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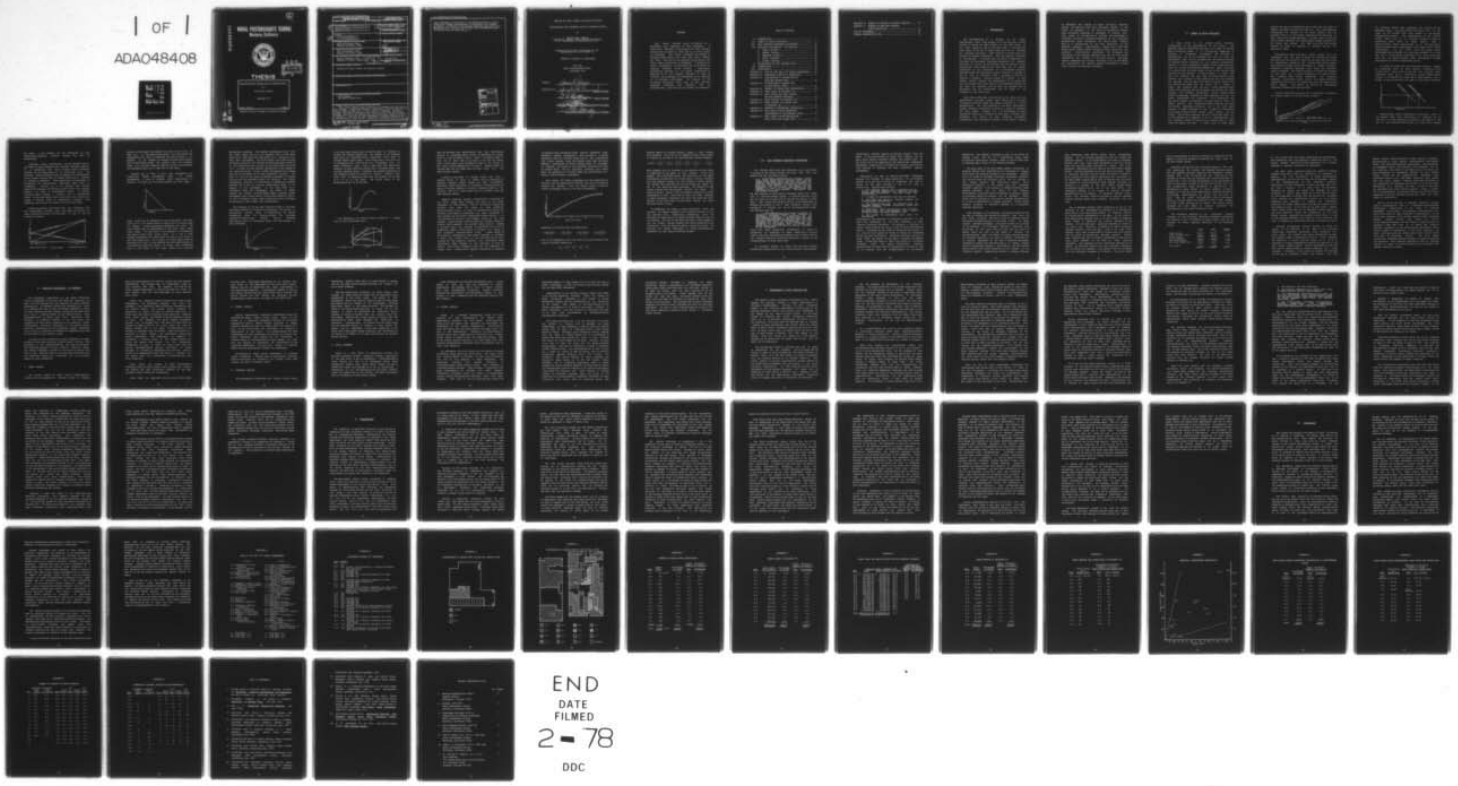

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NAVAL POSTGRADUATE SCHOOL
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THESIS

REALLOCATING NAVY EXCHANGE SPACE TO MAXIMIZE PROFIT

by

William Earl Johnson

September 1977

Thesis Advisor: J. Owens

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)

(6) Reallocating Navy Exchange Space to Maximize Profit.

(9) 5. TYPE OF REPORT & PERIOD COVERED
Master's Thesis; September 1977

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

(10) William Earl Johnson

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS

Naval Postgraduate School
Monterey, California 93940

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

(11)

11. CONTROLLING OFFICE NAME AND ADDRESS

Naval Postgraduate School
Monterey, California 93940

12. REPORT DATE
September 1977

13. NUMBER OF PAGES
72

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)

Naval Postgraduate School
Monterey, California 93940

(12) 72p.

15. SECURITY CLASS. (of this report)
Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Navy Exchanges
Navy Resale System Office

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This thesis explores space allocation as a management tool available to Navy Exchanges. A theoretical approach to determining the most economic distribution of space to items sold in a retail outlet is presented. The theory evaluates the changes in marginal gross profits that occur when space changes are made. When all of the marginal gross profits are equal, space utilization is maximized. A technique in linear programming is presented that would assist in equating marginal gross profits. Operational information relating to the →

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S/N 0102-014-6601

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

251 450

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by

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Lieutenant, Supply Corps, United States Navy
B. S., University of Pennsylvania, 1970

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the
NAVAL POSTGRADUATE SCHOOL
September 1977

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Approved by: _____
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ABSTRACT

This thesis explores space allocation as a management tool available to Navy Exchanges. A theoretical approach to determining the most economic distribution of space to items sold in a retail outlet is presented. The theory evaluates the changes in marginal gross profits that occur when space changes are made. When all of the marginal gross profits are equal, space utilization is maximized. A technique in linear programming is presented that would assist in equating marginal gross profits. Operational information relating to the retail departments in Building 301 of the Monterey Exchange is used to evaluate the strengths and weaknesses of the approach in an Exchange environment. An overview of the attitudes concerning space held by five Monterey Peninsula retailers, and excerpts from an Exchange-wide space utilization survey are presented.

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I. INTRODUCTION

The merchandising of a product in any retail organization where that product is to be sold for a profit equates to having the right product, at the right price, in the right quantity, and at the right time. A retailer who falls short in any one of these areas will fail to maximize his business' potential. Right product and right price are matters of consumer preference. With the possible exception of advertising, a retailer does not have an opportunity to influence his customers' decisions concerning the products they want to buy and the prices they will be willing to pay. Fortunately, right quantity and right time can be readily influenced by the activities of an individual retailer. Organizational characteristics impact directly on whether or not an item is available when a customer is willing to complete a purchase. Ordering enough of a product to meet demand, timely receipt, and availability in the sales area are all matters that occur after an entrepreneur decides how and when the ordering will be done, the receipts will be processed, and the merchandise will be moved to and displayed in the sales area.

This thesis addresses availability in the sales area and specifically concerns itself with making the right space allocation decisions among the products carried by a retail organization. The Navy Exchange at the Naval Postgraduate School, Monterey, California is used as a point of reference for this thesis. Chapter two is a development of space allocation theory as it applies to retailing. Chapter three discusses the nature of Navy Exchange management environment, with particular emphasis on the unique aspects

of Exchanges that impact on space allocation decision making. An overview of how five retailers, located in the County of Monterey, in the State of California, address space allocation decisions is presented in chapter four. This review of private-sector methods and techniques is intended to provide a broader perspective on the practical applications found throughout the Retail Trade. Chapter five is a presentation of the data pertaining to the Monterey Exchange. Additionally, extracts of a 1974 Navy Resale System Office survey concerning space allocation are provided. Observations concerning the strengths and weaknesses of the Monterey Exchange data and the 1974 survey information are offered in the sixth chapter. The final chapter summarizes the thesis, detailing a set of procedures for determining the optimal spacial arrangement of sales floor area for the Monterey Exchange.

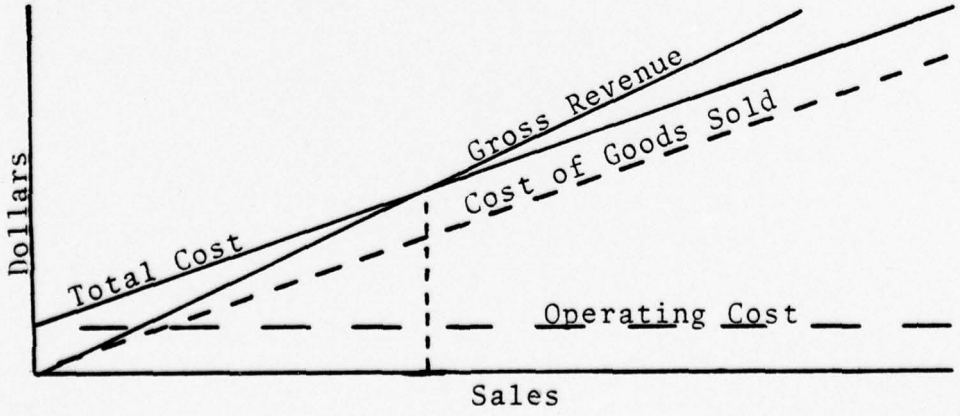
II. THEORY OF SPACE ALLOCATION

A major goal in any private sector retailing organization is the maximization of net profit. One specific means of achieving this goal is to reach an optimum space allocation scheme. It is intuitively appealing to envision an allocation arrangement that requires no improvements. All of the customers are able to find the merchandise they want to purchase and the retailer derives the highest return possible on his spacial investments. Implicit in this optimization scheme is the assumption that there is a direct relationship between the space allocated to a product and the total amount of net profit derived from the sale of that product. At first glance, it might seem that the retailer who has room for four widgets on his shelves, has a demand of eight widgets per day, and restocks his shelves once per day, will obtain less net profit than the retailer who makes room for eight, has a demand of eight, and restocks once per day. Closer analysis might reveal that although the two retailers are selling the same widgets, the consumer populations, retail prices, gross profit percentages, expenses of doing business, and the net profit percentages are different. It is conceivable that the first retailer is achieving a higher level of total net profit dollars, even though the second retailer has twice the volume. Similarly, products A and B may have equal amounts of space allocated to them. Product A outdistances B in terms of gross retail sales, gross profit, and net profit. The initial reaction may be to give more space to A at the expense of B; however, it is not inconceivable that A's original amount of space is far greater than it needs, while B's space, far less. A could give up some space

without any loss in performance and B could use the space to remedy a periodic out-of-stock position. The circumstances surrounding the widgets in the first example and the products A and B in the second, complicate the solutions of what seem to be simple problems. A proper space allocation theory should identify the relationship between products and the space they occupy. The goal is to find the optimal amounts of space to allocate to products within the retailer's store.

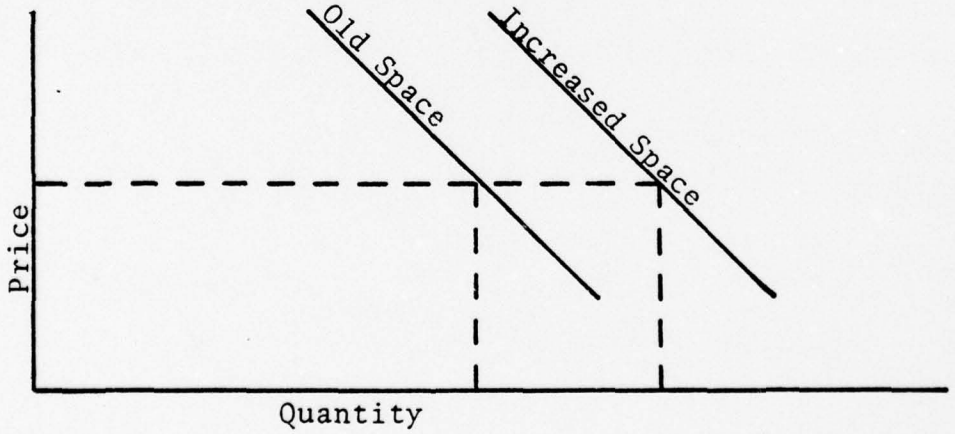
Developing a space allocation theory begins with the assumption that the cost at which the retailer can obtain his goods and the prices at which he can sell them are fixed by competition, custom, or law. Fixing these prices causes each product's gross profit percentage to remain constant. Likewise, operating expenses, both fixed and variable, remain unchanged. The fixed character of operating expenses in the short run is widely accepted in the retail trade. With constant gross profit percentages and operating expenses, calculating gross profit is a simple matter of subtracting the cost of the goods sold from the gross retail sales figure. Net profit is derived by subtracting operating expenses from gross profit.

