

Unit – I

- Designing for production includes the work of two distinct functions: product design and process design.

- **Product Design Function:**

The product design function involves the development of specifications of a product that will be functionally sound, have eye appeal, and will give satisfactory performance for an adequate life.

- **Process Design Function:**

The Process-design function includes developing the method of manufacture of the product so that it can be produced at a competitive price. This work will include planning the sequence of operations and inspection to be performed; the design of the jigs, fixtures, gages, and special equipment needed to produce the work; and the establishment of allowed elemental times for performing the work.

LOCATING IDEA FOR NEW PRODUCTS

- Ideas that lead to the development of new products may come from several sources. Usually ideas come from
 - Company executives.
 - Company sales force.
 - Customer suggestions.
 - Government agencies. and
 - Research laboratories.

SELECTING THE RIGHT PRODUCT

- After a firm has developed a list of ideas that appear to have product potential, it will need to select those that will most likely lead to success.
- This selection procedure takes place at new-product conferences. Those attending the new-product conference should be **representatives of sales, product engineering, manufacturing engineering, and marketing.**

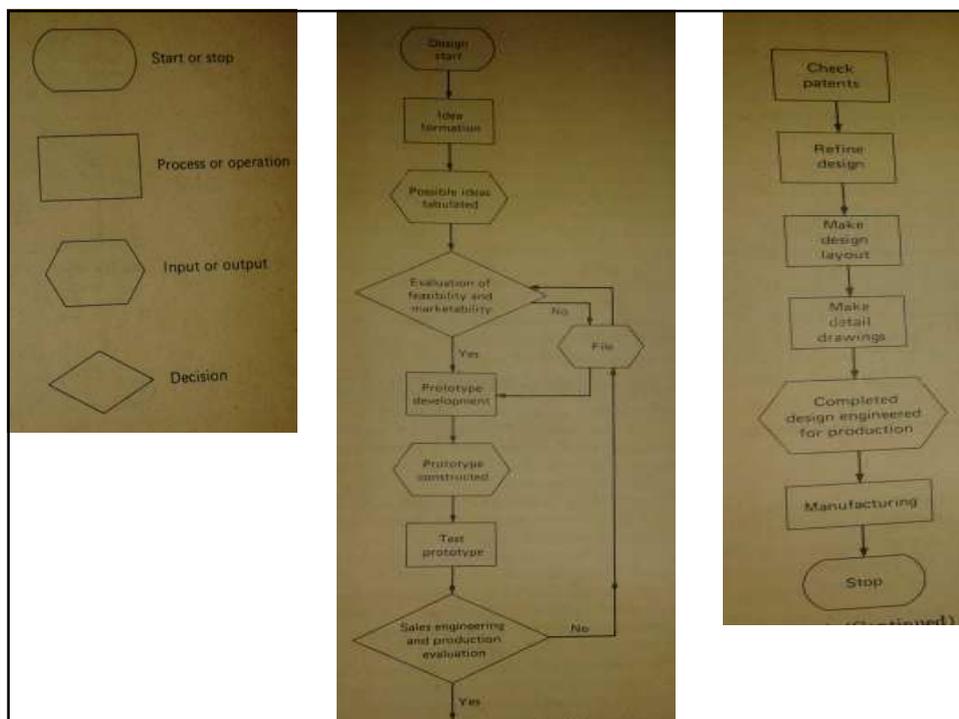
At the new product conference, it is a good idea to record a profile of the various influencing factors for each new product being considered. Some of the more important factors include:

- The utility value of the product
- The need for the product
- The product's sales appeal
- The advantages and improvements over similar products on the market
- The size of the potential market
- The patentability of the product
- R&D costs
- Setup and tool costs
- The profit potential
- The suitability of the company's engineering talent and production facilities
- The suitability of the company's sales force and means of distribution
- The strength of the company compared to the competition
- The expected life of the product
- The compatibility of the product with other company products

Systematic procedure of product innovation

- A systematic procedure for the development of a product will reduce the time and effort of the engineer, who promotes the development from its early stages to completion.

