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Developed by
Industrial Promotion and Technology Branch (UNIDO)
in cooperation with the Inter-Regional Centre for Entrepreneurship
and Investment Training (EDII, Ahmedabad)

Market Analysis and Marketing



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INVESTMENT PROJECT PREPARATION AND APPRAISAL

IPPA Teaching Materials

Market Analysis and Marketing

Module 2

Developed by

Industrial Promotion and Technology Branch (UNIDO)

in cooperation with

The Inter-Regional Centre for Entrepreneurship and Investment Training
(EDII, Ahmedabad)



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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MODULE 2 – MARKET ANALYSIS AND MARKETING

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INTRODUCTION

MARKET ANALYSIS AND MARKETING

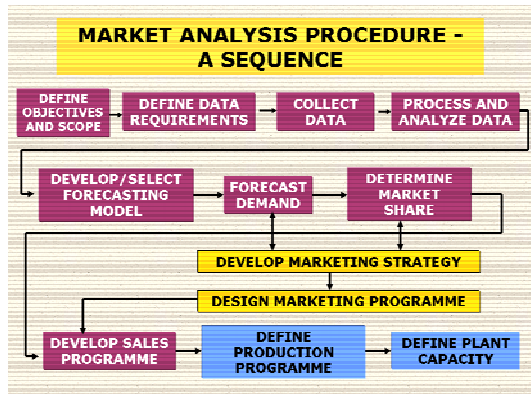


Market analysis: A fundamental requirement for an investment project is to secure clients or customers for the output (goods and services). The purpose of a market study is to clarify the nature of the product and who may be willing and able to buy it. This process involves the interplay between the product characteristics and the desire or need for its acquisition by segments of the population. What product specifications, which population segments, where they are, how numerous they are and will be in

the future, what is their willingness and capacity to purchase the product and at what price - these are the issues that are covered in a market analysis.

Marketing: After the product is defined and potential consumers identified, the issue of how to approach the market must be addressed. The project study should include an analysis of the marketing issues - what is the best way to inform clients about the product, how clients can best be convinced of its utility, how the product should be 'packaged', what would be the most favourable methods of distribution - these are the components of a marketing strategy that is an essential part of an investment project study.

MARKET ANALYSIS PROCEDURE - A SEQUENCE



The process is comprised of analysing the existing or potential market for the project's output and then developing a marketing strategy and a marketing programme to carry out the strategy.

Define objectives and scope of the market analysis: The intent of the analysis and the development of a marketing programme is to predict the sales program and the means for carrying it out. The essential feature of the study is understanding customer needs and

working out ways and means of responding to these needs. It is not enough for an entrepreneur to arrive at a "demand forecast".

In deciding on the scope the question should be answered - what is to be learned from a market study? It is useful to prioritise the objectives into essential, desirable and unimportant categories. Such decisions help to allocate time and efforts for the study.

Define data requirements: Information needs should respond directly to the scope and objectives of market study, although it should be recognized that issues of importance can be overlooked in the initial assessment; peripheral vision should always be alert to such possibilities.

Collect data: Information can be acquired from published data - i.e. secondary data. Consultation with experts or exploratory-cum-desk study is another means of gathering secondary information. Primary data is first hand information gathered directly from prospective/existing customers, competitors and trade channels in the form of surveys, test marketing (for new or innovative products) and experimentation.

Process and analyse data: After the data is gathered, it is collated, tabulated and then reviewed for consistency and accuracy. Spurious data is often expurgated, but not discarded in the event that further analysis reveals its relevance.

Develop/select forecasting model: Through either quantitative or qualitative methods a forecast of demand is required. Judgemental methods employ the knowledge and assessments of experts. Quantitative methods are based primarily on statistical tools. Compilatory models quantify links between the proposed and related activities (e.g. end use or consumption coefficients). Technological methods are based upon analysis and prediction of technological innovation.

Once a model is constructed it is evaluated to test its validity by applying it either to historical data or by testing its logic against analogous scenarios or against the consensus of experts. A model should include only those variables that are relevant. Statistical analysis, with or without software, can assist in selecting variables that are highly correlated with demand.

Forecast Demand: The appropriate forecasting methods are identified and demand forecasted based upon the selected model. This could be in the form of extrapolations on quantitative models or scenarios that emerge from the qualitative analyses.

Develop marketing strategy: Analysis of information pertaining to customer needs, competitors and the market environment leads to a set of market related decisions covering the product features, packaging, branding, product mix, pricing policies, distribution channels and the like - the marketing strategy to be employed in securing customers and delivering the product.

Determine Market Share: Market share is estimated on the basis of the demand forecast and marketing strategy adopted. For existing products, the rate at which market share can be realized will depend upon the strength and astuteness of competitors. It is generally prudent to assume a gradual build-up of market share. For innovative products, unless protected by patent or other property rights, some response by other investors should be assumed.

Design marketing programme: The marketing organization is designed to execute the marketing strategy. The means of establishing the selected channels of distribution and access to promotional media are defined. Marketing costs are then determined.

Develop sales programme: The sales forecast derives from the demand forecast and analysis of market share. The sales programme is linked to decisions on inventory policy and plant capacity. The quantity and timing of market penetration will be a function of marketing strategy in the face of competitive countermeasures for existing products. Based on the sales programme, revenues and marketing and distribution costs are estimated.

Define Production programme: Product mix, schedule and volume of production is predicated on the sales programme.

Define Plant capacity: The selection of plant capacity is linked to the marketing programme and technical factors.

MARKET ANALYSIS



Market analysis involves study of relevant information and making predictions or estimates on future demand and sales of the project output. It includes both quantitative and qualitative aspects. Quantitative estimates are inevitably linked to qualitative factors. It is particularly important to recognize that numbers derived in isolation from qualifying information are often unsupportable.

Study market environment:

Information on the market environment must be identified, collected, processed and analyzed so that the interactions of the project are understood. These interactions involve potential consumers, suppliers, competitors, government and private institutions. As an industrial project is likely to be operating in a competitive environment, the nature and extent of competition, the basis of competition, strengths and weaknesses of competitors and their possible reactions to the presence of a new entrant should be studied. Changes in consumption patterns, in consumer tastes and preferences must be anticipated. Advancements in technology that could have an impact on the market in the advent of possible substitute products need to be studied. Social changes (basically value systems) are to be studied to the extent that such changes have an impact on market prospects.

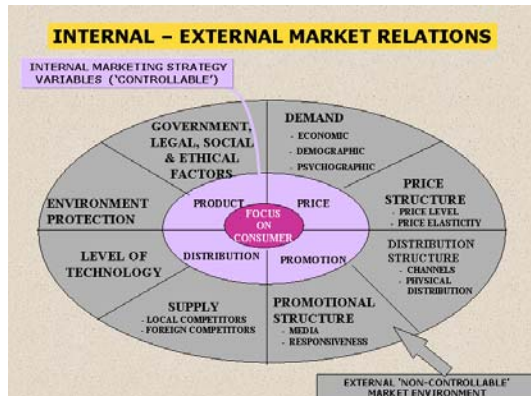
The strengths and weaknesses of competitors and their likely counter strategies, and information concerning other aspects of the project's external environment have a bearing on the project design and the marketing strategy adopted. These are only some of the environmental factors that are usually of concern. The relevant environmental influences should be identified and studied on a case by case basis.

Understand consumer needs: Understanding customer wants and needs provides vital clues on required product design and quality and ability to buy the product. Survival of any business depends on this understanding and how needs can be fulfilled. It is necessary to gather relevant data with a view to identifying the market segments, i.e. how the market is differentiated by demand for specific elements of the product line. Once the market segments are defined (even broadly), consumer needs can be more accurately understood.

Assess demand: Reliable estimates of demand for the project output and the estimated market share and rate of penetration are principle outcomes of market study.

Estimate market share: The proportion of total market to be captured by the project, and rate of market penetration are estimated. There are links to technology choice, manufacturing equipment and decision on plant capacity. The analysis of financial investment and returns depends upon revenues that will be generated from sales.

EXTERNAL - INTERNAL MARKET RELATIONS



When considering the market environment, the focus has to be on the Consumer. Those aspects of the project's market environment that relate to consumer needs and how they can be satisfied are of primary interest. The elements of the project's market environment comprise a subset of the elements of the project's internal and external environments.

EXTERNAL ENVIRONMENT:

Variables of the external environment are 'uncontrollable' only in a general sense. The strategic plan and activities are intended to deal with the characteristics of the external environment, and perhaps secondarily to stimulate changes that are conducive to the needs of the enterprise.

DEMAND

Determinants of demand are: personal income and its distribution, disposable income; demographics and cultural characteristics of population groups. This can be considered an external constraint, but often the market approach (application of internal marketing variables) can influence both the magnitude of demand and the proportion of demand captured by the enterprise.

Demand elasticity is another determinant of the marketing approach. For products with highly elastic demand (large variation in demand for a given change in price) pricing might be a potentially significant aspect of marketing.

PRICE

In almost every market there is an existing structure of prices determined by the interplay of supply and demand. The project analyst has to recognize the prevailing price structure, either accepting it or developing a price-oriented marketing approach.

In the classical view demand decreases as price increases. In real markets the issue is not so simple. For basic commodities perhaps the classical model serves, but for other products the situation is more complex. In the sale of automobiles, for example, there is great competition in serving the middle class with a fairly reliable, moderately priced product. But the competition flocks around this middle ground, making access to market share difficult. In some cases low priced transportation alternatives can offer the availability of greater market share and perhaps a greater customer base. High priced alternatives similarly are not so competitive for several reasons: the numbers are much lower, price is less of an issue (in fact, a high price is sometimes competitively advantageous), quality and skills issues are more problematic for producers.

SUPPLY

Established goods and services to be provided by the project may now be supplied by domestic producers or importers. A rational marketing approach for the project will take into account the nature of the competition. Factors to be taken into account are the volume of competitors, their market reach (geographical extent of market penetration), their approach to the market (marketing strategy and programme) and their dominance in the market. For example, if a competitor is dominant, the adoption of a penetrative pricing strategy by the project could easily fail. Quality factors, reliability, production capacities will provide clues regarding the most sensible marketing approach. The possibility of substitutes should be considered as market structures can be radically altered.

PROMOTIONAL STRUCTURE

Promotion is the means of attracting potential consumers to buy. There usually are formal (media) and informal (grapevine) structures - media, promotional strategy and promotion professionals to design and carry out the promotion strategy. Promotion is the main influence on the way that marketing variables are applied. Effectiveness of media alternatives, their access and costs should be ascertained as part of the study. In some cases there is a political or regulatory dimension of media access or constraints on promotional approaches.

GOVERNMENT, LEGAL, SOCIAL AND ETHICAL FACTORS

Through government regulations, legal structures, social norms and ethical considerations, the project is constrained in its application of marketing variables. For example, in some cases the extent of sexual innuendo or family relationships included in advertising may be circumscribed by local standards as defined by these entities. Institutions such as the World Trade Organization and trade agreements such as NAFTA and ASEAN limit strategies that can be employed. For example, in GATT of WTO there is a prohibition on the use of trade barriers.

ENVIRONMENT PROTECTION

The marketing strategy can be affected by environmental protection measures related to impacts from the use and disposal of the product. There may emission regulations and material constraints such as the use of biodegradable substances in product and packaging or recycling requirements. In some cases life cycle pricing is mandated, whereby the manufacturer retains responsibility for the product from its production through ultimate disposal. Product designs that eliminate or mitigate direct impacts (whether or not regulated) may be a way of appealing to consumers aware of environmental issues.

DISTRIBUTION STRUCTURE

Distribution comprises the system and infrastructure for moving the product from plant to consumers. For existing products there are normally well-established distribution channels. Where stages in the distribution channels are inefficient, or can reasonably be bypassed, competitive advantages can be realized and incorporated into the marketing strategy. It is worth noting that interfering with existing distribution channels should be approached cautiously. Distribution channels are often strongly institutionalized. The physical attributes of the distribution channels should also be understood: capacities and qualities of transport media and warehousing.

LEVEL OF TECHNOLOGY

Technology can be a constraint on the application of marketing variables. An established production technology often sets a quality standard that must be respected by the project analyst. Once consumers are accustomed to an advancement in product quality an entrant would not easily be able to reverse the trend. However, this is not true in all cases. For example, if there is a very large low end of the market, a pricing strategy predicated on barely acceptable quality could work.

INTERNAL VARIABLES

Internal or "controllable" variables include the four P's of Philip Kotler [Product, Promotion, Price, Place (Distribution)]. Project analysts have to determine how these variables can be applied in the marketing approach.

PRICE

Pricing decisions may be based upon the existing structure or on a price-oriented strategy. With buyer sensitivity to price increasing around the world as a consequence of 'globalization', a pricing strategy in isolation may not work.

PRODUCT

The product line can be tailored to the perceived needs of the market: whether to build bicycles for ordinary transportation, for racing or for mountain climbing has to be decided, considering the external environment.

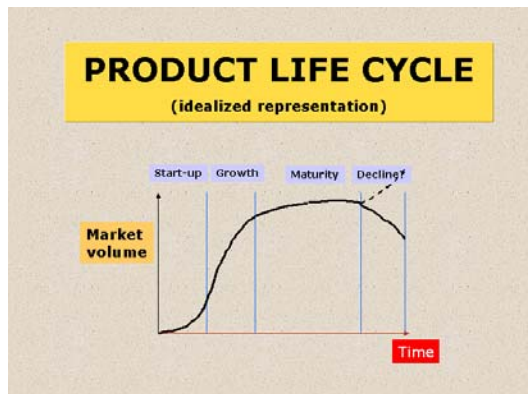
PROMOTION

Promotion decisions may be predicated on the existing external promotion structure or, if the existing structure is inadequate or otherwise unacceptable, on an alternative approach devised by the analyst.

DISTRIBUTION

The analyst may plan distribution involving existing channels based on access to consumers, pricing structure, accessibility, reliability, physical characteristics and any impacts on product quality. If the existing channels do not serve the purpose, alternative means of delivering the product to consumers may have to be devised.

PRODUCT LIFE CYCLE MODEL (PLC)



Most products traverse a life cycle comprised of phases in which the rate of growth varies widely. The usual phases are: start-up, growth, maturity and decline.

The market analyst should be aware of the phase in the Product Life Cycle (PLC) of the sector of interest because the marketing strategy has to adapt to conditions that vary in each phase: strategic objectives of the enterprise, competitive situation; structure of costs

and benefits, and specific market conditions.

At the time of entry the project's output may be in any of the typical phases of its PLC. Examples of products currently in different phases are as follows: bio-genetics (start-up); communications technology (growth); cars (maturity or saturation); and, incandescent light bulbs (decline). The phases may differ depending on whether they are viewed in the context of the world economy or the economy of a single country.

Profitability is a function of the phase in the life cycle of the sub-sector, which in turn determines the intensity of competition. Competition is most intense when the firms have to compete for slowly growing, stagnating or even shrinking sales.

Some characteristics of each phase are as follows:

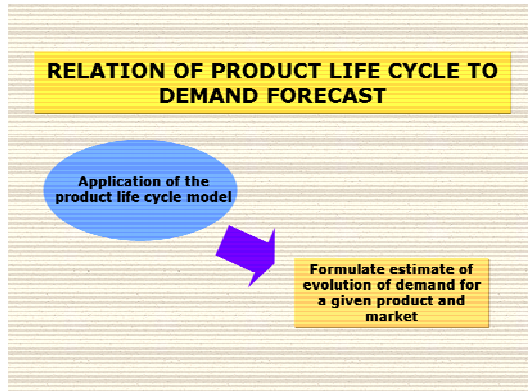
Start up: Usually a high growth oriented phase. As the product has just been introduced demand has to be created, so that there is a relatively high level of risk and uncertainty. Profitability may be high.

Growth: Demand is more established and increasing with not much competition. Profitability tends to be high. Technological development (product or process) takes place as new entrants come into the field.

Maturity: The market tends to become saturated. Profitability comes under pressure as supply exceeds demand.

Decline: Demand decreases as a result of product obsolescence. Some producers are forced out of the business as profitability shrinks.

RELATION OF PRODUCT LIFE CYCLE (PLC) TO DEMAND FORECAST



For a new entrant to the market, the Product Life Cycle can be an important component of demand forecasting.

Some of the traditional forecasting models, discussed in other sections, are predicated on assumptions relating markets to general economic trends, demographic factors or consumption patterns of linked products and services. Knowledge of where the product of interest stands in terms of the PLC can be a significant factor in adjusting these

models to demand estimates for the product and market more realistically.

PLC does not normally apply to traditional products, with national or cultural characteristics being the predominant demand factor, unless the local economy and culture is in the process of global integration or other type of upheaval.

DEMAND

DEMAND DEFINED

THE TOTAL VOLUME OF A PRODUCT (GOOD OR SERVICE) LIKELY TO BE CONSUMED

- ❖ **BY A DEFINED GROUP OF CONSUMERS**
- ❖ **IN A DEFINED GEOGRAPHICAL AREA**
- ❖ **DURING A DEFINED TIME PERIOD**
- ❖ **IN A DEFINED MARKET ENVIRONMENT**
- ❖ **UNDER A PARTICULAR MARKETING APPROACH**

Demand can be defined as the total volume of a product (good or service) likely to be consumed - by a defined group of consumers, in a defined geographical area, during a defined time period, in a defined market environment, under a particular marketing approach.

Demand is the anticipated consumption of a good or service, the total amount to be consumed in the economy or world market, as the case may be. Demand generally varies over a product's life cycle.

The likely consumption is ascertained from statistical or survey information. The relevant consumer group may be an entire population or a segment having the characteristics of potential consumers of the project output. For innovative products there may well be no historical data that is meaningful. In this case the estimates of demand would have to be derived from primary data such as surveys, test marketing, etc. or from the opinion of experts.

A geographical area should be identified that is within the reach of the marketing efforts planned by the project designers. The area may be a region of the country, the whole economy or defined export markets.

Consumption patterns may vary over time. The market study should attempt to establish the demand to end of the project planning horizon. Demand may vary with demographic changes (population size, age distribution, income distribution, etc.)

The market environment is a factor in establishing demand: the secular trend and cyclical phase of the economy, monetary and fiscal policy, trade relations, competition in the industry, etc. The general approach to the target consumer group, or marketing strategy, of enterprises currently serving this market is another factor that may enter into the determination of demand.

SEVEN ELEMENTS OF DEMAND

SEVEN ELEMENTS OF DEMAND	
PRODUCTS	PRESENT AND FUTURE APPLICATIONS
VOLUME	PHYSICAL MEASURE MONETARY VALUE
CUSTOMERS	SEGMENTS
GEOGRAPHICAL AREA	ORGANISATIONAL LIMITATION NATURE OF PRODUCT ENVIRONMENTAL LIMITATIONS
MARKET ENVIRONMENT	EXTERNAL ("UNCONTROLLABLE") VARIABLES
TIME PERIOD	TO PLANNING HORIZON
MARKETING STRATEGIES	APPROACH TO MARKETS

Product: The relevant demand for the product has to be specifically defined. It is not sufficient to find the number of bicycles, for example, that will be purchased in an economy over a period of time. The product has to be clearly identified according to existing market differentiation (say 20-speed mountain bicycles below a certain weight) or perhaps according to a product innovation to be introduced by the project. The decision depends upon how the analyst perceives the opportunity for capturing

the market segment.

Volume: Demand can be measured in terms of quantity, monetary value, or both. Volume should be determined for specific products, rather than product classes. Estimates of demand for each planning period should be determined at least to the planning horizon.

Customer group or population segment: Demand may be measured for the whole market or for various customer groups or population segments separately. For example, furniture demand may be analysed for households and for institutions (offices, shops, hotels, hospitals, etc.,) - two distinct customer groups.

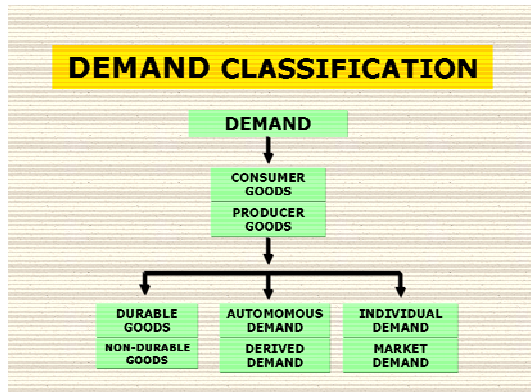
Geographical Area: Demand should be measured with reference to a well-defined geographical area. New entrepreneurs often do not have organizational resources to sell on a nation-wide scale. There are products that can be marketed only within a certain radius from the location of the manufacturing unit due to perishable nature, fragility, high transportation costs, or climatic conditions, e.g. some agricultural produce, sheet glass, bottled soft drinks.

Time Period: Demand must be forecast for a specific planning horizon. It is customary, for the purpose of a market study, to estimate demand for each period to the planning horizon.

Market Environment: Estimates of demand are predicated upon the "uncontrollable" variables of the external environment.

Marketing Strategies: Demand can be intrinsic to the needs of the population, but is at times stimulated. The specific approach to markets of existing suppliers, e.g. product quality, pricing strategies, promotional efforts and the like, is usually a demand factor. These aspects should be taken into account in estimating demand with alternative strategies conceived by the project designers as an additional factor.

DEMAND CLASSIFICATION



Demand can be determined for various classifications of goods and services. One reason for this is that trade statistics are based upon product classification. To derive accurate predictions from published data the project output must be identified with a particular classification. Another reason is the specific customer base for the various product classifications.

Consumer goods and Producer goods: Consumer goods are those that are meant for final consumption by members of

households, humans and animals, e.g. processed foods, clothing, household legal services.

Producer goods are intermediates used in the production of other goods and services, e.g. machines, factory buildings, raw materials and the like.

There is not always a clear distinction between consumer and producer goods. Application is the key to determining in which category the project output would fall. For example, mango when consumed fresh is a consumer good but when processed into juice is a producer good. The distinction helps to understand demand for a given type of good or service.

The demand for a consumer good depends on income levels of consumers whereas demand for producer goods depends on the production level of the goods for which they are inputs. Consumer and producer goods can be separated into the following categories:

Non-durable goods and Durable goods: Non-durables are goods that are consumed in the short term. Perishable goods and other types of goods with short shelf lives (e.g. cheese) are bought to satisfy current demand. Durable goods are not consumed per se; rather the purchasers avail themselves of the good's utility or functions over an extended period of time. Washing machines, televisions and refrigerators are some examples. Durable goods are 'long term' in nature and can be 'first-time' purchases or replacements. Although not consumed in the usual sense, durable goods have finite technological lives and eventually wear out. There is, therefore, a continuing cyclical demand based on the replacement market for such goods.

Autonomous demand and Derived demand: The demand for a good/service is said to be autonomous, or direct, if it is not tied to the demand for any other item. Derived or indirect demand is tied to demand of other goods. For example, the demand for fountain pens is autonomous whereas an demand for ink is derived. A closer analysis reveals that sometimes it is difficult to envisage a product whose demand is totally independent of the demand for any other product. Even fountain pens are tied to the demand for writing paper. The issue is, rather, the degree of dependency. An understanding of the degree of dependency of demand for a given product on demand for other products will help to properly forecast demand for the project's output.

Individual Demand and Market Demand: Market Demand is comprised of the demand of the individuals or other entities (consumers) within the market. If each individual within the market demands a quantity x of a product in a certain period, say a year, then the market demand for the year will be the number of entities multiplied by x . If the demand is broken down to time intervals less than a year, the consumption patterns may be non-uniform or seasonal. Longer demand variations may coincide with economic or product life cycles.

DEMAND TERMINOLOGY



Demand can be expressed in several ways, each having its particular meaning. When determining demand, or using demand information, the terms used should reflect the way that the information was derived.

Apparent consumption: This represents the consumption in a period of time, usually a calendar year, as determined from statistical information involving output of existing producers, imports, exports and change in inventory during

the period.

Effective demand: The apparent consumption does not necessarily reflect current or future demand. Effective demand is the desire to buy coupled with the ability to pay. Some potential consumers who fall into this category do not have access to the product. The current Effective Demand does not necessarily reflect the future as it may be altered by changes in the level of income of potential consumers relative to price.

Latent demand: Some potential consumers are not included in the effective demand because they either are not aware of the product or are unwilling to buy for reasons other than ability to pay. The product may be inaccessible because the infrastructure is insufficient. There may be a constraint on supply.

Unsatisfied demand: This is the difference between the Effective Demand (all consumers who are willing to buy and able to pay) and those who actually purchase the product. It is essentially the demand / supply gap.

Potential market: The current effective demand may not be a good reflection of potential for many reasons: Inadequate current promotion; quality factors; productivity and pricing of existing enterprises.

Degree of market saturation: The proportion of the effective demand that is currently served. A market that is currently saturated may not reflect prospects for a new entrant as the current effective demand may not reflect the extent of the potential market.

DETERMINANTS OF DEMAND



Population: Demographic characteristics that may influence demand are size, growth rate, the distribution of population by various categories such as age and income. Disposable income can strongly affect discretionary buying, even cultural and ethnic orientations and backgrounds. The employment level in the region of the target market will influence demand - high unemployment, even if not directly affecting targeted consumers, has a dampening effect on demand.

Macro environment: The state of the national economy influences demand. Some products, such as durable goods, are considered to be cyclical - demand follows the economic cycle. The general state of the economy - the size and rate of growth of GDP, the rate of inflation can influence short-term demand for affected items as a hedge. High savings rates tend to dampen demand for consumer goods but may stimulate demand for producer goods. Balance of payments, as it relates to exchange rates and trade, impacts upon demand for imported goods. Fiscal and monetary policies as they relate to income and taxation - may stimulate or discourage demand.

The degree of political instability is an influence, positive for some products (e.g. staples) and negative for others (e.g. luxury goods). Changing social values and mores can influence what people would like to acquire. Price is usually a strong determinant of demand, not only for the item under study but for other products and commodities.

Physical environment: Climate can affect demand for some types of products. Inclement weather patterns can adversely affect demand for recreation goods but positively influence demand for fertilizers. Enhanced alertness to environmental issues can affect demand for products that present problems of pollution or disposal. Poor transportation infrastructure can discourage demand for fragile goods.

State of linked industries: Strong demand for downstream production is a positive influence on demand.

Marketing strategy: The effectiveness of marketing strategies of existing enterprises and for the project may have a significant effect upon the size of the market. An innovative marketing strategy to be employed by the project can significantly alter the demand situation. The other factor is execution - how well the strategies are carried out.

Competitiveness: The state of competition may affect demand. The strategies utilized by the competition with regard to pricing, distribution and other marketing approaches may cause an expansion or contraction of demand. If a competitor's strategy is to offer a substitute, for example, demand may falter as a consequence.

International factors: The state and trend of trading partners' economies will affect the volume of goods being exported and imported, and therefore would have

implications for demand for the products being exported and for import substitutions. The international political situation will also affect demand. When trading partner's conditions are unstable demand tends to diminish.

Product life cycle: The position in the product life cycle can be a very important determinant of demand, as discussed previously.

DEMAND-SUPPLY RELATIONSHIP

DEMAND-SUPPLY RELATIONSHIP

- ❖ **DOMESTIC SUPPLY:**
= LOCAL PRODUCTION + IMPORTS
- ❖ **DOMESTIC DEMAND (APPARENT CONSUMPTION):**
= DOMESTIC SUPPLY - (EXPORTS ± Δ INVENTORIES)

$$C = S - (E \pm \Delta I)$$

C Apparent consumption
S Supply
E Exports
 ΔI Change in inventories

Understanding the current supply situation is necessary for assessing apparent consumption of a product that is currently offered in the market.

Domestic supply: Within a given region or country, the current supply of a product is the sum of local production and imports - this is the quantity that is apparently available for consumption. When using statistical information care should be taken that the imported product is really the same as the project output. Often

these data are aggregated and can not be directly associated with a project's output. Another caveat is to try to account for product losses - warranty services and product losses in distribution channels. The accuracy of data is another issue.

Domestic demand (apparent consumption): If statistical information is the basis for demand estimates, the relationship is as shown. The expression shows how apparent consumption, based upon statistical data, is derived. Some of the supply (see above) is used for export and for changes in inventory. Exports clearly diminish the amount available for consumption. If the change in inventory of the product is an increase, this represents an absorption that diminishes the amount apparently consumed. The reverse is true if inventory declines - this would represent product consumed from inventory.

Understanding the current supply situation is necessary for assessing demand for a product that is currently offered in the market. The gap between demand and supply indicates the ease of penetration of the existing market by the project. The higher the gap, the greater are chances of being able to effectively penetrate the market with an appropriate marketing programme.

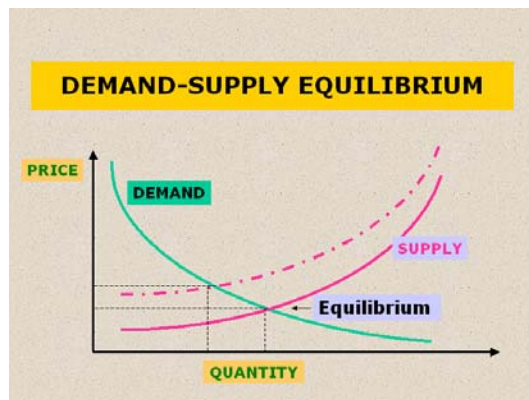
Within a given region/country, the current supply of a product is the sum of local production and imports. When using statistical information care should be taken that the imported product is really the same as the project output. Often these data are aggregated and can not directly be completely associated with a project's output.

Any changes in the import policy and the level of production of competing products affect the supply. The supply is then related to the apparent consumption, (or demand) by the following relationship:

$$\text{APPARENT CONSUMPTION} = \text{SUPPLY} - (\text{EXPORTS} + \text{INCREASE IN INVENTORIES})$$

For innovative products, either technological advances on old products or completely new products, the existing supply situation will not be very meaningful. For all practical purposes there will be no supply, and certainly no supply data. In this case estimates of the demand must be derived either from primary data or from expert assessment.

DEMAND - SUPPLY EQUILIBRIUM



In efficient markets, basically markets where information flows freely and there are no constraints that impede access of buyers and sellers, the illustration shows the equilibrium relationship for demand and supply.

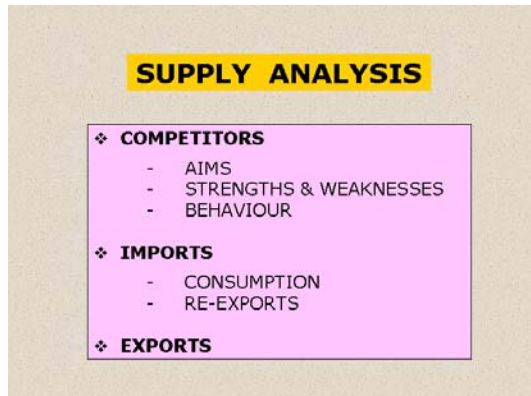
Generally demand falls with price increase - there are fewer potential consumers who are willing and able to buy as the price increases. Suppliers are encouraged to produce more as the price increases. Suppliers will presumably enter the

market with more goods so long as they can obtain the required price, essentially based upon their production costs and margin expectations. The more efficient producers will take up the last segments of the available market as their criteria are more readily satisfied. No suppliers will produce beyond the equilibrium point because the marginal cost of production is too high - consumers are not willing to pay the price.

The supply or demand situation can change. For producers, if the price of a major input increases for example, the supply curve shifts upward as shown. Then there will be a new equilibrium price and quantity at which the market will settle. The increased price will result in a lower demand equilibrium.

Markets are seldom perfect in the sense that prices reflect the equilibrium price. Some of the reasons for price distortions are the following: monopoly, oligopoly (small number of firms controlling the market), tariffs and duties, subsidies, quotas, foreign exchange controls, product differentiation (real and contrived), promotional distortions, entry barriers, official price controls. The project analyst should try to understand the extant pricing mechanisms as a means of estimating the price for the project output.

SUPPLY ANALYSIS



In the absence of the project, supply is provided in part by competitors and by imports. Some of domestic production may be diverted to exports, and thus unavailable for local consumption. Supply analysis for a product currently offered forms the basis for deciding upon the scope of products that can be absorbed by the market.

Competitors: An understanding of the status of the competition is essential for determining prospects for entering the

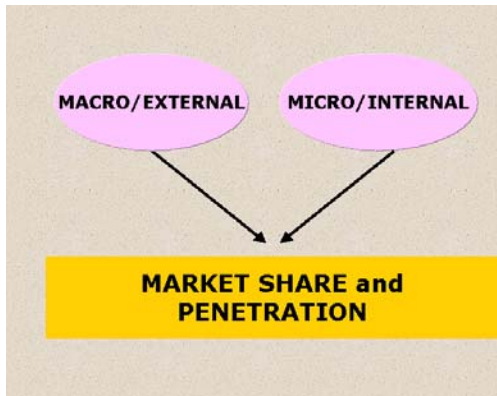
market. How supply will be affected by competitors' reactions to the presence of the project is the key issue: Counter-measures or actions that competitors are expected to take to maintain market share in the face of new competition; the way that they may employ competitive advantages such as higher productivity in the face of the project's marketing strategy; the competitors' strengths (e.g. brand recognition, well-respected product services, high productivity) and weaknesses (e.g. poor management, inadequate distribution channels, low or inconsistent product quality); how competitors use their marketing tools, i.e. the extent to which they utilize media and other marketing channels and restrict access for the project; the market segments in which they concentrate their efforts as an indication of market segments that are not presently adequately addressed.

Imports: Imports augment supply. The analyst should be aware of the proportion of domestic supply covered by imports. The distinction between imports for local consumption and for re-exports should be observed.

Exports: Exports reduce domestic supply. The relationship between domestic and international prices can have a strong influence on domestic supply as producers will seek to maximize their profits.