Graphic break-even analysis can be employed to visualize the linear nature of the net profit picture:



The vertical dotted line indicates the location of the breakeven point. Any sales beyond this point (i.e. to the right of the dotted line) will result in net profits accumulating linearly. The maximization of net profits should result even if the retailer chooses to focus on maximizing gross sales or gross profit. Thus a space-to-gross sales relationship is at the same time a space-to-gross profit relationship and a space-to-net profit relationship. In the event that the gross profit percentages are different for individual products (i.e. soap may have a gross profit percentage of 20, while polish may have, 25), the space-to-gross sales relationship becomes meaningless in terms of maximizing profit.

It should be noted that this breakeven analysis assumes an increasing level of sales without a lowering of the retail price. This is not to say that the retailer faces something other than a negatively sloping demand curve; rather, it is saying that price can be held constant and a change in space allocation can cause a gross sales increase:

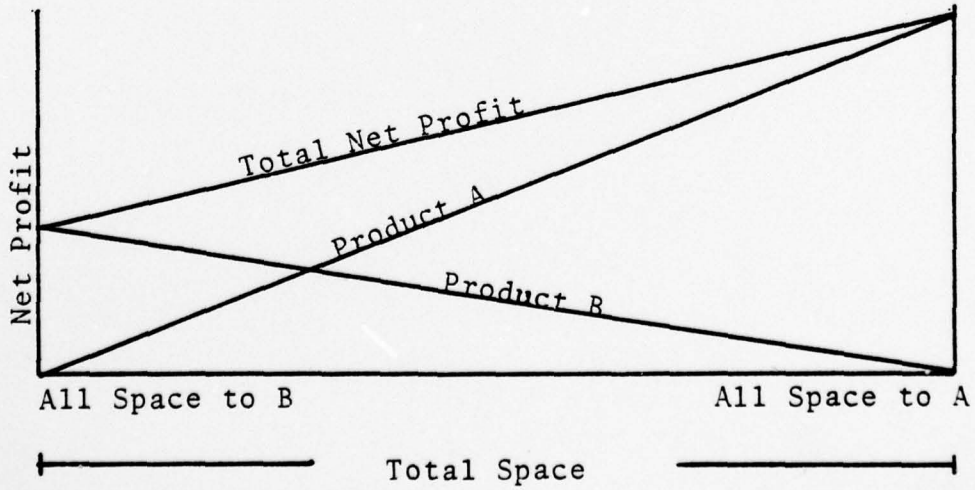


Microeconomic theory establishes an identical shift in the demand curve when advertising is employed by the retailer. In this advertising situation, the quantity that can be sold increases even though the retail price remains

the same. A key concern for the advertiser is that advertising-generated profits exceed the cost of advertising.

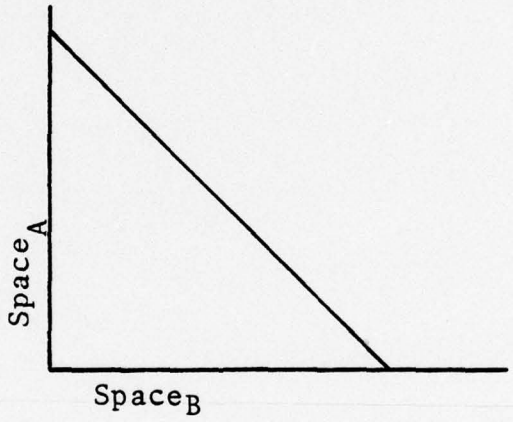
Similarly, space reallocation can be valuable only if the costs of space change do not outweigh increased profits. It is conceivable that space changes among different products can be accomplished at no additional cost. For instance, store personnel could accomplish the reallocation during normal working hours by simply moving shelf dividers on existing equipment. When renovations are necessary to accomplish the reallocation, additional costs must be considered. Clearly, as in all matters that involve operational changes, the expected profits have to be weighed against the costs of reallocating space. In matters involving space change, a retailer with a preconceived notion of how much profit will be derived from a change can assume a certain level of reallocation expenses with assurance that he will be better off after the change.

Taking the simple two-product case and supposing that the relationship between space and profit is linear, the space allocation between the two goods (A and B) can be viewed as follows:



Within a given space the retailer can sell all A, all B, or some mix. In the graph shown above, the total profit for combinations of A and B is greatest when only product A is stocked. In the absence of minimum stocking constraints, such as must-carry items, the product with the greatest slope (i.e. the most superior space-to-profit relationship) will maximize profit if it gets all of the space.

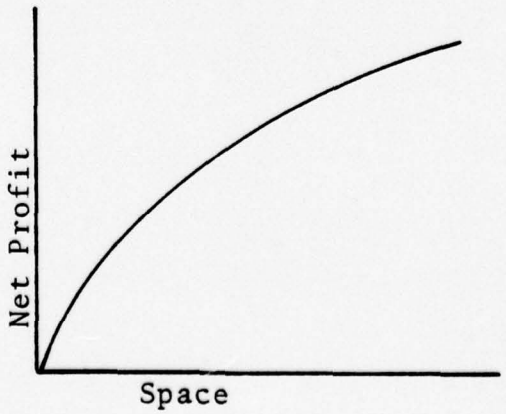
Another way to look at this same phenomenon is in traditional linear programming terms. In linear programming, a line of possible space combinations is plotted. A's space plus B's space equals the total space:



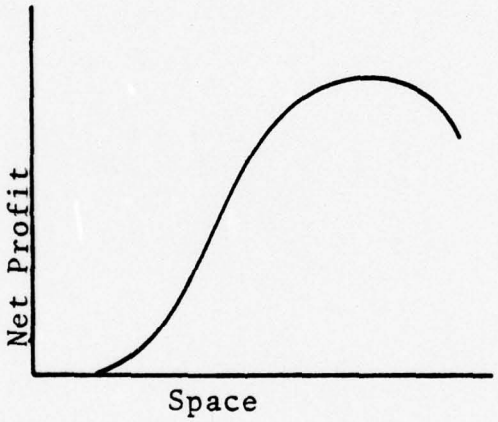
Total profit can be expressed as the contribution from both A and B (i.e. A's slope times A's space plus B's slope times B's space). Linear programming maximizes this value. The total profit line is superimposed on the total space graph shown abcve. At this point it is important to contemplate the slope of this total profit line. If A and B were equally profitable, the slope would be equal to the slope of the total space line. As a result, the total space could be allocated to A and B in any fashion and the profitability of the operation would not change. If A were more profitable than B, the slope of the total profit line would be

horizontally inclined. The closest intersecting point with the total space line is on the vertical axis, at the point where all of the space has been given to A. Similarly, if B were more profitable, the total profit line would be more vertically inclined, the closest intersecting point would be on the horizontal axis, and all of the space would be given to B. In fact, without further constraints on the shapes of the space-to-profit curves, linear programming will always give all of the space to the most profitable product. The same is true in any linear programming approach to problem solving when the measured outputs act linearly. The linear programming solution to the problem of maximizing customer exposure with a mix of various advertising media is an example of this phenomenon. If for each media (i.e. television, radio, and newspapers) the number of people reached per dollar of advertising budget is known, linear programming will always select the one most effective media. To get a different result, some constraints such as minimum expenditures in each media must be specified.

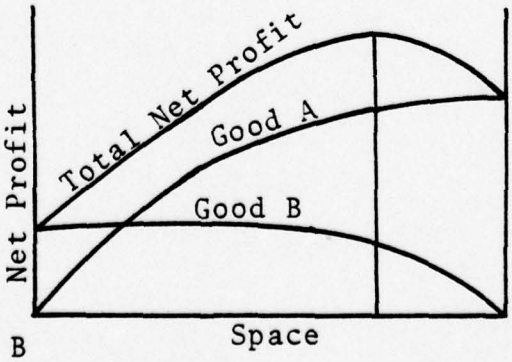
The choosing of the one most effective media or the most profitable product is intuitively appealing. The notion of diminishing returns leads to questioning the linear assumptions about the space-to-profit and customer exposure-to-advertising dollars curves. Assuming diminishing profit on increasing space, the relationship is much different:



It is even more likely that the curve could be refined to account for extreme conditions. For example, it is possible that there is a threshold space allocation which must be reached before sales occur. Once sales start, they do so at an increasing rate, then switch to a decreasing rate. It seems plausible, also, that at some point more space will generate no more sales and beyond that, increased space may actually decrease sales. Customers may become suspicious of the excessive amount of product on display, thinking that there must be something wrong with the product for so much of it to be in one place. The actual shape of the relationship may be as follows:



For simplicity, the concave curve is used for a second look at the two-product case:



All Space to B All Space to A

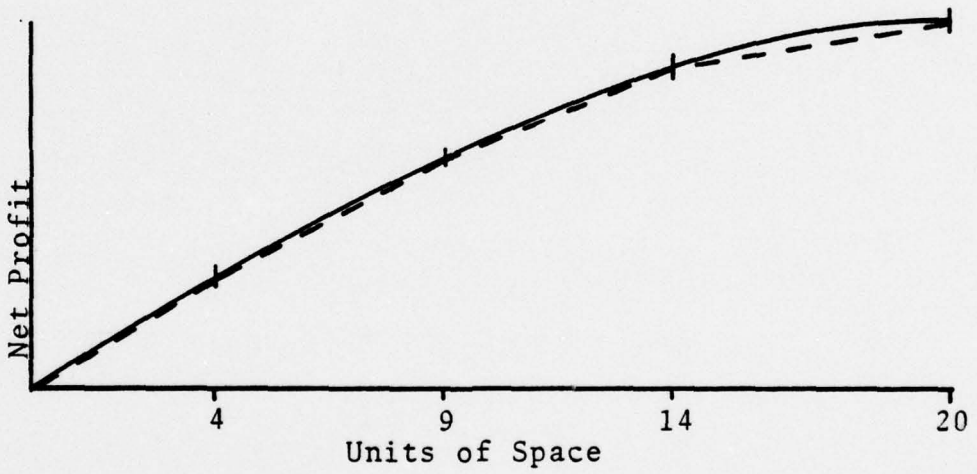
This two-product case demonstrates that with diminishing returns on increased space, profit is maximized at a point which is a mix of goods A and B. Good A is graphed right to left and we find that if we start at the left and travel right, total profit will increase as long as the slope of the good A curve exceeds that of good B. Maximum profit is reached when the two goods have the same slope (i.e. the same marginal profit).

A maxim in the world of finance states that with a limited amount of money to invest, gain is maximized by equating marginal return across all cash investments. Similarly, space allocation is investing a limited amount of space in various products in order to maximize profits. The decision rule is to shift space until all products have the same marginal profit.

Equating marginal profits necessitates a knowledge of how sales change when changes are made to the space allocated to each product. This is the same as saying the retailer must know the shape of each product's space-to-profit curve. In order to discover this shape, the retailer would begin by recording the space allocated to each product and the profit experienced during Period 1. At the beginning of Period 2 (all Periods being of the same length), space changes would be made and a second record of profits would commence. The process would continue through N Periods until the retailer is satisfied that he has a sufficient number of data points to estimate the shape of each product's space-to-profit curve. A large number of data points, sufficiently close enough together to estimate a curve will result only if the retailer carries this process out over numerous periods, with relatively small incremental space changes at the beginning of each new period. (Note that, although it will not be explained at length here, a Monte Carlo computer simulation is possible

if historic data concerning gross profits generated under different spacial arrangements were available.) A second difficulty that the retailer would face is the possibility that sales changes occur for reasons other than the space changes. Maintenance of control groups would be necessary to identify the extent of the influence externalities have on product sales. For all practical purposes this would mean the operating of a second retailing establishment in a similar sccio-economic environment.