- He sees it through design;
- selection of materials;
- setting up of operations and processes;
- selection of equipment;
- design of tools;
- formulation of specifications,
- operation sheets, and sales data;
- use of standards;
- adoption of ideas;
- obtaining of patents;
- and many other function.
- All of these items are governed by economic or cost requirements and are developed by a systematic procedure.



Need for Creativity & Innovation

- Designing for production is a creator operation. Creating new product is not routine work. A product design engineer should have creative attitude irrespective of his level of knowledge about the product.
- Creative thinking is not confined to any particular field. In case of product design engineer, creativity helps in improving existing manufacturing process, materials to the creations of better product.

- Creativeness implies newness, but it is as often concerned with the improvement of old product. Mostly the products are improved in trying to develop better products. It may be functional aspect, external appearance, comfort, cost etc.
- Newly creative thing must be useful, it should benefits to people. Alfred Nobel invented dynamite. He later found that it is harmful to people and it is moral obligation on part of inventor, not to develop products which are harmful to society.

- Innovation should not be to the extent that people cannot purchase them. Total cost of the product developed is very important factor, which decides the achievability of the product. If a product is developed, which results in high selling price, which is beyond the capacity of sizeable no. of customers, then the product development engineer should not try to incorporate particular innovation aspect in development of product.

- For creating new product, one should have attitude of how to make some thing better with good judgment.
- It means that during the process of developing the product, the product development engineer should keep in view the attitude of people , size of potential customers, existing trends in the market, present need and expected few needs of people, demand for similar products in market etc.

- Without creative thinking an industry gradually decline. Any industry depends on modifications in regular intervals for existing products & introduce new product. This process should be continuous. It keeps the organization healthy & prosperous and helps in being competitive in the market.
- Creative thinking brings new & improved products, better quality, increased sales, higher profits.
- Advancement of human civilization / society depends on creativity as it is the basis for continuous bringing of new or developing the existing products.

CRITERIA FOR PRODUCT SUCCESS

- With so much dependence on the success of new products, it is surprising that only one out of five new products put on the market in the United States proves to be successful. This is especially disconcerting in view of the cost of new product failure.

- the principal reasons for the failure of new products is due to lack of technical expertise related to the new product. This lack of expertise may be inadequate experience with applicable new materials, inadequate experience with applicable processes, or inadequate experience with field testing or market analysis.
- Before a product is designed for production, it should undergo a thorough analysis to determine if the probabilities for its success are of sufficient magnitude to warrant the outlay of capital that would be necessary to get into production.

The areas that should be examined preparatory to design include the following:

- An analysis of the market in order to determine its size, the nature of the customers, and possible trends.
- Evaluation of the competition to determine its extent and strength and to get a clear picture of the pricing situation.
- Appraisal of distribution to determine if the product can be sold through the company's regular channels of distribution and with its existing sales organization.

- Determination of how much advertising and promotion will be needed to introduce the product.
- Appraisal of the effect of the product on the existing business to determine if it will increase or decrease the sale of existing products.
- Determination of financial requirements in order to learn how much investment may be required to handle development, manufacture, and marketing of the product and what the probable returns will be.

Important factors that must be considered in the product-design function.

- Have a sound functional design
- Have eye appeal
- Have quality characteristics, both in material and workmanship
- Provide for convenient maintenance
- Be competitive in price
- Be delivered to the customer in time to meet his needs
- Of the above requirements, 1,2,3, and 4 are principally the responsibility of the product-design function and 5 and 6 are, to a large extent, the responsibility of the process-design function.

FUNCTIONAL DESIGN

- Sound functional design assures that the product will satisfactorily operate for a reasonable period of time in the manner intended.
- Thus the materials going into the design will have been thoroughly checked for physical characteristics, such as strength, stiffness, and weight, as well as for such service characteristics as corrosion resistance and conductivity.

- Sound functional design takes into consideration all those details that affect the operation of a product. In other words, functional design assures a design that will work and accomplish the purpose for which it was intended.
- However, since the “pure” functional designer so frequently gives insufficient consideration to appearance, quantity, and human engineering, these criteria, which so greatly affect sales, would be discussed. Shape, color, texture, quality, and consideration of human expansions are more intimately related to the work of the product designer to that of the process designer.

