8717832

AN ANALYSIS OF PURCHASING PERFORMANCE

Johnson, Ellen Jane, Ph.D.
Indiana University, 1987

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark ✓.

1. Glossy photographs or pages _____
2. Colored illustrations, paper or print _____
3. Photographs with dark background ✓
4. Illustrations are poor copy _____
5. Pages with black marks, not original copy _____
6. Print shows through as there is text on both sides of page _____
7. Indistinct, broken or small print on several pages ✓
8. Print exceeds margin requirements _____
9. Tightly bound copy with print lost in spine _____
10. Computer printout pages with indistinct print _____
11. Page(s) 92 lacking when material received, and not available from school or author.
12. Page(s) _____ seem to be missing in numbering only as text follows.
13. Two pages numbered _____. Text follows.
14. Curling and wrinkled pages _____
15. Dissertation contains pages with print at a slant, filmed as received _____
16. Other _____

UMI

AN ANALYSIS OF PURCHASING PERFORMANCE

Ellen Jane Johnson

Submitted to the faculty of the Graduate School
in partial fulfillment of the requirements
of the degree
Doctor of Philosophy
in the School of Business
Indiana University

April 1987

ACCEPTANCE

Accepted by the Graduate Faculty, Indiana University, in partial fulfillment of the requirements of the Degree of Doctor of Philosophy.

William C. Perkins, Chairman

John F. Muth

A. Victor Cabot

Rosann L. Spiro

December 18, 1986

DEDICATION

This effort is dedicated to my parents,
who continually supported and encouraged me
throughout my long educational process.

ACKNOWLEDGEMENTS

Completing this doctoral program is possibly the biggest single personal accomplishment which I will experience. Certainly, it is the biggest and most important to date. Within the course of the doctoral experience, I have matured and grown as an individual. Although I can never thank everyone who provided support and encouragement during this sometimes difficult maturation process, I would like to express gratitude to several individuals in particular.

I am especially indebted to the members of my dissertation committee: Professor William C. Perkins (Chairman), Professor A. Victor Cabot, Professor John F. Muth, and Professor Rosann L. Spiro. All of these individuals, in their own way, continually provided the encouragement and support which was necessary for me to complete this work. I especially thank Professor Cabot for his willingness to step into the project "midstream" and for his insightful comments which helped me direct my life down the right path. I especially thank Professor Muth for consistently asking the "right" questions at the "right" time and for providing vocal support and insight when it was certainly most needed. I thank Professor Spiro, especially for her initial support of the project and for her final question: "What have you actually done in this dissertation?" Addressing that question was most helpful. And to my Chairman, Professor Perkins, I owe the most thanks. I sincerely thank Professor Perkins for chairing this research. Working with him was indeed a pleasure and a learning experi-

ence. His knowledge of research design, simulation, and the overall purpose and nature of a dissertation was invaluable throughout this project. Additionally, I thank him for his patience, understanding, and encouragement--all of which were desperately needed at various points throughout the dissertation. I am indebted to Professor Perkins not only for his significant role in this dissertation but also for his support throughout my doctoral program. At all times, he was a friend, providing guidance, encouragement, and objectivity.

To my dissertation committee, I express my profound gratitude. They have made this dissertation something of which I am proud. And, more importantly, they have made this phase of my doctoral program the most exciting, rewarding, and enjoyable.

I also wish to thank another individual, my dear friend (and now husband), John Dumond, for his continual support and encouragement throughout my doctoral experience. He provided motivation and encouragement when nobody else could. I will always be indebted to him for his true friendship during this period. Additionally, I thank him for his computer programming assistance and his ability to withstand never-ending discussions about this dissertation.

A sincere note of gratitude goes to the National Association of Purchasing Management for their total support of this project through a Doctoral Research Grant. It was inspiring to know that this research was deemed to be worthwhile by such a knowledgeable professional organization.

Next, I would like to recognize two individuals who played a significant but unobtrusive role in my doctoral experience. These

individuals are Professor William Ruch of Arizona State University and Professor Ross Reck of Ross Reck and Associates. I sincerely thank both of these individuals for encouraging me to pursue a doctoral degree. Additionally, I especially thank them for the encouragement, advice, and willingness to listen which each of them so uniquely provided during my doctoral program. Their friendship was very much appreciated. Further, I wish to recognize the contribution of Professor Reck in the initial formation of this dissertation. His experience and enthusiasm in the area instigated the selection of this dissertation topic. I especially thank him for the many hours which we spent discussing and investigating the issues involved in this topic of research.

And finally, I wish to acknowledge all of you who were a part of my doctoral experience. You will always be remembered.

ABSTRACT

This research addresses the performance of the purchasing function in a business organization. The research is designed to analyze the impact of various purchasing operating environments on the performance of the firm.

Three independent variables are used in the study: 1) nature of the performance goals and measures for the purchasing function; 2) the type of interaction required of purchasing, and 3) the amount of strategic information provided to purchasing. Through these variables, this research explores the impact of the performance measurement system and the degree of integration (through variables two and three) of the purchasing function on the performance of the firm.

The research provides several contributions to the field of purchasing management. These contributions include: 1) the development of a simulator for evaluating the effectiveness of various ways of managing the purchasing function; 2) the provision of a methodology for quantifying the performance of the purchasing function as it impacts the firm; 3) the quantitative evaluation of the impact of performance measurement systems and degree of integration (through components of interaction and information) upon purchasing and firm performance; 4) the application of an existing methodology to a new field of research; and 5) the addition of empirical research in an area where little exists.

The research methodology is a laboratory simulation in which subjects, performing the role of a purchasing manager, respond to various

problem situations via an interactive simulation. The subjects are randomly assigned to a treatment or particular type of purchasing environment. The computer simulation simulates the operations of a manufacturing operation over twelve periods. The simulation "implements" the subject's responses and captures the impact on the dependent variable, profit.

The findings of the research, analyzed through univariate analysis, indicate that the nature of the purchasing environment (or the manner of managing the purchasing function) produces a significant impact on the firm's profit. Specifically, the results indicate that an effectiveness performance measurement system provides significantly higher profit performance for the firm than an efficiency performance measurement system; required interaction provides significantly higher profit for the firm than optional interaction; and high strategic information provides significantly higher profit for the firm than low strategic information. The performance measurement system, type of interaction, and amount of strategic information impact the firm's profit through the elements of demand, sales, material costs, labor costs, inventory carrying costs, purchasing costs, and number of backorders.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

According to the 1980 Annual Survey of Manufacturers [132], the cost of materials accounts for 59 percent of the revenue received by the average manufacturing firm. When capital expenditures are included, this figure rises to 63 percent. This means that more dollars are spent for purchased materials and services than for all other expenses combined, including wages, salaries, depreciation, and taxes. Thus, the effectiveness of the purchasing function can have a significant impact on the profits of many firms.

The impact of the purchasing function on the firm's profit performance has been recognized in recent years. However, much confusion still exists as to the role of the purchasing function in a business organization. For example, general managers are not even in agreement that the purchasing function has the sole responsibility of purchasing materials. According to a survey by Ammer [10], less than 20 percent of the general managers surveyed gave unqualified endorsement to this role of the purchasing manager. In addition, many general managers, and a large number of purchasing managers, do not believe that purchasing can make a significant direct contribution to the firm's profit objectives.

Because of this confusion as to the role of purchasing in a business organization, it appears as though the purchasing function is often mismanaged. Two key components in the management of purchasing

are the degree of integration of the purchasing function into the operations of the firm and the nature of the performance measurement system being used to direct the purchasing function. Both of these components also influence the extent to which the purchasing function is used to enhance the performance of the firm.

The purchasing function of today is often not integrated into the firm's operations, thereby performing little planning, and is directed by a performance measurement system emphasizing functional efficiency. In contrast, however, many authors believe that in today's more complex, volatile buying environment, a firm needs a purchasing function which is integrated into the firm's operations, performs long-term planning, and focuses on functional and firm effectiveness [2,5,20,22, 45,46,111,125]. This research seeks to examine this incongruence and experimentally determine the impact on the firm's performance of various methods of managing the purchasing function.

This chapter continues with a discussion of the integration of the purchasing function and subsequently describes the performance measurement systems for the purchasing function. Next, a short narrative is provided on the relationship of this study to strategic purchasing. The chapter concludes by presenting the need for the proposed research and the potential contributions of this research.

1.1 Integration of the Purchasing Function

The management of a business organization has the opportunity to determine the degree to which the purchasing function is involved in the operations of the firm. Management may choose to develop an "isolated" function--one which essentially operates as its own entity; or

it may choose to develop an "integrated" purchasing function--one which operates with a total firm perspective. Clearly, the degree of integration of the function exists along a continuum. It is, however, generally possible to categorize the function as being essentially isolated or integrated on the basis of existing characteristics.

The purchasing function of today tends to be managed as an isolated function. Purchasing generally participates in few nonpurchasing decisions and does not interact on a regular basis with other internal functions. Purchasing is generally not involved in the firm's planning process; consequently, the function does not usually receive any direct information from the process nor contribute any information to the process. In addition, purchasing is not performing sufficient (if any) planning within the function itself. The purchasing function in most business firms is in essence mostly a tactical operation and, in fact, the purchasing individuals tend to view themselves in this manner [46].

Purchasing has historically been neglected in the firm's planning process. Reasons for this neglect have included the following [2,46, 100]:

1. Following World War II, U.S. productivity exceeded demand, resulting in more marketing problems than buying problems.
2. Purchasing has traditionally been a low-key, isolated function, not drawing much attention.
3. Purchasing does not have the "glamour" marketing seems to have.
4. Many purchasing decisions involve judgmental considerations, making it difficult to use quantitative models.
5. Many purchasing people have been selected, trained, and conditioned

to perform a highly demanding operational job.

6. Purchasing individuals have been passive because of management's view of the function and the lack of strategic decision making.

7. Purchasing is motivated to perform an operational role because of the performance measurement system and the attitudes of other executives.

8. Resistance to change is prevalent and changes are needed to increase the scope of purchasing.

The purchasing function has been operating as an isolated unit for some time and only within the past decade have criticisms been waged against the function for its performance. For the most part, purchasing appears to have been meeting its main responsibility of providing materials when they were needed. There is increasing evidence, however, that the buying environment has been rapidly changing and becoming more complex, and will continue to do so. Rising worldwide demand, rising nationalism, few sources of significant materials, technology, and inflation are combining to create an environment with permanent supply problems, making the acquisition of materials a difficult, if not impossible, process. In addition, firms of today are operating in a more competitive selling environment and excess costs cannot be tolerated. Therefore, purchasing individuals are being required to perform their jobs effectively, but at a lower cost. To enable purchasing to meet the challenges of the supply environment and the requirements of the sales market, it is suggested that purchasing needs to be integrated into the operations of the firm.

An integrated purchasing function is an active unit of the firm's

operations and possesses two key characteristics: 1) The purchasing function is involved in the firm's communication process, and therefore has access to greater amounts of information; and 2) The purchasing function interacts to a greater extent with the other internal functions, top management, and the external environment. Both of these characteristics of an integrated purchasing function can enable purchasing to contribute more fully to the performance of the firm.

As an integral unit of the firm, purchasing has information as to expected future demands, short-term changes in demand, projected needs for new materials, and upcoming changes in current material specifications. In addition, purchasing is aware of the goals, objectives, and long-term plans of the firm itself. This information enables purchasing to deal with suppliers on a more informed basis; the function is able to plan ahead to ensure future supply; and purchasing has the opportunity to perform its function in accordance with the objectives of the firm.

Performing as an integrated function, purchasing also interacts to a greater extent with the other internal functions and top management. This higher level of interaction on the part of purchasing can provide valuable benefit to the firm as the purchasing function has the opportunity to provide needed supply information to the firm's planning process. This information can provide valuable assistance in developing plans for marketing, expansion, facility location, product line, diversification, and other strategic decisions of the firm. In addition, through such interaction, purchasing can obtain information which will help the function to better serve the firm's needs.

To illustrate the role of an integrated purchasing function, it may be helpful to return to that point in history when most businesses were very small and most products and markets were rather simple. At that time, the owner of the business and the chief executive officer were generally the same person, and this person participated in nearly everything that occurred. The owner/CEO was directly involved in the selling side of the business as well as the purchasing side and, as a matter of course, became very much aware of the relationship between his purchasing decisions and the impact of these decisions on his sales volume.

For example, consider a 16th century tailor [111]. At some point in time, the tailor (owner/CEO) may have considered the idea of reducing the material costs of his clothes in order to increase his profits. This reduction in costs could have been accomplished by substituting a lower quality and therefore less expensive cloth for the cloth currently being used. Such a move may have appeared to be very logical to the tailor; however, the tailor soon learned that his customers bought clothes on the basis of value, rather than price alone. If the substitution of lower quality, less expensive cloth did not impact the product's value as perceived by his customers, the intended result was realized and the larger profits were obtained. On the other hand, if the substitution decreased the value of the product in the eyes of his customers, sales would decline, thereby diminishing the tailor's profits.

In a comparable manner, the tailor (owner/CEO) also recognized that he could sometimes increase the value of his product by actually

increasing his material costs. For example, he could purchase a higher quality, more expensive cloth to make his clothes look better and last longer. If the use of this higher quality, more expensive cloth increased the value of the clothes in the eyes of the customers, more customers would have been willing to buy the clothes, even at a higher price. As a result, his sales and consequently his profits would have increased. Through time and experience, the tailor developed an understanding of the relationship between his purchasing decisions and his sales volume; this relationship became the basis for evaluating his purchasing alternatives. The owner/CEO was now consciously using the purchasing function to increase sales and profits.

The business firms of today are much different than that of the tailor's as they are larger, departmentalized, and managed by several specialists rather than one individual. These specialists often possess a very narrow perspective and focus on the performance of their own department, oblivious to the performance of the firm. The purchasing function is often a function operating as a "narrow-minded" function, immersed in its own daily activities. In this age of specialization, management appears to have lost sight of the potential of purchasing to enhance the firm's sales and profits. By integrating purchasing back into the operations of the firm, management has the opportunity to use the potential of the purchasing function to benefit the firm.

1.2 Performance Measurement System for the Purchasing Function

Another component in the management of the purchasing function is the performance measurement system. A performance measurement system

refers to the manner in which management motivates and measures purchasing performance. Through the performance measurement system, management sets the goals and objectives for the purchasing function. These goals and objectives provide a focus for the purchasing function and, as indicated by the Locke model, direct purchasing's actions toward the achievement of these goals and objectives. The Locke model of goal setting [83] indicates that individuals generally seek to achieve the goals which are set for them; therefore, management can influence purchasing behavior through the goals it sets for the function.

Management has long regarded purchasing as a subsidiary service function with the role of aiding the other more important functions. Ammer [9] has found that top management often perceives purchasing as performing a "passive" role. He notes that the purchasing manager's performance is considered to be satisfactory if 1) he operates his department efficiently, as measured by operating costs, and 2) he does not antagonize those executives who really do make a direct contribution to company objectives. The implication behind this finding is that management perceives purchasing to be a reactive, tactical operation. This managerial viewpoint causes management to control purchasing with a system emphasizing functional efficiency.

A performance measurement system emphasizing departmental efficiency focuses on the ability of the purchasing function to minimize costs and operate efficiently. Typical performance measures in this type of system include the amount of cost reduction achieved, the total cost of purchases, the ability to maintain a price control policy, and internal operating efficiency measures such as the time required to

process a purchase requisition, the number of requisitions processed in a particular amount of time, or the time required to place an order with a supplier. These efficiency measures are useful for reducing or eliminating unnecessary costs, but they may also encourage purchasers to continue to reduce costs below a "reasonable" level, often at the expense of quality, delivery, or vendor relations. In addition, these measures do little to motivate and actually improve purchasing performance.

Recent research [92] indicates that, in American business firms today, there is an overwhelming use of an efficiency-oriented performance measurement system. There is doubt, however, whether this is a beneficial manner by which to control the purchasing function. Let's return for a moment to the situation of the tailor. In his situation, if he had established efficiency-oriented goals, the tailor would work to minimize his costs. Therefore, the tailor would purchase less expensive, lower quality cloth. This action, as previously indicated, could either maintain the product's perceived value, thereby increasing the tailor's profits, or it could decrease the product's perceived value, decreasing the tailor's profits. This dichotomy indicates that trying to minimize costs may not always be beneficial. With an efficiency oriented system, the alternative action of purchasing a higher quality cloth would most likely not have been considered as it would have increased the tailor's purchase costs. Therefore, the possibility of increasing the tailor's profits by increasing the product's perceived value would not be available.

The purchasing function of today is larger than the tailor's and

more removed from the sales side of the firm, but the concepts still apply. There may be instances when the goal of cost minimization for the purchasing function may not be a beneficial practice to follow. And there may be times when the purchasing function should be allowed (and encouraged) to increase its own costs to provide increased benefit to the firm. This situation spurs the suggestion that perhaps the purchasing function should be directed with a system which focuses on the function's effectiveness rather than its efficiency.

A performance measurement system emphasizing the effectiveness of the purchasing function focuses on the ability of the function to contribute to the attainment of the goals and objectives of the firm. In this type of performance system, the performance of the purchasing system is often measured against objectives such as the ability to gain long-term supplier relationships, the maintenance of suppliers who provide quality, on-time delivery, the provision of accurate information as to the future supply environment, or the function's contribution to the firm's performance.

An effectiveness-oriented performance measurement system is believed to allow the purchasing function to develop and employ its potential to enhance the financial position of the firm. In addition, such a performance system encourages the purchasing function to develop a broader firm perspective rather than a departmentalized perspective. This "systems" perspective may allow the function to interact more cohesively with the other internal functions.

Management has the opportunity, through the performance measurement system, to influence the manner in which the purchasing function

performs. Certainly, management would like to develop a purchasing function which works toward the benefit of the firm. A purchasing function managed by an efficiency-oriented performance system may provide some benefit to the firm; however, a purchasing function governed with an effectiveness-oriented performance system has the potential to provide much greater benefit to the firm.

1.3 Relationship to Strategic Purchasing

The particular concepts of efficient and effective purchasing can be related to the idea of tactical and strategic purchasing. Strategic purchasing has been given many definitions [12,13,115,125,126], but in a general sense strategic purchasing can be viewed as those decisions which link the firm to its environment. The environment in this case may be the internal firm (conversion process), the input (supply) market, or the output (sales) market.

A firm deals with its environment at many different levels, each requiring different types of decisions. For example, at times a buyer in a large company may be primarily concerned with expediting an order from a particular supplier (a tactical issue), whereas at other times the buyer might focus on the development of a long-term relationship with the supplier (a strategic issue). The information needs associated with these decisions, the nature of the decisions, and the ability to implement the decisions are all very different. Therefore, these two types of decisions must be recognized.

This dichotomy is similar to that of purchasing efficiency versus purchasing effectiveness. Specifically, purchasing decisions which are tactical (or operational) in nature tend to deal with routine, short-

range, structured kinds of problems (similar to efficiency types of decisions). At the other end of the continuum are strategic purchasing decisions. These decisions are typically of a longer range, less structured nature and deal with the future needs of the company (similar to effectiveness types of decisions). These kinds of decisions often require much information from the firm's environment and are linked to the firm's goals and objectives.

Because of the similarity of the concept of tactical/strategic purchasing to that of efficient/effective purchasing, literature from both areas may be applicable in this research.

1.4 Need for the Research

Although the purchasing function is vitally important to the profit performance of many firms, relatively little research has been conducted in this area. Adamson [2] notes that extensive research and attention has been focused on the marketing function, the output side of the firm, while very little consideration has been given to purchasing, the input side of the firm. Argenti [14] observes that of twelve standard texts on strategy and planning, only four [1,24,103,136] mention supply strategies, and then only briefly.

Research has been performed which examines the activities, characteristics, and effectiveness of the individual purchaser but little work has been performed on the effectiveness of the purchasing function as a unit or how to manage the purchasing function to enhance its contribution to the firm. Some work exists in the area of purchasing performance measurement, but empirical work is difficult to find. Several

authors have promoted concepts and beliefs indicating that purchasing could be more effective if it were integrated into the firm's planning process and flow of communication but no empirical data is presented [2,5,20,22,111,125]. Industrial "success stories" and anecdotes have been presented in the literature, illustrating the positive effect purchasing can have on firm performance, but again no data exists. The relationship between purchasing and firm performance has not been empirically investigated.

It is known that the actions of the purchasing function impact the performance of the firm. The direction and extent of this impact may depend upon how the purchasing function is managed. The research objective of this study is to examine the impact on the firm's performance of various ways of managing the purchasing function.

This research investigates the effects of three elements in the management of the purchasing function. These elements are the nature of the performance measurement system being used to direct the purchasing function, the type of interaction required of purchasing, and the amount of strategic information possessed or obtained by the purchasing function. The second and third elements, type of interaction and amount of strategic information, may be considered separately as influencing factors on the performance of the purchasing function or they may be considered together as primary indicators of the degree of integration of the purchasing function.

The research examines two types of performance measurement systems: an efficiency-oriented performance measurement system and an effectiveness-oriented performance measurement system. An efficiency-

oriented system focuses on minimizing costs and maximizing departmental operating efficiency. Performance measures include the cost of purchases, the amount of cost savings, and operating efficiency. An effectiveness-oriented performance measurement system centers on the ability of the purchasing function to contribute to the attainment of the firm's goals and objectives. Performance measures include the contribution to profit, quality of supplier relations, and extent of customer satisfaction.

Two types of interaction, optional and required, are examined in the research. In an environment in which interaction is optional, purchasing personnel participate in few nonpurchasing decisions, do not regularly interact with the other internal functions, and do not contribute to the firm's planning process. In such an environment, purchasing possesses little knowledge about what is occurring in the other functions. In an environment in which interaction is required of the purchasing function, purchasing personnel are active participants in nonpurchasing activities; they have high work-related interaction with the other internal functions; and they regularly participate with top management in the corporate planning process. In this type of environment, purchasing possesses much knowledge about the firm's internal activities and the planning process.

Two levels of strategic information, low and high, are investigated in the research. Strategic information includes information such as the nature and characteristics of the end customer, the goals and objectives of the firm, and future expected market conditions and trends.

The research is conducted through an interactive laboratory sim-

ulation experiment. A full factorial design with eight treatments (2x2x2) is used. The research method involves obtaining decisions from a sample of subjects as they respond to a series of purchasing situations through a simulation of the operations of the firm. The subjects, playing the role of a purchasing manager, are randomly assigned to an experimental treatment. The subject is asked to select a response to a series of purchasing problems. Feedback on the subject's performance is provided to the subject after each problem situation. The impact of each response on the firm's profit is captured by the computer simulation. The data from the simulation is then analyzed. The following chapters discuss the relevant literature for the research, the research methodology, the experimental results and analyses, and the implications of the research.

1.5 Contributions of the Research

The major contributions of the research include:

1. The development of a simulator for evaluating the effectiveness of various ways of managing the purchasing function.
2. The provision of a methodology for quantifying the performance of the purchasing function as it impacts the firm.
3. The quantitative evaluation of the impact of performance measurement systems and degree of integration (through its separate components of information: the amount of strategic information possessed by the purchasing function and interaction: the type of internal interaction required of purchasing) upon purchasing and firm performance.
4. The application of an existing methodology to a new field of re-

search.

5. The addition of empirical research and insight in an area where little exists.

2.0 LITERATURE REVIEW

This chapter presents a review of previous research relevant to this study. The review encompasses the topics of the importance and role of the purchasing function, the integration and performance measurement system of the purchasing function, strategic purchasing, and methodologies similar to that used in this research.

2.1 Importance and Role of the Purchasing Function

Every business firm has a better chance for success if its purchasing function is operating properly. In most firms, purchasing plays such an important role that purchasing effectiveness is essential for profitable operations. The importance of the purchasing function was noted over twenty years ago in a Wall Street Journal article: "On the average, 52 cents of each dollar brought in by a corporation goes back out for purchases; a bad buy can conceivably price a company's product out of the market." [129, p.1]

In 1969, an executive in an aerospace firm told an audience:

"We fully recognize that 50 percent of our dollars are on the outside and we must maintain the same surveillance over our suppliers that we do inhouse. Otherwise we could lose our shirt, either financially, schedule-wise, or performance-wise because of actions or lack of action on the part of the supplier. We can no longer afford to take this risk." [108, p.6]

Additional indication as to the importance of purchasing is pro-

vided by the following observations: [92]

1. The 1980 Annual Survey of Manufacturers indicates that in the average manufacturing firm, the purchasing function controls 63 percent of the firm's sales dollar. The potential impact of this control has been noted by several individuals [7,22,104,105,110].

2. The effect of purchasing performance on the firm's profit can be substantial. Victor Pooler comments on the leverage of the purchasing function:

> "If the average company spends 53 percent of its sales dollar on goods and services, a company with a sales volume of $60 million would spend $31.8 million to cover the cost of purchased material, supplies, and services. At an average profit margin of nine percent, it takes $6 million in sales to produce a profit of $540,000; yet, by a reduction of only five percent in the cost of purchases, this profit can be increased by 29 percent ($159,000)". [104, p. 19]

Burt [22] also notes this leverage effect, indicating that a reduction in purchasing expenditures can greatly impact the firm's profitability, and for the equal impact on profit, it is often easier to reduce purchasing expenditures than to increase sales, decrease labor costs, decrease overhead, or increase prices by the needed amount.

3. The effectiveness and efficiency of an organization depends upon the provision of an adequate flow of goods and services by purchasing. Fisk [48] notes the accuracy of this observation, indicating that mas-

ter schedule stabilization is dependent upon the purchasing function, for without the cooperative efforts of the "outside firms" valid master schedules are not possible.

4. The increasing scarcity of materials and energy sources requires purchasing to work to insure adequate supplies for the organization. This situation of decreasing sources of supply and the need for planning on the part of purchasing is recognized by several authors [20,44, 45,70,105,112].

5. Effective purchasing can help decrease or contain the inflationary conditions in the economy. The impact that purchasing can have on inflation and the economy has been noted several times by the National Association of Purchasing Management [96,97] and Hoagland [62,63].

It is generally realized that it is important for a firm to possess an effective purchasing function. Confusion arises, however, in determining what the role of the purchasing function should be. Dinsmore [38] indicates that the role of a successful purchasing function is that of finding sources and materials that will secure for the firm the greatest ultimate value. Lewis [81] notes that among many groups there exists the belief that the primary task of an industrial buyer is that of securing goods at the lowest possible price obtainable, when actually the role of the buyer is much broader, including tasks such as reviewing requisitions, evaluating suppliers, and performing quality, service, and cost tradeoffs. Yet, survey data [10] indicates that less than 20 percent of the general managers surveyed believe that the purchasing function should be solely allowed to purchase the necessary materials. Rather, they believe that purchasing should be given recom-

mendations as to exactly which items to purchase. In addition, twenty percent of the survey respondents want to give the user control over supplier selection.

In a survey questionnaire of purchasing managers and chief operating officers, Pooler and Pooler [105] examine the role of purchasing in industry. The results indicate that the overall role of purchasing in industrial firms has increased in the recent past and will continue to increase in the future.

Purchasing plays an important role in the profit performance of a firm, yet only in the past decade has any significant amount of research been performed in the area. This study attempts to add to that body of knowledge.

In the following three sections, the independent variables to be used in the research are discussed. These variables are: 1) the amount of strategic information available to the purchasing function, 2) the type of interaction required of purchasing, and 3) the nature of the performance measurement system for the purchasing function. The first two variables together represent the degree of integration of the purchasing function while the third variable stands alone in representing the performance measurement system.

2.2 Integration of the Purchasing Function

The degree of integration of the purchasing function refers to the extent to which the purchasing function is involved in the operations of the firm. The degree of integration can be a broad, abstract concept with which to work; therefore, for the purpose of explanation and

experimentation, this variable is decomposed into two primary factors: 1) the amount of strategic information provided to the purchasing function, and 2) the type of interaction required of purchasing.

The use of the above components to represent an integrated purchasing function is supported by a previous work by Reck, Woodson, and Long [111]. These authors describe an integrated purchasing function as a key participant in the firm's strategy process, interacting with the internal functions and obtaining and providing information to the process. This description includes the flow of strategic information to and from the purchasing function and the need for purchasing to interact with the other internal functions. Additionally, previous survey work by the author [66] indicates that these components are most often used in discussing an integrated purchasing function.

The amount of strategic information provided to the purchasing function and the type of interaction required of purchasing is discussed next. Following this discussion, the need for an integrated purchasing function is presented.

