MARKET SEGMENTATION:

A QUANTITATIVE MODEL

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PREFACE

This paper grew out of a personal interest in the effect of a pricing change on the marketability and profitability of a product for which I was responsible. Since my company competes in a rather small industrial market where the number of units sold is small and the data on competitors is sketchy or nonexistent, I was forced to look for managerial judgement and normative ratings as a base for product decisions. In hindsight, it appears that this is normal phenomenon for most markets--only very large operations can justify extensive data gathering. And, even if such data is available, judgement is necessary to project future trends. I have found this model useful personally, and believe it is applicable to a wide variety of problems.

I wish to express my appreciation to my advisor, Steven J. Miller. His enthusiasm for the model in its early stages and his support later in resolving numerous complications has kept me in the track throughout the development work. My thanks also to my employer, Applied Automation, Incorporated, a wholly owned subsidiary of Phillips Petroleum Company, for allowing me time on the job to explore and develop the model and apply it to a real life problem. Although the data used in the paper is disguised from its original form, the results are reasonable representations of the actual problem and solution.

My especial thanks to my wife, Donna Jeanne, and four children - Steven Dean, Clair Jeanne, Catharine Lynn, and Craig Alan - for their patience and support over the last five years of nighttime MBA school. Their willingness to forego home repairs, weekend trips, and evening activities in order to cater to my instructors' demands (whims?) is appreciated. This is not to say that I now plan to eagerly attack the home repairs, but....

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CHAPTER I

INTRODUCTION

Managers must make decisions in a complex world noted by market uncertainties, competitive actions, changing technologies, and other variable forces. To operate in such an environment, managers will develop intuitive models to simplify the decision process. The models used are ones which simplify "all that data out there" and which have proven useful in their experience. For example, the marketing manager may describe in general terms the advertising, distribution channels, and product end users. These may be classified by type of media, region, size of order, or other characteristics which suggest themselves to the manager. The model that combines these decision inputs may change daily due to new experiences, and will certainly be focused on the problem at hand.

Developmental work in marketing has attempted to formalize these models by developing and/or using techniques for application of linear programming, sequential flow charts, predictive equations, and so on. Each format model has its strengths and weakness, and generally each addresses some business function better than the others.

Models tend to vary in appropriateness based on the problem being addressed. Linear programming models can be used with specific area or route measurements to allocate salesmen's territories. Advertising effectiveness models use relationships based on human reactions to various stimuli. Buyer behavior models use direct observations to determine shelf arrangement, package color, etc. In each case, simplifying assumptions are made to emphasize those factors being studied.

Computerized models first used the powerful computational capabilities of the machine to solve very complex linear programming models, or to reduce data to predictive equations through curve fitting. As the data storage and retreival capabilities of computer systems improved, sophisticated models of market behavior were developed. Examples of these are SPRINTER (Urban 1970) for test marketing, BRANDAID (Little 1975) for marketing-mix studies, and a price forcasting model by Strobaugh and Townsend (1975).

The latest use of computers reflects the developing interactive powers of the computer. Models which answer questions in a conversational mode are being developed. These models may rely on the earlier models utilizing computational power and emulating human behavior. Such systems are described by Little (9,10), Aaker and Weinberg (1), Montgomery (11), and others.

But by far the most interesting aspect of the new models is their reliance on managerial judgement to fill the

gaps left by the available data. Only interactive systems can be sufficiently personal and sufficiently responsive to make this approach possible. Thus, a new wave of models providing a very personal tool for the marketing manager can be expected in the near future.

This paper describes one such model which relies almost exclusively on managerial judgement, and is intended for the personal use of the marketing and/or product mangaer. It combines a model of relative competitive advantage, the market segmentation concept, and profitability issues to assess the relative effectiveness of alternative product/service packages. Its use can be simple or complex, depending on the nature of the problem at hand, and it is as useful as a learning tool as a source of specific answers. One of its values is that it can pinpoint areas of insufficient data, and allows the manager to fill the void temporarily with judgemental information. It can be easily used to predict gross margin/profit effects of product changes, and supports sensitivity ("what if") analysis on various overall product features. An example of its use is included.

In the following chapter, key aspects of model building will be discussed. This will include an overview of the approach to model building to date, problems of implementation, and a methodology for model development. Chapter III will develop a model structure for the product/service package. Chapter IV will apply this model with relevant data. Finally, conclusions and extensions to the model will be discussed.

CHAPTER II

MODEL BUILDING IN MARKETING

Marketing models are created to simplify market analysis. Like the models of Chemistry, Physics, or other fields, models are designed to simplify the Universe and emphasize certain characteristics for study. No attempt is made to completely characterize the market, any more than Newton sought to completely characterize the physical universe with his laws of gravitational attraction. Models are thus adjuncts to decision making, rather than replacements for decision makers, since they offer incomplete representations of the market being studied. Thus, "the issue is not men versus models, rather it is managers' unaided judgement versus managers plus an analytical tool designed to augment, but not replace, their judgement." (13)

History of Model Building in Marketing

The earliest market models were intuitive, and undoubtedly were used by the first traders in deciding what size clay pot, what shape reed basket, or what type of sea shell to transport from tribe to tribe. Beyond the intuitive models, and unlike the physical sciences, formal model

building was slow in developing in marketing and other buisness activities.

In modern times (beginning about 1950), the first general application of modeling to marketing was the use of operations research tools. Primarily in the form of linear programming models, these tools required excessive structure to be applied to the basically unstructured, nonlinear, unstable market. The resulting models deviated so far from the real thing that only a few applications realized any significant returns.

Later, attempts (such as the Claycamp and Amstrutz model [4]) were made to model the real world in detail--including all the uncertainties, probabilities, human behavioral, and other characteristics which could be imagined. The result was so complete that it was unusable, due to the amount of time required to develop the data base and then to analyse the result.

However, during these times, the industry was developing some basis for understanding the modeling activity. New models supplementing uncertain data with managerial judgement were tried with some success. New interactive computer interfaces, where the manager provided data to a computer system in a form familiar to him, were being developed. And the requirement for computer priests or operations research people were reduced while making the modeling process more personal to the manager.