Once again, the linear programmer has the capability of dealing with the maximization problem, even when deminishing returns are evident. With the shape known, a trick in linear programming looks at the curve "piecewise":



Equations are written for the constraints:

$$0 \leq sp_1^1 \leq 4 \qquad 0 \leq sp_1^2 \leq 5 \qquad 0 \leq sp_1^3 \leq 5 \qquad 0 \leq sp_1^4 \leq 6$$

All of the segments of the line add to the tctal space to be given to product number one:

$$sp_1 = sp_1^1 + sp_1^2 + sp_1^3 + sp_1^4$$

Product number two through product number i have similar line segments. With all of the segments known, total profit is written as the sum of the contributions of each segment:

$$\text{Profit} = {}^{1}_{1}m\,sp + {}^{2}_{1}m\,sp + {}^{3}_{1}m\,sp + {}^{4}_{1}m\,sp + {}^{1}_{2}m\,sp + \cdots + {}^{j}_{i}m\,sp$$

What segments will be included in the equation written above is determined by the slope of each segment. Since each segment has a different slope, the first step in the linear programming process will be to give space to those segments with the greatest slopes, and then proceed to lesser slopes. The process will stop when all of the slopes are equal and all of the space has been allocated. The equality of the slopes insures that the marginal returns are equal. the space-to-profit curves must be concave downward for linear programming to work. The slope of each curve must decrease as space increases; otherwise, the logic will make the final section of the curve high in value while making the other sections equal to zero.

To summarize, the theory of space allocation tells the retailer to conduct analysis of the marginal returns of all the products sold. Simplifying assumptions give the retailer the opportunity to equate marginal gross as well as net profits. The key to the space-to-profit relationship is how the profit picture changes when space adjustments are instituted. Once the space-to-profit curves are known, the retailer can employ techniques in linear programming to determine the best space allocation scheme.

III. NAVY EXCHANGE MANAGEMENT ENVIRONMENT

One hundred sixty four Navy Exchanges, with total sales in excess of one billion dollars for fical year 1976, are tasked with the following mission:

> . . . to provide a convenient and reliable source from which authorized patrons may obtain, at the lowest practicable cost, articles and services required for their well-being and contentment; to provide, through profits, a source of funds to be used for the welfare and recreation of naval personnel; and to promote the morale of the command in which it is established through the operation of a well-managed, attractive and serviceable Exchange.

The key elements in this mission statement define the major goal of the Navy Resale System: to provide service to the men and women of the Navy and to improve the quality of Navy life. What makes this mission unique in the Department of Defense environment is that a Navy Exchange Officer must accomplish it through the use of non-appropriated funds. The Exchange must be:

> . . . self-sustaining with respect to payment of salaries of civilian employees, the purchase of operating equipment and supplies, and the maintenance of equipment. However, Exchanges may use available equipment of the Government provided that all operating and maintenance costs of such equipment are paid by the Exchange. (With the exception of a few minor cases) Exchanges will reimburse the Government for the cost of heat, water, light, power and other utilities furnished by the Government.

Faced with these operational constraints, it would be reasonable for Exchanges to liken themselves to private sector retailing organizations complete with a profit motive and limited amounts of resources available to employ in the accomplishment of their major goal.

An Exchange Officer is faced with the same resource allocation problem faced by his private sector counterparts:

distributing limited amounts of dollars, people, time, and space. In the distribution of space, poor choices can be made, space wasted, customers enraged, and profits lost. At the other end of the spectrum is the testing and subsequent successful application of reasoned and logical solutions to this problem of choosing the most productive spacial arrangement.

Theoretical as well as seat-of-the-pants techniques address the problem of space allocation. For an Exchange Officer it is not only a matter of technique, but also a matter of how much latitude he has in the area of application. Instructions specify:

1. The maximum square feet authorized for the entire Exchange operation to include offices, storerooms, warehouses, lay-a-way rooms, and selling floor;

2. A subset of merchandise that must be carried;

3. The items that cannot be carried because of Congressional limitations;

4. The services that must be provided such as Customer Service Windows, Lay-a-Way Areas, and Cashier's Offices;

5. Particular places in the store where specific products must be merchandised (i.e. adult literature must be behind counters); and

6. The number of departments that must be maintained.

Additionally, the decisions to reallocate space are at the same time influenced by, and have influence in other resource allocation decisions. For example, a decision to employ fewer workers may cause a need for more self-service aisles. A decrease in the hours of operation may result in the need for more check-out stands to support the increased patron per hour utilization. Investing inventory dollars in bulky items may result in less space available for smaller items. Giving more space to some items might tax warehouse personnel costs and space limitations. Finally, reallocations of space based on maximization of profits may be in conflict with the accomplishment of the mission

objectives. For example, providing an area in the store for uniform sales may not be a financially sound space utilization alternative; however, there is little doubt that an Exchange must remain in the uniform business.

The major goal of the Navy Resale System stimulates an Exchange Officer into distributing his resources in a manner which gives the greatest benefit to his customers. Benefit can be in terms of customers receiving convenient, reliable, and low-cost goods and services, and it can be through a well funded Welfare and Recreation Program. Since increasing benefits in the former area can seriously decrease benefits in the latter, an Exchange Officer finds himself balancing the two parts of his mission. Additionally, no matter where the benefit is derived, profit is necessary before the benefit can be realized. Either profit can be foregone in the name of customer satisfaction, or it can be distributed to special services. Profit drives benefit, becoming an important measure of a successful Exchange operation.

Some customers of an Exchange, particularly those who do not use the Welfare and Recreation benefit, feel that the most ideal situation would be to have an Exchange Officer utilizing increased profits at the store level. He would finance customer-satisfying activities within the confines of the Exchange. If an Exchange Officer's operation were fine-tuned to the point where he could tell on a daily or weekly basis how well he was doing at meeting the pre-established needs for funds, he could decrease margins and increase expenses in the name of customer satisfaction. At present, Exchanges do not have a financial management information system that generates daily or weekly returns that are completely reliable. Additionally, the Navy Resale System Office holds final authority on the content of all financial reports. Regulations prohibit an Exchange Officer

from decreasing Navy Resale System Office established margins. He can increase expenses but not in a timely and effective manner. It is unfortunately true that an Exchange Officer has only "ball park" estimates of how well he has done, and then only after the month is closed. The final operating statements are the work of the Navy Resale System Office. Profits generated in any one month are never under an Exchange Officer's control after the month is complete. Final figures for each month's operations are forwarded to the Navy Resale System Office and, in keeping with the motto All Profits Go To The Recreation Fund, Special Services is typically in receipt of the Navy Resale System Office distributed profits by the end of the next month. The Commanding Officer is in control of Special Services' manipulations of the profits. An Exchange Officer cannot direct that certain funds be returned to him for customer service, special sales, loss leaders, new-hires, and the like.

For an Exchange Officer profit generation is one of the measures of how successful his Exchange is at meeting the major goal of the Navy Resale System. An Exchange Officer can attack profit maximization in two ways. He can labor to hold operational expenses down or he can attempt to maximize sales volume by employing his limited resources to the fullest. For the most part, operating expenses are fixed in the short run; therefore, attempting to reduce operating expenses remains a long term goal. Even in the long term, extreme care must be exercised to insure that cost-cutting does not result in sacrificing customer service. Holding down expenses may not be entirely successful in meeting the major goal; however, in the case of fully employed resources, once expenses are met, additional revenues go to profit. An Exchange Officer with fully employed resources, who is meeting all expenses , can operate with the knowledge that all additional revenues go to profit. The total profit

that is distributed to Special Services is indicative of the degree to which his Exchange is meeting the major goal of the Navy Resale System.

Financial information for the fiscal years of 1975 and 1976 emphasizes the concern the Monterey Exchange should have for properly utilized resources and maximizing profits (fiscal 1975 = Feb. 75 through Jan. 76). 1976 saw an 8.3% increase in sales over the previous year (from $6,684,869 to $7,237,146), and a virtual maintenance of the percentage of cost of goods sold to sales of 76.1% and 76.2% for 1975 and 1976 respectfully (from $5,088,887 to $5,511,313). The percentage of gross profit to sales remained virtually constant at 23.9% and 23.8% respectfully (from $1,595,982 to $1,725,833). Unfortunately, net profit did not fair as well. 1975 net profit was $208,498 (3.1% of 1975 sales) while in 1976 net profit was $209,417 (2.9% of 1976 sales), or a $919 (.04%) increase in net profit. The result clearly affected the total number of dollars available for distribution to the local recreation fund.

The following analysis of the percentage changes involved in the two annual operating statements highlights the effects of the .1% decrease in gross profit, and the .7% increase in direct expenses mentioned in the paragraph above:

	1975	1976	Change
Gross Sales	100.0%	100.0%	---
Cost of Goods Sold	76.1	76.2	+.1%
Gross Profit	23.9%	23.8%	-.1%
Direct Expense	13.9	14.6	+.7
Net Contribution	10.0%	9.2%	-.8%
Gen. Exp./Other Inc.	6.9	6.4	-.5
Net Profit	3.1%	2.9%	-.3%

It can be seen that even small percentages are significant. This emphasizes that the Exchange is operating close tc the margin, expense controls are most important, and a studied approach to resource allocation is imperative.

The most ideal situation would be a subset of clearly defined rules that direct the allocation of resources in general, and the allocation of space specifically; unfortunately, this is not the case for an Exchange Officer or his contemporaries in the Retailing Industry. Determining the best allocation of space has been more of an art than a science. It is clear that the successful retailers are paying top dollar for managers who have exhibited a second sense about how to best utilize space. It would seem safe to assume that the artists who recognize their talents are capitalizing heavily on it by either demanding high salaries or working for themselves. Retailers who cannot afford space utilization wizards settle for something less. In the case of the Navy Resale System, fixed salary structures and an employment system similar to the Civil Service's reduce the probability of the Navy Resale System employing the leaders in this field. It may be the Exchange Officers, more than any other retailers, who need to embrace the scientific methods of allocating space.

Although distributing limited amounts of space may appear to be difficult in the face of the external limitations previously mentioned, other resources (i.e. time, money, and people) have their restrictions as well. For example, times of operation are set by local commands. The decision to carry certain items, or to not be in business in certain departments requires the approval of the Navy Resale System Office. This is compounded by the fact that captive markets such as on-base residents, are a mixed blessing. Providing a full range of products and services is done out of necessity rather than choice. The Navy

Resale System Office maintains a tight control on pricing, participation in sales events, merchandising loss-leader items, and authorized markdown percentages. Advertisements in newspapers, radio, and television are completely out of the question. The costs of the goods sold in the store are often determined by agreements between the Navy Resale System Office and the manufacturers. Sometimes these agreements restrict the individual Exchanges from buying from any other sources. Finally, there are directives on how competitive the Exchanges are allowed to be in the local communities (i.e. gasoline pricing). It can be seen that all resources have their limiting aspects. Given a special set of circumstances, an Exchange Officer may find his space resources to be most flexible because they have the least number of constraints.

This is not to say that an Exchange Officer's private sector contemporaries live in a completely unconstrained environment. Restrictions in all areas of resource management can be found. For instance, Sears managers must carry Sears lines in some catagories of merchandise. On the other hand, examples of the private sector's wider latitudes abound: greater control over hiring and firing, profit-sharing programs, and the ability to sell anything to anybody, to name just a few. It is likely that Exchange Officers operating in the public sector environment face a greater number of constraints. In the final analysis, the wider latitudes give the private sector more options within each area of management control. The more highly constrained Exchange resources present a unique opportunity and challange. More numerous constraints force an Exchange Officer to focus on a more limited area of influence that remains within his control.