2.2.1 Amount of Strategic Information

The amount of strategic information provided to the purchasing function is a key component in depicting the degree of integration of the function. An integrated purchasing function, because of its involvement in the operations of the firm, has access to a greater amount of strategic information than does an isolated purchasing function. In addition, this information is clearer and more complete since it is directly conveyed by the original source rather than being informally transmitted through various channels.

Organizational analysts place varying degrees of importance upon the communication process or flow of information. For example, Chester Barnard [15] essentially places communication as the cause of all else that happens in an organization, while other researchers [47,78] place little or no emphasis on the communication process. Wilensky [139] suggests that four factors determine the importance of communication for the organization: 1) the degree to which the organization is in conflict or competition with the external environment; 2) the degree of dependence upon internal support and unity; 3) the degree to which internal operations and external environment are subject to planned influence; and 4) the size and structure of the organization, its heterogeneity of membership and diversity of goals, and its centrality of authority.

These factors indicate that communication is most important in those organizations (and organizational segments) which deal with uncertainty, are complex, and have a technology that doesn't allow for routinization. Further, the more an organization is people- and idea-oriented, the more important communication becomes.

In relation to the purchasing function, these factors suggest that communication is rather important in the function. The purchasing function generally interacts with an uncertain supply environment; the function consists of many diverse activities; purchasing activities are not easy to totally routinize; and the purchasing function is extremely people- and idea-oriented.

An information flow is generally based upon both social factors and organizational factors. For this research, since the flow of in-

formation does not involve personal contact, the social factors of the information process are not considered. The organizational factors are, however, relevant and are therefore discussed.

The primary organizational considerations are those of vertical and horizontal communication. Vertical communication within an organization involves upward, downward, and external communication flows. Downward communication generally flows from top management to the individuals in the subunits while the reverse flow occurs in upward communication. External communication refers to communication with the outside environment.

Katz and Kahn [67] identify five elements of downward communications. The first element is that of job instruction, in which a subordinate (or subfunction) is informed what to do either through direct orders, training sessions, job descriptions, or other such mechanisms. The intent of such instructions is to ensure reliable job performance.

The second element relates to the meaning of the job and its relationship to the rest of the organization. It is through this information that individuals are provided with the reasons for and importance of their function within the organization.

The third element is information regarding the procedures and practices within the organization. The purpose of this information is to enlighten the subordinate (or subfunction) as to the operations of the overall firm.

The fourth element of downward communication involves feedback to the individual (or the function) regarding his/her performance (or the performance of the function). Feedback, although creating varied re-

sponses, is generally found to be a consistent part of downward communications.

The fifth and final element of downward communication involves the communication of ideology. Through the transfer of ideology, the organization tries to involve the subordinate (or subfunction) into the purposes of the organization and convince him/her to accept and work toward the organization's or subunit's goals. Hall [54] indicates that this transfer of goal information is essential for the effective functioning of the individual and the effective implementation of the individual's ideas. If the individual (or subfunction) is not aware of what the goals really are, his own actions may not contribute to the organization. Members of an organization must know the "system" if they are to operate within it or to change it.

Downward communication is an important flow of communication within an organization and it is the primary means by which a function (purchasing included) or an individual receives information on job responsibilities, the importance of the function's organizational role, or the role and procedures of the organization itself.

Upward communication, in accordance with Katz and Kahn [67], generally takes the form of what the person says 1) about himself, his performance, and his problems, 2) about others and their problems, 3) about organizational practices and policies, and 4) about what needs to be done and how it can be done. Obviously, this type of communication can range from a personal complaint to a fact-based suggestion for the improvement of the organization. Upward communication is important as it is a primary means by which top management gains information. This

information may concern the firm's external environment, the overall performance of the firm, the performance of the individual subfunctions, or problems existing within the subfunctions.

Vertical communication also occurs within an organization in the form of external communication. This type of communication includes the flow of information between the customers and the firm and the suppliers and the firm. It also includes the attainment of basic information about either the supply or sales environment. Such external communication is necessary if the organization is to deal effectively with its various environments.

The second major type of organizational communication is that of horizontal communication. Horizontal communication can occur both within an organizational subfunction or between subfunctions. Communication within a subfunction generally deals with task-oriented information and serves to coordinate functional efforts on various activities. Communication between subfunctions serves to coordinate activities between the functions and is vital for the overall coordination of operations. Such communication is also beneficial in solving conflicts between the functions.

The factor of communication is quite amenable to experimentation; thus, a significant amount of research has been conducted using this factor. Several authors have attempted to determine the communication system that is most efficient under particular circumstances [19,36, 79]. Katz and Kahn [67] and Blau and Scott [19] note that the more complex the task, the more time is required for the communications network to become structured. Guetzkow [52] discusses problems of

omission and distortion, and Katz and Kahn [67] and Jacoby et al. [65] discuss problems of information overload.

This research uses the factor of information as an independent variable; however, the information is provided to the subjects without personal contact and without the intent to overload the subjects with information. Depending upon the experimental treatment, incomplete information is at times provided.

Communication, or the flow of information, is necessary within an organization. The key to the communication process is to ensure that the correct people get the correct information (in quality and quantity) at the correct time. For the purchasing function, timely conveyance of this information is necessary because the function is entirely dependent in its operation upon information flows both from the other functions of the firm and from the external environment.

Every functional activity within the firm generates information to, and/or requires information from, the purchasing system. The information sent to purchasing can be essentially divided into two major categories [40]:

1. Statements of needs for materials and services obtained from outside the firm.
2. Requests for information available within purchasing or obtainable from outside the firm.

A brief description of some of the information flowing to the purchasing function from the internal functions is as follows:

The planning function provides purchasing with information necessary to obtain the long-term future requirements of the

firm for facilities, materials, and outside services. This information is especially important in preparing for future construction and for raw materials in tight or diminishing supply.

Sales forecasting provides sales forecasts to purchasing for periods up to twelve months in advance. Such information allows purchasing to obtain the optimum balance between the conditions in the marketplace and the needs of the firm.

The accounting function provides information on payments to suppliers, cost studies for make or buy decisions, and comparison of actual expenditures to budget.

The production function often provides information on the quality requirements for materials. Production control provides information on what materials are needed and in what quantities for a given time period.

Quality control and receiving provide information which determines if the suppliers have furnished materials of the quality and quantity sought by the purchasing function.

New product development provides information about material requirements for upcoming products. This information is required by purchasing at the inception of the project if purchasing is to fully contribute to the product development.

The purchasing function not only potentially receives information from all of the internal functions, but it can also be one of the firm's major contact points with the external environment. As such, the function can be a major receiving point for the flow of information

from sources outside the firm.

A brief description of a few of the major types of information that may be obtained from external sources is as follows [40]:

General market conditions--Purchasing executives and buyers become specialists on general market and business conditions. They are constantly informed as to prices, supply and demand factors, and competitors' actions.

Sources of supply--Purchasing individuals are continuously receiving information from current and new vendors; therefore, in new product development and sourcing of any type, purchasing has the information.

Suppliers' capacity, suppliers' production rates, and labor conditions in the suppliers' plants and industries--Information flows on these factors are of great importance in determining inventory policy and assuring continuity of production as far as materials are concerned.

New product and product information--Purchasing can obtain information about external products that may be useful to the firm in improving effectiveness, reducing costs, or aiding in the development of new products by the firm.

The purchasing function potentially receives information from both the other internal functions and external sources which can improve its own performance. Much of the external information received by purchasing can also be valuable to other functions within the firm.

According to England [40], there are very few functions of a business which are not concerned to some degree with the information which

flows or can be generated from purchasing. For example, purchasing can provide general management with information about the current market and business conditions. This information, when correlated and refined, can provide top management with valuable information in the operation of the firm. Purchasing provides engineering with information on products, pricing, and sourcing. Product development can be provided with new materials information and price information. The production function depends upon purchasing for information about materials, material availability, material delivery lead times, material substitutes, and information on supply sources for production equipment, maintenance, and repair.

The operations of the purchasing function are dependent to a large extent on the flow of information from the various functions of the firm to purchasing, and from external sources to purchasing, while the operations of the firm and many of the internal functions are dependent to a large extent on the information obtained from (or through) purchasing. The purchasing function can obviously be a communications center in which it receives, processes, and distributes information.

2.2.2 Type of Interaction

The type of interaction required of purchasing is the second key factor in describing the degree of integration of the purchasing function. The types of interaction to be considered are those of required interaction and optional interaction. The factor of interaction has been studied by several previous researchers. Much of this previous research is useful in that it is helpful in defining the treatments for this research.

Turner and Lawrence [131] study the relationship between task attributes and worker response, incorporating required interaction and optional interaction as task attributes. Required interaction refers to the amount of necessary interdependence between tasks, particularly that kind of interdependence for which direct face-to-face communication is needed to perform the task properly. The communication (or interaction) can be required either to solve a job problem or to exchange task relevant information. The amount of required interaction in a job is measured by 1) the number of people with whom the worker is required to interact at least every two hours and 2) the quantity of time spent in required interaction.

Optional interaction refers to the opportunity available for interaction which is not essential for task completion. The authors look at optional interaction both on the job and off the job. Optional interaction on-the-job is measured by 1) the number of people available for interaction in the work area and 2) the quantity of time available for interaction while working. Optional interaction off-the-job is measured by the amount of time during which the worker is free to choose to leave the work area without reprimand.

Patchen [102] examines the individual's degree of participation in decision-making in an attempt to determine the degree to which the employee is involved in his job and the company. Walker and Guest [134] employ factors of frequency of social interaction and size of interacting group in studying the jobs of workers on an automobile assembly line. Hackman and Lawler [53], in their research on employee reactions to job characteristics, include two job dimensions of interaction:

dealing with others--the degree to which a job requires employees to deal with other people (either customers, other company employees, or both) to complete the work; and friendship opportunities--the degree to which a job allows employees to talk with one another on the job and to establish informal relationships with other employees at work.

In terms of the interaction variable and an isolated or integrated purchasing function, an isolated purchasing function generally has only the option to interact with the other internal functions, top management, and the external environment; whereas an integrated purchasing function is generally required to have a high degree of interaction with such elements.

Within the isolated function, this optional interaction occurs only if the purchaser herself chooses to interact and if those parties involved desire the purchaser's interaction. Often, with the existence of an isolated purchasing function, other personnel are not accustomed to the participation of purchasing and therefore might consider it to be a form of intrusion.

Within an integrated function, purchasing is expected to provide input for traditionally nonpurchasing decisions; the function is expected to interact with top management in the firm's planning process; and purchasing has the opportunity to obtain information from the other functions, which improves purchasing's ability to meet its responsibilities. Anyon [13, p.37] depicts this interaction process in his description of the relations between purchasing and other personnel:

> "In most organizations, the purchasing personnel should cooperate with all individuals to obtain far more than

> a superficial knowledge of their requirements. The value of the purchasing organization to the enterprise depends upon the efficiency of the service it renders in procuring materials, supplies, and information necessary to the operation of the other departments. It is impossible for purchasing to be completely familiar with all details of all needs. Therefore, it is only by the establishment of mutual confidence and a free flow of information that economical purchasing can be accomplished."

The purchasing process is not departmentalized; instead, the process cuts across organizational boundaries, including activities in operations, marketing, engineering, inventory control, quality control, and finance. In view of the level of interaction involved in the purchasing process, Heizer [60,p.22] indicates "...that a large proportion of the critical aspect of the purchasing manager's job is dependent upon his prowess in the areas of technical competence, communication, external environment, and coordination."

Empirical work involving the interaction of the purchasing function into the operations of the firm is limited; however, several survey studies deal with this topic. In 1974, Ammer [9,10] conducted a survey of general managers and purchasing managers. A portion of this survey deals with the participation of purchasing in decision-making. Ammer indicates that one of the best measures of top management's support of purchasing is the latter's participation in nonpurchasing decisions. It is necessary that purchasing be involved in these deci-

sions as almost all of these decisions have ramifications that affect purchasing. However, despite the need for a purchasing opinion in all decision-making, the survey results indicate that only 21 percent of the general managers surveyed said that purchasing managers "frequently" participated in nonpurchasing decisions; 53 percent of the managers said that this was an "infrequent" occurrence. A majority of the general managers believe that purchasing managers should actively participate only in decisions that are directly related to purchasing, such as major contracts with suppliers, inventory policy, and make-or-buy analyses. A small minority of general managers agree that purchasing should actively participate in all decisions concerned with (in order of declining popularity) major changes in product line, market and price forecasting, facilities planning, long-range planning and overall strategy, trade relations, acquisitions, and financial planning.

In another survey questionnaire, Rich [112] compares the status of the purchasing organization in times of material shortages with the status prior to such a period. The survey indicates that in times of material shortages, two changes occur: 1) The purchasing function is often expanded to include additional responsibilities such as forecasting, inventory control, and warehousing; 2) Purchasing increases its participation in new product development and long-range corporate planning. In addition, in an open-ended question, purchasing directors were asked if there were any other significant measures which their companies took to cope with problems of material scarcity. The responses obtained included the following: interdivisional coordination in purchase and usage of materials (14%), formation of a special mate-

rials committee or task group at the corporate or at the operating level (11%), expansion of the purchasing staff (11%), and stronger support for, or involvement in, purchasing by top management (20%). These results indicate that during times of shortage, management tends to place more importance on the performance of purchasing and to more fully integrate the function into the operations of the firm.

Bonfield and Speh [20], in their survey of chief operating officers and purchasing managers, found that the overall role of purchasing in the decision making process of the firm is seen to have increased in the past and is expected to continue to increase. The survey respondents expect to see changes in five dimensions of purchasing: 1) vendor analysis, 2) top management functions, 3) production planning, 4) educational needs, and 5) materials management functions. In all five areas, the participation and responsibility of the purchasing function are expected to increase. Increases expected in the area of production planning are not as dramatic as those in other areas, reflecting the fact that production planning is often considered as part of the traditional purchasing job. Increased participation in top management functions such as the establishment of purchasing policies, centralization of purchasing, and overall planning is expected to be large, as is the involvement in materials functions such as planning and forecasting future or long-run supply needs, and inventory control.

In the context of non-empirical work, numerous authors have commented on the interaction of the purchasing function. Several authors [9,14,16,48,74] have discovered that purchasing is not involved in the firm's planning process. The function generally does not receive any

information from the process and does not provide any information to the process. Bauer [17] and Farmer [44] purport that purchasing is not doing enough (or any) planning within the function itself. Fisk [48] and Ammer [10] indicate that purchasing is not interacting with the other functions; and Farmer [45] finds that purchasing individuals view themselves only as tactical purchasers working within departmental boundaries. Farmer [46] also finds that the strategies of the more successful companies already incorporate analysis of and action toward the supply market (purchasing activities).

2.2.3 Need for Integrated Purchasing

An integrated purchasing function is completely involved in the operations of the firm, regularly interacting with both the internal and external environments. As such, the function has access to an abundance of information. Many authors [2,5,20,22,45,104,125] believe that an integrated purchasing function is necessary if the purchasing function is to adequately perform its responsibilities. Reasons for this viewpoint stem primarily from the uncertainty and complexity of today's purchasing environment.

Shortages were a severe problem for managers in the early 1970's. Conditions have recently improved but supply problems are not a thing of the past. Enis and Smith [41] indicate that a number of environmental factors will continue to contribute to the problems in purchasing materials and components. A few of these factors include rising worldwide demand, rising nationalism, few sources of certain critical materials, inflation and devaluation, and supplier cartels. The authors feel that supply problems will become a permanent part of the economic

scene, and that purchasing managers are currently not ready to effectively meet these supply problems. To prepare themselves for these problems they need to begin to plan, to anticipate shortages, and to trigger action. To perform these functions effectively, the purchasing function needs more information about the firm and its environments. To obtain this information, the function needs to be integrated into the firm's operations.

One paper by Reck, Woodson, and Long [111] addresses the re-integration of the purchasing function in depth. The authors discuss the evolution of a neglected purchasing function and the consequences to the firm and purchasing which are associated with this evolution. The authors then present a solution to these problems and the specific steps for implementing this solution. The authors suggest that the solution to the problems created by possessing an isolated purchasing function simply lies in re-integrating this function back into the strategy of the firm. Purchasing needs to become an active participant in the firm's top management strategy team. The steps for implementing this integration involve: changing top management's perceptions of purchasing, utilizing the customer satisfaction effect, elevating and re-integrating purchasing to equal status with the other key functions, and redefining the role of purchasing. According to these authors, benefits arising from this integration include: the development of valid purchasing goals and performance standards, improved purchasing performance, reduced interdepartmental conflicts, the elimination of unnecessary purchasing costs, and an increase in the firm's total sales, market share, efficiency, productivity, and long-term profita-

bility.

Reck, Woodson, and Long believe that if the current managerial problems are to be resolved, three basic issues must be addressed:

1. Why does top management often not understand the purchasing function, and therefore not effectively manage it?
2. How should the purchasing function be managed in order to capitalize on its total potential to benefit the firm?
3. What are the tangible benefits that a firm would derive if it did effectively manage the purchasing function?

The research described in this paper attempts to examine, through empirical data, the viewpoint of these authors and to provide an experimental basis by which to address the issues presented by the authors.

2.3 Performance Measurement System

This section reviews the literature regarding the third independent variable, the performance measurement system of the purchasing function. The section covers the topics of managerial expectations of purchasing, Locke's model of goal setting, and the nature of performance measurement systems for the purchasing function.

2.3.1 Management Expectations

The purchasing organization performs a particular function for the firm, and thus top management has certain expectations or requirements for the performance of the purchasing function. In a survey of over 200 top executives [59], questions were asked as to management's expectations of purchasing performance. The results of the survey are quite extensive; however, to summarize the views of management, the following

six responsibilities indicate the expectations of the purchasing function:

1. Buy competitively. Top management expects its purchasing department to buy competitively and at prices at least as good as those at which its competitors buy. The purchasing function is expected to keep the company competitive by purchasing the right amount, at the right time, at the right price. Purchasing is also expected to stay informed of all factors which will affect supply and price and make recommendations as to when to buy.

2. Materials: help in selection. Top management expects purchasing to constantly recommend new, different, and substitute materials. If prices are too inflexible, if supply is short, or if new materials have been developed, the purchasing department is expected to bring this information to the chief executive.

3. Alternate sources of supply. Purchasing should always have at least two sources of supply available for its major requirements.

4. Effective inventory levels. Purchasing is expected to examine inventory levels in relation to needs and assist in establishing the most economical and safe level.

5. Vendor relations. Top management expects the purchasing department to develop and promote good vendor relations as a company asset.

6. Effective coordination and cooperation. Purchasing is expected to coordinate effectively with all other parts of the business and obtain the cooperation of all departments.

The survey results also indicate that 89 percent of the managers believe that purchasing performance would improve if purchasing respon-

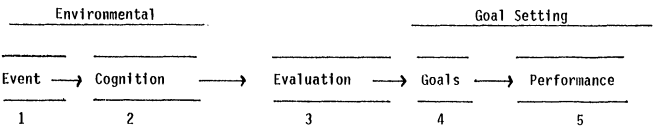
sibilities were more clearly pinpointed and the capabilities of present personnel were developed to a higher state. The implication of this finding is that top management is expecting improvement in the performance of the purchasing function.

2.3.2 Locke's Model of Goal Setting

Locke's model of goal setting deals with the relationship between conscious goals and task performance, in which the goals indicate the future levels of performance that an individual will seek to attain. The underlying premise of the model is that an individual's conscious intentions or goals generally regulate his or her actions. The model is partially based on Ryan's theory of motivation which states, "A very large proportion of behavior is initiated by tasks (goals, intentions) and a very large proportion of tasks lead to the behavior specified by the task...a task is a necessary condition for most kinds of behavior." [117, p.79]

In particular, Locke's model of goal setting is illustrated in Figure 2.1. The model consists of five stages: 1) Events--Events are the nature and various properties of things existing within the environment, i.e., incentive; 2) Cognition--Individuals must perform value judgments, and to do this they must develop a set of standards by which they may determine these judgments; 3) Evaluation--Individuals must develop a set of standards by which to evaluate their judgments; 4) Goals--Goals are directive in nature and work to guide one's thoughts and actions toward a particular result; 5) Performance--Performance is the process of directing action toward some level of performance.

For this study, primary attention is focused on the relationship



Locke, E. A. (1968) "Toward a Theory of Task Motivation and Incentives," Organizational Behavior and Human Performance, 3, 157-189

Locke's Model of Goal Setting

Figure 2.1

between stages four and five, the impact that goal setting has on subsequent action and performance. According to the theories of Locke and Ryan, goals regulate the action and performance of an individual. In the case of the purchasing function, management determines and sets the goals for the function through its performance measurement system. Therefore, through the goals it sets for the purchasing function, management has the ability to influence the actions of purchasing. For example, if management sets goals related to cost minimization and internal operating efficiency, purchasing individuals will seek to attain these goals. Consequently, management must develop goals which will produce the purchasing behavior which management desires.

Currently, as indicated by the survey of Monczka, Carter, Hoagland, and Foster [92], most performance systems for purchasing emphasize goals of cost minimization and internal operating efficiency; yet, these goals will not serve to meet the expectations that management seems to have of the purchasing function. Evidently, management appears to be setting goals for the purchasing function which are inconsistent with the performance it expects to obtain. In regard to this situation, Lewis [81, p.141] states, "...If management gives to the procurement officer no larger place than that of a routine price buyer, then one can scarcely condemn the occupant of such a position for doing only the thing expected of him." Lewis implies that the buyer must do his job well, but to do it effectively it is necessary for management to recognize his potential and provide appropriate motivation.

2.3.3 Purchasing Performance Measurement Systems

Lee and Dobler [80] indicate in reference to the purchasing function that successful departmental operation is largely dependent upon two broad factors: 1) organization, operating policies, and procedures; and 2) personnel. It is the first factor on which we focus when we consider the performance measures for the purchasing function. The goals, objectives, and performance measures for the purchasing function provide the means by which management guides, motivates, and controls purchasing performance.

The performance measurement system for the purchasing function exists along a continuum between a purely efficiency-oriented system and a purely effectiveness-oriented system. Of course, systems of varying combinations can be developed. For the exploratory research described in this paper, these systems are broadly categorized into two types, a performance system which primarily emphasizes efficiency measures and a system which primarily emphasizes effectiveness measures.

Organizational effectiveness, as defined by Etzioni [42], is the degree to which an organization realizes its goals. He indicates that it is not a simple issue and that often "efficiency" is confused with effectiveness. He defines efficiency as the amount of resources used to produce a unit of output and continues by indicating that an organization can be efficient without being effective, and vice versa.

Etzioni indicates that often an organization has a tendency to develop goals for only those activities which are easily quantifiable. Such a tendency often results in the formation of only efficiency-oriented goals. When this occurs, the true goals of the organization may

not be recognized and the purpose for which the organization was developed may not be realized.

Research in the area of organizational effectiveness has not produced any clear-cut approaches to the issue. In early work on effectiveness, Georgopoulos and Tannenbaum [50] suggest that measures of effectiveness must be based on organizational means and ends (i.e., productivity, flexibility, absence of conflict) rather than on external criteria. More recently, Price [106] has compiled a set of hypotheses dealing with several characteristics which he believes to be indicators of effectiveness. The primary indicator is that of productivity. Price continues this work by linking specific organizational characteristics to effectiveness. He proposes, for example, that characteristics such as the acceptance of the legitimacy of the decision-making system and high rates of communication within the organization are positively related to effectiveness.

Seashore and Yuchtman [121] approach the issue in a slightly different manner and recommend the use of a systems-resource model (or open system) for analysis of organizational effectiveness. According to such a model, effectiveness is the ability of the organization, in either relative or absolute terms, to exploit its environment in the acquisition of scarce and valued resources. The authors indicate that an organization is most effective when it maximizes its bargaining position and optimizes its resource procurement.

Empirical research in the area of purchasing performance is rather minimal, and that research which does exist generally does not directly refer to the performance system as being either efficiency- or effec-

tiveness-oriented.

Monczka [90] classifies the literature on purchasing performance into four categories:

1. Conceptualizations about why purchasing performance should be measured and general suggestions for how to do so.
2. Descriptions of how one company measures purchasing performance along a selected dimension.
3. Research that is directly or indirectly related to purchasing performance but which is not very useful for developing purchasing performance measurement systems.
4. Research directly related to purchasing performance measurement but which has limited generality due to the research sample and/or analysis.

Much of this literature serves to provide information; however, few pieces provide substantive research. Therefore, most of this literature is not addressed; rather, only the empirical and related explanatory work is presented.

Ammer, in the previously discussed survey work [10], discovered that purchasing performance is rarely measured by the objective, occasionally rigid standards that are applied to other activities. As long as material flows in a reasonably smooth fashion, management does not seem to be interested in the performance of the purchasing function. Those performance measures which do exist tend to be developed by the purchasing manager or the internal audit committee. In addition, according to the study, 33 percent of the general managers and 27 percent of the purchasing managers do not believe that purchasing performance

should be measured in terms of its direct impact on profitability. Instead, they view purchasing as an activity to be performed as economically and efficiently as possible.

Monczka, Carter, Hoagland, and Foster [92] performed a survey to determine the type of purchasing performance measures that are being used in American firms. They discovered that there is a fairly common set of performance measures being employed. These measures include 1) productivity, 2) price effectiveness, 3) availability, 4) supplier delivery, 5) supplier performance, and 6) purchasing activity. The productivity measures consist mainly of output/input measures and are primarily used to monitor purchase activity and establish or justify manpower levels for budget purposes. Price effectiveness is often measured on the basis of comparison of actual price against operating plan or standard cost. In addition, various cost reduction and cost savings measures are being used. Availability measures are often reported in terms of on-time delivery quantities, percentages, or service levels provided for the items needed in the manufacturing process. Supplier delivery and performance are generally based on indices of delivery and quality levels over a period of time. Purchasing activity measurements are used to monitor and control purchase activities and often consist of time objectives, such as time required to perform requisition processing, bid evaluation, and order placement. The survey concludes that in American business firms there exists an overwhelming reliance on the use of performance measures for cost reduction, cost avoidance, price control, and internal operating efficiency. The use of these measures focusing on efficiency and cost minimization

may work to decrease unnecessary costs but do little to motivate and improve the effectiveness of the purchasing function from a broader perspective.

Spekman and Hill [126] note that in recent years more emphasis has been placed on methods to improve purchasing performance. This emphasis, however, has centered on improving purchasing efficiency--which implies a focus on short-run, day-to-day, tactical decisions. As a result, insufficient attention has been given to improving purchasing effectiveness, which includes those longer range strategic purchasing decisions which should mesh corporate goals with the purchasing process. The authors feel that objectives such as decreasing the number of dollars invested in inventory, minimizing the internal cost of purchasing, and searching for the lowest cost alternative are all important; however, these objectives do little to prepare the purchasing individual for dealing with strategic issues like worldwide sourcing, supplier development, or materials availability.

In order to determine if purchasing managers tend to approach their job in an efficiency-oriented, tactical manner, Spekman and Hill conducted a survey questionnaire of purchasing individuals at various levels in the hierarchy. The results of the survey indicate that higher level purchasing individuals perform more environmental monitoring (obtaining information regarding governmental factors, general economic indicators, corporate policies, and local economic conditions) than the lower level purchasing individuals. However, this activity is the least important activity for these higher level managers. These managers spend more time on the operation, coordination, and management

of purchasing activities than on environmental monitoring activities. Higher level purchasing individuals tend not to think of their activities in terms of strategic implications and spend little time obtaining information for the firm's planning process. In view of this finding, the authors conclude that purchasing managers are not prepared to cope with the complex, dynamic market of the 1980's.

In addition to the empirical work previously presented, there is also some relevant non-empirical work in this area. Croell [34] discusses the measurement of purchasing effectiveness and presents a set of both efficiency and effectiveness measures. Efficiency measures which must be compared over time include: dollar purchases, purchases divided by sales expressed as a percent, number of purchase orders, ratio of purchasing costs to company costs. More objective, or timeless efficiency measures are 1) departmental operating expenses, 2) cost of materials purchased or standards costs, 3) dollar value of materials on order, and 4) cancellation charges paid.

In terms of effectiveness, the author suggests that purchasing be judged on its performance in areas such as the following:

1. Review of present product costs, and comparison with purchase prices on sub-parts to determine short or long-term directions in which to move in producing parts in-house.
2. Planning and negotiations required to assure adequate fuel supplies for short and long-range needs.
3. Review of present and long-term future commodity needs, and then performance of subsequent analysis to determine if an acquisition or internal development of the area of concern would be appropriate.