Problems of Implementation

In spite of the purported advantages of marketing models, Little charges that "The big problem with management science models is that managers practically never use them."(10) Often, Formal modeling is not well understood by these managers, and they lack the experience to either set up a model or use it to solve their problems. Often the models themselves are difficult to set up and use, and offer only limited information when used. Little suggests certain criteria which he believes would improve this situation. He proposes that a usable model would be "simple, robust, easy to control, adaptive, as complete as possible, and easy to communicate with." Such a model "consists of a set of numerical procedures for processing data and judgments to assist managerial decision making and so will be called a decision calculus."(10)

Decision Calculus and Information Systems

The description of this decision calculus sounds a little like "motherhood and apple pie," but with the power of the computer, it may be realizable. With the immense data storage and manipulation capabilities of the computer, numerous models, data, statistical packages, and optimization packages can all be available as useful tools. Little's decision calculus describes a system of such resources which are sometimes collected into a Marketing Information System (MIS). Various authors have commented on

how these can all be brought together in a system such as shown in FIGURE 1. (9,11,12).

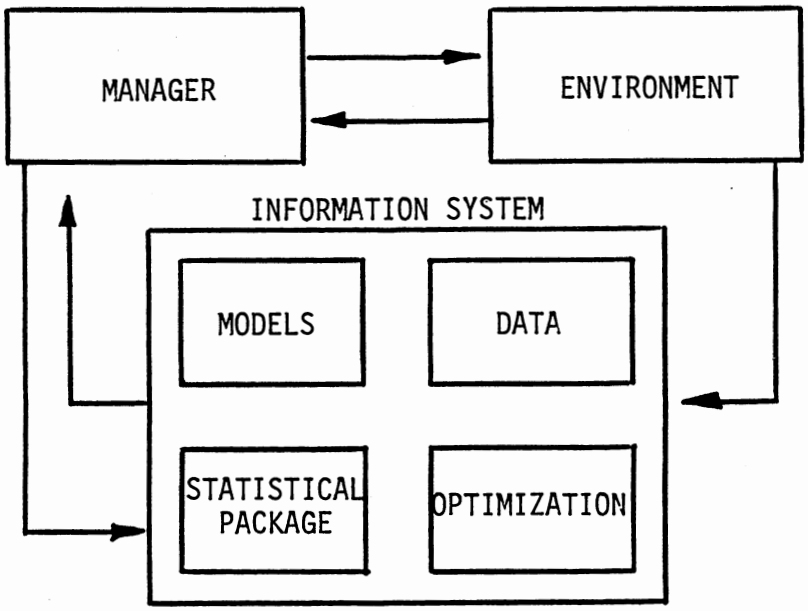


Figure 1. Marketing Information System

In this MIS, data is collected in an organized fashion from the environment, and stored in the data bank. The manager perceives events in the environment, and decides to investigate whether he can gain any advantage from these events. Using the models, statistical packages, and optimizing programs, he evaluates the data. Based on this analysis, he takes some action to affect the environment. The system with its powerful tools and available data base makes this analysis possible in a reasonable time span.

As a manager preceives changes in the environment, he can quantify these changes and evaluate their effect on his product strategy by using the models and other packages in the MIS. The results of these analyses can be used to guide

his strategy in responding to the environment. With a suitable collection of data, models and other packages, plus a proper interactive interface, the MIS becomes the decision calculus described by Little.

Using Models

An often overlooked key in such systems is the interaction with the environment. Models provide "advice," but the manager lives in a world of power struggles, an oscillating economy, goverment requirements, and other factors often impossible to model and/or quantify, yet which may be overwhelming factors in his decision.

It is these "unmodelable" factors which make a personal, interactive modeling capability essential. Such models have been studied extensively in recent years, by Aaker and Weinberg (1), Little (8-10), Montgomery (11), Montgomery and Urban (12), Montgomery and Weinberg (13), and Urban and Karash (17). As the computer and marketing community gains in experience in this mode of computing, interactive modeling will become commonplace.

Easy to use interactive models will improve one more aspect of modeling which will have a profound effect on how the models are used--managerial confidence. Unless and until a manager uses a model long enough to understand its strengths and weaknesses, he won't utilize it in his decision making. Easy to use interactive models make the analysis both personal and understood.

A final benefit of these interactive models is the ease of performing sensitivity analysis. The "what if" questions that managers need to ask when exploring alternatives can be explored through these systems, quickly and easily. Models which help managers meet their bottom line objectives in this manner will be used often.

Market Segmentation

In general, models assume a fixed environment with given parameters. In fact, markets are generally so diverse that there is no way to measure the reaction to a stimulus. To simplify the market analysis, the concept of market segmentation was developed. This concept is widely used and easily understood.

Segmentation as a view of the market was formalized by Smith in 1956 (14), and has been widely explored since (1,6,18). Basically, the idea is to subdivide an amorphus market into homogenous groups. This is normally shown as a matrix in n-dimensions. FIGUREs 2 and 3 show examples of two dimensional and three dimensional segmentation, respectively.