VALUE OF APEARANCE

- This modern trend of thinking was apparent at a recent machine-tool show. Visitors gathered around the “attractive” machines, which had good appearance built into the design, and tended to pass by less-attractive machines designed for function alone. An operator takes pride in a machine with a good appearance. His interest results in lower maintenance costs and better-quality products.

- Appearance has become a major factor in all types of household appliances, machinery, process equipment (such as banking and canning machinery), locomotives, and power equipment. Better balance is now being attained between functional design, materials, finishes, colors, processes, methods of manufacture, maintenance, and appearance.

- The appearance of a product makes deep impressions on a buyer: it may suggest power and speed in a locomotive, durability in a machine tool, cleanliness in hospital equipment, precision in an instrument. When two products have approximately the same functions, the same cost, and the same time required for delivery, the product with the better appearance will have the most sales appeal.

Principles and Laws of Appearance

- A design that has appealing appearance has marked sales advantages over one that does not. The designer must keep in mind that the ultimate consumer or user of his creation is probably an ordinary person, and it is he to whom the designer must appeal and not an esthete. All men have a sense of beauty to some degree.

- The basic form of a drill press, a milling machine, or an orange squeezer is determined by its function, utility, and many other factors. This basic form can be modified and given a pleasing appearance by considering:
 - **Utility** – simplification of form; proportional relationship; repetition
 - **Interest** – emphasis; contrast; rhythm
 - **Balance** – symmetry
 - **Surface treatment** – color; texture

Unity

- Unity in product design means that the form of the product is such that people will like it automatically. If the design has unity, then all components are blended together to make a complete and self-contained design. The three qualifications leading to “unity” are (1) simplicity of form, (2) proportional relationship, and (3) repetition.

Interest

- Though “interest” the designer uses contrasting elements placed and controlled so as to attract and hold attention. To accomplish this, he calls for emphasis, contrast, and rhythm in his designs.
- **Emphasis:** Emphasis is accomplished through prominence in size or color.

- **Contrast:** Contrast is used to show differences among two or more components or to stimulate emphasis on a given component of a design. Contrast is obtained through size, color, and location.
- **Rhythm:** Rhythm in design is signified by a regular occurrence of elements. Thus, due to arrangements of components, the eye will move along a design and see a regular pattern of similarly shaped components.

Balance

- Balance of design gives the viewer an immediate impression of stability. Balance is inherent in our makeup – we tend to look for this property in all objects with which we come in contact.
- Symmetry is the most used method of giving balance to a design. When two halves of an object are identical, the halves are classified as being symmetrical. A design can also be symmetrical when developed around a central point. Thus, concentric discs within a wheel are examples of radial symmetry.

Surface Treatment

- When an individual “sees,” patterns of light are reflected from the object he is viewing to his eye. The surface of the object being viewed will have certain qualities which will either aid or detract in the perceptive process.
- For example, the reflection of light by white surfaces is considerably greater than gray surfaces and gray surfaces will reflect more than black surfaces. The reflective ability for light striking a surface is known as value. White surfaces are at the top of the value scale and black, with theoretically no light-reflecting ability, is at the bottom, with all colors falling in between these limits.

- **Color:** Color and texture have selling power. The psychological effects of color on people are very real. Yellow is the accepted color for better; therefore, margarine must be made yellow in order to appeal to the appetite.
- **Texture:** Texture is the pattern of contrasts in light reflections that identify the surface. The influence of surface texture on customers is as significant as color. There has been a definite trend toward mirror finishes, for example, glass fronted stores, Koroseal fabrics, and chrome finish on automobiles and appliances.

Table 2-1 EMOTIONAL AND PSYCHOLOGICAL SIGNIFICANCE OF THE PRINCIPAL COLORS

Color	Characteristics
Yellow	Has the highest visibility of any color under practically all lighting conditions. It tends to instill a feeling of freshness and dryness. It also can give the sensation of wealth and glory, yet can suggest cowardice and sickness.
Orange	Tends to combine the high visibility of yellow and the vitality and intensity characteristic of red. It attracts attention more than any other color in the spectrum. It gives a feeling of warmth, and frequently has a stimulating or cheering effect.
Red	A high-visibility color, having intensity and vitality. It is the physical color associated with blood. It suggests heat, stimulation, and action.
Blue	A low-visibility color. It tends to lead the mind to thoughtfulness and deliberation. It tends to be a soothing color, although it can promote a depressing mood.
Green	A low-visibility color. It imparts a feeling of restfulness, coolness, and stability.
Purple and Violet	Low-visibility colors. They are associated with pain, passion, suffering, heroism, etc. They tend to bring the feeling of fragility, impotence, and dullness.

