to incorporate into the sales forecasting process. A similar conclusion is reached upon an analysis of these last three sales forecasting processes. In developing total potential estimates, these three respondents talked about consultants, market surveys, and so on. Also, the information was in a form so that it could be directly incorporated into the sales forecast. On the other hand, the data which were used to develop estimates for growth rate and market share dealt with things such as price comparisons, technical capabilities of the new product, propensity to innovate, and so on. These are more subjective data than those data incorporated in the first phase. By the same token, the methods employed for the incorporation of these data were also obscure and subjective. Terms such as guesstimates and ratings are used in describing these methods. Respondent L_1 said, "Well, the other two people who worked on the other reports in the series and I sat down and looked at them and put down what we thought it was collectively." This was quite obviously a subjective technique.

Even though these last three approaches had these basic similarities to the approaches used in the other sixteen instances, they also possessed a very basic dissimilarity. Each of these three approaches developed the forecast for a disaggregated market. The total potential for the total market was not estimated; total potential in each of several--and in one case many--market segments was estimated instead. The advantages of this approach will be detailed and discussed in the next chapter. For now it suffic to point out the existence and nature of this basic difference between

the approaches employed by these last three forecasters as compared to the previous sixteen.

3.2.5 Problems encountered using present sales forecasting methods

Besides examining how firms are presently developing the sales forecasts for their new industrial products, it is instructive to also look at the problems they are encountering. If this information is then combined with the description of the approaches they're presently using, it may be possible to suggest sales forecasting techniques which will improve the process.

The subject of difficulties encountered in the preparation of new-product sales forecasts was often discussed during the conversations with the various persons interviewed. Table 3-4 is a compilation of what the various respondents felt to be the most difficult part of the development of sales forecasts for new industrial products.

TABLE 3-4

MOST DIFFICULT ASPECTS OF NEW-PRODUCT SALES FORECAST DEVELOPMENT

Most difficult aspect	Number of respondents
Market share and growth rate	10
Total potential	5*
Application identification	2

*Two of these respondents indicated that they were not concerned about growth rate because they felt that it was controlled by their marketing strategy. Two others indicated that they used rules-of-thumb for their estimates of the market share and the growth rate.

The reader will note in Table 3-4 that only five of the seventeen respondents felt that the size of the total potential market available to the new product was the most difficult figure to derive. Also, it should be noted that two of these five felt total potential was the most difficult because, for their particular products, the market was such that the growth rate was primarily influenced by their ability to achieve distribution of the product and their technical ability to meet the particular technical specifications of each individual application. Thus, they felt that growth rate was not something to be predicted but, instead, something which they controlled. Two of the other three respondents who felt that the total potential was the most difficult part of the forecast thought so because they used rules-of-thumb for estimating market share and growth rate. In a sense these respondents had "given up" estimating the growth rate for each forecast they generated. It is not surprising, then, that these two respondents would indicate the total potential to be the most difficult because, once they had established the rules-of-thumb to be used in the other parts of the forecast, these parts ceased to be a problem to them.

Since only five of the respondents felt that total potential was the most difficult, twelve felt that some other aspect of the forecast was more difficult to derive. Ten of these twelve felt that the market share or the growth rate was the most difficult. Based on the material presented in Table 3-3 earlier in this chapter, it is not surprising that most of the respondents felt this way. Since both the data available and the methods used to incorporate this data into the forecast for total potential were found to be quite objective and

direct, and since nearly the opposite of this was found to be the case for estimating the market share and growth rate, it is reasonable that most of the respondents would feel that the market share and the growth rate estimates were the more difficult to obtain. As Respondent E_1 put it, "The hardest would be the growth rate. . . . Next would be the share. The total market is easy because there's 11,000,000 (units of customers' product) made and there's two (of his products) in each one so 22,000,000 units." How the respondents feel about this problem is also evident in this bit of conversation with Respondent W_2 concerning the market share estimate:

> I've got the total market available. Now my supervisor would say, 'That's great! Your competitor is already in there and selling like crazy. How much of that market are you going to get? Is there going to be anything left for you? So then, from this total number you've got to determine your percentage.
>
> . . .
>
> That's subject to discussion and debate. You get down to the gut feel. How good is your product? You have to discuss how strong your competitor is. It becomes purely an opinion factor.

Both of these comments are typical of the way that the ten respondents felt who thought that market share and growth rate were the most difficult to predict.

The remaining two respondents felt that identifying all of the potential applications for their new product was the most difficult part of the forecasting task. But this is essentially product characteristics forecasting and beyond the established objectives of this research.

3.3 Chapter Summary

Even though the design of this research was such that firm

conclusions cannot be drawn from these results, it is expected that the reader will feel comfortable generalizing these results to situations of interest to him. The basic conclusions which the researcher has reached upon an examination of these results are the following:

1) Consultants can be helpful in developing the new-product sales forecast but only to a limited extent.
2) Formal models are not now used to any real extent in the development of the forecasts.
3) Marketing research and test marketing can be helpful in developing the forecast. The problem remains, however, of incorporating the data obtained from the test market or market research into the sales forecast.
4) Two basic approaches are taken in the development of the forecast. The primary difference between the two approaches is that with one approach all estimates are made on an aggregated basis. The other approach breaks the market down into well-defined, smaller units and develops forecasts for each of these units.

   The two approaches are similar to the extent that the data incorporated and the incorporation methods applied to the data in the development of the total potential figures are considerably more objective than those used in the development of the market share and growth rate estimates.
5) More difficulty is encountered in the development of the market share and growth rate estimates than in the

derivation of total potential.

CHAPTER IV

AN APPROACH TO SALES FORECASTING

4.1 Introduction

The primary objective of this research, as described in Chapter I, is to learn what is needed to improve the development of sales forecasts for new industrial products, and to see whether an integration of the results of several diverse areas of research is helpful in meeting some of these needs. Chapters II and III presented those findings of this study which partially fulfill the objective of increasing our knowledge of what is needed to achieve improvement in the process of forecasting the market for new industrial products. The purpose of this chapter is to present the results of this research which bear on the second issue, that of attempting to integrate the results from other areas of research to meet some of the identified needs of the sales forecaster.

It is important, at this point, to remind the reader that the primary focus throughout this study is on the generation of forecasts rather than their accuracy. This was the focus of the interviews which were conducted, and this is also the focus of this portion of the study. Although this part of the research is designed to effect improvement in the forecasting process, the criteria which are employed to determine whether improvement can be achieved based on this work are related to the generation process; they are not related

to the accuracy of the forecast. It is hoped these results will help the forecaster eliminate some of the difficulties he now faces when developing a sales forecast for a new industrial product.

The next major section of this chapter, Section 4.2, specifies those findings from Chapters II and III which bear directly upon the problem of improving the development of sales forecasts for new industrial products. Information availability and the difficulty of the incorporation of information, structure of the model, and disaggregation versus aggregation are topics covered in this section of the chapter.

Section 4.3 is a review of the research literature in the areas of model building, industrial buying behavior, and adoption and diffusion. Integration of the results of this literature review to provide insight into the problem identified in Section 4.2 is the purpose of the concluding portion of this section.

An approach to the development of sales forecasts which attempts to meet the needs of the respondents in this study is described in Section 4.4. This approach draws heavily from the literature review in Section 4.3.

Although an actual test of the proposed sales forecasting approach is not possible due to the unavailability of data, the last major section of the chapter, Section 4.5, reports upon a demonstration of the basic approach in an actual business situation using a surrogate dependent variable in the analysis.

4.2 Desired Characteristics of an Approach to Sales Forecasting

As discussed in Chapter III, it was generally true that the

forecasters interviewed in this study had "hard," or objective, data relating to total potential, and they were able to incorporate this information into their forecasts in a straightforward manner. On the other hand, the available information pertaining to market share and growth rate was more subjective and the forecasters experienced considerable difficulty incorporating this information into their new-product sales forecasts. It was also found that only five out of seventeen forecasters queried felt that total potential was the more difficult component of the sales forecast to derive. And only one of these five was actually making predictions of total potential, growth rate, and market share. The others either didn't predict growth rate and market share, or they used rules-of-thumb estimates for these predictions. Thus, of all the respondents predicting all three components of the sales forecast, only one felt that total potential was the most difficult component to estimate. Clearly these results are related. It is to be expected that a forecaster would have the least difficulty predicting that component of the forecast for which (1) he has good, objective information related to it and (2) the information can be readily incorporated into the sales forecast.

Based on the discussion in the previous paragraph, significant improvement in the development of sales forecasts for new industrial products can be achieved (1) by providing better information related to the growth rate and market share of the new product and (2) by providing a mechanism for the incorporation of this new information (and already existing information) into the sales forecast. Item (1) is discussed in detail in Section 4.3; for now, attention will be focused on item (2), since two other findings from the interviews bear

on this issue of the incorporation of information into the sales forecast.

First, it was learned in this research that a formal model was used in only three of nineteen sales forecasting processes studied. The remaining sixteen processes were very unstructured and the respondent was unable to explain how he incorporated much of the information he had available to him into his sales forecast. Without such structure it is impossible for the forecaster to assess the relative importance of all the various pieces of information he has available and utilizes in the development of his forecast. Often, he is even unable to specify which information is related to a particular component of the forecast and which is not. Any approach which would be able to define clearly how information is to be incorporated into the forecast, and which would provide a mechanism for the assessment of the efficacy of the various pieces of information, would be viewed as an improvement by the forecasters interviewed.

Second, in the last chapter it was shown that three of the respondents interviewed had used a sales forecasting approach which was basically dissimilar from the approaches used by the remaining respondents. The difference was that these three had developed their forecasts on a disaggregated basis, that is, rather than making estimates for total potential, growth rate, or market share for the entire market, these respondents segmented their market into many segments (in one case on an individual customer basis) and then made their various estimates of total potential, growth rate, and market share for each market segment. The advantages associated with this approach to the development of the sales forecast were enunciated well

by two of the three respondents who had used this approach. Several different advantages were mentioned.

Respondent W_1 felt that the primary advantage of such an approach was that a strategic plan for the development of a marketing strategy was easier and more complete if the market forecast had been developed on an account-by-account or segment-by-segment basis since the peculiar opportunities or problems inherent in each account or segment were more readily identified. Thus, the marketing strategy could be tailored to meet each of these individual needs or opportunities.

But another of the three respondents, Respondent L_1, felt that the use of a disaggregated approach had even more immediate returns. In his words, "This additional disaggregation permitted a much more thorough market analysis." This statement was based on a comparison of a forecast developed on the basis of 88 market segments to an earlier forecast developed on the basis of 4 market segments. Both of these forecasts were for the same new product marketed to the same overall market. Therefore this respondent was in an unusual position to compare a basically aggregated approach to a basically disaggregated approach. The following are quotations from him outlining the advantages of the disaggregated approach:

> The many segments into which the (new product) market has been broken down allows a much more thorough analysis of the market to be performed. Because each segment can be analyzed individually and not combined with other segments, a more valid forecast results.
>
> . . .
>
> Such a disaggregation is important because the advantages of, acceptability of, and willingness to pay for an (new product)

> will undoubtedly weigh more heavily in one vocation than in another.
>
> . . .
>
> One great advantage of this system is that it makes it virtually impossible to start with a preconceived idea of what the sales volume should be in any one year and manipulate the ratings to achieve the desired results.

To summarize, if an approach to forecasting the sales of new industrial products is to be developed which answers the needs of the respondents in this study, it must (1) possess an explicit, well-defined structure, (2) consider each customer or market segment individually, and (3) provide a means for not only identifying the relevant information pertaining to the new product's potential success but also for incorporating this information into the sales forecast.

Three areas of research offer some insight into the problem outlined in the previous paragraph. These areas are:

1. Model building research
2. Industrial buying behavior research
3. Adoption and diffusion research

The next section of this chapter will briefly review each of these areas and some of their relevant findings.