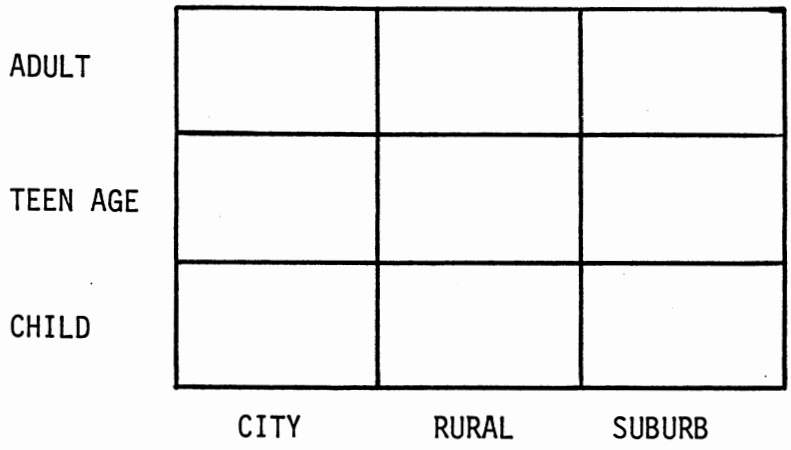


Figure 2. Soft Drink Market Segmented by Age and Environment

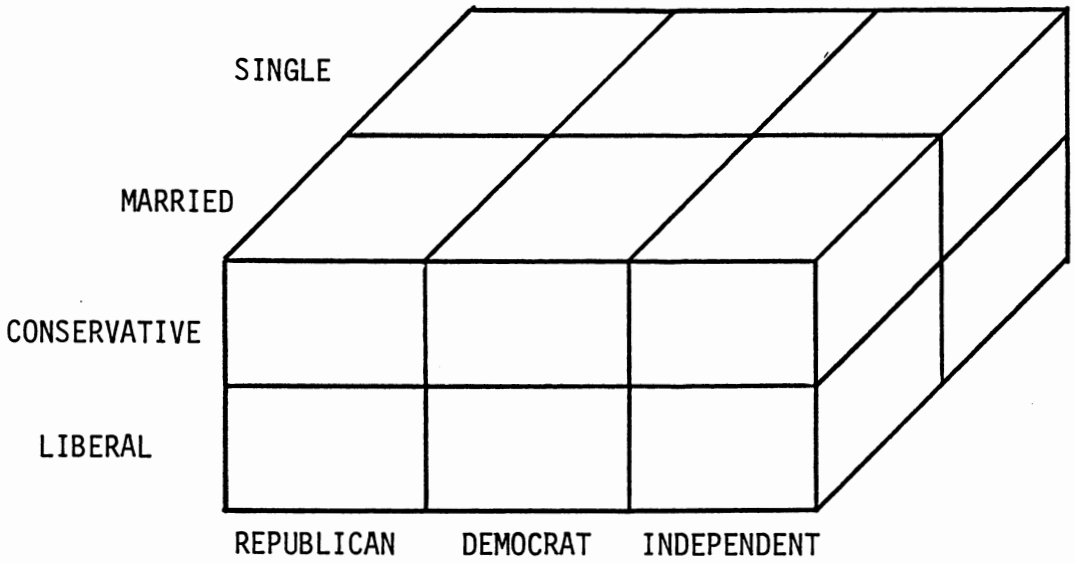


Figure 3. Potential Voter Market Segmented by Political Party Registration, Political Philosophy, and Marital Status

The object of segmentation is to create, conceptually, submarkets or cells in which "all" persons react the same to the same stimulus. That is, an "average person" can be postulated which reasonably reflects how the group will act. For instance, it might be reasonably supposed that the teenage segment for soft drinks in FIGURE 2 would react favorably to an ad featuring a teen rock group. Children would

react more favorably to an ad featuring a clown, while adults would be more attentive to an ad featuring family activities. A company can use this segmentation to plan a campaign by targeting ads to specific segments. These ads can then be run at times or in media where the appropriate segment is heavily represented.

Not all segmentation bases are equal, and choosing segments which result in homogenous cells is an art. In FIGURE 2, the segmentation of the soft drink market into age groups is probably more useful than the segmentation by environment. Likewise in FIGURE 3, the segmentation by marital status is probably not as important as segmentation by age, or perhaps by the number of children living at home, especially in an inflationary ecomony. This is an area where good managerial judgement is essential.

Although market segmentation is intuitive, and often used in an informal way (such as a manager remarking on a product "The kids'll love it!",) it is often overlooked in the formal planning process. Examples of its use to enhance profits by concentrating on profitable segments have appeared in the literature. Yet, it has been charged that "Segmentation appears to be largely an after-the-fact explanation of why a marketing program did or did not work, rather that a carefully thought-out foundation for marketing programs." (18) Segmentation has powerful implications not only for marketing strategy, but also for product and profit analysis.

Consider this example. We know that sales is a function of, among other things, the quantity and quality of advertising. That is,

$$\text{SALES} = f(\text{ADVERTISING}) \qquad (1)$$

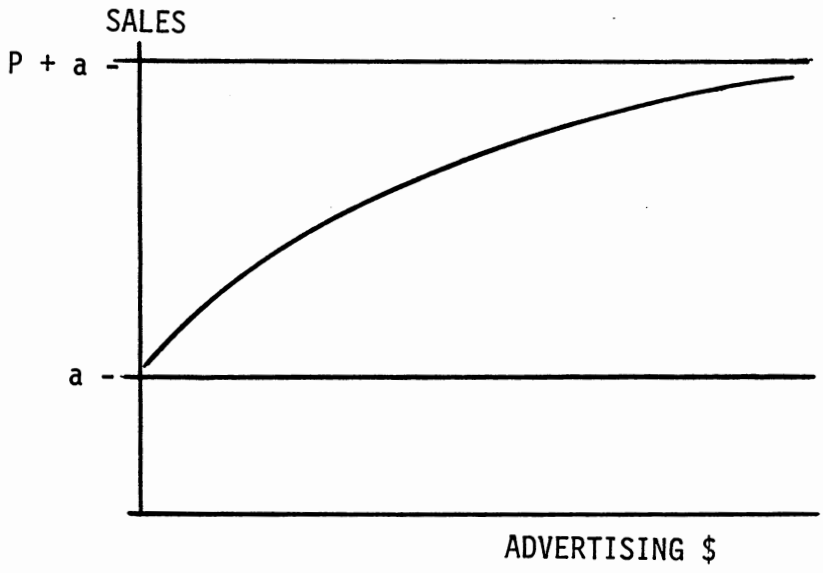
The advertising function chosen is dependent on the circumstances, but often is of the form:

$$\text{SALES} = a + P(1 - e^{-bx}) \qquad (2)$$

where

a = sales with no dollars spent on advertising,
P = a factor relating to the market size,
b = the effectiveness of the dollars spent, and
x = the amount of dollars spent.

The curve has the form:



This particular function emphasizes the declining marginal return on advertising - i. e. the first dollars are more effective than those spent later. The rate of growth is controlled by b.

If the makers of blue jeans had looked at their "market" in the mid 1950's, they would have felt that in their mature market, a was large with P being small. The conclusion is that advertising dollars would bring very little return. Emphasis would be placed on manufacturing effectiveness.

However, if the market were segmented into two parts, those who bought jeans for their toughness and wearability (workers) and those who bought jeans for their style (youngsters), a different result apears. Among the workers -the dominant force in the market at that time - the a was very large. But among youngsters, a was small! Thus advertising in the youngster segment would return a substantial sales increase by increasing P.

Today, the youngster segment of the market is substantial. A good segmentation strategy would have allowed the producer to catch this segment at its early growth stages. Because of its importance, segmentation plays a key roll in the model being developed in this report.