IV. PRACTICAL APPLICATION - AN OVERVIEW

The successful application of the space allocation theory is dependent on how well the theorical approach can cope with the problems that are inherent in every retailing organization. An Exchange Officer may recognize that space is a resource and that it must be handled carefully in order to avoid underutilization; however, practical problems arise that have a limiting effect on the theory's usage. Local representatives of major chain store operations were surveyed to determine whether or not the theory was recognized by these major companies in the retailing trade. Additionally, retailing operations in the private sector provided a perspective on how significant spacial decisions were as well as indicated the degrees of sophistication that can be found in the retailing trade.

In order to gain information on what approaches to space allocation were used by major, private sector stores, five retailers in the Monterey-Salinas area were interviewed. The operating managers of Sears, Penneys, Emporium, Macys, and K-Mart furnished a picture of the range of methods that were in use. Specific details and operating procedures were not disclosed during the interviews due to the private nature of this information.

A. SEARS, SALINAS

The initial amount of space given to departments is dictated by the headquarters. Historic trends in consumer

sales and profitability are used as a bases for this initial distribution. The original size of departments tends to stay constant over time. For example, the size of the ladies apparel department in this thirty year old store is much smaller than the same department in a more recently built store.

Almost all changes in space allocation are done within departments. The department managers use their own judgement plus quarterly space allocation information from the central office. The central office guidance is predictive in nature and does not address every item. It often lists new items or seasonal items along with expected gross sales levels. The method is called Balance of Sales to Total. For instance, the men's apparel department manager will be advised that a new style of dress shirt is expected to make up 10% of his total sales and that he should provide 10% of his space to these shirts at the expense of whichever line he chooses. Space allocation is a function of style, season, and anticipated gross sales within departments. Each department is expected to contribute a certain amount to the overall profit, but profit per square foot figures are not calculated. Information is kept on sales by color, size, type, and similar characteristics; however, statistics on space assigned to products or departments are not kept. This is viewed as an unmanageable task that may be a prospect for the future given the introduction of point-of-sale data entry terminals.

Sales levels are raised by other merchandising techniques such as price leaders, use of space near aisles, and placing the most profitable products in the most accessible spots within the departments.

Sears views the department store as many stores under

the same roof. Individual departments do not compete with each other or with departments in the other Sears stores. Rather, they are in competition with small proprietors in the surrounding community. A significant example of this is that Sears, Salinas does not carry dress suits because Jim Gattis Clothes and Dick Bruhns, two retailers who are merchandising dress suits, are close to the Sears store.

B. PENNYS, SALINAS

Initial departmental boundries, established during the construction phase, remain fairly fixed. Space is not viewed as a completely independent variable in the profit maximization effort. Pennys' "budget approach" to annual planning assigns each store an annual profit per square foot goal. At the store level, each department is assigned a contribution to the total. It is acknowledged that some departments are more profitable than others on a square foot basis; therefore, such figures are not calculated. A limited number of interdepartmental space changes are made with the purpose of increasing the contribution of one particular department. The basis of a change is historic profit-to-date contribution figures for departments.

Utilization of space within departments is attacked rather vigorously. Methods such as advertising, increased space utilization, and relocation of holiday items near aisles, are used to stimulate sales.

C. EMPORIUM, SALINAS

The headquarters established the initial store layout

boundaries. Boundry lines tend to be more subject to change than in the other stores surveyed although the changes are by no means frequent.

The most scrutinized statistic is gross sales, with figures on gross sales per square foot by department being accumulated at the store level. The result is that departments which have shown an upward trend in gross sales per square foot are looked at for enlargement, although additional space is not always provided. For example, if sales in the record department were to climb 10% to 20% higher, it would be considered for additional space; however, it would be unlikely that the records would get more space. Records have a small margin of profit, and this profitability level would deminish the likelihood of expansion. Interestingly, the margins and the gross sales are not combined locally to produce a gross profit per square foot by department. Gross sales experience is the force that drives space change decisions, and profitability is viewed as an element to be dealt with during the decision making process.

D. MACYS, MONTEREY

There is a high level of competition between the thirteen California stores. Competion between departments in the same store is not as significant. Interdepartmental space changes are done on an infrequent basis, after comparative studies with other macys stores, the use of industrial trends, and analysis of "a lot of statistics". A description of all the statistics was not given; however, profit per square foot is one of them. The main determinant used in evaluation is gross sales trends.

Local conditions and customer preferences have a large impact on size and even the existence of certain departments. For example, due to lack of sales, notions have been discontinued altogether. Ladies' clothing, although very profitable, has been greatly reduced in size because of keen competion from the specialty shops in the mall complex.

E. K-MART, SEASIDE

K-Mart is a discount merchandiser known for high turnover and high profitability per square foot. Departmental boundries are very fixed. Gross sales and gross profit per square foot minimums by department are established by the central headquarters. Statistics on sales per square foot and gross profits per square foot are kept at the headquarters. Expansion and contraction of various lines within departments is directed by the central office based on historic data and industrial trends. Most of the limited decision making at the local level goes into specific merchandising techniques within departments such as "blue light specials".

In conclusion, the five stores view the matters of space allocation, gross profit per square foot, and gross sales with varying amounts of concern. No store even considers a full item by item approach to space management. The approaches surveyed gave minimal attention to interdepartmental space changes; rather, they centered on intradepartmental changes. Space changes in departments are based predominantly on seasonal and style changes. Stimulating increased sales and profits is accomplished largely through merchandising techniques other than space changing. From this it may be concluded that either the

preceived benefit of space change is not as great as that of other techniques, or that the actual value of space change has not been fully discovered.

Profitability is not ignored; however, gross sales seems to be the most important variable. While the theory of space allocation addressed in this thesis is widely recognized, changes are not accomplished by the guidelines of the theory. This speaks to the practicality of the theory, particularly on an item by item basis. Attempts at space management vary from artistic to scientific and seem to be very much overshadowed by intradepartmental merchandising techniques.

The retailers agree that it is very difficult to isolate the effects of factors such as seasonal and style preferences. In some instances, a control group can provide enough data to show the difference which a space change makes by itself. Secondly, space allocation theory assumes that all space is created equal, but it is reasonable to assume that space near aisles and doors is more valuable than space in a rear corner of the store. Thirdly, in order to be able to plot the curve for the space-to-profit relationship, data must be gathered on a range of different product display sizes. This experimentation to gain points on a curve is costly in time and money, with no strictly theoretical decision possible until the results are tabulated. The record keeping of space allocated and changes in sales levels is by far the biggest chore. Finnally, use of analytical approaches seem to suffer because the direct benefits measured in added profits cannot be distinguished from the effects of the other merchandising tools which the retailers use. This overlap of effects fosters an intuitive approach since the gains in the analytical are indeterminable; therefore, decisions on space allocation are often made on intuitive rather than

analytical grounds. Attempts at applying the space allocation theory to supermakets on an individual product's gross profit basis have been done, but they have proven to be much too costly, even for just a portion of all the products sold in the market. Other schemes such as net profit per item per week, and direct product profit per cubic foot have been the subjects of studies but none have proven to be practical. The introduction of data processing combined with point-of-sale terminals may make the task more manageable. As long as space reallocations are noted in the data base, comparative analysis would become a relatively simple matter.

V. PRESENTATION OF NAVY EXCHANGE DATA

The theory of space allocation addressed in this thesis equates the marginal returns to space experienced in a retailing establishment. Deriving the best allocation scheme in any retailing organization, particularly in the Monterey Exchange, cannot occur without prior knowledge of the shapes of the space-to-profit curves. To find these shapes, the Exchange must gather information concerning space as it is presently distributed, and profit as it is now generated. From this base the Exchange must go through a series of space allocations, each period within the series being of equal length, constantly changing the size of each unit of space, until there are enough points on each of the unit of space graphs to estimate the true shapes of the curves. When the curves are known, all of the marginal returns can be equated and the proper size of each unit of space can be determined.

The entrepreneur begins by deciding what unit of space is significant for his purposes. Units of space can be stated in terms of space consumed by individual products, by product lines (i.e. all hand soaps), by product catagories (i.e. all cleaning agents) or by product families. This latter method of product identification usually equates to the departmental breakdowns that are typical in any large retailing organization. In 1976 there were twenty retail departments at the Monterey Exchange. 1977 began with an expansion of these twenty to twenty eight. Appendix A lists the old and the new departmental breakdowns, indicating where the changes were made to accomplish the expansion.

For the purposes of application to the Monterey Exchange, the space allocated to the twenty departments was selected as the significant unit of measure. Twenty eight was not selected because of the lack of significant sales experience in the newly created departments. As previously stated, other research in this area has found product-by-product analysis to be too costly. The fact that none of the five stores interviewed did product-by-product analysis, is significant as well. Finally, from a practical standpoint, the mechanized operational data available at the Monterey Exchange was available departmentally. Any further breakdown would have involved a level of effort that would have resulted in an excessive fiscal burden for the Exchange, particularly in the area of administrative payroll.

It is acknowledged that point of sale terminals instead of traditional registers would make product-by-product analysis a future possibility. Further, product-by-product analysis is a likely prospect if the parameters of the study were to be reduced from store-wide to a subset of products.

Along with deciding the significance level, the entrepreneur must determine whether or not he will conduct a two or a three dimensional study. For the purposes of this thesis, the two dimensional measure of square feet was used. Hanging racks and ankle high platforms may consume an equal amount of square feet; however, the hanging racks clearly consume a greater number of cubic feet. The three dimensional measure would take into consideration the intensified use that some fixtures make of space; however, there are numerous judgemental decisions that must be made that might negate the value of the seemingly higher level of sophistication. Additionally, the two dimensional study does not necessarily insure a lower level of spacial equality. For instance, in either method a wall unit and a

free-standing structure of equal heights, widths, and depths would be assigned equal amounts of square or cubic feet; however, customers have three hundred sixty degree access to the free-standing structure. Clearly, this accessibility cannot be reflected in either a two or a three dimensional study.

The final decision concerning space is whether or not to treat all space as equal. This study assumed this equality, but the wall unit and free-standing structure example points out the inequalities that can exist. If it were agreed that the inequalities were relavant, some form of weighting would have to occur for purposes of conducting the analysis. This would necessitate some sort of weighting scheme that would be based on the judgements of the individual retailer. Once again, the higher level of sophistication that is assumed to result, could very well be negated depending upon the accuracy of the method of weighting developed by the entrepreneur. The simplifiying assumption that all units of space are equal allows the retailer to proceed with the analysis without having to consider applications of a weight to every unit of space involved in the study, and yet the results are not rendered meaningless. It is evident that this spacial inequality reduces the significance of the equal marginal returns. As in any other economic analysis that involves other than purely financial considerations, the final result of the study becomes a departure point for decision making, rather than the decision itself.

With the unit of space measurement determined, the entrepreneur must decide what he will express in terms of the unit of measure. A retailer with the same gross profit percentage throughout the store and insignificant cost differences in retailing various products, could express gross sales, gross profit, or net profit by square feet. The result in any case would be the same. Unfortunately for

the Exchange, gross profit percentages can vary from 8.5% to 20% within a single department. Appendix B lists the retail departments and shows the spread of authorized markups within each department. Additionally, operational costs vary with the product being merchandised. For example, ticketing soft goods in a warehouse can consume considerably more man-hours than receiving and displaying unticketed cartons of milk. For an Exchange with a complex markup schedule and a non-existent system of allocating product handling costs, the logical direction to proceed is with departmental gross profit figures.

Having determined what to express in terms of an appropriate unit of measure, the final decision for the entrepreneur is the length of time that will elapse between space reallocations. For an Exchange, a month is probably the shortest significant period of time that should be considered. This was the period of time selected for this study. Exchanges report to the Navy Resale System Office on a monthly basis, operating statements cover a month's time, and Reservists as well as many other customers can be expected to shop at least once a month. Additionally, in terms of the operational aspects of an Exchange, employee morale might be seriously affected if periodic changes were made more frequently than once a month, and restricting changes to once a month reduces the likelihood of a significant overtime payroll expense.