To complete the estimate of demand and the demand-supply gap it is necessary to gather trade statistics for the product line, imports and exports. When analyzing import statistics it is important to distinguish between imports for local consumption and for re-exports. It is also important to understand trade classifications so that the data selected is related to the output of the project. There is a need to go a step further to assess future scenarios concerning imports and exports. Such predictions can be made on analysis of historical trends in trade or expert assessment of the trade position of the country. The foreign trade policies of the government and any anticipated modifications are important information for such an analysis and have an impact on such a scenario. Thus, understanding the trends in such policies is required.

MARKET SHARE



What is market share? It is the proportion of demand that can be captured by the project through employment of its chosen marketing strategy. Penetration is the rate at which market share is secured.

The market share forms the basis for the project's sales and production program, the capacity determination and level of investment. How is market share to be predicted? It depends on a variety of factors that can only be estimated at this point. The analyst has to try to determine

the significance and effectiveness of each factor as they relate to share and penetration.

During the life of a project, both external and internal factors will influence market share. These factors, and their future trends, must be understood to provide a good estimate. If competition is strong it is prudent to be conservative. How the internal "controllable" variables are employed in formulating the marketing strategy adopted by the project in a given environment will determine market share and rate of penetration.

External Factors:

Demand: The fundamental data is the demand for the project's output. The demand may well be influenced by the planned activities of the project, and under these circumstances can not be estimated in the absence of the project. Otherwise the forecasting model can include the factors indicated below, and others if they appear to be influential in the existence or creation of demand.

Competition: The number and strength of competitors, their operational characteristics and marketing strategies, the ease of entry for a newcomer to the market, the counter-reactions of competitors to the presence of a new entrant.

General economic and other macro-level conditions can affect market share in relation to the ease of entry for a newcomer (established companies may be less affected by these phenomena).

The physical environment can influence market share if the regulatory conditions in the location of the production facilities impose additional operating costs that affect competitiveness.

The market environment, i.e. taste and preferences of consumers, availability of substitutes, availability of complementary products (competitors have already been mentioned).

Internal Factors:

The market programme of the enterprise (product features, pricing, promotional efforts and distribution system), depending upon:

- The ability to segment the market and develop a niche
- The extent to which the needs and desires of the customers are understood and fulfilled by the marketing approach and distribution system
- Production activities that affect quality, production cost and price, including choice of proper quality of inputs, use of appropriate technology and equipment, skills of managers, administrators and workers.

SEEKING GROWTH OPPORTUNITIES



In regard to the domestic market, research should attempt to ascertain the degree to which the market potential is a function of (1) product insufficiencies, (2) distribution insufficiencies and (3) insufficiencies in usage - in addition to the demand-supply gap.

Product insufficiencies: Inappropriate size of product or package, of product options, of style, of desirable features, color, shape or quality. **Solution:** Complete or improve the product line.

Insufficiencies in distribution: Coverage: The product lacks sufficient distribution in all the areas in which it is desired. Intensity: The product is presently distributed in the network, but in insufficient quantities. Exposure: The product is poorly presented in the market place. **Solution:** Improve distribution channels.

Insufficiencies in uses: Many potential consumers are not using the product. The effective consumers utilize the product only sporadically. The effective consumers utilize the product in insufficient quantities, lacking opportunities for its employment. **Solution:** Stimulate usage.

In regard to global demand, how the project intends to capture market share is mainly a function of its relative competitiveness. One approach is to try to establish a beachhead and then set up defensively. This could be accomplished by an intensive campaign to lure clients with incentives and then to try to hold on to them with superior service.

If the project's position is advantageous in regard to production cost, technology, transport cost, quality or some other market factor, a more aggressive posture might be appropriate. To define the project's relative position should be the subject of market research.

MARKET RESEARCH



MARKET RESEARCH

What is market research? Why do market research?

First, what is the market? In the broadest sense it is the setting in which the project is to approach potential consumers of the goods and services to be produced. Its significant characteristics include those of the consumers, the social and economic environment in which they function, and the existing and potential alternatives available to them to satisfy their needs, including the project under study. By this

definition a market exists for private and public sector projects, whether or not the output has a market price.

Market research consists of collecting, organizing and analyzing information concerning the setting, which has to be delimited before embarking upon the search for its characteristics. The researcher/analyst has to determine if a market can be defined at all (not certain at the outset), a dilemma that can be resolved by keeping an open mind. The purpose of market research is ultimately to identify and to understand the market so that the project can be designed to serve it.

ORGANIZING MARKET RESEARCH - HOW INFORMATION IS COLLECTED



ORGANIZING MARKET RESEARCH



HOW INFORMATION IS COLLECTED

Market research is conducted by an individual or group with a specific task - to determine the extent of the market, the potential for the project to secure clients and the most appropriate approach to the market.

The research team should have a mandate in the form of terms of reference that specify the types and quality of the information to be collected and the analyses to be performed. Data can be collected from primary sources involving surveys, tests and experiments. This is usually very reliable but costly. Whether or not primary data collection should be undertaken is a function of the degree of progress in the project's development and the degree of need for the information. As the project progresses toward an investment decision, critical information if not otherwise available may have to be obtained from primary sources.

In the early stages, there is usually sufficient information from secondary sources, published information concerning the industry and its markets and studies of similar enterprises. Tertiary information, analyses of data by experts, is also sometimes available.

Information is a key to successful launching of an investment project. It should be sought when and to the extent necessary. Trying to obtain either more information than is needed, or information of a type or precision that is premature, can be wasteful and an impediment to successful launching of the project.

INFORMATION NEEDS: AN OVERVIEW

**INFORMATION NEEDS:
AN OVERVIEW**

- ❖ **PRODUCT/SEGMENT**
- ❖ **DETERMINANTS OF EXISTING DEMAND**
- ❖ **COMPETITION AND SUPPLY**
- ❖ **EXTERNAL ENVIRONMENT**
- ❖ **INTERNATIONAL TRADE**

A market study is predicated on information gathered from both primary, secondary and tertiary sources. Whether or not to seek primary information is generally a function of the availability of accurate secondary information, the stage of project development (preliminary, advanced) and cost.

Information must be gathered in all relevant areas of a project. It is not only a question of markets, but the entire spectrum of elements comprising the external and internal environments for which information can be useful. One of the first tasks for the researcher is to decide what information is available and what is needed to fill the gaps.

Product and market segments: the good or service currently offered to the market and the particular segment(s) of the market currently being addressed.

Level of existing demand and its determinants: Information concerning existing demand and significant factors, or variables, upon which demand is dependent.

Competition and supply: The number and characteristics of other domestic producers - the production and sales quantities, qualities, pricing, distribution.

International trade: Imports and exports: Trading partners, quantities, qualities, prices, tariffs and duties, trade restrictions.

External environment: Data concerning characteristics of the environment in which the project is to function.

PRODUCT DATA

PRODUCT DATA

- ❖ **DESCRIPTION**
 - EXISTING CONFIGURATION
 - STANDARDS
 - SEGMENTS
- ❖ **CURRENT USES**
- ❖ **SUBSTITUTES & COMPLEMENTARY PRODUCTS**

Description: Data concerning characteristics of the product currently offered in the market. For innovative products the characteristics of complementary or substitute products may be relevant. Usually data is required concerning applicable material and performance standards published by authorized testing and licensing authorities. Information should be gathered relating also to characteristics of the proposed product if different from what is currently offered.

Existing configuration: Physical/chemical composition; design; colour; odour, fragrance; size; quality; packaging; brand; label; fragility; bulkiness; servicing requirements.

Standards: product classification (e.g. ISIC); material standards (e.g. domestic or international standards for composition of materials); performance standards (e.g. strength, durability standards of domestic or international testing laboratories). Current performance characteristics in relation to these standards for existing products should be collected.

Segments: Market segments for product line should be clearly identified.

Current uses: Applications of the product as it is currently offered and promoted and other uses that have been discovered by consumers or others.

Substitutes and complementary products: Identification of products that are used in conjunction with the product to be produced (e.g. farm implements for tractors) and that can be used in lieu of the proposed product (e.g. PVC pipe instead of copper pipe for water distribution).

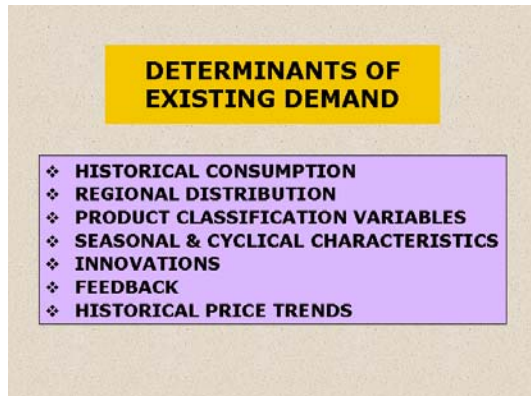
Geographic factors: Administrative regions, geographic regions, climate, city size, rural district size.

Demographics: Income; age; sex; occupation; education; family size; religion; nationality; social class; culture; life-style; leadership; ambition; conservatism; extroversion, introversion; buying motives; usage rate; brand loyalty; service sensitivity; promotional sensitivity.

Industrial markets: Number and type of users; size; ownership; age of equipment; regional concentration; vertical vs. horizontal markets, buying power, number of employees, number of plants, domestic value-added.

Agriculture: Farm income; area under cultivation; crop characteristics (type, yield, quality).

DETERMINANTS OF EXISTING DEMAND



Available data can be analysed to identify variables that are determinants of demand for the purpose of formulating demand forecasting models. Quantitative and qualitative models are possible. Which type of model is to be employed is a function of the type of industry (innovative industries would require more qualitative assessment of market potential) and the quantity and quality of available information.

The following types of information may be relevant to such an analysis.

Historical consumption (by segments): Apparent consumption may be a starting point for the estimate of future demand. Its estimate depends upon collection of statistical data on domestic production, imports, exports and inventory changes for each historical time period within the industry. If the data is available for market segments, so much the better; otherwise some method of disaggregating data will have to be determined. Some segments may be not served.

When such data is collected and analysed, the level at which demand is estimated should be clear: Apparent consumption; Effective demand; Latent demand; Market potential (see above).

If a quantitative model is to be utilized for extrapolation of demand to the planning horizon the amount of data should include a number of years that is of the same order of magnitude as the period for which extrapolations from the model will be projected.

Regional distribution: Market conditions may vary among geographical regions, e.g. demographics, climatic conditions, cultural patterns, cluster of intermediate goods producers.

Product classification variables:

Consumer goods: General economic conditions; Income (level, dynamics, distribution); Income elasticity; Price (level, dynamics); Price elasticity; Product obsolescence and fashion; Substitutes (price, availability); Complementary goods (prices, availability); Cross elasticity; Behaviour patterns; Credit; Government policies

Industrial goods: General economic conditions; Expected profit and market position; Price; Prices of substitutes; Technological progress; Number and types of users; Users' buying power; Credit; Government policies

New vs. replacement demand

Seasonal and cyclical characteristics: Product demand can be cyclical (demand fluctuates with economic cycle - e.g. consumer durables) or can vary by season (e.g. swimwear in northern climates with about 3 months of summer weather).

Innovations: Some information should be gathered concerning pending innovations in product design or applications, substitutes under development and other information relating to possible product obsolescence. Such information usually requires consultation from an expert in the field.

Feedback: If the project sponsors are currently marketing a line of products related to that of the project, it may be relatively easy to amass this information. If not, the level of satisfaction with existing brands and the level of acceptance of their attributes (why they are favoured and what would be preferred) might require a survey. When such a survey would be performed (conceptual or design stage) is a function of how critical the information is for determining the project configuration.

Historical price trends: Historical data on prices can be analysed for trend, cyclical patterns, statistical deviation and variance, averages, minima and maxima, etc. Historical data may not always be a harbinger of future trends. Extrapolations on historical price information can be very misleading if the industry is in a dynamic stage. In any case, if such data is collected the extrapolations should not be carried out for time periods much greater than the period for which such data is available. If the data covers a period of inflation prices should be adjusted by the appropriate deflator for comparison.

COMPETITION AND SUPPLY

COMPETITION AND SUPPLY

- ❖ MAJOR COMPETITORS
- ❖ CHARACTERISTICS OF COMPETITORS
- ❖ CAPACITY UTILISATION
- ❖ ADDITIONAL CAPACITY
- ❖ EXPORTS
- ❖ IMPORTS

Information concerning major competitors and the existing supply of the output of the project is used in the formulation of the forecasting model in regard to market share. For innovative products this information may relate to potential competition from enterprises with the skills and abilities to develop and market similar or substitute products.

Major competitors: Identification of the major existing or potential competitors and their market orientation (e.g. cartels, joint ventures, technical or marketing co-operations); relations with suppliers and clients (e.g. buy-back arrangements, put-or-pay or take-or-pay agreements, etc); subsidiaries or investment positions in technologically linked enterprises and their relationships to the parent enterprise.

Characteristics of competitors:

Nature of competition: Basis; Intensity; Major competitors' market shares; Marketing strategies: product features, prices, distribution channel arrangements, transportation routes and carriers used, promotional strategies, other elements of marketing strategy; Substitutes: quality, sales data, availability (regional breakdown), market responses (segment breakdown), prices.

Competitors' marketing strategies: Product (features, particular segments' preferences concerning desired product features); Price (level, dynamics, pricing policies and practices in the market, standard mark-ups, customary discounts and allowances, price competition, legislation on pricing).

Distribution channels: Number and type of intermediaries, forms of ownership, marketing tasks carried out, intermediaries' strengths and weaknesses

Physical distribution: transportation routes' carriers, costs of transportation, warehousing system and costs.

Promotion: Existing promotional media, most popular forms of promotion, susceptibility to different promotion forms (by segment), agencies, costs.


Competitors' strengths and weaknesses: Information concerning internal strengths and weaknesses of the competitor in terms of its ability to carry out its selected strategies.

Capacity utilisation: Average and cyclical utilization of plant capacity of competitors; Constraints on production (capital, infrastructure, supply, etc.).
Additional capacity: Investment activities planned by existing and potential competitors (planned ventures may be indicative of moves regarding the orientation and interests of the existing companies).

Exports: Quantities, prices, trading partners, terms of trade, trade barriers, export subsidies, foreign exchange rates (official and shadow).

Imports: Quantities, prices, trading partners, terms of trade, trade barriers, foreign exchange rates (official and shadow).

OTHER DATA for EXTERNAL ENVIRONMENT



The elements of the external market environment are discussed in Market Research. The analyst requires data concerning the external environment to deal with project interfaces and to develop an appropriate strategy.

Technology trends: Technological innovations in the pipeline from competitors and information concerning the general technological trends in the sector and related sectors that can have a bearing on the project design.

Economic trends: Status and growth rate of GDP, national income, personal income and disposable income; inflation; balance of payments and trade (foreign exchange balance and effects on exchange rates).

Government policies: Industrial policy (incentives, quotas, protection, etc.); strategic policies related to general business environment and specific to project classification; macroeconomic policies: fiscal, (liberal or conservative), monetary (tightening or relaxing), foreign trade policies: export/import financing by banking system, import quotas and other protective barriers, export/import duties, promotion facilities; entry-exit barriers to participation in sector, restrictions on foreign participation in the sector, policy on repatriation of earnings, exchange controls.

Politics & law: Nature of political process and power transitions, stability of political system, legal framework for industrial transactions, protection of intellectual property, efficiency of legal processes, degree of variability in application of laws and judicial processes, transparency, anti-trust legislation.

Socio-cultural aspects: Social and cultural norms that may impact upon the promotion and acceptability of the product in the market.

Environmental protection laws and regulations (in effect and proposed): Statutes and regulations at local, regional and national (even international) levels. The applicability and jurisdiction of legislation and regulatory agencies should be determined.

INTERNATIONAL TRADE

INTERNATIONAL TRADE

- ❖ EXPORTS, IMPORTS OF PRODUCT
- ❖ TRADE REGULATIONS, GENERAL AND COUNTRY-SPECIFIC
- ❖ SHIPPING AND HANDLING
- ❖ TRADE ORGANIZATIONS AND AGREEMENTS

Exports, imports of product: Quantities, prices, trade terms, trading partners and risks, exchange rate.

Trade regulations, general and country-specific: Quality standards, material standards, production standards, quotas, taxes and subsidies, trade restrictions.

Shipping and handling: Cost of processing, port facilities, transportation media, risk, insurance terms and costs.

Trade organizations and agreements: WTO/GATT, free-trade agreements (e.g. NAFTA), trade blocks and common markets.

This topic is more fully developed in the section "Export Market Research".

EXPORT MARKET RESEARCH

EXPORT MARKET RESEARCH

SPECIAL CONSIDERATIONS RELATED TO INTERNATIONAL TRADE

Research on export markets presents the obvious difficulty of distance. If the project sponsors are active in the importing country or region the job is simplified to some extent. The following types of data are useful for the project design when a significant part of the output is destined for export:

- For existing or related products, trade statistics are a starting point. Importing and exporting countries, trading partners, quantities and

prices are types of potentially useful information. If the product is innovative, of greater use is knowledge of the general environment - economy, culture, status of technology.

- Knowledge of domestic trade policies - the degree of export assistance offered by authorities - e.g. export financing, tariffs, subsidies, procedures.
- Trade policies of potential trading partners with regard to the product - quotas, import duties, procedures; general trade and payments balances.
- The export market - quality and safety standards, design preferences, competition from domestic producers and imports.
- International competition - the structure, strengths and weaknesses of other exporters, shipping routes and rates.
- Export distribution channels - structure, price build-up, strengths and weaknesses.
- Demand/supply gap in the importing country and its structure should be determined: what proportions of consumption is satisfied by imports and domestic production;
- Local trade representation: Trade representatives can often be contacted through the trade sections of embassies of potential trading partners. When conditions are favorable, these representatives will often facilitate import procedures and import credit.

EXPORT MARKET

EXPORT MARKET

- ❖ DETERMINANTS OF EXPORT DEMAND
- ❖ QUALITY STANDARDS
- ❖ MATERIAL AND SAFETY STANDARDS
- ❖ STRENGTH OF COMPETITORS

Determinants of export demand: The level and pace of economic development and cultural patterns affect demand. An expanding economy in the potential importing country favours prospects. Cultural patterns have to be considered when attempting to export a product unfamiliar to the population. Transportation and handling costs may be a determining factor for export potential. Analysts should seek markets in which a competitive advantage can be realized from favourable location or other factors

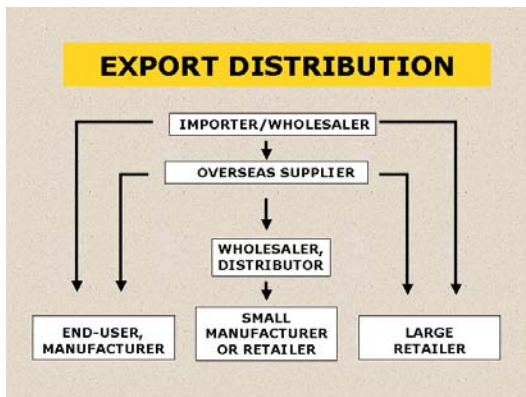
in regard to transportation routes. Transportation and handling costs can differ widely based upon the availability of transport media and the domestic price structure for handling and transport facilities.

Quality standards: Importing countries or firms may adopt quality requirements based upon their own abilities and marketing programs. The project has a great advantage if it can offer products with quality standards that exceed local standards, particularly if they are regarded unfavorably by consumers. Marketers in the importing countries often promote products on the basis of their foreign origin, particularly when local products have poor acceptance by consumers.

Material and safety standards: The product may have to adhere to international or domestic material and safety standards. These requirements may be imposed by regulation or statute in the importing country or by commonly accepted requirements of consumers.

Strength of competitors: The strengths and weaknesses of other exporters should be examined to the extent practicable.

EXPORT DISTRIBUTION



Knowledge of available and functioning distribution channels should be compiled. Understanding the export distribution system is useful for a number of project design decisions: capacity, price, quality.

Some alternative channel structures are shown:

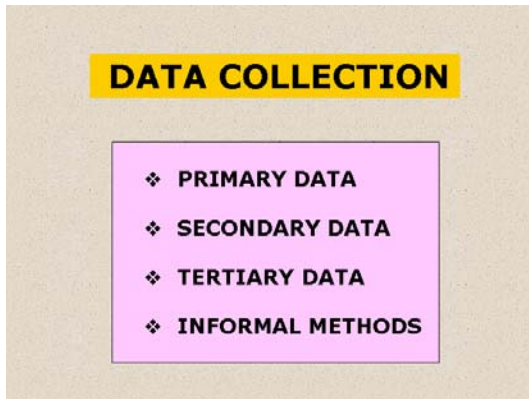
The project delivers its goods to an importer/wholesaler in the importing country. Depending upon the size of the dealer and the magnitude of its share of

the local consumer and industrial markets, the dealer may sell directly to an Original Equipment Manufacturer (OEM) or to large retail outlets or chains. If the quantities are relatively small, the channel may include a "middleman" or supplier, an agent who aggregates sales of small quantities from a number of importers.

The supplier's options are similar to the importer/wholesaler, selling either or both to OEM's and large retail organizations, or to a local wholesaler who generally deals with small producers and retailers.

Knowledge of the structure of the channels is used to estimate the price build-up from factory gate to ultimate consumer, all mark-ups and transportation and handling costs. This information is necessary to select the most advantageous channels and to determine if export is feasible. If the only channels available do not permit an adequate margin for the project, alternative markets would have to be sought.

DATA COLLECTION



Information can be obtained from primary, secondary and tertiary sources. Non-traditional sources can also provide useful information.

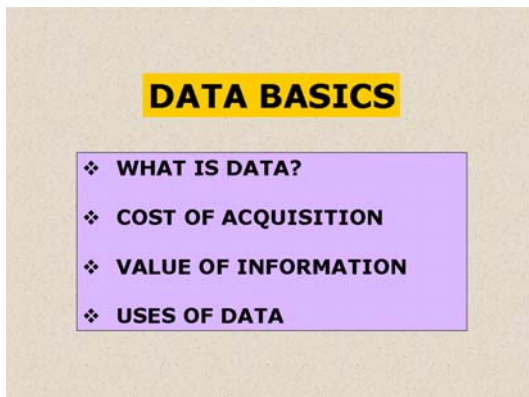
Primary information: Information that is not otherwise available and that must be collected by the sponsors from surveys, test marketing and other tests and experiments.

Secondary information: The most readily available form of information, mainly in published form but also in unpublished form.

Tertiary information in the form of analyses or opinions can be obtained from journals and other publications concerned with general economic conditions, with the business environment or with the industrial sub-sector of interest..

Informal information can be obtained from discussions with knowledgeable persons such as others involved in the industry or similar business, officers and members of trade and industry associations, and members of the business community such as bankers and brokers; and from observing phenomena in the industry, e.g. activities of competitors, traders and brokers.

DATA BASICS



What is data? Data is coherent information. In the context of project planning it pertains to the industry, the enterprise and its external environment that is relevant to project analysis. Data is gathered from sources that generally become less accessible and more costly as the project idea progresses from conception toward an investment decision.

Cost of acquisition: Acquiring any information has a cost that should be consistent with its value for the project.

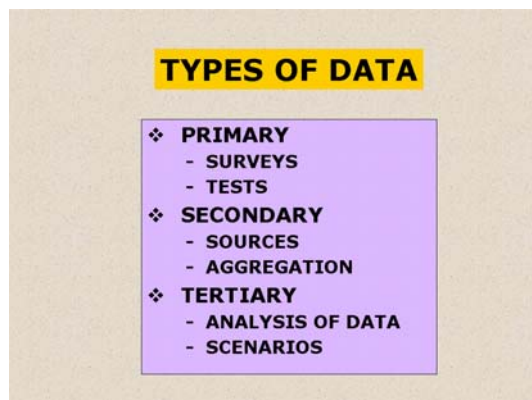
The analyst has to decide on the accuracy of information required at each stage of project development. In the conceptual stage the costs should be low as the commitment to the project is tentative. As the project nears the decision stage, more resources may have to be expended on the acquisition of information with the level of detail and accuracy upon which a sound investment decision can be made.

Value of information: The value of information depends on how it is used. An expensive survey or test marketing effort may provide a lot of information, but if it

does not illuminate the prospects for market acceptance of the product it is not very valuable. A measure of the value of data is the level of understanding of the user: being attuned to assimilating the information or message and relating it to the issues of concern to the investor or analyst.

Uses of data: Data is the information that is the basis for analysis of markets and other project features. Design of a marketing strategy, for example, requires information concerning the demand/supply balance for the project's output. Aggregate data from trade statistics may not segment the market sufficiently to provide good demand/supply information. Data can be used or abused. The project analyst needs to screen all information to be assured of its accuracy and objectivity. The analyst should be circumspect concerning data from potential technology and equipment suppliers, sales agents and suppliers, which might be biased to favour their interests.

TYPES OF DATA



Data may be found in the form of basic, undisturbed information from tests, surveys and experiments. It may be in processed form, organized into statistical distributions, tabulations or graphical displays. Here there should be some concern for filtered or expurgated data that may have been erroneously considered irrelevant by the compiler. Data may also be found in the form of forecasts or extrapolations of basic and processed information. It may also be in the form of decisions taken on the basis of

the analysis of data and the forecasts or extrapolations.

Primary data from surveys, experiments and tests (i.e. factual information) is usually generated with a specific goal in mind, in contrast with the data acquired in 'pure' scientific investigations. This is an expensive way to gather information, justified if it can be put to good use.

Secondary data, statistics and other processed information from surveys, tests and other sources, both published and unpublished, is often too aggregated for use in a feasibility study, but generally inexpensive. Even a basic commodity, such as raw coffee, is divided into several sub-products by the trade: Arabica and Robusta with more than 25 commercial varieties; cherry, pulped beans, green bean, wet processed/semi-wet processed/dry processed/washed and cleaned, etc. Consumer goods markets are segmented even more: "Toys" include "dolls" as its largest sub-group, "adult games" and many other sub-groups. Secondary data is sometimes subject to political or economic objectives of the publisher.

Tertiary data, conclusions by "experts" based on assumptions and theories related to primary and secondary data, is obtained from publications or directly from the analyst. Some tertiary data is in the form of futuristic scenarios that may refer to primary or secondary data obliquely or not at all. The user of tertiary data should be circumspect regarding conclusions and the underlying economic hypotheses from which they are drawn.

SECONDARY DATA

Published and unpublished: Data is collected and analyzed by secondary sources, which can be accessed in publications and from researchers.

Magazines, journals, reports: Data can be found in periodicals, research publications, project reports and profiles.

Trade statistics: Most countries publish statistics concerning their production, exports and imports and inventories. Data collected by government agencies is often not published but is available to the ardent researcher.

Census data: Demographic information can be obtained from census reports published by governments and private organizations.

Trade organizations: Organizations such as WTO and GATT publish data on international trade that is very comprehensive.

International development organizations: World Bank, IMF, UNIDO, UNDP are some of the sources of valuable information.

Analysts should be conscious of the possibility of imperfect authenticity in secondary data. Biases of the publisher may influence the data's accuracy.

PRIMARY DATA COLLECTION MECHANISM

Informal: Some primary data is obtained by informal means from individuals and groups involved in production, consumption or distribution of the product.

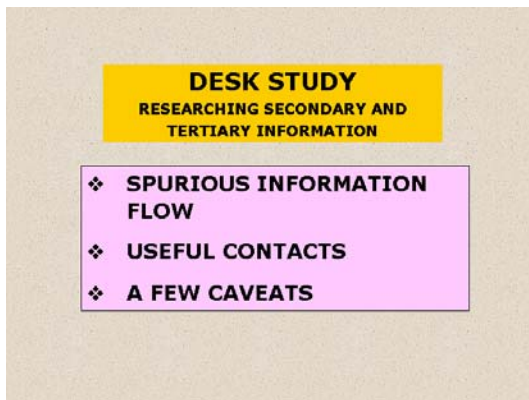
- Discussions with knowledgeable persons: bankers, industry association officers, senior entrepreneurs, officers and members of trade organizations, e.g. Chambers of Commerce, Rotary Club.
- Discussions with potential consumers, traders and managers of similar businesses (may be potential competitors).
- Observing competitors and traders in action.

Survey: This is an expensive and time consuming way of amassing data, but often is the most reliable way of assessing the market. Surveys must be designed to gather the desired data, a field staff trained to execute the surveys and the data must then be collected, organized and analysed.

Test marketing: The market is approached on a limited scale to understand consumer reaction to the product, their tastes and preferences.

Experiments: These are tests that examine consumer reaction to one or more "treatments" that are compared with reactions of a control group that does not receive the "treatments". A treatment, for example, can consist of subjecting a group to a promotional device and then measuring their response to a product or product features. Some tests are performed to assess consumer reactions to competitor products as an indication of design features that would provide a competitive edge. Experiments can also be performed to gather information on product features without regard to consumer reactions, e.g reliability (failure rate) tests.

DESK STUDY - RESEARCHING SECONDARY AND TERTIARY INFORMATION



Spurious information flow: Not all information flows conveniently. Often information is obtained without a sequential logic. At some point a comprehensive picture should emerge (it may occur suddenly). If it does not, the project is not really ready for implementation.

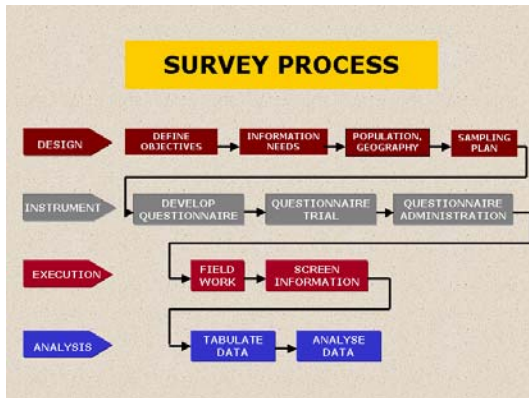
Useful contacts: A good 'feel' for conditions in the sub-sector can be obtained by discussions with knowledgeable persons and organizations,

some of which are as follows:

- Trade Associations, Chambers of Commerce and Industry
- Trade channels of competing brands
- Regulatory authorities (e.g. Food and Drug Administration)
- Commercial tax authorities
- Consulates, commercial departments of foreign embassies.
- Customs authorities.
- Official in development and commercial banks.
- Officials in industry-promotion agencies of government
- Consultants, technical experts

A few caveats: Some information is biased by the producer to either promote its own interests or to mislead authorities. In the process of eliciting information from knowledgeable persons, the analyst should be wary of motivated responses. For example, industrial equipment and process suppliers often present a rosy picture of market prospects for the product manufactured from equipment that they supply. They often produce data on costs of production that can only be attained under ideal laboratory-like conditions, and certainly not in the working environment. Trade statistics can be distorted both by traders and governments for their own economic or political purposes.

SURVEY PROCESS



A survey is a systematic and extensive exercise meant to gather information on issues relating to the market characteristics and marketing plan. The process of collection tends to be comparatively structured, aiming at a wider coverage but leaving aside factual information already that may have been collected by exploratory-cum-desk study. It is normally carried out among consumers of competing brands, adjacent-market consumers, potential consumers and intermediaries

(wholesales/distributors). The process is as follows:

Design of the survey

Determine survey objectives: Identify what is to be learned from the survey. This can be expressed in behavioral and quantitative terms.

Determine information needs: What data is required to satisfy the informational objectives, i.e., data concerning what variables of consumer behavior are necessary for understanding their reactions to the product.

Population and geographical coverage: Identifying all individuals/ institutions/ firms/ establishments from whom information is to be collected (the 'population'). For example: Population (women 18-50), sample unit (individuals), geographical reach (Bangalore), time (between 1 January and 30 June, 2xxx)

Sampling plan: As sampling of an entire population is expensive and time-consuming, it is necessary to draw a sample, i.e., only some elements from the population. The sample must be chosen so that the responses are statistically valid.

Survey instrument - Questionnaire design

Develop questionnaire: This involves converting information needs into concise, well-conceived and logical questions. The questionnaire design calls for specific skills. A questionnaire may be structured (possible responses to most questions may have been anticipated and provided in the questionnaire) or unstructured (open-ended questions).

Questionnaire trial: It is useful to try out the questionnaire among a few respondents. This brings to light issues omitted (if any), redundant questions, unanticipated responses or lack of clarity on issues raised. Based on experience of this trial, the questionnaire may be revised.

Select questionnaire administration methods: Two popular methods are mailing and personal administration. Mailed questionnaires generally elicit a low response. It is sometimes unrepresentative since there is no control over who responds and who does not. The personal administration method involves face-to-face interaction (at times, over the telephone) between the respondent and the interviewer. Another approach is to mail the questionnaires and await responses, which are then

selectively followed-up with personal interviews. This helps reduce the cost of personal administration.

Survey Execution

Field work, information gathering: This involves such tasks as recruitment, training and orientation of investigators, distribution of work among investigators, preparing copies of questionnaires and sending advance notice to prospective respondents. The actual survey involves the process of mailing and receiving completed questionnaires, or alternatively, investigators carrying out personal interviews, according to a sample plan. The need for supervision arises if the information is to be gathered by some one other than the entrepreneur. This is meant to ensure that questionnaire administration work is carried out well. The supervisor calls upon a fixed proportion of respondents who have already been interviewed

Screening of questionnaires: Incomplete questionnaires and those containing contradictory responses must be screened out. Care must be exercised so that biases are not introduced in the sample.

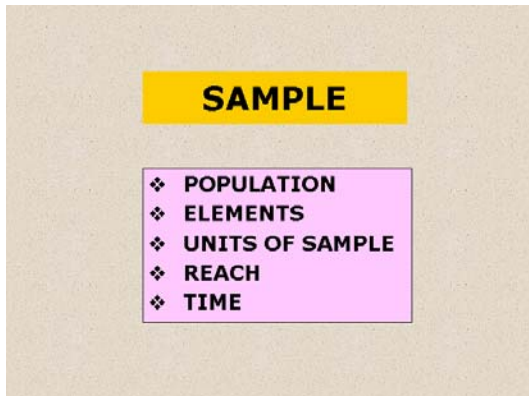
Data analysis

Tabulation: The starting point for tabulating the responses is to list the nature of possible conclusions that can be drawn from the primary data collection exercise. Questions pertaining to each conclusion are identified and responses to such questions then consolidated in a tabular form.