CHAPTER III

A DIFFERENTIAL ADVANTAGE MODEL

A model is developed below that provides a structure by which to evaluate alternative product features and their effect on a company's sales, market share and profitability. The output is of a measure of a product's differential advantage (or disadvantage) with respect to its competition. The model employs a segmentation strategy to look at the market in detail. It is deceptively simple to use, while allowing the input of managerial judgment.

Developing the Model

In a given market, gross profit is given as a product of market size, market share, and gross margin. Algebraically, this is demonstrated by:

$$PROFIT = SIZE * SHARE * MARGIN. \qquad (3)$$

Profit can increase by changes in any of the three variables in this equation.

A company can influence each component through its direct efforts. For example, it can increase market size through direct marketing development action. Likewise,

price increases or cost reductions can affect the margin. Finally, the company can increase share by correct strategy choices. This model basically concerns analyzing SHARE, although analysis of SIZE is also possible.

Buyer Evaluation

Buyer appeal is determined by how well a product satisfies felt needs. This has two aspects,

1) Strength of the buyer's needs, and
2) How well the product satisfies those needs.

Any given potential buyer possesses a set of needs that can be met by actual or perceived satisfiers that are a part of a product. These satisfiers might be price, product traits, services, etc. These satisfiers differ in importance to the buyer.

Suppose a buyer associates m satisfiers with a product, and that the importance of any given satisfier is indicated by I-j. Further, let us say that his perception of the degree to which the product i posesses that satisfier is noted by P. Then his view of the product is given by

$$M\text{-}i = \sum_{j}^{m} I\text{-}j * P\text{-}ij \qquad (4)$$

In (4), M-i is a measure of how well product i meets the potential buyer's needs. For every given buyer, if every potential product is evaluated, M-i's for that buyer provide a measure of product preferences. Thus the M-i provides a measure of a product's differential advantage (disadvantage) vis-a-vis the competition.

Establishing this measure is significant, since the seller can explore scenarios whereby he improves certain product features at some cost, or drops other features at a savings. Thus he has a quantitative measure of the value of certain features or feature groups for his product.

Choice

The raw numbers are useful in describing relative rankings for each buyer, But comparisons between specific pairs are not easy. One way to normalize these numbers for comparisons over buyers is to divide each by either the largest M-i or by a particular M-i - usually the M-i of the company doing the analysis. The new rankings are easier to conceptualize since they are basically deviations from a constant number, 1.00. Algebraically, this becomes

$$M'\text{-}i = \frac{M\text{-}i}{\underset{i}{MAX}\ (M\text{-}i)} \qquad (5)$$

for the former, and

$$M'\text{-}i = \frac{M\text{-}i}{M\text{-}a} \qquad (6)$$

for the latter (where the company chosen is company A.)

Another approach is to use information directly from the buyers. A count (C-i) could be made of how many times each M-i exceeds all others. Market share could then be determined by dividing each C-i by the total number of buyers surveyed.

Behaviorally, we could assume that the probability of purchase (P-i) is proportional to

$$P\text{-}i = \frac{M\text{-}i}{\sum_i M\text{-}i} \qquad (7)$$

for each buyer. This measure is much easier to establish since each person surveyed can provide a measure for each product. Statistical analysis on these P-i can show their reliability, deviations, etc. The P-i can also be used as market share percentages.

Another way to get market share estimates is more direct. Where the products analyzed represent a substantial share of the market, then

$$S\text{-}i = \frac{M\text{-}i}{\sum_i M\text{-}i} \qquad (8)$$

is a direct estimate of market share. Equations (7) and (8) are the same, and are used to compute market share throughout the remainder of this paper.

Profitability

This latter measure (S-i) is useful in profitability analysis. Consider that an investment in product feature improvement will be a cost and will be reflected in a change in the gross margin. Then, from equation 3, this will affect profits as

$$\text{PROFIT} = \text{SIZE} * \text{SHARE} * \text{MARGIN} \qquad (9)$$

where SHARE is determined by equations 4 and 8, after the new product features are evaluated. If the cost of improvement is considered a one time cost (X), rather than a change in margin, equation (9) becomes

$$\text{PROFIT} = \text{SIZE} * \text{SHARE} * \text{MARGIN} - X \qquad (10)$$

Nor is it necessary that features are the factors which are changed. The I-j in (4) represent perceptions of the product which are formed from advertising, sales effort, packaging, price, etc. Thus, these I-j can be effected by increased efforts in these areas - with corresponding costs. Equation (10) is useful in analyzing any of these changes.

Market Segmentation

Perhaps for each potential buyer at a given point in time in a given place and with specific circumstances, the satisfiers, their importance, and how well they are met by those products available to him can all be determined. On the other hand, estimates of all these factors can be made for the market as a whole. Unfortunately, the first is too

expensive, even if it could be done, and the latter treats the market too generally - not all satisfiers are of equal importance in the sight of all potential buyers. In any practical situation, one simply cannot deal with each and every potential buyer. Instead, an average buyer is often postulated.

This average, or composite buyer is analyzed to show his reaction to specific changes in marketing effort or product features. Unfortunately, this composite buyer does not exist in any real sense. And in markets with a reasonable variety of buyer traits, too many "minor" trends are not shown in the analysis. The ability to capitalize on changing attitudes and patterns allows the business to project market growth and decline and to position itself to take advantage of these changes. The composite is simply too gross a measure in most circumstances.

The solution is to segment the market into groups with sufficiently similar wants and needs that they can be treated as a single entry. Obviously, the groups should also be sufficiently large so that the structure is not too expensive to set up and use. Then in each cell, a computation of the rankings can be made, normalized, and used to project profits. Each cell can be treated as a complete market, and the results can be combined to give an overall analysis of the market.

Measurement

To demonstrate this technique, refer to TABLE I. Here, two dimensions by which to segment have been diagramatically shown at three levels each, and the resulting cells from this joint development of segments are numbered one to nine. Four satisfiers (numbered one to four) have been identified, and their importance (x-ij) in each cell tabulated. In addition, each company (product) has been rated (y-ik) as to how well it meets these satisfiers. Notationally, subscript i is the satisfier, j the cell, and k the company.

