Unit - 4

Analysis of the product

- Many factors have to be analyzed to development and design factors which vary in character and complexity, and factors related to different fields in production and industrial engineering.

1.Marketing Aspect

2. Product Characteristics

Functional aspect, operational aspect, Durability and dependability aspects, and Aesthetic aspect

3. Economic Analysis

Profit consideration, Effect of standardization, simplification, and Specialization, and Break – even analysis.

4. Production aspects.

Marketing Aspect

- Marketing aspect is to determine the suitability of property for profitable development and to define optimal products and amenities in accordance with projected market demand.

What are the main aspects of marketing

- The 4Ps, Price, Place, Product, Promotion are the main aspect of modern marketing and CRM (Customer relationship management). Building relationships with customers is the key in today's marketing environment.

Product characteristics

- Functional aspect,
- Operational aspect,
- Durability and dependability aspects, and
- Aesthetic aspect

The above are discussed in Unit – 2.

Economic Analysis

- Profit consideration,
- Effect of standardization, simplification, and Specialization, and
- Break – even analysis.

The above are discussed in unit – 2

Production Aspects

- Design for manufacturing, and
- Design for Assembly
- Material Selection

- All these factors are interrelated and each presents many issues that have to be carefully considered as shown in fig. Market research may guide product designers in their work to improve existing products or to develop new one.
- The design and its characteristics have to undergo an economic analysis and must be researched in the light of available production facilities and techniques.
- A costing analysis is naturally dependent on the sales volume; hence the proposed design has to be re-evaluated by market research so that a sales projection can be done.
- This expected sales volume provides the basis for a further study from the production methods aspect, and the economic analysis has to be rechecked and perhaps modified.
- Thus product development and design is an excellent example of interdependence of the multitude of factors that have to be unified and integrated into a final composition.

Design for Manufacturing (DFM)

- For the past 20 years engineers have seen a large amount of effort devoted to the integration of design and manufacture, with the goals of reducing manufacturing cost and improving product quality. The processes and procedures that have been developed have become known as Design for Manufacturing or Design for Manufacturability (DFM).

DFM Guidelines

- Minimize total number of parts
- Standardize components
- Use common parts across product lines
- Standardize design features
- Aim to keep designs functional and simple
- Design parts to be multifunctional
- Design parts for ease of fabrication
- Avoid excessively tight tolerances
- Minimize secondary and finishing operations
- Utilize the special characteristics of processes

Design for Assembly (DFA)

- Once parts are manufactured, they need to be assembled into subassemblies and products. The assembly process consists of two operations, handling, which involves grasping, orienting and positioning followed by insertion and fastening. There are three types of assembly Manual assembly, Automatic assembly and Robotic assembly.

DFA Guidelines

General Guidelines

- Minimize the total number of parts
- Minimize the assembly surfaces
- Use subassemblies
- Mistake-proof the design and assembly

Guidelines for Handling

- Avoid separate fasteners or minimize fastener costs
- Minimize handling in assembly

Guidelines for Insertion

- Minimize assembly direction
- Provide unobstructed access for parts and tools
- Maximize compliance in assembly

Material Selection

- Material selection is a step in the process of designing any physical object. In the context of product design, the main goal of material selection is to minimize cost while meeting product performance goals. Systematic selection of the best material for a given application begins with properties and costs of candidate materials.

General criteria for selection of Material

- Performance characteristics (Properties)
- Processing (Manufacturing) characteristics
- Environmental profile
- Business considerations

- Selection on the basis of performance characteristics is the process of matching values of the properties of the material with the requirements and constraints imposed by the design.
- Selection on the basis of processing characteristics means finding the process that will form the material into the required shape with a minimum of defects at the least cost.
- Selection on the basics of an environment profile is focused on predicting the impact of the material throughout its life cycle on the environment.

Overview of the materials selection process

- Analysis of the materials requirements. Determine the conditions of service and environment that the product must withstand.
- Screening for candidate materials. Compare the needed properties with a large materials properly database to select a few materials that look promising for the application.
- Analysis of the candidate materials in terms of trade-offs of product performance, cost, manufacturability, and availability to select the best material for the application.