Analysis: After the information is tabulated, a variety of statistical tools can be applied to the data, from simple averages to more complex processes of regression or analysis of variance. Simplicity is desirable for analysing qualitative aspects, such as consumer tastes and preferences or competitors' strengths and weaknesses. When information on determinants of demand are collected, regression analysis or analysis of variance can be used to develop models relating demand to independent variables.

Analysis should be oriented to the objectives of the survey. If the analysis of the data appears to be inconclusive in regard to original survey objectives, an alternative hypothesis may require a new survey rather than attempting to formulate a model for which the survey was not intended.

SAMPLE



The sample should be clearly specified in terms of the following variables:

Population: The set from which the sample will be drawn. The population can consist of individuals, households, enterprises or any other group that can be clearly defined. All possible respondents constitute the 'Population' from which the information is to be collected.

Element: Each member of the set comprising the population is an 'Element'.

A sample is a group of elements selected from the population. An element can be an individual, a household, an enterprise or other organization. The number of elements in a sample is usually less than the entire population because it is expensive and time-consuming to gather information from all of the elements.

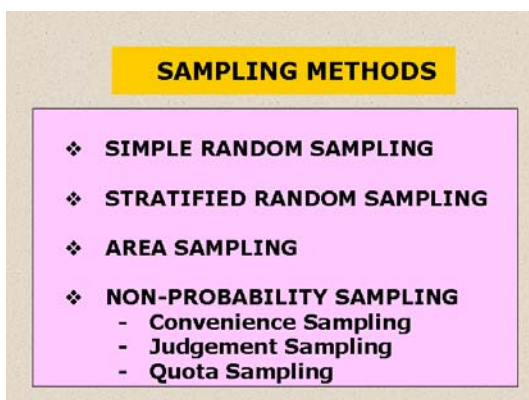
Unit of the sample: The basic unit of measurement should be specified. This could be an individual or a group. For example, if households are to be surveyed, the unit could be an entire household unit responding simultaneously, head of household, or the member(s) of households defined in any other way.

Reach: The sample is drawn from a population or population segment that is located in a certain geographical area.

Time: The characteristics of the population may vary over time, so in defining the sample, the time during which the elements are observed must be noted.

EXAMPLE: Sample for an industrial chemical product: Population - Chemical companies; Element - Chemical engineering department; Unit - Chemical engineer working for company with a capitalization more than \$x million; Reach - Bahia, Brazil; Time - Between 1/1/2xxx and 31/3/2xxx.

SAMPLING METHODS



Simple Random Sampling: All elements in the population are listed in seriatum and a pre-determined number of elements are picked at random. Each element in the population has an equal chance of being represented in the sample. Once each element has been assigned a serial number, a standard random number table can be used to choose the sample. Such standard tables are available in print form or can be generated electronically using appropriate software.

This system could be utilized when the population is homogenous and the list of all elements in the population is available. However, when the population is heterogeneous, use of this technique could lead to distorted conclusions.

Stratified Random Sampling: It is usual for the population to contain different classes of elements or sub-groups. Under such circumstances, it will be useful to divide the population into such distinct groups or strata. An equal number of elements from each strata can then be selected so that the sample is representative. This approach is widely practiced while carrying out market assessment exercises. This technique is useful when all the elements in the population are known and when the population is divided into distinct subgroups.

Area Sampling: Random sampling - whether stratified or not - presupposes availability of a complete list of elements in the population. Producing such a list can be cumbersome. A practical approach would then be to divide the population into mutually exclusive groups such as, towns or apartment blocks in a given town. Subsequently, a given number of groups or clusters are chosen randomly. Within such chosen groups, the entire population is covered. For example, a Market Analyst wanting to study the market for Home Computers in a given city could use a city map to divide it into blocks. Suppose there are 20 blocks, a pre-determined number of blocks could be chosen randomly. Subsequently, all the elements in the chosen blocks are to be interviewed. Such a method pre-supposes that individual blocks or clusters are representatives of the population as a whole.

Non Probability Sampling:

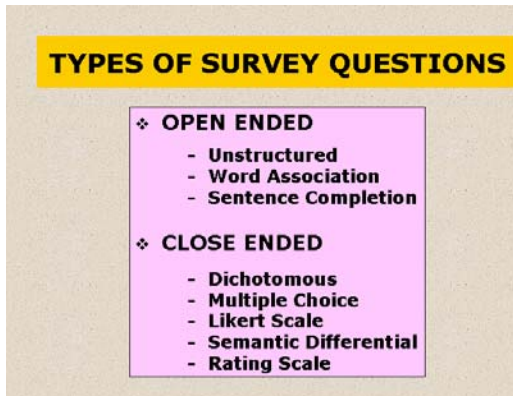
Any sampling technique where all the elements in the population do not have equal probability of being represented in the sample is known as Non Probability Sampling. There are 3 popular approaches viz., Convenient Sampling, Judgement Sampling and Quota Sampling.

Convenience sampling involves selecting the most accessible element in the `population' leading to cost advantage.

When judgement is used to select elements from the `population' who are most likely to provide useful and accurate information, it amounts to Judgement Sampling. For example, an entrepreneur proposes to set up production facility for manufacture of a laser knife - a sophisticated surgical equipment that affords extremely high level of accuracy in surgery. His market segment consists of 4 distinct groups of surgeons - orthopedic, pediatric, ophthalmic and neuro surgeons. The entrepreneur may decide that ophthalmic neuro surgeons are the most potential clients. He may, therefore, decide to talk to more surgeons in that group. While identifying the surgeons he needs to be interacting with, he may opt to choose those already possessing sophisticated surgical facilities.

Quota Sampling involves interactions with a prescribed number of elements in each of the market segments. The elements from the population could be picked up based on convenience.

TYPES OF SURVEY QUESTIONS



The design of the questionnaire is a key feature in the success of the data collection process. The questions must be carefully designed to elicit responses that are germane to the market issues of interest. This is often not a straight forward matter as human psychology enters the picture. The way questions are structured and ordered can bias the types of responses.

Open-ended question: The respondent can answer without being constrained by

a limited number of choices offered by the interviewer.

Completely unstructured: Example: How do you plan to utilize the skills acquired through this training program ?

Word association: Certain words preceded by a statement are presented one at a time and the respondent is asked to indicate the first word that comes to his or her mind. Example: When you hear the term `laser knife', what is the first thing that comes to your mind? In this illustration, the response indicates product attribute to which the respondent attaches the highest priority. If the answer is `accuracy', it is this attribute which is upper-most in the mind of the respondent.

Sentence completion: Incomplete sentences are offered to the respondent who has the liberty to complete the sentence in any manner that he or she wishes. This again indicates the concern that is uppermost in the mind of the respondent. Example: To succeed in life, the most important thing is

Close-ended question: A set of pre-determined responses is offered from which the respondent is to choose.

Dichotomous - The question has two types of answers, e.g Yes/No, adequate/inadequate, short/long etc. Example: The duration of the training programme is: Adequate Inadequate

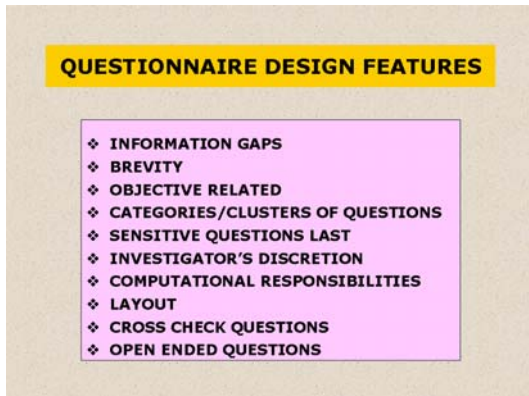
Multiple choice - Similar to dichotomous type but offers three or more responses to choose from. Example: What is your family income per annum? Less than US\$ 20,000 US\$ 20,000 to 30,000 US\$ 31,000 to 50,000 More than US\$ 50,000

Likert Scale - Similar to multiple choice questions but applied when seeking extent of agreement or disagreement of the respondent to a given situation. Example: The training programme must have a built-in provision for visits to Development Banks in neighboring countries. Strongly agree Agree Neither agree Nor disagree Disagree Strongly disagree.

Semantic differential - Two words/terms with diametrically opposite meaning are provided. The respondent indicates his choice by marking on a scale inscribed between the two terms. Example: Your opinion about the training programme:Very Useful, 1 2 3 4 5 6 7, Not at all Useful.

Rating Scale - This is more like the Likert scale but is used while expecting the respondent to rate a given attribute. Example: What is your opinion about the delivery of inputs in this training programme? Excellent Very good Good Fair Poor

QUESTIONNAIRE DESIGN FEATURES



Information gaps: To be effective and efficient, the survey questionnaire should be directed toward filling in information gaps.

Brevity: As there is often little incentive for the respondent to fill in the questionnaire, the questions should be as few and as brief as possible. This requires relating each question to the market assessment objectives and then deciding whether the question is expendable. Even apparently simple concepts need to be

explained. For example, a 'shift' may not always be perceived as a block of 8 hours of working time.

Objective related: Only questions that are related to the objectives of the survey should be included.

Categories/clusters of questions: It is useful to divide the questions into distinct categories especially when dealing with various groups of respondents. A particular question may not be relevant to a particular group of respondents and should be excluded from the survey.

Sensitive questions last: Questions that may cause negative feelings by respondents such as apprehension or dislike should be placed toward the end of the questionnaire.

Investigator's discretion: Questions should be designed so that they are not subject to field investigators' discretion while asking questions or collating responses.

Computational responsibilities: Respondents should not have responsibility for computation. For example, asking a respondent to round off his income to the nearest thousand dollars may lead to an inaccurate response.

Layout: The questionnaire layout should be convenient for respondents. For example, there should be no requirement to skip to another page or look for information outside the area in which the question is to be answered.

Cross check questions: A cross check question is one that provides a response similar to that of another question, which can be compared for consistency. This requires more than one question pertaining to a given aspect. Contradictory responses to these related questions may indicate either that the responses to these questions should be ignored or the entire questionnaire should be screened out of the analysis of the sample.

Open ended questions: It is customary to include an open-ended question towards the concluding part of any questionnaire so that the respondent has an opportunity to express views on issues that were not covered by the other questions. Such an open-ended question could be - 'Any other comments or observations?'

SELECTION AND TRAINING OF SURVEYORS

SELECTION AND TRAINING OF SURVEYORS

- ❖ **WHO SHOULD BE SELECTED**
- ❖ **IDENTIFYING TRAINING NEEDS**
- ❖ **TRAINING METHODS**

Who should be selected: Surveyors should have the following qualifications and characteristics - adequate level of education, accommodating personality, integrity, commitment to gathering accurate information, adherence to time constraints. Specialized tests may be administered to ascertain behavioral characteristics of surveyor candidates.

Identifying training needs: Inexperienced surveyors may have to be trained to approach respondents - how to present themselves, how to explain the need for the survey, how to assure confidentiality of the survey information, how to ask questions in a clear and unobtrusive manner, how to record information at the time of interview.

Training methods: Simulation survey, classroom training or on-the-job training (although caution should be exercised so that respondents are not intimidated).

SURVEY - MERITS AND DEMERITS

SURVEY Merits/Demerits

MERITS

- ❖ RELATIVELY INEXPENSIVE
- ❖ FASTER THAN TEST MARKETING
- ❖ MORE RELIABLE THAN SECONDARY DATA
- ❖ INDICATION OF CONSUMER PREFERENCES

DEMERITS

- ❖ DOES NOT TEST MARKETING STRATEGY
- ❖ RELATIVELY HIGH ERROR POTENTIAL

Merits

Relatively inexpensive - compared to test marketing.

Faster than test marketing - results can be obtained usually in a shorter time period.

More reliable than secondary data - first hand information according to project requirements.

Indication of preferences - when survey executed properly it can provide a good indication of consumer tastes and preferences and attitudes of other agents.

Demerits

Does not test marketing strategy - survey does not simulate market conditions so does not reflect the effectiveness of the marketing approach.

Relatively high error potential - survey is prone to error as a result of the reticence of people to reveal their true attitudes; the capability of surveyors to extract accurate information is difficult to ascertain.

TEST MARKETING



The analyst is faced with the problem of predicting demand and estimating sales. Both quantitative models and qualitative approaches, and perhaps some combination, can be used for this purpose when data is available for the former and information and expert opinion are available for the latter.

The effectiveness of qualitative methods such as consumer intention surveys presupposes respondents' knowledge of the product, its usage, advantages, limitations, etc. How can a market analyst deal with a situation when potential consumers have no experience with the proposed product? The validity of responses from potential consumers under these circumstances is likely to be low. One way to overcome this problem is to conduct market test, in which conditions are created for potential consumers to observe, use or experience the product and then react to the queries of the investigator.

When?

Test Marketing has greater relevance for new products, existing products that are to be introduced to new consumers or market segments, or where historical data is otherwise not available. For example, an entrepreneur generates an idea for a new powdered product that could be added to milk to make a complete breakfast. Potential consumers could be apprised in one way or another of product features: It provides necessary nutrition along with palatable taste and convenience in usage. It is offered in 3 flavours - Chocolate, Vanilla and Strawberry. It is packaged in sachets, the contents of each sachet being sufficient for single use. It sells for, say, 79 cents*.

Why?

On the basis of this explanation potential consumers could be asked to respond to a variety of questions on their perceptions and inclination to use the product: the credibility of the concept, the perceived advantages, reasonableness of the price, purchase intentions and other measures. The analyst can use this information to understand consumer response.

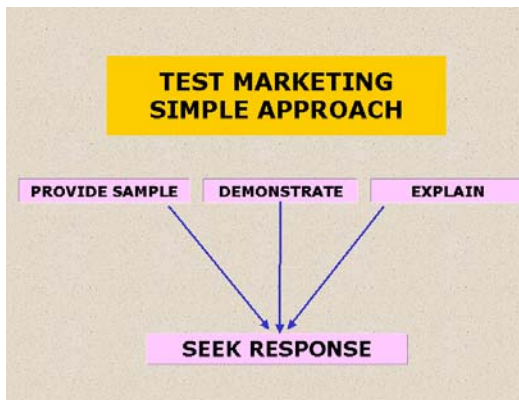
Another possibility is to produce samples of the product (if this is feasible with pilot-level or other simple equipment) and offer it to potential consumers. Potential consumers would use the product and then be asked to respond to questions involving their perceptions and acceptance of the product.

In a test of response to the product involving either description or use experience, care should be exercised so that the validity of the test is not compromised. For

example, if promotional efforts are added to the factual information or pure experience with the product, the responses of potential consumers may not measure what is intended. Experience with the product and promotion are two separate elements that could be persuasive in regard to the test results. If the test is only to measure consumer response then promotion should not be a part of the test. On the other hand, if the test is to understand the effects of the product characteristics and its promotion the test should be set up so that the effects of each can be ascertained.

(* Marketing Management', 7th Edition, Philip Kotler, Prentice Hall, 1991).

TEST MARKETING - SIMPLE APPROACH



A *simple approach* to test marketing involves exposure of the product to potential consumers either by providing samples, demonstrating the product or only explaining its characteristics. The validity of the test increases with more realistic experience of respondents. Use of a sample under representative conditions would ordinarily elicit more valid responses than an explanation.

Consumers are then surveyed with a prepared questionnaire to determine their responses. Both the sampling method and questionnaire should follow good design practice as previously discussed.

Such an approach could be applied to the above illustration on breakfast food. Consumers would be exposed to the product either through sampling or explanation. Clearly sampling would provide greater likelihood of valid responses in this case.

The responses from the questionnaires would then be used to generate the market forecast.

TEST MARKETING - COMPLEX APPROACH



A more complex approach to test marketing involves promotion and distribution of the product under realistic conditions followed by survey to collect primary data.

Select test markets: The extent of test markets selected is limited by economic considerations. The specific cities or regions selected for the test should be representative of the potential market. The inhabitants should be members of the

population segments that are considered to be the targets of the enterprise. Cities or regions are characteristically provincial, cosmopolitan, or something in between. Some cities are considered to be more representative of the country's population than others. The choice of the test markets depends upon the nature of the product and the segments to be targeted. Without a careful choice of the geographical area data generated from the exercise may not be representative.

Launch promotional campaign: Market conditions in the actual environment are simulated prior to test-launching a new product by promoting the product in the selected markets. The promotion is intended to generate awareness of and interest in the product among potential consumers. The design of the promotion should be representative of the programme that would be employed after the project is actually implemented, so that approaches to significant marketing issues should have already been decided. Any product promotion method can be included in the programme: dissemination of product information, psychological appeals, purchase incentives. Promotional instruments should also be selected so that they are representative: mass media, circulars, posters, demonstrations.

In summary, the promotional campaign undertaken as part of the test marketing programme should be as close to actual marketing conditions as practicable. The principle difference between this effort and the actual promotion during operations is the limited scope, restricting promotion to the cities or regions selected for the test.

Launch the product: The product can be produced in pilot facilities set up for testing purposes. It can be obtained under contract from generic producers to project specifications or it may be imported. Generally, the pilot plant capacity is sufficient to satisfy test marketing requirements, but not of a scale that can be used to test commercial viability. Investigators should verify that the quality and other features of the pilot plant output, or product obtained from other sources, are representative of full scale production.

Conduct survey: After launching the promotional campaign, and making the product available to the test market, a survey is conducted to measure consumer reaction. The design of such surveys has previously been discussed. The most important consideration is that the survey, and the market test, should provide the information necessary to project sales of the product to the entire target market, i.e. all market segments in all geographical regions to be covered by the project.

'LABORATORY' SIMULATION



A laboratory simulation can be performed to provide information similar to that of test marketing.

Design of experiment: The test should be designed as an experiment simulating market conditions and observing the behaviour of consumers. Generally there would be a control group that would not be 'treated' (e.g. provided with certain information about the product or products being tested) and another group or groups

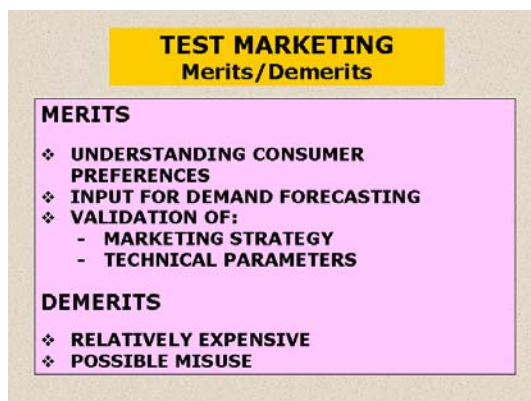
(control) that may be exposed to various treatments.

In a typical simulation, the treated group(s) of potential buyers are invited and resources are made available to them to purchase various products. The potential buyers are offered options to purchase a variety of products. The behaviour of the treated and untreated groups and their ultimate decisions are recorded.

Centralized testing: An advantage of this type of market research as compared with test marketing is that it can be performed in a centralized location and in a relatively short period of time. The costs may be lower than for test marketing.

Statistical analysis: The data derived from this type of experiment can be analyzed statistically using regression methods or analysis of variance (ANOVA). In the latter method a hypothesis concerning the effects of the treatment can be tested and either accepted or rejected. A simpler approach is to draw conclusions from the data without subjecting it to rigorous analysis.

TEST MARKETING - MERITS AND DEMERITS



Merits

The simple approach to test marketing described above can provide an understanding of consumer preferences. The more complex approach, which simulates the project's promotion and distribution, would probably provide more reliable information, as the entire marketing programme would be tested.

In either case the information is used as input for demand forecasting, to project demand and/or sales for the project. An important outcome of the test would be validation of the marketing strategy, and related estimates of market share and penetration.

A pilot plant set up as part of a complex approach to test marketing could also provide information on technical parameters of production and costs. However, data from the pilot plant should be carefully selected and scrutinized to understand fully just how representative of full scale production it would be. This applies to product features, production parameters and costs.

Demerits

Test marketing is usually expensive, whether simple or complex. The latter is quite expensive, as it involves pilot production, promotion, distribution and survey. For existing companies attempting to diversify the complex approach is more practicable than for start-ups, as many of the test elements are probably already in place, at least to some extent.

Another demerit, or at least a caveat, is the possible misuse of test information. Results should be subject to review by officials who have not taken part in the test, so that the greatest level of objectivity is applied to the analysis of results.

DATA COLLECTION STATISTICS

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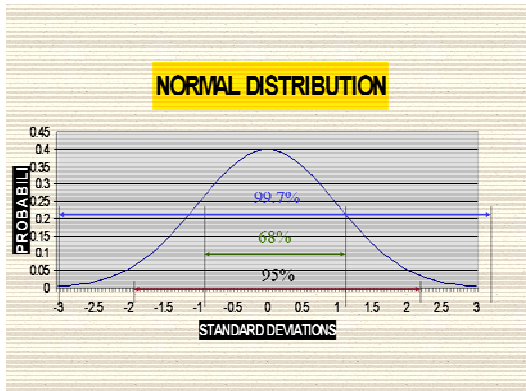
NORMAL DISTRIBUTION SAMPLE SIZE

Information required for analysis of an investment project is often in the form of statistics, numerical facts or data covering a population or changes in a phenomenon over time. A body of scientific knowledge concerning the manner in which a collection of large amounts of seemingly disparate information or data can be interpreted meaningfully has been developed.

The *normal distribution* is a mathematical construction that describes very closely many phenomena of interest to project designers and analysts. Variations in human population characteristics, market fluctuations, prices and many other phenomena conform closely to this mathematical structure. The *binary distribution* usually has characteristics much like the normal distribution and can be used to analyze situations in which there are two possible outcomes, for example a questionnaire in which the possible answers are 'yes' or 'no'.

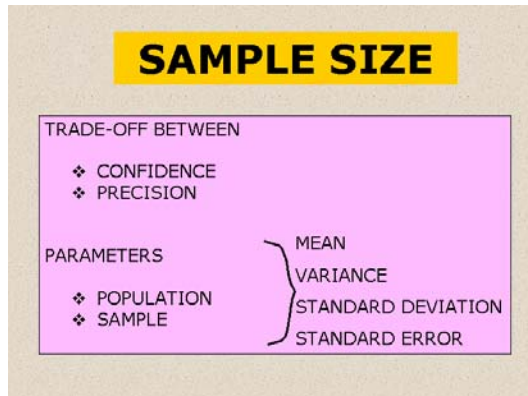
Another important statistical consideration is the *sample size* needed to justify conclusions from a survey or other type of test. The sample size required to assure that the result is representative within a particular level of confidence can be determined scientifically.

NORMAL DISTRIBUTION



The Normal Distribution (or Gaussian Distribution) describes the probability of occurrence for many phenomena in a natural population and in economic systems. Other types of distributions approach the Normal Distribution, e.g. the binary distribution, when the size of the population is large. The Normal Distribution has basically two parameters: *mean* and standard deviation (the slide shows a particular case, the Standard Normal Distribution, with mean = 0 and standard deviation = 1). Another is the variance, but it is very simply related to the Standard Deviation. (See Related Document).

SAMPLE SIZE



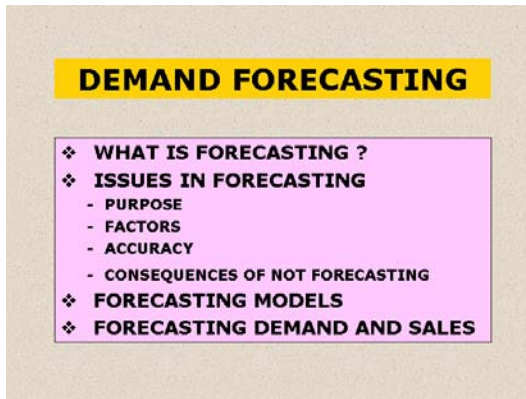
Selection of the sample size is, to some extent, a function of funds and time available for primary data collection. While a larger sample will lead to higher degree of reliability of results, a sample of less than 1% of the population could often provide reliable results when the population is large. There are statistical methods for selecting sample size based upon the level of confidence desired and the precision of the estimate drawn from the sample. Basically selection of sample size is a trade-off between these two

variables. Both increased confidence and higher precision require higher sample size to test a given population. Generally the confidence level is set and the sample size determined based upon the desired precision.

A sample will never provide a perfect representation of the population because of random errors inherent in sampling. A sample provides not a point estimate but a range of values within which the true value is reasonably sure to lie. This range of variations can be measured statistically. A sample size of more than 30 is required for statistical inferences based on the normal distribution.

There are a number of statistical approaches to determining sample size. For more information other resources will have to be investigated. One approach that is applicable when there is some indication of the sample standard deviation (perhaps from previous experience or from an initial trial) uses the standard error, the standard deviation of the sample means. (See Related Document).

DEMAND FORECASTING



What is forecasting?

Statistical methods are usually employed to deal with quantitative aspects of models in which historical data is applied. The models can be based on a variety of statistical tools and techniques. Statistical methods can also be used to determine confidence limits for the model.

A model based upon historical information can be tested by applying the data to see how accurately it would have predicted

the outcome. Futuristic models have only the vision of the analyst to draw upon. This does not imply that historical models are better - in many instances the future is very different from the past.

Forecasting is estimating or projecting future state or value. In the context of industrial project development, and specifically the market response, forecasting is an attempt to predict both demand and sales for the project. Estimates of sales depend upon estimates of market share to be captured by the project and timing of market penetration. Generally the forecasts are produced for all time periods (e.g. years) to the project's planning horizon.

Issues in forecasting

- What is the purpose of the forecast? Will the results influence the decision?
- What factors enter into the forecast? How do they interact? Are they endogenous (within control of decision-maker) or exogenous (outside the decision system)? What is the quantity and quality of information available concerning these factors?
- What degree of accuracy is desirable and what is the best and most cost-effective way to achieve it?
- What might be the consequences of not forecasting?

Forecasting models

To produce a forecast, the analyst needs a model. Models can basically be quantitative, qualitative or a combination. A model is built on dependent and independent variables.

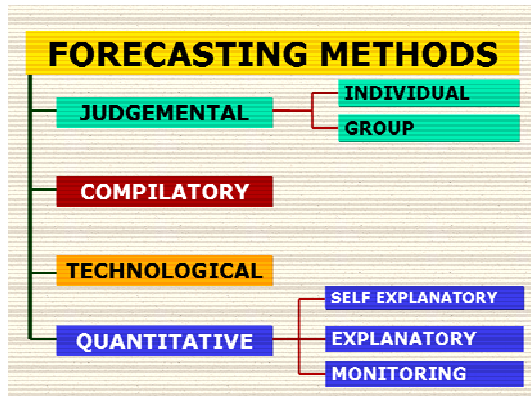
In constructing a model for demand forecasting the key internal and external factors believed to impact demand are identified. These include "controllable" factors, by and large 'internal' to the enterprise and less controllable factors, essentially 'external' to the enterprise. As demand is predicated on the future state of these independent variables, their future states must be predicted to arrive at an estimate of demand.

Forecasting demand and sales: The model, explaining the relationship between the dependent and independent variables, provides the basis for the forecast. Forecasting is an extrapolation, or extension, of the relationship to the future.

Some quantitative methods do not rely on historical information. There is still a need for a model, which is not a reflection of the past, but rather a vision of the future, in which the relevant variables may not yet exist. The dependence of the variable of primary interest, say demand or sales, must be explained in terms of these variables in a systematic way.

Applicability of forecasting methods: Some ideas on the limitations of the forecasting methods and their applicability are provided in Forecasting Methods: accuracy, short (1-3 yrs) and long (>3 yrs); identification of turning points (changes in trend); amount of data required; estimated time required to develop the model and create the forecast.

FORECASTING METHODS



Some forecasting methods are primarily quantitative - most or all of the model variables can assume numerical values. These can be models that depend upon historical data or others that are future-oriented in which the variables assume values based upon the expertise and vision of the analyst. Other models are essentially qualitative - they are more descriptive than numerical. In the case of market forecasts, ultimately the forecast has to relate to quantities of product that will be accepted by the market.

Some forecasting efforts are directed toward predicting technological or market trends, without attempting to be specific about quantitative market developments.

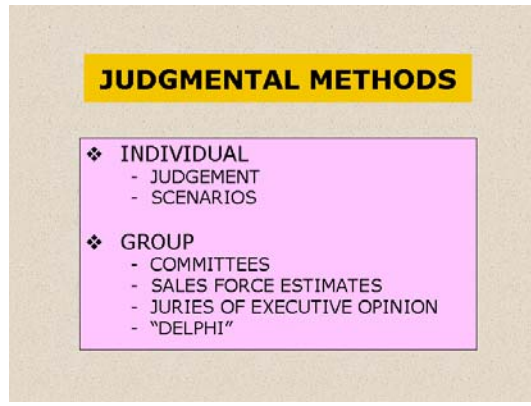
Judgmental: These are methods that depend on the judgment of an individual or group. It is essentially a futuristic approach to forecasting, but is usually predicated on the forecaster's command of both qualitative and quantitative aspects of the market.

Compilatory: Forecasts are predicated on a compilation of data concerning a directly related economic variable rather than a complex of independent market variables.

Technological: The future course of developments of technological systems is the forecasting basis. The validity of these forecasts depend upon the astuteness of the analyst to understand the dynamics of technology: how systems will develop to require new products; what features of new products will be in greatest demand because they are systematically most effective or efficient; what will be the interactions between one development and another.

Quantitative: All of these methods are based upon a statistical relationship between variables that are assigned numerical values. Self-explanatory methods are not based upon independent variables with the exception of time. In most of these methods it is assumed that the phenomena are strictly time-dependent. Explanatory methods use mathematically related independent variables to determine the value of the dependent variable. Monitoring involves the use of tracking signals, i.e. indicators that change with the phenomenon of interest.

JUDGMENTAL METHODS



JUDGMENTAL METHODS

- ❖ INDIVIDUAL
 - JUDGEMENT
 - SCENARIOS
- ❖ GROUP
 - COMMITTEES
 - SALES FORCE ESTIMATES
 - JURIES OF EXECUTIVE OPINION
 - "DELPHI"

Individual methods

Judgment: An expert with considerable experience in the sector of interest provides opinion on the demand for the product and the prospects for the project's output. The expert may predicate the forecast on a particular marketing approach and on predicted market developments. The expert basically projects a scenario describing the role of the project and the conditions that will prevail to the project's planning horizon.

Scenarios: A more comprehensive judgmental method is to project a scenario concerning the state of the enterprise (e.g. with regard to its market).. A scenario is a description of one conceivable state of affairs given certain assumptions about the present and the future. The future state is posited and the steps necessary to realize the scenario are analyzed in terms of precedents that must be achieved to realize the scenario. The analyst describes the sequence and logic of the precedent developments to justify the forecast scenario.

Group methods


Committees: This approach is similar to reliance on individual judgment, except that the committees are comprised of a number of experts rather than a single individual. Meeting as a group the issues are generally discussed and a consensus formed. Group dynamics play a part: a valid perception of one individual can be undermined by strong, united opposition.

Sales force estimates: For an existing enterprise in the process of expansion or diversification, sales personnel provide their best estimates, based upon their knowledge and experience with buyers and other market elements. Accuracy of forecasts is more assured with a close relationship between existing and new products, e.g. complementary or substitute products.

Juries of executive opinion: The board of directors or a management committee of a company may deliberate on prospects for a new product and formulate estimates of demand and sales. The distinction between entrepreneurship and management should be taken into account in using this approach. Managers may be very good at getting things up and running but may have difficulty in perceiving the future of the market.

Delphi method: A panel of experts is interrogated by a sequence of questionnaires in which the responses to one questionnaire are used to produce the next questionnaire. Any set of information available to some experts and not to others is thus passed on to the others, enabling all the experts to have access to all the information for forecasting. This technique eliminates the bandwagon effect of majority opinion. The experts re-examine their assumptions and rework their forecasts. The process can include several cycles until a consensus is approached. This method is mainly applied to new or novel projects where historical data is not available or is not relevant.

COMPILATORY METHODS



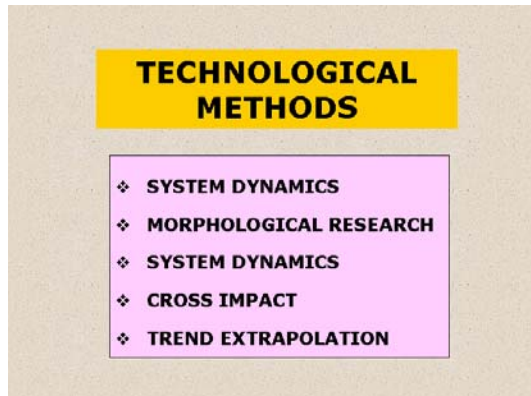
Forecasts can be derived in some industries through a compilation of data related to the product of interest. The accuracy of such forecasts depends upon the momentum within the underlying industry. For example, the number of homes to be constructed over the next few years will determine the quantity of door and window frames required. If the housing industry has a great deal of momentum (equivalent to turning a huge ship in the ocean) the forecast will tend to be more accurate.

End-use: The forecast depends upon a compilation of clients or consumers who will use the product. This method is generally applied to intermediate goods (raw materials and components). For example, a project to produce gas turbines needs to know how many and what capacity of power plants will be constructed over the next few years to provide an average estimate of demand.

Consumption coefficient: This is a technological coefficient based upon the intermediate or end-use product for which the planned product will be an input. Examples: The demand for cement or steel in metric tons can be related to the volume of new construction in space or monetary terms. The demand for coke can be related to steel production. Each automobile on the road will, on average, require 0.4 replacement tires per year. The accuracy of this method depends upon the accuracy of compilation of data related to the underlying activity level.