TABLE I

DIGRAMATIC REPRESENTATION OF RATINGS

VARIABLE 2	SEGMENT 1.1	SEGMENT 1.2	SEGMENT 1.3
SEGMENT 2.1	CELL #1	2	3
SEGMENT 2.2	4	5	6
SEGMENT 2.3	7	8	9

VARIABLE 1

	CELL					COMPANY/PRODUCT				
SATISFIER	1	2	3	...	9	1	2	3	...	n
1	x-11	x-12	x-13	...	x-19	y-11	y-12	y-13	...	y-1n
2	x-21	x-22	x-23	...	x-29	y-21	y-22	y-23	...	y-2n
3	x-31	x-32	x-33	...	x-39	y-31	y-32	y-33	...	y-3n
4	x-41	x-42	x-43	...	x-49	y-41	y-42	y-43	...	y-4n

The x-ij and y-ik might be either subjective judgments by management, or results from market surveys. The products and needs are often so diverse that this rating may well be subjective. Often the analysis is based on factors as different as apples and oranges - there is simply no exact comparison.

A company's (or product's) relative strength in a given cell can be computed as a figure of merit for that cell. From TABLE I, x-ij is the rating for the i-th satisfier by buyer's in cell j. The company-k rating on this satisfier is y-ik. Thus the figure of merit for company-k is given by:

$$M\text{-}jk = \sum_i x\text{-}ij * y\text{-}ik \qquad (11)$$

Market share (S-jk) for the company in cell-j is:

$$S\text{-}jk = \frac{\sum_i x\text{-}ij * y\text{-}ijk}{\sum_k \sum_i x\text{-}ij * y\text{-}ijk} * 100\%, \text{ or} \qquad (12)$$

$$S\text{-}jk = \frac{M\text{-}jk}{\sum_k M\text{-}jk} * 100\% \qquad (13)$$

Profitably, then, for each cell is

$$PROFIT\text{-}j = SIZE\text{-}j * SHARE\text{-}j * MARGIN, \qquad (14)$$

and overall profitability is

$$PROFIT = \sum_j PROFIT\text{-}j \qquad (15)$$

If the margin is different in each cell, then MARGIN should also be subscripted. Note that an accurate overview of the market is impossible without the SIZE-j since this weighs the product by an importance factor.

At this point, it is well to stop and fine tune the data. If the market share values do not agree with those known or estimated by management, then changes should be made to the segmentation strategies, satisfier choices, or ratings. Note that at this point, the object is to predict current market share or sales, not historical or installed base values. However, historical data may be useful in establishing the correct values for satisfiers or other ratings.

Fine tuning can take some time. It is at this step, however, that the manager works closely with the model and gains confidence in its accuracy. Hopefully, he can also begin to see how it can be used to answer questions about his market.

As the manager performs this fine tuning, he is constantly analyzing his product from the viewpoint of the potential user. Viewing the product in this light, on a normative scale, provides insight into the customers attitude toward the product.

Here also, the manager may see areas where his ratings are mere guesses. This will encourage him to look for more substantive data to support his rating in that area.

Using the Model

The segmentation allows the manager to analyse the profit in each cell, and target his effort to the most profitable cells. In addition, if he projects an opportunity in a cell or group of cells, he can evaluate the changes in profits based on the investment both in the cell and overall.

The model, once constructed, becomes a tool to evaluate market alternatives. The manager can manipulate the y-ik values to see how they affect his market share. If advertising is one of the satisfiers, he might ask "If I increase my advertising to a level comparable with the most highly rated company, how will this affect my market share in those cells where we are weakest?" If he only wishes to compete in certain cells, he can see the effect of changing satisfiers to maximize his share in those cells.

Profitability questions can also be asked. Suppose the manager measures his profitability in terms of gross margin. He establishes the size of the market in each cell, either through knowlege of the size or by estimation. In each cell, he multiplies his market share by the cell size times the gross margin. This establishes the gross profit in that cell. He can then see which are his most profitable cells, and, by summing profit in all the cells, he can establish his overall profit.

"What if" questions can now be asked about profitability in each cell, or for the market overall, simply by varying the rankings of the satisfiers. Suppose that it

costs z dollars to raise the company's rating on satisfier from 5 to 7. How does this affect profitability? The computation of the new profit level is straight forward, and after subtracting z dollars from the newly computed gross profit, he has the answer.

The manager can explore scenarios such as: If we steadly improve our ratings in satisfiers a, b, and c over the next five years, at a cost of z dollars per year, what will be our profitability in each of those years, and what will be our market share in the fifth year. With answers to these kinds of questions, he can decide where to invest in his product.

An interactive computerized version of this model which is available to the manager personally is a requirement to have the model used. The computations are straight forward, if tedious, and are easily programmed. The model is based almost entirely on managerial judgement, and needs no intermediate person to feed the computer. In fact, the main value of this model is its ability to quickly answer "what if" questions about various market segments where the manager is interested.

Building the computerized data base may require some effort, but varying the data for scenarios should be straight forward and simple. The real trick is to be able to predict the "what if" questions in order to provide a satisfactory interactive command set or menu.

CHAPTER IV

APPLICATION

This model was applied to an industrial market with three major competitors, companies A, B, and C. The market is for computer based control systems. These systems consist of sensors which provide data inputs in the form of temperature, pressure, and flow measurements, a computer with memory, various peripherals for the process operator, engineer, foreman, or manager, and a sophisticated collection of software for data gathering and analysis, logging, alarming, and conversational interaction with the users. These systems may be sold for user installation, or as a complete package including custom software and hardware -occasonally with a profit guarantee.

The market is highly competitive. Company A began with a base in application expertise, and expanded it into a product line selling total systems -software, hardware, and applications. The proportion of each of these three varies from system to system.

Company B is an old line instrument manufacturer who sells computers essentially as simply another instrument in the product line. The salesmen who sell instruments also

sell the computer, although with different technical support.

Company C has a narrow line of instruments. Like B, C sells computers as an extension of that product line.

Companies A and B have substantial financial resouces, while Company C is trying to grow. A fourth competitor has recently had cash flow problems and is currently in bankruptcy.

For potential customers, a computer system represents a sizable investment, usually requiring Vice Presidential or Presidential approval. Although often paying for themselves in less than six months, the system is difficult to sell because of this approval requirement. Thus, in addition to price being a factor in any buying decision, a lower price may enable a plant manager to authorize the purchase of the computer, making it easier to sell. Because of these potential savings, and the dependence on a single central computer, downtime is exceedingly costly. Hence, the user is concerned with the quality and reliability of the system.