- Development of the design data for critical systems or components. Determine experimentally the key materials properties for the selected material to obtain statistically reliable measures of the material performance under the specific conditions expected to be encountered in service.

Material selection process

- Availability
- Size limitations and tolerances on available material shapes and forms
- Excessive variability in properties
- Environmental impact, including ability to recycle the material
- Cost.

Product Strategies

Pricing Strategy for Product

- As an example of pricing strategy, one large chain of departmental stores aims at offering commodities to the public at a minimum price, whatever be the quality. In fact, one may be quite sure that articles bought at this stores cannot be obtained cheaper or even at the same price elsewhere.

Product quality strategy

- Other manufactures define their aim as high quality, whatever be the cost. The chairman of Bajaj auto ltd has recently expressed that for his company, product quality is the secret of success for over the last three decades.

Product Luxuriousness strategy

- In some cases, luxury and comfort are the prime considerations that cost becomes secondary, e.g. Mercedes, BMW and Toyta. The manufactures of these automobiles produce luxurious models but the number produced is not very large, and in spite of high price of the finished product with less profit.

Product utility strategy

- Other automobile firms like maruti motors aims at large volume production of low priced car that will compete with ore expensive models by having some of their successful and popular features and innovations.

Methods of launching new product

- Launching a new product attracts consumers as well as corporate buyers, and informs the public about your product and business. Your product launch needs to be exciting and informative. Here are a few suggestions on how to launch a new product.

- Determine your target audience.
- Implement a unique slogan.
- Know your competition.
- Consult a public relations firm.
- Write a product sheet.
- Launch a website.
- Purchase advertising.
- Design attractive packaging.
- Hold a press conference.
- Study your competition. (SWOT)
- Target the ideal customer.
- Create a unique value proposition.
- Define your marketing strategy and tactics.
- Test your concept and marketing approach.
- Roll out your campaign.
- Know your product's lifecycle.

Why New Products Fail

- Lack of differentiating advantage
- Poor marketing plan
- Poor timing
- Target market too small
- Poor product quality
- No access to market

Steps for introducing new products after evaluation

Seven phases to new product development

- New Product Strategy Development
- Idea Generation
- Product Screening and Evaluation
- Business Analysis
- Product Development
- Test Marketing
- Commercialization

Test marketing

- The penultimate phase in the development cycle called test marketing, consist of small-scale tests with customers. Until now, the idea, the concept, and the product have been tested or evaluated in a somewhat artificial context. Although several of these evaluations may well have compared the new product to competitive offering, other elements of the marketing mix have not been tested, nor has the likely marketing reaction by competitors.
- At this stage the appeal of the product is tested amidst the mix of activities comprising the market launch: salesmanship, advertising, sales promotion, distributor incentives and public relation.

Market Testing

- **Concept testing** (or **market testing**) is the process of using quantitative methods and qualitative methods to evaluate consumer response to a product idea prior to the introduction of a product to the market. It can also be used to generate communication designed to alter consumer attitudes toward existing products.
- These methods involve the evaluation by consumers of product concepts having certain rational benefits, such as "a detergent that removes stains but is gentle on fabrics," or non-rational benefits, such as "a shampoo that lets you be yourself." Such methods are commonly referred to as concept testing and have been performed using field surveys, personal interviews and focus groups, in combination with various quantitative methods, to generate and evaluate product concepts.

What is testing?

Testing is the practice of making objective judgments regarding the extent to which the system (device) meets, exceeds or fails to meet stated objectives

What is test?

take measures to check the quality, performance, or reliability of (something), especially before putting it into widespread use or practice.

What is marketing?

Marketing is the process of communicating the value of a product or service to customers, for the purpose of selling that product or service.

What is Market?

A regular gathering of people for the purchase and sale of provisions, livestock, and other commodities.

