PRODUCTION PROGRAMMING
by
REVENUE CURVE ANALYSIS

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Abstract

Since most corporations seem to be marketing or sales oriented, they presume that the magnetic pole, called Market Share, toward which total corporate effort is directed, is also the true North Pole of optimum profit.

Accordingly, sales forecasts, quotas and plans are based on holding and increasing the share of the market.

Admitting that this may be somewhat of an over simplification, we will grant that most corporate forecasts of total market volume may well be based on sound research of available published statistical information from the most respected and reliable sources, supplemented by careful consideration of the firm's own market position, products and prospects.

Nevertheless, these forecasts of total market volume, when factored by market share to determine a firm's sales plan or objective, cannot ipso facto produce either maximum revenue or optimum profit.

We grant that share of the market can and should be an important consideration in setting corporate goals, but it must not be the sole objective.

We believe that total market forecasts and the determination of a firm's own sales plan are valid, reasonable and necessary elements of a total decision system, but they are not the whole system.

We find that many current decision theories are generally applicable only to discrete static situations, that the time required for the decision process makes them inapplicable to dynamic business conditions; and that their highly theoretical nature often defies practical application.

We have developed a procedure, based on the maximax principle[1] and the application of the principle of subsidiarity,[2] to evaluate the influences bearing on profitability and to optimize profit on a continuing basis, thus providing management with a fully systematized, immediate and rational basis for decisions under an infinite variety of factual or hypothetical situations with respect to those elements basic to the profitable operation of a manufacturing firm.

We have formulated a model by which optimization will be achieved through the development of demand curves for various products (using factual, reliable quantitative information from within the firm) and interrogating these curves for the price where profit will be maximized, taking into consideration the demand elasticity for each product, manufacturing capacity limitations and production cost factors.

The model will be able to serve the dual functions of optimizing profit in a given product mix or simulating the effect of various product mixes. By the use of parameters, various manufacturing cost curves can be shifted to permit analysis of dynamic economic factors such as wage increases or higher freight rates.

Briefly, the model simulates the interactions of product demand, production costs and capacity limitations of a manufacturing company. Designed to provide a large degree of freedom and flexibility under varying constraints and conditions, it has the capability of predicting the company's financial results as a function of the present manufacturing facilities, subject to relevant cost constraints.

The model considers production capacity, demand for various products, selling price, material costs, labor costs, freight costs, overhead expense and fixed costs to arrive at a gross profit figure.

Two types of data can be input into the model. Data describing specific products, and indices[3] which are applied to analyze the effects of across-the-board increases or decreases in the production level, or the cost factors which affect profits.

The initial phase of the model calculates the maximum profit point for each individual product. These calculations are initially performed without taking into consideration the relationships among the different products. Once the calculation for all products has been accomplished, the profit applicable to all products together is considered. If the production capacity of the plant has been exceeded, the production of the least profitable product is curtailed.

The model is heuristic to the extent that the researcher may introduce the constraints but the program will generate the optimum profit level based on the available data.

We have developed a computer program which can perform the numerous repetitive calculations required to optimize the various factors. This program was written, de-bugged and test problems were run to demonstrate the effectiveness of the model. Appropriate documentation supporting the computer program is provided, as well as the finished reports generated by the program.

For this demonstration three products actually made by a large producer have been chosen. These products are interchangeable with respect to the firm's plant capacity and have different profit ratios, cost structures, demand elasticity and market and growth potential.

Product A is a material having widespread acceptance in a major diversified industry. The company presently enjoys a comfortable share of the total market. Competition on a price basis

is very strong with little differentiation among the products of the various competitors. Opportunities for improving market penetration on a purely price basis are excellent. High material, labor and freight costs are evident,with a low profit margin.

Product B is a material having general acceptance in a large industry for somewhat restricted uses. Price competition is moderate to heavy from like products of competitors in the industry and also from adequate substitute products of other industries. Product B is characterized by low material cost, moderate labor and freight costs, and a moderate profit margin.

Product C is a material having full acceptance in a number of small industries for limited uses. Competition on a price basis is moderate from manufacturers in our industry. Little opportunity exists for penetration into other markets. Low material, labor and freight costs prevail and the product has a high profit margin.

We believe that the one-plant, three-product restriction chosen for analysis does not necessarily carry with it the limitations that one might immediately assign to it; this hypothetical situation has many counterparts in the real world. The single facility with its three products has been chosen specifically to maintain simplicity and avoid the confusion inherent to the multiplicity of products and their attendant complex interactions.

In fact, broad interchangeability applies to the firm's basic production process which has flexibility made possible within the existing equipment through changes in raw materials input. More specialized equipment is available for adding value to this basic product; it is not unreasonable to assume that this fabrication equipment also has a certain amount of interchangeability for producing the higher level products. With this in mind, the model has been designed to allow simulation within a broader framework (more capacity, more different products) than the one described in the paper.

In summary, tests conducted utilizing the model lead us to the conclusion that better management decisions can be made when subjective judgments are replaced with a more scientific approach. The probability of optimization is increased by utilizing the approach demonstrated. We believe that with modest increase in sophistication, the model can be used in actual business environment.

The complete paper (36 pages) is made of the following seven sections: Introduction, Statement of Problem and Approach to Solution, Description of the Firm and Products Simulated, Formulation of Demand Curves, Production Cost Factors and Constraints, The Computer Program, The Model in Action. Copies are available upon request.

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[1]The maximax principle for arriving at decisions under uncertainty suggests the examination of the maximum profit associated with each alternative, and then the selection of that alternative which maximizes the maximum profit. It is considered an optimistic and adventurous principle corresponding to the extreme index of optimism in the Hurwicz principle. William T. Morris. The Analysis of Management Decisions (Homewood, Ill.: Richard D. Irwin, Inc., 1964), pp. 384-385.

[2]A fundamental social principle related by His Holiness Pope John XXIII in Mater et Magistra, and applied herein to a business firm in the sense that decision makers should look first and foremost within the firm for information and expertise, and that decisions should be based on the realities of the firm.

[3]The indices are: machine capacity index, material cost index, labor cost index, freight cost index, fixed cost index, and overhead expense index. For example, an index of 1.10 will result in across-the-board increase of 10%.