project planning and management series

ACKNOWLEDGEMENT

The Project Planning and Management Series consists of a set of manuals and associated modules presenting practical approaches, tools and techniques for project planning and management. (See list on back cover). A product of the Government of Jamaica/USAID National Planning Project (1976-1980), the series was developed by the Project Development Resource Team (PDRT) of PAMCO for use in "action-training" workshops and reflects extensive experience in training and project development. All present PDRT members are contributing authors and have worked together in writing, revising and publishing the series. Special credits are due to Dr. Merlyn Kettering for design and development of the series; Dr. Bruce Brooks for writing final versions of many modules; Mrs. Marjorie Humphreys for assuming primary editing and production responsibility and for organizing draft papers into more useful materials; Mr. Lascelles Dixon, head of PDRT since 1979, for designing the cover and improving many of the illustrations; and Mrs. Christine Hinds and Miss Linette Johnson for typing the drafts and final manuscripts. Any comments on the series and its usefulness are welcome.

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March, 1980

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Published by:

The Project Analysis & Monitoring Co. Ltd. (PAMCO)
Inter-Continental Hotel, 4th Floor
Kingston, Jamaica, W.I.

MODULE 14

DEMAND ANALYSIS
Conrad Smikle

A. *PREREQUISITES:* MODULE 1 - Defining Objectives

B. *DISCUSSION:*

The first step in investigating the feasibility of a project is to estimate as accurately as possible the demand for the proposed output of that project over its entire life.

Since the output of a project may be either marketable or non-marketable goods and services, the method of estimating demand will necessarily vary with the type of project being considered.

Marketable goods constitute those products for which there is a market demand; that is, there exists a set of consumers who are willing to pay a specific price for a specified quantity of goods and services. Non-marketable goods on the other hand, are usually the output of health, education, welfare, marketing and agricultural extension projects and a market demand cannot be said to exist for these services.

The demand analysis for marketable goods will follow a market study approach involving the economic theories of demand, supply and prices and using a number of statistical tools.

The demand analysis for non-marketable goods is much less objective as the demand for these services is determined through some form of "collective" decision, usually by government on the basis of a felt need. Even in this situation, however, the demand analysis should involve those elements of the conventional marketing study which will help in the valuation of the project. In particular, this analysis should define as clearly as possible the consumers who are being served and their characteristics.

C. *PURPOSE:*

To estimate the present and future demand for project outputs.

D. USE:

To assist in determining the size of the project.

E. OUTPUT:

The output of demand analysis is an estimation of the demand for the marketable or non-marketable products or services of a project over its entire estimated life.

F. STEPS FOR CONDUCTING A DEMAND ANALYSIS FOR MARKETABLE GOODS:

Step 1. *Compilation of relavant data*

Compilation of relevant data may involve surveys, library research, observations, etc.

The data should reveal the following information:

a. who the consumers or clientele will be, e.g., income groups, religious groups, etc.;

b. how the goods or services will be used - final consumption, raw materials, etc.;

c. standards and specifications;

d. prices and costs;

   i. selling prices to wholesalers and to the final consumer;

   ii. estimates of distribution costs;

   iii. profit margins;

   iv. production costs or delivery costs;

   v. prices of competing products;

   vi. other relevant price and cost information;

e. total local production;

f. total import and/or export;

g. sources of supply;

h. economic and fiscal policies such as exchange controls, rationing exchange rates, price incentives, taxes and other policies originating in political decision.

Step 2. *Analysis of the data*

Analysis of the data will entail an analysis of the demand function as well as an analysis of the quantitative relationships deriving from the concept of elasticity of demand.

By using elasticity concept in conjunction with the data, an estimate can be made of the "true volume of demand at any given moment of time".

Many factors have an important influence on the growth of demand for consumer goods including:

a. increases in population;

b. changes in the distribution of population;

c. growth in per capita income;

d. price changes;

e. shift in pattern of consumption etc.

While all of these factors usually influence demand directly or indirectly, factors such as population growth and changes in per capita income generally have a direct and profound effect on the level and pattern of future demand.

Reliable data for measuring the impact of all major variables affecting future demand are almost never available.