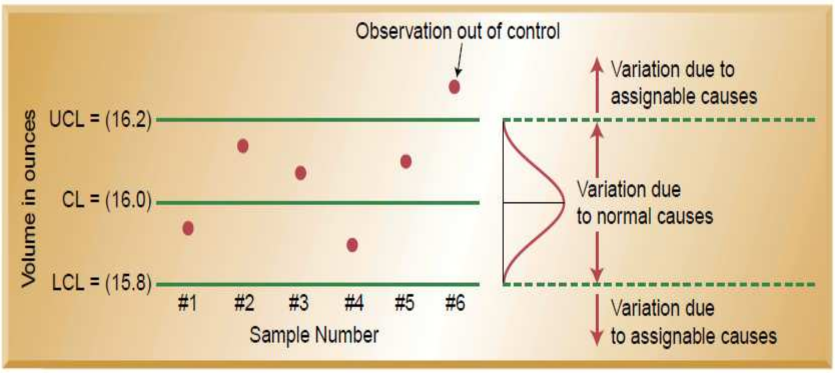
Statistical Quality Control

- SQC is define as the general category of statistical tools used to evaluate organizational quality. Statistical quality control can be divided into three broad categories:
- Descriptive statistics: Statistics used to describe quality characteristics and relationships.

- Statistical process control (SPC): A statistical tool that involves inspecting a random sample of the output from a process and deciding whether the process is producing products with characteristics that fall within a predetermined range.
- Acceptance sampling: The process of randomly inspecting a sample of goods and deciding whether to accept the entire lot based on the results.

Control Chart

- A control chart (also called process chart or quality control chart) is a graph that shows whether a sample of data falls within the common or normal range of variation.
- A control chart has upper and lower control limits that separate common from assignable causes of variation. The common range of variation is defined by the use of control chart limits.
- We say that a process is out of control when a plot of data reveals that one or more samples fall outside the control limits, as shown in fig



Quality control chart for Cocoa Fizz

Types of Control Charts

- Control charts are one of the most commonly used tools in statistical process control. They can be used to measure any characteristic of a product, such as the weight of a cereal box, the number of chocolates in a box, or the volume of bottled water. The different characteristics that can be measured by control charts can be divided into
- Two groups: variables and attributes.

Control Chart for Variables

- A *control chart for variables is used to monitor* characteristics that can be measured and have a continuum of values, such as height, weight, or volume. A soft drink bottling operation is an example of a variable measure, since the amount of liquid in the bottles is measured and can take on a number of different values. Other examples are the weight of a bag of sugar, the temperature of a baking oven, or the diameter of plastic tubing.

Mean (x-Bar) Charts

A control chart used to monitor changes in the mean value of a process.

$$\bar{\bar{x}} = \frac{\bar{x}_1 + \bar{x}_2 + \cdots \bar{x}_{\mathcal{K}}}{\mathcal{K}}$$

To construct the upper and lower control limits of the chart, we use the following formulas:

$$\text{Upper control limit (UCL)} = \bar{\bar{x}} + z\sigma_{\bar{x}}$$

$$\text{Lower control limit (LCL)} = \bar{\bar{x}} - z\sigma_{\bar{x}}$$

where $\bar{\bar{x}}$ = the average of the sample means
z = standard normal variable (2 for 95.44% confidence, 3 for 99.74% confidence)
$\sigma_{\bar{x}}$ = standard deviation of the distribution of sample means, computed as $\sigma/\sqrt{n}$
σ = population (process) standard deviation
n = sample size (number of observations per sample)

Another way to construct the control limits is to use the sample range as an estimate of the variability of the process. Remember that the range is simply the difference between the largest and smallest values in the sample. The spread of the range can tell us about the variability of the data. In this case control limits would be constructed as follows:

$$\text{Upper control limit (UCL)} = \bar{\bar{x}} + A_2\bar{R}$$

$$\text{Lower control limit (LCL)} = \bar{\bar{x}} - A_2\bar{R}$$

where $\bar{\bar{x}}$ = average of the sample means
$\bar{R}$ = average range of the samples
A_2 = factor obtained from Table 6-1.

Notice that A_2 is a factor that includes three standard deviations of ranges and is dependent on the sample size being considered.