First time users are often naive in understanding how a computer will improve the management of their processes. They will often purchase application expertise from the vendor in order to insure that the system will be productive immediately. However, even small plants now employ young engineers who understand the basics of computers. Thus, the customer will want to write some or all of his application software. In order to meet this requirement, and to match competitors, the vendors provide easy to use systems with

which the engineer can implement or change control strategies, logs, and graphical displays.

Thus, four satisfiers are identified. These are (1) Price, (2) Reputation (Quality), (3) Application Expertise, and (4) Product Features. The market is segmented two ways:

1. By the internal strength engineering/computing staff of the potential user, and
2. By the size of the application.

These variables and their respective segments are described in TABLE II.

TABLE II

SEGMENTATION VARIABLES AND RELATED SEGMENTS

COMPANY INTERNAL STRENGTH

Strong -- Highly trained and experienced staff of experts in both computers and applications. Mix of BS, MS, and PhD.

Medium -- Staff of engineers with exposure to computers and Application experience. Highest degree probably MS.

Weak -- One or two engineers with multiple responsibilities. Experience with one or two applications. Highest degree probably BS.

SIZE OF COMPUTER SYSTEM REQUIRED

Large -- Over 1,000 data points to be scanned and/or large matrices or data bases to analyze. Multiple uses such as time sharing common.

Medium -- from 200 to 1,000 data points to be scanned, several control programs, produces several standard reports, some non-standard reports.

Small -- From 20 to 200 points to be scanned, one or two control programs, limited reports.

FIGURE 4 shows this segmentation, and for each cell, shows the relative ratings (y-ij) of the satisfiers. Although the arrangement of the data in FIGURE 4 would be inappropriate for more complex situations, it serves to demonstrate the technique. Ratings are on a ten point scale, with ten representing the greatest importance.

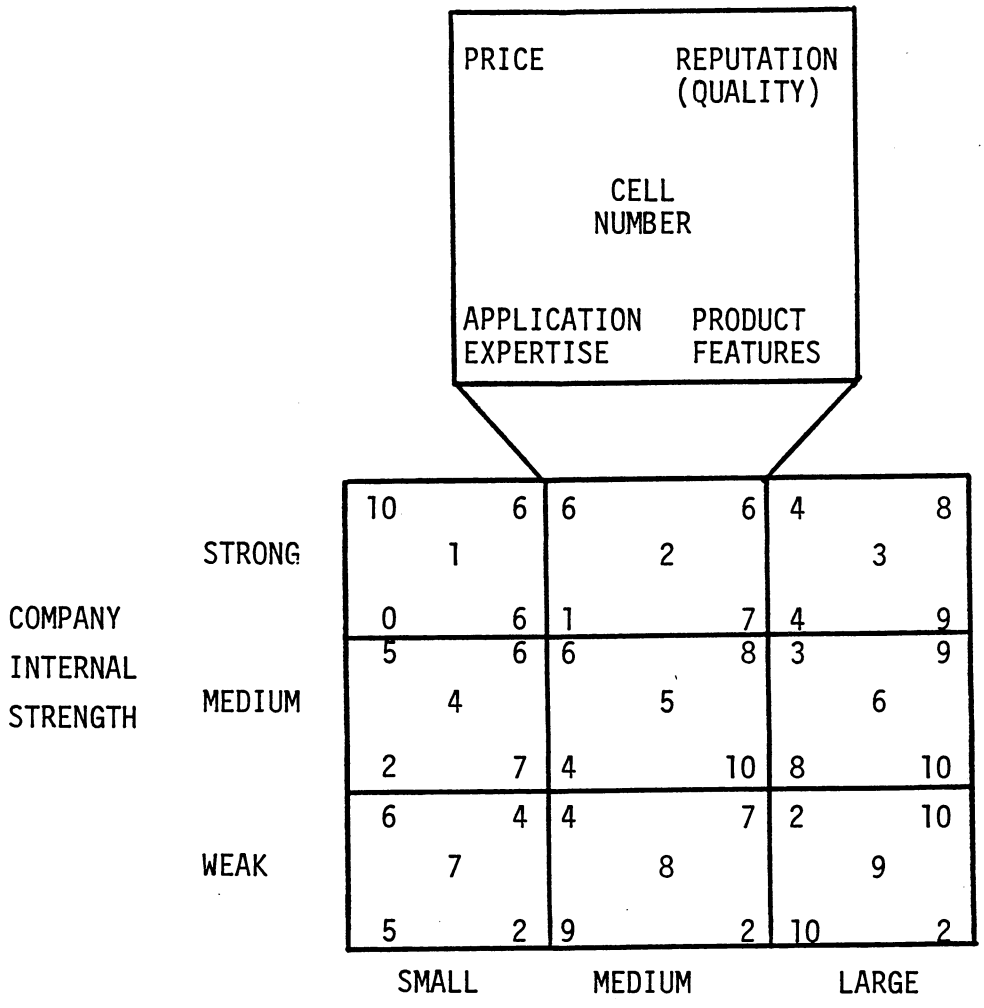


Figure 4. Market Segments and Ratings of Satisfiers in each cell

The satisfier ratings (y-ij) differ over the nine cells. For instance in cell eight, the customer has little or no internal staff and relies on the vendor for application expertise. Since he is risking a large (proportionate) amount of money, he is anxious to insure a quick payout. Hence company reputation (i. e. the quality image implies a system with high uptime) is important. Without a staff to make changes in the system, he is not overly concerned with product features -he wants a single purpose tool. Although he is concerned about cost, he is more concerned about payout and price is not a deciding factor, within some reasonable range. Thus the importance rating of the satisfiers in cell eight are:

PRICE = 4,
REPUTATION = 7,
APPLICATION EXPERTISE = 9, and
PRODUCT FEATURES = 2.

These rankings are purely subjective, but not unlike the evaluation procedure the customer may use to compare potential vendor's offerings. Since, objective data is expensive, and perhaps impossible to come by, and the number of systems sold is small for any given cell, this is the only reasonable approach to evaluating the market. A survey would generally involve a large percentage of the market, and one might just as well simply keep a score of systems bid and those sold!