In so far as this study restricted itself to a first estimate of the space-to-profit curves, departmental gross profits were calculated for one year to reduce the influence of seasonal changes. Using the origin and each of the single points gave a straight line approximation of the gross profit-to-square foot curves. Assuming a continuation of the linearity, the Exchange was given a reccommended set of changes to space, taking from the least profitable and

giving to the most profitable. Periodic analysis after this first set of changes would indicate the relative worth of the assumption that the most profitable can use additional space and the least profitable can afford to relinquish it.

An entrepreneur with an interest in conducting a similar analysis could begin in the same manner, dividing his result by twelve to acquire his first data point. From that point on, monthly reports of gross profits would have to be adjusted by some factor to reflect seasonal influences before points could be plotted on the gross profit-to-square foot graphs. Otherwise, the un-factored points would be insignificant since gross profits would include seasonal variations.

The Monterey Exchange has seven retailing locations: Main Retail Store (Building 301), Four Seasons Shop, Sporting Goods and Uniform Shop, Bookstore, Service Station, La Mesa Convenience Store, and Point Sur Store. Each of the locations are in different buildings and, in the case of the latter two, are geographically distant. Separate accountabilities for funds and merchandise, combined with the physical distances, limits the space reallocations that can be made between them. This study selected Building 301 for purposes of analysis, although any one of the seven could have been studied. The size of the sales floor dictated that the largest potential for space changes existed in Building 301.

There are four service and two retailing oriented activities within the building. The service departments (i.e. Barber Shop, Laundry and Dry Cleaning, Personalized Services, and Short Stop) were not included in the study because of the unlikely prospect of floor space being redistributed from retailing to services or visa-versa. This is so because of:

1. The nature of the two activities;

2. The physical boundries (i.e. walls) that form a natural barrier against redistribution;

3. The congressional limitations on the size of the two activities (i.e. retailing cannot take service space without forfeiting an equal amount of space somewhere else within the Exchange operation); and

4. The difficulties, including acccuntability, register capabilities, and departmental fractionalization, that would result when retail goods were merchandised by service personnel.

The two retailing operations within the building (i.e. Shoe and Luggage Shop, and Main Retail Store) remained for analysis. Combining these two operations was considered appropriate because of their operational similarities, the accountability of the stores' manager, and the possible capsulization of the other retail departments in the space occupied by the Shoe and Luggage Shop. Appendix C shows how the approximately 790 square feet in the Shce and Luggage Shop was apportioned to the E-7 department, C-1 department, and common use area. Common use area was defined as the square feet consumed by register stands, traffic areas, doorways, hidden corners, etc. Appendix D shows how the approximately 7,908 square feet in the Main Retail Store were distributed to the departments represented as well as to the common use area.

For purposes of this analysis the new departments that were started in February of 1977 were recombined with their parent departments before the square footage was distributed. This was necessary because, as was mentioned earlier in the chapter, the departmental sales data had to be expressed in a similar manner. At the time of the analysis, only two months of sales had been experienced under the new departmental arrangements. To obtain an annual sales figure, the new departments' sales had to be added to the parent departments' sales data. In affect, this reduced the sales data to a breakdown by old

departments. Since the sales data was stated in terms of pre-fiscal 1977 departments, the square footage had to be stated in such terms as well.

Appendix E summarizes the number of square feet distributed to the departments and to the common use areas. The percentage to the total that each department retained is shown, first alpha-numerically and then by the highest to the lowest percentage to the total.

With the spacial arrangement known, the only other information necessary was the gross profit figures by department. It was necessary to find the appropriate gross sales figures and gross profit percentages for each department involved. Given these two sets of data elements, finding the gross profit dollar figures was a simple matter of multiplying the former by the latter.

Month-end summaries of gross sales for the two retailing operations were available for the one year period starting in April of 1976 and ending in March of 1977. The practice of developing month-end summaries by operation was discontinued in March of 1977; therefore, this was the most current mechanized information available. Appendix F summarizes the yearly totals, showing the percentage to the total experienced by each department, once again giving the alpha-numeric and highest-to-lowest orderings.

The gross profit percentages were taken from the fiscal year end operating statement dated January 1977. The total sales, total gross profit, and gross profit percentages for all of the Exchange's retailing departments are shown in appendix G. The final column of the appendix reorders the Building 301 departments from the highest gross profit percentage to the lowest gross profit percentage. A gross profit percentage taken from this appendix applies to all

sales that occurred in a department, no matter where the sales were completed in the Exchange facilities. For instance, the gross profit percentage of 17.2% in the A-1 department is the result of confections and foods being sold at the La Mesa location as well as the Main Retail Store. This analysis assumed that the 17.2% was applicable to the sales that occurred in the Main Retail Store, when there was every likelihood that the mix of confections and food products in the Main Retail Store returned a higher or a lower gross profit percentage. This assumption was necessary since gross profit percentages by location are not calculated by the Monterey Exchange, except in the case where all of a department's sales occur in one location. An example of this would be all of the uniform sales occurring in the Uniform Shop. Another significant assumption that had to be made was that the fiscal year end gross profit percentages applied to the gross sales figures listed in appendix F. These sales figures are for one year; however, they are not for the Exchange's fiscal year. Once again, this assumption was necessary because of the eccentricities of the data base available at the Exchange. The application of the percentages to the sales figures seemed justified in light of the fact that the two yearly periods vary by only two months (i.e. fiscal year equals February through January; sales year, April through March). Both periods reflect the entire range of seasonal variations that occur during a year, and their equality in ten out of twelve months reduces the possibility of changes in customer buying patterns influencing the outcome.

Appendix H shows the result of the multiplication mentioned previously. This appendix combines the data elements expressed in the two previous appendices, resulting in a gross profit figure for each department represented in Building 301. The final two columns of the appendix show what percentage contribution each department made to the

total gross profit generated in Building 301, first alpha-numerically and then highest-to-lowest percentage.

The departmental gross profit figures were divided by the square footage figures listed in appendix E to derive the gross profit per square foot figures listed alpha-numerically and then in descending order in appendix I. This same gross profit per square foot information is displayed graphically in appendix J.

The Navy Resale System Office has approached the problem of proper space allocation by surveying space utilization in their various Exchanges. A 1974 study entitled Navy Exchange Retail Store Space Allocation Survey presented Fiscal Year 1973 data concerning system-wide space allocations and gross sales experience. The relavant unit of measure was the same as in this thesis (i.e. square feet); however, the 1974 study considered gross sales figures, as opposed to gross profit figures, the significant statistic to express in terms of square feet. The primary purpose of the study was to express gross sales in terms of square feet and to accumulate other significant operational information. It was hoped that the data would assist Exchanges in making retail store design decisions. The Monterey Exchange fit into the $400,000 to $800,000 sales per month catagory of Exchanges. Information concerning this catagory was extracted from the study and is presented in appendices K through L. Comparing information in these appendices with that of previous appendices is complicated by the fact that the Navy Resale System Office choose to combine departments found in the Self Service Section and report them as one department. The Self Service Section in the Monterey Exchange includes merchandise from the A-1, A-2, B-2, C-2, D-1, D-3, and E-5 departments. No effort was made to define the Self Service Section in the 1974 study, although, by process of elimination, it was apparent that at

least the A-1, A-2, C-2, and D-3 departments were included. Additionally, the E-1 department was included in the 1974 study, but was not located in the Monterey Exchange's Main Retail Store. Finally, there was no consideration for common use areas. In spite of the variances listed above, the statistics from the 1974 study were included in this thesis research because they are the only Navy Resale System Office statistics available concerning system-wide space allocation.

The various highest-to-lowest rankings exhibited in appendices E through L are summarized in appendix M. Column one of this appendix provides a numerical ordering of the departments as they are arranged in the various columns of the appendix. This ordering is restated alpha-numerically in appendix N.

VI. OBSERVATIONS

The objective of the first iteration in the process of employing the space allocation theory is to derive the first set of reallocation decisions. Specifically, the historic information concerning departments is analyzed to see which departments are most likely to benefit from receiving more space and which can best afford to give space away. Certain other benefits of this first iteration are evident as well. With the data accumulated, the Monterey Exchange Officer is in the unique position of comparing his present space allocation scheme and returns to space with the averages for Exchanges with similar sales volume. Additionally, the Monterey Exchange Officer is in a position to evaluate the relative merits of reallocation schemes eluded to in the overview of the five local retailing establishments and in the survey conducted by the Navy Resale System Office. Finally, the first set of reallocation decisions based on gross profit per square foot figures can be enumerated.

The Navy Resale System Office attempted to simplify their survey by treating the Self Service Section as one of twelve departments in the typical Main Retail Store. This effort at simplification made difficult the comparison between the 1974 survey results and the data presented in this thesis. The 1974 survey, by virtue of the lack of specific departmental data, treated departments A-1, A-2, C-2, and D-3 as one department, specifically the Self Service Section. The A-1, C-2, and D-3 departments were fully contained in the Self Service Section of the Monterey Exchange; however, the similarities to the 1974 survey ended there. The A-2, B-2, D-1, E-4, and E-5 departments had

merchandise located in the Self Service Section as well as in other areas of the store. In fact, there were only four departments in the Main Retail Store that did not have representative merchandise in the Self Service Section (i.e. the B-1, D-2, E-2, and E-3 departments).

A second area that made comparison between the two sets of data difficult was the treatment of common areas. The 1974 survey distributed all of the floor space to departments, whereas this thesis set aside certain areas (i.e. 13.1% of the total space) for common use. This setting aside of certain areas was viewed as a necessary refinement since it appeared that some areas were not a part of any one department. Registers that handled a multitude of departments and doorways were two cases where this reasoning applied quite readily. The 1974 survey stood mute as to the specific treatment of such areas, and it could only be assumed that all of the area available was distributed to the departments.

Thirdly, the 1974 survey included the E-1 department. The Monterey Exchange E-1 department was located in a separate building; therefore, it was not included in the data presented in this thesis. The E-1 department was located in the Main Retail Store, but was moved prior to the dates selected as significant for this thesis research. The E-2 department absorbed all of the space allocated to the E-1 department; therefore, for comparison purposes, combining the E-1 and E-2 departmental figures seemed relevant although "broad brush" in approach.

Finally, a significant difference between the 1974 survey and this thesis was the value expressed in terms of square feet. The 1974 survey expressed gross sales while this thesis expressed gross profit. Utilizing gross sales patterns to institute space changes ignores the actual

profit potentials of each department. Given that profit is the measure of how well the Exchange is meeting its mission, it would seem that gross profits instead of gross sales should be expressed in terms of square feet.

The four variations between the 1974 survey information and this thesis' data detailed above limited the observations that could be made. In terms of space allocations, it seemed marginally useful to compare the ordering of departments. In this regard, the D-1 and E-3 departments were significantly out of order. The D-1 department was lower in the 1974 ordering while the E-3 department was higher (appendix M). Only tentative conclusions could be drawn from this information. The Monterey Exchange Officer might consider the removal of space from the D-1 department and the adding of space to the E-3 department.

The 1974 survey provided gross sales per square foot figures for an Exchange-wide average and the average experience in the Discount Department Store Industry. These were $312.00 and $66.65 respectively. The Monterey Exchange figure for this value was approximately $405 in gross sales per square foot. Realizing that a factor for inflation must be applied to the first two figures before they can be compared with the $405 figure, the Monterey Exchange Officer still can be relatively certain that the Exchange was operating close to, if not over, the Exchange-wide average, and well over the industrial average.

The other comparison that seemed useful was the ordering of departments that resulted when gross sales were expressed in terms of square feet in the 1974 survey, and when gross profit was expressed in terms of square feet in this thesis. In either case the orderings would be used to identify candidates for gaining or losing space in the second

iteration of the space change process. The two departments that seemed significantly out of order were the B-2 and the E-3 departments. The 1974 survey identified the B-2 department as a department that should gain square footage, while the E-3 department was identified as one that should lose. The thesis data identified these departments as falling into exactly the opposite catagories. The net result would be different distribution decisions depending upon the measure used.