4.3 Literature Review

Each of the three areas of research mentioned in the previous section will be briefly reviewed with an emphasis on those findings which are relevant to the problem of developing sales forecasts for new industrial products. A summary section will integrate these various findings to relate them to the specific findings of this research detailed in the previous section of this chapter.

4.3.1 Model building research

Lippitt [16] considers the problem of the explicit integration of information into the sales forecast. He feels that this is the task of a formal model and makes the following statement about the value of such a model [16, p. 92]:

> More than for established products, the forecasting of sales of new products is dependent upon rapid accumulation and analysis of a wide range of causal data and upon effectively relating company plans to sales forecasts. Under such conditions, the contribution of an explicit model of the market can be great. A logical model showing the causal or analytical factors and the chains of relation between them can indicate what data inputs should be secured and can provide a framework within which information can be assimilated and used quickly and effectively.

Montgomery and Urban [22, p. 8] have described the methodology of management science as follows:

> In management science this methodology begins with a model to define and describe the problem (steps 1 and 2). Next the relationships within the model and the input to the model are specified and measured (step 3). A solution to the model or a specification of the explicit relationships necessary for understanding the problem is found by the application of a solution technique (step 4). The final steps in the approach are to validate the solution and model (steps 5, 6, and 7).

This approach has been applied to many marketing problems including the new-product sales forecasting problem. Both Bass [83] and Burger [36] have developed models which are applicable to new-product sales forecasting. Unfortunately, they are macro models--that is, they are models which examine the whole market and relevant factors within the whole market. Kotler [2, p. 320] has suggested that a micro-analytic demand model would be preferable and has defined such a model as:

> . . . a model which specifies the intervening behavioral variables and sequences occurring between the reception of stimuli and its crystallization in action. Here interest centers in explicating exactly what transpires when customers are exposed to particular marketing and environmental stimuli.

Such a model assumes that there are customers or market segments which can be identified and analyzed independently. The important feature of such a model is that it defines the behavioral variables and uses them in the analysis. It is apparent that such a model would be a better vehicle for studying customer characteristics, producers' actions, and competitive interactions than would a macro model. It also meets the respondents' expressed needs for structure and disaggregation.

4.3.2 Industrial buying behavior research

Researchers in the area of industrial buying behavior are striving to develop general concepts concerning the actions of industrial buyers. Kornhauser and Lazarsfeld [52, p. 4] have expressed the importance of such research as it relates to market research:

> We suggest simply that a systematic view of how people's market behavior is motivated, how buying decisions are arrived at, constitutes a valuable aid in finding one's way around midst the thousand and one questions of specific procedures and interpretations in market research.

Developing such behavioral concepts is useful because they provide an analytical structure for determining what information should be gathered and a framework for interpreting the results of research. The concepts can also suggest those relationships among variables that are likely to be most significant in a given situation.

Unfortunately, most buyer behavior research has considered consumer purchase decisions rather than industrial buying behavior. Frederick Webster in an appraisal of the state-of-the-art [24, p. 255] states:

> There are relatively few academic researchers working in the industrial buying behavior area. The most significant result in recent years was the publication of the Marketing Science Institute study, which was based on observation of buying decisions in three companies [25]. This rather limited data base was supplemented by analysis of a fourth company's buying decisions with special attention to the question of "source Loyalty" [90].

He then goes on to describe several other studies and concludes [74, p. 256]:

> What does all this sum to? Most of the studies referred to are exploratory in nature. The principal methodology has been the unstructured interview, and self-reporting, with the usual problems of bias and general lack of rigor. While these are necessary first steps, they add up to something less than a reasonably comprehensive theory of industrial buyer behavior.

Recently, however, some researchers in the field of industrial buyer behavior have become interested in the diffusion of innovations in industrial markets. This approach to the study of industrial buyer behavior has resulted in significant findings directly relevant to the problem of forecasting the sales of new industrial products.

4.3.3 Adoption and diffusion research

Webster [88, pp. 1 and 2] has described the general notions of adoption and diffusion as follows:

> Diffusion is the social process by which an innovation spreads through a social system over time. Diffusion reflects a series of adoption decisions by individual units (persons, farms, households, firms, etc.) within the social system. Thus, adoption is an individual decision-making process and since adoption requires change there is risk-taking involved in the decision to adopt.
>
> . . .
>
> As a form of risk taking, adoption decisions reflect the individual decision making unit's analysis of the relative advantage and benefits to be derived from the innovation compared with alternative courses of action including, most obviously, maintaining the status quo.

. . .

> To assess the degree of risk, the adopter may rely upon information from earlier adopters as well as from change agents. Communication among adopters is therefore an important ingredient in the diffusion. Communication and diffusion processes are therefore intimately related, the former emphasizing information flows and the latter emphasizing the results of individual decision making but both describing essentially the same process.

It is possible to identify two research traditions concerning the diffusion process in industrial markets: one emphasizes the results and the other emphasizes the process [88]. It is the results-oriented research which is most relevant to the sales forecasting problem.

Results-oriented research is concerned with developing relationships among characteristics of the firm, the product, and the environment and the time or rate of adoption. Some of the relationships found to be significant in these studies are:

1. Rate of return. Mansfield [58] found a relation between the rate of return to be gained by incorporating the innovation in the firm and the intrafirm rate of diffusion. He also found [60] that this factor is inversely related to the time for adoption.
2. Incremental revenues, costs, and profits. Enos [44] proposed that the rate of technological progress in an industry could be measured by estimating the incremental revenues, costs and profits attributable to the innovations.
3. Relative advantage. Webster [77, p. 37] feels that ". . . the decision to adopt an innovation is motivated by a search for relative advantage." He defines relative

advantage as ". . . the incremental profit that will be realized from the innovation, compared to the available alternatives." This advantage can occur through an increase in revenues, a decrease in costs, or some combination of both.

These three factors all relate to the economic benefits to be gained by adopting the new product. The next several factors relate to the risk perceived by the adopting firm. Cunningham [41, p. 84] describes this perceived risk as ". . . the perceived certainty of a given event happening and the consequences involved if the event should happen."

4. Size of investment. The necessary amount of investment to adopt the innovation was found to be inversely related to the rate of imitation by Mansfield [62]. Brozen [35] also concluded that the cost of changing over could affect the rate of diffusion of an innovation.
5. Time before adoption. The intrafirm rate of diffusion is increased as the time before adoption increases. Mansfield [58] felt this relationship held because the risk involved in the adoption decision decreased with time. More firms would have adopted and more information would have been obtained if the firm waited before adopting.
6. Information provided by selling firm. Webster [77, p. 38] contends that ". . . the probability that an individual firm will adopt an innovation during a given period of time is influenced by the amount, quality, and value of

the information available."

The last three factors relate to the amount of risk the adopting firm perceives in the adoption decision. Several factors which research has found to be important in the decision to adopt relate to the adopting firm's ability to tolerate risk.

7. Size of firm. Mansfield in two separate studies [58 and 60] found that the size of the firm was inversely related to the time before adoption and to the intrafirm rate of diffusion. The larger firm is better able to tolerate risk and, therefore, adopts earlier than the smaller firm. On the other hand, the rate of diffusion within the smaller firm will be more rapid than within the larger firm.

8. Total assets, predicted revenue growth, and debt-to-equity ratio. Webster [88] in a study of the airlines found these three factors to be related to the time before adoption. Each of these gives some indication of the firm's financial strength which, intuitively at least, would be related to the firm's ability to tolerate risk.

9. Liquidity. As a firm's liquidity increases so does its risk tolerance. Accordingly, it is not surprising that liquidity has been found to be directly related to the intrafirm rate of diffusion [58] and to the decision to adopt.

10. Aggressive or self-confident management. Webster [78] feels that this characteristic of management should have a direct bearing on the firm's attitude toward risk.

Sutherland's [71] finding that adopters tend to be aggressive and interested in intangible benefits and that non-adopters tend to be pessimistic lends support to this also.

The last several factors which have been found to be related to the adoption decision describe in some way the environment into which the innovation is introduced.

11. Vertical versus horizontal integration. Sutherland [71] discovered a relationship between the organizational structure of the adopting firm and the speed with which it adopted; vertically integrated firms have a tendency to adopt before horizontally integrated firms.

12. Technical progressiveness. Carter and Williams [39] developed a series of measures which were designed to assist a firm in assessing its relative degree of technical progressiveness, which is an indication of the firm's propensity and ability to introduce new products. The usefulness of this measure is that it is closely associated with a firm's rate of internal, new-product development.

13. Rate of internal, new-product development. Webster [78] concludes that firms doing more new-product development than other firms in their industry also spend a greater amount of time evaluating new products introduced by their suppliers. Accordingly, one would also expect these firms to be the earlier adopters.

14. Internal capability for evaluating new products. Webster

[78] found a relationship between this capability and the adoption decision. It seems reasonable that such a relationship would exist since the capability is an indication of the technical progressiveness of the firm. In addition, firms with a good capability for evaluating new products should be able to facilitate the new-product adoption decision process.

15. Extent and urgency of need. Brozen [35] concluded that although an invention may be economic for some resource patterns, it will not be applied unless it fits the pattern of relative scarcities in the world in which it finds itself.

Although this exhausts the factors which have been found to be related to the adoption decision, additional insights have been gained by researchers in this field which can be helpful in attacking the problem described earlier. The most significant of these findings is that ". . . the characteristics of an innovation which influence its rate of diffusion seem to apply equally to its rate of adoption" [89, p. 15]. Mansfield [62] reached a similar conclusion based on his research.

There is another important series of findings relating to the time for the adoption process. Rogers [26, p. 120] has summarized these as follows:

> The first individuals to adopt innovations require a shorter adoption period than do relatively later adopters. The portion of the adoption period from awareness to trial is longer than from trial to adoption. The awareness-to-trial period is shorter for relatively earlier adopters than for later adopters; however, the trial-to-adoption period is longer for relatively earlier

adopters than for later adopters. Earlier adopters try innovations on a smaller scale than later adopters.

The applicability of the research in the three areas discussed here to the problem of new-product sales forecasting is apparent. What still remains, however, is to integrate these various findings in such a way that they can be useful to those persons who have the responsibility of making sales forecasts for new industrial products.

4.3.4 Integration of research results

Earlier in this chapter it was concluded that an approach to forecasting the sales of new industrial products which meets the needs of the respondents in this study must (1) provide a means for identifying or generating relevant information pertaining to the new product's success, (2) use an explicit, well-defined structure to incorporate this information into the sales forecast, and (3) consider each customer or market segment individually. Let us examine the research results presented in the last three subsections of this chapter in the light of these expressed needs of the respondents.

Utilizing the techniques of model building in the development of a forecasting approach would certainly meet the need for an explicit, well-defined structure. Also, a well-defined structure will facilitate the incorporation of any information relevant to the problem. And if the model were a micro-analytic model, as defined by Kotler, the forecasts would be developed on a disaggregated basis, as desired by the respondents. Thus, the utilization of a micro-analytic model with a well-defined structure would meet the needs of the respondents with respect to (1) the incorporation of information into

a well-defined structure and (2) disaggregation. What remains is the generation and identification of the information for inclusion in such a model.

The results of industrial buying behavior research and adoption and diffusion research provide variables for inclusion in a model and guidelines for the generation of additional variables. A review of the results presented for both of these research areas shows that some of the variables found to be related to the adoption decision are variables about which the introducing firm already possesses extensive knowledge. For example, a firm considering the introduction of a new industrial product is likely to have extensive information about such variables as the relative advantage of the product to the customer, the size of the investment necessary to adopt the new product, the information provided by the selling firm, the size of the customer firm, etc. However, some of the variables found to be related to the adoption decision are not the type which one would expect to find in a firm's traditional data files. Some of these are the technical progressiveness of the customer, the internal capability of the customer for the evaluation of new products, characteristics of the customer's management, etc. Although one would not expect information on these types of variables to be readily available in the typical industrial firm, the nature of the variables does suggest a means for generating such information.

