CHAPTER | THREE

Demand Forecasting

PRODUCTION AND OPERATIONS MANAGEMENT

Every day managers need to make decisions not only regarding the activities carried on on a daily basis but also for what is going to happen in the future. They order inventory for the production and sales of products for the future period, purchase new machinery and equipments despite uncertainty about demand for products and make investments without knowing what would be the profits. Managers are always trying to make better estimates of what will happen in the future in the face of uncertainty.

Planning is an integral part of a manager's job. If uncertainties exist in the future planning period, it will be difficult for managers to plan effectively. **Forecasts** help managers by reducing some of the uncertainties, thereby enabling them to develop more meaningful plans. A forecast is an estimate about the future. Effective approaches to forecasting and preparing the forecasts have become integral part of business planning. Forecasts help managers to determine in the present what courses of action they will take in the future.

Forecast : A statement about the future.

Forecasting : Estimating the future demand for products/services and the resources necessary to produce these outputs.

Forecasting Defined : Forecasting is the first step in planning. It is defined as estimating the future demand for products and services and the resources necessary to produce these outputs. Estimates of the future demand for products or services are commonly referred to as **sales forecasts.** The sales forecasts or demand forecasts are the starting point for the entire planning in production and operations management. *For example,* material planning, capacity planning, manpower planning, financial planning and production scheduling, all depend on sales forecasting.

Forecasting is the art and science of predicting future events. It is not a mere guess or prediction about the future without any rational basis. It may involve taking historical data and projecting them into the future. It may include a manager's good judgement or a subjective or intuitive prediction in the absence of historical data.

Any business organisation can not afford to avoid forecasting and just wait to see what happens and then take its chances. Effective planning in both the short and the long run depends on forecast of demand for the company's products.

Uses of Forecasts : Forecasts help managers *plan the productive system* and also help them *plan the use of the system.* Planning the productive system involves **long-range plans** regarding the type of products and services to offer, what facilities and equipments to have, where to locate and the like. Planning the use of the system refers to **short-range and intermediate range planning** involving tasks such as planning inventory and workforce levels, planning purchasing and production, scheduling and budgeting.

Forecasts are also used to predict profits, revenues, costs, productivity changes, prices and availability of energy, and raw materials, interest rates, movements of key economic indicators (such as Gross National Product, inflation etc.,) and prices of stocks and bonds. But this chapter is limited in scope to the discussion of forecasting demand (i.e., forecasting of sales) eventhough the concepts and techniques apply equally well to other variables.

I NEED OF DEMAND FORECASTING

Demand forcasting is needed for:
• *New facility PLanning*
• *Production Planning*
• *Work force scheduling*
• *Financial planning*

Some reasons why forecasting is necessary in production and operations management are :

(i) **New Facility Planning :** Designing and building a new facility (factory) or designing and implementing a new production process may take as long as five years or even more. These strategic activities are based on long-range forecasts of demand for existing and new products to allow the needed lead time for production and operations managers for plant location, plant layout, installation of machinery and equipments to produce the products and services to meet the demand.

(ii) **Production Planning :** The rate of producing the products must be matched with the demand which may be fluctuating over the time period in the future. Since it may take several months to change the rate of output of the production processes, production mangers need medium or intermediate range demand forecasts to enable them to arrange for the production capacities to meet the monthly demands which are varying.

(iii) **Workforce Scheduling :** The forecasts of monthly demand may further be broken down to weekly demands and the workforce may have to be adjusted to meet these weekly demands. This may be done through reassignment of jobs to workforce, allowing overtime work, layoffs or hiring in order to match the weekly production rates with the weekly demands. Hence, short-range forecasts are needed to enable managers to have the necessary lead time to fine tune the workforce changes to meet the weekly production demands.

(iv) **Financial Planning :** Sales forecasts are the driving force in budgeting. Sales forecasts provide the timing of cash inflows (sales revenues) and also provide a basis for budgeting the requirements of cash outflow for purchasing materials, payments to employees and to meet other expenses of power and utilities etc. Hence, sales forecasts help finance manager to prepare budgets taking into consideration the cash inflows and cash outflows.

FORECASTING TIME HORIZONS

A forecast is usually classified by the *future time horizon* it covers. Accordingly, the three categories of forecasts are :

(i) **Short-range forecast :** This forecast has a time span of upto one year, but is generally less than three months. It can be even for monthly or weekly forecasts. It is used for planning purchasing, job-scheduling, workforce levels, job assignments and production levels.

Short-range forecast: Has a time span of upto one year, but usually less than 3 months.