Range (R) Charts

Range (R) charts are another type of control chart for variables. Whereas x-bar charts measure shift in the central tendency of the process, range charts monitor the dispersion or variability of the process. The method for developing and using R-charts is the same as that for x-bar charts. The center line of the control chart is the average range, and the upper and lower control limits are computed as follows:

$$\text{CL} = \overline{R}$$

$$\text{UCL} = D_4\,\overline{R}$$

$$\text{LCL} = D_3\,\overline{R}$$

where values for D_4 and D_3 are obtained from Table 6-1.

CONTROL CHARTS FOR ATTRIBUTES

- Control charts for attributes are used to measure quality characteristics that are counted rather than measured. Attributes are discrete in nature and entail simple yes-or-no decisions. For example, this could be the number of nonfunctioning lightbulbs, the proportion of broken eggs in a carton, the number of rotten apples, the number of scratches on a tile, or the number of complaints issued.

- Two of the most common types of control charts for attributes are p-charts and c-charts.
- P-charts are used to measure the proportion of items in a sample that are defective. Examples are the proportion of broken cookies in a batch and the proportion of cars produced with a misaligned fender. P-charts are appropriate when both the number of defectives measured and the size of the total sample can be counted. A proportion can then be computed and used as the statistic of measurement.

- C-charts count the actual number of defects. For example, we can count the number of complaints from customers in a month, the number of bacteria on a petri dish, or the number of barnacles on the bottom of a boat. However, we *cannot compute the* proportion of complaints from customers, the proportion of bacteria on a petri dish, or the proportion of barnacles on the bottom of a boat.

P - Chart

P-charts are used to measure the proportion that is defective in a sample. The computation of the center line as well as the upper and lower control limits is similar to the computation for the other kinds of control charts. The center line is computed as the average proportion defective in the population, $\overline{p}$. This is obtained by taking a number of samples of observations at random and computing the average value of p across all samples.

To construct the upper and lower control limits for a p-chart, we use the following formulas:

$$\text{UCL} = \overline{p} + z\sigma_p$$

$$\text{LCL} = \overline{p} - z\sigma_p$$

where z = standard normal variable
$\overline{p}$ = the sample proportion defective
σ_p = the standard deviation of the average proportion defective

As with the other charts, z is selected to be either 2 or 3 standard deviations, depending on the amount of data we wish to capture in our control limits. Usually, however, they are set at 3.

The sample standard deviation is computed as follows:

$$\sigma_p = \sqrt{\frac{\overline{p}(1 - \overline{p})}{n}}$$

where n is the sample size.

C - Chart

C-charts are used to monitor the number of defects per unit. Examples are the number of returned meals in a restaurant, the number of trucks that exceed their weight limit in a month, the number of discolorations on a square foot of carpet, and the number of bacteria in a milliliter of water. Note that the types of units of measurement we are considering are a period of time, a surface area, or a volume of liquid.

The average number of defects, $\bar{c}$, is the center line of the control chart. The upper and lower control limits are computed as follows:

$$\text{UCL} = \bar{c} + z\sqrt{\bar{c}}$$

$$\text{LCL} = \bar{c} - z\sqrt{\bar{c}}$$

PROCESS CAPABILITY

- So far we have discussed ways of monitoring the production process to ensure that it is in a *state of control and that there are no assignable causes of variation. A critical aspect* of statistical quality control is evaluating the ability of a production process to meet or exceed preset specifications. This is called process capability.

- To understand exactly what this means, let's look more closely at the term *specification. Product specifications,* often called *tolerances, are preset ranges of acceptable quality characteristics,* such as product dimensions. For a product to be considered acceptable, its characteristics must fall within this preset range. Otherwise, the product is not acceptable. Product specifications, or tolerance limits, are usually established by design engineers or product design specialists.

- Process capability is measured by the process capability index, *Cp, which is computed* as the ratio of the specification width to the width of the process variability:

$$C_p = \frac{\text{specification width}}{\text{process width}} = \frac{\text{USL} - \text{LSL}}{6\sigma}$$

- where the specification width is the difference between the upper specification limit (USL) and the lower specification limit (LSL) of the process.

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