In Chapter I it was suggested that:

> . . . one important reason for possibly using a different forecasting approach for industrial products than for consumer products is that the sales of industrial goods are often made direct to the consumer of the product. . . . When goods are sold direct the firm has extensive information about their customers.

Actually, the firm may not have extensive information about its customers, but the firm's salesmen do. This researcher maintains that industrial goods salesmen have extensive knowledge of their customers. Unfortunately, this knowledge has not been utilized to the fullest extent. Historically, if a salesman were expected to have information about a customer's propensity to buy a new product, the salesman would be asked if the customer were going to buy. Asking the salesman to make this assessment assumes that he not only has knowledge pertaining to the customer's purchase decision, but also that the salesman has a "model" with which he can process all of the relevant information he possesses about the customer. Why not, instead, ask the salesman questions directly related to his knowledge of his customers?

In the next section an approach to the development of sales forecasts for new industrial products is described which makes an explicit separation between obtaining information and processing information.

4.4 An Approach to the Development of Sales Forecasts

Basically, it is suggested here that an approach to forecasting the sales of new industrial products which meets the expressed needs of the respondents in this study would be one in which information, both already existing in the firm's data files and available from the firm's salesmen, is incorporated into an explicit, well-defined model. One such approach has been proposed by Root and Klompmaker [87].

An approach of this type treats the various components, or

parameters, of the sales forecast--such as the growth rate--as the dependent variables, and the data available in the firm's files or obtainable from the firm's salesmen as the independent, or predictor, variables. On the basis of previous new-product introductions, or on the basis of experience gained from a test market, relationships between the dependent variables and the independent variables are established. In this step it is determined whether, in fact, a relationship exists between each of the independent variables and each of the dependent variables, and, if so, the nature--in a mathematical sense--of the relationship. If the data analysis shows that no significant relationship exists between a particular independent variable and a particular dependent variable, then the predictor is irrelevant for the purpose of predicting the dependent variable. Conversely, the existence of a relationship establishes both the relevance of the predictor variable and its relative importance when compared to the other predictor variables.

After the relationships between the independent and dependent variables have been established for a test market situation, or for a previous new-product introduction, these same relationships can be used to predict the results of either a full-scale commercialization, or another new-product introduction to the same market. Values for the various independent variables are obtained from the firm's data files or from the firm's salesmen and inserted into the mathematical equations which express the various relationships between the predictor variables and the dependent variables. The solution of these equations yields the values for each of the dependent variables which are the components, or parameters, of the sales forecast for the new

product.

In summary, information from the firm's files or from its salesmen about an earlier new-product introduction, or about a test market, is used to develop a series of predictor variables. The dependent variables are the values of the components of the sales curves obtained in the earlier new-product introduction, or in the test market. Once an analysis of the data has revealed which of the predictor variables are relevant, and the nature of the relationships between the relevant independent variables and the dependent variables, the sales forecast can be developed. Insertion of new values, which have once again been obtained from the firm's files or salesmen, for the predictor variables into the mathematical expressions of the relationships determined previously will yield the values for the components of the sales forecast.

Unfortunately, because firms do not use such an approach to develop their forecasts, the data on the dependent variables needed to test this approach are not available. However, it is possible to demonstrate that subjective information from a firm's data files and from its salesmen is useful in predicting a surrogate variable, one closely related to the components of a sales forecast. The remainder of this chapter will describe one such demonstration.

4.5 Demonstration of the Basic Approach in an Actual Business Situation

4.5.1 Description of the test environment

The company which participated in this phase of the study, Respondent J_1's firm, is one of Fortune's 500 and it is known for its

past successes in developing and introducing new products, both consumer and industrial. The division of the company which was responsible for the development and the introduction of this particular new product had well over 40,000 industrial customers for its product line. This particular product though was designed for only their largest customers.

The company maintained a data file on each of its over 40,000 customers which included information such as the names of the key personnel in the customer's organization; the production methods employed; the number, size, and types of production equipment; and the extent of the usage of every product the firm offered. This file was updated continuously by both marketing and sales people. With the aid of this data file, it was possible to isolate the approximately 200 customers who were potential users of this new product.

Other than trial runs with selected customers in various parts of the country, the new product was not introduced to the market until June 24, 1971. On this day, a premiere showing of the new product was made to approximately 35 potential customers in the Chicago area. Subsequent to that showing, the product was introduced to the market across the country by the sales force of this division of the company. The receipt of orders for the new product was carefully monitored by the marketing group in division headquarters.

Because the date of introduction to the customers in the Chicago area was established, it was possible to tell how much time had passed between the date of introduction and the date of the original purchase which is termed the time before adoption. Unfortunately, it was not possible to determine the time of introduction

for any of the accounts outside Chicago since none of the other accounts were introduced to the product in the way that it was done in Chicago and since the salesmen had not kept a record of the date on which they had introduced each of their customers to the new product. Moreover, the growth rate could not be determined for any of the accounts, either in or outside of Chicago, since it normally takes a considerable period of time for an innovation in this industry to gain general acceptance.

Since it was not possible to use either the time before adoption or the growth rate, both of which are components of a sales forecast, as the dependent variable for the aforementioned reasons, a surrogate dependent variable was chosen. The variable chosen was a dichotomous variable--whether the customer had tried the product. This information was available from sales records.

4.5.2 Collection of the data-- the dependent variable

Information was obtained on 35 customer accounts, 12 of these accounts were covered by sales branches other than Chicago and 23 were covered by the Chicago salesmen. A customer was assigned a value on the dependent variable of 1 if they had purchased an initial quantity of the new product, and a 0 if they had not. The initial analysis was done on the data from the 23 Chicago accounts to establish the relationships that existed between the dependent variable and the appropriate independent variables. These relationships were then used to predict which of the 12 accounts outside Chicago would or would not try the product. The validity of the predictions was easily determined since it was already known which of these 12

accounts had tried and which of them had not.

Of the 23 Chicago accounts, only 6 had purchased an initial order. In other words, over 70% of the accounts in the "test market" had decided at that point to hold off buying the initial order. On the other hand, 6 of the 12 accounts outside of Chicago had purchased an initial order or, put another way, only 50% had not yet purchased their initial quantity of the new product. This difference in the acceptance of the product was very important in this test of the model because it negated the possibility of using a naive forecasting model for prediction purposes. This will be discussed in greater detail in a later section of this chapter.

4.5.3 Collection of the data-- the predictor variables

The predictor variables were derived from two separate sources. The first of these sources was the data file which the marketing department maintained on each of its customers. The following four variables were developed from this data source:

1. The maximum total annual potential (in thousands of dollars) of the new product which a customer could use.
2. The total annual volume (in thousands of dollars) of purchases by a customer of the products this firm produces. (This number included any of the products which the customer purchased from competition also.)
3. The percentage share of the total annual volume of purchases of a customer which the firm enjoyed.
4. The maximum total annual potential of the new product for a customer expressed as a percentage of the customer's

total annual volume of purchases. (This is variable 1 divided by variable 2 multiplied by 100.)

Each of these variables is ratio scaled as defined by Green [11]. Because of this high level of scaling, these four variables did not restrict the choice of a data analysis tool.

In addition to their attractive scaling properties, these four variables also were included in the analysis because of their close association with other variables found to be significant in earlier adoption and diffusion research. For example, variable number two above, total annual volume of purchases, has a close relation to the size of the firm which Mansfield found to be significant in two separate studies [58 and 60]. Variables one and four above both relate to the importance of the adoption decision to the customer's firm. Variable one is a measure of this importance in an absolute sense and variable four is a measure of this importance in a relative sense. Both of these then would be expected to relate to the severity of the negative consequences associated with a wrong decision. As pointed out earlier, these negative consequences are simply a component of perceived risk which is directly related to the adoption decision. Lastly, variable three, the firm's percentage share of the customer's annual volume of purchases, is an indication of the customer's trust in, and reliance upon, the producing firm. If this percentage is high, one would expect more trust and reliance on the part of the customer with regard to the firm's products than if this percentage were low. Furthermore, this manifestation of trust would be expected to have a close association with the risk perceived by the customer in the adoption decision. Thus, all four variables which

were developed from the marketing department's data file had both a high level of scaling and a close association with previous findings of new-product adoption studies.

The second source which was used to develop the predictor variables for the data analysis was the firm's salesmen, i.e., those people in the introducing firm's organization who were closest to and, therefore, the most knowledgeable about the dynamics of the adoption process for this new product. One of the basic assumptions of this research was that a firm possesses a considerable amount of information about the potential success or failure of each of its new-product introductions. Specifically, it has information about the characteristics of each of the potential customers of the new product, information about how this new product will fit in with each customer's existing operations, and why the product offering might be more or less attractive to each of several potential customers. This is particularly so for the industrial goods marketer since he often sells his product direct to the customer. In the case of this particular product, each salesman personally contacted the customer so each salesman would be expected to have a great deal of information about, and insight into, each customer for which he was responsible.

In order to tap this reservoir of information, it was necessary to develop a means whereby the data could be gathered from several different salesmen about many different customers in many different locations. Also, the information would have to be comparable from salesman to salesman or it would not be adequate for data analysis.

As a first step in gathering this information, the researcher arranged a luncheon meeting with the Chicago branch salesmen. Also

present were the Chicago branch Sales Manager and a representative from the division's marketing group. The researcher explained to the group that, as a part of his research, he was interested in determining those factors in the marketplace which these six salesmen felt were critical to the success or failure of this particular new product. The meeting was held November 30, 1971. The discussion ranged widely and the salesmen exhibited little reticence in airing their opinions. (A copy of the typed notes from this meeting with certain information blocked out is shown as Appendix II.)

Based on the interview and information gained from earlier studies on the adoption process for new products, the questionnaire shown in Figure 4-1 was developed. This questionnaire was sent to the salesmen responsible for the 23 Chicago accounts and the 12 accounts outside of Chicago referred to earlier in this chapter. The completed questionnaire thus yielded an additional 16 predictor variables to be used in the data analysis.

It was necessary to convert the responses to the questionnaires into numerical data to be able to use conventional data analysis tools. For the first 13 questions shown in Figure 4-1, a response of "Strongly agree" was assigned a score of 5 and a response of "Strongly disagree" was assigned a score of 1. The responses between these two extremes were appropriately assigned values of 2, 3 or 4. These scales were then assumed to be intervally scaled for purposes of data analysis.

Each of these questions was worded in such a manner that a high score on the question would be expected to relate to a propensity to adopt the new product and vice versa. The same thing is true of the four predictor variables developed from the customer data file

Figure 4-1.--Questionnaire Used to Obtain Information from Salesmen

_____ Survey

Account name _____ Branch name _____

Circle the description which most suits your feeling about each of the following statements about this account?

1. My relationship with them is good.
   Strongly agree | Agree | Undecided | Disagree | Strongly disagree

2. They will work with me on something new.
   Strongly agree | Agree | Undecided | Disagree | Strongly disagree

3. They will do me a favor when I need it.
   Strongly agree | Agree | Undecided | Disagree | Strongly disagree

4. New product introductions to them by _____ have gone well.
   Strongly agree | Agree | Undecided | Disagree | Strongly disagree

5. They are willing to try new products by _____.
   Strongly agree | Agree | Undecided | Disagree | Strongly disagree

6. Their _____ presses are in good condition.
   Strongly agree | Agree | Undecided | Disagree | Strongly disagree

7. Their pressmen on the _____ presses are better than average.
   Strongly agree | Agree | Undecided | Disagree | Strongly disagree

8. Their _____ problems are minor.
   Strongly agree | Agree | Undecided | Disagree | Strongly disagree

9. They like to try new approaches to _____.
   Strongly agree | Agree | Undecided | Disagree | Strongly disagree

Figure 4-1.--Continued.

10. They are interested in other aspects of new products besides the cost saving features.
    Strongly agree | Agree | Undecided | Disagree | Strongly disagree

11. Their management is aggressive.
    Strongly agree | Agree | Undecided | Disagree | Strongly disagree

12. They do a good job of evaluating products.
    Strongly agree | Agree | Undecided | Disagree | Strongly disagree

13. They are known as a quality _____ shop.
    Strongly agree | Agree | Undecided | Disagree | Strongly disagree

Please answer the following questions in the spaces provided.