(ii) **Medium-range forecast (or intermediate range) :** A medium range or intermediate range forecast generally spans from 3 months to 3 years. It is used in sales planning, production planning and budgeting (quarterly or yearly), cash budgeting and analysing various operating plans.

Medium-range forecast: Has a time span from 3 months to 3 years.

(iii) **Long-range forecast :** Generally 3 years or more in time span, long range forecasts are used in new product planning and development, capital expenditure planning and planning for facility location or expansion and research and development.

Long-range forecast: Has a time span of 3 years or more.

Three features which differentiate short-range forecasts from medium range and long range forecasts are :

(i) Intermediate and long-range forecasts pertain to more comprehensive issues and support management decisions (strategic and tactical decisions) regarding planning for products, plants and processes.

(ii) The forecasting methodologies used in short-term forecasting are different from those used for long-term forecasting.

(iii) Short-range forecasts tend to be more accurate than longer range forecasts because as time horizon lengthens forecast accuracy will diminish because factors influencing forecasts change everyday. *Table 3.1* illustrates characteristics of forecasts based on time horizon.

Table 3.1 : Types and characteristics of forecasts based on time horizon

Forecast Horizon	Applications	Characteristics	Forecast Methods
Long-range (3 to 5 yrs. or more)	Business planning, Product planning, Capital planning, Facility planning Location planning	Broad, general, often only qualitative	Technological, Economic, Demographic Marketing studies, Judgement
Medium or intermediate (3 months to 3 years)	Aggregate planning Capital and cash budgets, Production planning and budgeting, inventory planning and budgeting	Numerical, not necessarily at the item level. Estimate of reliability needed	Collective opinion, Time series/Regression analysis, Judgement
Short-range (1 week to 3 months)	Short run adjustment of production and personnel levels, purchasing, job scheduling, capacity changes by over time, lay offs etc.	May be at item level for planning of activity level, should be at item level for purchasing and inventory control.	Extrapolation of trends, Judgement, Exponential Smoothing

TYPES OF FORECASTS

Technological forecasts: Concerned with rates of technological progress

1. **Technological forecasts** are concerned with rates of technological progress. Technological changes will provide many companies with new products and materials to offer for sale. Even if the products remain unchanged, a new process for producing the products can be developed with a new or improved technology using new machinery and equipment.

Economic forecasts: Statements of expected future business conditions.

2. **Economic forecasts** are statements of expected future business conditions published by governmental agencies. These forecasts address the business cycle by predicting inflation rates, money supplies, housing starts and other economic indicators such as tax revenues, levels of employment, gross national product etc. These forecasts give ideas about long range and intermediate range business growth to business organisations.

Demand forecasts: Projections of demand for a company's products or services throughout some future period.

3. **Demand forecasts** are projections of demand for a company's products or services. These forecasts, also called *sales forecasts* give the expected level of demand for a company's goods or services throughout some future period and usually provide the basis for the company's planning and control decisions. These forecasts drive a company's production capacity and scheduling systems and serve as inputs to financial, marketing and human resource (manpower) planning. Economic and technological forecasting are specialised techniques which fall outside the scope of production and operations managers and hence not discussed in this book.

FEATURES COMMON TO ALL FORECASTS

Eventhough a wide variety of forecasting techniques which are quite different from each other are used to determine the demand forecasts, there are certain features which are common to all forecasting techniques. They are :

(i) Forecasting techniques generally assume that same underlying reasons (causal system) that existed in the past will continue to exist in the future.

(ii) Forecasts are rarely perfect. Actual results (demand) usually differ from forecasted results (demand) Allowances should be made for inaccuracies.

(iii) Forecasts for groups of items tend to be more accurate than forecasts for individual items.

(iv) Forecast accuracy decreases as the time period covered by the forecast (forecasting time horizon) increases.

Elements of a Good Forecast (or Requirements of a Good Forecast)

(i) The forecast should be *timely*. This means that the forecasting horizon must have the time necessary to implement possible changes in production capacity, financial needs etc.

(ii) The forecast should be *accurate* and the degree of accuracy should be known.

(iii) The forecast should be *reliable* (should be consistent in accuracy).

(iv) The forecast should be expressed in *meaningful units* such as rupees, units of products, machines and skills needed.

(v) The forecast should be in the *written form* to permit an objective basis for evaluating the forecast once the actual results are known.

(vi) The forecasting techniques should be *simple to understand and use* (comfortable for users).

I OBJECTIVES OF DEMAND FORECASTING

The objectives of demand forecasting are divided into : (i) Short-range objectives and (ii) Medium or Long range objectives.