However, the company (A) preforming the evaluation has a history of contacts in the market to draw upon. In addition, surveys of one type or another have been done over the

years, and thses results are used in setting the ratings. Moreover, the user will make his decision on just such subjective data, and the company is trying to view the market from his viewpoint. Gone are the days in which a computer system was rated exclusively on the speed of its memory access or adder, subjective data is often as important as objective data.

TABLE III shows how the three companies rate on these satisfiers. Companies A and B are relatively close together, while company C has a significant price advantage while trailing elsewhere. Ratings are again on a ten point scale with ten representing the greatest satisfaction.

TABLE III

RELATIVE RATING OF COMPANIES ON SATISFIERS

	COMPANY		
SATISFIER	A	B	C
1. PRICE	1	1	5
2. REPUTATION (QUALITY)	7	10	4
3. APPLICATION EXPERTISE	10	6	5
4. PRODUCT FEATURES	8	9	3

A composite market rating can be defined by summing the satisfier scores in each cell. The resulting single cell would be:

Applying equations (11) and (13) to a single cell, the relative rankings and market shares for companies A, B, and C are:

COMPANY	RATING	SHARE
A	1364	37%
B	1439	39%
C	866	24%

With just this information, Company A might be tempted to invest in improving its reputation, even at the expense of its application expertise. This would be the wrong thing to do, as we shall see in the following cell by cell analysis.

Applying equations (11) and (13) on a cell by cell basis, the relative ratings of the companies and their relative market shares are shown in TABLE IV. As expected, Companies A and B appear to have the greatest shares. However, note that company B has a 7% lead over A in cell 1, but A has achieved a 3 point advantage in cell 8, due to the relative importance of reputation in the low numbered cells and application expertise in higher numbered cells. Company C is a distant third except in cell 7 where they still trail significantly.

TABLE IV

RELATIVE RATINGS AND MARKET SHARES

	RANK			MARKET SHARE		
CELL	A	B	C	A	B	C
1	100	124	82	32	39	29
2	114	135	80	35	41	24
3	172	189	99	37	41	22
4	123	140	80	36	41	23
5	182	200	112	37	40	23
6	226	231	121	39	40	21
7	100	94	77	37	35	28
8	159	146	99	39	36	25
9	188	180	106	40	38	22

This information is far more detailed that that of the overall market or composite buyer analysis described earlier. Company A has learned that its application expertise is essential to its continued success in certain segments of the market. If company reputation is to be enhanced, it should be at the expense of some other satisfier.

Share sizes have less meaning without more attention to the segments. It is certainly true that success in small segments is less impressive than in larger segments. Let's see how this effects the analysis. The overall size of the market is $300,000,000. By segment and cell, this breaks down to the amounts shown in TABLE V. Multiplying SHARE by SIZE gives a projected sales of $111 million for company A, and $116 million for company B. The overall market shares are 37% for company A and 39% for company B. Company C trails with only 24% of the market.

TABLE V

MARKET SEGMENT AND CELL SIZES IN MILLIONS OF DOLLARS

COMPANY INTERNAL STRENGTH		SIZE OF COMPUTER	
Strong	90	Small	70
Medium	140	Medium	110
Weak	70	Large	100
TOTALS	300		300

SIZE BY CELLS

CELL	SIZE	CELL	SIZE	CELL	SIZE
1	21	2	33	3	16
4	33	5	51	6	26
7	36	8	56	9	28

TOTAL = 300

"What If"

Several changes have been recomended to improve company A's competitive position. Three of these are changes in pricing policy. Under consideration are:

1) Reduce prices to the level of Company C,

2) Reduce prices dramatically to a level where Company A would rank 10 on pricing, and

3) Employ a sliding scale, exceeding company B prices slightly for large systems, meeting company C on medium systems, and earning a rank of 10 on small systems.

These options have various marketing objectives. When Company A has gone head to head with C on small and medium systems recently, C has been winning. It is believed that proposal one will enable A to win these confrontations while holding onto or increasing its share of the remainder of the market.

Proposal two is basically learning curve based. Company A expects to drive prices down so far that they will essentially gain control of the market. With increased volume, they expect to dramatically lower costs. And at the higher volume, they expect to require a lower gross margin on sales and still retain an acceptable return on investment. And, of course, with market control comes the opportunity to raise prices as the market matures.

Proposal three is a strategy for improving volume on small systems - thus forming an efficient manufacturing base for the company - and retaining margins on the very profitable large systems.

The results of recommendations 1 and 2 will be discussed together. Table VI shows these results where the single apostrophe (e.g. A') indicates recommendation 1 and the double apostrophe (A'') is for recommendation 2.

TABLE VI

RATINGS, MARKET SHARES, AND SALES WITH RECOMMENDATIONS 1 AND 2

RATING OF COMPANY

	COMPANY			
SATISFIER	A'	B	C	A''
1. Price	5	1	5	10
2. Reputation	7	10	4	7
3. Application Expertise	10	6	5	10
4. Product Features	8	9	3	8

RANKING AND MARKET SHARE BY CELL

	RANKING				MARKET SHARE (IN PERCENT)					
CELL	A'	B	C	A''	A'	B'	C'	A''	B''	C''
1	140	124	92	190	39	35	26	47	31	23
2	138	135	80	168	39	38	23	44	35	21
4	143	140	80	168	39	39	22	43	36	21
5	192	180	104	222	40	39	22	43	36	20
6	238	231	121	253	40	39	21	42	38	20
7	124	94	77	154	42	32	26	47	29	24
8	175	146	99	195	42	35	24	44	33	23
9	196	180	106	206	41	37	22	42	37	22
TOTAL $ (IN MILLIONS)					121	111	69	131	104	65
OVERALL MARKET SHARE					40	37	23	44	35	21

As company A drops its prices, it increases its sales from $111 MM (million) to $121 MM, to $131 MM, increasing market share from 37% to 40%, and finally to 44%. Gross margins drop from 45% to 42.5% to 40%, yielding profits of $50 MM, $51 MM, and $52.4 MM respectively. Overall, Recommendation 1 projects a 2% increase in profits, while recommendation 2 projects a 4.8% increase in profits, with

just a price change, i.e., no increase in investment. Sales increase by 9% and by 18%.