Market build-up: This approach relies on estimates of the rate of expansion of demand and the market saturation level. A compilation of historical data on demand provides an estimate of the rate of growth. If the product is in the growth phase of its cycle, the growth may accommodate the new capacity. The closer to saturation the greater the risk.

TECHNOLOGICAL METHODS



These methods are applied primarily to industries in which technology plays a major role. The technology can be embedded in the product, production process, equipment and tools, or in the promotion. These methods may be equally applicable to advances in the technology of production for a simple product, or to advances in the product technology without a corresponding change in manufacturing methods.

System dynamics: An industry is like a dynamic organism, forever seeking the 'better mouse trap' that will provide advantages for consumers from which benefits will accrue to producers. Knowledgeable individuals, usually with technical or scientific expertise, attempt to understand the complex interrelationships between advancing technology and the external and internal environments. How telecommunications, for example, will be carried out in the future: What kinds and what volume of information will be exchanged, and between whom? What communications media will be employed? What will be the components of the system; What kinds of organizations will be in a position to provide goods and services? Understanding these issues provides the basis for providing a forecast of demand.

Morphological research: Morphology deals with form and structure without regard to function. A problem is defined, broken down into its elements, then the elements are combined and recombined into new arrangements. The approach is to study the structure of the industry to better understand the possible niches for a new entrant. By assigning efficiency and other weights, the best combinations are chosen for further study.

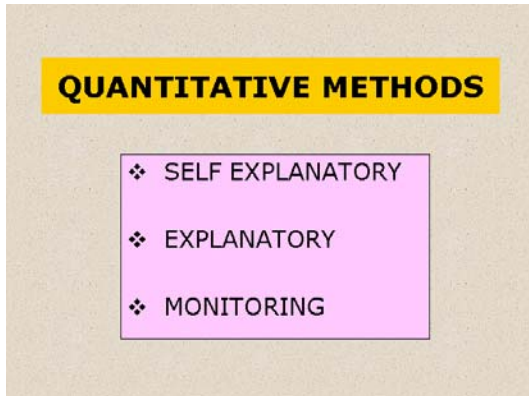
Cross impact: Forecasts are based upon the impact of developments in other industries on the sector of interest. For example, the globalization trend in manufacturing and trade has impacted demand for mobile communications. The demise of the railroads in the US spurred road construction and demand for commercial vehicles. The development of glass fiber bundles for imaging and communications had a cross impact on the copper mining industry (copper's use in electrical wiring).

Trend extrapolation: Historical and current market developments are systematically analyzed and then extrapolated to predict the future trend. The extrapolation, in this case, would not rely so much on analysis of future market forces, perhaps because the product trend has a high level of momentum - future developments appear inevitable. An example is during the growth phase of an innovative product that has responded well to a societal need.

This method does not rely upon an exhaustive dissection of the industry into its component parts and analysis of the dynamics of the system with which the industry interacts. Rather, the approach is to understand the 'visible' movements in the industry over time. In what direction has the industry been moving and what will be the shape of movements in the future? The basic assumption is that the technological trend will continue for some period of time. The job of the analyst in

producing this kind of model is to properly formulate the trend, either or both in qualitative and numerical terms. An example is computer software. A perceptive analyst some years ago would have been able to discern the trend toward the use of higher level languages and less involvement of users in the formulation of programs and coding instructions. The trend toward graphic and vocal interfaces might have been recognized.

QUANTITATIVE METHODS



Most types of quantitative models include variables with historical information - the assumption is that the future behavior of the market will be much like the past. The problem is then to decide what are the independent variables and how they are related. Other quantitative models can be built upon mathematical relationships between variables that arise from the vision of the analyst. Such models do not rely on the assumption of continuation of historical precedent.

Quantitative models are tested when possible, and in all cases used for extrapolating to, or forecasting, the future. They can be divided into three categories:

Self explanatory models do not depend upon historical relationships with other variables (excepting time). In most of these models the assumption is that the phenomenon of interest, the dependent variable (demand or sales), is a function of time. No explanatory system is attempted. The analyst's problem is to ascertain which mathematical function best describes how the dependent variable varies over time.

Explanatory models provide mathematical expressions that describe relationships between dependent and independent variables. Demand for medicines, for example, may be related to personal income and health status of the population. The analyst's problem is to discover or otherwise determine the mathematical forms that best explains the relationship.

Monitoring models are not built upon explanations. Indicators are employed that do not explain the relationship but which signal changes in the phenomenon of interest. There may be an explanatory mechanism, but the basic model does not attempt to discover what it is. In building the model the analyst's problem is to find which signals are significant and how they affect the phenomenon of interest.

SELF EXPLANATORY MODELS

SELF EXPLANATORY MODELS

- ❖ NAIVE
- ❖ SIMPLE TIME-SERIES
- ❖ DECOMPOSITION
- ❖ EXPONENTIAL SMOOTHING
- ❖ ADVANCED TIME-SERIES

Naive methods: Based upon the analyst's expertise in the field, a visionary mathematical model is created that relates selected independent variables to the dependent variable(s) of interest. There is no formal reliance on historical data - it may not be available or considered irrelevant. There is not an opportunity to test such a model, except perhaps in regard to an analogous marketing situation.

Simple time-series: The simple time series model relates the dependent variable to time. The model can be discrete (value of dependent variable determined for finite time intervals) or continuous (value of dependent variable described for every 'instant').

Decomposition: In these models time-dependent data is decomposed into separate elements to determine their mathematical forms and coefficients. One method of decomposition is the use of moving averages to smooth data at several levels. The dependent variable can then be explained as a composite of effects from various independent phenomena.

Exponential smoothing: This method is similar to decomposition with moving average, except that more recent data points are weighted more heavily. Descriptively, the new forecast is equal to the old one plus some proportion of the past forecasting data. There are many variations of this technique.

Advanced time-series: In an advanced time series model, the dependent variable can be a function of more than one time-related variable. For example, demand can be a function of a time-dependent trend and, in addition, to cyclical or seasonal variations.

SIMPLE TIME SERIES (STS) - METHODS OF ANALYSIS

**SIMPLE TIME SERIES (STS)
METHODS OF ANALYSIS**

- ❖ GRAPHICAL
- ❖ GROWTH RATE
- ❖ REGRESSION
- ❖ CAVEAT - IS STS APPLICABLE ?

A simple time series comprised of time-based values of a single variable can be used to develop a forecasting model. Once the model is developed it is used for extrapolating the variable to the future. The development of each of the following methods applied to a single time series is shown in Simple Time Series:

Graphical method: The value of the variable is plotted on graph paper with time as the abscissa (horizontal axis) and the variable as the ordinate (vertical axis).

The type of graph paper can be linear, semi-log or log-log. A linear form is the easiest to extrapolate.

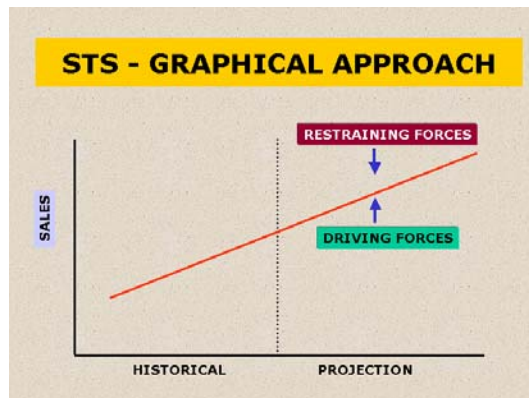
Growth rate: From values of the variable at two points in time a growth rate can be determined mathematically. The growth rate can be assumed continuous or discrete. In the latter case the growth rate represents the average growth over a finite time interval. If the data is available for each year, for example, the rate determined will be the annual growth. Assuming that this growth rate will continue in the future, a forecast for any desired year can be estimated.

Regression: This is a method for statistically determining the mathematical equation that best fits the data. The 'least squares' approach is used to find the values of the coefficients of the regression equation that defines how the variable changes with time. Some advantages of this method over others is that confidence intervals for the coefficients and for the regression values can be determined. It is also possible to compare various equation forms in regard to the level of conformance with data.

Caveat - Is STS applicable? If time series data is available it is very tempting to use it to develop a forecasting model. However, there could be certain circumstances in which the past is not a harbinger of the future. A trend can be suddenly disrupted by a change in consumer taste or life style.

When forecasting demand using time series analysis an implicit assumption is that the historical trends will prevail in the future. In other words, it is assumed that future is a continuation of the past. This seldom is the case in the highly competitive and dynamic business environment. Time series analysis does not explain the reasons behind the trends observed in the historical data. These caveats notwithstanding, the approach can be useful in understanding the total market demand.

STS - GRAPHICAL APPROACH



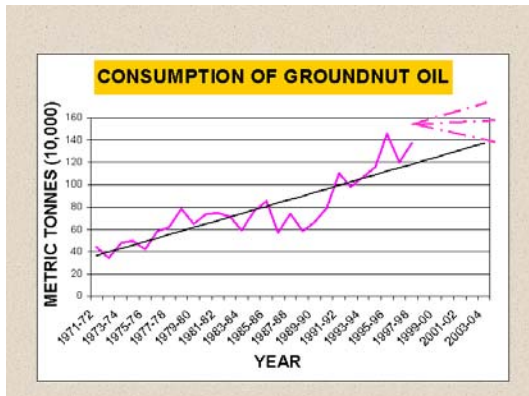
Data can be plotted on graph paper that has linear vertical and horizontal axes, semi-log paper with linear ordinate and log abscissa or log-log (both axes logarithmic).

The plot that appears to be the most linear can most readily be used for projecting to the future.

When attempting a projection it is prudent to consider the dynamic forces that operate within the marketing system of interest. Even though a formal mathematical approach is not used, a qualitative assessment of these dynamic forces can indicate whether the straight line projection (plotted on any of the types of paper noted above) is optimistic or pessimistic. As a result of these external forces, the positive rate of change may increase (driving forces) or decrease (restraining forces).

The assumption of applicability of historical information is often suspect. Unless the output of the project is so firmly entrenched economically and culturally that there is little doubt that past trends will remain intact, it is prudent at least to consider those forces that may cause some change in the pattern. In some cases, a review of these forces may precipitate an entirely different view of the forecasting problem.

CONSUMPTION OF GROUND NUTS



An example of the graphical approach is the plot of data on the consumption of ground nuts. The original data covers the years 1971-72 to 1997-98, as shown in the attached slide (REF. RELATED DOCUMENTS). The forecast is required for the next five years. Generally the data is collected on an annual basis. The data is plotted on a graph with horizontal (X) axis representing time period and vertical (Y) axis representing demand. The graph is then visually extrapolated to cover the forecast period.

Using the graphical method, it is tempting to try to extrapolate from the last data point. A better approach is to try to estimate the trend line that "averages" all the existing data points and then to perform the extrapolation on that trend.

The mathematically derived trend line is shown in black. In this case, the most recent data appears to be setting a new upward trend (a break-out). However, it is more conservative to perform the extrapolation on the general trend, unless there is compelling evidence that the trend has recently been revised upward.

A simplified approach of extrapolating on the best estimate of the trend does not take into account wider fluctuations that may occur from external restraining and driving forces as shown in the previous slide. In most circumstances, when a graphical approach on a time series is employed, these forces should be included in the forecast analysis.

The simplified approach would apply only when the trend, as reflected in the historical data, is strongly entrenched and unlikely to change.

GROWTH RATE

GROWTH RATE

CONTINUOUS: $\gamma_c = \frac{\ln \frac{X_{12}}{X_{11}}}{T}$

DISCRETE: $\gamma_d = \left(\frac{X_{12}}{X_{11}} \right)^{\frac{1}{n}} - 1$

γ_c	Growth rate, continuous
γ_d	Growth rate, discrete
X_{12}	Ending value
X_{11}	Beginning value
T	Time
n	Number of periods

Using the initial and terminal values of a phenomenon (e.g. population), the growth rate can be determined mathematically. The continuous function assumes that the growth is active over each differential (infinitesimal) increment of time. The discrete function assumes the growth rate to be active period by period. For example, if the initial value is 1 and the growth rate is 10%, 1 period hence the value will be 1.10. After two periods the value will be 1.21 (1.1 x 1.1).

In general, for the continuous function, if the growth rate is known, the terminal value can be determined by:

$$X_{12} = X_{11} e^{\gamma_c T}$$

For example, if $x_{11}=1$ with a growth rate of 10%, after 20 periods the value x_{12} is:

$$x_{12} = 1e^{0.1 * 20} = 7.39$$

Using the discrete method for the same example:

$$x_{12} = x_{11} (1 + \gamma_d)^n = 1(1 + 0.1)^{20} = 6.73$$

Whether the continuous or discrete method is used, any forecast based upon these relationships is predicated on the assumption of the continuation of the historic growth rate. While this approach can be applied in some industries with high developmental momentum, the actual forecasts should be verified with other methods of analysis. An example of the application of these formulas is shown in *Simple Time Series* (see Related Documents).

REGRESSION FOR SIMPLE TIME SERIES

REGRESSION

- ❖ COLLECT TIME-BASED DATA FOR VARIABLE
- ❖ SELECT MATHEMATICAL FORM OF TREND FOR $Y = f(T)$
- ❖ APPLY REGRESSION TO DATA TO DETERMINE COEFFICIENTS
- ❖ FIND CONFIDENCE INTERVALS

A simple time series consists of values of a single variable at intervals over a period of time. For example, the values of GNP of a country for each year from 1990-2000 would constitute a simple time series.

Cross section data refers to observations on a variable at a given point in time across different populations, e.g: the sales of computers during the year 1995 in USA, India and China.

A simple time series forecasting model is developed as follows:

Collect time-based data for variable: Data should be collected for a period at least equal to the length of the forecast to be produced.

Select mathematical form of trend: A time-based trend can have any number of mathematical forms. Although this step is not essential, the data can be plotted on a linear paper, semi-log paper and log-log paper to determine which, if any, provides the closest approximation to a straight line. The approximation to a straight line is desirable because it permits the use of the least squares method that is commonly available for determining the coefficients of the regression line.

Some of the mathematical forms that can be applied and their conversions to the linear form are shown in the file *Linear Transformations* (see Related Documents). The equations described are Linear, Exponential, Logarithmic, Power, and Growth models.

Apply regression to data to determine coefficients: The method of least squares is used to find the coefficients of the equation that best fits the data. Many computer software programs are available for performing these calculations. Spread sheet programs generally include these functions. An example of the application of regression to a simple time series is shown in Simple Time Series.

Find confidence intervals: These intervals are determined statistically and provide a range of values that cover the uncertainty in the model. Intervals can be determined for the coefficients of the equation and for the regression line. An example is shown in *Simple Time Series* (see Related Documents).

TIME SERIES ANALYSIS - WHEN TO APPLY?

TIME SERIES ANALYSIS - WHEN TO APPLY ?

- ❖ DEMAND DETERMINANTS DIFFICULT TO IDENTIFY
- ❖ HISTORICAL DATA AVAILABLE AND RELEVANT
- ❖ TREND or CYCLICAL PATTERNS EXIST
- ❖ MARKET PERTURBATIONS IMPROBABLE

Time series analysis, whether simple, advanced or decomposition, should only be applied when considered appropriate by the following criteria:

Determinants of forecast variable difficult to identify: If determinants can be identified it is better to use an alternative model that includes causative, or at least associative relationships.

Historical data available and relevant: There should be sufficient data available,

at least covering the length of time of the intended forecast, although it is certainly better to have up to two or more times the length of the forecast. Too much data can also be problematical as its relevance usually fades over time.

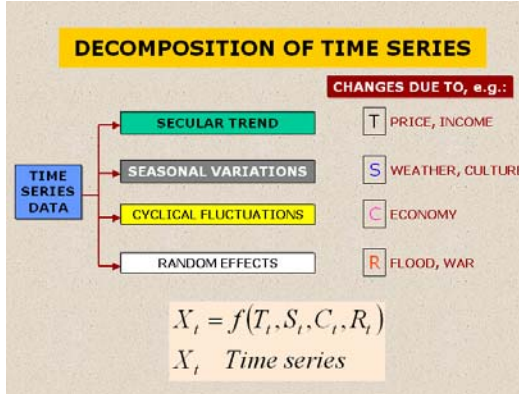
The level of aggregation of the data should be examined. Data may not be relevant to the market segment of interest if it is in aggregated form. A demand forecast for aggregated steel consumption, for example, says little of demand for tool steels.

Trend or cyclical patterns exist: If there is no discernible trend or cyclical patterns, analysis of a time series will be misleading.

Market perturbations improbable: The time series model is predicated on continuation of the existing pattern of market behavior. A forecast based upon a time series should be accompanied by analysis of the external market forces that would sustain or change the trend. If disruptions to the existing patterns are foreseen, little reliance should be placed on the extrapolation of a trend from the time series. Even if not foreseen, it is prudent to be circumspect about any forecast based solely on a trend. Some additional approach should be attempted to provide a more reliable estimate of the forecast variable.

Standard software packages are available for statistical time series analysis. Most spread sheet programs contain a statistical package to perform statistical analysis of simple time series.

DECOMPOSITION OF TIME SERIES



A time series, e.g. variations in demand over a number of years, can have embedded periodic components resulting from a seasonal pattern and the economic cycle. Variations may also be the result of random or irregular factors. When there is evidence of these patterns, the time series can be decomposed into the constituent elements of which it is comprised.

Consider the following illustration of demand for a product over a period of the

past 5 years:

Year	Demand	Growth Rate, %
1	42.0	
2	43.8	4.3
3	45.2	3.2
4	45.4	0.4
5	46.8	3.1

Simple extrapolation of this data to obtain an estimate of demand in year 6 does not seem very promising. There is too much variation in the pattern with erratic changes in the growth rate. Some attempt to understand the reason for the fluctuations in growth rate should be undertaken. *Decomposition* can shed some light on the underlying pattern.

In some Asian countries in a 5-year period two years of normal rainfall followed by one year of deficient or heavy rainfall and then two more years of normal rainfall is a normal weather pattern. In this case, a forecast of demand for fertilizer based on the time series data for the past 10 years should take into account uneven movements in demand that can be affected by the weather pattern.

Secular trend is the long term pattern of growth (or decline) in the dependent variable attributable to major factors in the external environment. For example, continual growth in the consumption of milk might be attributable to increases in population and per capita income.

Cyclical fluctuations arise from 'wave-like' movements in general economic activity or perhaps from regular weather patterns. These fluctuations follow a regular pattern of increase and decline over a time interval. For example, the global economic cycle is thought by some to follow an 11 year pattern.

Seasonal variations take place within a year, and are attributable to factors such as annual weather variations, local customs and festivals. For example, the price of food grains might be at its lowest during the harvest season.

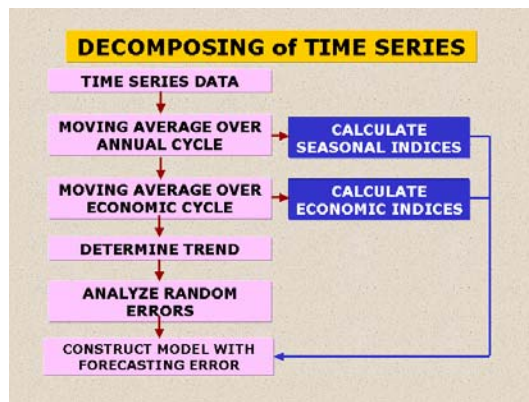
Random or irregular movements are attributable to unpredictable or unusual events that affect the observed variable. Unusually severe weather can lead to

heavy demand for small power generators and pumps. The decision to restrict production of crude oil by the OPEC countries in the light of falling prices led to an increase in crude oil prices in the international market. The recent Asian currency crisis led to sharp devaluations of currencies in several countries with corresponding decrease in demand for imported goods.

It is prudent to take a close look at the times series data to understand whether the changes in the observed variable are due to one or more of the factors mentioned above. If so, the times series data should be decomposed to identify the impact of the component factors. Statistical tools are available for this purpose. The coefficients for each of the factors can then be used to provide a more accurate forecast.

An example of the application of decomposition is provided in Related Documents.

DECOMPOSING OF TIME SERIES



A time series can be decomposed to produce a model with seasonal and other cyclical indexes. The model can be expressed as follows:

$$X_t = f(T_t, S_t, C_t, R_t)$$

where the independent variables are, respectively, the Trend, Seasonal, Cyclical (economic), and Random. The model can be additive, multiplicative or another mathematical form. The general procedure for developing the forecasting

model is as follows:

Historical data on the forecast variable (e.g. demand) is obtained for the product within the defined population. The minimum data time frame should be the maximum of (1) the length of time that the model will attempt to forecast and the duration of the longest cycle included in the model.

1. The centred moving average is calculated for the seasonal variation (generally annual).
2. The ratio of the original data value to the seasonally smoothed data for each time interval provides the seasonal indices.
3. The centred moving average of the seasonally smoothed data is calculated for the cyclical variation (e.g. length of the economic cycle).
4. The ratio of the seasonally smoothed data to the cyclically smoothed data for each time interval provides the cyclical indexes.
5. The trend line is determined by statistical means on the original data.
6. The trend line can be analysed statistically to determine the Standard Error and Standard Error of Forecast.

A model is developed using the trend and the seasonal and cyclical indices. This is used for forecasting with confidence intervals based on the random error analysis.

An example of decomposition of a time series is provided in Decomposition.

EXPONENTIAL SMOOTHING

EXPONENTIAL SMOOTHING

- ❖ MOST RECENT DATA IN TIME SERIES WEIGHTED MORE HEAVILY
- ❖ APPLICABLE FOR SHORT TERM FORECASTING
- ❖ WEIGHT FOR PAST PERIODS:

$$\text{Weight} = \alpha (1-\alpha)^t$$

t number of periods before present

$$\sum \text{Weights} \approx 1.0$$

Events in the recent past often provide clues to what is likely to occur in the near future. In the method of exponential smoothing of a time series, a greater weight is assigned to the data of recent periods. When the forecasting horizon is short, say 5 years, and when the time series data does not show excessive fluctuations, the exponential smoothing technique can be applied.

$$\text{Weight} = \alpha (1 - \alpha)^t$$

t number of periods before present

$$F = \sum_{t=1}^{t=n} w_t A_t$$

$$\Sigma \text{Weights} \approx 1.0$$

a Weighting Parameter

F Forecast

w_t Weight factor, $\alpha(1 - \alpha)^t$

A_t Historical datum, *t* period prior to forecast period

The new forecast (F) is equal to the sum of weighted historical data (A_t) for each period *t*. The sum of all weights for each period (*w_t*) must approach 1. This is accomplished by choosing a value *a* (alpha) for the most recent data and weighing the prior data sequentially back in time by the factor $a(1 - a)^t$ where *t* is the number of periods prior to the most recent period used in the analysis.

EXAMPLE: *a* = 0.4 and (1 - *a*) = 0.6; *t* is the number of periods prior to the most recent period used in the analysis.

Period	A _t	Weight factor, <i>w_t</i>	Weighted value
-5	1100	$0.4(0.6)^5 = 0.0311$	34.2
-4	1175	$0.4(0.6)^4 = 0.0518$	60.9
-3	1210	$0.4(0.6)^3 = 0.0864$	104.5
-2	1250	$0.4(0.6)^2 = 0.1440$	180.0
-1	1290	$0.4(0.6)^1 = 0.2400$	309.6
0	1350	$0.4(0.6)^0 = 0.4000$	540.0
1	1229		1229.2

The sales projection for period 1 is determined using the above weights for prior periods. Using the weight factors on recent historical data, as shown in the above table, the estimate for period 1 is about 1229.

ADVANCED TIME SERIES

ADVANCED TIME SERIES

- ❖ ALTERNATIVE TO DECOMPOSITION
- ❖ SEASONAL AND CYCLICAL COMPONENTS
- ❖ MORE COMPLEX MATHEMATICAL FUNCTIONS

$$X_t = F(t) + a_s \sin(\omega t + \phi_s) + a_c \cos(\omega t + \phi_c)$$

$$\omega = 2\pi f$$

$\phi_{s,c}$ phase angles, seasonal and cyclical, respectively

f cyclical frequency

A time series that contains cyclical components in addition to a linear trend can be analyzed using the statistical technique of multiple regression. In this approach the cyclical components can assume the form of trigonometric functions (e.g. sine, cosine). Phase angles can also be included. The frequencies and phase angles of the cyclical components would have to be assumed. Usually the frequency would be determined by the nature of the phenomenon. For example, seasonal patterns would have a frequency

of 1 cycle per year. The economic or other cyclical component might have a frequency of 1 cycle per 5 years.

The normal equations are set up using the expressions for each of the numerical coefficients to be determined. They are then solved to determine the values of the coefficients. Confidence intervals for each of the coefficients and for the curve of the regression can also be determined by statistical methods.

An example of multiple regression is shown in the solution to the exercise at the end of this section, Exercise FORECASTING. This is applied to a correlation model rather than a time series, but the method is essentially the same.

EXPLANATORY MODELS

EXPLANATORY MODELS

- ❖ SIMPLE CORRELATION
- ❖ COMPLEX CORRELATION
- ❖ ECONOMETRIC MODELS
- ❖ INPUT-OUTPUT ANALYSIS
- ❖ MULTIVARIATE METHODS
- ❖ SIMULATION
- ❖ ELASTICITY

These models attempt to identify the nature of the relationship between variables. In contrast to time series models, correlation is a study of the joint variation of two or more variables, none of which is restricted by circumstances or by the experimenter.

Simple correlation: The simplest form of correlation study attempts to discover the relationship between two variables. A mathematical form is assumed and the coefficient of the variable and constant

estimated by analyzing the data statistically. Confidence intervals on the estimates are also determined. Regression, similar to that explained in Simple Time Series, is a statistical method of relating variables.

Complex correlation: A phenomenon, such as demand for a product, may have more than one explanatory variable. These models use the statistical technique of multiple regression to determine the form of the mathematical relationship. The statistical process is similar to simple regression. The dependent variable is a function of some combination of the independent variables. The regression is a means of determining the coefficients of the independent variables and constants that describe the relationship.

Econometric models: An econometric model is a simulation of the economy of a region or country. It consists of a system of interdependent regression equations that describes the economy or some sector of it, or both. The parameters of the regression equations are usually estimated simultaneously. As a rule, these models are relatively expensive to develop. Due to the system of equations inherent in such models, they will better express the causalities involved than ordinary regression equations and therefore will predict turning points more accurately.

It is usually difficult to test these models for completeness or reality. Setting up the model and obtaining data are difficult, costly and time consuming. Such a model would be used only for very large projects.

Input-output analysis: A method of analysis concerned with the inter-industry or inter-sector flow of goods or services in the economy or in a region of the country. It shows what flows of inputs must occur to obtain certain outputs. Considerable effort must be expended to use these models properly, particularly in regard to maintaining up-to-date technical coefficients. A discussion of input-output analysis is contained in the file Input-Output.

Multivariate methods: These methods consider joint variation of two or more variables, none of which is restricted by the investigator. One approach is correlation, in which relationships between variables are studied on the basis of statistical information drawn from historical data. Data can be obtained from experiments using treated groups of subjects and an untreated control group. Such experiments have been described previously. An hypothesis concerning the relationship between the variables can be tested statistically using the methods of Analysis of Variance (ANOVA).

Simulation: A marketing situation can be analyzed using a computer simulation model. In this case the model is a logical-mathematical representation of the marketing system. The relationships between variables can be deterministic (unique outcomes for a given set of inputs), non-deterministic or stochastic (variables have probabilistic relationships) or expected value (expected value or means are assigned to the probabilistic parameters). For the stochastic relationships, Monte Carlo methods are employed, in which the values for the variables are selected randomly. The simulation consists of repeated trials of the system until a pattern of relationships emerges.

Elasticity: Elasticity relates the percent change in a dependent variable, e.g. demand, to the percent change in another parameter, e.g. income or price. The problem of the analyst is then to predict the change in the related parameter.

CORRELATION METHOD

CORRELATION METHOD

- ❖ **OBSERVE RELATIONSHIPS SYSTEMATICALLY**
- ❖ **FORM A THEORY ABOUT FACTS**
- ❖ **GRAPH OR DIAGRAM OBSERVATIONS**
- ❖ **MEASURE WHAT IS HAPPENING**
- ❖ **DEVELOP MODEL**

The following procedure can be followed to develop a correlation model for forecasting purposes:

Observe relationships systematically: These observations may consist of the identification of elements of the system that appear to be related. The effects of variables can be studied independently and conjointly.

Form a theory about facts: The theory can describe how the elements of the system are related - what appear to be the causal and associative relationships.

system are related - what appear to be the causal and associative relationships.

Graph or diagram observations: A graphical or diagrammatic representation of the data and other information can help to better define the underlying theory or principle. These diagrams would primarily indicate the relationships and sequences of activities and events, something like a flow diagram. Some quantitative information may be included.

Measure what is happening: This consists of the compilation of quantitative data concerning the relationships from primary, secondary and / or tertiary sources.

Develop model: The model is effectively a mathematical and/or functional description of how the variables are related. For a statistical correlation model, it would consist of a mathematical relationship between the variables and confidence intervals on the parameters.

CORRELATION MODEL

CORRELATION MODEL

- **DETERMINE FORM OF RELATIONSHIP**
- **USE REGRESSION TO FIND COEFFICIENTS OF VARIABLES**
- **DETERMINE COEFFICIENT OF CORRELATION**

$$r = \frac{n \sum X_1 X_2 - \sum X_1 \sum X_2}{\sqrt{n \sum X_1^2 - (\sum X_1)^2} \sqrt{n \sum X_2^2 - (\sum X_2)^2}}$$

$$r = \frac{S_{12}}{\sqrt{S_{11} S_{22}}} \quad S_{ij} = \sum X_i X_j - n \bar{X}_i \bar{X}_j$$

$$-1 \leq r \leq +1$$

A procedure for determining the degree and form of correlation between variables is as follows:

Determine form of relationship: The relationship may be linear or another form. Some mathematical expressions that are not inherently linear can be changed mathematically to linear form (see Linear Transformations) so that the method of least squares can be applied.

Use regression to find coefficients of variables: The numerical constant and coefficients of the variables are found by regression. Confidence limits for the regression can be determined in a manner similar to that shown in Simple Time Series.

Determine coefficient of correlation: The coefficient of correlation is a measure of the strength of association between variables, as shown for the two-variable case. The squared deviations, S_{jk} can also be used to find the coefficient.

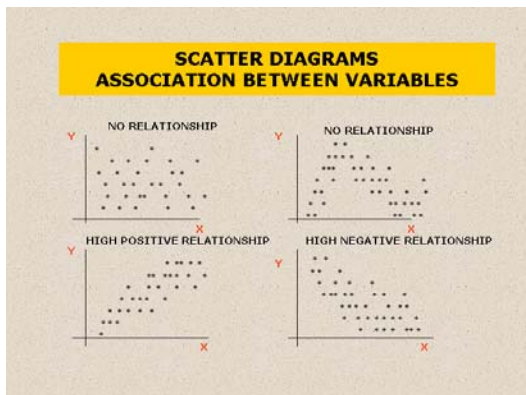
The coefficient of correlation can have values from -1 to +1. A high value (above 0.9 or -0.9) only shows a strong association between the variables. Whether or not there is a causal relationship, i.e. if a change in one variable causes a change in the other can only be determined by examining the causal mechanism. There can be a high value of r without a causal relationship. The price of tea and the number of robberies might show a high association, but there would not appear to be a causal mechanism.

A low value of r (near zero) does not necessarily signify the absence of a relationship. It does indicate that there is not a linear relationship (or assumed linearized relationship). Some other kind of relationship might exist.

The Product Moment Coefficient of Correlation as shown measures the strength between a single dependent and independent variable. If more than two variables are involved, multiple correlation should be applied with corresponding coefficients of correlation for each of the independent variables. These are calculated in a similar manner.

An example of multiple correlation is shown in Exercise FORECASTING (see RELATED DOCUMENTS).

SCATTER DIAGRAMS - ASSOCIATION BETWEEN VARIABLES



For a relationship between two variables, a simple scatter diagram showing all points X_1 , X_2 can be very useful in determining whether relationship exists and the nature of the relationship. The points are plotted at the observed value of X_1 corresponding to the observed value of X_2 .

If a consistent pattern fails to emerge, this indicates that there is probably no relationship. This can occur if the scatter points appear to be random or if a pattern appears that changes in direction. In the latter case there may be effects of other variables on one or the other of the variables included in the diagram.

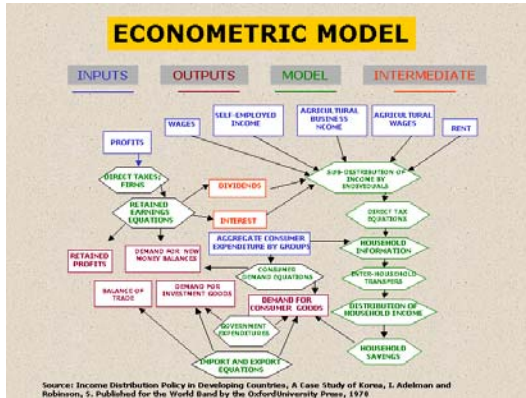
A definitive pattern of increase or decrease of one variable with respect to the other may indicate that a relationship exists. The relationship might have a linear or other mathematical form (see Linear Transformations).

If a relationship does appear to exist, it could be causal or merely associative. In a causal relationship a state or value of one variable implies the state or value of the other. An example is the relationship between excessive money supply and inflation rate. The buildup of money in circulation causes inflationary pressure.

In an associative relationship there is no cause and effect (at least none that can be identified) - one variable simply changes in synchronization with the other. There may be statistical association between the state of the economy and the outcome of an annual sports event. There would likely be no discernible association between a person's height and level of intelligence.

A scatter diagram is also possible for a three-variable model, although plotting the data in three dimensions presents some practical difficulties.

ECONOMETRIC MODEL



An econometric model is a system of equations (probabilistic and/or deterministic) that describe an economic system. The model requires takes inputs and produces outputs. Some of the outputs are at the intermediate stage that are used as inputs for other parts of the system.