4. Development of purchased material inventory policy, followed by close coordination with or control of the inventory group personnel actually implementing the policy.

5. Review of new products being developed to determine whether or not parts should be produced internally, or purchased from suppliers.

6. Active participation in buying from, and development of, minority enterprises.

The measurement of purchasing performance in each of these areas can best be achieved by setting specific goals relevant to the problems at hand. The objectives can then be evaluated in terms of how well these goals are achieved.

Zenz [142] promotes the use of a materials management organization with purchasing being one of the included functions. He suggests using the following measures of performance for the purchasing function:

1. Ratios of total purchasing salaries and expenses to total purchases and total manufacturing salaries and expenses.
2. The value of purchase orders subjected to competitive bidding, as a percentage of total orders placed.
3. Number of rush orders.
4. Quantitative measures of expediting expenses.
5. Savings on discounts and quantity purchases.
6. A measure of the extent of successful substitutes of materials and parts.
7. A quantitative measure of idle machines and/or personnel resulting from a lack of purchased supplies.
8. Ratio of rejected purchases to total purchases.

9. Measure of the extent of supplier technical assistance.

10. Measure of vendors' keeping delivery promises.

Of these measures, the first five appear to be oriented toward efficiency as they focus on internal operating efficiency, activity measurement, and short-term cost. The latter five, especially seven and nine, are more oriented toward effectiveness as they deal with items which impact the firm's performance and focus on the development of long-term relations.

Bauer [16] indicates that management would like to change the passive, efficiency orientation of the purchasing function but they don't know how, for criteria for measuring the effectiveness of purchasing are rare. Bauer recommends that purchasing be profit-oriented, always considering how their actions affect the company as a whole. He suggests three areas in which performance should be measured:

1) Purchasing savings--the effectiveness in reducing costs. Measures in this area include the mere existence of a cost reduction program and the ratio of total annual purchasing savings to total annual purchases.

2) Procurement planning--the systematic procurement of key items. Measures for this area include the number of commodities planned and the number of commodity plans per buyer.

3) Purchasing efficiency--efficiency in performing purchasing activities. Measures in this area include the ratio of total buying costs to total annual purchases and the ratio of purchasing employees to total company employees.

The second area of measurement, procurement planning, highlights the effectiveness of the function while the third area, purchasing

efficiency, highlights the efficiency of the function. The first area, that of savings, is not as clearly defined. This area appears to primarily focus on the efficiency aspect of the function. However, if it considers savings obtained within the total firm because of purchasing actions, as opposed to only purchasing savings, or if it considers the longer term effects of cost reductions, then this area might also be a measure of effectiveness.

Spekman [124] feels that management must develop purchasing's potential to generate profits. To do this, a methodology is needed for evaluating the efficiency and effectiveness of the purchasing function. Through a systematic evaluation or audit, management can ensure that its purchasing department is attuned to those environmental and corporate factors which impact a company's long-range objectives. As a part of this audit, the performance measures should be examined. He explains that many purchasing managers incorrectly rely on efficiency measures such as dollars purchased, purchases as a percentage of sales dollars, number of purchasing orders, or dollars spent per buyer as measures of purchasing effectiveness. These measures, while providing information, do not permit analysis of the purchasing department as a profit generating center. Instead, these purchasers should be using effectiveness measures. Spekman feels that two of the more widely recognized indicators of purchasing effectiveness are cost savings and delivery performance.

Cost savings is a difficult measure to use in evaluating purchasing effectiveness because of 1) the difficulty in defining what constitutes a cost savings and 2) the fact that factors causing cost vari-

ances (difference between standard cost and actual price paid) are not always within the control of the purchasing function. Despite these problems, however, savings can be an indication as to how well purchasing is controlling costs.

Delivery performance is measured by two components: on-time deliveries and quality of materials. Both of these measures help describe supplier performance. They also measure events which can have a negative impact on the firm's profit performance: Late deliveries can cause production slowdowns and unanticipated inventory fluctuations, thereby impacting the firm's profit. The rejection of key materials can cause substantial expense if revision of production schedules is necessary because of not having the needed material.

Evans [43] recognizes the need to differentiate efficiency versus effectiveness measures by grouping purchasing performance measures into three categories:

1. Financial parameters (effectiveness measures)--those that relate directly to the impact of the department's activities on the cost/price performance of the company. Parameters included in this category are price variance identification, price trend analysis, and the major parameter of cost savings/value analysis.

2. Functional effectiveness parameters--those that relate to the non-price requirements of the purchasing function. Parameters included here are mainly based on user requirement satisfaction and vendor effectiveness control.

3. Operations efficiency parameters--those that relate to the internal efficiency of the department itself. Parameters in this category

include budgets and operating costs, activity measurement, and throughput measurement.

2.4 Strategic Purchasing

Empirical work specifically dealing with strategic purchasing is quite rare; however, since the proposed research deals with this topic, some expositional work is described here.

No universal definition or description of strategic purchasing exists; however, several authors have put forth their own definition of the term. Spekman and Hill [126] state that strategic purchasing can be viewed in terms of those decisions which link the firm to its environment. They view purchase decisions on a continuum ranging from operational or tactical decisions to strategic. Tactical decisions are often enacted at lower levels in the purchasing hierarchy and tend to deal with routine, short-range, structured kinds of purchasing problems. Strategic purchasing decisions typically occur at higher levels in the purchasing hierarchy and focus on those problems that will impact future, long-range procurement requirements of the firm. These types of decisions often require a great deal of information from the firm's external environment and are tied inextricably to the firm's corporate goals and objectives.

Farmer [45] feels strategic purchasing is based on obtaining a competitive advantage from the company's supply market. Supply factors not only have considerable effect on near-term profitability and risk, but they also affect long-term competitive strength and firm security.

Kiser [71] feels strategic purchasing must incorporate knowledge about the market place and its segments and the buying firm's competi-

tive advantages and disadvantages relative to suppliers, as well as the potential synergy involved in the situation.

Rink [115, p.232] provides a working definition of strategic purchasing as "...a set of rules that guides the configuration of the firm's purchasing effort over time in response to changes in competition and the environment so as to permit the firm to take advantage of profitable opportunities."

Many authors feel it is necessary for purchasing to become a strategic component of the firm. Spekman [125] indicates that effective strategic procurement can have a profound impact on a firm's stance in the marketplace. Spekman and Hill [126] believe the purchasing issues of worldwide sourcing, supplier development, and materials and energy availability will be the issues of the future to affect long-run corporate profitability. Pooler and Pooler [105] feel purchasing must broaden its activities to include strategic activities such as the integration of market and supply strategies; more intensive selection, motivation, and evaluation of vendors; and greater utilization of vendor's technological innovations.

Several authors [2,21,45,111,125] promote the idea that purchasing has two roles to play within the corporate planning process. First, the function must develop an internal, functional strategy which supports corporate strategy. This internal strategy must include operating plans and budgets based on a specific plan of action and a timed sequence of resource commitments. Second, purchasing must contribute to the firm's strategic planning process. A composite of these contributions should include the following:

1. Short-term anticipated cost increases (or decreases) and long-range cost trends.

2. Long-range availability of specific critical raw materials.

3. Plans of vendors that may change the price or availability of materials.

4. The influence of the firm and the influence of its industry with vendors.

5. Identification of materials and services required to support the firm's strategies.

6. Development of supply options.

7. General expected availability of parts, assemblies, and related materials due to various forces in the economy and marketplace.

The authors feel that this dual role of purchasing is very valuable, since the firm would be receiving data necessary for corporate strategy from the source of expertise--purchasing. Often when purchasing is not included in the corporate planning process this information is either ignored or assumed, causing the firm to base its strategy on erroneous data.

To employ the concept of strategic purchasing, it is important to recognize the composition of a strategically-oriented purchasing function. In a previous work by the author [66], the literature regarding strategy and purchasing was reviewed and analyzed. Through this review a listing was formed of those primary variables used in defining or describing a strategic purchasing environment. These variables include: the amount of interaction with other functions, the involvement in nonpurchasing decisions, the type of goals and objectives, the

type of performance measures, the level in the hierarchy, and participation in the corporate strategy process. On the basis of these variables, it was determined that a strategically-oriented purchasing function will: 1) generally be located at a "high" level in the organization, 2) have a "high" degree of involvement with other functions and upper management, 3) participate in a "high" degree of nonpurchasing and strategic-type decisions, 4) possess goals and objectives broad in scope and aimed toward profit maximization, 5) have access to a large amount of information, 6) have performance measures focusing on effectiveness rather than efficiency, and 7) provide input to corporate strategy.

These characteristics are not separate and distinct; rather, they overlap and often go hand-in-hand. As such, several of these variables can be reasonably grouped together and considered as one variable. For example, the involvement with other functions, in nonpurchasing and strategic-type decisions, and in corporate strategy can be considered together as the type of interaction required of the purchasing function. The types of goals and objectives and the focus of the performance measures can be considered together as the type of performance measurement system, and the access to information represents the clarity and amount of information available to the purchasing function. For the purpose of this particular experiment, it is adequate to consider several of these characteristics as a single variable. Future work may want to concentrate on the particular characteristics composing the variables in this research.

2.5 Methodology

The methodology employed in this research is not new; rather, it is simply being applied to a new subject area. This research combines the use of laboratory experimentation and simulation. In the laboratory portion, subjects, provided with an initial orientation scenario, respond to several problem situations. The simulation captures the subjects' decisions and then determines the impact of these decisions on the firm's performance. Laboratory experimentation, orientation scenarios, and problem situations have been used in purchasing and marketing research while simulation is often used in operations management research.

The use of simulation as an experimental vehicle is quite common in the operations area [61,119,135]. PROSIM [51,89], an operations simulation, has been extensively used as a teaching tool for graduate students.

PROSIM provides an opportunity to plan and schedule a simple, simulated factory. The factory consists of three departments: final assembly, subassembly, and parts. Four types of inventory are tracked: finished goods, sub-assemblies, parts, and raw materials. Raw materials are ordered from suppliers and sales of finished goods are made to customers.

The simulation operates on a monthly basis, and each month 48 decisions are required. These decisions determine issues such as the production rates for each of the end products, subassemblies, and parts; the order quantities for each raw material; and the manpower levels for each department. When the decisions are submitted, the

simulator checks the available material and labor input against the desired production and, if necessary, reduces production. Then all inventory levels are updated; demand is filled from inventory; excess demand is added to next month's demand; and finally, raw material orders are received and updated. Costs are calculated for: hiring, firing, and transfer of workers, payroll costs, inventory holding, and backorder costs.

The simulation model in the present research incorporates the basic structure of PROSIM, but for this research the production decisions are totally automated to produce the best solution given the situation. Decisions are needed within the purchasing interface which has been added to the model.

The use of laboratory experimentation as a research tool is well established in purchasing research [18,27,39,55,58]. This previous work, although not in the area of purchasing performance, indicates that laboratory experimentation can be useful in addressing several purchasing issues.

The use of orientation scenarios and problem situations is also not new to the field of purchasing research. Cardozo and Cagley [25] investigate buyer behavior in risk situations by means of a buying game in which each participant is presented with eight purchase decisions, one at a time. The amount of risk is manipulated through variations among the eight purchase decisions. The type of risk (two levels) is manipulated by using two short written scenarios, each preceding a group of four decisions. The two orientation scenarios describe the external environment of the company for which the participant works and

are identical except for the type of risk.

Lambert, Dornoff, and Kernan [77] examine the impact of feedback upon buyers' attitudes and subsequent behavior through the use of a buying game. In the buying game, the subject plays the role of the person responsible for component part purchase decisions for a hypothetical firm. The subjects are provided with several vendor proposals and, on the basis of the firm's requirements, requested to select a supplier for the part. Feedback is provided after the decision.

Crow, Olshavsky, and Summers [35] performed a detailed analysis of the choice strategies of industrial buyers by using protocol analysis. The research method involves collecting protocols from a sample of industrial buyers as they are reacting to hypothetical purchasing problems. The purchasing situations are designed to represent situations in which an individual purchasing agent could reasonably be expected to make the decision. A written orientation scenario describing the purchase environment is given to the buyer at the beginning of the session to ensure that all buyers develop essentially the same perception of the task facing them.

2.6 Summary

This chapter has reviewed the relevant literature for this dissertation. First, the importance and role of the purchasing function in a firm was presented. Second, the degree of integration of the purchasing function was discussed. This section included a discussion on the amount of strategic information provided to the purchasing function, the type of interaction required of purchasing, and the need to develop

an integrated purchasing function. Third, the performance measurement system of the purchasing function was examined. Information was provided as to management expectations of the purchasing function, the Locke model of goal setting, and the different types of performance measurement systems for purchasing. Fourth, the concept of strategic purchasing was reviewed. And finally, a review was provided on previous research which had employed methodologies similar to that used in this study.

The literature reviewed in this chapter has demonstrated the overall importance of this research as well as the relevance of the independent variables used for the experiment. The following chapter describes the methodology used in the research.

3.0 RESEARCH METHODOLOGY

This chapter describes the research methodology for conducting the study. This description includes 1) the research strategy, 2) the research questions, 3) the experimental variables, 4) the experimental design, 5) the experimental procedures, 6) the pilot study results, and 7) the planned data analysis.

3.1 Research Strategy

The research strategy for this study is a laboratory simulation experiment. A laboratory simulation experiment combines the techniques of laboratory experimentation and simulation in an effort to obtain an experimental environment in which both internal and external validity are high. In this research, a computer simulation of a firm is incorporated within a laboratory experiment.

A laboratory experiment is a research strategy with the following characteristics [128]: 1) the researcher creates a setting or environment for the study of some phenomenon; 2) the researcher has control over the assignment of subjects to treatment conditions; 3) the researcher has control over virtually all independent variables that might impact the dependent variable; and 4) the researcher manipulates one or more independent variables of interest.

In essence, a laboratory experiment involves the development of a setting in which the experimenter has a high degree of control over the stimuli to which the subjects are exposed and the conditions associated with the observation of behavior [140]. In developing the laboratory setting, the experimenter's objective is not to replicate some naturally occurring system but rather to highlight selected aspects of the system.

Laboratory experiments, as with all research strategies, possess both advantages and disadvantages [128]. Among the advantages of such an approach are:

1. Measurement is often more precise than with other research strategies since measurement in the laboratory takes place under highly controlled conditions.
2. The experimenter controls the assignment of subjects to treatment conditions.
3. The independent variable(s) can be precisely and unambiguously defined by the experimenter through the manipulations used to produce them.
4. Laboratory experiments can be replicated.

Some disadvantages of a laboratory experiment include:

1. Some phenomena or problem situations cannot be studied in the laboratory.
2. The generality (external validity) of the results from laboratory experimentation may be limited.
3. Laboratory settings may lack "realism".
4. A number of artifacts (i.e., demand characteristics, evaluation ap-

prehension, and experimenter expectancy effects) may influence the results obtained.

5. The strength of independent variables produced by experimental manipulations is, in general, very low when compared to the strength of these same variables in "real-life" situations.

An alternative research strategy is that of simulation. A simulation (computer-based in this case) is a research strategy with the following elements: 1) the simulation settings are created so as to replicate, to varying degrees, the attributes of naturally occurring systems; 2) "real-world" events occur within the simulation; and, 3) the researcher has control over the independent variables, treatments, and outside stimuli.

Unlike the setting within a laboratory experiment, the setting within a simulation is designed to replicate, with as much realism as possible, a naturally occurring system. At the same time, the researcher still possesses a high degree of control over the events which occur within the system.

Advantages associated with this research strategy include:

1. Realism is higher than in laboratory experiments because the setting mirrors a "real-world" setting and the events that occur in the simulation are similar to "real-world" events.

2. Subjects are not necessary.

3. Control over extraneous sources of variance is generally higher than in field studies.

4. More complex situations or problems can be studied than in a laboratory experiment.

5. Simulations allow for the manipulation of independent variables.

Disadvantages associated with simulation include:

1. Simulations may be expensive.
2. Excessive time may be required on the part of the researcher in preparing the simulation.
3. Some phenomena cannot be studied via a simulation.
4. The setting is not as "real-world" as in a field study.

A laboratory simulation experiment, which combines both a laboratory experiment and a simulation, has several advantages: 1) A more realistic decision task and environment can be created; 2) Higher subject involvement is obtained; 3) Fewer experimental biases occur because of experimental error and environment; and 4) Subjects are exposed to a number of events that parallel those found in naturally occurring systems.

A laboratory simulation experiment also has a few disadvantages: 1) The subject may require longer preparation to become familiar with the decision task; 2) The decision task itself may require more time to perform; 3) The researcher may lose the subject's attention or concentration if the task is too complex or lengthy; and 4) Excessive time may be required by the researcher to develop both the simulation and the laboratory experiment and to integrate the two methodologies.

A laboratory simulation is created in such a way as to maximize the degree of realism associated with the study and also maintain a high degree of control over the events to which the subjects are exposed. Thus, a laboratory simulation may be viewed as a strategy falling somewhere between the laboratory experiment and the field study

[33]. Such a research strategy offers an approach in which both the internal and external validity can be high.

Laboratory simulation allows the researcher to take actions which create a high degree of control over the experimental environment and outside sources of variation. These actions, including 1) randomly selecting and assigning subjects to treatments, 2) controlling events experienced by the subjects, 3) developing an objective, accurate means to measure the treatment effects, and 4) minimizing the total time required to perform the experiment, allow the researcher to increase the level of internal validity. Although no research strategy or setting can ensure external validity, laboratory simulation improves the prospects for obtaining external validity by 1) allowing for the development of a common, realistic task and 2) producing results which are directly comparable and replicable.

This research employs a laboratory simulation experiment. The use of standard laboratory experimentation as a research tool is well established in purchasing research [18,26,27,39,58]; therefore, the laboratory approach to a research topic will not be new. The use of the laboratory simulation approach is not common within purchasing research, but this research tool is well established in other fields [51,89,113,119,138].

3.2 Research Questions

As described in Chapter 1, the actions of the purchasing function impact the performance of the firm. The direction and extent of this impact may depend upon how the purchasing function is managed. The

research objective of this study is to examine the impact on the firm's performance of various ways of managing the purchasing function.

To achieve the research objective, the study addresses four research questions:

1. Do various ways of managing the purchasing function have a significant impact on the firm's performance?
2. Does an effectiveness-oriented purchasing function provide better firm performance than an efficiency-oriented purchasing function?
3. Does an integrated purchasing function provide better performance for the firm than an isolated purchasing function?
4. Is there one way of managing the purchasing function which outperforms the others?

3.3 Experimental Variables

This dissertation investigates the effects of the performance measurement system, the type of interaction, and the amount of strategic information on the process and outcome of purchasing decision-making. In particular, the impact of purchasing on the firm's profit will be examined. A discussion of the independent and dependent variables is presented next.

3.3.1 Independent Variables

The first independent variable, performance measurement system, portrays the type of performance measurement system for the purchasing function. Variables two and three, type of interaction and the amount of strategic information, can be considered separately as influencing factors on the performance of the purchasing function or they may be

considered together as primary indicators of the degree of integration of the purchasing function. These three variables were selected as the independent variables because the literature indicates that these variables may be primary governing factors in the performance of the purchasing function.

In addition, the degree of integration and the performance measurement system can be key differentiating characteristics between a tactical and a strategic purchasing environment. For example, a tactical purchasing environment generally possesses an efficiency-oriented performance measurement system and performs as an isolated function (low amount of strategic information with optional interaction). A strategic purchasing environment, on the other hand, generally has a performance measurement system oriented toward effectiveness and is integrated into the operations of the firm (possesses high amounts of strategic information with required interaction).

3.3.1.1 Performance Measurement System

The purchasing function of a firm may be managed with different types of performance measurement systems. It is believed that the use of different performance measurement systems impacts the profit which is earned by the firm.

To investigate the effects of the performance measurement system on the firm's profit, this research employs two types of performance measurement systems: an efficiency-oriented system and an effectiveness-oriented system.

An efficiency-oriented performance system centers around minimizing costs and maximizing the departmental operating efficiency. In

this system, the subject is told that his performance is evaluated in two areas, cost of purchases and operating efficiency. Although both of these areas are to be considered in the subject's decisions, the area of primary importance is the cost of purchases.

The cost of purchases is measured by the total annual cost reductions obtained by the subject. This amount is then compared by management to the potential cost reduction which is available if the subject chooses the "best" action. The closer the subject comes to obtaining the potential reduction, the better is his performance in this area.

To operationalize the concept of cost reduction within the simulation model, a total annual cost reduction and a potential cost reduction are calculated for each problem response. The total annual cost reduction indicates the cost reduction (from the current situation) that is obtained by the subject if the subject selects that response. The total annual cost reduction is calculated by multiplying the actual unit cost reduction times the annual usage of the item. The potential cost reduction is calculated in the same manner except it employs the maximum unit cost reduction available to the subject rather than the actual cost reduction obtained.

Operating efficiency is measured by 1) the amount of operating cost which the subject incurs for the department, and 2) the amount of time required for the subject to process an order through the system. Operating costs consist of those additional costs incurred by the subject in performing his buying activities. These costs include telephone and postage cost, travel costs, cost of supplies, and administrative costs because of order modification. The subject is informed that

he is allowed to incur an operating cost of $2000 per decision. Costs above this amount will negatively impact the subject's performance evaluation.

To operationalize the concept of operating costs within the simulation an operating cost is associated with each problem response, indicating the amount of operating costs incurred if the subject selects this response. The amount of the operating cost is arbitrary but it is assigned so that inefficient buying actions have higher operating costs than efficient buying actions. All operating costs are assigned consistently so that no particular action has an extraordinarily high or low operating cost associated with it.

The amount of time required for the subject to process an order through the system is measured by the order processing time. The order processing time is the amount of time from the receipt of the requisition to the time at which the order is placed with the supplier. The subject is informed that to maintain or improve the order processing time, he/she must take actions which allow the requisitions to be processed as soon as they are received. This means that the subject should select actions which minimize the amount of time spent before placing the order with a supplier. The order processing time is provided in days and the smaller the number, the better is the subject's performance in this area. The subject is informed that management expects him to maintain an order processing time of 14 days or less.

To operationalize the order processing time within the simulation, the order processing time is increased or decreased depending upon the action taken by the subject. Actions which would process the order

through the system faster are assigned lower order processing times while actions which impede the processing of the order are assigned higher order processing times. The values for the order processing time are arbitrary but are assigned consistently so that no action has an extraordinarily high or low processing time associated with it.

An effectiveness-oriented performance measurement system highlights the ability of the purchasing function to contribute to the attainment of the firm's goals and objectives. In this performance measurement system, the subject is informed that his performance measures are: 1) contribution to profit, 2) quality of supplier relations, and 3) extent of customer satisfaction. Although all of the measures are to be considered in the subject's decisions, the contribution to profit is indicated as being the most important to management.

The contribution to profit indicates the extent to which the subject (purchasing manager) contributes to the company's profit because of his decisions. The key to improving the contribution to profit is for the subject to consider the impact of his actions on the firm as a whole. Suggested methods by which to increase the contribution to profit include: decreasing costs elsewhere in the company, for example, in production or quality control by purchasing materials with fewer defects; increasing the company's sales by improving the value of the end product in the eyes of the customer, thereby creating more demand; or simply reducing the purchasing costs. The subject is informed that his decisions must provide benefit to the company, not necessarily to the purchasing function.

The amount of the contribution to profit is the net benefit ac-

crued to the company (Benefits - Costs) because of the subject's action. Management compares the contribution actually obtained to the potential contribution which would have been obtained if the subject had selected the "best" action. The closer the subject comes to obtaining the potential contribution to profit, the better is his performance in this area.

To operationalize the concept of contribution to profit, specific benefits and costs are assigned to each problem response. The simulation then calculates the contribution to profit given the selected problem response.

The quality of supplier relations incorporates the quality of service obtained from the vendor and the quality of service which the vendor receives from the company. The subject is urged to select actions which develop long-term, productive relations with suppliers, trying to obtain quality material and service from suppliers while providing them with fair, courteous service.

The quality of supplier relations is evaluated on a scale of 1 to 100, with 100 being the best possible relationship. A value of 79 is considered to be an "average" level of supplier relations. The quality of supplier relations is increased or decreased depending upon the actions taken by the subject. Actions which improve supplier relations (for example, working with a current supplier rather than quickly switching to a new supplier) are assigned higher values for supplier relations while actions which decrease the quality of supplier relations are assigned lower values for the level of supplier relations. The specific values assigned to the responses are arbitrary, but con-

sistently applied to the problem responses so that no response has an unreasonably high or low value of supplier relations associated with it.

The level of customer satisfaction refers to the extent of customer satisfaction with the firm's product and service. The subject is informed that the level of customer satisfaction is determined by the firm's management through customer surveys. Again, the extent of customer satisfaction increases or decreases depending upon the actions of the subject. If the subject takes actions to purchase the type of components desired by the customer when they are desired, the level of customer satisfaction will be high. If the customer does not receive the type of product desired, in terms of quality, reliability, or features, or if the product is late because of stockouts, the customer will not be very satisfied. The subject is urged to try to satisfy the customer since the success of the company depends upon its ability to create and maintain its customer base.

The level of customer satisfaction is evaluated on a scale of 1 to 100, with 100 being a fully satisfied customer. The subject is informed that, on the average, a value of 79 indicates a customer who is satisfied with the product. Each problem response is assigned a particular value for the level of customer satisfaction. Values are assigned so that actions which improve customer satisfaction, for example, purchasing parts with higher reliability yet passing little extra cost to the customer, are assigned higher values while actions which decrease customer satisfaction are assigned lower values.

3.3.1.2 Type of Interaction

The purchasing function may perform in an environment in which interaction with the other internal functions and top management is optional or required. Previous research [53,131] indicates that the type of interaction can impact the individual's performance. It is believed that this interaction can also impact the performance of the purchasing function, and consequently the performance of the firm.

In an environment in which interaction is optional, purchasing personnel participate in few nonpurchasing decisions, do not regularly interact with the other internal functions (for example, do not consistently attend staff meetings), and do not contribute to the firm's planning process. With optional interaction, purchasing is not involved with the other functions and therefore possesses little knowledge about what is occurring in the other functions. In addition, since purchasing does not regularly interact with the other internal functions and top management, purchasing does not have the opportunity to contribute information to management or to nonpurchasing decisions.

In an environment in which interaction is required of the purchasing function, purchasing personnel are active participants in nonpurchasing activities; they have high work-related interaction with the other internal functions such as product development, marketing, production planning and control, engineering, and inventory control; and they regularly participate with top management in the corporate planning process. In a situation with required interaction, the purchasing function receives information about the firm's internal activities and also contributes information to nonpurchasing decisions and the plan-

ning process.

The heart of the concept of optional or required interaction is internal information flow. Therefore, to operationalize the concept of interaction within the simulation, the level of information received by purchasing from inside the firm is controlled. Subjects operating within an environment of optional interaction receive minimal information about the firm's internal activities whereas subjects operating with required interaction receive all relevant information from within the firm. The subject is able to use this information in responding to the problem situations. Only one piece of internal (or interaction) information is provided to the subject for each problem situation. This information may be information from product development, production, marketing, inventory control, forecasting, facilities, or top management.

3.3.1.3 Amount of Strategic Information

The purchasing function may operate in an environment in which it obtains a high amount of strategic information or it may operate in an environment in which it obtains a low amount of strategic information. The availability of strategic information allows the purchasing function to 1) consider the welfare of the entire firm in making its purchasing decisions and 2) base its long-term decision-making on additional relevant information. Several authors [13,16,45,46,125] indicate that the possession of strategic information, or lack thereof, in the purchasing function can greatly impact the performance of the firm.

For this research, strategic information refers to information about 1) the nature, characteristics, or product perspective of the end

customer; 2) the goals, objectives, and financial condition of the firm; 3) the long-term projected demand or expected demand changes; 4) future material needs and/or specifications; or 5) the future expected market conditions and trends. Subjects operating in a treatment with a high amount of strategic information receive one piece of strategic information for each problem situation. Subjects operating in the treatment of low strategic information receive no additional strategic information.

3.3.2 Dependent Variable

The dependent variable for this study is the firm's profit obtained at the end of the simulated time horizon. This measure was selected because 1) it is typically used to measure overall firm performance, 2) it is the single most common measure used in distinguishing between the performance of different organizations, and 3) the actions of the purchasing function impact the measure.

Profit arises from activities which produce income and involve expenses, and may be expressed as profit = income - expenses. The profit level of a firm is therefore an indication of the success of the activities which the firm (through its functional areas) has undertaken.