Although the neglect of some factors may restrict the usefulness of demand projections, there is usually no practicable alternative to the preparation of projections on the basis of only two or three variables for which reasonably good data are obtainable.

In projecting the domestic demand for consumer goods in low income countries, the growth of population is usually considered the basic variable. And since an increase in national income is generally a major objective of development plans and programmes, the second most important factor is usually considered to be the expected increase in per capita disposable income.

As long as data on size of the population and its rate of increase are available, population presents no great problems since demand (for goods) tends to expand by the same percentage as population. The same is not true for income; as incomes rise demand tends to rise but not by the same percentage, i.e., less than proportionately.

There are different ways in which the influence of income on demand may be measured.

Step 3. *Estimation of the share of the market*

An estimate of the share of the market to be taken up by the project will be a logical outcome of the analysis of the data. This estimate is usually obtained by looking at total production, total demand as well as the external trade statistics of the given project output. Statistical tests (such as tests of hypothesis) may also be applied to the data in order to arrive at an estimate of the project's share of the market.

Simple methods of statistical estimation are not always the best, as results obtained from them are not as useful for economic analysis. However, paucity of good data makes it necessary for developing countries to settle for simple techniques.

(a) *Impact of population and income on Demand.*

A simple method of estimating the impact of increased population and income on demand for consumer goods is by the formula:

$$Y = a + bx$$

Where y is the rate of increase in demand

a is the rate of population growth

b is the income elasticity of demand for the goods

x is the rate of growth in per capita income.

Let's say a = 1.6 percent per annum

b = 0.8

x = 2 percent per annum

Then the annual rate of increase in demand would be:

$$y = 1.6 + (.8 \times 2) = 3.7\%.$$

(b) *The Income-elasticity of Demand*

The income-elasticity of demand is defined as the percentage change in quantity demanded divided by a percentage change in income. Expressed as:

$$E_i = \frac{\Delta Q}{Q} \div \frac{\Delta Y}{Y} \quad \text{where,}$$

E_i = the income elasticity

Q = original quantity demanded

ΔQ = the change in quantity demand after change in income

Y = the original per capita income

ΔY = the change in per capita income

Assuming that the present demand for a product is 200 units per month and the average monthly income is \$100, then, if an increase of 10% in per capita income is accompanied by an increase of 8% in demand then the income elasticity of demand is 0.8, thus:

$$E_i = \frac{\Delta Q}{Q} \div \frac{\Delta Y}{Y} = \frac{16}{200} \div \frac{10}{100} = \frac{.80}{.10} = 0.8$$

It follows that the elasticity of demand can be used to make a ready determination of a change in demand brought about by a known percentage change in income.

For example, if per capita income changes by 20% then the change in demand is calculated thus:

$$0.8 = \frac{\Delta Q}{200} \times 100 \div \frac{20}{1}$$

$$\text{Therefore } 0.8 = \frac{\Delta Q}{200} \times 100 \times \frac{1}{20} = \frac{\Delta Q}{40}$$

$$\text{" } \quad \Delta Q = 40 \times 0.8 = 32$$

The disadvantage of this method is that it assumes a linear relationship which may not necessarily be so.

Other simple methods of forecasting demand are:

a. average change method;

b. weighted average method;

c. regression analysis or method of Least Squares.

(c) *Average Change Method*

In this method, statistics are obtained for a known period of time and it is assumed that the average of the change for each of the years that cover this period will be reflected in the future period e.g. :

	years	consumption of sugar ('000 tons)	change
known	(1971	74.0	
	(1972	84.0	+ 10
	(1973	99.0	+ 15
	(1974	118.0	+ 19
	(1975	136.0	18
	$\overline{X} = \frac{Exi}{}$		Exi 62

$\overline{X}$ = average change = 15.5

forecasted	(1976	151.5	
	(1977	167.0	+ 15.5
	(1978	182.5	+ 15.5
	(1979	198.0	+ 15.5
	(1980	213.5	+ 15.5

The advantage of this method is the ease in calculating future trends, while the disadvantage is that it assumes a linear increase in consumption of sugar in the future from a non-linear relationship of the known quantity. It is most likely that the trend of consumption would continue to be non-linear in future years.