1. What percent of their _____ press business could use the new _____?

   _____

2. During periods when business is normal, how many times per week will they change _____ on each _____ of their _____ presses?

   _____

3. Do they have their own _____ equipment?

   _____

which were described in the previous section of this chapter.

Questions 1 and 2 of the second section of the questionnaire did not require a similar coding scheme as the 13 questions in the first section of the questionnaire. They, like the four predictor variables developed from the customer data file, were already numerical and were ratio scaled. No problem existed, therefore, with their incorporation into any of the available data analysis techniques.

The third question of the second section of the questionnaire was similar to the dependent variable in that it was a dichotomous variable. The response was either a Yes or a No. Although this variable is definitely nominally scaled, treating it as a dummy variable as suggested by Lansing and Morgan [15] makes it possible to use the variable with techniques such as regression analysis and discriminant analysis which require intervally scaled predictor variables. For this reason then, the responses to this question were assigned a value of 1 if they were "Yes" and a value of 0 if they were "No," which is what Lansing and Morgan suggest. The variable was then treated as an interval scale.

4.5.4 Data analysis strategy

The discriminant analysis model has been succinctly described by Maxwell [63, p. 259]:

> Let us assume that the members of a population can be classified into k exhaustive and mutually exclusive groups or categories. Let us further assume that a random sample from each of these groups is drawn and that, for each individual, measurements on p normally distributed variates, x_1 to x_p are obtained. The problem is to find a linear function, or orthogonal linear functions, of the variates which will best discriminate between the groups. The functions will be of the form where the w's are weights which have to be determined.

$$f(x) = w_1x_1 + w_2x_2 + \ldots + w_px_p \qquad (4.1)$$

Looking at Maxwell's description of discriminant analysis from the standpoint of this particular data analysis, the k exhaustive and mutually exclusive groups are the two groups into which the 23 Chicago area customers were classified: 17 non-triers and 6 triers. The p normally distributed variates are the 20 predictor variables described in the two previous sections of this chapter.

Even though discriminant analysis was the technique chosen for this data analysis, two other techniques were also considered. The first of these was regression analysis.

Although regression analysis is normally associated with continuous dependent variables, it is possible to use regression analysis when the dependent variable is dichotomous. Lansing and Morgan [15, p. 296] have described this technique:

> The most widely used method with a dichotomous dependent variable is to proceed as in an ordinary regression analysis. The calculated value of y is treated as a conditional probability, and the regression equation is referred to as a linear probability function.

There are two basic objections to the use of regression analysis for the analysis of this data. First, it is possible for the predicted scores of the dependent variable to fall outside the range from 0 to 1 using this approach. It should be apparent that any predicted score outside of this range is, at best, embarrassing and, at worst, absurd. The second objection to this approach is that the primary concern in this particular problem was not with the prediction of the probability of trial, it was to predict which potential customers would try and which would not. Lansing and Morgan [15, p. 300]

describe this difference between regression analysis and discriminant analysis by pointing out that ". . . in regression analysis the independent variables are regarded as fixed, while the dependent variable is regarded as fixed in discriminant analysis."

The second approach which might have been employed for the data analysis was multiple correlation analysis of the data. Here again, however, there is a basic difference between the two approaches. In the words of P. Justin Rulon [69, pp. 88 and 89]:

> The discriminant analysis does what the multiple correlation approach does not. It uses group membership as the criterion and makes all comparisons between groups and none within the groups.
>
> . . .
>
> Clearly the multiple correlation technique applied to one group ignores all the data from other groups. The multiple discriminant technique employs all the data from all the groups.
>
> . . .
>
> The fact of group membership is not entered into the data matrix for multiple correlation analysis, but the criterion score for goodness and badness is. In the multiple discriminant analysis it is the other way around. The criterion score is not entered in the data matrix but the fact of group membership is.

As Mr. Rulon has concluded elsewhere [70, p. 114] ". . . the Multiple Correlation Technique applied successively to different groups yields information not given by the Discriminant Function applied to all the groups, and vice versa."

Clearly then, discriminant analysis was the appropriate technique for the problem at hand. Both regression analysis and multiple correlation analysis are designed to answer questions which were not of primary interest in this particular case. It is well at this point, then, to further describe discriminant analysis since it

was the technique chosen.

The objective of a discriminant analysis is to classify objects, by a set of independent variables, into one of two or more mutually exclusive and exhaustive categories [65]. For clarity's sake, this description of discriminant analysis is limited to the two-group classification problem.

For notation, let:

x_{ij} be the value of the predictor variable j for the ith customer,

w_j be the discriminant coefficient for the jth variable,

z_i be the discriminant score for the ith customer,

$z_{crit.}$ be the value for the discriminant score.

Then the discriminant score z_i for the ith customer is a linear function of the independent variables:

$$z_i = w_0 + w_1x_{1i} + w_2x_{2i} + \ldots + w_nx_{ni} \qquad (4.2)$$

The classification procedure then is as follows:

if $z_i > z_{crit.}$, classify customer i as belonging to Group 1;

if $z_i < z_{crit.}$, classify customer i as belonging to Group 2.

In this case where there are two groups, the classification boundary, which defines the value of $z_{crit.}$, is a straight line.

The particular approach to discriminant analysis described above uses a single classification boundary to classify individual customers. If a particular customer's discriminant score, z, falls on one side of this boundary, he is assigned to Group 1 and he is assigned to Group 2 if his discriminant score falls on the opposite side of the classification boundary.

Another discriminant analysis algorithm calculates separate

linear functions for each group and then these functions serve as indices for classifying a particular customer into one of the given groups. The coefficients and a constant are computed for each of these linear discriminant functions, after which a probability associated with each discriminant function is computed for each customer. Each customer is then assigned to the group for which his probability is highest.

The discriminant analysis computer program chosen for this particular problem, BMD07M, uses this latter approach for classifying customers [3]. Mathematically, the approach employed in this program is the following:

The posterior probability of customer i having come from group m is:

$$P_{im} = \frac{\text{Exp}(S_{im})}{\text{Exp}(S_{i1}) + \text{Exp}(S_{i2})} \tag{4.3}$$

where

$$S_{im} = w_{om} + w_{1m}x_{1m} + w_{2m}x_{2m} + \ldots + w_{nm}x_{nm}. \tag{4.4}$$

This formulation is appropriate when the prior probability of belonging to either group is .5. However, when the prior probability is different for each group, the following formulation is used:

$$P_{im} = \frac{\text{Exp}(S_{im})p'_m}{\text{Exp}(S_{i1})p'_1 + \text{Exp}(S_{i2})p'_2} \tag{4.5}$$

where p'_m is the prior probability of belonging to group m.

Stepwise discriminant analysis is an approach to performing a discriminant analysis in which one variable is entered into the set of discriminating variables at each step of the analysis. With

BMD07M, which is a stepwise discriminant analysis program, the variable which is entered at each step is the variable with the largest F value [3]. It is also possible for a variable to be deleted if its F value becomes too low. This feature of BMD07M was particularly attractive for this analysis. First, since there were 20 predictor variables used in the analysis, it was desired to reduce this number in the discriminant functions which were to be used for prediction. Second, a stepwise analysis technique provides information to the researcher about the relative merits and importance of each predictor variable entered into the analysis. This was especially important in this case because the firm not only desired a technique which could be used for prediction purposes but also one which could be used to analyze and sort out the data the firm had about its customers, the new product, and the test market experience.

4.5.5 Results of the data analysis

Most of the options available to the user of computer program number BMD07M are irrelevant to this discussion of the results of this analysis. There is one option, however, which was employed and which deserves discussion.

It was pointed out in the previous section of this chapter that the formula which was used for the calculation of posterior probabilities is dependent upon the assumptions which the user is willing to make about the prior probabilities of group membership. This choice, in turn, affects the assignment of each individual case to one or the other groups since the assignment is made on the basis of the group for which the individual case has the highest posterior

probability. In other words, each individual customer in this instance was assigned to the group to which he most likely belonged.

The user of BMD07M has basically three assumptions which he can make about the prior probabilities of group membership:

1. He can assume equal probabilities.
2. He can assume that the prior probabilities are n_i/n.
3. He can assign the prior probabilities.

Since the only information which was available about the extent of group membership was that 17 out of 23 accounts in the Chicago region were non-triers, the second option was chosen. It certainly would have been inappropriate to assume that the probability of group membership was the same for both groups given that the ratio of non-triers to triers was 17:6. On the other hand, no other information was available which would have led the researcher to believe that the Chicago experience was atypical. If information of this nature had been available, then the third option would have been the appropriate choice. On this basis then, the prior probabilities which were used in the calculations for the posterior probabilities of group membership were 0.7391 for non-triers and 0.2609 for triers.

Table 4-1 is selected information from the output of computer program number BMD07M using the data from the market experience with the 23 Chicago area accounts. The 20 variables which were included as independent variables, the dependent variable which was used, and the program options which were chosen have all been described earlier in this chapter and require no further explanation. Only the first nine steps of the stepwise analysis are included in this table.

It should be noted that Table 4-1 does not include any of the

TABLE 4-1

OUTPUT FROM STEPWISE DISCRIMINANT ANALYSIS

STEP NUMBER: 1

VARIABLE ENTERED: PCTSHAR

DISCRIMINANT FUNCTIONS:

VARIABLE	NO TRY	TRY
PCTSHAR	0.02319	0.08292
CONSTANT:	-0.39277	-2.50117

NUMBER OF CASES CLASSIFIED INTO GROUP:

	NO TRY	TRY
NO TRY	16	1
TRY	4	2

* *

STEP NUMBER: 2

VARIABLE ENTERED: PCTSP

DISCRIMINANT FUNCTIONS:

VARIABLE	NO TRY	TRY
PCTSP	0.05548	0.03601
PCTSHAR	0.02153	0.08185
CONSTANT:	-1.78134	-3.08640

NUMBER OF CASES CLASSIFIED INTO GROUP:

	NO TRY	TRY
NO TRY	17	0
TRY	3	3

* *

STEP NUMBER: 3

VARIABLE ENTERED: VAR009

DISCRIMINANT FUNCTIONS:

TABLE 4-1.--Continued

VARIABLE	NO TRY	TRY
VAR009	5.42604	4.45904
PCTSP	0.18382	0.14149
PCTSHAR	-0.06565	0.01020
CONSTANT:	-12.80760	-10.53278

NUMBER OF CASES CLASSIFIED INTO GROUP:

	NO TRY	TRY
NO TRY	17	0
TRY	3	3

* *

STEP NUMBER: 4
VARIABLE ENTERED: VAR002
DISCRIMINANT FUNCTIONS:

VARIABLE	NO TRY	TRY
VAR002	2.55403	3.32395
VAR009	4.39752	3.12048
PCTSP	0.18246	0.13972
PCTSHAR	-0.08825	-0.01921
CONSTANT:	-15.12375	-14.45584

NUMBER OF CASES CLASSIFIED INTO GROUP:

	NO TRY	TRY
NO TRY	16	1
TRY	2	4

* *

STEP NUMBER: 5
VARIABLE ENTERED: VAR003
DISCRIMINANT FUNCTIONS:

TABLE 4-1.--Continued

VARIABLE	NO TRY	TRY
VAR002	-6.40556	-4.05757
VAR003	14.25346	11.74298
VAR009	7.61591	5.77200
PCTSP	0.31966	0.25275
PCTSHAR	-0.28458	-0.18096
CONSTANT:	-31.30656	-25.44006

NUMBER OF CASES CLASSIFIED INTO GROUP:

	NO TRY	TRY
NO TRY	17	0
TRY	3	3

* *

STEP NUMBER: 6

VARIABLE ENTERED: PCT77

DISCRIMINANT FUNCTIONS:

VARIABLE	NO TRY	TRY
VAR002	-7.05193	-4.47060
VAR003	12.77227	10.79650
VAR009	9.03742	6.68035
PCTSP	0.31532	0.24998
PCTSHAR	-0.21463	-0.13626
PCT77	0.11792	0.07535
CONSTANT:	-33.09032	-26.16841

NUMBER OF CASES CLASSIFIED INTO GROUP:

	NO TRY	TRY
NO TRY	16	1
TRY	1	5

* *

TABLE 4-1.--Continued

STEP NUMBER: 7

VARIABLE ENTERED: VAR012

DISCRIMINANT FUNCTIONS:

VARIABLE	NO TRY	TRY
VAR002	-5.61471	-2.73357
VAR003	12.95811	11.02110
VAR009	7.61958	4.96674
VAR012	3.93192	4.75213
PCTSP	0.28231	0.21008
PCTSHAR	-0.25144	-0.18076
PCT77	0.06354	0.00962
CONSTANT:	-37.91933	-33.22224

NUMBER OF CASES CLASSIFIED INTO GROUP:

	NO TRY	TRY
NO TRY	16	1
TRY	1	5

* *

STEP NUMBER: 8

VARIABLE ENTERED: VAR005

DISCRIMINANT FUNCTIONS:

VARIABLE	NO TRY	TRY
VAR002	-5.96725	-4.16808
VAR003	12.74480	10.15314
VAR005	0.61207	2.49055
VAR009	7.50296	4.49224
VAR012	4.04282	5.20340
PCTSP	0.27995	0.20050
PCTSHAR	-0.25057	-0.17721
PCT77	0.06354	0.00961
CONSTANT:	-37.94351	-33.62263

TABLE 4-1.--Continued

NUMBER OF CASES CLASSIFIED INTO GROUP:

	NO TRY	TRY
NO TRY	16	1
TRY	1	5

* *

STEP NUMBER: 9

VARIABLE ENTERED: OWNEQUIP

DISCRIMINANT FUNCTIONS:

VARIABLE	NO TRY	TRY
VAR002	-4.92078	-2.99989
VAR003	1.26755	-2.65913
VAR005	19.80373	23.91454
VAR009	0.27013	-3.58191
VAR012	12.46635	14.60674
PCTSP	0.35147	0.28034
OWNEQUIP	62.57797	69.85692
PCTSHAR	-0.28450	-0.21509
PCT77	0.29184	0.26448
CONSTANT:	-89.56982	-97.95760

NUMBER OF CASES CLASSIFIED INTO GROUP:

	NO TRY	TRY
NO TRY	16	1
TRY	1	5

statistics, such as an F statistic, which are part of the output of BMD07M. This information was not included in the table because it was irrelevant to this data analysis. These statistics are used to indicate the probability that a particular result could be obtained from a sample taken from a population with hypothesized characteristics. In other words, they are useful when one is trying to draw conclusions about a population based upon information from a sample which was taken from that population. This was not the situation in this particular case. The 23 Chicago area accounts were the population; they were not a sample taken from some larger population. They were the test market as it was defined in this problem. The purpose of the data analysis was to learn something about this population; it was not whether some generalization about a larger population could be made based on the analysis. It was assumed that the relationships which were observed in the test market would also be true of other parts of the total market. But the test of this assumption was not the level of significance of a statistic; it was instead the predictive ability inherent in these relationships. That is, the relationships observed in the introduction of the product to the 23 Chicago area accounts would be assumed to be generalizable if they enabled one to predict which of the remaining 12 accounts would or would not try the new product. If such a prediction was not possible, then the relationships observed in the Chicago experience would be assumed to be situation specific and largely irrelevant for further market planning purposes. Tests of significance do not answer that kind of question.

A second point which should be noted about Table 4-1 is that it includes only information about the first nine steps in the data

analysis. This also was done because the remaining information was irrelevant. A word of explanation about this is required.

Since the primary purpose of the discriminant function was prediction, the criterion employed by the researcher for choosing the appropriate discriminant function was its ability to classify individual cases properly. The matrix included in each of the nine steps covered by Table 4-1 and entitled, "Number of Cases Classified into Groups," gives this information by showing which of the 17 non-triers, labeled NO TRY in Table 4-1, would be classified as non-triers by the discriminant function obtained in that specific step and which of the 6 triers would be classified as triers. For example, the matrix for step number one in Table 4-1 shows the following:

	NO TRY	TRY
NO TRY	16	1
TRY	4	2

This illustrates the fact that of the 17 accounts which were known to have not tried the new product, 16 would be classified as non-triers and 1 would be classified as a trier by the discriminant function which includes only the variable with code name PCTSHAR and a constant term. Similarly this discriminant function, which appears in Table 4-1 just above the matrix referred to, would classify 4 of the 6 known triers as non-triers and 2 as triers. This means, then, that any cases classified into the upper right-hand or lower left-hand cells of any of these matrices, commonly referred to as confusion matrices, are incorrectly classified. The intent was to find that discriminant function which minimized the number of cases classified "off-the-diagonal."

The reader will note that after step number one, 5 cases were misclassified; after each of steps two, three, four and five, 3 were misclassified; and after step six, 2 were misclassified. It was not until step number nineteen that this was reduced to one misclassification and the discriminant function was never able to do better than one misclassification. Based on these results, it was decided that the "best" discriminant function from both the standpoint of (1) its ability to classify specific cases properly and (2) its ability to classify cases with a minimum number of included predictor variables was the discriminant function obtained in step number six.

Since Table 4-1 shows only the coded names for each of the six variables included in the discriminant function selected, the reader is referred to Table 4-2 for an explanation of each of these predictor variables and their source.

4.5.6 Calculation of posterior probabilities and assignment to groups

Once the appropriate discriminant function had been selected, it was necessary to calculate the posterior probabilities of group membership for each of the 12 accounts outside of Chicago and then classify these 12 accounts according to their probabilities of group membership. Since it had been decided that the appropriate prior probabilities for this analysis were n_i/n, the appropriate formula for the calculation of the posterior probabilities was equation 4.5. To facilitate the calculations required in the application of this equation to each of the 12 cases, an APL computer program was written. The results of the calculations using this program are shown in Table 4-3. These probabilities were then used to assign each of these

TABLE 4-2

THE PREDICTOR VARIABLES BY CODE NAME AND SOURCE

Code name	Description	Source
VAR001	Relationship with customer.	Question 1 of survey
VAR002	Will work on something new.	Question 2 of survey
VAR003	Will do me a favor.	Question 3 of survey
VAR004	Successful new product introductions.	Question 4 of survey
VAR005	Will try new products.	Question 5 of survey
VAR006	Presses in good condition.	Question 6 of survey
VAR007	Pressmen better than average.	Question 7 of survey
VAR008	Minor production problems.	Question 8 of survey
VAR009	Like to try new approaches.	Question 9 of survey
VAR010	Interested in more than cost savings.	Question 10 of survey
VAR011	Management is aggressive.	Question 11 of survey
VAR012	Do a good job of new-product evaluation.	Question 12 of survey
VAR013	Known as a quality shop.	Question 13 of survey
PCTSP	% of business potential for new product.	Question 1, Section 2 of survey
CHANGES	Plate changes per week.	Question 2, Section 2 of survey
OWNEQUIP	Do they own certain equipment?	Question 3, Section 2 of survey
PLATPOT	Potential for new product in $.	Customer data file
TOTALBUS	Total business in $.	Customer data file
PCTSHAR	% of business for this company.	Customer data file
PCT77	% of business for new product.	Customer data file

TABLE 4-3

POSTERIOR PROBABILITIES OF GROUP MEMBERSHIP
FOR 12 ACCOUNTS OUTSIDE CHICAGO

Account No.	Posterior Probabilities	
	NO TRY	TRY
1	0.996	0.004
2	0.131	0.869
3	0.634	0.366
4	0.811	0.189
5	0.004	0.996
6	0.719	0.281
7	0.352	0.648
8	0.832	0.168
9	0.499	0.501
10	0.999	0.001
11	0.240	0.760
12	0.424	0.576

12 accounts to either the non-trier or trier categories. The account was assigned to the group with the highest probability. For example, account number 6 was assigned to the NO TRY group. Since it was already known which of these 12 accounts were triers and which were not, it was a simple matter to construct the "confusion" matrix shown in Figure 4-2.

The reader now has the results of the data analysis and the predictive ability of the derived discriminant function. It still needs to be shown, however, the value of these results; that is, are these results good or bad.

		Classification from discriminant function	
		NO TRY	TRY
Actual	NO TRY	4	2
Classification	TRY	2	4

Figure 4-2.--Classification of 12 Accounts

4.5.7 Discussion of results

The most important result obtained from this application of the proposed model is that it was able in this case to correctly classify 8 out of the 12 customers of interest. Whether or not this prediction is "good," however, is dependent upon what other predictions might have been made and also upon what would have been expected on the basis of pure chance. Both of these issues deserve further examination.

Given that the test market had 17 non-triers and 6 triers, two different naive prediction models could have been used to predict the results of marketing the product to the 12 accounts outside of Chicago. One approach to prediction could have been to simply predict that all 12 would be non-triers since there were more non-triers than triers in the test market. There are two things wrong with this approach. First, it would have misclassified 6 of the 12 accounts whereas the proposed model only misclassified 4 of the accounts. So in this case it would have resulted in a poorer prediction. Second, with this approach the forecaster is forced to predict either total acceptance or total rejection of the new product. Certainly neither

of these projections would have any foundation based on previous experiences with most other new products. Also, such projections would be virtually useless for many marketing decisions. For example, it could only be used for a go-no go type decision and could not be used in a sales forecasting decision. Nor could it be used for salescall planning decisions or salesmen evaluation decisions since it does not distinguish between the various accounts; all are considered triers or all are considered non-triers.

The second approach could have been to predict that (6/23)(12) of the accounts would try and that (17/23)(12) of the accounts would not try. This would yield a prediction of 3.1 triers and 8.9 non-triers. Here again the approach has problems on two counts. First, as with the previous naive model, the proposed model does a better job of predicting. Disregarding the assignment of particular accounts to particular categories, the proposed model predicted 6 triers and 6 non-triers which is better than the prediction using the naive model. But this is not the more serious of the two problems associated with this naive model. The serious problem with this naive model is that it fails to classify individual accounts. Thus, it possesses some of the same inherent weaknesses of the previous naive model. It is not possible to use this model in most sales strategy decisions since information about individual accounts is not provided. Also, sales forecasting is more difficult because of this failure to classify individual accounts. It is necessary to multiply each of the 3.1 accounts by some average potential per account to get total sales with this approach. But what if the accounts which purchase are different than those which do not purchase on the basis of their

potential? Then the use of an average potential would be inappropriate. With the proposed model, in which individual accounts are classified, it is not necessary to assume some average potential; each account can be assigned its own appropriate potential figure.

In summary then, both of the available naive models failed to predict as well as the proposed model in addition to limiting the usefulness of the predictions for sales forecasting and marketing strategy purposes. It still must be shown however, that the predictions obtained using the proposed model were better than predictions which might have been obtained by pure chance. Morrison [65] has provided the basis for such a comparison.

If we let:

p = the true proportion of non-triers
α = the proportion classified as non-triers

then the probability of an individual being classified correctly by pure chance is

$$P(\text{Correct}) = P(\text{Correct/Classified non-trier})\,P(\text{Classified non-trier}) + P(\text{Correct/Classified trier})\,P(\text{Classified trier})$$

which reduces to

$$P(\text{Correct}) = p\alpha + (1-p)(1-\alpha). \tag{4.6}$$

For this particular prediction,

$$P(\text{Correct}) = (.5)(.5) + (.5)(.5) = .5$$

which Morrison terms the proportional chance criterion. Thus, the probability of correct prediction in this case based on pure chance was .5 but the proposed model exhibited a probability of correct prediction equal to .67. On this basis also then the proposed model resulted in a "better" prediction.