The purchasing function can impact the profit (or success) of the firm in several ways: Purchasing can increase (or decrease) the perceived value of the product through the purchased materials; purchasing can decrease (or increase) the cost of the purchased materials or the departmental operating cost; or the purchasing function may increase (or decrease) their own departmental costs but decrease (or increase)

costs elsewhere in the firm by a greater amount.

Profit may be increased by increasing the price of the end product; however, if the price is raised above the market level, the number of units sold will decline, thereby decreasing the current profit level.

One way to maximize profit without changing the selling price of the product is to sell more units by increasing the product's value. Purchasing can help in this regard by purchasing better quality components, purchasing higher quality or more convenient packaging, or purchasing components which are easier or less expensive to maintain. These alternatives may increase the product cost and result in a lower profit margin per unit. However, the lower profit per unit multiplied by a larger number of units sold may lead to a total profit increase. This effect illustrates the concept of "spending money to make money."

A direct way to maximize profit while holding the product price constant is to decrease costs. This is generally the aim of industrial engineers and cost analysts. Initially, this cost reduction effort is often productive; however, it becomes very difficult to reduce costs in an established operation. When a product or service is first introduced, it meets a high demand and operational inefficiencies can easily be absorbed. But as competition forces prices down, cost must also come down. These cost savings are easy to find at first but as further cost reduction efforts are applied, the law of diminishing returns begins to apply.

The purchasing function can help in cost reduction by decreasing the cost of materials or by decreasing their operating or administra-

tive costs through more efficient purchasing. But the law of diminishing returns also applies in the efforts of the purchasing function. In addition, care must be taken to ensure that cost reduction efforts do not result in less than acceptable product quality, unreliable delivery, or poor supplier relations. These cost reductions would reduce the cost of material but increase costs elsewhere in the firm.

The purchasing function can also improve the firm's profit by increasing its own departmental costs while reducing costs by a greater amount elsewhere in the firm. For example, if purchasing convinces a supplier to develop an outgoing inspection before shipping the components, purchasing may pay a little extra for the components. But this action should also reduce the number of incoming defects, decrease the time needed for inhouse inspection, and decrease the administrative costs for reordering replacement components.

The purchasing function impacts the firm's profit in many ways. In this research, using the firm's profit as the dependent variable serves to capture not only the overall performance of the firm but also the impact of the actions of the purchasing function.

3.4 Experimental Design

Each independent variable in this research is implemented at two levels. Since the research is exploratory and there is no prior expectation of nonlinear effects, two levels are considered sufficient to detect the presence and direction of effects. Subsequent studies in this program of research can follow-up on promising findings.

The laboratory simulation experiment is conducted employing a

full-factorial experimental design. Performance measurement system (P), interaction (I), and strategic information (S) are dichotomous variables. The treatments of full-factorial experimental design of form PxIxS are graphically represented in Figure 3.1. Fifteen subjects (15s) were assigned to each cell in the design.

3.5 Experimental Model

The research method involves obtaining decisions from a sample of subjects as they respond to a series of purchasing situations through a simulation of the operations of a firm. Subjects, upon arriving at the laboratory, are randomly assigned to an experimental treatment.

3.5.1 Subjects

The participants in the study were undergraduates in the business school at Indiana University. The subjects were recruited from upper division undergraduate operations management and policy courses. All of the subjects were "volunteers", receiving no class credit for their participation.

Students, as opposed to business individuals, were selected for the research because the role-playing literature [49,64] indicates that individuals have difficulty playing a role different from the one they normally play in the work environment. Therefore, for this experiment, purchasing individuals accustomed to working in a particular type of purchasing environment (e.g., efficiency oriented) may not provide unbiased results if requested to perform in a different type of purchasing environment (e.g., effectiveness oriented). Additionally, research [56] indicates that student subjects do not perform significant-

ly different than business individuals.

The subjects were volunteers in that they were not required to participate in the research and they did not receive class credit for participating in the research. The use of volunteers serves to provide subjects who are interested in the experimental task.

A total of 125 male and female students were recruited. Of these, 120 subjects completed the research, resulting in 15 subjects per cell. The high participation rate was undoubtedly partially due to the existence of a monetary reward which was available to participants. Subjects were informed that the amount of the reward, ranging from a minimum of $3.00 to a maximum of $10.00, would depend upon their performance. It was believed that a performance-based reward system would lead to careful attention by the subject to the instructions, the experiment procedures, the purchasing problems, and the particular role responsibilities.

The high participation rate was probably also due to the fact that all subjects were contacted by telephone prior to the experiment and reminded to participate. With this extra reminder, few subjects who had committed themselves to the experiment failed to show up.

This sample size was chosen to ensure adequate power. A power calculation was made based on the results from a pilot study. The data revealed that to be able to detect a difference between treatments of $25,000 (about one-half of the pilot standard deviation) at an alpha level of .05 and a power of .95, a sample size of 15 per cell was required. This combination of detection, power, and alpha level is quite high for research involving subjects; however, the exploratory nature

of the research warranted these conditions and a sample size of fifteen subjects per cell appeared to be feasible. The power calculation is depicted in Table 3.1.

3.5.2 Task

The subject, performing the role of a purchasing manager, is responsible for purchasing a family of components. In particular, the subject is working for an automobile firm and is in charge of purchasing 14 components for a particular line of automobiles. The components for which the subject has responsibility include items such as a quartz clock, antenna shaft and housing, inside trim, seat upholstery, and radio tuner. An automotive firm and components such as these were selected as it was believed to be valuable for the subject to be able to envision the role he/she is performing and the components he/she is purchasing. However, the use of an automotive firm in the description is not necessary. Other industries and components could easily be used as the model and financial information are not specific to a particular industry.

The subjects perform a decision-making task. Performing as a purchasing manager, the subject is asked to select a response (or solution) to a series of purchasing problems, one-at-a-time. Each subject is informed that he will respond to sixteen problems, but only fourteen problems are provided. This misinformation was provided to prevent the dwindling of attention which frequently occurs in the last phase of a study [122]. Feedback on the subject's performance is provided to the subject after each problem situation. This feedback is designed to guide the subject toward selecting a "better" response on the following

TABLE 3.1

POWER CALCULATION

$$\Phi^2 = bcn \frac{\sum_{i=1}^{a} \tau_i^2}{a\sigma^2}$$

where a = # of treatments in factor A
b = # of treatments in factor B
c = # of treatments in factor C
n = # of replicates
τ = treatment effect
σ = standard deviation of pilot

$$\Phi^2 = \frac{(2)(2)(15)(25000)^2}{(2)(53479)^2}$$

$$\Phi = 2.56$$

Using an operating characteristic curve for a fixed effects model analysis of variance [93] with numerator degrees of freedom equal to 1 and a denominator degrees of freedom of 112, a Φ of 2.56 results in a power of about .95.

Similar results would occur for factors B and C because the number of treatments of each factor and the number of replicates is equivalent.

problems.

Each purchasing problem includes a short narrative describing a problem situation and four possible ways in which to respond to the situation. The problem situation describes a purchasing problem in which the subject has to make a decision trade-off between characteristics such as quality versus cost, delivery reliability versus cost, extra features versus cost, short-term actions versus long-term planning, or departmental cost versus company savings. These trade-offs are not directly expressed to the subject. For example, the trade-off of quality versus cost may be portrayed via a problem of supplier or product material selection. The purchasing problems were adapted from existing purchasing cases, informal discussions with industry managers, or the researcher's knowledge of purchasing situations.

The subject reads the purchasing problem on the terminal screen. At the end of the problem description, the subject is provided with four ways in which to respond to the problem and the option to re-read the problem. The responses to the problem situations illustrate reasonable ways in which a purchasing individual can respond to the particular situation. These responses impact, within the simulation, the delivery of the purchased items, the quality of both the purchased items and the end item, the price of the purchased material, the need to expedite purchased materials, the backorders incurred, the expense incurred by the production function, or the product demand experienced by the firm. To illustrate the nature of the problems and their responses, a problem situation, including the responses to the problem and the impact of those responses, is presented next.

For example, the first problem confronted by the subject is:

"In talking with your supplier for inside trim, the supplier mentions that there is a less expensive trim that could be substituted for the trim that you are currently purchasing from him. Currently, you are purchasing a cockpit trim which is a wood-tone and costs $360 per sheet.

The supplier indicates that the new trim has the same specifications as the current one; the only difference is that it is a lighter wood-tone. The supplier feels that the new trim would adequately meet your needs.

The new trim costs $342 per sheet if you sign a one year contract for the trim. If you purchase the trim on an order-by-order basis, it costs $351 per sheet.

You recently received a MEMO from marketing on recent consumer research. It read "We are continuing our efforts to obtain consumer attitudes toward various aspects of our product. Our recent survey indicates that the consumer is extremely satisfied with the interior cockpit of the car. The overall style and darker tone of the cockpit rated especially high. The consumer's attitude toward other cockpit styles and tones was not obtained."

You also recall a letter from Dan Jones, Purchasing Manager at EBCO Company, on the trim question. He said that they had recently switched to the lighter trim and found it to be quite acceptable. Although they had found that Production had a few complaints they decided that because the lighter trim is cheaper they would continue to buy it.

IN THIS SITUATION, YOU DECIDE TO TAKE THE FOLLOWING ACTION:

1. You place the new trim under contract with the supplier.
2. You order the new trim on an order-by-order basis and pay a higher price until the impact of the new trim is determined.
3. You continue to order the current trim and not switch to the new trim.
4. You continue to order the current trim but you also place one order for the new trim at $351 per sheet to compare the quality of the two trims."

The paragraph which discusses the MEMO from marketing is received only by those individuals in a treatment with required interaction. The paragraph which presents the information from Dan Jones is received only by those individuals in a treatment with high strategic information. The remainder of the problem is viewed by all subjects.

The subject responds to the problem situation by choosing one of the four options. The impact of each of the responses, as programmed

in the simulation, is as follows.

For response 1: Per unit price decreases to $342 per sheet (down from $360) for the twelve periods simulated. Perceived value (customer satisfaction) decreases, which leads to decreased demand. (Demand decreases by three percent for periods three through twelve.) Production hours per unit increases to 7.5 (up from 7.0).

For response 2: Per unit price decreases to $351 per sheet for periods one through six, then returns to $360 per sheet for periods seven through twelve. Perceived value decreases then returns to original, so demand temporarily decreases. (In period 3, demand decreases three percent; in period 8 returns to original.) Production hours per unit increases to 7.5 for periods one through six; returns to 7.0 for periods seven through twelve.

For response 3: Per unit price stays at $360 per sheet. Demand remains as predicted.

For response 4: Per unit price for one order is $351. The remaining orders are purchased at $360 per sheet. Demand remains as predicted.

The subject, upon selecting a response to a problem situation, keys the appropriate choice into the computer. Feedback is then provided to the subject which indicates the subject's performance because of the selection of that particular choice. The type of feedback depends upon whether the subject is in the treatment of an effectiveness-oriented performance measurement system or an efficiency-oriented performance measurement system. After receiving and analyzing the feedback, the subject continues to the next problem situation. The subject responds to 14 problem situations in this manner.

The subjects were allowed to move through the problem situations at their own pace. All subjects respond to the same problems in the same order. Random assignment of problems does not seem necessary as all subjects perform the problems in the same order and the performance at the end of all decisions is what is of importance rather than the performance at each individual problem. All of the problems are to be considered independently in that the subject does not have to consider the actions of the previous problem in responding to the current problem. The feedback is also non-continuous in that the feedback reflects only the impact of that particular problem choice.

The subject is provided with "scratch" paper and allowed the opportunity to make any notes or calculations. The experimenter did not provide additional problem clarification unless it dealt with the experimental procedures.

3.5.3 Task Instructions and Manipulations

The instructions provided to all subjects are identical. All subjects are asked to read the instructions carefully. The instructions provide the subjects with a detailed explanation of the necessary steps to perform the task. The subjects are to assume the role of purchasing manager for Autotech Inc. Their primary responsibility is to make managerial decisions in a purchasing environment.

After reading the instructions, the subjects are to carefully read the handout entitled, "The Purchasing Manager at Autotech." This narrative describes the role of a purchasing manager, the expectations of management in terms of performance, and the nature of the purchasing environment.

After reading the handout, the subjects respond to a series of purchasing situations, one-at-a-time. Each situation is followed by four different ways in which to respond to the problem. The subject is to consider the situation, analyze each response, and select that option which he/she believes will maximize the subject's performance. After selecting a response to a situation, feedback indicating the subject's performance is provided. The subjects are encouraged to use the feedback to assist them in making the next decision. After responding to all problem situations, the subject is asked to complete a post-experiment questionnaire.

The instructions, purchasing situations, and problem responses are the same for all subjects. However, the contents of the narrative, "The Purchasing Manager at Autotech", are different for each of the eight cells in the design. Within the narrative, the performance measurement system, the type of interaction, and the amount of strategic information are manipulated.

In terms of the performance measurement system, half of the subjects are described as operating with an effectiveness-oriented measurement system. The other half are described as operating with an efficiency-oriented measurement system. Subjects operating with an efficiency-oriented performance measurement system are provided with the following performance measures:

Cost of Purchases

1. Total Annual Cost Reductions
2. Potential Cost Reductions

Efficiency

1. Operating Cost
2. Order Processing Cost

Subjects operating within an effectiveness-oriented performance measurement system are provided with the following performance measures:

1. Contribution to Profit
2. Supplier Relations
3. Customer Satisfaction

The nature and measurement of each of these performance measures are explained to the subject in the narrative. The description of an efficiency-oriented performance measurement system or an effectiveness-oriented performance measurement system which is provided to the subject is included in Appendix A.

The feedback which the subject receives after each problem situation depends upon the performance measurement system under which the subject is operating. As indicated in Table 3.2, subjects operating in an efficiency-oriented system receive numerical feedback on total annual cost reductions, potential cost reductions, operating cost, and order processing cost. Subjects operating under an effectiveness-oriented system receive numerical feedback on contribution to profit (including the subject's actual contribution to profit and the potential contribution to profit), supplier relations, and customer satisfaction. The feedback on these measures is not cumulative over the problems; it indicates only the impact of a particular decision.

In terms of the type of interaction, the subjects are again split

TABLE 3.2

FEEDBACK PROVIDED TO SUBJECTS

Efficiency Performance Measurement System

Cost of Purchases
- Total Annual Cost Reductions
- Potential Cost Reductions

Efficiency
- Operating Cost
- Order Processing Time

Effectiveness Performance Measurement System

Contribution to Profit
- Actual Contribution to Profit
- Potential Contribution to Profit

Supplier Relations

Customer Satisfaction

in half. Half of the subjects are placed in an environment of required interaction while the other half are placed in an environment with optional interaction. The required interaction treatment is handled by stating that the subject, in the role of a purchasing manager, is required by management to become involved in nonpurchasing activities and to attend the weekly functional staff meetings. Subjects operating with optional interaction are informed that their purchasing responsibilities require most of their time; therefore, management encourages them to involve themselves totally in purchasing activities, minimizing the time spent in nonpurchasing activities or staff meetings. The description of required interaction or optional interaction which is provided to the subject is included in Appendix A.

The manipulation of type of interaction is also supported within the computer simulation. Prior to responding to each problem situation, those subjects with required interaction receive an additional piece of relevant information. This information provides the subject with additional knowledge about the activities within the firm. It is believed by the researcher that if the concept of required/optional interaction were actually implemented in an organization, an individual with required interaction would reasonably possess (or obtain) more, or clearer, internal information than would an individual who was only involved in purchasing activities.

The manipulation of the amount of strategic information also requires that the subject base be divided in half. Half of the subjects are placed into an environment with a low amount of strategic information while the other half are placed into an environment with a high

amount of strategic information. Subjects with low strategic information are encouraged by management to spend very little time in activities external to the company. Management feels that the subject's (purchasing manager's) time can be more productively spent on activities within the company.

Subjects with a high amount of strategic information are strongly encouraged by management to become involved in activities external to the firm. Management feels that the subjects (purchasing managers) must be active members of outside professional organizations and be aware of what is happening in the marketplace if the individual is to buy competitively for the firm. The description of the treatment of low or high strategic information which is provided to the subject is included in Appendix A.

The manipulation of strategic information, like the type of interaction, is also supported within the computer simulation. Subjects operating with high strategic information receive the basic problem situation and one additional piece of relevant strategic information. This information may deal with 1) the nature, characteristics, or product perspective of the end customer; 2) the goals, objectives, and financial condition of the firm; 3) the long-term projected demand or expected demand changes; 4) future material demands and/or specifications; or 5) the future expected market conditions and trends. The subject receives one additional piece of strategic information per problem situation. Subjects operating with low strategic information receive no additional strategic information.

3.5.4 Computer Simulation

The computer simulation model simulates the operations of an assembly firm and the firm's interface with both the supply and sales market. The model includes a forecasting system, an MRP order system, the manufacturing process and data for the necessary components, the cost data for each component (setup cost, production cost, raw materials cost), and additional cost data such as order cost, backorder cost, inventory carrying cost, overtime cost, and a standard wage rate. The purchasing problems with the respective responses are also incorporated into the model.

The simulation, programmed in FORTRAN, uses some of the concepts from PROSIM [51,89] to develop a simulated assembly environment with the ability to utilize a multi-level product structure. Within the simulation, a two-level MRP system is used to determine the requirements for fourteen different purchased parts. These requirements originate from the requirements for eight different subassemblies. One end item (an automobile) is produced. The product structure employed in the model is displayed in Figure 3.2. Although a number of different product structures could have been used for the research, this structure seems to serve the desired objectives: the structure provides a sufficient number of purchased parts with which to work; the structure allows for the determination of the impact of the purchasing decisions on the production process; and the structure is representative of many products. Many products, for example, airplanes, blenders, clocks, and automobiles, are composed of a number of subassemblies which are themselves composed of two or more components.

The product structure as illustrated in Figure 3.2 indicates a ninth subassembly in addition to the eight which are used in the MRP explosion process. This subassembly represents the remaining time, money, and materials required in the assembly of the product after accounting for the other eight subassemblies. The ninth subassembly is necessary to increase the cost of the end product to a reasonable level. This subassembly adds additional cost to the product but does not impact the production schedule. The subassembly is assumed to always be available when needed and to be of adequate quality and reliability.

The demand for the end item is known in that the actual demand equals the forecasted demand. Demand uncertainty is not allowed in the model since this uncertainty would impact the performance of the production process. To determine the impact of the purchasing decisions on the production process and the firm it is necessary to minimize all other impacts within the model. However, to provide a realistic MRP environment, the demand varies uniformly around a mean of 100 units per period with a range of 70 units to 130 units per period. Additionally, the demand is impacted by the subject's purchasing decisions. If the subject's decision increases the value of the product in the eyes of the customer, the demand for the product is increased by a particular amount. If, on the other hand, the subject's decision decreases the perceived value of the product, demand decreases by a particular amount. If demand increases or decreases because of a problem response the manpower level is minimally adjusted to compensate for the change in demand.

The simulation model simulates the operations of the assembly firm

for twelve periods. Within the course of the year, the fourteen problem situations occur. The impact of these problems is interactive and cumulative.

A simplified flowchart of the computer simulation is presented in Figure 3.3.

3.6 Experimental Procedures

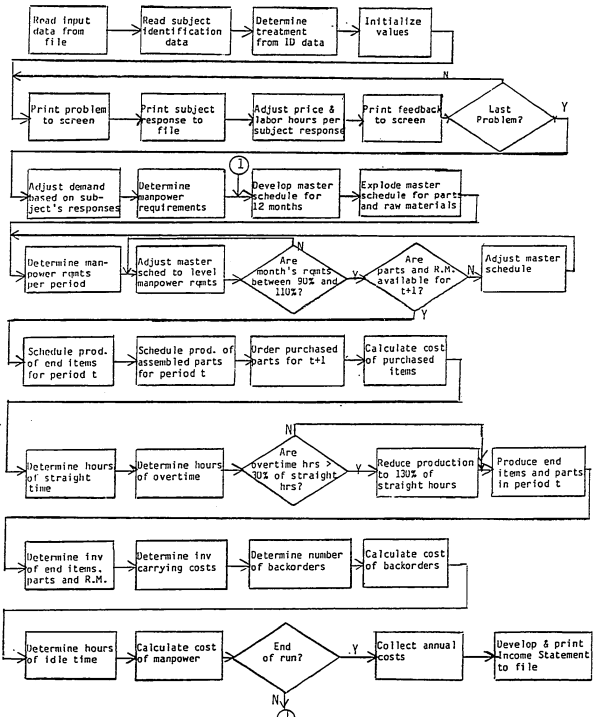
All participants were scheduled for a one-hour time block over a period of four days. The participant arrived at the computer laboratory at the scheduled time. Depending upon the participants' availability, one to eight participants were scheduled for a particular time period.

Upon entering the room, the subject was assigned to a computer terminal, randomly assigned to an experimental treatment, and given a set of materials. The materials included an experimental consent form, a set of instructions, and a role description, "The Purchasing Manager at Autotech". Subjects were instructed not to discuss the task with their neighbors. In addition, they were told to read and sign the consent form before proceeding further. After this was completed, subjects were told to read the instructions and the narrative and notify the researcher when they had completed that phase. Upon notification, the researcher then started the subject in the interactive computer simulation.

The subjects continued through the simulation at their own pace, reading the problem situation, selecting a response, and receiving feedback. After the subject had completed all fourteen problems, the experimenter collected all experimental materials and gave the subject

FIGURE 3.3

SIMPLIFIED FLOWCHART OF COMPUTER SIMULATION



a post-experiment questionnaire to complete. After completing the questionnaire, the subject received his payment (in a sealed envelope) and was free to leave the room. All but two subjects were able to complete the entire experiment in one hour or less. Appendix A contains the set of materials given to each participant in the study, including the consent form, instructions, role description, and post-task questionnaire.

3.7 Pilot Study

A pilot study was conducted prior to the actual experiment. The objectives for the pilot study were: 1) to test the experimental design, 2) to determine the clarity and usefulness of the instructions, 3) to test the usefulness and structure of the orientation scenarios, 4) to test the understanding of the problem situations, 5) to examine the appropriateness and subsequent impact of the problem responses, 6) to refine the procedures and logistics for the actual experiment, 7) to estimate the time required to perform the experiment, and 8) to obtain the data needed for the determination of the necessary sample size.

The pilot study employed 24 graduate students, three per treatment, as the subjects. The subjects were processed through the experiment in 1 1/4 hour time blocks. The subjects were randomly assigned to a treatment and provided with the materials which would be provided in the actual experiment: a subject consent form, a set of instructions, a narrative which described their role as a purchasing manager, several sheets of note paper, and a questionnaire following the experiment.

The pilot study was successful in meeting its objectives as it provided the researcher with much relevant information. The experimen-

tal design for the research appeared to be satisfactory, since the two levels of each factor provided no problems within the pilot study. The pilot study revealed that the set of instructions was too long and was ambiguous in certain areas. In terms of the orientation scenarios, it was discovered that they were effective in that they produced different "orientations" by the subjects, but the scenarios also seemed to be too long. The subjects were leafing through the pages, appearing to skim the materials in order to finish the scenario. The subjects had no difficulty understanding or responding to the problem situations. The responses to the problems were quite acceptable to the subjects, although two subjects indicated that they would like to provide their own response rather than select a preconstructed response. The results of the pilot study indicated that most of the outcomes associated with the responses were quite satisfactory; however, a few of the outcomes needed fine-tuning because the resulting impact was unreasonable. The manipulation of the experimental treatments also needed some refining. Some of the information provided to those subjects in conditions of high strategic information or required interaction appeared to have either no impact on the subject's decision process or, in some cases, served to encourage the subject to select an action that was the opposite of that intended. The pilot study revealed the inefficiency of some of the laboratory procedures and also indicated that subjects should have no problems completing the entire experiment within one hour. As previously indicated, the pilot study also provided the information which was necessary to calculate the desired sample size to obtain a specified power level.

A rather unexpected observation from the pilot study dealt with the subjects. The pilot subjects, MBA and doctoral students, appeared to have "pre-established" ideas as to how a purchasing manager should perform. Consequently, these "pre-established" beliefs were difficult to change, even with effective orientation scenarios. In addition, the subjects continuously wanted more detailed information. This perceived lack of information appeared to frustrate the subjects, disrupting their concentration process.

The results from the pilot study, in terms of the dependent variable, profit, were analyzed using univariate analysis of variance. The analysis indicated that two main effects, performance measurement system and amount of strategic information, were significant at the .002 and .001 levels respectively. The main effect, type of interaction, was not significant. Two two-way interactions were significant: performance measurement system and type of interaction and performance measurement system and amount of strategic information. These interactions were significant at the .017 and .042 levels respectively. The three-way interaction was not significant.

Based upon the results of the pilot study, several minor changes were made to the experiment and experimental materials prior to the main experiment. The instructions and the orientation scenarios were modified to make them clearer and more concise; the outcomes assigned to a few of the responses were changed to provide more realistic outcomes; the information given to the subjects was adjusted to provide the intended perception; and the experimental procedures (handling of experimental materials and terminals) were made more efficient. Addi-

tionally, because of the problems experienced by the graduate students, it was decided to use upper division undergraduates for the main experiment. It was believed that the use of undergraduates would minimize experimental bias on the part of the subjects.

3.8 Experimental Validity

The experimental design was evaluated for validity using the framework developed by Campbell and Stanley [23]. Campbell and Stanley divide research errors into two groups, errors affecting internal validity and those affecting external validity.

Internal validity addresses the question: Does the experimental treatment really make a significant difference on the results of the experiment? Anything affecting the controls of the experimental design becomes a problem of internal validity. If there is little or no confidence in the impact of the treatment on the dependent variable, there is no internal validity [69].

Campbell and Stanley define seven factors affecting internal validity. These factors, along with actions that were taken to control these factors, are discussed below.

History: History is the effect that specific events occurring between the first and second measurement (in addition to the experimental variable) have on the experimental outcome or the dependent variable. Since the experimental environment is totally controlled via a simulation, history is not a factor affecting internal validity in the present study.

Maturation: Maturation is the process within the experimental subjects

which is a function of the passage of time. Examples include growing older, growing tired, and growing hungry. The effect of maturation on internal validity was controlled by minimizing the total time required for the experiment.

Instrumentation: Changes in the calibration of the measuring instrument or changes in the observers or scores used may produce changes in the measurements obtained. This factor was controlled by using only written instructions and scenarios for the experiment, by employing the same problem situations for all subjects, and by using a simulation to consistently determine the value of the dependent variable.

Statistical Regression: This factor suggests that individuals who have been selected for a treatment (or an experiment) on the basis of extreme scores on some dependent variable will likely have experiment scores which will regress toward the mean of the measured subjects. To control this effect, the subjects were not selected on the basis of prior measures; rather, the subjects were "volunteers". Additionally, the subjects were randomly assigned to each of the eight experimental treatments.

Differential Selection of Subjects: Biases result from differential selection of experimental subjects, thereby affecting internal validity of the experiment. This factor was controlled by using volunteers as subjects and by random assignment of the subjects to each of the eight treatments. Volunteers, according to previous research, are known to possess those characteristics of the population in general [116].

Experimental Mortality: The loss of respondents from the comparison groups can affect the internal validity of the experiment. To control

for the effects of mortality, incomplete data, if there had been any, would have been dropped from the data analysis. Subjects were processed through the experiment to obtain equal cell sizes.

Testing: The effects of performing the same task repetitively may impact the internal validity of the experiment. To control for the testing effect, the problem situations to which the subjects must respond varied in style, format, and content. To provide a realistic environment, however, the subject was expected to "learn" through the feedback how to respond within the particular experimental treatment. Also, the end result is what is of importance, rather than the response to each individual problem situation.

External validity concerns the generalization of the experimental results to actual conditions and situations. An experiment has validity on the basis of several conditions associated with the study. First, if a study has experimental validity, its findings can be obtained with different measures of the variables under study. This research uses only one dependent variable but several secondary measures were also obtained. The analyses of the secondary measures support the findings of the analysis of the dependent variable; consequently, the research demonstrates external validity in this regard.

Second, if a study has external validity, then the results demonstrated for one set of subjects should be generalizable to other sets of subjects. In this study, upper division undergraduates were used as the subjects. Research [56] indicates that student subjects do not perform significantly different than individuals working in industry.

Third, if a study has external validity, its findings should be

reproducible in various settings. The opportunity for external validity is enhanced in this area by the validation of the problem situations, the orientation scenarios, and the response outcomes through a modified Turing test. The Turing test utilized a panel of academicians, students, and industrial managers to analyze the problems for accurate representation and comprehensibility. Additionally, the simulation is designed to simulate the realistic operations of a firm and the purchasing function. The pilot study was also useful in this area in that it tested the subject's perceptions of the environment and determined that there were no major incongruencies between the simulated environment and a real environment.