(d) *Weighted Average Method*

In this method, weights are given to the changes in consumption according to the importance associated with the changes. For example, in the situation shown below, the change in 1975 is regarded as being 10 times as important as the other changes, maybe because of some significant

development that took place etc.

Years	consumption of sugar ('000 tons)	change (xi)	weights (wi)	xiwi
1971	74.0			
1972	84.0	+ 10	1	10
1973	99.0	+ 15	1	15
1974	118.0	+ 19	1	19
1975	136.0	+ 18	10	180
			Ewi= 13	Exiwi =224

Average change $\bar{X} = \frac{Exiwi}{Ewi}$

$= \frac{224}{13} = 17.23$

Years	consumption of sugar ('000 tons)	change
1976	153.23	
1977	170.46	+ 17.23
1978	187.69	+ 17.23
1979	204.92	+ 17.23
1980	222.15	+ 17.23

The advantage of this method is that if there are known factors which have brought about change in consumption, the relative importance of these factors can be taken into account in forecasting future trends, while the disadvantage is that the method of applying weights is purely subjective and may be misleading.

(e) *Regression Analysis or Method of Least Squares*

This method is the most tedious of those described as it involves much more calculation. The basis behind this method is that two variables are plotted on a graph, and not necessarily giving a linear relationship, but the line of best fit can be drawn between the points to describe the linear relationship between two variables. The location on the graph of this line of best fit can be calculated as shown below in the method of regression. Take a hypothetical relationship between the two variables, number of sales outlets, and volume of sales. If this relationship was plotted on the y axis and volume of sales on the x - axis, the line of best fit could be represented by a straight line

with equation $y = a + bx$ where, a is the gradient or slope of the line, and bx is the intercept of the Y axis.

y = outlets	x = sales volume	xy	x^2
3	16	48	256
4	24	96	576
5	36	180	1,296
6	41	246	1,651
7	53	371	2,809
8	62	496	3,844
E = 33	E = 232	E = 1,437	E = 10,462

$$y = a + bx$$

$$b = \left[\frac{Exy - \frac{(ExXEy)}{n}}{Ex^2 - \frac{(Ex)^2}{n}} \right]$$

N.B. E = "sum of"

$$a = (\bar{y} - b\,\bar{x})$$

$$b = \left[\frac{1,437 - \frac{(232 \times 33)}{6}}{10,462 - \frac{53,824}{6}} \right]$$

$$= 0.11$$

$$a = 5.50 - 4.25 = 1.25$$

$$y = 1.25 + 0.11x$$

Thus for any value of number of outlets, sales volume can be determined.

Example, suppose there were 20 outlets, what would be the sales volume?

$y = a + bx$ where x = sales volume

$20 = 1.25 + 0.11x$

$x = 170.5$

This method is also applicable in the forecasting of annual data shown below:

year	consumption of coffee (mill. lbs.)			
X	X	X	Xy	X^2
1971	1	4	4	1
1972	2	9	18	4
1973	3	12	36	9
1974	4	18	72	16
1975	5	26	130	25
	E15	E69	E260	E55

$y = a + bx$

$$b = \left[\frac{Exy - \frac{(Ex)(Ey)}{n}}{Ex^2 - \frac{(Ex)^2}{n}} \right] \qquad a = (\bar{y} - b\,\bar{x})$$

$$= \left[\frac{260 - \frac{(15 \times 69)}{5}}{55 - \frac{225}{5}} \right] \qquad = 13.8 - (5.3 \times 3)$$

$= 5.3$

Forecast for years 1976 - 1980

	consumption coffee (mill. lbs.)	
	X	X
1976	6	29.7
1977	7	35.0
1978	5	40.3
1979	9	45.6
1980	10	50.9

Earlier PDRT working papers relevant to this topic include "Demand Analysis", D. Logan, 1977. (13 pages).

Project Planning and Management Series.

MANUAL - I Planning for Project Implementation
MANUAL - P Project Planning
MANUAL - M Project Management
MANUAL - PF Pioneer Farm Implementation Planning

MODULES

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6. Linear Responsibility Charts
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