The various orderings in appendices M and N are suggestive of the space utilization techniques eluded to in the overviews discussed in Chapter Four and in the Navy Resale System Office 1974 survey. Analysis of gross sales was common in the overviews and seemed particularly important in the 1974 survey. Other methods of measuring productivity included an analysis of the actual gross profit percentages, and the actual gross profit dollars. The four final columns of appendix N highlight the significantly different conclusions that could be drawn from using one measure as opposed to another. Possibly the best example is the B-1 department. If gross sales or gross profits were the measures that instituted space changes, this department would be among the first to receive more space; however, if gross profit as a percentage of sales or gross profit per square foot were the measures, the department would have a tendency to remain the same in size or to be reduced. By far, the most frequently mentioned element that caused retailers to add space or to take it away was gross sales. If the Monterey Exchange Officer were to use gross sales as opposed to gross profit per square foot to make reallocation decisions, he would probably make the same decision only once. Department A-1 holds the twelfth position in either ordering scheme. All other departments hold different positions in the two orderings. The differences are probably most significant in the case of six departments

where the positions held vary by five to eight digits.

This thesis held that space change decisions should be base on observation of the gross profit per square foct and how that amount changed with changes in the square feet assigned. Appendices I and J show in tabular and graphic form the data necessary for the Monterey Exchange Officer to make the first reallocation decisions based on net profit per square foot figures.

The space allocation theory states that all of the marginal gross profit per square foot values should be the same, which is the same as saying that all of the plotted points on the graph in appendix J should end up on the same line. The objective, when stated in graphic terms, becomes one of equating slopes. Using the origin and each of the plotted points, straight line approximations of the various curves were noted. Assuming that either deminishing returns were operational or linearity would continue, and based on the broad profitability categories into which the departments seemed to fall, a first sweeping conclusion was to give more space to the top four departments listed in appendix I at the expense of the lowest three. The D-2, A-2, B-1, and C-1 departments performed in a significantly better manner than any of the other departments, particularly the A-1, E-5, and D-3 departments. The former four were utilizing space in a more efficient manner and the Exchange might benefit from an expansion of these departments at the expense of the worst performers. With this narrowing of departments to seven where space change is recommended, effort can be placed where it will do the most good. Record keeping efforts can be consentrated on the most promising departments and marginal information can be generated. In other words, the closer the plotted point is to the hoped for central line, the less continuing effort need be expended in that department.

The usefulness of this sweeping conclusion rested on assuming that profits were either linear as space was changed or influenced by diminishing returns. Since there was no data on which to judge the nature of profit potentials, estimates of profit gains because of space changes had to be tempered with individual knowledge of the methods and characteristics of departments. It was recognized that not having data available for generating marginal information left the process exactly where the intuitive approach would leave it (i.e. take from the worst and give to the best). The difference is that the intuitive approach is not normally iterative in nature; therefore, it does not normally follow up on what began with very good intensions. Additionally, the intuitive approach relies heavily on the intuitive abilities of the individual. Aside from this paradox which questioned the necessity for the economic analysis conducted in this thesis, one of the more interesting things about the graph was that it permitted speculation as to the shape of the curves that actually passed through the single points which were plotted. Additionally, the graphic representation made it easier to visualize the aligning of all of the points on one central line. It provided a very good representation of the space allocation conditions in the store and it stimulated a better understanding of the magnitudes of sales and space in each department.

Together, appendices M and N provided an understanding of why each department fell where it did in terms of gross profit per square foot. For example, it was apparent from the appendices that the C-1 department ranked eleventh in space, eleventh in sales, but third in margin. Its margin in fact boosted it to fourth in gross profit per square foot. Also, it was noted that three out of the top four departments in gross profits per square foot were characterized by high margins and low amounts of space.

Minimum space requirements have a limiting effect on the magnitude of space change that can be made. In considering specific changes in space between departments, it was important to be aware of absolute size. For instance, the area of Macys' men's clothing department was much larger than all of the area consumed by the men's, women's, and children's clothing departments in the Monterey Exchange. This observation brought to the forefront the notion of a threshold area necessary for doing a reasonable business. Even though the nearness of one poorly performing department to another good performer suggested some possible space changes that could be accomplished with very little expense other than personnel costs, this notion of threshold stymied the otherwise sound recommendation. Childrens' clothing with the lowest profit margin in the clothing departments, appeared to be a candidate to give up space to womens' clothes; however, childrens' clothes required a wider range of clothing from infants through teenager. Making the department any smaller could have rendered it ineffective. In fact, the department may have been ineffective at the time of the analysis. It may have been that increases in space would have brought an increasing rate of profit. The straight line would turn upwards as the S-shaped curve did in chapter two; however, as was previously mentioned, the straight line approximations ignore the possibility of anything other than linearity. Other recommended space changes based on profitability per square foot and proximity of less profitable departments were to enlarge the Luggage section at the expense of Shoes, and Jewelry at the expense of Domestics and Dry Goods.

Certain recommendations came out of the fact that some departments were found in more than one store. This fact, together with the notion of threshold amounts of space, lead to questioning the operation of a mini-grocery unit in the Main Retail Store. The D-3 department was lowest in gross

profit per square foot. This made it crucial to ponder the shape of the space-to-profit curve. Once again, the curve could turn upwards with increased space. That is, perhaps more space would yield profits at an increasing rate to some point. The D-3 department in the Main Retail Store existed so that shoppers could buy a light bulb, detergent, cigarettes, and film all under one roof. To be in other than the mini-grocery business, and to discover the actual shape of the space-to-profit curve, D-3 needed more room. The C-2 department was in the same postion. Moving the C-2 department to the Bookstore to join the rest of the C-2 department merchandise and moving the D-3 department to do likewise in the La Mesa Store would free Main Retail Store space that should be devoted to more profitable departments. The hoped for results would be greater profits realized and better selections made possible.

In making such changes it would be necessary to take into consideration the amount of customer convenience sacrificed, the willingness to shop elsewhere, the Navy Resale System Office requirements concerning specific items in specific sales locations, the ability of other retail activities to absorb the additional sales volume, and the effect eliminating an item would have on other sales generated by its presence. On economic grounds alone, elimination of the C-2 and the D-3 departments from the Main Retail Store appeared to be a likely prospect. The recommendation followed the same line of reasoning used by the large local retailers who eliminated departments when they were not in a position to compete. On the other hand, it would have definitely meant a sacrifice in customer convenience.

The final observation concerned the lack of control groups. The Monterey Exchange Officer would want to feel reasonably certain that changes in gross profits per square

foot figures were due to changes made to the spacial arrangements. Without control groups, the hypothesis that gross profit per square foot improvements were due to space changes would boarder on pure conjecture. One possible way to derive the benefit of control group information without actually having control groups would be to determine the historic sales trends in departments. Certain departments have almost no month-to-month variations in sales while others fluctuate by reasonably constant percentages. Use of this historic sales trend data might act as a reasonable substitute for control groups; however, the level of certainty concerning the validity of the result would be significantly lower than with the use of control groups.

VII. CONCLUSIONS

This thesis has explored the theory of space allocation as it applies to retailing. The theory, when used in its most sophisticated mode, would equate the marginal net profit returns of every item sold in a store. Numerous changes to the spacial arrangements, enough to define the space-to-net profit curves, would be made before the final arrangement was determined. Each individual unit of space would be weighted to reflect its true value relative to all of the other units of space in the store. A control group would be operated to detect changes in net profit that occurred because of something other than a space change.

The parameters change when the theory's application in an Exchange environment is contemplated. Gross profit instead of net profit is the measure of productivity. Departmental instead of product-by-product analysis is conducted. Changes to space would occur monthly, imposing a long experimentation phase on the research effort. All space would be considered equal and stated in terms of the two demensional measure of square feet. The control group would consist of theoretical estimates of how departments would operate in spite of the space changes.

The theory, when applied in an Exchange retail store, may not be in its purest form, but that would not render the information meaningless. After the experimentation phase is complete an Exchange would have a compilation of data that would suggest where the decision making process should begin, not where it should end. The adjustments that have to be made to the parameters before the experimentation

process begins, and the peculiarities of an Exchange operation highlight the fact that the data is the result of an analysis of the pure economics of an Exchange operation. The results of the research effort do nothing more than set the stage for the decision making process. In the end, profit is only one of the measures of a successfully operated Exchange.

For an Exchange, the application of the theory begins with deciding where the greatest potential is for changes to the spacial arrangements. In the case of the Monterey Exchange, this meant excluding the notion of changes between operations that were geographically distant and between retailing and services activities. Building 301 was physically the largest retailing operation and had fourteen departments. Determining the number of square feet and the gross profits in each department is the next step. Once these figures are calculated, the gross profit per square foot amounts are easily determined. If these amounts are yearly results, they must be adjusted to monthly figures if they are to be the first points plotted on the space-to-profit graphs. The location of the points will be some indication of how the departments will react when space is changed. In the Monterey Exchange, four departments were selected for gaining space, three were identified as potential losers, while the rest were left alone.

Once changes are made, gross profit information must be recorded so that month-end comparisons can be completed. This necessitates the establishment of a management information system that details sales and gross profit information by activity. In the case of the Monterey Exchange, this would mean reinstituting their month-end reporting of sales by activity. Additionally, determining gross profit results by activity would be a refinement to the entire process that would eliminate the application of

Monterey Exchange-wide percentages to sales that represent a fraction of the merchandise sold in a department.

Another refinement that should be made before the month-end comparisons are completed, is the development of information that would otherwise be provided by control groups. This would involve estimates of how departmental profits would act in spite of the space changes that were insituted. Although this area will not be expanded upon in this thesis, research into control group simulation is a possibility for future thesis research. After a series of changes have taken place, linear programming can be utilized to equate the marginal gross profits. For the Monterey Exchange, the number of departments influenced by the space changes may not necessitate a full linear programming effort. On the other hand, greater numbers of changes, as might occur in product-by-product research, could be inputs to a computer program that utilizes linear programming to equate marginal returns. Once again, a possibility for future thesis research is indicated. An additional possibility, as was indicated in chapter two, is Monte Carlo computer simulations to deal with the historic data concerning gross profits generated under different spacial arrangements.

The costs of making changes to the spacial arrangements must be considered before the changes take place. The act of accumulating the data involves a personnel cost, use of computer time would be an additional operating expense, and repositioning departments could be quite costly. The advent of point-of-sale terminals may dampen these cost considerations, given that space assigned to departments or products could be just one of the many data elements that defines departments or products in the computer model.

A final conclusion involves an attitude concerning gross

sales that is repeated in private sector retailing organizations as well as in the Navy Resale System. The overview of the five retailing organizations and the attitudes of the Navy Resale System reflected in the 1974 survey indicated that a basic concept in maximizing operational efficiency is for the most part being ignored. The five retailers and the Navy Resale System consider gross sales as the element that drives the decision making process. Thoughts about spacial arrangements seem to begin with consideration of patterns in gross sales. Gross profit and eventually net profit are secondary matters that do not seem to act as the original impetus for making changes to space.

Space is just one of the resources available to an Exchange Officer. Other resources are time, money, and people. How these resources interact with each other and the limitations placed on each resource directly influences the decision making process. Ultimately, an Exchange Officer must act in the best interests of his customers, providing service in the best manner possible and attempting to improve the quality of Navy life. This thesis has shown that directing the use of space can have a significant impact on accomplishment of this mission.