Fourth, and finally, for a study to have external validity, the strength and range of variables associated with the study should approximate the strength and range of variables in other situations to which the study's results are to be generalized. Within this study, the independent variables cover the extreme conditions for performance measurement systems, type of interaction, and amount of strategic information. These conditions are considered to exist within industrial purchasing organizations. In addition, the dependent variable of profit is based upon financial information which is representative of that in industrial firms.

3.9 Data Analysis

The design of this research is a full factorial design with three independent variables: nature of performance measurement system, type of interaction, and amount of strategic information. Each variable has two levels, resulting in a 2x2x2 matrix. A factorial experimental

design permits the study of several variables in combination or one at a time. Thus, the main effects of each variable may be studied as well as the interactive effects of the variables in combination. This type of design is considered important for this research, because it is believed that the interaction effects can provide additional insight to the problem.

The dependent variable, profit, obtained from the simulation runs will be analyzed using univariate analysis of variance. The univariate F tests are very powerful for the detection of main and interaction effects. An assumption required for the use of univariate analysis of variance is that the observations of the dependent variable are independent. In this experiment, each observation within each cell is independent because each is from a separate individual and separate simulation run.

The univariate F test detects significant differences between the treatment means. In other words, the test rejects or accepts the null hypothesis of equal treatment means at a particular significance level. The choice of a significance level for rejection of the null hypothesis is a matter of judgment by the researcher. The significance level serves to control the Type 1 error, where the Type 1 error is the probability of rejecting the null hypothesis when it is true. Some areas of research use very high significance levels for control of Type 1 errors. For example, some physicists use a probability of .0000001 as a significance level for rejection. On the other hand, similar methodologies to that employed in this dissertation have used levels of .10 to .15 for weak significance and from .01 to .05 for strong signifi-

cance [25,113,118,119].

For this research, a .05 significance level is used for rejection of the null hypothesis. A .10 significance level appears to be too liberal, incurring a higher risk of Type 1 error. On the other hand, a .01 level seems much too conservative for such exploratory work as this research.

3.10 Summary

This chapter has described the research methodology, including a discussion of the research strategy, the research questions, the experimental variables, the experimental design, and the experiment procedures. Additionally, the pilot study results and the planned data analysis were discussed.

A laboratory simulation experiment was conducted to investigate the impact of purchasing actions on the performance of the firm. Three independent variables were employed in the experiment: nature of the performance measurement system, type of interaction, and amount of strategic information.

The performance measurement system refers to the manner in which management motivates and measures purchasing performance. This research employs two types of performance measurement systems: an efficiency-oriented system and an effectiveness-oriented system. An efficiency-oriented performance measurement system focuses on minimizing costs and maximizing departmental operating efficiency while an effectiveness-oriented system focuses on the ability of the purchasing function to contribute to the attainment of the firm's goals and objectives.

This research investigates two types of interaction: optional and required. Optional interaction portrays an environment in which the purchasing function participates in few nonpurchasing decisions, does not regularly interact with the other internal functions, and does not contribute to the firm's planning processes. Required interaction portrays an environment in which purchasing is an active participant in nonpurchasing decisions, regularly interacts with the other internal functions, and consistently participates in the firm's planning processes.

The research examines two levels of strategic information: low and high. Strategic information refers to that information which is helpful in developing long-term plans. In this research, strategic information includes information regarding the nature and characteristics of the end customer, the goals and objectives of the firm, the future expected market conditions, the long-term projected demand, and the future expected material needs.

The research employs a full-factorial experimental design, resulting in eight (2x2x2) experimental treatments. The dependent variable for the research is the firm's profit obtained at the end of a simulated time horizon.

One hundred twenty upper division undergraduates were randomly assigned to the experimental treatments, resulting in 15 subjects per cell. The subject, performing the role of a purchasing manager, was requested to select a response to a series of purchasing problems. Feedback on the subject's performance was provided to the subject after each problem situation. The subject's response to each problem situa-

tion is captured via a computer simulation model.

The computer simulation model simulates the operations of an assembly firm and the firm's interface with both the supply and sales market. The purchasing problems with the respective responses are incorporated into the model. The simulation model operationalizes the purchasing problems and captures the impact of the subject's response on the profit performance of the firm.

A pilot study was conducted prior to the main experiment. The results of the pilot study provided guidance in developing and refining the main experiment.

The data collected from the main experiment is presented and analyzed in Chapter 4.

4.0 EXPERIMENTAL RESULTS

This chapter presents the results of the laboratory simulation experiment that was described in Chapter 3. All computations are based on a cell size of fifteen (N=120). The chapter begins with a brief review of the main experiment. It follows with a presentation of the experimental results and data analyses; it concludes with a summary of the results.

4.1 Main Experiment: Description

This research examines four general issues: 1) the relative operating performance of two performance measurement systems, 2) the relative operating performance of two types of interaction, 3) the relative operating performance of two levels of strategic information, and 4) the possible combination of these elements into a purchasing environment which performs significantly "better" than the other combinations. Additionally, the research, by combining the elements of interaction and strategic information, examines the performance of an integrated purchasing function versus a non-integrated function.

Performance is measured using one principal criterion, profit. Additionally, the components of profit are examined. These components are important in that they provide insight into the nature of the treatment's impact on profit. The profit components which are discussed include: demand, sales, material costs, labor costs, inventory carrying costs, and total purchasing costs.

The main experiment was conducted using a full factorial design (two levels each of performance measurement system, interaction, and strategic information) with eight cells. Each of the cells contains fifteen observations, resulting in a total of 120 observations for the experiment.

An observation consists of the simulation of one year of operation. During the year, fourteen purchasing problems occur, to which the subjects select an appropriate solution. These solutions impact various elements of the model. The simulation captures the impact of each solution and determines the aggregate impact on the dependent variable, profit. Each observation is from a separate subject and a separate simulation. The problems, problem responses, and the impacts of the various solutions are representative of actual purchasing problems.

4.2 Main Experiment: Results and Data Analyses

The results and analyses of the data from the experiment are presented in terms of the primary criterion, profit, and the various components of profit.

4.2.1 Profit

The primary performance measure is the firm's profit (before taxes) at the end of a series of purchasing situations occurring over a simulated year of operations. Profit is often used to measure overall company performance, and it is the single most common measure used in distinguishing between the performance of different organizations. In addition, the level of this variable is impacted by purchasing decisions made within the organization. These reasons combine to support

the use of this performance measure for the research.

Profit, the difference between the firm's income and expenses, is calculated in accordance with standard accounting principles, as illustrated in Table 4.1 presented below. Only those costs which vary among the treatments are used in the calculation.

TABLE 4.1

PROFIT CALCULATION

Total Revenue		19,168,000
Less Material Costs	12,473,576	
Labor Costs	4,122,980	
Inv Carry Costs	5,365	
Cost of Goods Manufac	16,601,922	
Plus Purch Costs	15,100	
Cost of Goods Sold		16,617,022
Net Profit Before Taxes		2,550,978

As indicated in Table 4.1, profit is impacted by the following elements: 1) unit sales, 2) material costs, 3) total labor costs, 4) total inventory carrying costs, and 5) total purchasing costs. These elements are examined in Section 4.2.2.

Table 4.2 presents the experimental results in terms of profit. The table indicates the mean profit for each of the main effects. The results are graphically depicted in Figure 4.1. Bar graphs are used throughout this chapter because they present the necessary information while also providing a visual representation.

It is obvious that the amount of profit obtained by the firm is impacted by the type of performance measurement system, type of interaction, and amount of strategic information. Treatments of effectiveness, required interaction, or high strategic information obtain higher mean profit than do their counterparts of efficiency, optional inter-

TABLE 4.2

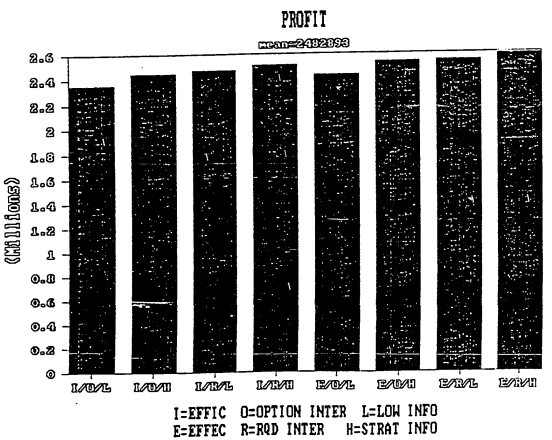
MEAN PROFIT

Main Effect	Mean Annual Profit
Effective PMS	$2,521,770*
Efficient PMS	2,444,016
Required Inter	2,518,563*
Optional Inter	2,447,223
High Strat Info	2,525,966*
Low Strat Info	2,439,820
Grand Mean	2,482,893

*Significant at the .05 level

FIGURE 4.1

MEAN PROFIT



action, or low strategic information.

An effectiveness performance measurement system has a systems perspective in which the good of the entire firm is primary; an efficiency system, on the other hand, has a more narrow, departmentalized perspective in which the benefit of the firm is important but is considered more indirectly. Instead, the performance of the purchasing function is the primary focus of an efficiency performance measurement system. Considering the lower profit obtained by the efficiency treatments, it is conjectured that perhaps those actions which tend to improve the performance of the purchasing function do not always improve the performance of the firm.

A purchasing organization which interacts on a required, regular basis with the other internal functions and top management obtains a broad awareness of the activities occurring within the firm, thus possessing more information with which to make purchasing decisions. An organization which seldom interacts with the other internal functions and top management is unaware of the activities occurring within the firm and must make its decisions in ignorance of these other internal functions. It is conjectured that the additional information obtained through interaction is useful because those treatments with required interaction obtain higher mean profit for the firm than do those treatments with optional interaction.

A purchasing organization which obtains information about the external environment or the long-term plans of the firm is able to realistically plan for future supply or take advantage of current market conditions. Conversely, an organization which does not possess

this environmental or company information may not be able to take advantage of current market conditions or effectively plan for future supply. The data suggests that the additional environmental and planning information is useful because those treatments with a high amount of strategic information obtain higher mean profit for the firm than do those treatments with a low amount of strategic information.

If one considers the mean profit data for all treatments (Appendix B), another observation arises regarding those purchasing treatments with both interaction and strategic information. Within the treatments of effectiveness or efficiency, it can be noted that those treatments with both required interaction and high strategic information provide higher mean profit for the firm than do those treatments with only required interaction or high strategic information.

The analysis of variance (ANOVA) displayed in Table 4.3 supports the general observations presented above. The analysis indicates that there is high significance of all three main effects: performance measurement system, interaction, and strategic information. This level of significance is surprising considering that the data was obtained from human subjects. One interaction effect, interaction and strategic information, is significant at the .043 level.

4.2.2 Components of Profit

The analysis of the profit criterion indicates that the independent variables provide significantly different profit levels for the firm. However, it is also useful to understand why the profit levels are different. To examine the nature of the profit differences the components of profit are analyzed. These components include: demand,

TABLE 4.3

ANALYSIS OF VARIANCE FOR PROFIT

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	556686.684	3	185562.228	37.432	0.000
EFFEC	181366.959	1	181366.959	36.586	0.000
INTER	222634.861	1	222634.861	44.910	0.000
INFO	152684.864	1	152684.864	30.800	0.000
2-WAY INTERACTIONS	21598.544	3	7199.515	1.452	0.231
EFFEC INTER	302.184	1	302.184	0.061	0.805
EFFEC INFO	427.194	1	427.194	0.086	0.770
INTER INFO	20869.166	1	20869.166	4.210	0.043
3-WAY INTERACTIONS	166.197	1	166.197	0.034	0.855
EFFEC INTER INFO	166.197	1	166.197	0.034	0.855
EXPLAINED	578451.425	7	82635.918	16.669	0.000
RESIDUAL	555219.013	112	4957.313		
TOTAL	1133670.438	119	9526.642		

sales, material cost, labor costs, inventory carrying costs, and total purchasing costs.

4.2.2.1 Demand

The firm's overall demand for a product indicates the amount of potential sales for the firm. Consequently, customer demand has an impact on the firm's total revenue and profit.

The simulation model allows demand to vary uniformly over a range from 70 units to 130 units per period, with a mean of approximately 100 units per period. The nominal demand (without the impact of purchasing decisions) is 1198 units per year. However, the purchasing decisions allow the demand for the product to increase as much as five percent over the period's expected demand or decrease as much as four percent less than the period's expected demand.

The amount of product demand is impacted by the quality of purchased materials, reliability of purchased materials, customer acceptance of the purchased materials, perceived ethicality of purchasing decisions, and the customer service level.

Table 4.4 presents the mean demands obtained from the simulation. The means are graphically displayed in Figure 4.2. Graphically, the mean demand appears to be very similar for all treatments; however, because of small within-cell variance, the analysis of variance indicates significant main effects for all three factors.

In terms of the performance measurement system, individuals in the effectiveness treatments, those with a broad, firm-oriented perspective, consistently solve purchasing problems in a manner which creates higher product demand. Conversely, individuals in the efficiency

TABLE 4.4

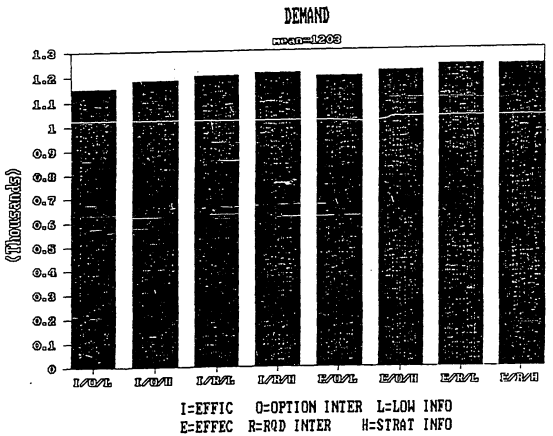
MEAN DEMAND

Main Effect	Mean Annual Demand
Effective PMS	1220* units
Efficient PMS	1185
Required Inter	1220*
Optional Inter	1185
High Strat Info	1210*
Low Strat Info	1195
Grand Mean	1203

*Significant at the .05 level

FIGURE 4.2

MEAN DEMAND



treatments, those with a narrow, cost-based perspective, consistently solve purchasing problems in a manner which creates lower demand (F statistic, alpha = .000).

With regard to interaction, individuals who regularly interact with the other internal functions consistently make purchasing decisions which create higher product demand. Those individuals who do not regularly interact with the other internal functions consistently make purchasing decisions which create lower demand (F statistic, alpha = .000).

In terms of the third main effect, strategic information, the ANOVA indicates that individuals with information about the external environment and the long-range plans of the firm (high strategic information) make purchasing decisions which increase demand. Conversely, individuals without this information (low strategic information) tend to make purchasing decisions which decrease demand (F statistic, alpha = .017).

These results indicate that individuals in effectiveness treatments, treatments with required interaction, and treatments with high strategic information tend to make decisions which make the customer more satisfied with the product and/or the company.

No interaction effects are significant at the .05 level; the interaction of interaction and information is significant at the .084 level.

4.2.2.2 Sales

The firm's demand indicates the firm's potential sales. If demand is not met because of backorders, sales are lower than demand.

The amount of profit obtained by the firm is impacted by the firm's unit sales. If sales increase more than expenses, the firm experiences a higher profit; whereas if sales decrease, the firm experiences a lower profit (unless costs decrease by a greater amount).

The firm's sales are affected by the ability of the firm to generate demand and meet that demand. Therefore, sales are impacted by the potential sales (demand), availability of quality materials, and the availability of labor.

Table 4.5 presents the mean sales obtained from the simulation. Figure 4.3 graphically presents the data.

The analysis of variance indicates results similar to those for demand in that treatments with an effectiveness performance measurement system, required interaction, or high strategic information provide higher mean sales than treatments of efficiency, optional interaction, or low strategic information. This result indicates that not only do individuals with an effectiveness performance system, required interaction, or high strategic information create more demand for the firm, they are also able to capture that demand.

4.2.2.3 Material Costs

The cost of purchased materials also impacts the profit obtained by the firm. Lower material costs increase the firm's profit (given all else remains the same), while higher material costs reduce the profit experienced by the firm (given all else remains the same).

In this research, material costs are best reported as the material cost per unit. If total material costs are used, those treatments which increase their unit sales are at a disadvantage since the total

TABLE 4.5

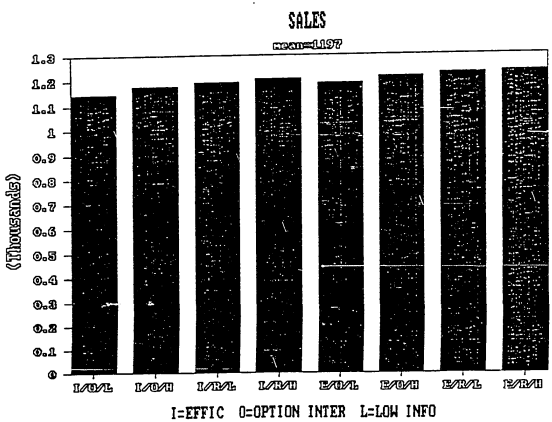
MEAN SALES

Main Effect	Mean Annual Sales
Effective PMS	1214* units
Efficient PMS	1179
Required Inter	1213*
Optional Inter	1180
High Strat Info	1207*
Low Strat Info	1187
Grand Mean	1197

*Significant at the .05 level

FIGURE 4.3

MEAN SALES



material costs increase as more units are produced. The material cost per unit is reduced by purchasing materials at a lower price. A lower price may be obtained by purchasing lower quality items, purchasing in larger quantities, or minimizing service considerations. Material cost per unit generally increases if one purchases higher quality parts, purchases in small quantities, or tries to obtain higher levels of service or product reliability.

Table 4.6 presents the results of the simulation in terms of the mean material cost per unit. The means are graphically displayed in Figure 4.4.

As indicated by the data, the mean material cost per unit is higher for those treatments with an effectiveness performance measurement system than for those treatments with an efficiency performance measurement system. The ANOVA supports this general observation, indicating a significance of .011. This result is not surprising since one of the objectives of an efficiency performance measurement system is to minimize the cost of purchased materials. However, in recalling the profit results, it is interesting to note that efficiency treatments, while obtaining significantly lower material costs, also obtain a significantly lower profit for the firm than do the effectiveness treatments.

No other main or interaction effects are significant with regard to material cost per unit.

4.2.2.4 Labor Costs

Every production or assembly operation incurs labor costs in producing its products. These labor costs vary inversely with the profit

TABLE 4.6

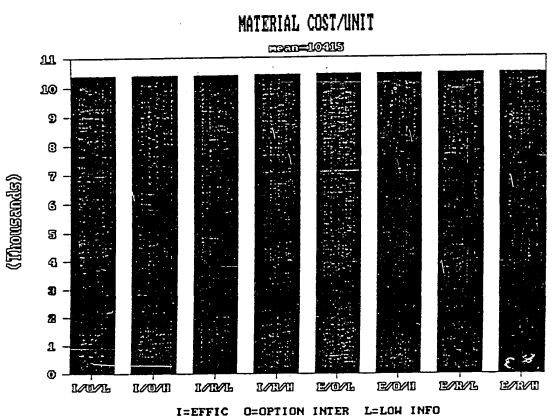
MEAN MATERIAL COST PER UNIT

Main Effect	Mean Material Cost/Unit
Effective PMS	$10432*
Efficient PMS	10397
Required Inter	10424
Optional Inter	10406
High Strat Info	10421
Low Strat Info	10409
Grand Mean	10415

*Significant at the .05 level

FIGURE 4.4

MEAN MATERIAL COST PER UNIT



obtained by the firm.

The purchasing function impacts labor costs through the provision of the purchased materials. If materials are not available when needed or are of inadequate quality, labor costs may increase because of overtime required to make-up for lost production or to perform rework because of quality problems. Additionally, if materials are not available when needed and other products cannot be rescheduled, idle time may occur.

The mean overtime hours obtained from the simulation are provided in Table 4.7. These results are graphically depicted in Figure 4.5.

Although particular treatments incur a greater number of mean overtime hours, as illustrated in Figure 4.5, the ANOVA indicates no significant main or interaction effects at the .05 level. The main effect of interaction is significant at the .092 level.

The mean overtime hours among the treatments, although appearing to be relatively different, are not significantly different because there is a high amount of within-cell variance on this measure. For example, in the treatments with an efficiency performance measurement system, optional interaction, and low strategic information the mean overtime hours ranged from 1,729 hours to 13,418 hours. This high within-cell variance decreases the possibility of obtaining significant differences between the treatments. Those profit components which have been previously discussed (see Tables 4.4, 4.5, and 4.6), although appearing to exhibit relatively small differences between the treatments, possess significant treatment differences because the within-cell variance is much smaller.

TABLE 4.7

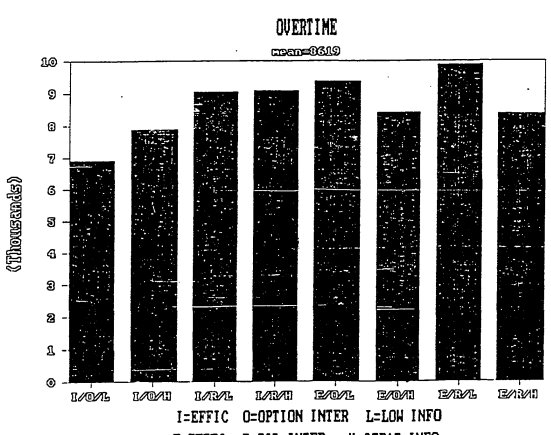
MEAN OVERTIME HOURS

Main Effect	Mean Annual Overtime
Effective PMS	9011 hours
Efficient PMS	8227
Required Inter	9091
Optional Inter	8147
High Strat Info	8432
Low Strat Info	8805
Grand Mean	8619

*Significant at the .05 level

FIGURE 4.5

MEAN OVERTIME HOURS



The lack of significance with regard to overtime hours is important because it reveals that those treatments which experience a higher amount of demand (and sales) manage to produce these additional units without significantly more overtime.

Idle time occurs when the required amount of labor hours is less than the available amount of straight time labor hours. As such, no additional cost is assessed for idle time; the cost is simply the straight time cost of labor. Although idle time does not increase overall labor costs, it may provide some insight into the efficiency or productivity of the organization.

The amount of idle time is affected by the purchasing function through late delivery of materials, poor component quality, decreased demand, or decreased required production time per unit.

Table 4.8 displays the mean amounts of idle time from the simulation. The results are graphically portrayed in Figure 4.6.

The data suggests two rather interesting observations: 1) Those treatments with high strategic information consistently incur greater amounts of idle time than do those treatments with low strategic information (F statistic, alpha = .004); 2) Those treatments with required interaction consistently incur greater amounts of idle time than do those treatments with optional interaction (F statistic, alpha = .028).

In examining the possible reasons for additional idle time within the treatments of high strategic information as opposed to those with low strategic information, one first notes that the additional idle time is most likely not caused by decreased demand because, as indicated by the demand data, those treatments with high strategic information

TABLE 4.8

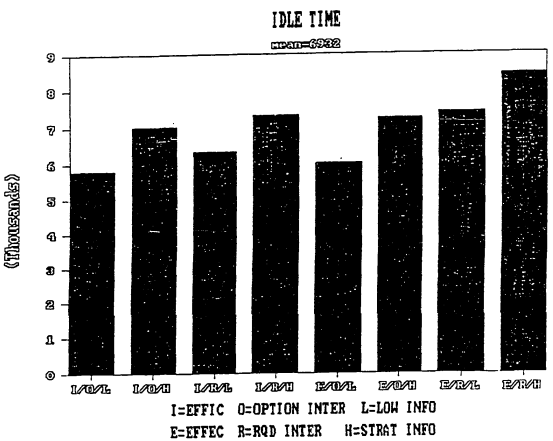
MEAN IDLE TIME HOURS

Main Effect	Mean Annual Idle Time
Effective PMS	7252 hours
Efficient PMS	6611
Required Inter	7360*
Optional Inter	6504
High Strat Info	7495*
Low Strat Info	6369
Grand Mean	6932

*Significant at the .05 level

FIGURE 4.6

MEAN IDLE TIME HOURS



produce significantly more demand than those treatments with low strategic information.

Additionally, the increased idle time is probably not caused by late delivery of materials or poor component quality because these occurrences would cause additional backorders, and treatments with high strategic information produce significantly fewer backorders than treatments with low strategic information (this data is yet to be presented).

Another possible reason for the additional idle time is an increase in labor productivity. It is conjectured that treatments with high strategic information, as opposed to those with low strategic information, are better able to make decisions which decrease the required production time per unit. This reduction in required production time decreases the number of required labor hours, creating additional idle time.

The rationale employed in examining the additional idle time in treatments of required interaction, as opposed to those with optional interaction, is similar to the above discussion. Again, lower demand is probably not the reason for the additional idle time because treatments with required interaction produce significantly more demand than those with optional interaction. Late material delivery and poor component quality are again probably not the appropriate explanation because the backorders for treatments with required interaction and optional interaction are essentially equivalent. Decreased production time per unit is hypothesized to be the explanation for the additional idle time experienced by the treatments with required interaction as

opposed to those with optional interaction.

The ANOVA indicates no additional effects which are significant at the .05 level; the main effect of performance measurement system is significant at the .098 level.

4.2.2.5 Inventory Carrying Costs

Inventory carrying costs reflect the cost which the firm incurs by carrying inventory throughout the simulated time horizon. Purchasing decisions affect the inventory carrying costs through the price which it pays for materials and the quantity of items ordered at a point in time (order sizes).

The mean inventory carrying costs from the simulation for the main effects are displayed in Table 4.9. Figure 4.7 graphically displays the data.

Although particular treatments incur relatively higher mean inventory carrying costs, as illustrated in Figure 4.7, the ANOVA indicates no significant main or interaction effects at the .05 level. The interaction of interaction and information is significant at the .082 level.

The mean inventory carrying cost, although appearing to be relatively different among the treatments, is not significantly different because there is a high within-cell variance on this measure. For example, in treatments with an effectiveness performance measurement system, optional interaction, and high strategic information the mean inventory carrying cost ranges from $5,838 to $30,832. This high within-cell variance decreases the possibility of obtaining significant differences between the treatments on this measure.

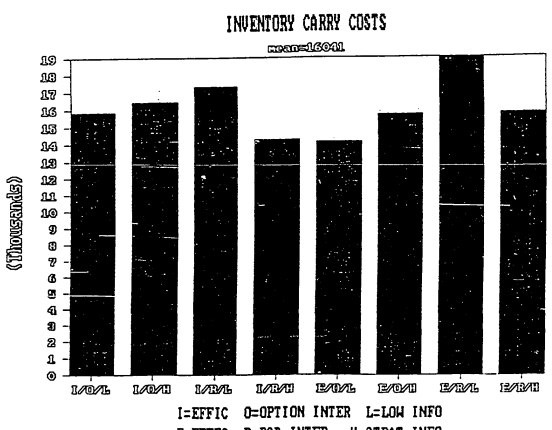
TABLE 4.9

MEAN INVENTORY CARRYING COSTS

Main Effect	Mean Inventory Carrying Cost
Effective PMS	$16122
Efficient PMS	15961
Required Inter	16574
Optional Inter	15508
High Strat Info	15519
Low Strat Info	16564
Grand Mean	16041

FIGURE 4.7

MEAN INVENTORY CAPRYING COSTS



4.2.2.6 Total Purchasing Costs

The total purchasing costs reflect the operating costs which the purchasing function incurs for the firm. This cost category does not include the price paid for materials but includes items such as order costs, administrative costs (including expediting costs, excessive transportation costs, and rework costs because of purchasing decisions), and backorder costs. These costs reduce the profit which could be obtained by the firm. These costs also provide insight as to the extent to which the purchasing function is performing its responsibilities effectively.

The mean purchasing costs for the main effects are presented in Table 4.10. The data is graphically depicted in Figure 4.8.

Analysis of the data indicates that total purchasing costs are affected by the type of performance measurement system, type of interaction, and amount of strategic information. Treatments with an effectiveness performance measurement system, required interaction, or high strategic information produce lower purchasing costs than their counterparts of efficiency, optional interaction, or low strategic information (F statistic, alpha = .000). No interaction effects are significant.

It is also interesting to note that, with one exception, purchasing functions with an effective performance system incur lower mean purchasing costs than purchasing functions with an efficiency performance system. The exception is an effectiveness purchasing function with optional interaction and low strategic information.