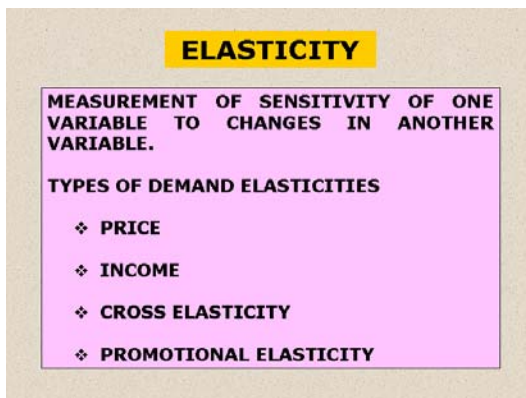
The solution to the model can be deterministic (fixed values) or can be in the form of probability distributions.

The model shown takes information on the distribution of national income and some characteristics of the disposition of income by social groups to project demand for consumer and producer goods, impact on the balance of trade, retained profits of producers and demand for new money balance.

The input data is processed through the systems of equations representing various segments of the economy, e.g. direct taxes, consumer demand, to produce output estimates.

Creating such computer models is a time-consuming and expensive process. Such a model would be attempted only for a very large project that has considerable impact on the national economy.

ELASTICITY



Elasticity of demand is the sensitivity of demand to changes in its determinants. Generally, an elasticity is measured in terms of the ratio of percent change in the forecast variable (e.g. demand) to the percent change in the determinant variable.

Price elasticity: The ratio of percent change in demand for a product to percent change in its price.

Income elasticity: The ratio of percent change in demand for a product to percent change in income.

Cross elasticity: The ratio of percent change in demand for one product to percent change in price of another.

Promotional elasticity: The ratio of percent change in demand to the percent change in promotional effort.

Elasticity can be used for short term forecasting but requires an estimate of change in the independent variable. This method would be appropriate, for example, when the project has a significant impact on the independent variable. A project that is to introduce a new technology that will significantly change the production cost, and consequently can offer the product at a price significantly lower than the current market price, might find the elasticity approach useful.

Elasticity can be useful for studying sensitivities in the economics of a project. If an estimate of price elasticity is available it can be used to test sensitivity of the project design to anticipated price changes, not only in regard to demand and sales, but also production levels and unit cost of production.

Applying elasticity to forecast demand is predicated on the assumption that other market conditions and behaviour remain constant. Elasticity is applicable only to quite small variations in price - it does not remain constant over a wide range of price variations.

ELASTICITY DEFINED

ELASTICITY DEFINED

$$e = \frac{\frac{\Delta X_1}{X_1}}{\frac{\Delta X_2}{X_2}} \quad e = \frac{dX_1}{dX_2} \cdot \frac{X_1}{X_2} = e \frac{\Delta X_1}{X_1} \frac{\Delta X_2}{X_2}$$

e.g. VALUES OF PRICE ELASTICITY OF DEMAND:

- 0** PERFECTLY INELASTIC - NO IMPACT OF PRICE ON DEMAND
- < 1** LESS THAN PROPORTIONATE CHANGE IN DEMAND
- 1** PROPORTIONATE CHANGE IN DEMAND
- > 1** MORE THAN PROPORTIONATE CHANGE IN DEMAND
- ±∞** PERFECTLY ELASTIC - INFINITE CHANGE IN DEMAND

The first form is the finite version of the expression. The second is the differential form, i.e. the value at a point in the scale of the determinant variable X2.

The value of elasticity can range between ∞ infinity. Elasticity is negative when the dependent variable decreases with a positive change in the independent variable. For example, when price increases demand generally decreases, so the price elasticity of demand would usually be negative. The price elasticity of

supply would generally be positive, because with increase in price the supply would generally increase.

When a variable is perfectly elastic with respect to another, a differential change in the independent variable causes an infinite change in the dependent variable. High elasticity may approach perfect elasticity as a limit. For example, the price elasticity of demand for some luxury goods and services, e.g. travel, is highly elastic.

When a variable is perfectly inelastic with respect to another a differential change in the independent variable causes no change in the dependent variable (elasticity = 0). For example, water use is highly inelastic. Perfect elasticity and inelasticity are theoretical concepts only, that do not occur in reality.

The forecast is developed by multiplying the elasticity by the change in the independent variable.

For a more detailed description of the mathematical methods of determining demand, see *Elasticity* (in Related Documents).

PRICE ELASTICITY OF DEMAND

PRICE ELASTICITY OF DEMAND

❖ **SENSITIVITY OF DEMAND WITH RESPECT TO PRODUCT'S OWN PRICE**

❖ **DETERMINED BY:**

$$e = \frac{\% \text{ change in demand}}{\% \text{ change in price}}$$

$$e = \frac{\frac{\Delta D}{D}}{\frac{\Delta P}{P}} = \frac{\Delta D \cdot P}{\Delta P \cdot D}$$

D demand
P price

❖ **APPLICABILITY: LIMITED TO SMALL CHANGES IN INDEPENDENT VARIABLE**

Price elasticity expresses the percentage change in demand for a product (or service) related to percentage change in its price. It is a forecasting tool that has applicability over a limited percentage change in price. The demand curve for an item (price as ordinate, quantity as abscissa) usually indicates that elasticity varies from point to point. The value of elasticity can range between infinity. For a straight line relationship between price and quantity the elasticity is constant.

Demand elasticity is usually high for non-basic items and low for basic items. Exporters of basic commodities are usually faced with low elasticity so that a pricing strategy is not effective. Elasticity is negative when the dependent variable decreases with a positive change in the independent variable. When price increases demand generally decreases, so the price elasticity of demand would usually be negative. The price elasticity of supply would generally be positive, because with increase in price the supply would generally increase.

When a variable is *perfectly elastic* with respect to another, a differential change in the independent variable causes an infinite change in the dependent variable. A horizontal line (large percent change in demand per percent change in price) indicates perfect elasticity. *High elasticity* may approach perfect elasticity as a limit. Demand for some luxury goods and services, e.g. travel, is highly elastic with respect to price.

When a variable is *perfectly inelastic* with respect to another a differential change in the independent variable causes no change in the dependent variable (elasticity = 0). This relationship would appear as a vertical line in the demand vs. quantity relationship. Demand for water is highly inelastic, although some packaged water products may have higher elasticity. Perfect elasticity and inelasticity are theoretical concepts that do not occur in reality.

INCOME ELASTICITY OF DEMAND

INCOME ELASTICITY OF DEMAND

SENSITIVITY OF DEMAND TO CHANGE IN CONSUMER INCOME DETERMINED BY:

$$e = \frac{\% \text{ change in demand}}{\% \text{ change in consumer income}}$$

$$e = \frac{\frac{\Delta D}{D}}{\frac{\Delta Y}{Y}} = \frac{\Delta D \cdot Y}{\Delta Y \cdot D}$$

D demand
Y consumer income

TYPE OF PRODUCT	INCOME ELASTICITY
HIGH QUALITY	POSITIVE
LOW QUALITY	NEGATIVE
CONSUMER STAPLES	POSITIVE AND < 1
LUXURY GOODS	POSITIVE AND > 1

PROJECT CONCERN: EXPANDING ECONOMY? INCREASING INCOME ?

The income elasticity of demand indicates the extent to which the demand for a product is sensitive to changes in consumer income. It is calculated in the same manner as that of price elasticity.

For high quality goods the income elasticity is positive - as income increases demand for high quality goods increases.

As income increases there is a diminishing demand for low quality as more affluent

consumers opt for better quality. The income elasticity for low quality good is therefore negative.

For *consumer staples*, income elasticity is positive, but less than one - there is not a large change in demand with respect to income; for luxury goods it is positive and greater than one - increased disposable income is applied toward more discretionary purchases.

This concept is useful to understand the impact of consumer income on demand. If change in consumer income can be projected, demand for a product can be estimated if the income elasticity is known.

Income elasticity differs among products, income groups and regions for the same product. Therefore, whenever it is possible to determine variations in per capita income by income groups and regions, the analysis should not be limited to the average per capita income in the whole national economy but should extend to occupational, socio-economic and geographical areas.

Some authors of demand studies overlook the fact that elasticity changes from one income level to another. Products commonly supposed to have a negative correlation to income can be positive up to certain levels of income. High income elasticity evident at lower income levels declines as high income thresholds are crossed. This is true of most products. In developing countries, these thresholds are not crossed quite so often over the life span of industrial projects. Nonetheless, the tendency for lower income elasticity with increased income is repeatedly found within lower income brackets.

The aggregate result will therefore depend on the income structure. The demand for refrigerators is low up to a fairly high level of income. This implies that the income elasticity of demand for refrigerators is low for low income population segments. Above these levels, the income elasticity rises and reaches a plateau. The demand for radios shows a similar pattern.

Income elasticity of demand is applicable for forecasting when the change in income is small. For example, if an increase in per capita income of 1% results in an increase in consumption of paper by 2%, the demand for paper in future years could be estimated by applying the income elasticity coefficient. However, as income level increases the elasticity will change.

An income elasticity based upon recent data should be applied only for short range forecasting. Over time the system under which the elasticity is valid will inevitably undergo change.

CROSS ELASTICITY OF DEMAND

CROSS ELASTICITY OF DEMAND

SENSITIVITY OF DEMAND FOR PRODUCT X TO CHANGE IN PRICE OF PRODUCT Y

$$e = \frac{\frac{\Delta D_x}{D_x}}{\frac{\Delta P_y}{P_y}} = \frac{\Delta D_x \cdot P_y}{\Delta P_y \cdot D_x}$$

D_x demand for product X
 P_y price of product Y

TYPE OF PRODUCT	INCOME ELASTICITY
SUBSTITUTES	POSITIVE
COMPLEMENTS	NEGATIVE
UNRELATED	ZERO

PROJECT DESIGN CONCERN: FUTURE PRICE MOVEMENTS OF RELATED PRODUCT

This elasticity indicates the extent to which the demand for product X is sensitive to the changes in the price of product Y. The elasticity is positive when the products are perfect substitutes. It is negative when the products are complements. For example, the demand for motorcycles could be negatively related to the price of petrol. For unrelated products, the elasticity is zero. If the project envisages manufacture of a product that has a significant level of cross elasticity of demand, the price

stability of the related products have to be examined.

When the complementary or substitutable products are identified, the demand forecast should be amended to provide for the impact of expected price changes in these products. This can be a major concern for the project designer.

PROMOTIONAL ELASTICITY OF DEMAND

PROMOTIONAL ELASTICITY OF DEMAND

SENSITIVITY OF DEMAND FOR PRODUCT X TO CHANGES IN ADVERTISING BUDGET A

$$e = \frac{\frac{\% \text{ change in demand}}{\% \text{ change in advertising budget}}}{\frac{\Delta D}{D} = \frac{\Delta D \cdot A}{\Delta A \cdot D}}$$

D demand
 A advertising budget

MUST BE POSITIVE. WHY?

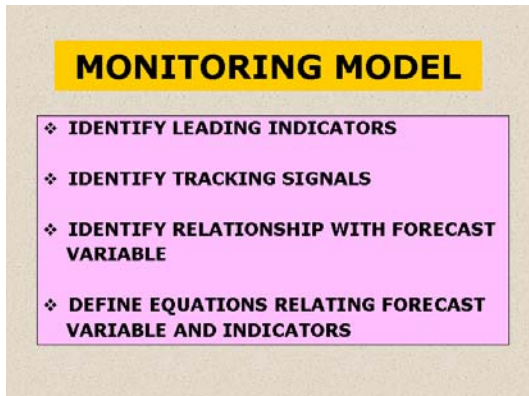
This elasticity indicates the extent to which the demand for a product is sensitive to the changes in the promotional efforts/advertising budget of producers. The data can be obtained by considering the past history of sales and advertising.

Under ordinary circumstances this elasticity would be positive. It would be inappropriate to consider additional promotional efforts if a negative return were anticipated.

The promotional elasticity is difficult to calculate because the impact of advertisement is a function of the advertising budget and also that of the efficacy of the message and the media utilized.

Project designers should attempt to determine what the effects of promotional efforts will be on demand for the product in general and on prospects of sales for the enterprise.

MONITORING MODEL



A model is developed that relates tracking signals to the phenomenon of interest, e.g. demand. The emphasis is not on explanation (although an explanation may be included in the analysis) - the method is really one of associating values and trends of the indicators with the forecast variables.

A leading indicator is a variable that changes ahead of other variables. For example, the activity level in the civil construction industry is followed by the demand for air conditioners. The level of activity in the construction industry is the leading indicator. It is widely held that the hemline of women's fashions in western countries is a signal on the future state of the economy. If so, the hemline is the leading indicator.

Demand for consumer durables is usually cyclical in the sense that it follows the economic cycle. Some of the leading economic indicators may be related to demand for automobiles: e.g. money supply, business inventories. When these indicators reach certain levels they may signal significant change in demand. Some indicators may bear a more current relationship to demand for automobiles, e.g. unemployment rate or government payrolls. The attainment of certain levels by these indicators may similarly signal a significant change in demand.

The problem of the analyst is to estimate the future trend of these indicators and when they will signal an effect on demand. The method is as follows:

- Identify the leading indicators
- Identify tracking signals, i.e. levels at which significant effects occur in the variable of interest
- Establish the relationship between the indicator and the variable to be forecast, and
- Define an equation that relates the leading indicator with the variable under forecast.

The analyst must then use the model for predicting the value of the dependent variable. Historical data on the indicators can be used for short range forecasting, but estimates of future trends in the indicators would be required for long-term forecasting.

FORECASTING DEMAND OR SALES

FORECASTING DEMAND OR SALES

- ❖ PRODUCE A MODEL
- ❖ TEST THE MODEL
- ❖ FORECAST INDEPENDENT VARIABLES
- ❖ EXTRAPOLATE

Produce a model: Any forecast is based upon a model, which can be oriented to the past, the present, and/or the future. The model generally relates variables of the external environment, and perhaps the internal marketing variables, to the variable to be forecast.

Test the model: A forecasting model should be tested where possible. The model might be tested against developments in an environment that is similar, but in a more advanced state with

regard to the industry of interest. The outcome of alternative forecasting methods can be compared to gain more confidence in the forecast.

Forecast independent variables: It is usually necessary to forecast the independent variables, those upon which the state of the variable of interest (e.g. demand or sales) depend. These forecasts may require the development and application of other models. For example, if a demand forecast is based upon future GDP estimates, a model to forecast GDP may be required, which can involve an entirely different set of variables.

Extrapolate: Any forecast is an extrapolation. Even the "naïve" approach, in which history is largely unheeded, depend to some extent on experience. The project is to be implemented at a point in time on the expectation of future events that are inevitably dependent upon ideas of how systems function, ideas that can not be entirely separated from the past.

MARKETING STRATEGY



A plan for approaching the market so that (1) potential consumers are aware of the existence of the product, what are its features and how those features can satisfy real or perceived needs, and (2) how the needs can be satisfied by the project or enterprise rather than the competition - a marketing strategy - is virtually a requirement for any enterprise functioning in a market system. This applies to enterprises regardless of size.

The extent of the market may be dependent on the marketing efforts of the project, i.e. new or expanded segments may result from the project's efforts to attract customers.

The project's will be exposed to an external environment that may be variously supportive and hostile, dependent to a great extent upon how well the internal nature is attuned to its features. An example of this is the attitude toward the market - will the project tailor its output to its own perceptions of need or to the need as expressed by its potential clients?

STRATEGIC PLANNING



A strategy is a plan for survival and growth. How does the enterprise, or project, move from the status quo to some fixed goal? Both the status quo and goal are states, or sets of conditions that prevail at a point in time. The overall strategy is the plan to make the transition from the status quo to the goal. The goal should define the desired state of the enterprise at some point in the future - market share and penetration.

Objectives are intermediate states. Objectives and goals are reached by action plans, one or more actions or activities that will facilitate the transition. A particular objective may have precedent objectives, those that must be achieved before actions can be initiated to move toward the objective desired. An example is Objective 4, which requires attainment of Objectives 1 and 3 (carrying out Strategic Action Plans 1, 4 and 7) to be realized.

In the context of a proposed investment project, the action plan or plans should be reflected in the business plan, which is an outgrowth of a feasibility study.

WHAT IS A MARKETING STRATEGY?



A marketing strategy is a plan for approaching and securing the target market in the face of competition. It includes the means and manner of informing potential clients of the product characteristics, encouraging them and providing a way to acquire and use the product.

Demand-supply gap: For a standard product understanding the gap that may exist between available supply and willing and able buyers might be attained from

analysis of statistical information. In this case the project analyst may decide to simply follow the lead of other producers by adding capacity just to fill the gap. There would be no need for an excessively creative marketing approach.

For innovative products the existing data may not serve. In such cases a further analysis of product features is necessary to estimate net additions to the consumer base. The innovation might change existing consumption patterns.

Consumer needs: A strategy is needed to address existing consumer needs or those created by information about product characteristics and advantages over alternatives or substitutes.

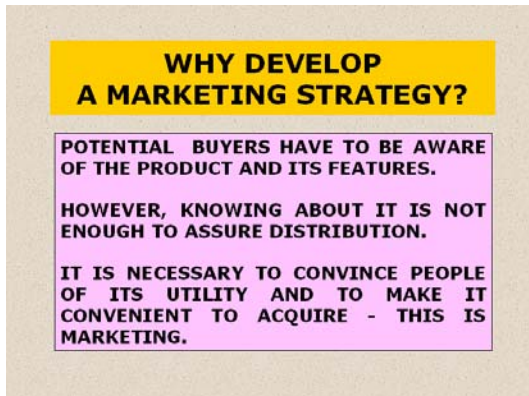
Many enterprises have only recently discovered the benefits of market orientation - listening to the voice in the market place to discern what is being sought, rather than attempting to foist on the market the product conception of the sponsors. That "the customer comes first" is an old adage, but one which has often been ignored. Customer needs should be the point of departure for the design of the project.

Competitors' strategies: The current strategies and programmes of competitors and their likely responses to a new entrant have to be taken into account. The marketing strategy should make sense in the context of the competitors' strengths and weaknesses and possible countermeasures.

External environment: The strategy for survival and growth should accommodate to the external environment to the greatest possible extent. If the marketing approach is to be deliberately obtrusive, then this should be the hallmark of the strategy so that everyone concerned is ready for the reaction.

Marketing strategy: Only when the external environment is understood and competitors' strategies taken into account can the marketing strategy for the project be formulated and a plan of implementation devised.

WHY DEVELOP A MARKETING STRATEGY?



Potential buyers have to be aware of the product and its features. A market analysis provides information on the product characteristics and the likely level of sales that can be anticipated by the project.

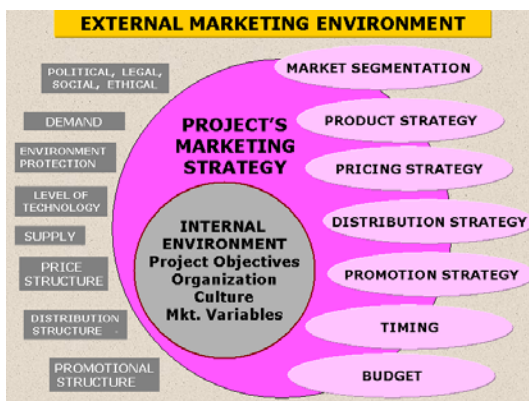
However, knowing about it is not enough to assure distribution. The achievement of sales targets is very much a function of the approach to marketing - the strategy of attracting buyers and making it possible and desirable for them to acquire

the product.

You can build a better mousetrap, but the world will not beat a path to your door unless they know about it. It is necessary to convince people of its utility and to make it convenient to acquire - this is marketing. Even though the product has superior features that would appeal to consumers, it is necessary to convince potential consumers of the utility of the product and to devise a strategy to assure the acquisition of the planned market share and for convenient means of delivery.

The marketing strategy involves informational and promotional approaches to the market. The competition will likely not stand still in the face of challenge from a newcomer.

EXTERNAL MARKETING ENVIRONMENT



The project or enterprise must function in an external marketing environment - existing demand; price structure; alternative supply; distribution structure; political, legal and social features; existing technology; environmental protections; promotional structure.

The marketing strategy is developed taking into account the external project environment (including those elements that might be considered part of the marketing environment). The project or

enterprise confronts this environment with its own corpus - its organization (structure and competencies) and culture, and how it exercises its options in regard to marketing variables.

Culture defines the constraints upon behaviour and actions of project staff inside and outside the organization and is a reflection of the aspirations or visions of the sponsors. There are some things that the sponsors are determined to do and some that they will not do, which are reflected in the expectations for the organization and staff.

The project designers have choices in regard to market segments to be targeted, and policies on product, price, promotion and distribution. There are also decision on timing - when and in what sequence to introduce marketing innovations - and the extent of the marketing effort, defined by the marketing budget. All of these decisions should be taken in the context of an overall strategy for achieving market share and the planned rate of market penetration.

MARKETING STRATEGY: CASE 1

MARKETING STRATEGY: CASE 1

RAPIDLY EXPANDING MARKET IN A HIGH-GROWTH INDUSTRY

• GOAL:	BUILD AND SUSTAIN ADVANTAGE IN FACE OF GROWING COMPETITION
• SITUATION:	GROWING MARKET GENERATES GOOD PROFITS, BUT REQUIRES LARGE RESOURCES TO CONTINUE GROWTH
• STRATEGY:	NEW PRODUCT INTRODUCTIONS, PRICE REDUCTIONS, PROMOTION, IMPROVED SERVICES

RAPIDLY EXPANDING MARKET IN A HIGH GROWTH INDUSTRY

GOAL: For an existing enterprise the goal is to sustain the company's advantage in the face of growing competition. A new entrant would seek to acquire market share, but would have to apply a strategy aimed at building a new consumer base and/or luring existing consumers away from present suppliers.

SITUATION: The growing market generates good profits, but requires large resources to continue growth. For the new enterprise plans should include a gradual increase in production capacity to accommodate their share of the growing market.

STRATEGY: The new entrant would attempt to differentiate its product, to offer a new product that would supplement an existing product, or target market segments that have not yet been addressed. Differentiation could be promoted through cultural or esthetic associations. Improved warranties and technical services could be offered.

MARKETING STRATEGY: CASE 2

MARKETING STRATEGY: CASE 2

SLOW MARKET GROWTH; MATURE INDUSTRY

• GOAL:	ATTAIN MARKET SHARE AND AND MAINTAIN EARNINGS WITH THE LEAST AMOUNT OF RESOURCE AND EFFORT
• SITUATION:	STEADY SALES, GOOD PROFITS
• STRATEGY:	INTENSIVE PROMOTION, PERIODIC PRICE DISCOUNTS, INNOVATIVE OPTIONS; DEVELOP BRAND LOYALTY TO ENCOURAGE REPEAT BUSINESS.

SLOW MARKET GROWTH; MATURE INDUSTRY

GOAL: For the existing enterprise the goal is to maintain earnings with the least amount of resources and effort. The new entrant would seek to draw market share away from existing producers.

SITUATION: Sales are steady, profitability is sustained by utilizing well-tested technology and methods of distribution. Competitors are in the process of improving productivity through application of technology and better use of resources.

STRATEGY: For the new entrant, intensive promotional efforts are needed to capture market share. It might be necessary to promote through a pricing strategy, perhaps introducing new and more efficient production technology. Another possibility would be to identify market segments whose needs and desires have not been addressed, for example the "high end" of the market. Planning periodic discounting might be a strategy for the new entrant. Innovative product features might be introduced (e.g. baking soda and peroxide in tooth paste). Brand loyalty would be promoted to encourage repeat business.

MARKETING STRATEGY: CASE 3

MARKETING STRATEGY: CASE 3	
MARKET GROWTH DECLINES; DECLINING INDUSTRY	
• GOAL:	IDENTIFY ADVANTAGE OR... THINK ABOUT ANOTHER PROJECT
• SITUATION:	UNABLE TO ATTRACT CUSTOMERS, EASY TO FALL BEHIND COMPETITORS
• STRATEGY:	APPEAL TO SPECIALIZED MARKETS, DEVELOP NEW PRODUCT APPLICATIONS, CUT PRICES BY CUTTING SUPPORT SVCS, OR ... EXIT THE MARKET.

MARKET GROWTH DECLINES; DECLINING INDUSTRY

GOAL: For the existing enterprise the goal is to identify an advantage, or failing that, to exit the industry. A new entrant would have to find an edge, perhaps economy of scale or alternative technology that could provide production cost advantages. If that is not possible it makes no sense to enter the business. Better to seek another project.

SITUATION: Both existing and new enterprises are faced with a stagnant or declining customer base. Maintaining profitability is achieved by not only maintaining customer base, but by increasing it to compensate for decreased profitability. Productivity improvement is a possibility, but expending large amounts to achieve it is risky in this environment. The new entrant is also faced with a great deal of risk. Only if there is some innovative aspect of the new production, or if a brand or trademark identification is accessible from parallel activities or by licensing can the new entrant expect to capture sufficient market share to make the enterprise worthwhile.

STRATEGY: The new entrant can appeal to specialized markets or develop new applications for the product. For example, one of the major skin care products in the United States was promoted as an insect repellent. A pricing strategy can be employed, but it would have to be justified by improved production technology (better productivity) or by reduced services. Brand identification can be employed if this is an expansion of an existing, well established company or if the brand identification can be secured through licensing.

ELEMENTS OF MARKETING STRATEGY



The marketing strategy is part of the plan for the survival and growth of the proposed enterprise. It should be an integral part of the overall strategic plan for the enterprise. Strategic decisions should be reflected in the project design:

Product: What should be the features of the product in relation to the consumer needs and the competing brands? How should the product be packaged?

Price: What should be the pricing approach considering the buying patterns of potential consumers and the prices of competitive products?

Promotion and advertising: How can customers be attracted and retained?

Distribution: What are the best channels for moving the product from factory to consumers?

Services: What kind of post-sale service network is needed to maintain the loyalty of clients?

Answers to such questions comprise the marketing strategy to be implemented through a marketing program for the enterprise. The program consists of the marketing organization, promotion activities and media, distribution and their associated costs.

The strategy would be affected by the product's phase in its Product Life Cycle. Another factor is the type of industry. Some consumer staples may be new introductions that will follow the general life cycle pattern as consumers gradually become adapted, as production capacity is added to meet demand and as distribution channels develop. Other products may be innovative, so that demand growth may be very rapid as consumers' eagerness expands rapidly.

Some examples of goals, situation of the industry and the strategies that could be successfully employed under the stated conditions, are described below. This is certainly not an exhaustive treatment of all the possibilities. The major point is that both the type of product and the nature of the market have to be considered in developing a marketing strategy.

Strategies that are relevant to the various phases of the Product Life Cycle are discussed more thoroughly in the Market Environment section.

PRODUCT



CLASSIFICATION: Products are generally classified as producer or consumer goods and services.

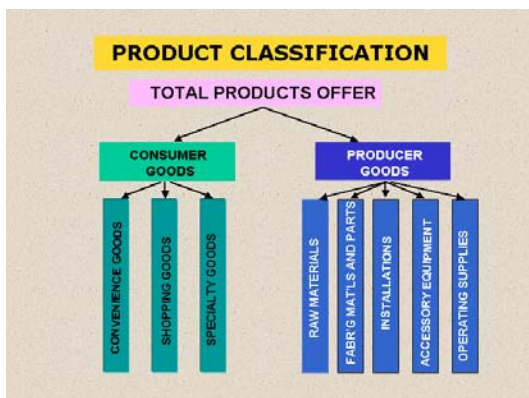
FEATURES: The characteristics of the selected products must be defined in terms of specific designs and performance standards or that produce defined results. The specifications may include the design, materials and standards, production and assembly methods and sequences and maintenance procedures.

PRODUCT MIX: The selected product line may address what is wanted or needed by one or more market segments. This may involve variations on a product class or different products oriented to various segments.

BRAND POLICY: The project may decide to establish its own brand or trademark identification or to produce generic products with brand identification established by the distributors or retailers.

PACKAGING: The size (volume, weight) of a product unit and how it is packaged for distribution and sale must be determined.

PRODUCT CLASSIFICATION



Consumer and producer can be classified on the basis of application.

Consumer products: Convenience products are purchased usually as an adjunct to other consumer activities (e.g. drinks at the beach) and are not subject to the same competitive pressures as normal consumer products. Shopping goods are those for which consumers seek the best combination of quality and price. Purchases of specialty goods are highly brand or trademark-dependent and are

predicated largely on the basis of consumer loyalty.

Producer products: These are raw materials or intermediates (processed materials, parts and components) that are consumed by downstream producers. Producer products also include capital and accessory machinery and equipment and operating supplies.

FEATURES



Features of the proposed product should be defined based upon consumer needs, their preferences, the competing brands and cost factors.

Standards: Reference to international or national quality and performance standards are a good way to instill consumer confidence. One source of such standards is the International Standard Organization (ISO). Other possibilities are American and the British Standards (e.g. ASTM) and specific industry standards.

Identical products: For a product that is similar or identical to one already offered to the market, it is useful to try to establish some features that distinguish the product from those of the competitors. The differentiation might be tangible or intangible. A tangible differentiation is one which is obvious when viewing the product at rest or in action - its colour, shape, texture or effect. For example, when paper napkins were first introduced, there was hardly any product differentiation amongst the competing brands. The introduction of absorbent paper napkin followed, giving a message of differentiation from the regular paper napkin. to the user. The next stage was introduction of tear proof paper napkin, and later the lint free paper napkin.

An intangible differentiation requires efforts by the promoter to communicate a feature that is not obvious. Cigarette companies have used this method of differentiation by stressing association of the product with desirable life styles.

Innovative products: Innovative products serve consumers in ways that they have not been previously served. For example, the change in computer operating system from DOS (disk operating system) to graphical user interface (Windows) was an innovation for computer users that had an explosive effect on demand for this type of product.

PRODUCT MIX

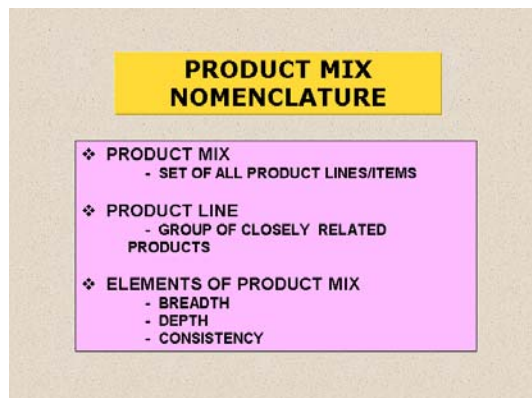


Range of products: Project designers must decide upon the range of products to be produced, their quantities and timing of production. The product line selected may respond to the wants or needs of different market segments of a particular product class or to different classes. Such decisions may be strongly influenced by the production process and its associated cost structure. Processes that share capital equipment for alternative products are favourable for a broader product line.

Absolute and relative quantities: Integrated production processes tend to place greater limits on the range of products. For example, in the petrochemical industry relative quantities of distillates can only vary within certain ranges. Where unit operations are not integrated a wider variety of choices in regard to quantities of production are possible.

Rationale: The decision may be based upon the profitability of each product possibility. In some industries it is important to maintain a full line of products on the basis of client convenience, even though some products may be unprofitable.

PRODUCT MIX NOMENCLATURE



Product mix: A product mix is the set of all product lines or items that the project proposes to manufacture. For example, an agro-based industrial complex could include both sugar and alcohol in its production program. Sugar could be produced in more than one form - crystals, cubes and powder. There could be two types of alcohol viz., potable and industrial, produced from molasses, a by-product of sugar production. Sugar in various forms and the types of alcohol together constitute the product-mix.

Sugar and alcohol are distinct product lines.

Product line: A group of closely related products. In the above example, sugar and alcohol are distinct product lines, each with a number of products included.

Elements of product mix: Breadth refers to number of product lines (two in the above illustration). Depth refers to number of variants in a given product line (three types of sugar). Consistency denotes the extent of relationship among the product lines. The relationship could be based upon the use of common production facilities, common marketing channels and similarity of end-user groups.

PRODUCT MIX IMPLICATIONS



Distribution network: When the relationships among product lines is minimal, each product line might require a different distribution network. Sugar is sold to food distributors or through supermarkets or grocery shops; industrial alcohol is sold through specialized channels. The employment of more than one distribution channel could have cost implications and call for additional efforts to manage the channels.

Promotion: A project proposing to operate in different market segments and product lines responding to different needs - may have to adopt varied promotional strategies with cost implications. For example, the message and the medium for promoting industrial alcohol is different from that of sugar.

Pricing strategy varied? Each product line could target market segments with different levels of sensitivity to the price, requiring the development of pricing strategies appropriate for each.

Inventory cost? Breadth of the product line affects the amount of raw materials and intermediates to be included in inventories. The task of inventory management becomes more complex and inventory carrying costs increase with increasing breadth. For example, in a project to manufacture electrical motors of a range from 0.5 Horsepower to 100 Horsepower different sizes of castings and other components are required. Higher lead times for procurement of castings and other items requires greater stocks of each type of casting with attendant procurement, storage and financing costs.

Risk factor - spread? Diversification spreads risk. When the project plans more than one product line the effect is to diminish somewhat the risk for the enterprise. If production and sale of one of a number of products or lines of products can keep the enterprise at or above the break-even level the risk for the enterprise is reduced.