APPENDIX A

LIST OF 1976 AND 1977 RETAIL DEPARTMENTS

---1976---	---1977---
A-1 Confections & Food Products	A-1 Candy & Confections
A-2 Tobacco & Smoking Accessories	A-2 Tobacco & Smoking Access.
	A-4 Food Products*
B-1 Cameras & Photo Access.	B-1 Camera & Photo Access.
B-2 Household Appliances & Accessories	B-2 Home Furnishings & Housewares
B-3 Sporting Goods	B-3 Sporting Goods
	B-4 Electrical Appliances**
	B-5 Consumer Electronics & Musical Instruments**
C-1 Luggage & Leather Goods	C-1 Luggage & Leather Goods
C-2 Stationary & Periodicals	C-2 Stationary
	C-3 Books, Periodicals, & Greeting Cards***
C-4 Hardware & Garden Supplies	C-4 Hardware, Garden, & Pet Supplies
C-5 Toys & Wheel Goods	C-5 Toys & Wheel Goods
C-6 Text Books	C-6 Text Books
D-1 Toiletries	D-1 Toiletries & Drugs
D-2 Jewelry	D-2 Jewelry
D-3 Household Supplies	D-3 Household Supplies
	D-5 Fragrances & Cosmetics+
E-1 Uniforms & Uniform Accessories	E-1 Uniforms & Uniform Accessories
E-2 Men's Accessories	E-2 Men's Accessories
E-3 Women's Accessories	E-3 Intimate Apparel & Access.
E-4 Domestics & Dry Goods	E-4 Domestics
E-5 Infants' & Children's Wear	E-5 Infants' & Children's Wear
E-7 Family Shoes	E-7 Family Shoes
	E-8 Women's Ready to Wear++
E-9 Miscellaneous (Point Sur Store)	E-9 Miscellaneous (Point Sur Store)
	F-2 Fabrics & Sewing Access.+++
	L-1 Uniform Retail Clothing Store

* From Dept. A-1
** From Dept. B-2
*** From Dept. C-2

\+ From Dept. D-1
++ From Dept. E-3
+++ From Dept. E-4

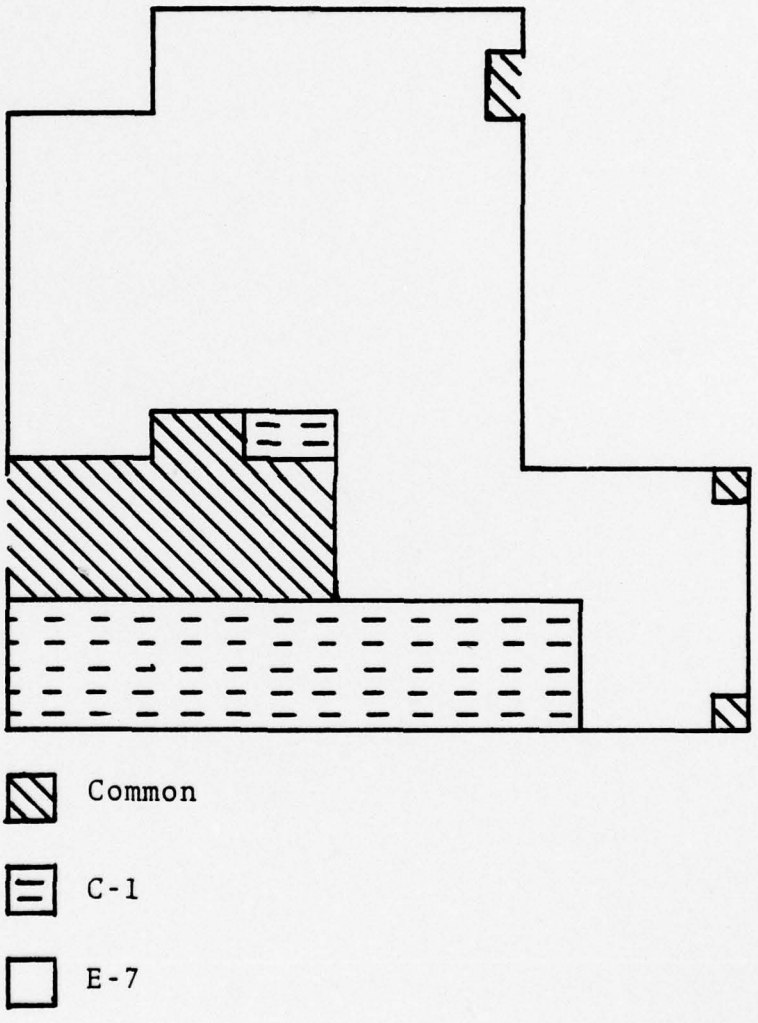
APPENDIX B

AUTHORIZED MARKUPS BY DEPARTMENT

Dept.	Markup	
A-1	20%	
A-2	10%	Cigars, 25% Accessories, & Special Schedule for Cigarettes
A-4	8.5%	Through 20%
B-1	10%	Through 15%
B-2	15%	Through 25% & Special Schedule for Lamps
B-3	15%	Through 25%
B-4	15%	
B-5	15%	Through 20% & Special Schedule for Home Entertainment Catagories
C-1	15%	Through 20%
C-2	15%	Through 20%
C-3	20%	Through 25% & Special Schedules for Gift Wrapping, Greeting Cards, Party Goods, Comics, Magazines, & Pocket-Size Books
C-4	10%	Through 25%
C-5	20%	
C-6	15%	
D-1	10%	Through 25%
D-2	15%	Through 25%
D-3	8.5%	Through 20%
D-5	15%	Through 25%
E-1	15%	Special Schedule for Some Uniform Articles
E-2	10%	Through 25% & Special Schedules for Some Apparel
E-3	15%	Through 25% & Special Schedules for Some Apparel
E-4	15%	Through 25%
E-5	10%	Through 20% & Special Schedules for Some Apparel
E-7	15%	Through 25% & Special Schedules for Family Shoe Items
E-8	20%	Through 25% & Special Schedules for Some Apparel
F-2	25%	Special Schedules for Sewing Accessories, Bolt Fabric-Trim, & Patterns

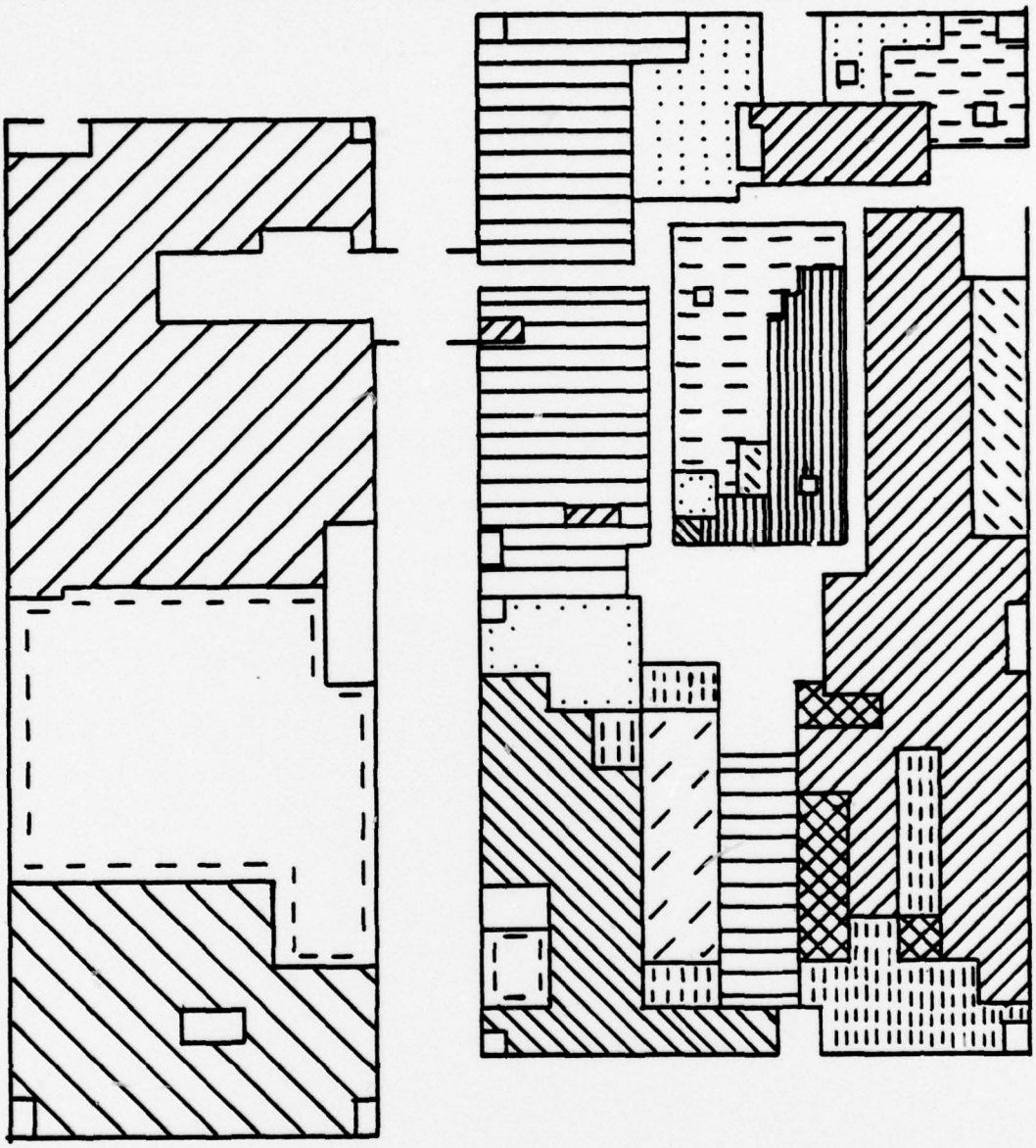
APPENDIX C

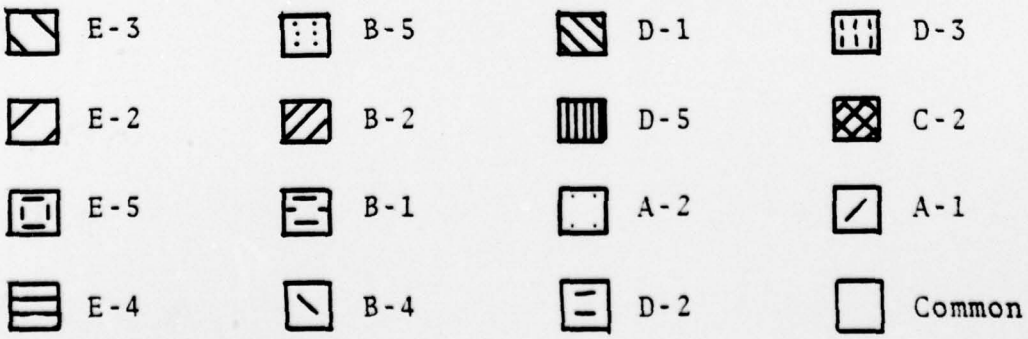
DISTRIBUTION OF SQUARE FEET IN SHOE AND LUGGAGE SHOP



APPENDIX D

DISTRIBUTION OF SQUARE FEET IN MAIN RETAIL STORE





APPENDIX E

SUMMARY OF SQUARE FEET DISTRIBUTION

Dept.	Square Feet	Percentage to Total	Depts. Reordered Highest to Lowest %	
			Dept.	Percentage
A-1	192 sq.ft	2.2%	B-2	16.4%
A-2	130	1.5	E-2	14.2
B-1	113	1.3	E-5	10.8
B-2	1,425	16.4	E-4	10.2
C-1	146	1.7	D-1	7.9
C-2	119	1.4	E-3	7.5
D-1	687	7.9	E-7	5.8
D-2	210	2.4	D-3	3.6
D-3	314	3.6	D-2	2.4
E-2	1,234	14.2	A-1	2.2
E-3	648	7.5	C-1	1.7
E-4	889	10.2	A-2	1.5
E-5	938	10.8	C-2	1.4
E-7	509	5.8	B-1	1.3
Common	1,143	13.1	Common	13.1
Total	8,697 sq.ft.	100.0%		100.0%