Whether the proposed model improves prediction enough to

warrant its use by marketing practitioners will be dependent upon whether the differences in the predictions are great enough to warrant the added cost of using the model. This is a decision which would have to be made each time the model's use is considered. But in addition to these considerations regarding the cost of using the model versus the improvement in the forecaster's ability to classify accounts, the person considering the employment of this model must also take into account the additional information which the model provides.

It has already been shown that the model provides information useful for sales forecasting and marketing strategy formulation simply because it classifies individual accounts. Neither of the available naive models were able to do this. But the proposed model also provides information besides this basic information. Specifically, it specifies which of the information about the various customers which the introducing firm already possesses, or which it can readily obtain, was found to be related to the purchase decision and which was not.

In this instance, only 6 of the 20 predictor variables thought to be related to the purchase decision were necessary to construct a useful discriminant function. Therefore, the forecaster has also learned that these six characteristics of each customer interrelate in some way to assist him in discriminating between customers who will purchase a trial order and those who will not. Unfortunately, since the equations used to calculate the probabilities of group membership are not simple linear equations, it is not possible to draw conclusions about the relative importance of each of these six variables nor even

the direction of their effects. This is so because the relative importance of each variable is not only dependent on its own coefficient in each of the two discriminant functions, but also upon the coefficients for the other variables in the functions and the prior probabilities. Thus, it is not possible to make statements about the direction of the effects and the relative magnitude of the effects of these 6 variables as in a linear regression equation when the variables are standardized.

Even with these limitations, however, conclusions about the predictor variables can be drawn. First, the 6 variables included in the equations helped to discriminate in this case and the remaining 14 did not. Second, the 6 predictor variables found to be useful for classification purposes can be used to successfully classify customers from a "fresh" group. Third, the predictive ability of this approach was better than both pure chance and two naive predictive models which could have been used.

4.6 Chapter Summary

Those findings of this research which were specifically related to the problem of improving existing sales forecasting practices were detailed in this chapter. It was learned that the needs of the respondents in this regard could best be met by:

1. Developing approaches which are more structured than present methods so that various data can be effectively incorporated into the sales forecasting process and so that the relative efficacy of the various data can be assessed.

2. Utilizing approaches which develop forecasts for each individual portion of the market rather than the market as a whole. These market portions can be either individual customers or market segments.

With these needs in mind, a general approach to forecasting the sales of new industrial products was proposed which incorporated results from three separate research traditions:

1. Model building research
2. Industrial buying behavior research
3. Adoption and diffusion research

Although it was not possible to test the proposed sales forecasting approach because of lack of data, it was possible to demonstrate the use of the basic proposition upon which the approach is based in an actual business situation to determine whether there were serious problems inherent in it. The basic proposition which was assessed in this analysis was that the firm possesses, or can readily obtain, information about its customers which relate to the problem of the adoption of new industrial products, and that this information can be incorporated into an explicit, well-defined model and used for predictive purposes.

Conclusions to be drawn from the results of this research which have been presented in the last three chapters, and recommendations for future research which logically follow from these findings, are detailed in the next chapter.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

A basic objective of this research was to study the sales forecasting practices for new industrial products of the firms participating in the study. More specifically, it was proposed that the emphasis of the research would be on the generation of predictions instead of the accuracy of the predictions. For this reason, a series of unstructured-direct interviews were conducted with persons responsible for, and experienced in, the generation of such forecasts.

Given that the interviews were unstructured and given that the subject of the interviews was a process--a process which takes many different forms in many different situations--it is not surprising that the results obtained from these interviews possess two characteristics: (1) they cover a wide range of sub-topics and (2) they are not conclusive. Expansion is required on both of these points.

Because the respondents were only guided by the researcher--and sometimes it was difficult to not simply direct the conversation--each of the respondents was able to emphasize those aspects of the process he felt were most important and interesting. Rarely were issues of importance to the researcher not covered in the interview but different issues were given varying degrees of emphasis by each of the various respondents. Additionally, the respondents introduced

topics into the conversation which had not been previously considered by the researcher. Since this was basically exploratory research, it was hoped from the outset that this would occur so it was fortunate that it did. It did, however, make for an extensive list of topics covered in the interviews and it made summary more difficult. Beyond this, the results are not conclusive.

For reasons mentioned earlier, the technique chosen for interviewing the respondents was the unstructured-direct interview. As Green and Tull [11, p. 146] have expressed it, this type of interview is "useful in obtaining a clearer understanding of the problem and determining what areas should be investigated." It is therefore particularly suitable for exploratory studies such as this one. Unfortunately, the information gleaned from this type of interview has limitations. The primary limitation with unstructured interviews is that rigorous hypothesis testing is not possible so firm conclusions cannot be drawn. Instead, only tentative generalizations are permitted and these generalizations can then be used as a strong guide to further, more rigorous research. It is in this spirit that the results of this research are considered and the reader is asked to bear this in mind as he considers the conclusions reached by the researcher.

The sample, because of the time-consuming interviewing technique chosen, was small. Nor was it representative, in a statistical sense, of some larger population. This is not to say the sample was necessarily atypical. It simply means that the sample was not a probability sample from which it is possible to draw statistical inferences. Even though statistical inferences cannot be made about some larger population, it is possible to derive conclusions about the

firms participating in the study. Generalization to other firms will be left to each user of these results.

Therefore, even though the results are quite varied and even though firm conclusions cannot be drawn, it is possible to summarize these results and to suggest topics for future research. In addition, to the person experienced in industrial marketing the results have intuitive validity. The situations discussed are quite typical of a large number of industrial marketing situations and it is expected, therefore, that the reader will feel comfortable in generalizing the results of this research to other situations in which he is interested.

Prior to the presentation of the conclusions drawn from this research and the recommendations for future study, it is well to briefly summarize the various results obtained in this study. Accordingly, the next section of this chapter will draw together all of the findings presented earlier in this dissertation. Following this summary section is a discussion of the conclusions reached on the basis of this research. Owing to the exploratory nature of this study and the inherent limitations of the research techniques employed, the conclusions are limited. For this reason, the primary emphasis of this chapter--and of this dissertation--is on the directions this research suggests for future research. The last section of the chapter presents these recommendations.

5.2 Summary of Research Results

Generation and accumulation of new-product ideas is the focus of the new-product development process in the firms studied. Rather than treating the customer as the sole source of these ideas, these

firms continually monitor, stimulate, and encourage a whole variety of sources. Customer needs and wants are not--because of this focus--neglected, however. Instead the firms recognize that their emphasis on new-product idea generation can well result in a deemphasis of their customers' needs in the new-product development process. To forestall such an occurrence, the firms use various approaches to the organization of their firms.

In three of the firms venture management groups are incorporated into the organization of the firm to act as a liaison between the potential customers of the new product and those persons in the firm actively engaged in the development of it. Although the details of the approaches used in the remainder of the firms vary considerably from one firm to another, it is possible to generalize to this extent: each firm strives for more customer involvement by their people during the developmental process. Considerable effort is expended to insure that the customers' needs and wants are not neglected.

Besides the problem of coordinating the product development activities within the firm with the desires of various customers, an additional problem arises due to the firm's emphasis on new-product idea generation. Often considerable monies and time are spent on the development of the new-product before market analysis; decisions are made without the benefit of this very significant information. It is not possible to determine how these investment decisions are made based on the results of this research. Even though several of the firms appear to be taking considerable risks by their actions in these situations, no other instances of significant risk-taking were uncovered. Rather it was more typical for the respondent to describe

the use of checklists, test marketing, market research, and well-defined, phased new-product introduction programs to minimize the risks inherent in the new-product development process.

Probably the most interesting approaches to controlling the risks inherent in the new-product development process involve the use of interdependency effects. Typically these effects are natural outgrowths of the particular situation such as when a new product is found to be either a complementary product or a substitute. Another possibility is for the equipment required for the production of the product to possess interdependencies with other pieces of equipment. Situations of this nature are found in the firms studied and the decision makers are acutely aware of the effects of these interdependencies on their decisions even though they may not formally incorporate these effects into their investment analyses. But some of the firms not only are aware of product interdependency effects and their potential, they have learned to reduce the overall risk in the new-product development process by using product interdependency effects. Two simple approaches for doing this are (1) to introduce products which open entire new markets and (2) to rely on technology transfer to reduce the costs of product research and development. Two of the firms studied use a more sophisticated approach for the deliberate introduction of product interdependency effects into the new-product development process. These firms choose carefully which product lines they are going to develop and which technologies they will ask their technical groups to perfect. Selection of these product lines and technologies is made on the basis of the extent of the overlap existent between the various product lines and technologies and

with the assurance that a number of core technologies will result. It is felt that such an approach increases significantly the potential for technology transfer and, in turn, reduces the costs of research and development.

The approaches to new-product development have a significant effect on the role of the sales forecast in the overall developmental process. The sales forecast becomes an integral part of the process; it is no longer simply input to an investment decision. A series of forecasts are required in the typical development process and the information required from each forecast varies in accordance with the stage of the developmental process and the needs of that particular stage.

Information about the sales forecasting process was of central importance in the study from the outset and the importance of this information increases when one considers the interrelationships which were found to exist between the sales forecasting process and the overall new-product development process. Since the presentation of the results was divided into various components, the summary of these results is also. It was found that:

1. Consultants are infrequently used and their usefulness is limited; the main task of developing the overall forecast remains with the firm.
2. Formal models are not typically used.
3. Marketing research and test marketing can provide useful information to the forecaster but he experiences difficulty in attempting to incorporate the results into the forecast.

4. Although forecasters differ in their basic approach to the development of the forecast by using either an aggregated or a disaggregated approach, all use considerably more objective data and more objective techniques for the incorporation of the data into the forecast for the derivation of the total potential figure than those used to derive market share and growth rate estimates.

This series of findings is descriptive of the sales forecasting process in the firms studied. Improving the forecaster's ability to develop new-product sales forecasts required further information.

The respondents generally felt that a worthwhile goal would be to develop a more formal approach to forecasting the sales of new industrial products which would:

1) develop the forecast on a disaggregated basis.
2) provide a mechanism for explicitly incorporating various data into the forecast.
3) provide a mechanism for assessing which of the myriad data are relevant to the particular problem of interest.

Based on these needs, an approach to forecasting the sales of new industrial products was proposed. A major input to the development of this approach was the results of three separate research traditions:

1. Model building research
2. Industrial buying behavior research
3. Adoption and diffusion research

While a lack of data made it impossible to test the proposed sales forecasting approach, it was possible to assess the basic

proposition upon which the approach was based. This was done by studying the application of this basic notion in an actual business situation. Briefly, the basic proposition was that a firm possesses, or can readily obtain, information about its customers which relate to the problem of the adoption of new industrial products, and that this information can be incorporated into an explicit, well-defined model and used for predictive purposes.

The results of the study, which was an application of the basic proposition in an actual business situation, were encouraging. It was found that predictions formed on the basis of the propositions were better than predictions which would have been made if either of two naive prediction models had been used, and the predictions formed on the basis of the proposition were better than chance.

Notwithstanding all of the results obtained and described above, the conclusions to be drawn from this study are limited.

5.3 Conclusions Drawn from the Results

Several conclusions about each of the several sub-topics covered in this research could be drawn based on the information obtained from the interviews. Such an approach would result in a long list of conclusions; some of these the researcher would feel strongly about and others he would feel less so and the reader would be left to sort one from the other. Accordingly, the conclusions presented here are restricted to those the researcher feels strongest about. They are the following:

1. The focus of the new-product development process is upon the generation of new-product ideas. The firm is not just

a responder to customer needs; it is an anticipator of the customer's needs and wants.

2. Frequently decisions are made in the development of a new product with limited information about the market.
3. The firm acts as a risk adjuster rather than a risk accepter or risk rejecter in the development of a new product. Intentionally exploiting product interdependency effects in a variety of ways is a poignant example of this organizational attitude.
4. The new-product development process and the sales forecasting process are intimately interrelated.
5. The firm experiences considerable difficulty attempting to incorporate certain data, primarily of a subjective nature, into the sales forecasting process. This occurs primarily in the development of market share and growth rate estimates.
6. The firm experiences considerable difficulty in the assessment of the efficacy and the relevance of its many data relating to the sales forecasting problem.
7. Information existent in a firm, and information available from the firm's salesmen, can be incorporated into an explicit, well-defined model and used for predictive purposes.