PRODUCT MIX EXAMPLE

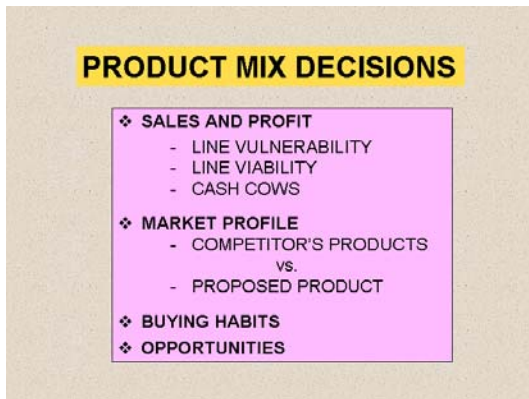


The share of sales and profit for each product is one of the key factors influencing product mix decisions. Consider the illustration of five products being produced by a company, each product having a certain share in the total profits and sales of the enterprise, as shown in the following table:

Product	% Sales	% Profit
1	40	38
2	20	18
3	15	12
4	16	24
5	9	9

Product 1 has the largest share of sales, but a lower proportion of profit. With such a high proportion of total sales the project is vulnerable to shortfalls in sales levels. Product 4 is a "cash cow", with a high proportion of profits relative to sales. Product 5 is marginally interesting, with a small proportion of sales and profits, and its viability as a component of the product mix could be questionable.

PRODUCT MIX DECISIONS



Sales and profit: A shortfall in sales of a vulnerable line during the operational stages could have substantial impact on the profitability of the project. In the example shown Product 1 contributes about 40% of total sales (twice as much as any other product) according to the proposed product mix, but its share in the profit might be lower than 40%, perhaps slightly lower. Any shortfall in its sales could substantially and adversely affect the project's viability.

The share of Product 4 in total profits is much greater than its share in total sales. The share of Product 5 in the total sales and profits is less than 10%. So long as a line profitable and does adversely affect allocation of resources for more profitable lines, it should be retained.

Market profile: At the project formulation stage the contribution (Sales revenue less Variable Cost) of each product in the mix should be estimated. 'Cash cows' could be the focus of attention, but several factors other than financial have an impact on product mix decisions. For example, the breadth and depth of the product line and other product factors such as quality, price and service are other dimensions of the image of the enterprise for potential clients.

Buying habits: Clients might find it convenient to purchase a number of related products from the same source, so deleting a product from the mix might lead to loss of business to competitors. Such decisions should be considered in view of competitors' product mix. The buying habits of potential consumers or clients could influence product mix decisions. These factors should also be taken into account in formulating diversification plans for an existing enterprise.

Opportunities: Having formulated the product mix, opportunities available to add on to the mix should be considered. Distribution channels for a proposed product could be used for some other product with low incremental cost. For example, an enterprise proposing to manufacture washing machines may consider adding a Domestic Mixer/Grinder as both products are targeted at the same market segment and could be distributed through the same channels.

BRAND POLICY



Generic or brand/trademark? One issue for project designers is whether to establish its own brand or trademark identification or to market generic products with brand identification left to distributors or retailers, which can be domestic or foreign companies.


Brand or trademark identification: There is a choice between establishing a new brand or trademark or marketing under one established by another domestic or foreign entity.

The decision on using a distinguishing brand name or trademark for the product depends on the cultural aspects of the marketing climate - whether or not it is possible to establish brand loyalty. In some cases this prospect is enhanced with the use of an international brand name. The project can purchase rights to produce according to the licensors process and other terms, and retain exclusive rights in the region or country. In most instances there are quality and production standards that have to be met. The cost of licensing and meeting international standards has to be weighed against the possible reduced market potential in its absence. This approach could save considerable resources that otherwise would be invested by the promoter to establish the brand name.

Legal implications: There may be legal implications of the use of a brand name. Product liability provisions of the laws and regulations of the country should be examined to understand the consequences in regard to using the licensor's or the project's own trade mark or brand name. In some cases international trade agreements permit production without consent of the holder of intellectual property (e.g. patents or designs), particularly when there is a national emergency.

Consumer reactions: Ultimately the decision with regard to brand name rests on anticipated consumer reaction. Establishing a brand name is not without cost, but if it is expected to enhance consumer loyalty then perhaps it is worth the effort. There are risks as well. If one product in the line turns out to be unsatisfactory it could affect prospects for the rest of the line.

PACKAGING



PACKAGING

- ❖ PROTECTIVE vs. PROMOTIONAL
- ❖ ENVIRONMENTAL ISSUES
- ❖ STATUTORY REQUIREMENTS
- ❖ COSTS

Protection vs. promotion: Packaging can have one or both functions of protection (during handling, transport and distribution) and promotion. Packaging for producer products (raw materials or intermediate goods) tends to be more utilitarian as the clients are generally aware of the product's characteristics and are not likely to be swayed by outward appearances. Even in this case, however, some attempts are made to promote the product by attractive packaging that delivers a message of quality and

reliability. Packaging for consumer products can respond to consumer preferences and also to promotional needs.

In regard to protection during handling up to the end user, packaging must maintain the product integrity and quality under all of the handling and storage conditions to be encountered.

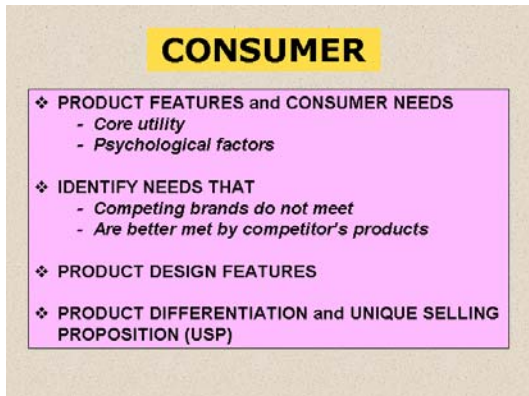
Environmental issues: Packaging designs will increasingly have to take into account the methods of disposal. Customers will be faced with added costs for packaging that can not be recycled or reused without disposal in landfills or into the atmosphere or bodies of water. Packaging choices that avoid these problems can improve product acceptability. Biodegradability of packaging materials is another consideration.

Some environmental issues may be covered by statutes or regulations, e.g. handling of hazardous materials.

Statutory requirements: Packaging may require printed information for consumers, for example date of expiry, date of manufacture or batch number.

Costs: Determining the means of packaging the product up to delivery to the end user has to be a balance between degree of protection and consumer appeal and the costs of losses in handling and transport.

CONSUMER



Product features and customer needs: A consumer buys a product to satisfy needs that are related to the product's core utility (its function) and its psychological appeal. For example, a television set may be purchased to satisfy needs such as access to information and entertainment (core utility). The decision on the brand might rest on the prestige associated with the brand name (psychological factor). When core and psychological consumer needs are understood the strategy can be devised to

satisfy them.

Identify needs: Consumer needs should be identified. The appeal to consumers should focus on product features that competing brands do not meet and the superior features of project output. The marketing approach could be silent on those features that are better satisfied by competitor's products.

Product design features: The product design is an integral part of the marketing strategy adopted.

Product differentiation: Uniqueness of the product is an important consideration for strategic purposes. Differentiation can be effected through product, packaging or distribution. Making potential consumers aware of these differentiating features becomes part of the marketing strategy. A Unique Selling Proposition (USP) - a package of decisions in which the marketing variables of product, price, promotion and distribution are uniquely defined to provide product differentiation - can be an effective means of attaining market share.

APPROACHES TO PRICING DECISIONS



Pricing decisions arise from customer perceptions. Value, real or perceived, determines what the price that the consumer is willing to pay.

Cost - based: The price is based upon the cost of production, the desired contribution (price - variable cost) and profit. To estimate profitability requires the fixed cost burden per unit of production. The contribution is not necessarily constant over all levels of production (non-linear variable cost). The

fixed cost burden is also dependent on the level of production. It may be necessary to determine the contribution and fixed cost at some average level of production anticipated over the planning horizon. Price is set at some margin above cost.

The major demerit of the cost-based approach is that the cost of production is not the problem of the customer but that of the producer. Ultimately, the product will be able to stand the test of the market only when its prices are in line with what customers are willing to pay.

Buyer- based: The buyer may dictate the price, particularly if the number of clients is limited. For industrial production, buyers have their own cost structures and profitability requirements that often fix maximum amounts that they are willing or able to pay according to their criteria. Consumers similarly are constrained in some cases by disposable income that can be allocated to certain purposes.

Consumer segments vary in the degree of price consciousness or concern. Some segments are extremely price sensitive, both in terms of low and high prices. For luxury goods a low price can be a deterrent to consumption. Some consumers equate quality with price - higher price, better quality.

Competitor - based: The competitor's price is often a benchmark for the pricing decision. However, it is likely that the prices set by competitors' operating costs are relatively low enough to justify their prices. Profitability is enhanced when the project's productivity is greater than that of the competitors, or sacrificed when it is lower.

One or more of the competitive brands could be under-priced due to ignorance/complacency in regard to willingness of consumers to pay. Many companies in developing countries do not maintain accurate costing systems, particularly when the product line is extensive.

Channel price buildup: Analysis of the mark-ups along the distribution channel can provide an indication of an appropriate ex-factory price. Starting from the consumer price, the mark-ups at each level in the channel, taking into account both costs of handling and distribution and profit margins, can establish the maximum ex-factory price.

Statutory or regulatory: In some industries, e.g utilities, price is regulated by legislative or administrative authorities. The goal of the new project could be to be lower operating costs or to expand the customer base by addressing the needs of market segments or regions presently not being served.

PRICING STRATEGIES



Strategies on pricing can be related to the enterprise objectives, production cost, competitors, identified market segments and the consumer profiles, or relationships between price and demand.

Rapid skimming: When demand is high and there are constraints on supply (a "sellers' market") the project may find it advantageous to skim profits rapidly by taking advantage of the demand-supply relationship. In this case the true equilibrium price (the price if supply could

be added without constraints other than price) will not be realized. For a period of time, determined by the nature of the supply constraint, the demand price is fixed by the supply. This involves pricing the product at a relatively high level so as to generate maximum margins rapidly. The approach is relevant when:

- The product is new or novel offering distinct advantages to the customers
- Customers are willing to pay the asking price
- Small quantities of the product are to be produced
- Customers equate price with quality

Rapid penetration: Aggressive pricing relative to competitors is a strategy for rapidly securing market share and for increasing the level of demand when the project's planned output is a significant portion of the total market. The product is priced lower than competition so that potential customers are encouraged to make an initial purchase - repeat purchase being a function of consumer satisfaction. This approach is followed when an enterprise wishes to capture a large part of the market share under the assumption that as production volume increases, the fixed cost gets distributed over a larger number of units leading to lowering of total unit costs. The approach works in tandem with aggressive promotional efforts. It is relevant when the project has high economies of scale.

This strategy is easier to carry out when the expected market share is low (huge market, with economic scale possible at small market share). If it starts eating into revenue of competitors there is more likelihood of a response.

Slow penetration: This approach is similar to rapid penetration but for the difference that the enterprise does not plan to carry out an aggressive promotional campaign. When the economy of scale is significant, but the profit margins are relatively narrow, this approach is relevant.

Psychological: The psychological profile of clients can be the basis for pricing strategy. Price conscious consumers can be lured, for example, by discounts. The official price is set at an artificially high level, but discounted to give the impression of a "bargain". In some instances price is equated with quality calling for relatively high price levels to establish and maintain the image of the product.

Prices ending with odd numbers are common, especially for consumer goods. A product is priced at \$19.95, leading consumers to perceive the price is in the range of \$10 rather than \$20. Studies indicated that Circular numbers (8 for example) have a more soothing impact on human minds than angular numbers (7 for example).

Discriminatory: Pricing can differ by market segment or region. In some industries in developing countries, tourism for example, goods and services provided to expatriates are higher than for nationals. A pricing strategy to maintain the loyalty of major clients sets favorable prices for such clients, including quantity price breaks. Another basis for discriminatory pricing is the economic status of the region. Pricing is set according to varying willingness or ability to pay for the inhabitants, depending upon the general level of wealth and income.

A product could be priced at two or more different levels depending on the point of purchase, the customer segment and the time (season) when the sale is effected.

A product sold in a down-town retail outlet could be priced lower compared to the one sold at a fashionable shopping centre - the difference in prices being more than proportionate to the difference in selling costs. During festival seasons, certain consumer products could be priced low with the expectation of generating extra sales volumes.

Loss leader: Prices for a portion of the product line can be set at an artificially low level to attract clients to the entire product line. This is also applicable to export markets.

PRICING WITH BREAK-EVEN ANALYSIS



The purpose of this analysis is to determine the price level, based upon price-demand relationship, that will yield the highest profit. Such pricing decisions are only available when the project is a major influence upon market prices, a situation that would not prevail when there is considerable or aggressive competition.

In this example the Variable Cost of production (VC) is 30 (per unit). Fixed Cost (FC) for the project amount to 250.

The expected sales level for 4 price levels is shown in the table.

Demand (D) at each price (P) is determined from a demand-price relationship. Revenue (R) at each price is D multiplied by P. The Contribution (C) at each price level is the difference between P and VC ($C = P - VC$). The Break Even Point (BEP), in terms of units, is determined by dividing the FC by C.

The total cost (TC) at each price level is the FC (250) plus the product of VC and D. Profit is $R - TC$.

In the graph the expected revenue R is shown as a small circle on the revenue line for each price. The profit is the difference between expected revenue R and total cost TC. In this example, as seen in the chart above the graph, the optimal price is 100 (profit is a maximum of 100).

PROMOTION



Products have to be promoted - knowledge of their availability and features usually do not just happen. Word of mouth is an inefficient and unreliable means of making potential consumers aware. Some ideas about how the project's output can be promoted. Incentives, mostly short term, can be presented to potential consumers to stimulate demand. "While advertising offers a reason to buy, sales promotion offers an incentive to buy" (Kotler, "Marketing Management", 1998.)

Trade shows and expositions: Products can be successfully launched and promoted at well-publicized trade shows and expositions. Demonstrations of the product, perhaps samples or trial applications can be offered to potential consumers.

Media advertising: Presentation of the company's product/service through various advertising media is a principle method for stimulating or creating demand and market share. The project design may include plans for radio, television and newspaper advertising and electronic (internet) sites. Other printed media can be used, such as circulars (handouts) distributed either through the mail or at concentration points for potential consumers, telephone books. The Worldwide Web can be an effective means for promoting almost any type of product. The project can set up a web page for this purpose.

Free or no-risk trials: One powerful promotional strategy is to offer free or no-risk trials to potential consumers.

Lobbying: The political and administrative establishments can be fertile grounds for product promotion, particularly when there is some concern for safety or other health hazard from the use of the product. An example is the fire alarm industry, where local government bodies were successfully lobbied in many cases to make use of the product mandatory.

Warranty and other services: A promotional tool used successfully by producers of durable goods is a liberal warranty policy. This has been used to launch sales of unfamiliar brands, for example in the automobile industry. Costs for providing replacements for defective products according to the strategic policy should be included in the project plan. There is usually a need for a service network that would be set up during the implementation phase and maintained during operations. Although service operations may be self-sustaining to some extent, there may be costs involved. For example, if the enterprise plans to provide technical support there would be costs for setting up and maintaining the system.

Technical service: One method of appealing to consumers is to set up an effective technical service program providing easy access of information or assistance in solving product-related problems.

Public Relations (PR): This approach to projecting or protecting the image of the a company or its products involves relations with the press. PR is targeted to influencing opinions within the larger client system consisting of customers, suppliers, trade channels and all those whose actions and opinions are likely to have an impact on the achievement of the project's objectives, rather than directly contributing to sales. Information is offered about the company, corporate communications (within the organisation and among the client system), and sponsorship of various events (sporting events for example).

AFTER SALES AND WARRANTY SERVICES



After-sales and warranty services can be included as part of the strategic marketing plan. The appeal to potential consumers can be based on technical support and repair services that are superior to the competition, particularly for durable goods.

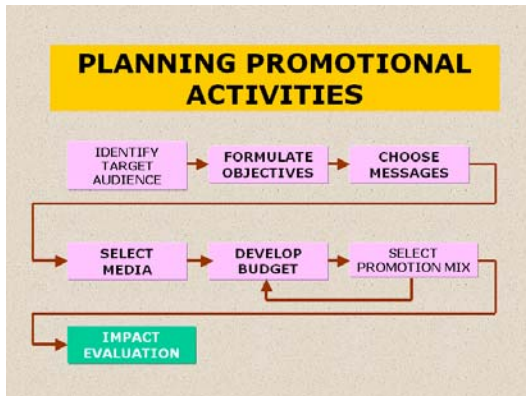
After sales service: For producer goods and consumer durables, the quality of the after sales service network can determine the success of a project. Services to customers of capital goods can enhance

prospects for market penetration and survival in the face of intense competition. After sales services can include technical advice, repairs and provision of spares and consumable components. Unit operations that produce parts that need frequent replacement must be adjusted to reflect this part of sales. Production facilities or other sources of consumable components (e.g. printer cartridges) should be included in the project design.

Warranties : Consumers increasingly seek protection from a producer in regard to the durability of its products. A warranty, which is an agreement by the producer to repair or replace the product within a defined time period if it degrades or becomes otherwise unserviceable, is often used as a promotional tool. The warranty policy to be selected, depends as a starting point upon the extant industry practices and the value that the potential consumers place on the warranty (as determined from a market assessment exercise). The cost of repair and replacements during the warranty period should be assessed.

Spare parts: Advising potential consumers of easily available spare parts may be an important component of the strategic plan, particularly for imported products.

PLANNING PROMOTIONAL ACTIVITIES



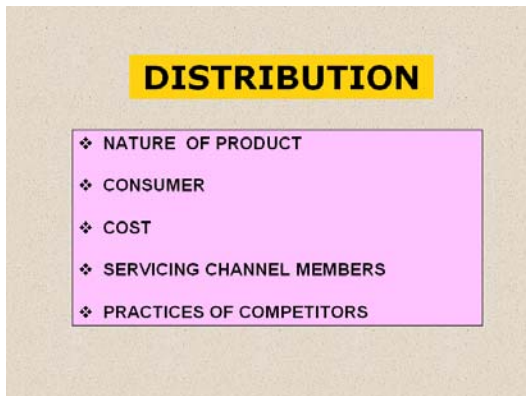
The marketing programme will include planning promotional activities during the operations phase within the strategic framework.

The audience may include potential customers, local communities, suppliers, officials of industrial regulatory and promotion institutions (public and private). The process includes the identification of the target audience, whose segments may require differing strategies. This can further be refined into

sub-objectives such as changing consumer attitudes or influencing the consumer to act in a particular manner. Having defined the objectives, the message to be communicated and the promotional mix (media and other activities) can be decided. Then the tentative promotional budget can be estimated and refined through one or more iterations involving impacts vs. costs.

Budget estimates for promotion will include both capital and operating costs. Design and implementation costs prior to commercial operation can be capitalized. Operating costs during the production phase will include personnel, facilities and media fees.

DISTRIBUTION



The advent of direct marketing and E-Commerce has added distribution options. Generally the longer the distribution channel, the more expensive to distribute the product. The channels selected should be consistent with other strategic decisions. If the project involves a fast-growing market in a high-growth industry (Case 1 above), for example, the channels should include high volume, low margin outlets. The following are determinants of the channel design.

Nature of output: At the retail level, the nature of the product often determines what outlets are accessible. Staples and other standard consumer goods can be sold through a variety of outlets whereas specialty goods are sold only through 'quality outlets'. A manufacturer of an expensive wrist watch may not prefer to use supermarkets or watch dealers as point-of-sale. With a view to lend exclusivity to the product the project may opt to sell only through up-scale jewellery shops.

Industrial goods (raw materials and components) are generally sold directly to downstream producers. Some industrial goods for small manufacturers are sold through specialty wholesalers.

Gathered forest or horticultural products are often sold to dealers at points of concentration who then sell to wholesalers or directly to manufacturers.

Traded goods have more complex distribution channels - exporters and importers and other intermediaries on both ends of the trade.

Consumer: The preferences, number and geographical spread of customers influence the choice of distribution channels.

Preferences: Customers may prefer to buy directly from the manufacturer on the basis of the perception of assured product quality and price. Some computer manufacturers, for example, have successfully marketed with this direct approach. Some private internet service providers sell 'installation and access packs' through several retail outlets (including book sellers) making it easy for potential customers to receive the materials necessary to set up access.

Price-conscious consumer segments are sometimes willing to sacrifice service for price. Formerly some durable goods manufacturers sold only through specialty outlets featuring service but switched over to large discount outlets to gain market share or to follow competitors.

Consumers are increasingly attracted to the internet. The range of products that can be marketed in this way is practically limitless. The sale is consummated on the company's web site and delivery is effected either through local retail outlets or through public and private delivery services.

Number and geographical spread: Unless media marketing is the only selected mode, setting up dealerships, or marketing through wholesalers may be necessary if there is a wide geographical area in which the product is to be distributed. A large number of potential customers spread over a wider geographical area may entail use of longer distribution channels to achieve reach. Such long distribution channels may be expensive given that each intermediary in the channel has to be compensated. Further, such an intensive distribution strategy may lead to loss of control over several factors such as, display arrangements and service at the point-of-sale.

Cost: For the project the cost of distribution include the packaging, handling and transport to the point of sale. There may be costs for setting up the channel, perhaps facilities that are needed during the transport stage and also at the point of sale. Producers of commercial gases, for example, must often bear the cost of setting up delivery and storage facilities at the customer's plant. The price build-up, handling and transport charges and margins of channel should be determined to assist in developing the strategy.

Servicing channel members: When wide distribution of the product is planned, it may be prudent to set up servicing intermediaries in local areas rather than providing services at the plant. A selected number of dealers authorized to sell the product who are located in some or all of the areas in which the product is to be distributed can also service the product. These services may include technical advice, warranty replacements and repairs. Decentralized service facilities tend to be more costly.

Issues to be addressed in considering the members or participants in the channel are availability, suitability and the scope of responsibility.

Availability and suitability: Members of a distribution channel can include importers and exporters, transport media, dealers, wholesalers and retailers. Wholesalers take possession of the product and assume responsibility for marketing and distribution to consumers outlets or retailers. Some wholesalers also maintain retail outlets. Retailers market the product directly to consumers.

A short distribution channel would generally require servicing a large number of retailers with more control by the project; a longer channel may involve a limited number of dealers or wholesalers with less control over marketing and distribution approaches. Availability of intermediaries, their infrastructure facilities, their image among potential customers and the quality of their sales force are to be considered.

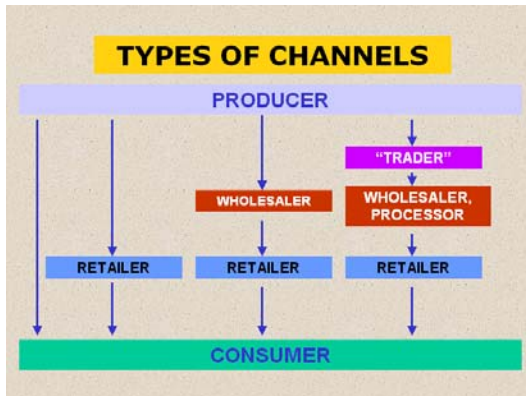
Scope of responsibility: The responsibilities of intermediaries have to be defined. A member of the channel could be willing to push the product (recommending the product to customers) in return to relatively higher commission that could add to distribution cost. The intermediary may be willing to accept consignments (in exchange for higher commission) thereby reducing the warehousing problem for the producer.

Ultimately all the necessary functions must be covered, but who does what can to some degree be decided by the project. Associated cost and benefits have to be identified and logical decisions made at the project formulation stage, keeping in view customer preferences, the reach and other such factors.

Practices of competitors: Distribution practices of competitors may be the foundation upon which a distribution policy is built. One approach is to follow a successful practice. If the channel is somehow restricted or closed for a new entrant, alternatives may add a distinct character to the new product. The internet is one answer that many new enterprises have employed.

Accessible channels may influence product quality. Products that are of high quality relative to the competition could be distributed through selected dealerships rather than the mass marketing channels of the competitor. Conversely, a relatively average quality product could be mass marketed through discounting or other mass retailing outlets.

TYPES OF CHANNELS



Distribution is the process of transferring the product from the producer to the consumer.

'Direct selling' involves delivery directly from producer to consumer, either through the producer's retail outlets or through sales agents booking orders from buyers. In either case the product moves directly from producer to consumer. This approach has been utilized when buyers are few and/or are clustered in a manageable geographical area. Through

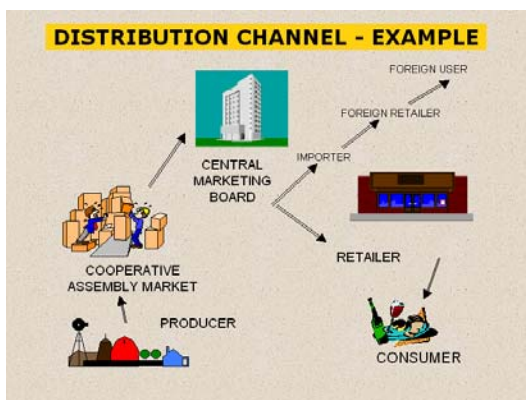
the internet, and to facilitate closer interaction with the customers, a producer can sell directly to many consumers spread over a wide geographical area

Another approach is to sell the project output to wholesalers, who then assume responsibility for further distribution efforts and costs. Wholesalers maintain warehouses and perhaps transport facilities. The advantage to the producer is a less complicated distribution problem, but there is a corresponding loss of control over marketing, promotion and customer services. This approach is selected when it is not feasible to manage a large number of retailers required to service a large number of potential customers who are geographically widespread.

Some producers sell to retailers. This system is a bit more complicated in terms of the number of points of sale for the producer, but there are cost and control advantages. Franchising, or licensing the right to sell under the brand or trademark, is a way to maintain tight controls over the manner of merchandising. Producers specify virtually all aspects of the retailing operation: price, promotion and retail processing.

For industries with small producers, traders may be involved in the chain. These are dealers who concentrate quantities from the small producers and then sell either to wholesalers or downstream processors.

DISTRIBUTION CHANNEL - EXAMPLE



An example of a fairly complex system of distribution for cheese that is both exported and sold in domestic markets is shown. In this case there is more than a single distribution channel.

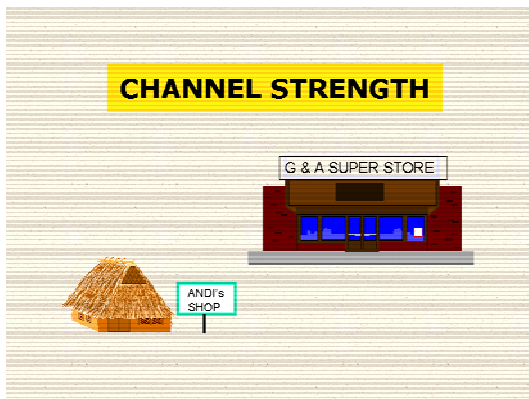
A producer of cheese may sell to a central marketing board through a cooperative that warehouses product from a number of small producer members. The cooperative usually operates under rules established by the members, which can involve actual sales or consignment. The

cooperative sells to a Central Marketing Board (CMB), which assumes responsibility for exporting and for domestic distribution.

The CMB reaches overseas consumers through its exports to local importers, who in turn sell either directly to the consumer or through wholesalers or retailers. The CMB serves the domestic market through sales to local retailers.

The price structure for the two distribution channels are often quite different - types of intermediaries, their mark-ups, handling and transport costs. Local sales may be subsidized, particularly staple goods.

CHANNEL STRENGTH



Distribution channel alternatives available to the project designer may differ in terms of strength, the ability to sustain the anticipated volume of the project's output.

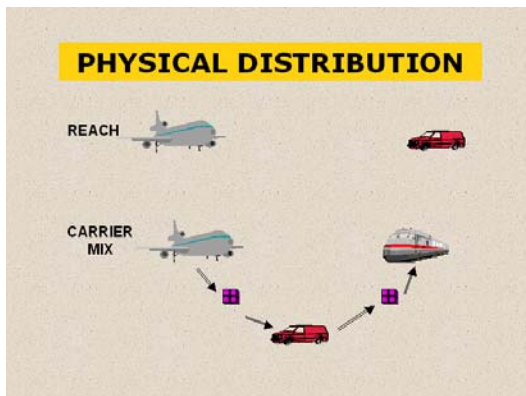
Each of the components in the distribution chain must be able to maintain the level of anticipated throughput. The weakest component, or link in the chain, defines the strength of the entire channel. If selected wholesalers, distributors, dealers or retailers are not capable of handling the anticipated volume it would be

necessary to appoint additional agents so that the aggregated capacity is sufficient.

Some channel components are inherently stronger than others, a factor that may affect pricing and other sales aspects. At the retail level, discount superstores attract many more potential consumers than small convenience outlets. They are fewer in number and offer goods usually at attractive prices, which are reflected in the prices that they are willing to pay suppliers that are compatible with their own profitability goals. Channeling goods through such outlets usually involves discounting and stringent account servicing conditions.

How components of the distribution channel are able to bear up under adversity is an important consideration for project designers. All climate zones experience disruptive weather patterns, for example. Channel elements have to be selected that can maintain service under a wide variety of weather conditions.

PHYSICAL DISTRIBUTION



The choice of modes of physical distribution is a function of cost, time and reach. Timing is often an important determinant of the proper type of physical distribution. This is true for perishable goods and also for seasonal goods. For example, readymade garments for autumn wear must hit the retail showrooms a couple of weeks prior to the season. Given the fast changing world of fashion, a producer might have a short lead time to produce the garment and to get it to market in a timely manner. Air

transport may be the best choice although it is costly.

Products with large volume or weight relative to value are usually constrained to surface modes of transportation. A combination of railroad and highway may be appropriate for distant markets of these types.

Competitors' modes of physical distribution may be an important determinant in this decision. It is one factor that has to be considered in conjunction with those previously mentioned: cost, timing and reach. The optimal decision would tend to maximize an advantage for the project. Some weighting system can perhaps be employed in making these decisions, taking into account all the variables and the criteria deemed most significant by the sponsors.

MARKET ASSESSMENT REPORT

MARKET ASSESSMENT REPORT

CONTENTS

- ❖ MARKET ENVIRONMENT
- ❖ COMPETITION and SUPPLY
- ❖ DEMAND ESTIMATION
- ❖ MARKET SEGMENTS
- ❖ MARKET SHARE
- ❖ MARKET STRATEGY
 - PRODUCT
 - PRICING
 - PROMOTION
 - DISTRIBUTION
- ❖ MARKETING PROGRAMME

A report by a consultant responsible for the market assessment and development of a marketing strategy should be presented to the project sponsors. The content and format for presentation of the findings of a market study depend, to some extent, upon the activity level of the proposed enterprise, the nature of activity and the objective of market assessment exercise. The market assessment report should cover the following:

Market Environment:

- Government, legal, social, ethical policies and practices and trends
- External demand
- Environment protection
- Level of technology
- Supply structure
- Price structure
- Distribution structure
- Promotion structure
- Indicate the existence of any controls on prices and product movements.

Competition and supply:

- Identify major competitors.
- Indicate their strengths and weaknesses.
- Indicate the product features and USP of competing brands.
- Compare the proposed product features with that of competing brands.
- Explain the basis of competition, i.e. how the product features respond to the competition.
- Indicate the approaches to developing a competitive edge.
- Broadly describe the strategies to manage competition.
- Discuss trade practices of competitors including credit facilities, warranties and costs.

Demand estimation:

- Explain the process of data collection. In case primary data collection is involved, describe the process indicating the sample plan. Enclose copies of questionnaire.
- Provide indication of the market share of competing brands.
- List determinants of demand and indicate the proposed strategy in regard to controllable factors (e.g. if after sales service is a major determinant, explain its features and effects).

- Provide details of statistical data and tools used to forecast demand. For time series data, describe calculations and projections. For correlation models, describe and justify independent variables, the nature of the model and validity of forecast. Provide rationale for using a particular technique to forecast demand.
- Discuss the possibilities of emergence of substitutes.
- Discuss the possible impact of new technologies in the offing.
- Discuss trends in consumer tastes and preferences.

Market segments:

- Describe the profile of the target segment/s
- Provide rationale for targeting a given market segment
- Specify the geographical coverage
- List consumer needs as determined from market study.

Market share:

- Basis for estimating market share by segment

Marketing strategy:

Taking into account all of the above, provide an overview of the marketing strategy to be employed by the project to enter the market and manage the competition - how market share and penetration will be attained in the competitive environment. Broadly describe the strategies to cope with the expected changes in the environment. Provide the rationale for the selected trade practices. Discuss how marketing variables are employed.

Product:

- Indicate applicable standards and government regulations, if any.
- Detail the specification of the proposed product/ service.
- Relate information on competing brands and consumer preferences to the proposed specifications.
- Indicate the Unique Selling Proposition (USP - see Consumer) and link to consumer needs as determined from market study
- Describe present and possible applications of the product.
- Provide details of substitutes and comparison with the proposed product.
- Indicate the nature of packaging, its rationale and cost.
- Describe the rationale for the product mix.

Price:

- Provide information on the price structure of competing brands.
- Indicate the objectives of pricing, the approach to be adopted, the price levels and rationale.

Promotion:

- Discuss the approaches used by competitors for attracting and retaining customers.
- Describe the proposed promotional strategy substantiated by the information gathered from the market study.
- Provide and analyse costs of promotion.
- Describe promotional measures prior to commercial production and costs.

Distribution:

- Indicate the current practices and any innovative approaches used by competitors.
- Specify the distribution channel and rationale.
- Indicate the cost of distribution and management of the channel.

Marketing programme

- Describe the marketing organization, marketing activities and estimated costs during each phase of project development, operations and decommissioning (if appropriate).
 - Describe the sales forecast, as predicated upon determinant factors such as product mix, plant capacity and seasonal factors.
 - Describe the sales programme
-

MARKETING PROGRAMME

MARKETING PROGRAMME

- ❖ **ORGANIZATION**
- ❖ **DISTRIBUTION**
- ❖ **PROMOTIONAL ACTIVITIES**
- ❖ **SALES METHODS**
- ❖ **AFTER SALES SERVICE**

A marketing programme is the means of implementing the project's strategy. The programme is set up during planning and implementation phase. Some and operations phases should be included in the study. During implementation the strategy is developed and the organization designed and set up. During operations the marketing program consists of promotion activities and carrying out distribution functions - servicing distribution channels as necessary and providing customer services.