One of the costs included within the category of purchasing costs

TABLE 4.10

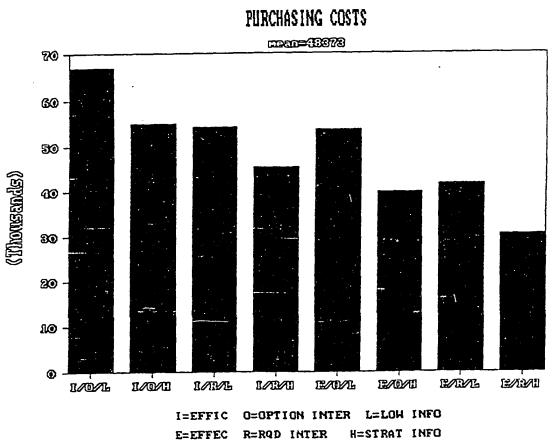
MEAN PURCHASING COSTS

Main Effect	Annual Purch Cost
Effective PMS	$41360*
Efficient PMS	55386
Required Inter	42943*
Optional Inter	53803
High Strat Info	42643*
Low Strat Info	54102
Grand Mean	48373

*Significant at the .05 level

FIGURE 4.8

MEAN PURCHASING COSTS



is that of backorders. The number of backorders reflects the extent to which the firm is unable to meet its demand.

The mean number of backorders for the main effects is presented in Table 4.11. The means are graphically presented in Figure 4.9.

As illustrated by the data, the treatments with high strategic information consistently incur fewer backorders than the treatments with low strategic information (F statistic, alpha = .015). This result is rather interesting when considered with previous results: Treatments with high strategic information obtain significantly more demand, experience significantly more idle time, and incur significantly fewer backorders than treatments with low strategic information. It is conjectured that a purchasing function with strategic information may enable the firm to operate more productively.

The ANOVA indicates no additional effects which are significant at the .05 level; the main effect of performance measurement is significant at the .08 level.

4.3 SUMMARY OF THE MAIN EXPERIMENT

The objective of the main experiment was to produce data that could be analyzed to provide answers to the research questions. This section draws together the results on the measures of performance and uses them to draw inferences about each of the factors separately and then on selected combinations of the factors. These inferences are presented in response to the research questions.

Research Question 1

Do various ways of managing the purchasing function have a significant impact on the firm's performance?

TABLE 4.11

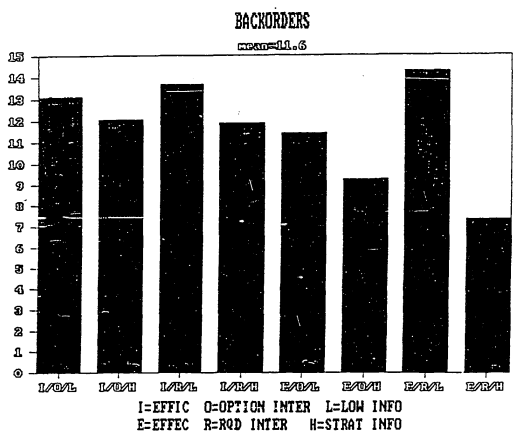
MEAN BACKORDERS

Main Effect	Annual Backorders
Effective PMS	10.5 units
Efficient PMS	12.7
Required Inter	11.8
Optional Inter	11.4
High Strat Info	10.1*
Low Strat Info	13.1
Grand Mean	11.6

*Significant at the .05 level

FIGURE 4.9

MEAN BACKORDERS



The management of a business organization has the opportunity to determine the performance measurement system for the purchasing function, the type of interaction required of the function, and the extent to which the function is involved in external activities (or obtaining strategic information). These managerial elements, or ways of managing the purchasing function, have a significant impact on the firm's performance in terms of profit performance.

Table 4.12 presents a summary of the experiment results. The values presented are the mean values for each of the main effects for the dependent variable, profit, and the components of profit.

As indicated in Table 4.12, the performance measurement system for the purchasing function has a significant impact on the firm's performance when one measures the firm's performance in terms of profit. The table also illustrates the manner in which the performance measurement system impacts the profit of the firm. For example, the performance measurement system impacts profit by significantly influencing customer demand, unit sales, cost of materials, and total purchasing costs. The performance measurement system also affects overtime and idle time hours, inventory carrying costs, and number of backorders; however, the effect in these areas is not statistically significant.

The type of interaction required of purchasing also significantly impacts the firm's performance, when measured in terms of profit, as presented in Table 4.12. The results indicate that interaction impacts the firm's profit through the components of customer demand, unit sales, total purchasing costs, and amount of idle time. Interaction also affects material costs, overtime hours, inventory carrying costs,

TABLE 4.12

SUMMARY OF EXPERIMENT RESULTS

	Annual Profit ($)	Annual Demand (units)	Annual Sales (units)	Material Cost/Car ($)	Inventory Carry Cost ($)
Effectiveness	2521770	1220	1214	10432	16122
Efficiency	2444016	1185	1179	10397	15961
Rqd Interact	2518563	1220	1213	10424	16574
Option Interact	2447223	1185	1180	10406	15508
High Strat Info	2525966	1210	1207	10421	15519
Low Strat Info	2439820	1195	1187	10409	16564
Grand Mean	2482893	1203	1197	10415	16041

	Annual Overtime (hours)	Annual Idletime (hours)	Annual Purch Cost ($)	Annual Backorders (units)
Effectiveness	9011	7252	41360	10.5
Efficiency	8227	6611	55386	12.7
Rqd Interact	9091	7360	42943	11.8
Option Interact	8147	6504	53803	11.4
High Strat Info	8432	7495	42643	10.1
Low Strat Info	8805	6369	54102	13.1
Grand Mean	8619	6932	48373	11.6

and number of backorders, but these effects are not statistically significant.

As illustrated in Table 4.12, the extent to which purchasing obtains strategic information also significantly impacts the firm's profit performance. The results indicate that strategic information impacts the firm's profit by significantly impacting customer demand, sales, total purchasing costs, number of backorders, and amount of idle time. Statistically insignificant effects exist for material cost, amount of overtime, and inventory carrying costs.

In summary, the managerial elements examined in this research--performance measurement system, interaction, and strategic information--impact the firm's profit performance. The elements impact the firm's profit through different components and in different directions.

Research Question 2

Does an effectiveness performance measurement system provide better firm performance than an efficiency performance measurement system?

The answer to this question is yes if the firm's performance is measured in terms of profit.

The performance measurement system for the purchasing function guides the actions of the purchasing function toward the accomplishment of particular objectives. An efficiency performance measurement system focuses on departmental cost and activity-based objectives while an effectiveness performance measurement system focuses on total firm and contribution-based objectives. These different objectives tend to encourage the purchasing individuals to solve purchasing problems in different ways. As previously indicated, these purchasing decisions

significantly impact the firm's profit performance.

Table 4.12 presents the mean values for the dependent variable, profit, and the components of profit for the main effects. The results indicate that an effectiveness performance measurement system provides significantly more profit for the firm than an efficiency performance measurement system. An effectiveness performance measurement system, as compared to an efficiency performance measurement system, increases the firm's profit by creating significantly more customer demand, significantly higher sales, and significantly lower total purchasing costs. However, in providing these benefits the effectiveness system incurs significantly higher material costs than an efficiency system.

These results are logical if one examines them in light of the objectives of each system. For example, the objectives and performance measures of an effectiveness performance measurement system incorporate a total systems approach and deal with improving the performance of the firm. Improving the firm's profit is therefore foremost to an effectiveness system. An effectiveness performance measurement system improves the firm's profit by concentrating on product quality and the customer's desires. This focus creates higher demand and sales for the firm. Total purchasing costs reflect not only costs which occur within the purchasing function but all costs incurred because of purchasing decisions. An effectiveness performance measurement system seeks to minimize the total purchasing costs incurred by the firm.

An efficiency performance measurement system is also concerned with the firm's performance but in a more indirect manner. The primary focus of an efficiency performance measurement system is to improve the

performance of the purchasing function. Individuals within an effectiveness performance measurement system may solve purchasing problems in a manner which increases the costs of the purchasing department but decreases costs elsewhere in the company by a greater amount. Since an efficiency performance measurement system focuses on the performance of the department, an efficiency performance system may not encourage such an action. However, an efficiency performance measurement system obtains significantly lower material costs. It is interesting to note that lower material costs do not always provide higher profit.

The type of performance measurement system creates no significant differences in number of backorders, idle time, overtime, or inventory carrying costs. This lack of significance is interesting because it indicates that an effectiveness performance measurement system is able to increase demand and sales while incurring about the same amount of backorders, idle time, overtime, and inventory carrying costs.

Research Question 3

Does an integrated purchasing function provide better performance for the firm than an isolated purchasing function?

The answer to this question is yes if the firm's performance is measured in terms of profit.

To consider the performance of an integrated purchasing function one must first examine the performance of the two elements of integration: interaction and strategic information. A purchasing function may operate with optional or required interaction and low or high strategic information.

If a purchasing function operates with optional interaction, the

function does not regularly interact with the other internal functions and top management. Consequently, the function possesses little information about what is occurring in the other functions. If purchasing operates in an environment in which interaction is required of the function, purchasing personnel have high work-related interaction with the other internal functions such as product development, marketing, production planning and control, and inventory control. Consequently, purchasing is aware of activities occurring within the other functional areas of the firm. For example, purchasing is aware of marketing research, production processing concerns, transportation regulation, and engineering activities.

The additional interaction appears to be beneficial for, as presented in Table 4.12, required interaction provides significantly more profit for the firm than optional interaction. Required interaction provides higher profit by creating significantly higher customer demand, greater unit sales, and lower total purchasing costs. However, while providing these benefits, required interaction incurs significantly more idle time than optional interaction.

The type of interaction provides no statistically significant differences in terms of overtime hours, inventory carrying costs, and backorders. This lack of significance is informative because it indicates that individuals with required interaction are able to significantly increase the firm's profit through higher demand and sales while incurring about the same amount of overtime, inventory carrying costs, and backorders as those individuals with optional interaction.

The purchasing function may operate in an environment in which it

obtains a low amount of strategic information or it may operate in an environment in which it obtains a high amount of strategic information. Strategic information includes information about 1) products or suppliers, 2) the goals, objectives, and policies of the firm, 3) the long-term projected demand or expected demand changes, 4) future material needs and/or specifications, or 5) the future expected market conditions and trends.

Table 4.12 indicates that the strategic information appears to be beneficial because high strategic information treatments provide significantly better profit performance for the firm than low strategic information treatments. High strategic information improves the firm's profit by creating significantly higher customer demand, significantly greater unit sales, significantly lower total purchasing costs, and significantly fewer backorders. However, high strategic information incurs significantly higher idle time.

The amount of strategic information provides no significant differences in material costs, overtime, or inventory carrying costs. This lack of significance is important because it illustrates that high strategic information is able to provide more demand and sales while incurring about the same material costs, overtime, and inventory carrying costs.

An integrated purchasing function is one which possesses both required interaction and high strategic information. An isolated purchasing function is one which possesses both optional interaction and low strategic information. Purchasing functions with different combinations of the two elements are partially integrated functions.

Treatments with required interaction or high strategic information produce significantly higher profit for the firm than their counterpart treatments with optional interaction or low strategic information. Additionally, the treatments with both required interaction and high strategic information produce significantly more profit than the treatments with either required interaction or high strategic information (F statistic, alpha = .004). These results indicate that an integrated purchasing function provides significantly better performance for the firm than a partially integrated or an isolated purchasing function.

An integrated purchasing function improves the firm's profit by producing lower inventory carrying costs (.082 level of significance) and greater customer demand (.084 level of significance). The degree of integration provides no significant results in sales, material costs, labor costs, or total purchasing costs.

Research Question 4

Is there one way of managing the purchasing function which outperforms the others?

In the strictest sense, the answer to this question is no. However, particular ways of managing the purchasing function appear to provide better profit performance for the firm than other ways of managing the function.

A purchasing function (treatment) with an effectiveness performance measurement system, required interaction, and high strategic information provides statistically significantly better profit performance for the firm than a purchasing function with an efficiency performance measurement system, optional interaction, and low strategic

information. No other three-way interactions are statistically significant.

Further, an integrated purchasing function (one which possesses both required interaction and high strategic information) provides significantly better profit performance for the firm than a partially integrated purchasing function (one which possesses either required interaction or high strategic information) or an isolated purchasing function (one which possesses neither required interaction nor high strategic information).

Additionally, it should be recalled that, in accordance with the results presented in Table 4.12, an effectiveness performance measurement system provides significantly higher profit performance for the firm than an efficiency performance measurement system; required interaction provides significantly higher profit for the firm than optional interaction; and high strategic information provides significantly higher profit for the firm than low strategic information.

4.4 SUMMARY

This chapter has presented a review of the main experiment and a discussion of the experimental results and data analyses. It concluded with a summary of the research results in response to the research questions.

This research examined the relative operating performance of an efficiency versus an effectiveness performance measurement system, optional interaction versus required interaction, and low strategic information versus high strategic information. The performance of

various combinations of these elements was also examined. Performance was measured using profit as the principal criterion. Additionally, the various components of profit were examined. These components included demand, sales, material costs, labor costs, inventory carrying costs, and total purchasing costs.

The experimental results and analyses indicate that the performance measurement system, type of interaction, and amount of strategic information significantly impact the profit obtained by the firm. In particular, treatments with an effectiveness performance measurement system, required interaction, or high strategic information obtain higher mean profits than treatments with an efficiency performance measurement system, optional interaction, or low strategic information.

A purchasing function with an effectiveness performance measurement system, as compared to a purchasing function with an efficiency performance measurement system, produces significantly more profit for the firm by creating significantly higher customer demand, significantly greater unit sales, and significantly lower total purchasing costs. However, in providing these benefits, a purchasing function with an effectiveness performance measurement system incurs significantly higher material costs than a purchasing function with an efficiency performance measurement system.

A purchasing function with required interaction, as compared to a purchasing function with optional interaction, provides significantly more profit for the firm by creating significantly higher customer demand, significantly greater unit sales, and significantly lower total purchasing costs. However, a purchasing function with required inter-

action incurs significantly more idle time than a purchasing function with optional interaction.

A purchasing function with high strategic information, as compared to a purchasing function with low strategic information, provides significantly better profit performance for the firm by creating significantly higher customer demand, significantly greater unit sales, significantly lower total purchasing costs, and significantly fewer backorders. However, a function with high strategic information, as compared to one with low strategic information, incurs significantly higher idle time.

Further, an integrated purchasing function (one with both required interaction and high strategic information) produces significantly more profit for the firm than a partially integrated purchasing function (one with either required interaction or high strategic information) or an isolated purchasing function (one with neither required interaction nor high strategic information). An integrated purchasing function produces more profit by creating higher customer demand (.084 level of significance) and lower inventory carrying costs (.082 level of significance).

Finally, a purchasing function with an effectiveness performance measurement system, required interaction, and high strategic information provides significantly better profit performance for the firm than a purchasing function with an efficiency performance system, optional interaction, and low strategic information. Additional three-way interactions are not significant.

The next chapter, based upon the results presented in Chapter

Four, draws conclusions and implications about the independent variables. Further, it presents the limitations of the research and identifies areas for future research.

5.0 DISCUSSION

This research examined the performance of the purchasing function in a business organization. In particular, the research analyzed the impact of various ways of managing the purchasing function on the performance of the firm.

The research investigated the relative operating performance of two types of performance measurement systems (efficiency and effectiveness), two types of interaction (optional and required), and two levels of strategic information (low and high). The performance of various combinations of these elements was also investigated.

Performance was measured in terms of the firm's profit. To provide additional insight, the components of profit were also examined. The profit components which were examined included demand, sales, material costs, labor costs, inventory carrying costs, and total purchasing costs.

This chapter discusses the results of the experiment. The chapter presents a brief summary of the significant experimental results, examines the limitations of the research, and describes potential contributions and implications of the research. Finally, suggestions for future research are offered.

5.1 Summary of Experimental Results

The experimental results and analyses indicate that the nature of the performance measurement system, type of interaction, and amount of strategic information significantly impact the profit performance of the firm. In particular, a purchasing function with an effectiveness performance measurement system, required interaction, or high strategic information provides higher profit for the firm than a purchasing function with an efficiency performance measurement system, optional interaction, or low strategic information.

Additionally, the analyses indicate that an integrated purchasing function (a purchasing function with required interaction and high strategic information) produces higher firm profit than a partially integrated purchasing function (a purchasing function with either required interaction or high strategic information) or an isolated purchasing function (a purchasing function with neither required interaction nor high strategic information).

Finally, the analyses indicate that a purchasing function with an effectiveness performance measurement system, required interaction, and high strategic information provides better profit performance for the firm than a purchasing function with an efficiency performance measurement system, optional interaction, and low strategic information.

5.2 Limitations of the Research

Steps were taken in the design and conduct of the research to minimize threats to internal and external validity. Serious violations did not occur; however, potential limitations of the research do exist. These potential limitations, in terms of possible threats to internal

and external validity, are discussed here.

5.2.1 Internal Validity

Internal validity addresses the question: Does the experimental treatment really make a significant difference on the results of the experiment? Anything affecting the controls of the experimental design becomes a problem of internal validity. The experimental design and careful operationalization of the experiment decreased the threats to internal validity; however, one potential threat to the internal validity of this research is communication between subjects.

There is reason to believe that when respondents can communicate with each other, one treatment group may learn information that was not intended for them. Within the experiment, care was taken to prevent subjects from communicating with one another. Additionally, the complexity of the experiment made it difficult for subjects to convey useful information to other subjects and no subjects were debriefed until all subjects had completed the research. Regardless, it is possible that some individuals were able to learn about the study prior to participating in the research. It is not believed that this possibility of communication between subjects is a serious threat to the internal validity of the research.

5.2.2 External Validity

External validity concerns the generalization of the experimental results to different conditions and situations. This study may be limited in terms of its generalization over people and settings.

The extent to which the experimental results (cause and effect relationships) can be generalized beyond the experimental groups is of

some concern for this research because this research involved the use of student subjects in a laboratory setting. Generalization beyond experimental groups is usually one of the more important concerns for any laboratory study, particularly those using student subjects. The key is not to overgeneralize. It is difficult to generalize from student subjects to purchasing individuals. However, it is known that students have been compared favorably with practitioners [56]. Nevertheless, it is not the intent of this dissertation to generalize over all types of decision-makers. Rather, it is to incorporate some of the salient features of purchasing decision-making into a controlled setting to test hypotheses regarding the impact of the purchasing function on the performance of the firm. Regardless, it would be advisable to test these hypotheses using different samples from different populations before making any claims about generalization over people.

It should be noted that if a task were to take substantially longer than the one used in this study, one day for example, it might be less generalizable [31]. In other words, executives often have to make decisions quickly on a daily basis. Studies in which multiple decisions are made within a complex task over less than one day may have some bearing to the "real" world. Moreover, if the subjects find it easy to participate, generalization over people can be improved because students are less likely to be atypical than if great effort is necessary to participate. Atypical behavior may have been reduced in this study because the study was conducted in the business school using business students during normal hours.

Clearly, it is difficult to generalize results obtained in a lab-

oratory setting to more real-world management settings. This research attempted to enhance the generalizability over a wider range of conditions by employing a simulation within a laboratory setting. The use of simulation allowed for the development of a more complex, realistic task and task environment while maintaining a high degree of control over the events occurring within the system.

However, the simulation itself represents a particular type of environment. Parameters or conditions within the model can be potential threats to external validity. Two threats to external validity within the model include the use of particular cost data (e.g., inventory carrying cost, material costs, labor costs) and the use of particular outcomes for each problem response. If a researcher is to examine the impact of decisions on the firm's profit, specific values need to be assigned to the various costs. Care was taken to select representative costs but these costs are a potential threat to external validity. To minimize this threat, non-cost components of performance were also examined.

Additionally, within a computer simulation, if a researcher is to examine the impact of various decisions on a firm's profit, the particular impact of each decision must be determined and programmed.

Within this research, the subject is placed into a particular purchasing environment and requested to perform the role of a purchasing manager. The purchasing environment in which the subject operates portrays an efficiency- or an effectiveness-oriented performance measurement system, optional or required interaction, and low or high strategic information. Operating within this environment, the subject is

presented with a series of purchasing situations. The subject responds to each problem situation by selecting one of four possible responses. The environment in which the subject operates should influence the manner in which the subject responds to the problem situations. For example, an individual operating with an efficiency-oriented performance measurement system is more likely to select a problem response which appears to increase efficiency, while an individual operating with an effectiveness-oriented performance measurement system is more likely to select a problem response which appears to increase effectiveness. After selecting a response to each problem situation, the subject has no further impact on the results of the experiment. The impact of each problem response on the firm's operations is preprogrammed into the simulation. Within the simulation model, each of the responses has a particular series of events associated with it. These responses, through the preassigned events, impact the elements within the model, subsequently impacting the profit obtained by the firm. The subject is unaware of the actual impact of the responses on the firm's performance.

Care was taken to assign events and outcomes for each response which were representative of those which might reasonably occur in a "real world" environment. (The outcomes were examined by purchasing professionals through a modified Turing test and no problems were revealed.) However, the same research results may not be obtained if different outcomes were to be associated with the problem responses.

The methodology employed in this research certainly impacts the manner in which the research results might be interpreted. From one

perspective, it might be argued that the major contribution of this research is the result that individuals, when operating in different environments, do indeed make different decisions when confronted with the same problem situation. This result is, in itself, an important contribution to the field of purchasing management. This result indicates that managers, by creating a particular type of operating environment, influence the decisions made by those individuals operating in that environment. For example, if a purchaser is motivated and evaluated with an efficiency-oriented performance measurement system, that purchaser is encouraged to make buying decisions which increase throughput or minimize costs, thereby improving efficiency. Given the results of this research, it is beneficial for managers to realize that the decisions made by individuals are influenced by their operating environment. Consequently, managers should strive to develop that type of environment which encourages the desired decision-making behavior on the part of those individuals.

Another possible threat to the generalization of the results to different settings lies in the structure of the model. The model does not portray a particular firm or a particular industry; rather, it attempts to portray a generic organization. However, there is one limitation: The model is inappropriate for firms in which the purchasing function controls a small percent of the firm's revenue. This model is structured such that the purchasing function controls (impacts) about 52% of the firm's revenue. The results from the research should be applicable to firms in which the purchasing function exerts more or equivalent control over the firm's revenue, but the results may

not be appropriate for firms whose purchasing function possesses substantially less control over the firm's revenue.

This research possesses several potential limitations. The possibility of communication between subjects might limit the internal validity of the study while the use of student subjects, particular cost data, preassigned decision outcomes, and the structure of the model might limit the external validity of the study.

5.3 Potential Contributions and Implications of the Research

Despite the potential limitations of the research, this work has contributed to the field in several ways. The contributions of the research and their implications are discussed in this section.

The major contributions of the research include:

1. The development of a simulator for evaluating the effectiveness of various ways of managing the purchasing function.
2. The provision of a methodology for quantifying the performance of the purchasing function as it impacts the firm.
3. The quantitative evaluation of the impact of performance measurement systems and degree of integration (through components of interaction and information) upon purchasing and firm performance.
4. The application of an existing methodology to a new field of research.
5. The addition of empirical research in an area where little exists.

Each of these contributions and their potential implications for researchers and managers are discussed next.

This research has developed a simulator by which various ways of

managing the purchasing function can be evaluated. The simulation can be a valuable contribution to both researchers and managers. Through the simulation model, the behavior of purchasing functions with different characteristics (e.g., different levels and types of information, feedback, or goals) can be examined. Additionally, these purchasing functions can be evaluated in terms of their performance (or impact on the firm) when operating in different types of environments (e.g., environments with multiple products, varying amounts and types of uncertainty, or different amounts and types of resources). In essence, the model allows research to be conducted on the different ways of managing the purchasing function in different types of environments. The results of this potential research will provide management with insight and information about how the purchasing function might be better managed.

It has been recognized for some time that the actions of the purchasing function impact the performance of the firm. However, the nature and extent of the impact of the purchasing function has not been examined. The results of this research indicate that the purchasing function significantly impacts the amount of the firm's profit. Purchasing may impact the firm's profit through demand for the end item, sales of the end item, material costs, labor costs, number of backorders, or total purchasing costs.

The results from the research may be useful for management in trying to establish the position and importance of the purchasing function within an organization. Additionally, the results indicate that the actions of the purchasing function impact more than the costs typi-

cally attributed to the purchasing department. The actions of purchasing individuals may increase as well as decrease costs elsewhere within the organization.

This research has quantitatively evaluated the impact of performance measurement systems, type of interaction, and amount of strategic information upon purchasing and firm performance. The results of the research can be quite useful for purchasing managers because the results can provide guidance and insight into the impact of various ways of managing the purchasing function.

Today, purchasing functions are generally managed with an efficiency performance measurement system; purchasing is often not regularly involved with the other internal functions; and the purchasing function is often not continually involved in the planning processes of the firm. The research results indicate that this method of managing the purchasing function may not capitalize on the function's total potential to benefit the firm.

A purchasing function which is directed with an efficiency performance measurement system focuses on decreasing material costs and increasing operational efficiency. Such a purchasing function is capable of performing quite well in terms of these criteria. Lower material costs do indeed directly impact the bottom line, often creating greater profit for the firm. However, constantly striving for lower material costs may encourage the purchaser to make decisions which sacrifice quality, delivery, supplier relations, service, or technological advancements. Additionally, a continuous drive for cost reductions may encourage the purchaser to lose sight of the other objectives

of the organization, such as lower production costs, higher quality, less scrap and rework, or increased sales.

Currently, with the prevalence of efficiency performance measurement systems, there is little incentive or motivation for the purchasing function to maximize its contribution to the goals of the firm except through cost minimization. Consequently, the performance objective of the purchasing function often becomes one of continued reduction in spending when, in fact, sometimes an increase in spending (e.g., purchasing higher quality) might lead to an increase in profits. If management continues to reward purchasing for cost minimization, the individual in the purchasing function will continue to reduce costs.

An efficiency performance measurement system serves a valuable purpose within a purchasing function. The research results indicate that material costs are significantly lower in such a system, and material costs are a major element of a firm's total costs. However, total concentration on efficiency also creates a lower profit for the firm. Perhaps the goals of an efficiency performance measurement system need to be overlaid with the broader, systems concepts behind an effective performance measurement system.

The goals, objectives, and performance measures of an efficiency performance measurement system are generally more objective, more quantitative, and easier to develop and measure than the goals, objectives, and performance measures of an effectiveness performance measurement system. Consequently, efficiency measures are often used as the primary performance criterion for the purchasing function. More attention

needs to be devoted to the development and subsequent measurement of effectiveness goals, objectives, and measures.

This research employed effectiveness measures of contribution to profit, quality of supplier relations, and extent of customer satisfaction. Developing a measure to capture the contribution to the firm's profit by the purchasing function is not easy. Often, this contribution is determined by evaluating the purchasing function as a profit center. However, the profit center concept might also tend to create a departmentalized viewpoint on the part of purchasing and might also place little emphasis on issues other than cost. An alternative measure (or measures) of the contribution of the purchasing function needs to be developed.

One measure of effectiveness which is fairly straightforward to develop and measure is the quality of supplier relations. A performance measure in this area could include aspects of delivery reliability, rejection rates, incidence of supplier assistance, length of relationship with supplier, and the supplier's view of the relationship. A solid base of quality suppliers is an indicator of an effective purchasing function.

The idea of measuring purchasing performance in terms of customer satisfaction is a new approach to purchasing performance measurement. However, if the goal of an effectiveness performance measurement system is to contribute to the goals of the firm, then relating purchasing actions to customer satisfaction may not be so unusual. The goals of a firm often deal with increasing market share, improving profit performance, or meeting a growth strategy. These goals deal with increasing

the perceived value of the product, consequently increasing demand for the product. The actions of purchasing, for example, the choice of materials and suppliers, impact the perceived value of the product through quality, price, or delivery. Consequently, if purchasing individuals purchase materials (components) as desired by the customer the perceived value of the product may increase.

The purchasing function within an organization is often not regularly involved with the other internal functions and often does not consistently participate in nonpurchasing decisions. This lack of interaction is unfortunate because it forces purchasing individuals to make decisions without all relevant information. Consequently, as indicated by these research results, these decisions may not be in the best interests of the firm. The research results indicate that if purchasing is aware of the future needs and plans of the other functions, purchasing is better able to satisfy those needs in the interests of the firm. For example, if purchasing is involved in product development from the initial stages, purchasing can provide valuable supply information to the process and begin to examine the supply environment for the raw materials.