Equally important as these conclusions are the recommendations giving direction to future research.

5.4 Recommendations for Future Research

It is possible to succinctly describe this research as an exploratory study of the generation of sales forecasts for new industrial products. Owing to the exploratory nature of the study, the primary benefit to be derived from the research is the direction it can give to future studies. Owing to the emphasis on the generation of forecasts (rather than their accuracy), the recommendations for future research relate primarily to the generation process. The remainder of this chapter, accordingly, presents recommendations, based on the results of this research, concerning the new-product sales forecasting process.

Interrelationships between the sales forecasting process and the new-product development process have been stressed throughout this dissertation. Because of these interrelationships, studying the sales forecasting process requires an understanding of the new-product development process also. It is necessary to understand the context in which a forecast is made to understand why a certain approach is used in its development. Therefore, while the primary objective of the research was to study the sales forecasting process, the new-product development process was also studied. Suggestions for future research, then, concern both the new-product development process and the sales forecasting process.

Further research into both of these processes is of critical importance to many industrial marketers. It is a fact that many new product introductions result in failure. Research into the new-product development process could reduce this problem and, in so doing, reduce the costs of new-product introductions to the firm and

to society. Research into the sales forecasting process for new products could also contribute significantly to this problem by improving the accuracy of forecasts. But improvement in the sales forecasting process itself may also yield rewards to the manager of the future. Joseph L. Bower, in his book Managing the Resource Allocation Process: A Study of Corporate Planning and Investment, discusses the problems of developing a forecast when the forecaster knows that the results of the forecasting process are going to not only be used for an investment decision, but also used as input to the firm's planning process. The forecast becomes a commitment. Bower states [4, p. 314]:

> There is no doubt that to the extent that forecasts underlie the budgeting, and capital investment processes, some kind of performance review is required. Certainly if the corporation is to plan the use of its resources it must expect managers to meet their commitments. But no manager who is judged on his success in meeting commitments will fail to take into account the asymmetry of costs and the rewards to him in making up his budget or plan.

Bower offers a tentative solution to the problem he poses [4, p. 315]:

> Separation of the forecast from the commitment is a logical but tantalizing difficult-to-achieve resolution to the 'bias' question. It would seem impossible in political terms as long as forecasts are evaluated by comparing them with results. Although Chapter 10 offers some tentative suggestions as to how managers might accomplish a separation, a good deal of research is needed to discover and demonstrate how--if at all--performance can be improved by rewarding managers for the forecasting process rather than results.

Should such a separation become possible, research into the forecasting process could have immediate benefits to the manager.

Before proceeding to a discussion of the various suggestions for future research in the two aforementioned areas, it is fruitful to briefly present this researcher's observations about the research

approach employed in this study since these observations can also be used as guides for the conduct of future studies.

5.4.1 Observations on the research approach employed

Boyd and Westfall [5, p. 53] describe the case method as an:

> . . . intensive study of a relatively small number of situations. The emphasis is on obtaining a complete description and understanding of the relationships of factors in each instance, regardless of the number involved.
>
> . . .
>
> There is some question as to whether the case method is a type of descriptive research, or should be considered only as a method of exploratory research or as a step in the research process. One view considers the case method applicable only to exploratory studies and considers exploratory studies as the first step in the research process. Thus, the case method would be used to discover new ideas about relationships which could then be tested by conclusive research.
>
> . . .
>
> The case method is often used in the above manner--as a first step in the research process. Without doubt, this is the best application of the case method.

As an example of conclusive research, Boyd and Westfall describe the statistical method [5, p. 57]:

> The statistical method differs from the case method in the number of cases studied and in the comprehensiveness of the study of each case. While the case method involves complete study of a few cases, the statistical method involves the study of a few factors in a larger number of cases. Since more cases are involved, the statistical method must use different methods of analysis--methods designed for mass data. Instead of comparing individual cases by analogy, the statistical method ceases to identify individual cases and focuses instead on classes, averages, percentages, measures of dispersion, and more sophisticated statistical procedures.

Describing the approach used in this study as either the case method or the statistical method is misleading; it is neither. Some of the advantages of both approaches accrue to the technique employed

but so do some of the disadvantages.

The primary advantages of the approach employed here, as observed by this researcher, are: (1) more factors are considered than the number considered when using the statistical method, (2) each situation is studied and does not lose its identity through averaging, classification, etc., (3) the data obtained, or measurements made, are more accurate than those made using the statistical method, and (4) the descriptions are descriptions of real situations and not abstractions of some "average" situation. On the other hand, there are disadvantages associated with the technique. These are: (1) researcher bias can enter into both the observation and the analysis of the data, (2) generalizations are not warranted yet both the researcher and the user of the research are tempted to make generalizations, and (3) statistical tests of reliability are not possible so the results are inconclusive. Because of these characteristics, it is most appropriate to use this approach only in situations where a significant amount of information is already available--or where a case method approach has already been employed--and as the basis for the development of hypotheses which can be tested later using more conclusive methods of research design. This approach falls chronologically between the case method and the statistical method.

Much can be learned about the applicability of the approach employed here by considering a problem which arose early in this research. Originally, it was proposed that this study would consider the effectiveness of a particular sales forecasting model by asking a very limited number of forecasters to develop a forecast as they

would normally, and then develop a forecast using the proposed model. The success of the test would be measured by testing the following two hypotheses:

H_1: More causal factors will be considered when sales forecasts are made using the proposed model than forecasts made using the traditional approach.

H_2: More people will provide inputs into forecasts made using the proposed model than forecasts made using the traditional approach.

It soon became apparent that neither of these tests were feasible.

As the researcher began his search for firms to participate in the study, he began to understand that the length of the sales forecasting process and its lack of structure made the tests of the two hypotheses infeasible. The reason the process was lengthy and unstructured was in part due to its close interrelationship with the new-product development process, but this fact was not readily apparent to the researcher. That interrelationships existed was known to the researcher; the extent of these interrelationships was not. Since tests of the hypotheses were not possible, it was decided that, since there was obviously much to be learned about the sales forecasting process itself, the study would become more exploratory and concentrate instead on the generation of forecasts.

Although the results obtained from this study are significant and informative, more could have been learned about the interrelationships which exist between the sales forecasting process and the new-product development process if more of this information had been sought during the interviews. Conceivably, an in-depth study of two or three

situations prior to the series of shorter interviews which were conducted would have prompted such an emphasis. Certainly, at this point after the completion of the interviews, the researcher feels strongly that there is a good deal more to be learned about these interrelationships; he is convinced they are numerous and strong but he is uncertain as to their nature.

What has been said about the approach used, particularly in the context of the problem encountered in this study, is not meant as an indictment of the approach. The approach has value and this value is maximized in those situations where the complexities are so great that it is simply impossible to go directly from a case study to a statistical study. Furthermore, it may have particular usefulness to the practitioner who has less need for statistical tests of reliability due to his willingness to rely on his ability to generalize the results of case study research based on his experience and judgment. Thus, to the more academic researcher, the approach used in this study can be an effective intermediate step between a case study and a statistical study; to the more pragmatic market researcher, the technique can be an effective approach to "conclusive" research.

5.4.2 Recommendations for research into the new-product development process

The recommendations for research in this chapter are divided into two categories: (1) recommendations for research into the new-product development process and (2) recommendations for research into the sales forecasting process. This section of the chapter presents the recommendations in category (1) and the next section presents the

recommendations in category (2). Within each of these categories, there is a further division. The first group of recommendations within each category are for studies which have a high priority to this researcher; the second group of recommendations are for studies of lower priority.

The content of the recommendations in each of the two groups differ considerably. The recommendations for those studies which have a high priority to this researcher include a discussion of (1) what should be done, (2) why it should be done, and (3) how it should be done. The recommendations for those studies which have a low priority only include a discussion of what should be done.

Three recommendations for research into the new-product development process are especially important to this researcher and, therefore, are discussed in detail.

Decision-making with limited information

This research included several instances where investment decisions had been made on the basis of little, if any, market analysis. Market analysis is a major input to new-product investment decisions and yet some of the decisions in this study had been made with only limited analyses of market potential. Because of the emphasis and the nature of this study, it was impossible to speculate how these decisions were made. It is only known that the decisions were made and little analysis of the market had been done. That is known: unknown is how the decisions were made. It is suggested that exploratory research be undertaken to answer this basic question. It may well be that the circumstances surrounding the decision made

market analysis less important than is normally the case. Or it may be that time constraints forced a premature decision, but, if that was the case, the question still remains of how the decision-maker reacted to these circumstances. Did he leave himself alternatives? Or did he only approve the absolute minimum expenditures? Questions of this nature remain and need an answer for, in all likelihood, there are many instances of decision-making with very little information available.

The research recommended here is important because it would contribute to an understanding of decision-making under uncertainty. Executives are frequently required to make decisions with only limited information available but, because of the difficulty of new-product decisions and because of their importance to the firm, new-product decisions made on the basis of very limited information are some of the most trying experiences confronted by an executive. Understanding how executives react in these extreme situations would not only be a significant contribution itself, but it would also contribute significantly to understanding how executives react in less trying situations.

Because of the exploratory nature of the recommended research, various research methodologies could be employed. However, as a first step, it is recommended that an in-depth case study approach be used. Ideally, the researcher would be present during the entire decision process to monitor relevant discussions between the decision-maker and other individuals involved in the decision, and to ask probing questions of these individuals while the matter is still fresh in minds. If this is impossible, interviews should be conducted with the

various individuals involved in the decision over the period of the decision process at intervals which would be as short as conveniently possible. Any other approach would be severely limited by problems of recall.

Focus of the new-product development process

New-product idea generation was found to be the focus of the new-product development process in the firms participating in this study. Only rarely did the ideas for new products come directly from customers or from the introducing firm's marketing group. Whether a similar focus exists in other firms should be determined.

Confirmation of the findings of this research would be a contribution to the new product development literature but, more importantly, it would also serve as the basis for the research study recommended next.

A mail survey of a probability sample of firms drawn from a specified population is the recommended research methodology. Generalizations about the firms in the population could then be made on the basis of statistical confidence levels.

Product-orientation versus market-orientation

If it is found that producers of industrial goods do, in fact, emphasize idea generation in their new-product development processes, the needs of the customer are conceivably overlooked. There exists the possibility for the firm to assume a product-orientation rather than a market-orientation if the focus of the process is on new-product idea generation. And yet modern marketers agree that the needs of the customer should be of paramount importance to the firm

if its marketing efforts are to succeed. Based on this line of reasoning, two specific questions arise which can be answered using conclusive research designs: (1) is there a significant correlation between a focus on new-product idea generation in the firm's new-product development process and an overall orientation toward products rather than markets, and (2) if not, how do those firms with a focus on new-product idea generation maintain a market-orientation? How do these firms insure that customer needs and wants remain a central basis for new-product development?

Critics of American industry contend that the needs of the consumer are often overlooked in the manufacture of consumer goods. The modern marketing concept states that an emphasis on the satisfaction of customer needs is not only a way of satisfying the critics, but that such an emphasis is also in the best <u>business</u> interests of the producer. This research would determine (1) if industrial marketers generally agree with, and practice, this concept and (2) whether an emphasis on new-product idea generation in the new-product development process is one of the reasons that some firms do not practice the concept. The importance of this research for both the marketer and the customer is apparent (if the marketing concept is accepted).

For this research, it is recommended that a series of personal interviews be conducted with a sample of respondents drawn from a specified population of industrial marketers. Personal interviews are recommended because of the difficulty in explaining terms such as product-orientation, market-orientation, focus of the new-product

development process, etc., in a mail questionnaire or over the telephone.