Organization: During the early stages of project implementation, perhaps even during the construction phase, a marketing organization may have to be designed and set up. The organizational design will include positions, descriptions of responsibilities, structure and compensation. All costs for maintaining the organization should be estimated and included in the financial analysis. Costs associated with various phases of development may differ. For example, setting up the marketing organization may entail one time costs while those in the operational phase will be recurring.

Distribution channels: The marketing program will include establishing distribution channels and any maintenance and service that may be necessary during the operations phase for maintaining access and smoothly functioning channels.

Promotional activities: Setting up the promotional effort will involve designs and establishing media connections. During the operational phase media designs will often require updating or revision so that there may be recurring design costs. Media rental costs should be included as appropriate.

Sales methods: As part of the marketing programme, sales methods should be selected, e.g: personal selling - Face-to-face selling traditionally carried out by having members of the sales force visit the potential customers and make presentations with a view to generate sales; direct marketing - does not involve face-to-face contact between the customer and sales force (mailing brochures to potential and actual customers, telemarketing, electronic marketing).

After sales and warranty services: The network of after-sales and warranty services has to be set up and maintained. This may involve arrangements with distributors or service facilities. There are also costs of repairs and replacements covered under warranty.

OBJECTIVES OF MARKETING PROGRAMME



A marketing programme is the means of implementing a market approach or strategy.

Generate sales: The major component consists of promotional devices and activities designed to foster consumer loyalty to the product and to the enterprise with the ultimate objective of generating sales. Promotional efforts via mass media are directed towards various stages of purchase decisions starting from generating awareness among the

potential customers about the availability of product, its features and benefits. Awareness should then lead to the potential customers developing interest in using the product that, coupled with a desire to acquire the product, leads to the action of purchase transactions.

Build company's image: Promotional measures can be oriented toward particular segments to effectively build the image of the company. The image building process is most likely to have long term implications - ability to tap capital markets for example.

Generating brand loyalty: Long term benefits can be derived from promotional efforts by building brand loyalty among the potential customers.

PRODUCTION PROGRAMME AND PLANT CAPACITY

PRODUCTION PROGRAMME AND PLANT CAPACITY

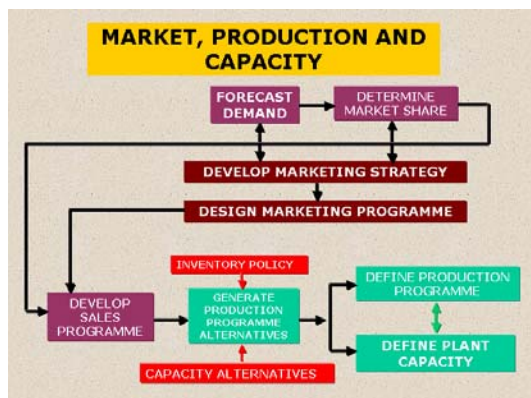
From the market analysis an estimate of demand is obtained. An estimate of market share and rate of market penetration is developed in conjunction with the marketing strategy to be employed. This information provides a means of estimating the sales programme, which defines the products to be sold in terms of quantities and timing. The sales programme provides the scope of the production programme, considering inventory policy and capacity alternatives. Inventory and capacity tradeoffs lead to

the selection of optimum capacity in terms of cost and satisfaction of the sales demands. Once the capacity is decided, the definitive production programme can be determined. The production programme and plant capacity are linked so that one can not be decided without the other.

Market analysis leads to the design of the production programme and selection of plant capacity. The plant capacity should be determined from analysis of the sales projections coupled with technology issues of scale and timing. Scale refers to the installed capacity of the plant. Timing defines the amount to be produced in each period and can be optimized dynamically (over time) considering the varying (over time) costs of production and the cost of maintaining inventories. The importance of this analysis can not be overstated.

Under-capacity can result in lost sales or inordinately high production costs. Over-capacity represents idle capital. The production programme and plant capacity should be determined considering the sales projections in an iterative process that seeks to optimize the use of capital and the benefits to be derived for the project from satisfying the needs of the market.

MARKET, PRODUCTION AND CAPACITY



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**RELATED
DOCUMENTS**

NORMAL DISTRIBUTION

The Normal Distribution (or Gaussian Distribution) describes the probability of occurrence for many phenomena in a natural population and in economic systems. Other types of distributions approach the Normal Distribution, e.g. the binary distribution, when the size of the population is large. The Normal Distribution has basically two parameters: *mean* and standard deviation (the slide shows a particular case, the Standard Normal Distribution, with mean = 0 and standard deviation = 1). Another is the variance, but it is very simply related to the Standard Deviation.

The mean is the weighted average value of the phenomenon. As an example, for a population of 20 people of ages between 18 and 28: 1 each of 18-20, 28; 2 each of 21-25; and 3 each of 26, 27. The mean age of the population is:

$$\mu = \bar{X} = \frac{\sum n_j X_j}{\sum n_j} = \frac{\sum n_j X_j}{N}$$

$$\bar{X} = \frac{1*18 + 1*19 + 1*20 + 2*21 + 2*22 + 2*23 + 2*24 + 2*25 + 3*26 + 3*27 + 1*28}{20} = 23.7 \text{ years}$$

The symbol μ is usually used for the *population* mean. The *standard deviation*, signified by the symbol σ , measures the amount of dispersion of data. The variance, σ^2 is calculated as the mean squared deviation:

$$\sigma^2 = \frac{\sum (X_j - \mu)^2}{N}$$

$$= \frac{\sum X_j^2 - \frac{(\sum X_j)^2}{N}}{N} = \frac{11394 - \frac{474^2}{20}}{20} = 8.01$$

$$\sigma = \sqrt{8.01} = 2.83$$

Rather than survey an entire population, usually inferences are drawn from a *sample* of the population. The *sample mean* and *sample variances* are determined as follows:

$$\bar{x}_j = \frac{\sum x_j}{n}$$

$$s^2 = \frac{\sum (x_j - \bar{x})^2}{n-1} = \frac{\sum x_j^2 - \frac{(\sum x_j)^2}{n}}{n-1}$$

$$s = \sqrt{s^2} = \sqrt{\frac{\sum x_j^2 - \frac{(\sum x_j)^2}{n}}{n-1}}$$

As an example, suppose a sample of 5 individuals is drawn from a population. Their ages are 22, 26, 25, 21 and 19. In this case the statistics *mean* and *standard deviation* are:

$$\bar{x} = \frac{22+26+25+21+19}{5} = 22.6$$

$$s^2 = \frac{2587 - \frac{113^2}{5}}{4} = 8.3$$

$$s = \sqrt{8.3} = 2.88$$

BINOMIAL DISTRIBUTION

Another special kind of distribution that may be important for sampling issues is the Binomial Distribution. In this type of distribution there are only two possible outcomes of a trial, for example where a respondent answers either yes or no. When the population is relatively large, the binary distribution approaches a normal distribution in the sense that samples drawn will have the mean (e.g. number of respondents answering "yes") and the standard deviations of the samples approximate a normal distribution. The parameters of the binary distribution for the entire population and for a sample drawn from the population and their relationships are as follows:

	Population	Sample
Proportion "yes"	π	p
Proportion "no"	$(1 - \pi)$	$(1-p)=q$
Variance	σ^2	s^2

For this distribution the mean is π (population) or p (sample). The sample variance is calculated as:

$$s^2 = p * q \left(\frac{n}{n-1} \right)$$

$$s = \sqrt{p * q \left(\frac{n}{n-1} \right)}$$

For example, if two respondents in a sample of five answer affirmatively, the mean and standard deviation are as follows:

$$p = \frac{\sum x_j}{n} = \frac{2}{5} = 0.4$$

$$q = (1 - 0.4) = 0.6$$

$$s^2 = p * q \left(\frac{n}{n-1} \right) = 0.4 * 0.6 * \frac{5}{4} = 0.3$$

$$s = \sqrt{0.3} = 0.55$$

SAMPLE SIZE

A sample will never provide a perfect representation of the population because of random errors inherent in sampling. A sample provides not a *point estimate* but a range of values within which the true value is reasonably sure to lie. This range of variations can be measured statistically. A sample size of more than 30 is required for statistical inferences based on the normal distribution.

There are a number of statistical approaches to determining sample size. For more information other resources will have to be investigated. One approach that is applicable when there is some indication of the sample standard deviation (perhaps from previous experience or from an initial trial) uses the *standard error*, the standard deviation of the sample means.

STANDARD ERROR

The standard error (standard deviation of sample means) is determined as follows:

$$s_{\bar{x}} = \frac{s}{\sqrt{n}} = \frac{\sqrt{\frac{\sum x_j^2 - \frac{(\sum x_j)^2}{n}}{n-1}}}{\sqrt{n}}$$

In the previous example the standard error is calculated as:

$$s_{\bar{x}} = \frac{s}{\sqrt{n}} = \frac{2.88}{\sqrt{5}} = \frac{2.88}{2.24} = 1.28 \text{ or } 1.3$$

A *confidence interval* is the range of values for the statistic of interest (e.g. the mean of the population) based upon the sample statistics. Following is the expression for determining the confidence interval and its application to the previous example. In this case, a *confidence level* of 95% is the interval 2 standard errors on each side of the mean (recall this from the discussion on Normal Distribution). A confidence level of 99.7 % would include the range within 3 standard errors from the mean. Using the previous example, the confidence interval CI for the mean age of the population is as follows:

$$CI = \bar{x} \pm 2 * \frac{s}{\sqrt{n}} = 22.6 \pm 2 * \frac{2.88}{\sqrt{5}} = 22.6 \pm 2.6$$
$$CI = 20 \text{ to } 25.2$$

Now suppose the sample size is required with a confidence level of 99.7% (3 standard errors) to determine the mean age of the population with a precision of 10%. This means that the confidence interval is within 10% of the sample mean, or $22.6 \pm 0.1 * 22.6$, a range of about 20.3 to 24.9 years. The sample size required is determined as follows:

$$\frac{\text{Precision, \%}}{100} * \bar{x} = 3 * \frac{s}{\sqrt{n}}$$

$$n = \left(3 * \frac{s}{\frac{\text{Precision, \%}}{100} * \bar{x}} \right)^2 = \left(3 * \frac{2.88}{2.26} \right)^2 = 14.6 \text{ or } 15$$

Sample size for binary variables is determined in a similar manner. The *confidence interval CI* for a binary variable is (α is the number of standard errors based upon the desired confidence level):

$$CI = p \pm \alpha * s_p$$

$$s_p = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{p * q}{n}}$$

Suppose for the previous binary example the desired confidence in the proportion answering affirmatively is 95% with a precision of 4%. The sample size would be determined as follows:

$$\frac{\text{Precision, \%}}{100} * p = 2 * s_p = 2 * \sqrt{\frac{p * q}{n}} = 2 * \frac{\sqrt{p * q}}{\sqrt{n}}$$

$$n = \left(2 * \frac{\sqrt{p * q}}{\frac{\text{Precision, \%}}{100} * p} \right)^2 = \left(2 * \frac{0.49}{0.04 * 0.4} \right)^2 = 3750$$

s_p is the standard error of p in the samples drawn from the population. To determine the sample size an estimate of p is required. This can be estimated from a small initial sample. Then the sample p and size can be determined by a trial and error approach.

For finite or relatively small populations a correction factor should be applied to both the continuous and binomial distributions for the estimate of standard error (N =size of population).

$$s_x = \frac{s}{\sqrt{n}} * \sqrt{\frac{N-n}{N-1}}$$

$$s_p = \sqrt{\frac{p * q}{n}} * \sqrt{\frac{N-n}{N-1}}$$

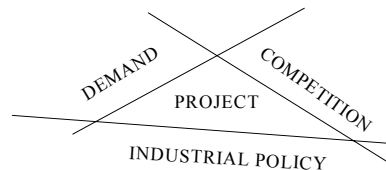
Note that the maximum standard error occurs when $p=0.5$.

FORECASTING METHODS AND APPLICATIONS

Any project will reap its benefits only in the future; that is why we attempt to predict what the future will bring. However, the future cannot be known with certainty -- we must guess, estimate, prophesy -- i.e., we must forecast.

During the lifetime of a project both EXTERNAL FACTORS and INTERNAL FACTORS will come into play. We must be able to estimate all the effects, especially the CHANGES that may make the future different from the known present and the known past.

A business venture can be seen as an entity constrained by its interactions with the external environment and by its internal characteristics. Movements are restricted, to some extent, by external constraints, e.g. demand, competition and institutional factors.



- DEMAND may change and even fade away - no sales can take place without demand.
- COMPETITION: who are the competitors, how do they operate, how easily can a newcomer enter the market, how interesting are the possibilities, how easily can a competitor exit (e.g., in the event of non-profitability).
- INSTITUTIONAL FACTORS, the set of conditions prevailing in the industry.
 - General economic conditions
 - Legal, political, social environment
 - Availability and quality of manpower, etc.
 - Physical environment: climate, infrastructure, etc.
 - Marketing environment, including distribution

Forecasting the project environment: Forecasts may be required for various aspects of the project environment, not only the outlook for demand and prices, but perhaps for other elements that can have a significant impact on the project.

General economic conditions

AREA AND CLIMATE

POPULATION: size, composition, structure, dynamics

RESOURCES

GDP: size, basic structure, dynamics

INDUSTRIAL PRODUCTION (TOTAL AND RELEVANT SECTORS): size, structure, dynamics

LOCATION OF BASIC INDUSTRIES

OWNERSHIP STRUCTURE

EXPORTS: size, structure, dynamics

IMPORTS: size, structure, dynamics

BALANCE OF TRADE AND BALANCE OF PAYMENTS

Government policies and legislation (not covered elsewhere)

ON PRODUCTION: investment incentives/disincentives, credit facilities, tax holidays, market protection, subsidies

ON CONSUMPTION: consumer credit, manipulating propensity to save, price controls, taxes

ON IMPORTS: tariffs, non-tariff barriers, quotas, taxes

ON EXPORTS: direct subsidies, indirect subsidies, foreign currency allocation priorities

FISCAL: taxes, subsidies, customs duties

MONETARY: money supply, inflation

Forecasting the marketing environment

PRODUCT: Particular segments' preferences concerning desired product features

PRICE: Level, dynamics, pricing policies and practices in the market, standard markup, customary discounts and allowances, price competition, legislation on pricing

DISTRIBUTION CHANNELS: Number and type of intermediaries, forms of ownership, marketing tasks carried out, intermediaries' strengths and weaknesses

PHYSICAL DISTRIBUTION: Existing network's coverage, transportation routes, types of carriers available, costs of transportation, warehousing system and cost

PROMOTION: Existing promotional media, most popular forms of promotion, susceptibility to different promotion forms (by segment), agencies, costs

CLASSIFICATION OF FORECASTS

Forecasting methods can be classified on the basis of the temporal view of the analyst. Some analysts regard the past as a harbinger of the future and base projections on historical information. Others tend to discard history under the assumption that the marketplace is too dynamic to rely on information from the past. The prudent analyst selects the method, or combination of methods, based upon a careful analysis of the relevance of each method in a given situation.

Forecasting based on historical data

- Study historical data and draw conclusions on behavior
- Construct a model
- Estimate parameters
- Test parameters, e.g.:
 - ◆ Standard deviation
 - ◆ Variance
 - ◆ Coefficient of determination
 - ◆ Coefficient of correlation
 - ◆ Function parameters, e.g., slope and intercept for straight line function
 - ◆ Extrapolate

"Future-based" forecasting

Predict trends based on future-oriented phenomena such as:

- Phase in the product development cycle
- Technology trends
- Political developments
- Evolving consumer preferences

APPLICATIONS OF FORECASTING TECHNIQUES

TIME SERIES METHODS

		<i>Graphical</i>	<i>Compound Growth Rate</i>	<i>Trend Extrapolation</i>	<i>Moving Average</i>	<i>Exponential Smoothing</i>
<i>Technique description</i>		<i>Plot the value and, by using judgment, draw the trend line. The future is predicted by extending this trend line.</i>	<i>Compute the compound growth rate for the time series. Assuming that this growth rate will continue in the future, a forecast for any desired year can be estimated.</i>	<i>A trend line is fitted to a mathematical equation and then projects it into the future by means of this equation. Variations in the mathematical form are possible.</i>	<i>Each point of a moving average of a time series is the arithmetic or weighted average of a number of consecutive points of the series, where the number of data points is chosen so that the effects of seasonal effects or other irregularities are eliminated.</i>	<i>Similar to the moving average, except that more recent data points are weighted more heavily. Descriptively, the new forecast is equal to the old one plus some proportion of the past forecasting data. There are many variations of this technique.</i>
<i>Accuracy</i>	<i>Short range (1-3 yrs)</i>	<i>Excellent</i>	<i>Fair</i>	<i>Excellent</i>	<i>Good</i>	<i>Good</i>
	<i>Long range (over 3 yrs)</i>	<i>Good</i>	<i>Poor</i>	<i>Good</i>	<i>Poor</i>	<i>Poor</i>
<i>Identification of turning points</i>		<i>Poor</i>	<i>Poor</i>	<i>Poor</i>	<i>Poor</i>	<i>Poor</i>
<i>Data required</i>		<i>At least five years of historical information</i>	<i>Same as graphical</i>	<i>Same as graphical</i>	<i>At least two years' detailed data (e.g. monthly information)</i>	<i>Same as moving average</i>
<i>Time required to develop and forecast</i>		<i>< 1 day</i>	<i>< 1 day</i>	<i>1 day +</i>	<i>1 day +</i>	<i>1 day +</i>

QUANTITATIVE TECHNIQUES - CAUSAL METHODS

		<i>Regression analysis</i>	<i>Econometric model</i>	<i>Input-output analysis</i>
<i>Technique description</i>		<i>This method tries to detect cause-and-effect relationship between the factor to be forecast and other factors. It defines the regression line with the least -squares method</i>	<i>A system of interdependent regression equations that describes the economy or some sector of it, or both. The parameters of the regression equations are usually estimated simultaneously. As a rule, these models are relatively expensive to develop. Due to the system of equations inherent in such models, they will better express the causalities involved than an ordinary regression equation and hence will predict turning points more accurately.</i>	<i>A method of analysis concerned with the inter-industry or inter-sectoral flow of goods or services in the economy or in a region of the country. It shows what flows of inputs must occur to obtain certain outputs. Considerable effort must be expended to use these models properly.</i>
<i>Accuracy</i>	<i>Short range (1-3 yrs)</i>	<i>Very good</i>	<i>Good</i>	<i>Very good</i>
	<i>Long range (over 3 yrs)</i>	<i>Good</i>	<i>Very good</i>	<i>Good</i>
<i>Identification of turning points</i>		<i>Fair</i>	<i>Very good</i>	<i>Fair</i>
<i>Data required</i>		<i>At least five years or more of historical information</i>	<i>Same as regression model</i>	<i>Recent input-output tables; may be updated with estimates of new technical coefficients</i>
<i>Time required to develop and forecast</i>		<i>2 days +</i>	<i>3 months +</i>	<i>6 months +</i>

QUALITATIVE TECHNIQUES

<i>Technique description</i>		<i>Scenarios</i>	<i>Delphi method</i>	<i>Morphological research</i>
		<i>An outline of one conceivable state of affairs given certain assumptions about the present and the future. The future state is posited and the steps necessary to realize the scenario are analyzed.</i>	<i>A panel of experts is interrogated by a sequence of questionnaires in which the responses to one questionnaire are used to produce the next questionnaire. Any set of information available to some experts and not to others is thus passed on to the others, enabling all the experts to have access to all the information for forecasting. This technique eliminates the bandwagon effect of majority opinion.</i>	<i>A problem is defined, broken down into its elements, and then the elements are combined and recombined into new arrangements. By assigning efficiency and other weights, the best combinations are chosen for further study.</i>
<i>Accuracy</i>	<i>Short range (1-3 yrs)</i>	<i>Good</i>	<i>Good</i>	<i>Good</i>
	<i>Long range (over 3 yrs)</i>	<i>Fair</i>	<i>Good</i>	<i>Good</i>
<i>Identification of turning points</i>		<i>Fair to good</i>	<i>Fair to good</i>	<i>Good</i>
<i>Data required</i>		<i>Depends on the type and topic of scenario</i>	<i>A coordinator issues the sequence of questionnaires, editing and consolidating the responses</i>	<i>Depends on topic</i>
<i>Time required to develop and forecast</i>		<i>1 week + (depends)</i>	<i>3 months +</i>	<i>2 months +</i>

SIMPLE TIME SERIES

This paper presents the development of several methods of developing a forecasting model based on a simple time series: graphical approach, rate of growth and regression by least squares. Throughout, the example Imports for a Port is used to illustrate application of the methods. In the following table the data concerning imports (in thousand tons) are shown for years 1 through 9.

Year	1	2	3	4	5	6	7	8	9
Imports	79	82	90	98	104	109	114	124	130

GRAPHICAL METHOD: A plot of the data on linear paper is shown in figure 1. The plot also shows three trend lines, linear (blue), power (green) and exponential (red). The form of these equations is shown in *Linear Transformations*.

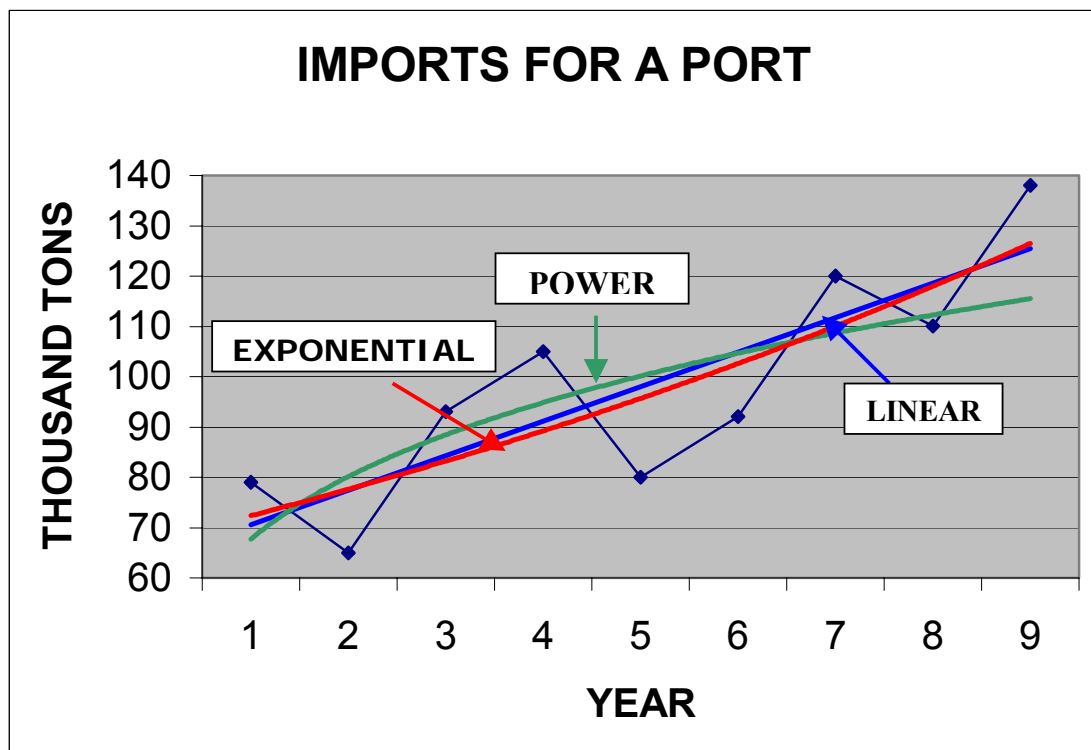


Figure 1

For extrapolation the best form of the curve would have to be selected. This can be better observed if the data is also plotted on semi-log paper and on log-log paper. The plot that best approximates a straight line can be considered the best way of extrapolating.

GROWTH RATE: The growth rate can be determined using the values of the variable of interest (in the example, imports) at two points in time. In the example the first and last data points are used. Growth can be assumed *continuous* (operating at every instant of time) or *discrete* (growth determined for finite intervals of time, in this case for each year).

Continuous compounding:

$$\gamma_c = \frac{\left(\ln \frac{X_{12}}{X_{11}} \right)}{T}$$
$$= \frac{\left(\ln \frac{130}{79} \right)}{8} = 0.062 (6.2\%)$$

γ_c	Compound growth rate, continuous
X_{11}	Starting value of imports
X_{12}	Ending value of imports
T	Time interval

Discrete compounding:

$$\gamma_d = e^k - 1$$
$$k = \frac{\left(\ln \frac{X_{12}}{X_{11}} \right)}{n} = \frac{\left(\ln \frac{130}{79} \right)}{8} = .062$$
$$\gamma_d = e^{.062} - 1 = 0.064 (6.4\%)$$

γ_d	Compound growth rate, discrete
X_{11}	Starting value of imports
X_{12}	Ending value of imports
n	Number of periods

REGRESSION ANALYSIS - LEAST SQUARES METHOD

Regression is a statistical technique that determines the mathematical form with the best fit for data relating two or more variables. The method of least squares can be applied to a variety of mathematical forms. One of the most commonly used methods involves a linear relationship between the variables, or a relationship that can be 'linearized'. A set of Normal Equations can be developed and solved simultaneously to find the coefficients of the trend equation that minimizes the deviations of the data from the trend line. Any equation with first-degree coefficients can be considered linear for this purpose. In its simplest form the equation would relate only two variables:

$$X_1 = a_0 + a_2 X_2$$

In this case a_0 is the intercept on the vertical axis and a_2 is the slope of the line.

The normal equations are formed as follows:

For each of the parameters a_0 , a_1 , a_2 , etc. form an equation by multiplying the original equation by the coefficient of the parameter and summing through the N data points. [These equations can be simplified if the point \bar{X}_1, \bar{X}_2 is taken as the origin of the plot of X_1 vs. X_2].

The normal equations are solved simultaneously to find the value of the coefficients. Forecasts are then determined by inserting values of the independent variables in the equation so formed and calculating the corresponding value of the dependent variable.

	<u>FORM</u>	<u>NORMAL EQUATIONS</u>
SIMPLE LINEAR:	$X_1 = a_0 + a_2 X_2$	$\Sigma X_1 = N a_0 + a_2 \Sigma X_2$ $\Sigma X_1 X_2 = a_0 \Sigma X_2 + a_2 \Sigma X_2^2$
MULTI-VARIABLE:	$X_1 = a_0 + a_2 X_2 + a_3 X_3$	$\Sigma X_1 = N a_0 + a_2 \Sigma X_2 + a_3 \Sigma X_3$ $\Sigma X_1 X_2 = a_0 \Sigma X_2 + a_2 \Sigma X_2^2 + a_3 \Sigma X_2 X_3$ $\Sigma X_1 X_3 = a_0 \Sigma X_3 + a_2 \Sigma X_2 X_3 + a_3 \Sigma X_3^2$

For the SIMPLE LINEAR case a more direct way of calculating the coefficients a and b is as follows:

$$a_2 = \frac{\sum X_1 X_2 - n \bar{X}_1 \bar{X}_2}{\sum X_2^2 - n \bar{X}_2^2}$$

$$a_0 = \bar{X}_1 - b \bar{X}_2$$

$$\bar{X}_i = \frac{\sum X_i}{n} \quad i=1,2$$

Data for the example is shown in the following table:

	X_1	X_2	$X_1 X_2$	X_1^2	X_2^2	X_{1C}
	79	1	79	6241	1	70.5
	65	2	130	4225	4	77.4
	93	3	279	8649	9	84.3
	105	4	420	11025	16	91.1
	80	5	400	6400	25	98.0
	92	6	552	8464	36	104.9
	120	7	840	14400	49	111.7
	110	8	880	12100	64	118.6
	138	9	1242	19044	81	125.5
TOTALS	882	45	4822	90548	285	882

$$\bar{X}_1 = \frac{882}{9} = 98 \quad \bar{X}_2 = \frac{45}{9} = 5$$

$$a_2 = \frac{4822 - 8(98)(5)}{285 - 8(5)^2} = 6.87$$

$$a_0 = 98 - 6.87(5) = 63.67$$

The regression equation is: $X_1 = 63.67 + 6.87X_2$

Alternative method

In the two variable case, the following equations are used to determine the least square coefficients a_0 and a_2 (the example is not shown here, an example of this method is shown in COR-1 for correlation between variables):

$$\begin{aligned}\bar{X}_1 &= a_0 + a_2 \bar{X}_2 \\ S_{12} &= a_2 S_{22} \\ \bar{X}_i &= \frac{\sum X_i}{n} \quad n=1,2 \\ S_{ij} &= \sum_1^n X_i X_j - n \bar{X}_i \bar{X}_j\end{aligned}$$

This can be extended to any number of variables by expanding the above equations as in the three variable cases shown below:

$$\begin{aligned}\bar{X}_1 &= a_0 + a_2 \bar{X}_2 + a_3 \bar{X}_3 \\ S_{12} &= a_2 S_{22} + a_3 S_{23} \\ S_{13} &= a_2 S_{32} + a_3 S_{33} \\ \bar{X}_i &= \frac{\sum X_i}{n} \quad n=1,2 \\ S_{ij} &= \sum_1^n X_i X_j - n \bar{X}_i \bar{X}_j\end{aligned}$$

For the two-variable linear model:

$$\begin{aligned}a_2 &= \frac{S_{12}}{S_{22}} \\ a_0 &= \bar{X}_1 - a_2 \bar{X}_2\end{aligned}$$

Tests of goodness of fit

After the form of the regression line is determined the degree of correspondence between the data and the regression line can be analyzed as follows:

Standard error of regression line: This parameter, S_e , provides an estimate of the range above and below the regression line within which the values may be expected to fall if the scatter is normal. The standard error represents the standard deviation of the differences between the regression line and the original data. One formula for the calculation of the Standard Error of Regression, S_e is as follows:

$$S_e = \sqrt{\frac{(\sum X_1^2 - a_0 \sum X_1 - a_2 \sum X_1 X_2)}{(n-2)}} \\ = \sqrt{\frac{90548 - 63.67(882) - 6.87(4822)}{7}} = 13.53$$

The proportion of values that would be expected to fall within multiples of the Standard Error are shown below:

Approximate % values	
± S _e	68
± 2S _e	95
± 3S _e	99

The upper bound for S_e is the Standard Deviation of X₁:

$$S_{X_1} = \sqrt{\frac{\sum (X_1 - \bar{X}_1)^2}{n}}$$

When all the X₁'s fall on the regression line (X_{1c} is a point on the regression line)

$$(X_1 - X_{1c}) = 0 \\ S_e = 0$$

When S_e = S_{X₁} then X₁ and X₂ are independent; In summary:

$$0 < S_e < S_{X_1}$$

Confidence limits for the regression line: These limits are the range of values comprising the confidence interval for the whole of the regression line. They are calculated by using the quantity S_{ef}, the Standard Error of the Average Forecast, given by:

$$S_{ef} = S_e \sqrt{\frac{1}{n} + \frac{(X_2 - \bar{X}_2)^2}{\sum X_2^2 - \frac{(\sum X_2)^2}{n}}}$$

While S_e is constant for the whole regression line, the second term

$$\frac{(X_2 - \bar{X}_2)^2}{\sum X_2^2 - \frac{(\sum X_2)^2}{n}}$$

varies depending on the value of X₂.

The confidence interval for the dependent variable X₁ for each value of X₂ is determined by

$$X_{1c} \pm t_{\frac{1}{2}\alpha} S_{ef} \quad \text{where} \\ T_{1/2\alpha} \quad \text{t score for } \frac{1}{2}\alpha, n - 2$$

α Two-tailed error, e.g., .05 for 95 % confidence interval

For the example, the data is applied to the formula for the confidence interval. The t score for $n-2=9-2=7$ degrees of freedom and a confidence interval of 95% for the two-tailed test is 2.365.

X_2	S_{ef}	X_{1c}	Upper limit	Lower limit	X_1
1	7.02	70.53	87.1	53.9	79
2	5.28	77.40	89.9	64.9	65
3	3.54	84.27	92.6	75.9	93
4	1.84	91.13	95.5	86.8	105
5	0.58	98.00	99.4	96.6	80
6	1.84	104.87	109.2	100.5	92
7	3.54	111.73	120.1	103.4	120
8	5.28	118.60	131.1	106.1	110
9	7.02	125.47	142.1	108.9	138

A plot of this data is shown in Figure 2.