To provide maximum contribution to the firm, the results of this research suggest that the purchasing function should not only be involved in making and implementing tactical or lower-level decisions, it should also be involved in making and contributing to the firm's strategic decisions. To involve purchasing in the strategy process, the senior purchasing manager might become a participating member in the firm's top management strategy development process, possessing author-

ity equivalent to the representatives of the other functional areas involved in the process [111].

The research results indicate that the possession of strategic information by the purchasing function improves the profit performance of the firm. Within this research, strategic information was simply provided to the purchasing individuals. In the "real world", purchasing is required to obtain this information. To obtain the information, the purchasing function needs to develop long-term plans within the function itself. These plans should include the results of market and price analyses, projections of market and price trends, and present and projected material availability. Top management needs to provide purchasing with both the opportunity and motivation to become part of the strategic planning process. The involvement of purchasing in the strategy process of the firm might provide the firm with valuable supply considerations and possibly more clearly define the role of purchasing in accomplishing the goals of the firm.

The results of this research indicate that a purchasing function with an effectiveness performance measurement system, required interaction, and high strategic information appears to provide the most benefit for the firm. Perhaps more effort needs to be devoted toward developing this type of purchasing function in industry.

This research used a laboratory simulation to examine the performance of the purchasing function. This methodology is relatively new to the area of purchasing research. The use of laboratory experimentation is prevalent in purchasing research; the use of simulation is quite rare. The simulation model in this research can provide some

guidance and insight into the application of simulation in studying the purchasing function. The use of this methodology may assist in the development of more complex, "real-world" research in the field of purchasing.

In summary, this research has provided additional information to the field of purchasing management. This information can be useful to both researchers and managers. Researchers may use the results and methodology of this research as a foundation in conducting future research in the area. Future research would be extremely valuable because relatively little research has been conducted in the area of purchasing management. Managers may find the results of the research useful when trying to establish the importance of the purchasing function or when determining how to obtain better performance from the purchasing function. Different managerial elements produce different behaviors from the purchasing function, thereby creating significantly different impacts on the performance of the firm.

5.4 Suggestions for Future Research

The field of purchasing management has received little academic attention and therefore is rich in areas for future research. Further, there are many possible extensions to the research reported in this dissertation. Many of these extensions fall into the following groupings:

1) Further exploration of the environment used in this experiment.

2) Development and evaluation of other managerial elements in the same environment.

3) Evaluation of the managerial elements used in this research extended

to other environments.

This research has developed and evaluated three elements in the management of the purchasing function. The environment in which these elements were evaluated could be further explored. The subjects in this research were upper division business undergraduates at Indiana University; other subjects could be used. Other purchasing problems might also be used; these problems might consist of different problem situations, different responses, or problems dealing with particular types of purchasing situations. This research used an automobile as the end product with the problems reflecting situations with the component parts; perhaps a different end product might be used. Another study might examine the issue of feedback. Feedback was provided primarily in the form of quantitative data; other forms and amounts of feedback might be examined. The investigation of issues such as these would help extend the generalizability of the results of this dissertation.

Other elements in the management of the purchasing function could be developed and evaluated. The research in this dissertation has explored three managerial elements. Other research could involve modification of these elements or development of entirely different managerial elements. Modifications could include the examination of the difficulty level of goals and objectives, the investigation of different types of information, the exploration of the clarity and/or specificity of the objectives or information, or the investigation of different types of performance measurement systems (including those currently in existence in the "real world"). New managerial elements

could include the investigation of group decision-making, the effects of role conflict, or the impacts of different types of feedback or reward systems. Research in this group of topics could lead to the development of better ways of managing the purchasing function.

The third group of suggested research expands the problem to include other environments. The environment used in this research assumes that resources are fixed at a certain level. Although this is a realistic assumption, other environments exist. Different resource levels might impact the relative performance of the different managerial elements. Other environmental changes might include the use of a multiproduct environment, different lot sizing rules, various cost data, or different levels of purchasing control on the firm's revenue. Additionally, various levels and types of uncertainty could be introduced into the environment.

Since this dissertation represents one of the few experimental investigations devoted to the problem of managing the purchasing function, the suggestions above represent only a few of the many studies that could be done to better identify and understand the problem.

APPENDIX A

EXPERIMENTAL TREATMENTS

AND

EXPERIMENT MATERIALS

PERFORMANCE MEASUREMENT SYSTEM

ID NUMBER _____

THE PURCHASING MANAGER AT AUTOTECH

You have recently been hired as a Purchasing Manager at Autotech Inc.. Autotech is a middle-sized firm which designs, manufactures, and markets a line of expensive automobiles. As a Purchasing Manager at Autotech, you are in charge of purchasing a family of components for one model of the Company's automobiles. Some of the items which you purchase include the automobile's clock, trim, antenna assembly, and seat assembly.

Autotech management, recognizes that your purchasing decisions have a significant impact on the performance of the firm; therefore, they closely monitor your performance. Management has established three measures by which they evaluate your performance. Your specific performance measures are:

1. Contribution to Profit
2. Supplier Relations
3. Customer Satisfaction

Of these measures, although all of them are to be considered in your decisions, your total Contribution to Profit is the most important to management. Your overall performance on these measures indicates the extent to which you are satisfactorily performing your responsibilities. On this basis, your promotions, pay increases, and tenure with the Company are determined.

Your primary performance measure, the Contribution to

Profit, indicates the extent to which you contribute to the Company's profit due to your decisions. Methods to increase your Contribution to the Company's Profit include: decreasing costs elsewhere within the Company, for example, in production or quality control by purchasing materials with fewer defects; increasing the Company's sales by improving the product for the customer, thereby creating more demand; or by reducing your purchasing costs. The key to improving your Contribution to Profit is to consider the impact of your actions on the Company as a whole. If you are unsure of the impact on the firm, it is better for you to choose a conservative option. Some actions, for example, purchasing a cheaper product, may decrease your purchasing costs but it may also create less profit for the Company if it decreases customer satisfaction or demand. Your decisions must provide benefit to the Company, not necessarily to the purchasing function.

The amount of your Contribution to the Company's Profit is the net benefit to the Company (Benefits - Costs) due to your decisions. Management compares the amount of your Contribution to the Company's Profit to the Potential Contribution to Profit which you could have obtained if you had chosen a different action. The closer you are to your potential, the better is your performance. The best performance in this area is to have your Contribution to Profit equal to the Potential Contribution.

Your second performance measure is the quality of your supplier relations. Management realizes that the performance of your vendors, in terms of product quality and delivery

reliability, impacts the performance of Autotech. They feel that the way to obtain good performance from your vendors is to establish and maintain mutually beneficial relationships with the vendors. Therefore, they insist that you establish long, productive relationships with suppliers, working with the supplier to solve problems and improve performance. This means that you should work with a minimum number of suppliers; provide the suppliers with accurate, on-time information; and continue to work with a supplier until the price offered by the supplier is much higher than elsewhere or there are major problems with the supplier's service. Delivery and quality reliability are worth more than obtaining a slightly lower price with unreliable service or quality.

Management evaluates the quality of your Supplier Relations on a scale of 1 to 100, with 100 being the best possible relationship. If you obtain good performance from your vendors and are willing to work with them, you should receive satisfactory performance in this area. Generally, a value of 79 is considered to be an "average" level of Supplier Relations. However, management rarely gives out values greater than 86.

The success of the Company depends upon its ability to create and maintain a customer; therefore, your third and final performance measure deals with the satisfaction of the customer. The level of Customer Satisfaction is determined through customer surveys. If you are purchasing the type of components desired by the customer, when they are desired, Customer Satisfaction will be high. If you are able to meet the customer's desires, the

Company's sales might increase, thereby creating more profit for the Company. On the same basis, stockouts of components could be extremely costly in terms of customer bad will. Therefore, you must provide the material requirements for today and work to ensure the long-term availability of these materials.

Customer Satisfaction is also measured on a scale of 1 to 100, with 100 being a fully satisfied customer. A value of 79 generally indicates a customer who is, on the "average" satisfied with the product. It is very difficult to obtain a value greater than 83.

Management evaluates your performance on your ability to contribute to the Company's profit, maintain good supplier relations, and satisfy the customer. If your performance is unsatisfactory in any of these areas, you can expect negative feedback from management.

ID NUMBER_____

THE PURCHASING MANAGER AT AUTOTECH

You have recently been hired as a Purchasing Manager at Autotech Inc.. Autotech is a middle-sized firm which designs, manufactures, and markets a line of expensive automobiles. As a Purchasing Manager at Autotech, you are in charge of purchasing a family of components for one model of the Company's automobiles. Some of the items which you purchase include the automobile's clock, trim, antenna assembly, and seat assembly.

Autotech management recognize that your purchasing decisions have a significant impact on the performance of the firm; therefore, they closely monitor your performance. Management has established two areas in which they evaluate your performance: the cost of purchases and the efficiency with which you perform your responsibilities.

Your specific performance measures are:

Cost of Purchases

1. Total Annual Cost Reductions
2. Potential Cost Reductions

Efficiency

1. Operating Cost
2. Order Processing Time

Of these measures, although all of them are to be considered in your decisions, your Total Cost Reductions is the most important to management. Your overall performance on these measures indicates the extent to which you are satisfactorily performing your responsibilities. On this basis, your promotions, pay

increases, and tenure with the Company are determined.

A cost reduction is obtained when you are able to obtain a lower price per unit than the current price which you are paying for the item. Methods to obtain a cost reduction include: purchasing in larger quantities to obtain a quantity discount; substituting a less expensive product or material; using a closer vendor to decrease transportation costs; or changing to a new vendor who is offering a lower price.

The amount of the cost reduction is the difference between the old unit price and the new unit price. The Annual Cost Reduction for an item is found by multiplying the unit cost reduction times the annual usage of the item ((Previous Price-New Price) * Annual Usage). The value of the Total Annual Cost Reduction will be negative if you choose an action which increases costs, rather than decreasing them.

Management compares the amount of cost reductions which you obtained to the Potential Cost Reductions which you could have obtained if you had chosen another action. The closer you are to your potential, the better is your performance. The best performance in this area is to have your Total Cost Reductions equal to the Potential Cost Reductions. To obtain your Potential Cost Reduction, you must purchase the components at the best price which is consistent with the quality and service requirements. Buy competitively, seeking to minimize costs wherever possible.

The second, and less important, area of evaluation is your ability to respond quickly and efficiently to the needs of the

organization. Your overall efficiency is measured in two ways: the amount of operating costs which you incur for the Company, and the amount of time required for you to process an order through the system.

Your Operating Costs consist of those additional costs which you incur in performing your responsibilities. These costs include telephone and postage costs, travel costs, cost of supplies, and administrative costs due to order modification. Management allows you to incur an Operating Cost of $2000. Costs above this amount are, in their eyes, due to irresponsible buying and will negatively impact your performance evaluation.

The amount of work that you process through the system, or your throughput, is measured by the Order Processing Time. The order processing time is the amount of time from the point at which you receive a requisition (a request to buy something) from the user to the point at which you have placed the order with the supplier. This figure is provided in days and the smaller the number, the better is your performance. For example, processing an order in 13 days is better than requiring 17 days to process the order. Management expects you to maintain an Order Processing Time of 14 days or less.

To maintain or improve your Order Processing Time, you need to process the requisitions as soon as they are received, minimizing the amount of time spent before placing the order with a supplier. This means that you must avoid spending <u>excessive</u> time developing a contract with a vendor, searching for a supplier, or spending time in unnecessary meetings or discus-

sions. You must concentrate on your daily responsibilities, performing them efficiently and productively.

Management evaluates your performance on your ability to reduce purchase costs and maximize your operating efficiency. If your performance is unsatisfactory in either of these areas, you can expect negative feedback from management.

INTERACTION

Management at Autotech, realizing that your responsibilities as a Purchasing Manager are quite time-consuming, has been quite helpful in allowing you to minimize the time you spend in internal non-purchasing activities. For example, management does not require, or even encourage, you to attend the weekly staff meetings. They feel that your time can be more productively spent elsewhere. If you have problems or questions on an issue, you may wish to contact the using department, but only if this contact is necessary, and only to the extent that it will not hinder your performance.

REQUIRED INTERACTION

Management at Autotech, realizing that you need information to successfully perform your responsibilities, has required you to become involved in internal non-purchasing activities. For example, they have strongly recommended that you attend the weekly staff meetings. These staff meetings, which you have been attending, have been very useful, providing you with information from the other functional areas.

STRATEGIC INFORMATION

However, management also realizes that your responsibilities as a Purchasing Manager are quite time-consuming. Therefore, they have been quite helpful in allowing you to minimize the time you spend in external non-purchasing activities. For example, they do not require, or even encourage you to become involved in professional organizations. They feel that your time can be more productively spent on activities within the Company.

In addition, management has encouraged you to become involved in activities external to the Company. They feel that you must be aware of what is happening in the marketplace if you are to be able to buy competitively. Following managements' encouragement, you have become an active member of the Purchasing Management Association and the American Production and Inventory Control Society. Both of these organizations have been invaluable. Through these organizations, you have obtained timely information on vendors, industry, technological developments, and the overall supply and demand situation.

EXPERIMENT MATERIALS

TO: Potential Participants in Research Project
FROM: Ellen Johnson, Principal Investigator
SUBJECT: Participant's Consent

Informed consent is necessary for all research and other activities which involve humans as subjects. Please read the following carefully and indicate your consent by signing where indicated.

The basic objective of this research is to increase our knowledge of purchasing decision-making.

PROCEDURE

In this research, you will be asked to make managerial decisions in a simulated environment. As a purchasing manager, you will select a course of action in response to various purchasing problems.

The total time involved should be about one hour. Even if you finish early, you will be given full credit for participating.

THE RIGHT TO STOP YOUR PARTICIPATION

You have the right to withdraw from this research project and discontinue participation at any time without penalty or prejudice.

SIGNATURE

We need your signature to indicate that you have read this form and, at this point, agree to continue with the project. Your signature does not require you to finish the research. Remember, YOU MAY DISCONTINUE YOUR PARTICIPATION AT ANY TIME.

Any questions regarding any aspect of this project may be directed to Ellen Johnson.

****

I have read the above and at this point, I agree to continue.

Signature _____

Date _____

INSTRUCTIONS

Please read these instructions carefully before beginning the research project. You will make decisions on an individual basis; therefore, please do not talk during the study. In addition, do not discuss the results of the research with anyone until all of the subjects have performed the research.

PROCEDURE

Assume that you are a Purchasing Manager for Autotech, Inc. As a Purchasing Manager, you will be making managerial decisions in a purchasing environment. Management has provided you with performance measures and you will be evaluated on the basis of how well you perform in relation to these measures.

Your first step in this research project is to carefully read "THE PURCHASING MANAGER AT AUTOTECH", a written narrative which has been provided to you. This narrative describes your role as a Purchasing Manager at Autotech, the expectations which management has of you, and the nature of your purchasing environment. Your responsibility is to maximize your performance in relation to the measures which management has established for you. Your performance is important not only to the success of Autotech, but to your success in this research project.

HOW SUCCESSFUL CAN YOU BE AS A PURCHASING MANAGER?

After you have read (and understand) "THE PURCHASING MANAGER AT AUTOTECH," you will proceed to the second step in the research project. In the second step of the research, you will be presented with a series of 16 purchasing situations, one-at-a-time, that are likely to occur in the life of a Purchasing Manager. Each situation provides adequate information for you to select a response to the problem. There are no "tricks" in the problems.

Each situation is followed by four different ways in which to respond to the problem. After you have completely read a situation, you will be asked to select one of the four solutions to the problem. Analyze each solution and try to determine its impact. Your response should be selected with the objective of maximizing your performance.

After selecting a response to a situation, you will be provided with feedback which indicates your performance due to the particular response which you chose. Using this feedback to guide you in your next decision, you will continue through the situations, until you have responded to all 16 situations. Please read each situation carefully before giving your response. You will not be able to change the decision, once entered.

You are being provided with blank sheets of paper in case you would like to take notes as you proceed through the research.

After completing all 16 situations, you will be asked to complete a post-experiment questionnaire. The questionnaire will obtain your opinion on several aspects of the experiment.

When you have completed reading these instructions and "THE PURCHASING MANAGER AT AUTOTECH," you are ready to begin the research project.

****

To begin the research project type
RUN PURCH
The computer will respond with "WHAT IS YOUR ID NUMBER?"
Enter the ID number which is located in the top left corner of "THE PURCHASING MANAGER AT AUTOTECH."

The first purchasing situation will be displayed on the screen. Read the situation and select a response, following the instructions on the screen. Continue to respond to all 16 situations in this manner, following the instructions on the screen.

You may go back and consider these written instructions and "THE PURCHASING MANAGER AT AUTOTECH," at any time during the study.

GOOD LUCK!

ID NUMBER _____

POST-EXPERIMENT QUESTIONNAIRE

INSTRUCTIONS: Please indicate your opinion on the seven-point scale below by circling the appropriate number.

1. How useful did you find the instructions?

1 2 3 4 5 6 7

Not useful at all — Extremely Useful

2. How carefully did you read the instructions?

1 2 3 4 5 6 7

Not carefully at all — Extremely carefully

3. How carefully did you read "THE PURCHASING MANAGER AT AUTOTECH"?

1 2 3 4 5 6 7

Not carefully at all — Extremely carefully

4. How well did you understand your performance measures?

1 2 3 4 5 6 7

Not at all — Very well

5. How committed were you to improving your performance?

1 2 3 4 5 6 7

Not committed at all — Extremely committed

6. Did you enjoy making the decisions?

1 2 3 4 5 6 7

No, I did not enjoy it at all — Yes, I enjoyed it a great deal

7. How unusual did you find the task?

1 2 3 4 5 6 7

Not unusual at all — Extremely unusual

8. How well do you feel you performed in this study?

1 2 3 4 5 6 7

Extremely poor performance — Extremely good performance

9. How much thought did you use in making the decisions?

1 2 3 4 5 6 7

Not much thought at all — A great deal of thought

10. How well did you understand the impact of each response on your performance measures?

1 2 3 4 5 6 7

Not well at all — Extremely well

11. How confident were you in your decisions?

1 2 3 4 5 6 7

Not confident at all — Extremely confident

12. How well did you understand your purchasing environment?

1 2 3 4 5 6 7

Not well at all — Extremely well

13. Do you feel that your performance measures were realistic?

1 2 3 4 5 6 7

Not appropriate at all — Very appropriate

14. Do you feel that your performance measures were the "right" performance measures for a Purchasing Manager?

1 2 3 4 5 6 7

Not appropriate at all — Very appropriate

15. Did you enjoy working in the particular purchasing environment?

1 2 3 4 5 6 7

No, I did not enjoy it at all — Yes, I enjoyed it a great deal

16. If you were to accept a position in a purchasing department, would you like to work in the environment you just experienced?

1 2 3 4 5 6 7

Would not like it at all — Would like it very much

17. I learned about purchasing from participating in this research.

1 2 3 4 5 6 7

I learned nothing at all — I learned a great deal

Please use the space below to provide comments on the experiment, the purchasing environment which you experienced, the performance measures assigned to you, or any other aspects of the research.

THANK YOU FOR YOUR ASSISTANCE

APPENDIX B

EXPERIMENT DATA IN TABULAR FORM

TABLE B.1

PROFIT

PROFIT

I/O/L	I/O/H	I/R/L	I/R/H	E/O/L	E/O/H	E/R/L	E/R/H	
2327644	2453576	2447146	2498996	2377188	2577406	2543486	2566718	
2317636	2459803	2508943	2378754	2478287	2523406	2536818	2498470	
2370661	2446994	2288354	2569760	2474424	2509064	2473084	2613614	
2362268	2549330	2473474	2420275	2364147	2575810	2576068	2674578	
2344554	2298822	2381770	2474700	2331807	2526056	2594082	2593716	
2263782	2516429	2526192	2572752	2300830	2507064	2548792	2681382	
2442150	2364824	2509552	2550260	2575674	2565944	2545474	2667534	
2491960	2486570	2540796	2597900	2483412	2368262	2392170	2658914	
2429750	2340323	2498234	2626550	2434293	2526163	2599000	2607106	
2318809	2439002	2530616	2498976	2497834	2551257	2608590	2447137	
2356174	2383013	2525961	2543998	2443254	2578516	2590060	2632440	
2368638	2532068	2447478	2488488	2459092	2514456	2521556	2625674	
2317908	2488282	2560990	2517216	2448428	2589644	2466060	2367961	
2309715	2483488	2312672	2439018	2406297	2526910	2550476	2604630	
2281785	2434736	2451374	2479097	2350463	2543116	2555230	2556856	
2353562	2445151	2466903	2510449	2428362	2532205	2540063	2586449	Cell Mean
59479	69130	79124	65760	70550	51348	56289	85618	Cell Std Dev

LEGEND

I=Effic			2444016				2521770	Effic/Effec
E=Effec						2447223	2518563	Lo Info/Hi Info
O=Opt Int					2439820		2525966	Opt/Rqd Interaction
R=Rqd Int								
L=Lo Info							2482893	Grand Mean
H=Hi Info								

TABLE B.2

DEMAND

DEMAND

I/O/L	I/O/H	I/R/L	I/R/H	E/O/L	E/O/H	E/R/L	E/R/H
1126	1164	1191	1184	1156	1224	1266	1215
1132	1191	1204	1146	1200	1230	1241	1222
1139	1200	1108	1241	1241	1220	1210	1230
1157	1213	1185	1160	1138	1230	1238	1266
1119	1132	1131	1217	1182	1200	1241	1215
1093	1201	1232	1229	1132	1224	1218	1266
1205	1145	1266	1226	1224	1230	1266	1251
1214	1193	1218	1237	1228	1143	1266	1266
1232	1140	1238	1251	1205	1181	1226	1235
1126	1191	1242	1216	1213	1202	1266	1209
1140	1155	1195	1235	1214	1262	1252	1247
1166	1202	1242	1218	1211	1198	1205	1251
1179	1206	1238	1228	1217	1235	1164	1143
1124	1214	1108	1171	1146	1235	1239	1266
1121	1191	1185	1172	1182	1209	1242	1242

1151.533	1182.533	1198.866	1208.733	1192.6	1214.866	1236	1234.933	Cell Mean
38.62618	26.69798	47.86211	31.93632	33.65273	26.99349	27.32520	31.28677	Cell Std Dev

LEGEND
I=Effic
E=Effec
O=Opt Int
R=Rqd Int
L=Lo Info
H=Hi Info

	1185.416		1219.6 Effic/Effec
		1194.75	1210.266 Lo Info/Hi Info
		1185.383	1219.633 Opt/Rqd Interact
			1202.508 Grand Mean

TABLE B.3

SALES

SALES

I/O/L	I/O/H	I/R/L	I/R/H	E/O/L	E/O/H	E/R/L	E/R/H
1119	1164	1185	1181	1150	1224	1239	1215
1126	1186	1204	1140	1195	1225	1234	1219
1133	1193	1102	1241	1236	1216	1203	1230
1152	1212	1185	1155	1132	1230	1238	1266
1113	1125	1124	1210	1174	1200	1241	1215
1088	1195	1225	1223	1126	1217	1211	1266
1198	1140	1238	1219	1224	1224	1239	1251
1211	1191	1211	1237	1218	1137	1212	1263
1218	1133	1231	1250	1198	1181	1219	1235
1119	1188	1239	1209	1206	1202	1258	1197
1134	1148	1189	1232	1209	1255	1245	1247
1159	1199	1221	1218	1205	1196	1202	1248
1165	1200	1227	1222	1210	1232	1164	1136
1117	1210	1102	1164	1140	1232	1239	1258
1115	1184	1179	1168	1175	1209	1235	1235

1144.466	1177.866	1190.8	1204.6	1186.533	1212	1225.266	1232.066	Cell Mean
37.47864	27.52178	45.15484	33.10750	33.90942	26.54053	22.82824	32.66081	Cell Std Dev

LEGEND

I=Effic			1179.433				1213.966	Effic/Effec
E=Effec						1186.766	1206.633	Lo Info/Hi Info
O=Opt Int					1180.216		1213.183	Opt/Rqd Interact
R=Rqd Int								
L=Lo Info							1196.7	Grand Mean
H=Hi Info								

TABLE B.4

MATERIAL COST PER UNIT

I/O/L	I/O/H	I/R/L	I/R/H	E/O/L	E/O/H	E/R/L	E/R/H	
10331.39	10404.62	10383.32	10429.86	10407.25	10444.88	10443.89	10461.18	
10271.50	10388.06	10403.08	10358.92	10452.82	10459.81	10460.60	10443.37	
10654.27	10407.78	10322.29	10460.07	10457.14	10432.28	10426.22	10448.67	
10438.34	10429.34	10409.70	10354.84	10359.25	10450.56	10424.42	10462.34	
10595.67	10356.87	10321.86	10406.78	10414.06	10430.80	10464.84	10440.53	
10622.00	10426.30	10440.96	10421.41	10371.52	10409.84	10430.03	10473.31	
10609.27	10336.23	10464.75	10409.80	10449.16	10466.62	10441.88	10472.33	
10432.26	10384.03	10405.79	10423.86	10451.62	10371.63	10407.31	10474.33	
10404.89	10356.07	10391.62	10447.43	10424.55	10407.02	10428.01	10442.12	
10037.71	10415.06	10426.11	10407.35	10441.51	10401.40	10442.30	10441.00	
10128.83	10384.11	10378.07	10437.09	10436.31	10435.23	10437.09	10434.04	
10322.77	10381.44	10425.37	10436.35	10426.80	10370.75	10446.56	10440.71	
10086.09	10408.68	10451.20	10441.42	10420.62	10467.33	10404.78	10361.54	
10479.76	10428.65	10330.55	10414.86	10375.45	10443.01	10456.67	10458.08	
10347.21	10393.67	10406.28	10358.98	10381.49	10438.36	10420.12	10460.20	
10384.13	10393.39	10397.40	10413.93	10417.97	10428.63	10435.65	10447.58	Cell Mean
188.7564	27.07147	42.96471	31.73346	31.35620	29.64553	17.30237	26.37907	Cell Std Dev

LEGEND

I=Effic			10397.21				10432.46	Effic/Effec
E=Effec						10408.79	10420.89	Lo Info/Hi Info
O=Opt Int					10406.03		10423.64	Opt/Rqd Interact
R=Rqd Int								
L=Lo Info							10414.84	Grand Mean
H=Hi Info								

TABLE B.5

OVERTIME

OVERTIME

I/O/L	I/O/H	I/R/L	I/R/H	E/O/L	E/O/H	E/R/L	E/R/H	
7062	4904	9041	3967	4479	7968	9398	5251	
3326	8609	11206	6331	5485	9303	10631	11198	
4555	10505	3575	10842	14646	7776	10167	6612	
7332	7279	8382	7284	5965	9464	13411	8447	
3462	6087	4846	12309	12842	5930	8471	5251	
1729	6668	10648	8966	6722	12016	7212	8057	
10514	6890	9426	10397	8081	6571	9398	7395	
10914	8887	8537	9329	11261	4412	14342	8050	
15034	5226	14491	10398	10528	4053	6204	9154	
5328	9310	13468	10537	8613	7603	11715	8396	
3029	5440	7144	12090	11130	13524	12464	10931	
8407	8260	13815	12337	10922	9845	5799	10035	
13419	9555	11541	11166	13203	7568	4324	5666	
3805	10750	2271	3652	4388	12737	11734	11795	
5824	9823	7279	6418	12330	7498	13054	9219	
6916	7879.533	9044.666	9068.2	9373	8417.866	9888.266	8363.8	Cell Mean
3875.880	1885.420	3525.707	2789.179	3250.060	2697.342	2911.854	2023.365	Cell Std Dev

LEGEND

I=Effic		8227.1			9010.733	Effic/Effec
E=Effec				8805.483	8432.35	Lo Info/Hi Info
O=Opt Int			8146.6		9091.233	Opt/Rqd Interact
R=Rqd int						
L=Lo Info					8618.916	Grand Mean
H=Hi Info						