Since the company currently has excess capacity, recommendation 2 appears to be advantageous. Since there is no increase in investment required, return on investment will increase.

However, this is just a short term phenomenon. By increasing market share from 2 points below the leader to 9 points above, company A can expect to increase profits over the years, since it is generally conceeded that the company with the greatest market share is the most profitable in the long run.

Sliding Scale Pricing

Under the third proposal, a sliding scale pricing policy, small systems would have a 25% margin, medium systems have a 45% margin, and large systems have a 65% margin. The new ratings, market share, etc., are shown in TABLES VII and VIII. Overall sales become $129 million, profits are $55 million, and overall gross margin is 43%.

In this analysis, it was assumed that the customer's view of the companies would change in areas other than price, somewhat due to the larger volume by company A. These changes include lower reputation for Company B and higher reputation for Company A, due to the larger volume of A's sales. People tend to associate volume with quality unless the product is considerably cheapened. Another change is the lowering in the buyer's view of B's product

features, again due to this change in volume. In large systems, A has raised prices so that both B and C can beat it in dollar amounts. A clearly intends to milk its application expertise for all it can in this segment.

TABLE VII

SLIDING SCALE PRICING POLICY RATINGS

Company Satisfier	Small			Medium			Large		
	A	B	C	A	B	C	A	B	C
1. Price	10	1	4	5	1	5	1	2	7
2. Reputation	8	9	5	8	10	4	8	9	4
3. Application Expertise	10	6	5	10	6	5	10	6	5
4. Product Features	8	8	3	8	9	3	8	9	3

CELL	COMPANY RATINGS			MARKET SHARES		
	A	B	C	A	B	C
1	196	112	88	50	28	22
2	144	135	80	40	38	22
3	180	185	107	38	39	23
4	174	127	81	46	33	21
5	214	200	112	41	38	21
6	235	225	127	40	38	22
7	158	88	75	49	27	23
8	182	146	99	43	34	23
9	198	172	110	41	36	23

TABLE VIII

SLIDING SCALE SALES, SHARES, AND PROFITS

	SALES($ MM)			SHARE (%)			PROFITS ($ MM)
	A	B	C	A	B	C	A
SMALL SYSTEM	43	26	20	48	29	22	10.75
MEDIUM SYSTEM	58	51	31	42	36	22	26.18
LARGE SYSTEM	28	26	16	40	37	23	18.20
TOTALS	129	103	67	43	34	22	55.13

The sliding scale pricing policy increases profits even further. This is in spite of lowering the gross margin by 2% from the overall current policy. The medium sized system segment produces the greatest sales and profit, while the

small system segment produces the greatest market share percent.

The current situation is very much improved for Company A over its position three years ago. At that time, A had an obsolete computer system which it was forced to sell at a mere 34% gross margin in order to be competitive. There was no net profit on this 34% gross, and the future of the product looked grim.

The system was difficult to program and operate, its operator displays were difficult to use, and the company's reputation was supported by its application expertise alone. In that environment, A could manage sales of only $82 MM and gross profits of only $28 MM per year, and both were declining sharply.

Table IX shows how the three companies were viewed by potential buyers at that time. Note that although A is high priced, only its application expertise seems to justify this. In fact, sales were low and morale was bad.

TABLE IX

POSITION OF COMPANY A THREE YEARS AGO

	COMPANY		
SATISFIER	A	B	C
1. PRICE	1	1	5
2. REPUTATION	5	10	4
3. APPLICATION EXPERTISE	10	6	5
4. PRODUCT FEATURES	1	9	3

Table X demonstrates the effect this marketing mix had on the company's ranking and market share. In some segments, share was below 20%, while Company B commanded up to

a 50% share. Even C beat A out overall by one percent, 28 to 27.

TABLE X

RELATIVE RANKINGS THREE YEARS AGO

	RANKING			MARKET SHARE (IN PERCENT)		
CELL	A	B	C	A	B	C
1	46	124	92	18	47	35
2	53	135	80	20	50	30
3	93	189	99	24	50	26
4	62	140	80	22	50	28
5	96	200	112	24	49	27
6	138	231	121	28	47	25
7	78	94	77	31	38	31
8	131	146	99	35	39	26
9	154	180	106	35	41	24

OVERALL	A	B	C	
SALES	82	135	83	($MM)
SHARE	27	45	28	(%)

With the new system introduced last year, sales increased by 35% from $82 MM to $111 MM, gross profits are up 79% from $28 MM to $50 MM, and market share climbed from 27% to 37%, a ten percent change in one year. In addition, a net profit of ten percent on current sales is yielding a $11 MM net, and the system development cost was only $3 MM.

The model has been used to show Company A its strengths and weaknesses in the market, specifically identifying strong and weak segments. It has been used to evaluate proposals intended to increase market share and profitability. And, finally, it was used to demonstrate the effect of major modifications on share and profitability.

CHAPTER V

SUMMARY AND CONCLUSIONS

While all models are of necessity incomplete representations of the real world, this model utilizes an often overlooked resource -managerial judgement. In addition, it places the manager in the position of looking at his company (or product) from the user's viewpoint. In this way, more variables are included in the analysis, although not all are explicitly stated. And although the basic model utilizes judgement almost exclusively, its application to specific sales projections provided an estimate of profitability of two specific scenarios concerning a proposed pricing policy.

The ability to perform "what if" analysis easily makes this model a powerful educational tool for the manager. It should join the model bank in the company's Marketing Information System, to be used as one of the last steps in decision making - after other models have provided the data on which the judgemental ratings can be made.

The Future

The application of this model was accomplished in an afternoon on a Texas Instruments TI-59 hand calculator. However, for a more extensive application, especially one involving three or more dimensions or 8 to 10 satisfiers, full computerization is required. The hand method is simply too tedious for a manager to utilize without frustration.

Several other additions to the model would be useful. A sensitivity analysis which would identify which cells are the most volitile would direct a manager to areas where the greatest opportunities or problems are likely to arise.

Another modification would be to provide a threshold mechanism. This feature would better represent those features which must be there for a sale to occur, but for which the strength of their implementation is of little importance.

Finally, this model assumes a somewhat linear relationship in the computations. In fact, this may be true in some limited region. However, whenever a major change occurs, such as the abrupt change of the company A price rating from one to ten, strict linearity is not necessarily the case.

CHAPTER VI

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