APPENDIX F

GROSS SALES IN BUILDING 301

Dept.	Gross Sales APR.76-MAR.77	Percentage to Total	Depts. Reordered Highest to Lowest % Dept.	Percentage
A-1	$ 56,858	1.6%	B-2	19.6%
A-2	148,737	4.2	E-2	16.5
B-1	209,879	6.0	D-1	10.7
B-2	691,406	19.6	E-3	8.4
C-1	103,657	3.0	D-2	7.7
C-2	34,499	1.0	E-5	7.1
D-1	375,329	10.7	E-4	7.0
D-2	269,857	7.7	B-1	6.0
D-3	47,314	1.3	E-7	5.9
E-2	582,535	16.5	A-2	4.2
E-3	295,706	8.4	C-1	3.0
E-4	247,611	7.0	A-1	1.6
E-5	251,300	7.1	D-3	1.3
E-7	207,879	5.9	C-2	1.0
	$3,522,567	100.0%		100.0%

APPENDIX G

GROSS SALES AND GROSS PROFITS FOR THE MONTEREY EXCHANGE

Dept.	February 1976 - January 1977 Sales	Gross Profit	% to Sales	Building 301 Depts. Reordered Highest to Lowest % Dept.	Percentage
A-1	$ 272,678.94	$ 46,895.19	17.2%	D-2	26.2%
A-2	178,803.31	45,158.71	25.3	A-2	25.3
B-1	203,906.65	24,090.84	11.8	C-1	24.3
B-2	717,382.13	130,719.92	18.2	E-7	23.2
B-3	184,600.99	30,854.38	16.7	C-2	23.1
C-1	105,246.37	25,610.34	24.3	E-3	22.7
C-2	401,486.18	92,784.77	23.1	E-4	22.7
C-4	447,313.93	87,280.71	19.5	E-2	21.0
C-5	194,322.17	38,992.06	20.1	D-1	18.8
C-6	188,845.88	29,589.30	15.7	E-5	18.4
D-1	389,679.94	73,264.94	18.8	B-2	18.2
D-2	238,694.98	62,443.49	26.2	A-1	17.2
D-3	70,302.99	10,255.71	14.6	D-3	14.6
E-1	41,835.85	6,353.29	15.2	B-1	11.8
E-2	605,374.83	127,211.37	21.0		
E-3	319,592.38	72,705.97	22.7		
E-4	246,538.69	55,868.20	22.7		
E-5	252,199.34	46,353.02	18.4		
E-7	238,705.03	55,306.38	23.2		
E-9	24,042.49	5,151.17	21.4		
Total	$5,321,553.07	$1,066,889.76	20.0		

APPENDIX H

GROSS PROFITS IN BUILDING 301

Dept.	Gross Profit	Percentage to Total	Depts. Reordered Highest to Lowest % Dept.	Percentage
A-1	$ 9,780	1.4%	B-2	17.5%
A-2	37,630	5.2	E-2	17.0
B-1	24,766	3.5	D-2	9.8
B-2	125,836	17.5	D-1	9.8
C-1	25,189	3.5	E-3	9.3
C-2	7,969	1.1	E-4	7.8
D-1	70,562	9.8	E-7	6.7
D-2	70,702	9.8	E-5	6.4
D-3	6,908	1.0	A-2	5.2
E-2	122,332	17.0	C-1	3.5
E-3	67,125	9.3	B-1	3.5
E-4	56,208	7.8	A-1	1.4
E-5	46,239	6.4	C-2	1.1
E-7	48,228	6.7	D-3	1.0
Total	$719,474	100.0%		100.0%

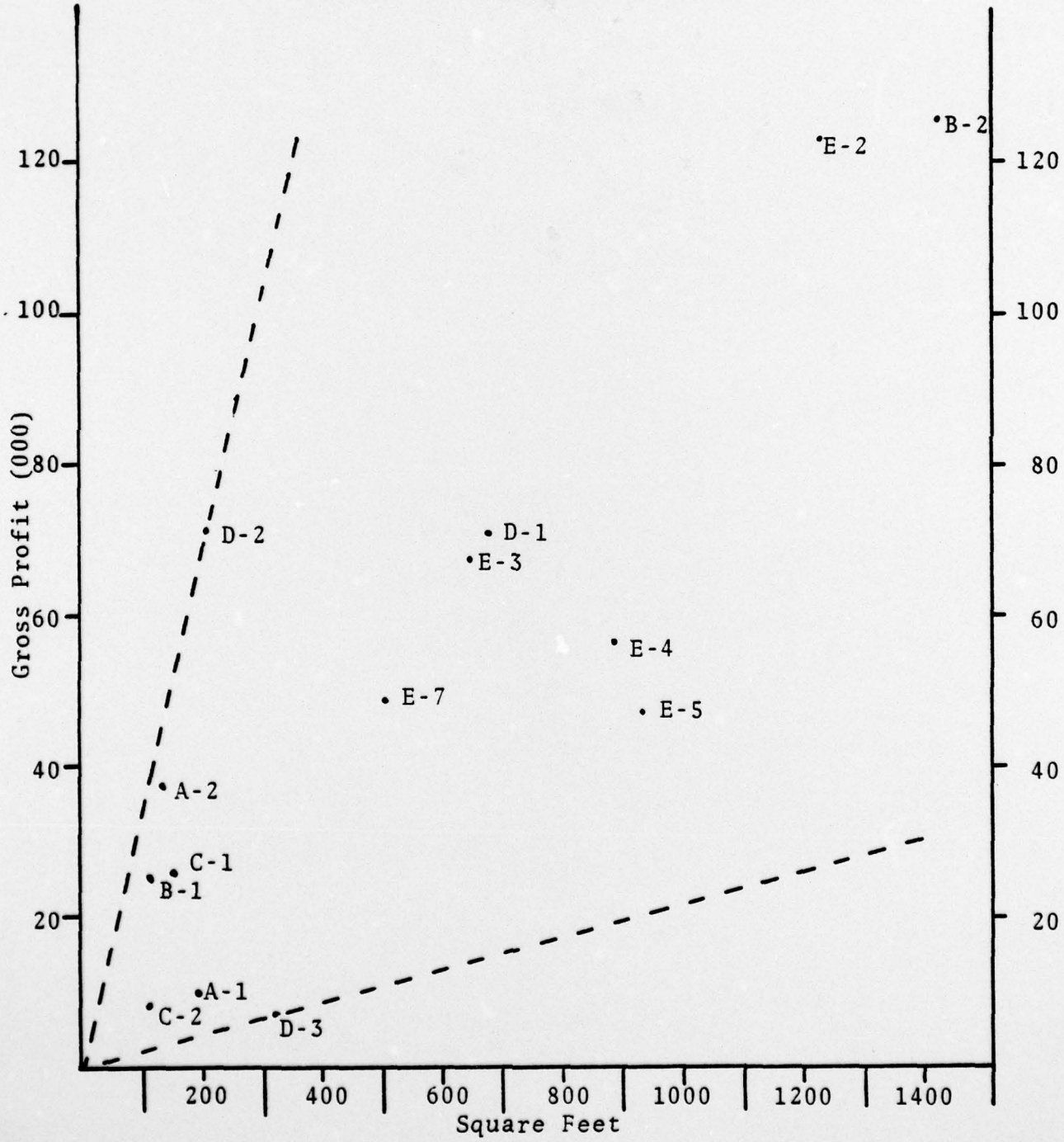
APPENDIX I

GROSS PROFITS PER SQUARE FOOT IN BUILDING 301

Dept.	Gross Profit per Square Foot	Departments Reordered Highest to Lowest Gross Profit per Square Foot Dept.	G.P. / SQ.FT.
A-1	$ 51 / SQ.FT.	D-2	$337 / SQ.FT.
A-2	289	A-2	289
B-1	219	B-1	219
B-2	88	C-1	173
C-1	173	E-3	104
C-2	67	D-1	103
D-1	103	E-2	99
D-2	337	E-7	95
D-3	22	B-2	88
E-2	99	C-2	67
E-3	104	E-4	63
E-4	63	A-1	51
E-5	49	E-5	49
E-7	95	D-3	22

APPENDIX J

APPENDIX I REPRESENTED GRAPHICALLY



APPENDIX K

NAVY RESALE SYSTEM PERCENTAGE DISTRIBUTION OF DEPARTMENTAL SPACE

Dept.	Percentage to Total	Depts. Reordered Highest to Lowest % Dept.	Percentage
Self Service	23.5%	Self Service	23.5%
B-1	1.5	B-2	14.0
B-2	14.0	E-2	13.7
C-1	2.1	E-3	12.0
D-1	2.9	E-5	12.0
D-2	3.0	E-4	8.1
E-1	3.0	E-7	4.2
E-2	13.7	E-1	3.0
E-3	12.0	D-2	3.0
E-4	8.1	D-1	2.9
E-5	12.0	C-1	2.1
E-7	4.2	B-1	1.5
Total	100.0%		100.0%

APPENDIX L

NAVY RESALE SYSTEM DEPARTMENTAL GROSS SALES PER SQUARE FOOT

Dept.	Gross Sales per Square Foot
Self Service	$ 35.10
B-1	107.53
B-2	33.04
C-1	38.69
D-1	27.19
D-2	74.21
E-1	30.27
E-2	29.22
E-3	20.18
E-4	12.67
E-5	12.87
E-7	24.68

Departments Reordered Highest to Lowest Gross Sales per Square Foot

Dept.	G.S. / SQ.FT.
B-1	$107.53 / SQ.FT.
D-2	74.21
C-2	38.69
Self Service	35.10
B-2	33.04
E-1	30.27
E-2	29.22
D-1	27.19
E-7	24.68
E-3	20.18
E-5	12.87
E-4	12.67

APPENDIX M

SUMMARY OF HIGHEST TO LOWEST RANKINGS

No.	Exchange-Wide Space	Exchange-Wide G.S./SQ.FT.	Space	Gross Sales	G.P.% to Sales	Gross Profit	G.P. per SQ.FT.
1	S.S.	B-1	B-2	B-2	D-2	B-2	D-2
2	B-2	D-2	E-2	E-2	A-2	E-2	A-2
3	E-2	C-1	E.5	D-1	C-1	D-2	B-1
4	E-3	S.S.	E-4	E-3	E-7	D-1	C-1
5	E-5	B-2	D-1	D-2	C-2	E-3	E-3
6	E-4	E-1	E-3	E-5	E-3	E-4	D-1
7	E-7	E-2	E-7	E-4	E-4	E-7	E-2
8	E-1	D-1	D-3	B-1	E-2	E-5	E-7
9	D-2	E-7	D-2	E-7	D-1	A-2	B-2
10	D-1	E-3	A-1	A-2	E-5	C-1	C-2
11	C-1	E-5	C-1	C-1	B-2	B-1	E-4
12	B-1	E-4	A-2	A-1	A-1	A-1	A-1
13			C-2	D-3	D-3	C-2	E-5
14			B-1	C-2	B-1	D-3	D-3

APPENDIX N

SUMMARY OF RANKINGS ARRANGED ALPHA-NUMERICALLY

Dept.	Exchange-Wide Space	Exchange-Wide G.S./SQ.FT.	Space	Gross Sales	G.P.% to Sales	Gross Profit	G.P. per SQ.FT.
A-1			10	12	12	12	12
A-2			12	10	2	9	2
B-1	12	1	14	8	14	11	3
B-2	2	5	1	1	11	1	9
C-1	11	3	11	11	3	10	4
C-2			13	14	5	13	10
D-1	10	8	5	3	9	4	6
D-2	9	2	9	5	1	3	1
D-3			8	13	13	14	14
E-2	3	7	2	2	8	2	7
E-3	4	10	6	4	6	5	5
E-4	6	12	4	7	7	6	11
E-5	5	11	3	6	10	8	13
E-7	7	9	7	9	4	7	8
S.S.	1	4					
E-1	8	6					

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5.	LCDR J. Owens, S.C., U.S.N., Code 540n Naval Postgraduate School Monterey, California 93940	1
6.	LCDR J. D. Buttinger, U.S.N., Code 54Bl Naval Postgraduate School Monterey, California 93940	1
7.	Lt. William E. Johnson, S.C., U.S.N. Navy Exchange U.S. Naval Facilities, United Kingdom 97 A Hawthorn Street Glasgow, Scotland G22 6JD	2