TABLE B.6

IDLE TIME

IDLE TIME

I/O/L	I/O/H	I/R/L	I/R/H	E/O/L	E/O/H	E/R/L	E/R/H
5194	9554	4689	10023	7109	5161	7404	10257
7298	9936	3371	6405	10230	8024	7638	6484
8302	6667	6704	5891	4864	5786	8031	7450
4682	9993	9710	5115	7170	7330	2893	9489
5871	5203	6690	4096	3538	7763	9011	10257
7358	9300	9081	6810	5368	2702	9849	9099
4284	4931	7066	8650	8232	9532	7404	8178
4400	6466	5591	8729	7141	11385	2242	9113
4483	4979	5223	8131	4298	11072	10266	6449
6075	8128	3278	3795	6444	6943	7905	9804
10046	5689	6335	6000	3337	7463	7257	7148
3712	7323	7401	9120	5226	3808	9648	7058
3689	6432	3475	8364	3885	10144	9791	7574
5238	4229	10114	11719	8382	4385	4329	7929
6369	6267	6002	6989	4624	6770	6876	10184

5799.933	7006.466	6315.333	7322.466	5989.866	7217.866	7369.6	8431.533	Cell Mean
1753.090	1879.976	2098.563	2130.294	1955.340	2500.119	2379.318	1339.665	Cell Std Dev

LEGEND

I=Effic			6611.05				7252.216	Effic/Effec
E=Effec						6368.683	7494.583	Lo Info/Hi Info
O=Opt Int					6503.533		7359.733	Opt/Rqd Interact
R=Rqd Int								
L=Lo Info							6931.633	Grand Mean
H=Hi Info								

TABLE B.7

INVENTORY CARRYING COSTS

INVENTORY CARRY COST

I/O/L	I/O/H	I/R/L	I/R/H	E/O/L	E/O/H	E/R/L	E/R/H
12018	15093	31399	12134	13188	5838	35062	13385
13006	16819	7460	12210	19012	20280	17622	18977
25811	15356	13058	10046	12843	30832	17855	6833
13086	18519	16186	10631	11999	7429	10522	16776
11901	12588	12672	15142	15603	15335	17481	13574
13630	12127	18295	17567	10907	13214	17747	15543
28906	32315	34294	16828	6328	12550	35058	11454
11870	9735	14136	25731	20785	17211	30492	17246
14919	14050	21214	8991	14976	14746	21891	8462
32175	12056	15698	15681	15201	8705	24065	30749
11013	10927	11247	10656	12094	19396	14292	10940
12260	19680	24708	14376	15361	29752	10393	15989
12816	29071	16345	15362	14056	13490	9814	13036
12479	12394	11600	19299	12469	19823	8500	17772
11672	15829	11535	9039	16632	6333	14186	25200

15837.46	16437.26	17323.13	14246.2	14096.93	15662.26	18998.66	15729.06	Cell Mean
6723.766	6218.122	7357.946	4367.976	3318.312	7324.402	8465.388	5910.849	Cell Std Dev

LEGEND

I=Effic			15961.01			16121.73	Effic/Effec
E=Effec					16564.05	15518.7	Lo Info/Hi Info
O=Opt Int				15508.48		16574.26	Opt/Rqd Interact
R=Rqd Int							
L=Lo Info						16041.37	Grand Mean
H=Hi Info							

TABLE B.8

PURCHASING COSTS

I/O/L	I/O/H	I/R/L	I/R/H	E/O/L	E/O/H	E/R/L	E/R/H
70808	30000	58800	32900	61300	35900	54508	28000
65300	65200	33400	52100	46500	40700	40908	37300
47100	52800	85000	37808	59208	69000	43008	35700
66600	37800	26308	57200	42900	27800	26000	28608
75600	83000	54300	60508	60503	39900	35708	25900
65100	29200	42808	39008	60300	55900	35708	15008
53283	63400	59408	40600	30200	35000	55008	10400
40200	64208	56808	47308	36000	61000	82902	24008
84508	83000	36300	36400	62265	28800	27500	28300
84100	55400	66908	58000	36500	38708	35208	43500
56700	62700	49308	40700	73400	41008	31708	26608
80400	50208	72408	39808	54608	35900	39500	37008
80617	36108	47100	35708	57708	22800	31300	54500
79700	51400	72600	47200	34600	32736	42400	24408
55200	59200	52108	55508	86900	31300	43108	38508

67014.4	54908.26	54237.6	45383.73	53526.13	39763.46	41631.6	30517.06	Cell Mean
13584.46	16100.72	15437.63	8892.960	15171.75	12367.56	13707.46	10642.69	Cell Std Dev

LEGEND

I=Effic			55386			41359.56	Effic/Effec
E=Effec					54102.43	42643.13	Lo Info/Hi Info
O=Opt Int				53803.06		42942.5	Opt/Rqd Interact
R=Rqd Int							
L=Lo Info						48372.78	Grand Mean
H=Hi Info							

TABLE B.9

BACKORDERS

BACKORDERS

I/O/L	I/O/H	I/R/L	I/R/H	E/O/L	E/O/H	E/R/L	E/R/H
11	11	14	12	8	6	27	2
8	16	12	8	12	9	9	8
9	8	12	6	18	22	9	8
15	15	5	13	8	6	12	7
11	15	11	12	9.8	5	6	5
11	10	9	10	7	8	9	0
8.5	11	28	12	6	6	27	3
17	16	12	17	18	12	54.1	5
25	13	11	11	9.1	5	9	12
11	12	27	22	9	9	9	17
8	11	8	8	22	22	7	5
14	16	26	6	10	10	12	12
26.3	12	12	9	9	6	5	8
12	12	10	16	13	7	12	8
10	3	8	16	12	5	7	9
13.12	12.06666	13.66666	11.86666	11.39333	9.2	14.27333	7.266666 Cell Mean
5.501054	3.375730	7.001587	4.287449	4.440190	5.393823	12.44960	4.154783 Cell Std Dev

LEGEND
I=Effic
E=Effec
O=Opt Int
R=Rqd Int
L=Lo Info
H=Hi Info

12.68

10.53333 Effic/Effec
13.11333 10.1 Lo Info/Hi Info
11.445 11.76833 Opt/Rqd Interact

11.60666 Grand Mean

BIBLIOGRAPHY

1. Ackoff, R.L., A Concept of Corporate Planning. (New York: John Wiley & Sons, 1970).

2. Adamson, J., "Corporate Long-Range Planning Must Include Procurement," Journal of Purchasing and Materials Management, (Fall, 1979), pp. 25-32.

3. Aggarwal, S.C., "Management of Material Shortages," Guide to Purchasing (New York: National Association of Purchasing Management, Inc., 1982)

4. Aljian, G.W., ed., Purchasing Handbook, (2nd ed., New York: McGraw-Hill, 1966), Section 1, pp.3.

5. Ammer, D.S., "Purchasing for Profits," Harvard Business Review, (May/June 1961), pp. 135-143.

6. Ammer, D.S., "Purchasing in the New Economy," Purchasing, Vol. 64 (January 11, 1968), pp. 68-72.

7. Ammer, D.S., "Purchasing as a Profit Center," Purchasing, Vol. 68 (January 9, 1969), pp. 67-70.

8. Ammer, D.S., "Make Purchasing a Profit Center," Purchasing, Vol. 72 (February 8, 1972), pp. 41-47.

9. Ammer, D.S., "Is Your Purchasing Department a Good Buy?", Harvard Business Review, (March/April, 1974), pp. 36-42.

10. Ammer, D.S., "Top Management's View of the Purchasing Function," Journal of Purchasing, Vol. 10, No. 3 (August 1974), pp. 5-15.

11. Andrews, K.R., The Concept of Corporate Strategy, (Homewood, IL: Dow Jones-Irwin, 1971).

12. Anthony, T.F. and F.P. Buffa, "Strategic Purchase Scheduling," Journal of Purchasing and Materials Management, (Fall 1977), pp. 27-31.

13. Anyon, G.J., Managing an Integrated Purchasing Process, (New York: Holt, Rinehart, and Winston, Inc., 1963).

14. Argenti, J., Systematic Corporate Planning, (New York: John Wiley & Sons, 1974).

15. Barnard, C.I., The Functions of the Executive, (Cambridge, MA: Harvard University Press, 1938).

16. Bauer, F., "Better Purchasing: High Rewards at Low Risk," Journal of Purchasing and Materials Management, (Summer 1976), pp. 3-9.

17. Bauer, F., "Managerial Planning in Procurement," Journal of Purchasing and Materials Management, (Fall 1977), pp. 3-8.

18. Benton, A.A., H. Kelley, and B. Liebling, "Effects of Extremity of Offers and Concession Rate on the Outcomes of Bargaining," Journal of Sociality and Social Psychology, Vol. 24, No. 1 (1972), pp. 73-83.

19. Blau, P.M. and W.R. Scott, Formal Organizations, (San Francisco: Chandler Publishing Co., 1962).

20. Bonfield, E.H. and T.W. Speh, "Dimensions of Purchasing's Role in Industry," Journal of Purchasing and Materials Management, (Summer 1977), pp. 10-17.

21 Browning, J.M., N.B. Zabriskie, and A.B. Huellmantel, "Strategic Purchase Planning," Journal of Purchasing and Materials Management, (Spring 1983), pp. 19-25.

22. Burt, D.N., Proactive Procurement, (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1984).

23. Campbell, D.T. and J.C. Stanley, Experimental and Quasi-Experimental Designs, (Chicago: Rand McNally, 1963).

24. Cannon, J.T., Business Strategy and Policy, (New York: Harcourt, Brace, and World, 1968).

25. Cardozo, R.N. and J.W. Cagley, "Experimental Study of Industrial Buyer Behavior," Journal of Marketing Research, Vol. 8 (August 1971), pp. 329-334.

26. Carnevale, P.J.D., D.G. Pruitt, and S.D. Seilheimer, "Looking and Competing: Accountability and Visual Access in Integrative Bargaining," Journal of Personality and Social Psychology, Vol. 40, No. 1 (1981), pp. 111-120.

27. Chertkoff, J.M. and M. Conley, "Opening Offer and Frequency of Concession as Bargaining Strategies," Journal of Personality and Social Psychology, Vol. 7 (1967), pp. 181-185.

28. Cohen, J., Statistical Power Analysis for the Behavioral Sciences, Revised Edition, (New York: Academic Press Inc., 1977).

29. Cohen, K.J. and R.M. Cyert, "Simulation of Organizational Behavior," in J.G. March (Editor), Handbook of Organizations, (Chicago: Rand McNally & Co., 1965), pp. 305-334.

30. Cook, R.I., "Industrial Buyers: Critical Incidents Which Distinguish Between Effective and Ineffective Purchasing Performance," Michigan State University: Unpublished Ph.D. Dissertation, 1974.

31. Cook, T.D. and D.T. Campbell, "The Design and Conduct of Quasi-Experiments and True Experiments in Field Settings," Chapter 7 in M.D. Dunnette, ed., Handbook of Industrial and Organizational Psychology, Chicago: Rand McNally, 1976, pp. 223-326.

32. Corey, E.R., Procurement Management: Strategic Organization and Decision Making, (Boston: CBI Publishing, 1978).

33. Crano, W.D. and M.B. Brewer, Principles of Research in Social Psychology, (New York: McGraw-Hill, 1973).

34. Croell, R.C., "Measuring Purchasing Effectiveness," Journal of Purchasing and Materials Management, (Summer 1980), pp. 22-26.

35. Crow, L.E., R.W. Olshavsky, J.O. Summers, "Industrial Buyers' Choice Strategies: A Protocol Analysis," Journal of Marketing Research, (February 1980), pp. 34-44.

36. Daniels, V., "Communication, Incentive, and Structural Variables in Interpersonal Exchange and Negotiation," Journal of Experimental Social Psychology, Vol. 3 (1967), pp. 47-74.

37. Davis, H.L., G.D. Eppen, and L.G. Mattson, "Critical Factors in Worldwide Purchasing," Harvard Business Review, (Nov/Dec 1974), pp. 81-90.

38. Dinsmore, J.C., Purchasing: Principles and Practices, (Englewood Cliffs, N.J.: Prentice-Hall, 1922).

39. Druckman, D. and T.V. Bonoma, "Determinants of Bargaining Behavior on a Bilateral Monopoly Situation: Opponent's Concession Rate and Similarity," Behavior Science, Vol. 21, No. 4 (1976), pp. 252-262.

40. England, W.B., The Purchasing System, (Homewood, IL: Richard D. Irwin, Inc., 1967).

41. Enis, D.M. and S.V. Smith, "A Marketing Perspective for Purchasing Management," Journal of Purchasing and Materials Management, (Fall 1980), pp. 11-17.

42. Etzioni, A., Modern Organizations, (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964).

43. Evans, D.L., "Measuring Purchasing Performance," Annual Conference Proceedings, American Production and Inventory Control Society, 1977, pp. 434-440.

44. Farmer, D.H., "Corporate Planning and Procurement in Multi-National Firms," Journal of Purchasing and Materials Management, (May 1974), pp. 55-67.

45. Farmer, D.H., "Developing Purchasing Strategies," Journal of

Purchasing and Materials Management, (Fall 1978), pp. 6-11.

46. Farmer, D.H., "Seeking Strategic Involvement," Journal of Purchasing and Materials Management, (Fall 1981), pp. 20-24.

47. Filley, A.C. and R.J. House, Managerial Process and Organizational Behavior, (Glenview, IL: Scott, Foresman, and Co., 1969).

48. Fisk, J.C., "Procurement Planning and Control," Journal of Purchasing and Materials Management, (Summer 1980), pp. 2-6.

49. Geller, D.M., "Involvement in Role-Playing Simulations: A Demonstration with Studies on Obedience," Journal of Personality and Social Psychology, Vol. 36, No. 3 (March 1978), pp. 219-235.

50. Georgopoulos, B.S. and A.S. Tannenbaum, "A Study of Organizational Effectiveness," American Sociological Review, Vol. 22, No. 5 (October 1957), pp. 534-540.

51. Greenlaw, P.S. and M.P. Hottenstein, PROSIM: A Production Management Simulation, (Scranton, PA: International Textbook Co., 1969).

52. Guetzkow, H., "Communications in Organizations," in J.G. March (Editor), Handbook of Organizations, (Chicago: Rand McNally & Co., 1965), pp. 534-574.

53. Hackman, J.R. and E.E. Lawler, "Employee Reactions to Job Characteristics," Journal of Applied Psychology Monograph, Vol. 55, No. 3 (June 1971), pp. 259-286.

54. Hall, R.H., Organizations: Structure and Process, (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1972).

55. Hamner, C.W. and D.L. Harnett, "Goal Setting, Performance, and Satisfaction in an Interdependent Task,"Organizational Behavior and Human Performance, Vol. 14 (1974), pp. 244-256.

56. Hamner, C.W., J.S. Kim, and D.G. Heid, "Bargaining Behavior: A Comparison Between Purchasing Agents and College Students," Paper Presented at the Midwest Conference of the American Institute for Decision Sciences, May 1974.

57. Harris, B.K. and K.M. Jenkins, "Unreliable Vendor Leadtimes and MRP," Journal of Purchasing and Materials Management, (Spring 1982), pp. 15-21.

58. Hathaway, W.A., "The Effects of Directed Versus Non-Directed Goal Setting on the Process and Outcome of Purchasing Negotiations," Arizona State University, Unpublished D.B.A. Dissertation, 1984.

59. Hayes, F.A. and G.A. Renard, "Management's Expectations for

Purchasing Performance," in Evaluating Purchasing Performance: AMA Research Report, No. 66, 1964.

60. Heizer, J.H., "Effective and Ineffective Actions of Purchasing Managers," Journal of Purchasing, (August 1971), pp. 11-23.

61. Helferich, O.K. and R.M. Monczka, "Development of a Dynamic Simulation Model for Planning Materials Input Systems: Formulation of the Conceptual Model," Journal of Purchasing, (August, 1972), pp. 17-33.

62. Hoagland, J.H., "Strikes, Politics, and Business Cycles," Paper Presented at Annual Meeting of American Statistical Association, December 1964.

63. Hoagland, J.H., "Keys to Business Forecasting," Address before the Twelfth Annual International Conference of the American Production and Inventory Control Society, November 1969.

64. Jackson, D.W. Jr., J.E. Keith, and R.K. Burdick, "Purchasing Agents' Perceptions of Industrial Buying Center Influence: A Situational Approach," Journal of Marketing, Vol. 48 (Fall 1984), pp. 75-83.

65. Jacoby, J., D.E. Speller and C.Kohn-Berning, "Brand Choice Behavior as a Function of Information Load: Replication and Extension," Journal of Consumer Research, Vol. 1 (1974), pp. 33-42.

66. Johnson, E.J., "Purchase Environment as it Relates to Strategy Development," Unpublished Paper, Indiana University, 1984.

67. Katz, D. and R.L. Kahn, The Social Psychology of Organizations, (New York: John Wiley & Sons, Inc., 1966).

68. Kempthorne, O., The Design and Analysis of Experiments, (New York: John Wiley & Sons, Inc., 1952), pp. 219-228.

69. Kerlinger, F.N., Foundations of Behavioral Research, (2nd ed., New York: Holt, Rinehart, and Winston, Inc., 1973).

70. Kiser, G.E. and S.R.G. Rao, "Purchasing Agents Are Obsolete," Journal of Purchasing, (May 1971), pp. 5-14.

71. Kiser, G.E., "Elements of Purchasing Strategy," Journal of Purchasing and Materials Management, (Fall 1976), pp. 3-7.

72. Kiser, G.E. and D. Rink, "Use of the Product Life Cycle Concept in Development of Purchasing Strategies," Journal of Purchasing and Materials Management, (Winter 1976), pp. 19-24.

73. Klebba, J.M. and F.R. Dwyer, "Environmental Impact on Purchase

Decision Structure," Journal of Purchasing and Materials Management, (Spring 1981), pp. 30-36.

74. Kotler, P. and S. Levy, "Buying is Marketing Too!," Journal of Marketing, Vol. 37, No. 1 (January 1973), pp. 54-59.

75. Kudrna, D.A., "Evaluating Purchasing Performance," Management Review, (October 1972), pp. 14-22.

76. LaLonde, B.J. and D.M. Lambert, "Management of Purchasing in an Uncertain Economy," Journal of Purchasing and Materials Management, (Winter 1975), pp. 3-8.

77. Lambert, D.R., R.J. Dornoff, and J.B. Kernan, "The Industrial Buyer and the Postchoice Evaluation Process," Journal of Marketing Research, Vol. 14 (May 1977), pp. 246-251.

78. Lawrence, P.R. and J.W. Lorsch, Organization and Environment: Managing Differentiation and Integration, (Cambridge, MA: Harvard Graduate School of Business, 1967).

79. Leavitt, H.J., "Some Effects of Certain Communications Patterns on Group Performance," Journal of Abnormal and Social Psychology, No. 46 (1951), pp. 38-50.

80. Lee, L. Jr. and D.W. Dobler, Purchasing and Materials Management: Text and Cases, (3rd ed., New York: McGraw-Hill Inc., 1977).

81. Lewis, H.T., Procurement, (Homewood, Ill.: Irwin, 1948).

82. Locke, E.A., "The Relationship of Intentions to Level of Performance," Journal of Applied Psychology, Vol. 50 (1966), pp. 60-66.

83. Locke, E.A., "Toward a Theory of Task Motivation and Incentives," Organizational Behavior and Human Performance, Vol. 3 (1968), pp. 157-189.

84. McFillen, J.M., R.R. Reck, and W.C. Benton, "An Experiment in Purchasing Negotiations," Journal of Purchasing and Materials Management, Vol. 19, No. 2 (1983), pp. 2-8.

85. McMillan, A.L., The Art of Purchasing, (Jericho, New York: Exposition Press, 1953).

86. Meitz, A.A. and B.B. Castleman, "How to Cope with Supply Shortages," Harvard Business Review, (Jan/Feb 1975), pp. 91-96.

87. Miller, G.A., "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capability for Processing Information," Psychological Review, Vol. 63 (March 1956), pp. 81-97.

88. Miller, J.C., "Supplier Turnover Rate as a Purchasing Measurement

Tool," Journal of Purchasing and Materials Management, (Spring 1978), pp. 16-17.

89. Mize, J.H. with B.E. Herring, C.L. Cook, M.S. Chun, C.R. White, Prosim V Administrator's Manual: Production System Simulator, (Englewood Cliffs, NJ: Prentice-Hall Inc., 1971).

90. Monczka, R.M., "Buyer Performance Evaluation: Major Considerations," Journal of Purchasing, (November 1974), pp. 51-60.

91. Monczka, R.M. and P.L. Carter, "Measuring Purchasing Performance," Management Review, (June 1978), pp. 27-28+.

92. Monczka, R.M., P.L. Carter, J.H. Hoagland, and L.W. Foster, Purchasing Performance: Measurement and Control, (Lansing: Michigan State University, 1979).

93. Montgomery, D.C., Design and Analysis of Experiments, (New York, NY: Wiley & Sons, 1976).

94. Mott, P.E., The Characteristics of Effective Organizations, (New York: Harper & Row, 1972).

95. National Association of Purchasing Agents, Purchasing as a Career, (New York: NAPM, 1961), pp. 14-15.

96. National Association of Purchasing Management, Business Survey, Committee Report published monthly in the Bulletin of the National Association of Purchasing Management, (New York, NY: NAPM).

97. National Association of Purchasing Management, Report on Business, monthly publication, (New York, NY: NAPM).

98. Newman, R.G., "Planning, Purchasing, and the Firm: Purchasing Linkages as a Prerequisite to Planning in Selected Areas," Indiana University: Unpublished D.B.A. Dissertation, 1964.

99. Owen, D.B., Handbook of Statistical Tables, (Reading, MA.: Addison Wesley, 1962), pp. 88-100.

100. Oxenfeldt, A.R., Executive Action in Marketing, (Wadsworth, 1966).

101. Paperman, J.B. and R.L. Shell, "The Accounting Approach to Performance Measurement," Journal of Purchasing and Materials Management, (Summer 1980), pp. 27-32.

102. Patchen, M., Participation, Achievement, and Involvement on the Job, (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970).

103. Payne, B., Planning for Company Growth, (McGraw-Hill, 1963).

104. Pooler, V.H. Jr., The Purchasing Man and His Job, (New York:

American Management Association, 1964), pp. 19-20.

105. Pooler, V.H. and D.J. Pooler, "Purchasing's Elusive Conceptual Home," Journal of Purchasing and Materials Management, (Summer 1981), pp. 13-18.

106. Price, J.L., Organizational Effectiveness: An Inventory of Propositions, (Homewood, IL: Richard D. Irwin, Inc., 1968).

107. Pritsker, A.A.B. and C.D. Pegden, Introduction to Simulation and SLAM, (New York: John Wiley & Sons Inc., 1979).

108. Raftery, C.R., "Meeting the Challenges to Professional Growth in Purchasing Today," in P.T. McElhiney and R.I. Cook (Editors), The Logistics of Materials Management: Readings in Modern Purchasing, (New York: Houghton Mifflin, 1969), pp. 6.

109. Reck, R.R., "Purchasing Effectiveness," Michigan State University: Unpublished Ph.D. Dissertation, 1977.

110. Reck, R.R. and B.G. Long, "Organizing Purchasing as a Profit Center," Journal of Purchasing and Materials Management, (Winter 1983), pp. 2-6.

111. Reck, R.R., J.D. Woodson, and B.G. Long, "Re-integrating the Purchasing Function Into Corporate Strategy," Working Paper, Arizona State University, 1983.

112. Rich, S.H., "The Impact of Materials Shortages on Purchasing Organizations," Journal of Purchasing, (Spring 1975), pp. 13-17.

113. Ricketts, J.A., "An Investigation of Some Effects of Environmental Complexity and Systematic Bias on the MIS User-System Interface," Indiana University: Unpublished D.B.A. Dissertation, 1982.

114. Rindsfoos, C.N., Purchasing, (New York: McGraw-Hill, 1915), pp.55.

115. Rink, D.R., "The Product Life Cycle in Formulating Purchasing Strategy," Industrial Marketing Management, (1976), pp. 231-242.

116. Rosenthal, R. and R.L. Rosnow, "The Volunteer Subject," in R.T. Mowday and R.M. Steers, eds., Research in Organizations: Issues and Controversies, (Santa Monica, CA.: Goodyear Publishing Co., Inc., 1979), pp. 101-113.

117. Ryan, T.A., "Drives, Tasks, and the Imitation of Behavior," American Journal of Psychology, Vol. 71 (1958), pp. 74-93.

118. Schilhavy, R.A. and A.M. Jenkins, "An Investigation of the Effects of Education on the Use of a Decision Aid," Unpublished Discussion Paper No. 210, Indiana University, 1982.

119. Schilhavy, R.A., "An Investigation of Some Effects of Task-Related General Education on Decision Aid Usage in the MIS User-System Interface: A Simulation Experiment," Indiana University: Unpublished Ph.D. Dissertation, 1984.

120. Schmelzlee, R., "Work Study in Purchasing--A Case Study," Journal of Purchasing, (February 1967), pp. 42-51.

121. Seashore, S.E. and E. Yuchtman, "A System Resource Approach to Organizational Effectiveness," American Sociological Review, Vol. 32, No. 6 (December 1967), pp. 891-903.

122. Shubik, M., Games for Society, Business, and War: Toward a Theory of Gaming, (New York: American Elsevier, 1975).

123. Siegel, S. and L.E. Fouraker, Bargaining Behavior, (New York: McGraw-Hill, 1963).

124. Spekman, R.E., "The Purchasing Audit: A Guide for Management," Journal of Purchasing and Materials Management, (Summer 1980), pp. 7-11.

125. Spekman, R.E., "A Strategic Approach to Procurement Planning," Journal of Purchasing and Materials Management, (Winter 1981), pp. 2-8.

126. Spekman, R.E. and R.P. Hill, "Strategy for Effective Procurement in the 1980's," Journal of Purchasing and Materials Management, (Winter 1980), pp. 2-7.

127. Spekman, R.E. and L.W. Stern, "Environmental Uncertainty and Buying Group Structure: An Empirical Investigation," Journal of Marketing, Vol. 40 (Spring 1979), pp. 54-64.

128. Stone, E., Research Methods in Organizational Behavior, (Santa Monica, CA.: Goodyear Publishing Co., 1978).

129. Tanner, J.C., "Canny Buyers," The Wall Street Journal, (June 23, 1964), pp. 1,14.

130. Tersine, R.J. and E.T. Grasso, "Forward Buying in Response to Announced Price Increases," Journal of Purchasing and Materials Management, (Summer 1978), pp. 20-22.

131. Turner, A.N. and P.R. Lawrence, Industrial Jobs and the Worker, (Boston: Harvard University, Division of Research, 1965).

132. U.S. Bureau of the Census, The 1980 Annual Survey of Manufacturers, (Washington, D.C.: U.S. Government Printing Office, 1980).

133. Van Eck, A., A.J. van Weele, and H. de Weerd, "Price-Performance Evaluation: A Conceptual Approach," Journal of Purchasing and Materials

Management, (Summer 1982), pp. 2-9.

134. Walker, C.R. and R.H. Guest, The Man on the Assembly Line, (Cambridge, MA: Harvard University Press, 1952).

135. Weeks, J.K., "A Simulation Study of Predictable Due-Dates," Management Science, Vol. 25, No. 4 (April 1974), pp. 363-373.

136. Weinwurm, E.H. and G.F. Weinwurm, Long-Term Profit Planning, (New York: American Management Association, 1971).

137. Westing, J.H., I.V. Fine, and G. Zenz, Purchasing Management, (3rd ed., New York: Wiley, 1969), pp. 345-346.

138. Whybark, D.C., and R.S. Collins, "Coordinating Manufacturing and Distribution Activities," Discussion Paper, Indiana University, 1982.

139. Wilensky, H.L., Organizational Intelligence: Knowledge and Policy in Government and Industry, (New York: Basic Books, Inc., 1967).

140. Zelditch, M. and T.K. Hopkins, "Laboratory Experiments with Organizations", in A. Etzioni (Editor), Complex Organizations: A Sociological Reader, (New York: Holt, Rinehart, and Winston, 1961), pp. 464-478.

141. Zenz, G.J., "Materials Management and Purchasing: Projections for the 1980's," Journal of Purchasing and Materials Management, (Spring 1981), pp. 15-21.

142. Zenz, G.J., "Evaluating Materials Management," Journal of Purchasing and Materials Management, (Summer 1980), pp. 18-21.

VITA

NAME:	Ellen Jane Johnson
BORN:	Boise, Idaho December 17, 1957
DEGREES:	B.S. Arizona State University, 1979 M.B.A. Indiana University, 1985 Ph.D. Indiana University, 1987
PROFESSIONAL ORGANIZATIONS:	Decision Sciences Institute The Institute of Management Sciences National Association of Purchasing Management
HONORARY ORGANIZATIONS:	Sigma Iota Epsilon Beta Gamma Sigma Phi Kappa Phi