Besides the three areas of research presented above, there are two other areas of research into the new-product development process recommended. Since these have a lower priority to this researcher, they are presented in less detail; specifically, the descriptions of these recommended research studies only include a discussion of what should be done and exclude discussions of why and how they should be done.

Effects of sales forecast results on the new-product development process

An earlier recommendation for research dealt with the effects on the new-product development process of an absence of sales forecasts. But this void primarily affected decision-making. The research recommended here would examine the effects of sales forecast results on the new-product development process itself. Do sales forecast results change the focus of the process? Do they alter the pace of the process? These are the type questions to which answers are needed. This study contributed to our knowledge of the effects of the new-product development process on the sales forecast but it contributed little to our knowledge of the converse. It is unfortunate but true that this question could have been made a part of this study without an excessive amount of additional effort but it was thought, prior to the research, that the interrelationships between the two processes were primarily unidirectional. That is, it was thought that the new-product development process influenced the sales forecasting process but that little influence flowed in the opposite

direction. This is now viewed by this researcher as a misconception, an oversimplification of the actual nature of the interrelationships. Sales forecast results can affect the new-product development process and exploratory research is necessary to identify the nature of these effects.

Utilization of interdependencies

Utilization of interdependencies between products, production equipment, etc., to reduce the risk inherent in the new-product development process was one of the more interesting findings of this research. While some of the approaches used by the firms in this study were clever, and possibly even unique, only a limited number of different approaches were observed and reported. Initially, further work should be done to determine if other approaches are being used to accomplish the same results. Once it has been satisfactorily demonstrated that most approaches to the utilization of interdependencies to reduce the risk inherent in the new-product development process have been identified and categorized, research can be done on several different fronts. A brief list of potential research topics would include: (1) which approach is most applicable for a particular situation, industry, product, etc.; (2) the advantages and limitations associated with each of the various approaches; (3) how these approaches affect the decision-making process, the new-product development process, and the sales forecasting process; and (4) how each of the approaches might be improved. Before these issues can be resolved, however, very basic descriptive research is required to identify, classify, and adequately describe the approaches presently

employed. The study reported here represents only a limited start in this direction.

5.4.3 Recommendations for research into the sales forecasting process

Of the four recommended areas of research discussed in this section, two are considered by this researcher to be high-priority studies and the other two areas have a lower priority. The high-priority studies are described first and, as the reader will recall from the previous section, in detail.

Effects of the new-product development process on the sales forecasting process

In the previous section of this chapter, it was recommended that exploratory research be conducted to determine the effects of the sales forecasting process on the new-product development process. Because of the almost total lack of information gained from the study reported here on these relationships, the recommended studies were necessarily exploratory. However, various effects of the new-product development process on the sales forecasting process were observed in this research and it is felt that conclusive research can be conducted in this area. Some specific issues which should be studied are: (1) how do the requirements placed upon the sales forecast change from one stage of the new-product development process to the next, (2) does the magnitude of the decision to be made on the basis of the sales forecast alter the manner in which the forecast is developed, and (3) how does the type of decision analysis employed affect the requirements placed upon the sales forecast?

The primary benefit to be derived from a study such as the one recommended here is that conclusive statements could then be made about how forecasts are currently developed. While this dissertation research studied the same subject matter as the research recommended here, the research methodology employed in the dissertation research limits the nature of the conclusions which can be drawn from the results. Conclusive research methodology is recommended to overcome these limitations.

It is conceivable that a mail survey could be employed in this recommended research but it is suggested that a series of personal interviews be used instead. The additional flexibility of personal interviews should more than offset their additional cost.

Test of the Root and Klompmaker sales forecasting model

The second area, and that of most immediate interest to this researcher, recommended for future research is a test of the sales forecasting model proposed by Root and Klompmaker [87]. The reader will recall that, even though the portion of this study presented in Chapter IV demonstrated the basic proposition upon which the Root and Klompmaker model is based in an actual business situation, the model was not tested in this research due to the unavailability of the requisite data. This should be done, particularly since a demonstration of the basic proposition in an actual business problem yielded good results. A second reason for pursuing this model further is that the basic assumption of this model--that the relationships found to exist in a test market are generalizable to other markets--when it is applied to test market data, is a weaker assumption than that normally

used in the application of test market data. For example, if test marketing shows that 25% of the customers tried the product in the test market, it is generally assumed that 25% of the remainder of the market will also try the product if it is felt that the test market is representative of the rest of the market. With the proposed model the only assumption required is that similar firms in similar situations will try the product. The reader will recall that in Chapter IV the test market only had 30% try the product and yet, in the firms whose behavior was to be predicted, the trial rate was 50%.

Returns from an actual test of the model would be twofold. First, the nature of the model is such that significant results from the test would be either additional contributions to the adoption and diffusion research literature or, at least, confirmation of earlier findings in this field. Second, a successful test would provide a significant new tool for the forecaster.

It was shown in Chapter IV how the model could be tested if the proper data were available. But to date, the necessary data has not been available. This researcher has discussed this matter with the market research managers of two firms and they both have tentatively agreed to gather the appropriate data during their next new-product introductions.

The last two recommendations for research into the sales forecasting process have a lower priority to this researcher and are, therefore, described in less detail than the two previous descriptions of recommended research.

Incorporation of information into the sales forecast

One of the most startling things observed during the interviews was the inability of the respondents to discuss the incorporation of subjective information into the sales forecast. The last column in Table 3-3 gives some of the actual quotations obtained from the respondents. Originally it was thought, because of the respondents' inability to describe how incorporation was accomplished, that the information had not actually been incorporated. As the number of interviews increased, however, and as the researcher learned more about the problem, it became apparent that incorporation was effected but that the technique itself was very subjective and, therefore, difficult to describe. Another observation that was made as the number of interviews increased was that the respondents' inability to describe how information was incorporated also reduced the number of factors which they said they took into account in the development of the sales forecast. They described primarily those factors which were readily incorporated into the forecast and they suppressed those factors which were not. This is another reason why a test of hypothesis H_1, which was discussed earlier, could not have been tested in this research. An accurate count of the factors considered would not have been possible because of this tendency of the respondents. Had this researcher been aware of this problem prior to the conduct of the interviews, he would have undoubtedly used a different research methodology to obtain this particular information. It is therefore recommended that exploratory research be undertaken to develop a means for identifying which factors the forecaster takes

into account and how their incorporation into the sales forecast is effected.

Product characteristics forecasting

Product characteristics forecasting is closely related to the sales forecasting problem and, some would say, preliminary to it. Product characteristics forecasts for new products consist of predictions concerning what the new product will be able to do in use, in what situations it will be most applicable, and when the new product will be able to satisfactorily perform the functions expected of it. Sales forecasts, on the other hand, are predictions concerning the size of the market for the new product, the length of time it will take to achieve this potential, and the share of the market the introducing firm will ultimately enjoy. All of these predictions are made given, or assuming, certain information relative to the product's forecasted characteristics.

That product characteristics forecasting is of concern to those persons interviewed is apparent from the interview results. At least twelve of the nineteen respondents indicated concern over this general problem and yet, a brief review of the available literature on the subject leads this researcher to the conclusion that it is an area still in its infancy and ripe for further work. It may be that the research tradition referred to as technological forecasting [51] is the most fruitful starting place to gain insight.

APPENDIX I

INTERVIEW GUIDE

Name: _____ Company: _____

Position: _____ Division: _____

Name: _____ _____

Position: _____ Address: _____

Name: _____ _____

Position: _____

1. What is the organization of the Marketing Group?

2. How does the Marketing Group fit into the overall organization of the division?

At this point the respondent(s) will be asked to discuss specific new products which have been introduced within the last few years and with which he (they) is quite familiar. The questions from this point on will pertain to a single product at a time. If more than one product is to be discussed, then another interview guide will be completed.

3. Product
   Brand name of product:

   Brief description of the product:

4. Brief historical account of the development of the product: (Date initiated, involvement of marketing group or lack thereof, whether spinoff from other research, etc.)

5. Brief historical account of the development of the marketing strategy: (What preliminary forecasts were developed and by whom, whether the target market changed during the development, whether distribution structure changed over time, whether emphasis on a marketing tool changed with time, etc.)

6. Description of target market
   Size:

   Composition:

   Competition:

Traditional marketing and distribution techniques employed:

Other characteristics of this market important to the marketing of a new product:

New or old market to the introducing company:

7. What was the pre-introduction sales forecast used for? Was it part of an investment decision? Was it used to establish sales targets or goals? Who was given the forecast? Etc.

8. How was the sales forecast developed? Was test marketing or market research done? Were outside consultants used? What information was explicitly included in the development? Were alternative marketing strategies considered in the forecasting process? Was competitive reaction explicitly considered? What assumptions were made? Was a formal model utilized? Etc.

APPENDIX II

Notes from Meeting at _____

12:00 noon 11/30/71

Present:

Marketing Department Representative

Branch Sales Manager

Six Branch Salesmen

Researcher

Discussion: The product discussed was the _____.

The Branch Sales Manager opened by saying that he felt that the important thing to look at was reorders. He felt that the initial orders were based more on friendship than on customer interest or need. He was concerned that the people who introduced this thing felt that it would go just because the _____ went. He thought there was a world of difference between the two sizes because of the equipment and the people who run it.

At _____ it was felt that the order was placed because of the cost factor and the length of the run. This costs more and runs for a shorter time. It is easy to change, however, so there is less labor costs. It should also be easy to change.

One salesman said that you had to do three things to sell this thing. One, you had to find what he called an innovator. Two, you had to find a guy who would work with you. Three, you had to have this guy be able to sell the people in his own plant.

Another salesman said that certain accounts of _____ had been burnt before and these people would not be willing to be the first to try this thing. You should find the people who hadn't been burnt. He also said that you had to identify the need in the field. The components of this need would be:

a. Does he have short runs?
b. Can he stand scratching?
c. Does he have poor presses or pressmen?
d. Does he have certain production problems?

In summary, is he looking for quality? Another consideration is whether he's busy or not? Also what % of his business is such that it can use the _____? If there's not much of the business which warrants it, then it may not be worth the bother. A final point made by _____ was that it is easier for some operators to change over to this than it is for others.

The _____, which is the standard of the industry, has a low cost but a high labor input. The _____ has a high cost but a low labor input.

According to another person the three important things are attitude, investment, and credibility. Credibility means: Does the person think it will be worthwhile? They will try the _____ on the _____ but not the _____.

At _____, the Superintendent likes the _____ based on trial runs they have conducted. He likes them because they save time. On the other hand the Plate Room Superintendent does not like them. He claims that the chemistry from it fouls up the chemistry of the other _____. This is not so but it is an excuse.

Another thing that helps this _____ is if the people are not very qualified. It is easier to sell this to a firm with less qualified people than to firms with more qualified people.

A third salesman got up and at great length said that these questions should be asked before making the product, not after it has been introduced. (I believe this is an indication that my model has validity to those actually involved in new product introductions.)

Throughout the conversation the term fit kept coming up. Fit is made up of the following factors:

a. The length of the run. (Shorter runs are better.)
b. Whether they have _____ processing equipment since the _____ is made on the outside.
c. Time available for _____ which is dependent on how busy they are.
d. How often the press is run.

Another thing that came out is that almost everybody should have purchased about 10 because that's the size package they came in. The next size up was 50.

Another factor affecting the sale would be the salesman's relationship with the company. They thought this was particularly so in this case because they felt most of the sales were done as favors anyway. With a good relationship you can ask for an order and get one

within reason. They also thought salesmen would be candid about where they had good relations and where they had bad relationships.

The Branch Sales Manager made a general comment which was critical of the model. He felt that the answers to almost all the questions we were asking were almost impossible to answer before the branch had the product. He thought you had to have the product in front of customers to answer the questions.

Another thing that could affect this product's success is that certain things could be geographic. For example, Chicago is called a _____ market so this would be expected to go well there. However, Dallas is _____ so it shouldn't go well there.

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