Short Range Objectives

Short range objectives of demand forecasting are :

Short range objectives of demand forecasting:
(i) Formulation of production strategy and policy
(ii) Formulation of pricing policy
(iii) Planning and control of sales
(iv) Financial planning

(i) *Formulation of production strategy and policy :* To bridge the gap between demand and supply of a product offered by the firm and to ensure :

(a) *Estimating the requirement of materials* to be purchased on a regular basis. The material requirements are based on volume of production in a prescribed time period which in turn is based on the forecasts of demand.

(b) *Optimum utilisation of plant and equipments,* by adjusting the production capacity using overtime, subcontracting, lay offs or hiring casual employees etc.

(c) *Planning the availability of labour on a regular basis* to meet the requirement of production schedules.

(ii) *Formulation of pricing policy :* Demand forecasts enable management to formulate a suitable mechanism for fixing the prices for products to be sold.

(iii) *Planning and control of sales :* Demand forecasts facilitate territory design and determination of sales quotas to be assigned to sales people.

(iv) *Financial planning :* Demand forecasts facilitate estimating cash inflows and cash outflows for the products for which forecasts are made. Accordingly, the funds requirements can be properly planned and cost of funding can be reduced.

Medium or Long-Range Objectives

Medium or Long-Range Objectives:
(i) Long-range planning for production capacity
(ii) Labour requirements (Employment levels)
(iii) Restructuring the capital structure

(i) *Long-range planning for production capacity :* The installed capacity of the plant is usually based on long-term demand forecasts.

(ii) *Labour requirements (Employment levels) :* Employment levels are based on reliable medium/long term demand forecasts so as to optimise the cost of production over the long term planning horizon.

(iii) *Restructuring the capital structure :* Long term forecasts facilitate planning for long-term finance requirements at reasonable financial costs and other terms and conditions for obtaining finance from lending institutions as well as planning for internal financial resources to meet the long-term financial needs.

STEPS IN THE FORECASTING PROCESS

The *seven* basic steps involved in forecasting are :

(i) *Determine the purpose (objectives) of the forecast :* What are the objectives of forecasting? When the forecasts are needed? Questions such as the above are required to be answered to determine the level of details required in the forecast, the amount of resources (manpower, computer time, rupees etc.,) that can be justified and the level of accuracy needed.

(ii) *Select the items for which forecasts are needed :* Determine whether the forecast is needed for a single product or for a group of products (product line).

(iii) *Determine the time horizon for the forecast :* Is it short-term, medium-term or long-term? The forecast must indicate the time horizon and whether to develop forecasts weekly, monthly, quarterly or yearly.

(iv) *Select the forecasting model (method or technique) :* Determine whether to use statistical models (quantitative) including moving averages, exponential smoothing and regression analysis or qualitative techniques such as judgemental or market research methods (customers buying plans).

(v) *Gather and analyse the data needed for the forecast :* Before preparing the forecast, data must be gathered and analysed. Identify any assumptions that are made in conjunction with preparing and using the forecasts.

(vi) *Prepare the forecast :* Using the selected method.

(vii) *Monitor the forecast :* Monitor the forecast to determine whether it is performing satisfactorily. If not, review the method, assumptions, validity of data and modify the forecast if needed and prepare a revised forecast.

Forecasting Approaches : The two general approaches to forecasting are : *(i)* Qualitative and *(ii)* Quantitative. Qualitative methods consist mainly of subjective inputs, often of non-numerical description. Quantitative methods involve either projection of historical data or the development of association models which attempt to use *causal variables* to arrive at the forecasts.

OVERVIEW OF QUALITATIVE METHODS

1. **Jury of Executive Opinion :** It is a forecasting technique in which the opinions of a small group of high-level executives (managers) are taken, based on which a group estimate of demand is obtained as the forecast.

   Advantages :

   (i) Uses experience and knowledge of two or more managers to arrive at a single forecast.

   (ii) Can be used for technological forecasting.

   (iii) Can be used for forecasting the demand for new products.

   (iv) Can be used to modify an existing forecast to account for unusual circumstances.

   Disadvantages :

   (i) Executive opinion can be costly because it takes valuable executive time.

   (ii) It sometimes gets out of control or gets delayed.

   (iii) Difficult to obtain consensus opinion of several experts.

2. **Salesforce Composite Method :** This is also known as **"Pooled salesforce estimate"** method. Each sales person estimates what sales will be in his or her territory. These estimates are then reviewed to ensure that they are realistic. Then they are combined at the district and national level to arrive at the overall forecast.

Sidebar notes:

Qualitative methods consists mainly of subjective inputs.

Quantitative methods involve projection of historical data or development of associative models.

Jury of executive opinion method involves taking opinion of a small group of high-level managers and results in a group estimate of demand.

Salesforce composite method is based on estimate of expected sales by sales persons.