Confidence limits for individual predictions: For the prediction of individual values of X_1 the previous formula must be amended to calculate the confidence interval. The amended formula for the Standard Error of the Individual Forecast is as follows:

$$S_{efi} = S_e \sqrt{1 + \frac{1}{n} + \frac{(X_2 - \bar{X}_2)^2}{\sum X_2^2 - \frac{(\sum X_2)^2}{n}}}$$

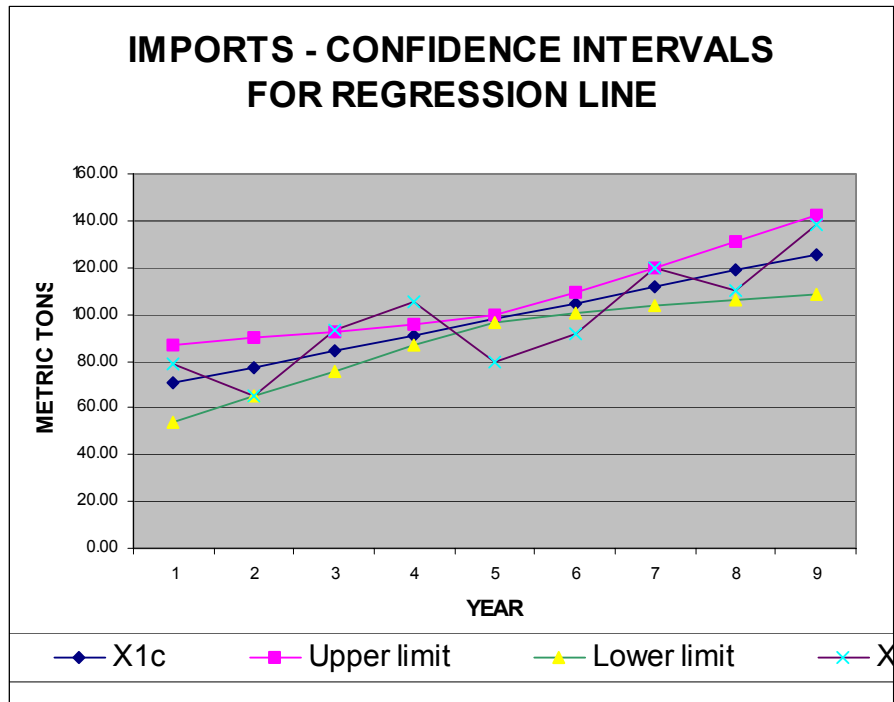


Figure 2

The calculation for any value of X_2 is left as an exercise. Similarly, the confidence interval is obtained by:

$$X_{1c} \pm t_{1/2\alpha} S_{\text{efi}}$$

Standard errors and confidence intervals for the intercept a_0 and gradient a_2 :

The standard error for the intercept, a_0 , is given by

$$S_{a_0} = S_e \sqrt{\frac{(\sum X_2^2)}{n(\sum X_2^2) - (\sum X_2)^2}}$$

The confidence interval for the intercept is determined by:

$$a_0 \pm t_{1/2\alpha} S_{a_0}$$

The standard error for the gradient, a_2 , is given by:

$$S_{a_2} = \frac{S_e}{\sqrt{\sum(X_2^2) - \frac{(\sum X_2)^2}{n}}}$$

The confidence interval for the gradient a_2 is determined by:

$$a_2 \pm t_{1/2\alpha} S_{a_2}$$

If the interval for a_2 includes zero then there is a possibility that within this confidence interval there will be no relationship between the variables. The calculation of confidence intervals for coefficients in the example is left as an exercise.

Coefficient of determinations, r^2 : The Coefficient of Determination is the proportion of the variation in the value of X_1 that is explained by changes in X_2 , or the percentage of variation in the dependent variable X_1 explained by the regression line (X_{1c} is the value on the regression line for any value of X_2):

$$r^2 = \frac{\text{Explained variation}}{\text{Total variation}}$$

$$r^2 = \frac{\sum(X_{1c} - \bar{X}_1)^2}{\sum(X_1 - \bar{X}_1)^2}$$

The unexplained variation is the sum of squares of differences between the actual values of X_1 and the corresponding values on the regression line:

$$\sum (X_1 - X_{1c})^2$$

The following table contains the numerator and denominator values for γ^2 :

$X_{1c} - \bar{X}_1$	$X_1 - \bar{X}_1$	$(X_{1c} - \bar{X}_1)^2$	$(X_1 - \bar{X}_1)^2$
-27.5	-19	754.4	361.0
-20.6	-33	424.4	1089.0
-13.7	-5	188.6	25.0
-6.9	7	47.2	49.0
0.0	-18	0.0	324.0
6.9	-6	47.2	36.0
13.7	22	188.6	484.0
20.6	12	424.4	144.0
27.5	40	754.4	1600.0
		2829.1	4112.0

$\gamma^2 = 2829.1 / 4112 = .688$ or 68.8%. This means that 68.8% of the variation in the values of imports is explained by the variation in time. The remainder is due to other factors.

CONSUMPTION OF GROUND NUTS
CONSUMPTION OF GROUNDNUTS, METRIC TONNES (10,000)

YEAR	QUANTITY	YEAR	QUANTITY
1971-72	44	1985-86	85
1972-73	34	1986-87	57
1973-74	48	1987-88	74
1974-75	50	1988-89	58
1975-76	42	1989-90	66
1976-77	58	1990-91	79
1977-78	62	1991-92	110
1978-79	78	1992-93	98
1979-80	65	1993-94	107
1980-81	73	1994-95	116
1981-82	75	1995-96	146
1982-83	71	1996-97	120
1983-84	59	1997-98	137
1984-85	76		

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LINEAR TRANSFORMATIONS

Selecting the mathematical form

The mathematical model should be consistent with the behavior of the variable(s) of interest. An estimate of the best mathematical form can be obtained by plotting the time series on graph paper. A suggested procedure is as follows:

1. Plot the data on linear paper.
2. If the trend is not linear but either upward or concave downward or downward and concave upward, plot the data on semi-log paper (one axis linear and one logarithmic). The data may then appear in essentially linear form.
3. If there is still no apparent linear trend, try plotting on log - log paper (both axes logarithmic).

Linear transformations

The least squares method can be used for time series that are not linear. Some mathematical forms can be converted to linear form; then the data can be analyzed using the linear least squares method. After determining the coefficients in this way they may have to be converted back to their actual values.

Some mathematical forms and their conversions are shown in the table below, including the method of converting the coefficients determined from the least-squares method back to their actual values.

In the equations a_0 is the numerical constant and a_2 is the numerical coefficient of the independent variable x_2 (for STS the independent variable is time T). The dependent variable is x_1 . Once the actual values of the coefficients a_0 and a_2 are converted they can be used in the original equation.

Type	Form	Transformation	a_0 conversion	a_2 conversion
Linear	$x_1 = a_0 + a_2 x_2$	Same	a_0	a_2
Exponential	$x_1 = a_0 e^{a_2 x_2}$	$\ln x_1 = \ln a_0 + a_2 x_2$	$e^{\ln a_0}$	a_2
Logarithmic	$x_1 = a_0 + a_2 \ln x_2$	Same	a_0	a_2
Power	$x_1 = a_0 x_2^{a_2}$	$\ln x_1 = \ln a_0 + a_2 \ln x_2$	$e^{\ln a_0}$	a_2
Growth	$x_1 = a_0 a_2^{x_2}$	$\ln x_1 = \ln a_0 + x_2 \ln a_2$	$e^{\ln a_0}$	$e^{\ln a_2}$

For the constant growth model, $(a_2 - 1)$ is the constant growth rate. In the power model, the exponent a_2 is the elasticity of x_1 with respect to x_2 (not really applicable for a time series, but rather for a relationship between two variables).

MOVING AVERAGE AND DECOMPOSITION

A moving average of time series data is developed by converting each value of the dependent variable in the series to the average of a selected number of points in the vicinity of the value. Generally the average is calculated from the given point plus an equal number of points on either side (earlier and later in time). In this way the data is 'smoothed', i.e., variations from the general trend are submerged in the averaging process. The smoothing effect becomes more pronounced as the number of points used to calculate the average increases.

Moving averages can be used in several ways for forecasting:

Averaging historical data for short-term projections of the future:

EXAMPLE:

Period	Sales	Projected Sales
1	1000	
2	1300	
3	1450	
4	1275	1250 (1000+1300+1450)/3
5	1400	1342 (1300+1450+1275)/3

Smoothing data to isolate the general trend (long-term) from the data series, which is affected by seasonal, cyclical and random variations. The average value of the dependent variable is plotted at the midpoint of the range of time for which the data is averaged. With this method the time series can be decomposed into the following components:

- * Long-term trend
- * Cyclical component (variations over period of years)
- * Seasonal component (variations within a year - monthly, quarterly, etc.)
- * Random fluctuations (identifiable and unidentifiable)

This technique can then be used to forecast seasonal and cyclical variations. The method is as follows:

A multiplicative model uses the equation for the dependent variable. The model could be additive or possibly another mathematical form.

$$Y = \text{Trend (T)} \times \text{Seasonal (S)} \times \text{Cyclical (C)} \times \text{Random (R)}$$

The procedure for determining the various coefficients is as follows:

1. Determine the trend line based upon historical data using least squares analysis or smoothing. The value for each period of the trend line is then T_j .
2. Smooth out the seasonal fluctuation in the data by using the appropriate time increment (e.g. month or quarter of the year) to calculate the moving average. A 12-month moving average will smooth the data for monthly variations and a 3-month period for quarterly variations.

$$\text{Let } Y' = T C R$$

Y' is the set of values of the dependent variable with seasonal variations eliminated by smoothing (period subscript j not shown for each variable). Y , as indicated above, is the original data. Then the seasonal index S for each period j is determined as follows (subscript j omitted):

$$\frac{Y}{T} = SCR$$

$$\frac{Y'}{T} = CR$$

$$S = \frac{\frac{Y}{T}}{\frac{Y'}{T}} = \frac{Y}{Y'}$$

3. Smooth the Y' data for cyclical variations by calculating the moving average for the length of the cyclical pattern.

Y'' is the set of values of the dependent variable with both seasonal and cyclical variations eliminated by smoothing.

$$Y'' = TR$$

$$R = \frac{Y''}{T}$$

$$C = \frac{CR}{R} = \frac{\frac{Y'}{T}}{\frac{Y''}{T}} = \frac{Y'}{Y''}$$

Data for the sales of swimming suits (data in thousands of swimming suits) show a one-year seasonal pattern and an additional cyclical pattern based on the style changes that are assumed to occur about once every two years (data has been modified to 'suit' the example).

Analysis by moving average is shown in Table 1. Smoothing with moving averages is used to develop a multiplicative model for forecasting sales. The original data are given for quarters (3 months) as shown in column Y of the Table 1. A linear least squares analysis on the data provides the values shown in column Y^* where:

$$Y^* = a + bX, \quad a = 450.2, \quad b = 12.06, \quad r = .56$$

The equation of the Trend line (T) is:

$$Y^* = 450.2 + 12.06X$$

where Y^* is the sales according to the trend line and X is the number of the quarter. This equation is used to determine the sales values based on the trend (T) only, as shown in the third column from the right Table 1.

In the first and second columns of Table 1 the midpoints of each quarter are shown. The purpose is to calculate a moving average for quarters that are symmetrical, in this case two quarters on each side of the centre. The third column Y shows the original data and the simple average of the quarterly midpoints derived from the quarters before and after.

The Season Average column, Y' , is the average for the quarterly centre points using two quarters on either side of the centre from the Y column. For example, the value for the quarter 2.5 is $(375+538+350+412)/4=418.8$. The column labeled $S=Y/Y'$ provides the Seasonal Index.

The Cyclical Average column, Y'' , is calculated for each quarter possible using four quarters on each side of the center from the Y' column. For example, the value for quarter 6 is $(418.8+471.8+517.3+567.8+584.0+579.8+567.3+569.3)/8=534.5$. The cyclical index, $C=Y'/Y''$, is calculated for each quarter where possible.

The column labeled TSC is the model value excluding any random effects. The value is the product of the Trend value and the Seasonal and Cyclical indices.

The column $Y/(T*S*C)$ shows that there is no greater than a 3 % error (in this case) in any of the values provided by the model. R could be calculated $Y/(T*S*C)$, but could not be applied in any systematic manner. The best way to handle the random errors is to calculate the Standard Error and confidence limits for the model using the deviations between the original data and the model values.

In this case the seasonal averaging is taken over sequential groupings of 4 quarters and the cyclical averaging over 8 quarters (assuming a 2 year cycle). Greater accuracy could be achieved by using monthly rather than quarterly data.

Table 1 Analysis by Moving Average (1)

SALES OF SWIMSUITS									
PERIOD, QUARTER	MIDPOINT QUARTER	SALES	SEASON AVG.	S=Y/Y'	CYCLE AVG.	C=Y'/Y''	Y* or T (2)	TSC	Y/TSC
		Y	Y'		Y''				
1		375					462.3		
2		538					474.3		
2.5	2.5	444	418.8	1.06			480.4		
3		350					486.4		
3.5	3.5	381	471.8	0.81			492.4		
4		412					498.4		
4.5	4.5	499.5	517.3	0.97			504.5		
5		587					510.5		
5.5	5.5	653.5	567.8	1.15			516.5		
6		720	575.9	1.25	534.5	1.077	522.6	702.6	1.025
6.5	6.5	636	584.0	1.09			528.6	611.7	1.04
7		552	581.9	0.95	554.3	1.05	534.6	532.4	1.037
7.5	7.5	514.5	579.8	0.89			540.7	493.8	1.042
8		477	573.5	0.83	568.6	1.009	546.7	458.6	1.04
8.5	8.5	523.5	567.3	0.92			552.7	507.1	1.032
9		570	568.3	1	579.9	0.98	558.7	549.2	1.038
9.5	9.5	620	569.3	1.09			564.8	603.3	1.028
10		670	573.4	1.17	584.1	0.982	570.8	654.8	1.023
10.5	10.5	615	577.5	1.06			576.8	605.0	1.016
11		560	581.9	0.96	588.8	0.988	582.9	554.3	1.01
11.5	11.5	535	586.3	0.91			588.9	535.0	1
12		510	596.9	0.85	595.3	1.003	594.9	509.7	1.001
12.5	12.5	557.5	607.5	0.92			601.0		
13		605					607.0		
13.5	13.5	680	601.3	1.13			613.0		
14		755					619.0		
14.5	14.5	645	621.8	1.04			625.1		
15		535					631.1		
15.5	15.5	563.5	631.8	0.89			637.1		
16		592					643.2		
17		645					655.2		

- (1) The moving averages may differ from manual calculations due to rounding differences.
- (2) Y* (T) is the value determined from the linear regression on the original data.

The moving average method loses some data. In the seasonal analysis 2 quarters are lost at the beginning and end of the data. The cyclical analysis loses 4 data points at the beginning and end. In some cases averages are taken so that relevant data for a particular point in time are available for the calculation. For example, data is averaged for Y' to be consistent with the data for Y in the calculation of S.

A summary of the available data from Table 1 is shown in Table 2 for values of T (Trend), S (Seasonal index) and C (Cyclical index).

Table 2 Moving Average Model $Y^* = TSC$
(T - Trend; S - Seasonal index; C - Cyclical index)

DATA FOR MODEL AVAILABLE FOR QUARTERS 6 THROUGH 12				
QUARTER	S	C	T	TSC
6	1.25	1.075	522.56	702.64
6.5	1.09	1.063	528.59	611.69
7	0.95	1.050	534.62	532.39
7.5	0.89	1.029	540.65	493.79
8	0.83	1.009	546.68	458.59
8.5	0.92	0.994	552.71	507.14
9	1.00	0.980	558.74	549.20
9.5	1.09	0.981	564.77	603.29
10	1.17	0.982	570.80	654.75
10.5	1.06	0.985	576.83	605.03
11	0.96	0.988	582.86	554.34
11.5	0.91	0.995	588.89	534.95
12	0.85	1.003	594.92	509.66

Regression Analysis

Constant	450.1825
Std Error of Y Est	83.26919
r^2	0.314989
No. of Observations	31
Degrees of Freedom	29
Slope	12.06216
Std Error of Coef.	3.303137

Regression equation: $Y = 12.06 X + 450.18$

To use this model for projections, the average factor for each time period in the appropriate cycle can be determined, in this case, the average factor S for each of the four annual quarters and the average C for each of the eight quarters in its cycle. The averaging of the indices is limited in this sample case by the small amount of data. Normally for a pattern with a 2-year cycle (8 quarters) about 40 quarters of data would be required.

Sales projections are calculated by:

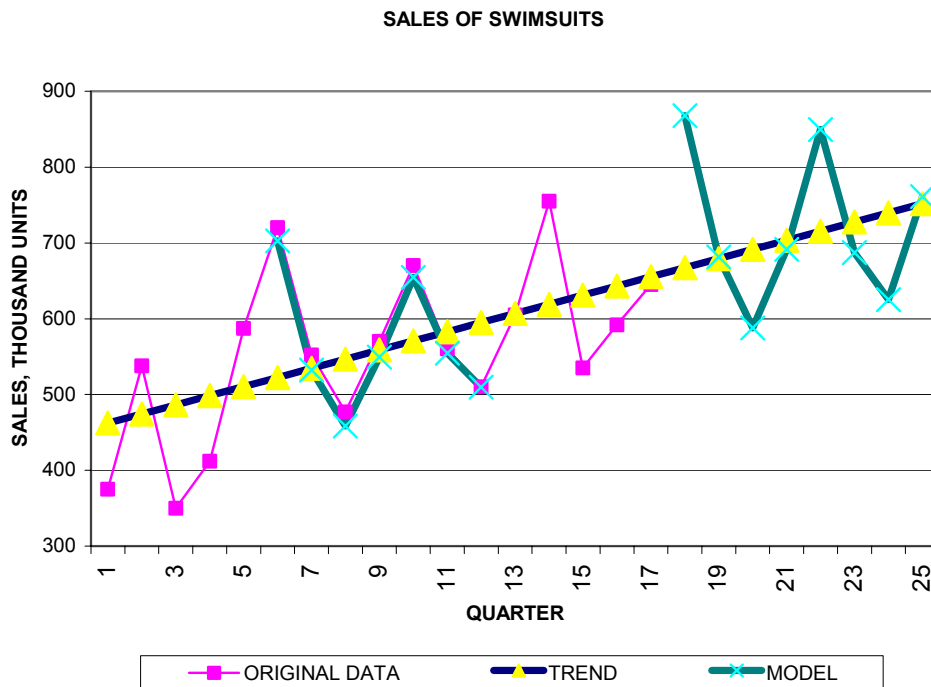
$$Y^*_j = T_j \times S_j(\text{avg}) \times C_j(\text{avg}) \quad j - \text{quarter}$$

A summary of the projections for the quarters 18-25 are shown in Table 3:

QUARTER	S (avg)	C (avg)	T	Y*
18	1.21	1.08	667.28	867.90
19	0.96	1.05	679.34	681.41
20	0.84	1.01	691.40	587.91
21	1.00	0.98	703.46	691.44
22	1.21	0.98	715.52	849.47
23	0.96	0.99	727.58	687.03
24	0.84	1.00	739.64	625.22
25	1.00	1.01	751.70	760.86

Figure 1 shows the original data, linear trend and results from the model. Model data is shown for those original data quarters for which indices could be calculated and also for the sales projections from quarter 18 through 25.

Figure 1 : Sales of Swimsuits (000) - Projections by moving average model



INPUT-OUTPUT ANALYSIS

(I-O) deals with interdependence of productive activities of an economy.

- Shows flow of goods and services among sectors in matrix form.
- Basic assumption is that there is known relationship between volume of inputs and outputs for each sector and that this relationship is stable over time.
- Technological coefficients of matrix define input requirements of each sector per unit of production.

Advantages:

- Can forecast the effect of a change in one sector on all other sectors.
- Uses efficient matrix procedure for solution.

Disadvantages:

- Does not inherently correct for technological change.
- Generally requires costly, time-consuming computer model.

It is more practical for economic analysis to set up the matrix using variables that represent industrial sectors rather than for products (or projects). Very large matrices would be required for analysis of individual products.

Within an individual plant or project, I/O can be used for analyzing cost or profit centers in the original design or for expansion projects. This is particularly useful for enterprises in which there are large internal flows of intermediate products that may also be marketed externally, for example, in the petrochemical industry

The I/O matrix is developed as follows:

$$\begin{array}{r}
 x_1 + a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n = b_1 \\
 x_2 + a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n = b_2 \\
 \vdots \\
 x_m + a_{m1}x_1 + a_{m2}x_2 + \dots + a_{mn}x_n = b_m
 \end{array}$$

This can be expressed in matrix form as:

[I - A]X = B	I	-	Identity matrix
	A	-	Matrix of technological coefficients; i.e.:
	a _{ij}	-	amount of product i used to produce one unit of product j
	X	-	Product vector
	B	-	External demand vector

The solution for the product vector can be determined by:

$$X = [I - A]^{-1}B \quad [I - A]^{-1} \text{ is the inverse of the original matrix.}$$

For an expansion project a row can be added to express the internal flows and external demand for the new product or for changes in existing external demand. The effect of the addition or modification can then be assessed.

ELASTICITY

Definition: Percent change of dependent variable *per* percent change of independent variable.

Elasticity of demand with regard to price, income, etc. can be used for generating forecasts of demand from assumptions (or projections) of associated variables.

Elasticity is applicable only for limited ranges of the variables.

Price or income elasticity for a linear relationship between the variables:

$$e_p = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}}$$

$$P = \frac{P_1 + P_2}{2}, Q = \frac{Q_1 + Q_2}{2} \text{ (approximately)}$$

$$e_p = \frac{(Q_2 - Q_1)(P_1 + P_2)}{(P_2 - P_1)(Q_1 + Q_2)} \text{ (approximately)}$$

$$\text{For } Q = a + bP, b = \frac{dQ}{dP}$$

$$e_p = b \frac{P}{Q} = \frac{dQ}{dP} \frac{P}{Q}$$

The value of P/Q changes with P ; therefore, the elasticity varies with each value of P . More generally:

$$e = \frac{dQ}{dP} \frac{P}{Q} = \frac{\ln Q_2 / Q_1}{\ln P_2 / P_1}$$

Functions with constant elasticity

$$Q = aP^\beta \quad \text{where } \beta \text{ is the elasticity}$$

This function is very useful since elasticity is constant and easily interpreted. The exponent β determines the percentage change of quantity Q per percent change in price (in this case).

Income elasticity (similarly)

$$e_I = \frac{(Q_2 - Q_1)(I_1 + I_2)}{(I_2 - I_1)(Q_1 + Q_2)}$$
$$e_I = -\frac{\ln Q_2 / Q_1}{\ln I_2 / I_1}$$

Cross elasticity - Relation between products A and B

$$C_{AB} = \frac{(Q_{A2} - Q_{A1})(P_{B2} + P_{B1})}{(P_{B2} - P_{B1})(Q_{A2} + Q_{A1})}$$

- > 0 Product B is a substitute for A
- = 0 No relationship
- < 0 Product B is complementary to A (a decrease in the price of B increases demand for A)

Compound elasticity

$$Q = kP^e R^b$$

$$\ln Q = \ln k + e \ln P + b \ln R$$

e, b are partial elasticities of Q with respect to other variables

FORECASTING DEMAND WITH MULTIVARIATE MODEL

EXERCISE

CEMENT PLANT IN GROWMANIA

INTRODUCTION

Growmania and its neighboring countries have relied on imports of cement from abroad but the construction of a common cement plant is warranted by local demand in recent years. The total demand forecast in year 0 is 1 million tons, whereas the supply capacity of two plants in the country is only 60,000 tons.

DEMAND FORECAST

Investment in social development is a recent phenomenon in the country, so there is strong potential for an increase in demand. Any forecast of demand based on simple extrapolation of historical demand is bound to underestimate future requirements. Considering the economic development programme now underway, the market for cement appears to be very favorable. In particular, there is renewed interest in improving material handling systems (roads, harbors, airports, rail lines and transportation systems generally), which will contribute to a reduction of distribution costs for cement and which should have a positive impact on demand. The economic program provides a direct linkage to cement demand from tourism-related construction.

A forecast of per-capita demand for cement is to be developed on the basis of the correlation with two variables:

X_1	Per capita cement consumption, tons
X_2	GDP per capita, Thousand US\$
X_3	Gross Domestic Investment, MFG

A power model is to be assumed, in which the exponents of the variables represent the elasticities of the independent variables with respect to the dependent variable. This type of model has shown to be effective in predicting demand in similar environments.

Table 1 shows the projected average growth rates and resulting values for the independent variables GDP (per capita) and GDI for the five years succeeding the last year of available data. The population growth rate is assumed at 3 % for all years.

Table 2 shows the data for the preceding 11 years of the variables of interest: Per capita consumption, GDP (per capita) and GDI. Cement consumption and population data for years 1-11 are obtained from the statistical bureau. Per capita consumption for years 1-11 are derived from cement consumption and population. The per capita GDP and GDI for years 1-11 are also obtained from the statistics bureau.

TABLE 1 Projections Of Rates Of Growth Of Independent Variables

YEAR	GDP ¹ GROWTH %	GDI ² GROWTH %	GDP per capita US\$	GDI (MFG, billions)
12	4.0	6.0	2473.12	135.68
13	3.5	5.0	2559.68	142.46
14	3.0	5.0	2636.47	149.59
15	3.0	5.0	2715.56	157.07
16	3.0	5.0	2797.03	164.92

TABLE 2 Regression Model Data And Result - Cement Consumption

Year	Cement Consumption Tons (000)	Population, thousands	Per capita Consumption, kg	GDP per capita US\$	GDI, MFG (billions)
			X ₁	X ₂	X ₃
1	109.20	8465	12.90	2961.00	171.00
2	128.59	8714	14.76	3055.00	162.00
3	77.84	9260	8.41	2709.00	93.00
4	87.67	9558	9.17	2481.00	92.00
5	78.67	9875	7.97	2081.00	96.00
6	97.32	10212	9.53	2443.00	98.00
7	80.66	10551	7.64	2360.00	98.00
8	69.08	10894	6.34	1803.00	101.00
9	119.25	11240	10.61	1783.00	111.00
10	110.06	11600	9.49	2050.00	119.00
11	115.00	11948	9.63	2378.00	128.00

The problem at hand is to develop a forecast of demand for cement based upon the model for the next five years (years 12-16).

¹ Gross Domestic Product

² Gross Domestic Investment

FORECASTING DEMAND WITH MULTIVARIATE MODEL

SOLUTION

CEMENT PLANT IN GROWMANIA

For the multivariate correlation model the form of the equation is as follows:

$$X_1 = a_0 X_2^{a_2} X_3^{a_3}$$

$$\ln X_1 = \ln a_0 + a_2 \ln X_2 + a_3 \ln X_3$$

The model is developed by linearising the equation and performing regression analysis on the historical data on the three variables. This provides the values of the constants a_0 , a_2 and a_3 .

Table 2 shows the data for the preceding 11 years of the variables of interest: Per capita consumption, GDP (per capita) and GDI. Cement consumption and population data for years 1-11 are obtained from the statistical bureau. Per capita consumption for years 1-11 are derived from cement consumption and population. The per capita GDP and GDI for years 1-11 are also obtained from the statistics bureau.

The table also shows the population projections for years 12-16 based upon the 3% estimated growth rate. GDP per capita and GDI for years 12-16 are based upon the estimated growth rates shown in Table 1. The Cement consumption estimates based upon the model are shown in the right column for all years (1-11 and 12-16). The results of the calculations for per capita consumption are obtained for years 1-11 from the actual consumption and population data. For the years 12-16 the forecasted consumption is used (dividing consumption by population).

TABLE 2 Regression Model Data And Result - Cement Consumption

Year	Cement Consumption, Tons (000)	Population, thousands	Per capita Consumption, kg	GDP per capita US\$	GDI, MFG (billions)	Cement consumption, Model – Tons (000)
			X_1	X_2	X_3	
1	109.20	8465	12.90	2961.00	171.00	121.18
2	128.59	8714	14.76	3055.00	162.00	123.60
3	77.84	9260	8.41	2709.00	93.00	86.71
4	87.67	9558	9.17	2481.00	92.00	83.42
5	78.67	9875	7.97	2081.00	96.00	77.76
6	97.32	10212	9.53	2443.00	98.00	91.48
7	80.66	10551	7.64	2360.00	98.00	92.17
8	69.08	10894	6.34	1803.00	101.00	79.64
9	119.25	11240	10.61	1783.00	111.00	86.17
10	110.06	11600	9.49	2050.00	119.00	102.57
11	115.00	11948	9.63	2378.00	128.00	122.88
12		12306	10.95	2473.12	135.68	134.79
13		12676	11.56	2559.68	142.46	146.52
14		13056	12.16	2636.47	149.59	158.70
15		13448	12.78	2715.56	157.07	171.90
16		13851	13.44	2797.03	164.92	186.20

The right hand column (Cement consumption, model – tons) is obtained by multiplying the model per capita consumption (not shown) by population. For years 11-16 population is estimated on the assumed growth rate, the independent variables GDP per capita and GDI from the assumed growth rates in Table 1 (see *Problem*) and the dependent variable Per capita consumption determined from the model.

Table 3 shows the values that are needed for calculations of the model parameters a_0 , a_2 , and a_3 .

TABLE 3 Calculations Of Products Required For Regression Analysis

YEAR	$\ln X_1$	$\ln X_2$	$\ln X_3$	$\frac{\ln X_1}{\ln X_2}$	$\frac{\ln X_1}{\ln X_3}$	$\frac{\ln X_2}{\ln X_2}$	$\frac{\ln X_2}{\ln X_3}$	$\frac{\ln X_3}{\ln X_3}$	$\frac{\ln X_1}{\ln X_1}$
1	2.557	7.993	5.142	20.4407	13.1485	63.8926	41.0988	26.4367	6.5395
2	2.692	8.025	5.088	21.5996	13.6943	64.3932	40.8256	25.8836	7.2452
3	2.129	7.904	4.533	16.8279	9.6497	62.4785	35.8272	20.5445	4.5324
4	2.216	7.816	4.522	17.3228	10.0212	61.0964	35.3442	20.4466	4.9115
5	2.075	7.641	4.564	15.8562	9.4722	58.3788	34.8744	20.8333	4.3067
6	2.254	7.801	4.585	17.5869	10.3365	60.8553	35.7672	21.0219	5.0825
7	2.034	7.766	4.585	15.7971	9.3259	60.3172	35.6088	21.0219	4.1372
8	1.847	7.497	4.615	13.8477	8.5244	56.2081	34.6005	21.2993	3.4116
9	2.362	7.486	4.710	17.6801	11.1227	56.0410	35.2558	22.1797	5.5778
10	2.250	7.626	4.779	17.1577	10.7531	58.1497	36.4437	22.8400	5.0626
11	2.264	7.774	4.852	17.6032	10.9868	60.4353	37.7198	23.5422	5.1274
TOTAL	24.68	85.329	51.975	191.720	117.035	662.246	403.366	246.050	55.935

The simultaneous equations that are solved to determine the values of the coefficients are as follows:

$$\begin{aligned} \overline{\ln X_1} &= \ln a_0 + a_2 \overline{\ln X_2} + a_3 \overline{\ln X_3} \\ S_{12} &= a_2 S_{22} + a_3 S_{23} \\ S_{13} &= a_2 S_{32} + a_3 S_{33} \\ S_{ij} &= \sum \ln X_i \ln X_j - n \overline{\ln X_i} \overline{\ln X_j} \\ \overline{X_j} &= \frac{\sum X_j}{n} \quad n = 1,2,3 \end{aligned}$$

The solution to these equations provides values for the three coefficients as follows:

$$\begin{aligned} \ln a_0 &= -6.193 & a_0 &= 0.002043 \\ a_2 &= 0.727857 \\ a_3 &= 0.5906 \end{aligned}$$

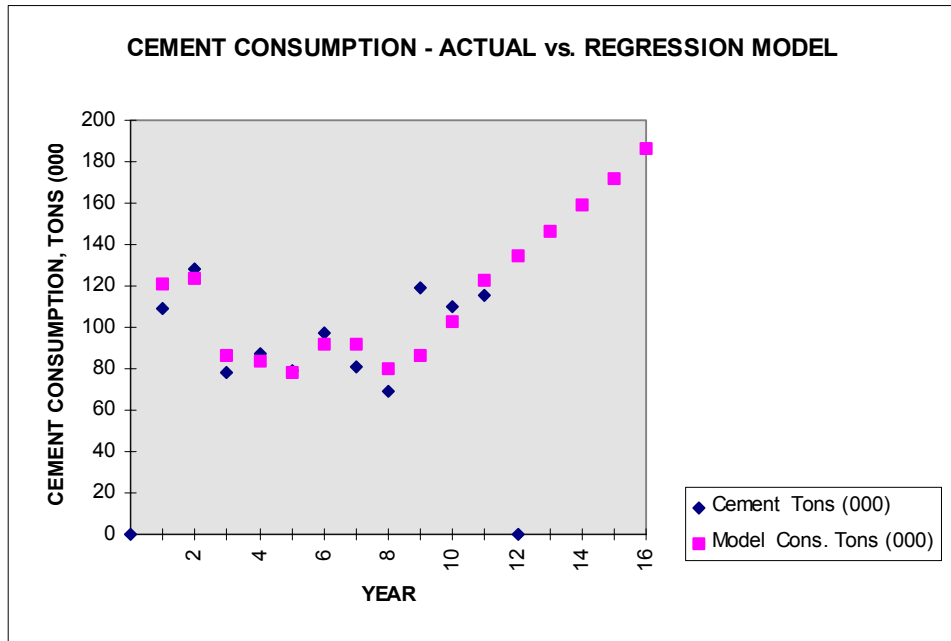
The form of the equation relating the variables is as follows:

$$X_1 = a_0 X_2^{a_2} X_3^{a_3} = 0.0020043 + X_2^{0.727857} + X_3^{0.5906}$$

For example, the model's predicted value for Per capita consumption in year 16:

$$X_1 = a_0 X_2^{a_2} X_3^{a_3} = 0.0020043(2797.03^{0.727857})(164.92^{0.5906}) = 13.44$$

The following graph shows the original data for cement consumption in years 1-11 and the values projected by the model for years 1-16.



The coefficient of correlation between the dependent and each of the independent variables can be determined from the linearised form of the model using the expression

$$r = \frac{S_{ij}}{\sqrt{S_{ii}} \sqrt{S_{jj}}}$$

$$S_{ij} = \sum X_i X_j - n \bar{X}_i \bar{X}_j$$

These calculations and their interpretation are left as an exercise.

The projections are predicated on growing GDP per Capita for years 11-16 of 3-4%. The historical data shows a highly variable year-to-year pattern of growth and decline with no discernible secular trend. It is unlikely that this pattern would change so dramatically in subsequent years unless the country's economic prospects had been radically changed. This factor should be investigated before accepting the projections of cement consumption.

- 1** Overview
- 2** Market Analysis and Marketing
- 3** Technical Analysis
- 4** Financial Analysis
- 5** Economic Analysis
- 6** Expansion/Modernization Projects
- 7** Project Appraisal



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