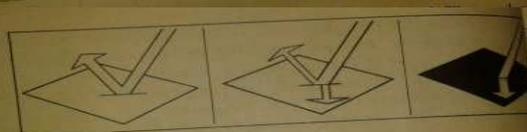
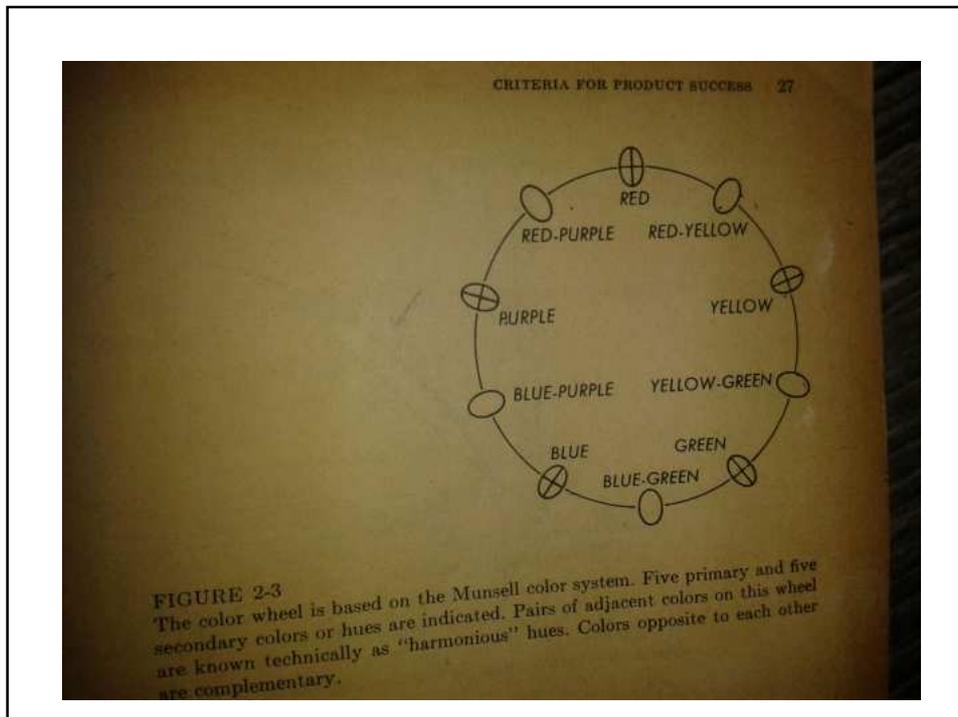


FIGURE 2-2 Reflection and absorption of light by white, gray, and black surfaces.



Creativity

- Creativity means the ability to develop a new object or a new idea.
- *"Creativity is defined as the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others."* – Robert E. Franken, Human Motivation
- *"'Creative' refers to novel products of value, as in 'The airplane was a creative invention.' 'Creative' also refers to the person who produces the work, as in, 'Picasso was creative.' 'Creativity,' then refers both to the capacity to produce such works, as in 'How can we foster our employees' creativity?' and to the activity of generating such products, as in 'Creativity requires hard work.'"* – Robert W. Weisberg, Creativity – Beyond the Myth of Genius

Creative Techniques

- Brainstorming Technique
- Gordon Technique (not pinpointing problem)
- Checklisting Technique (faulty memory what)
- Morphological Analysis (many combinations)
- Evaluation Comparison Technique (measuring between dimensions, physical properties, mechanical properties, electrical and magnetic properties, cost consideration and other.)

Innovation

- The word innovative means to use new, fresh and different ideas. Get out of the box and come up with something that hasn't been done previously.

Difference b/w creativity & innovation

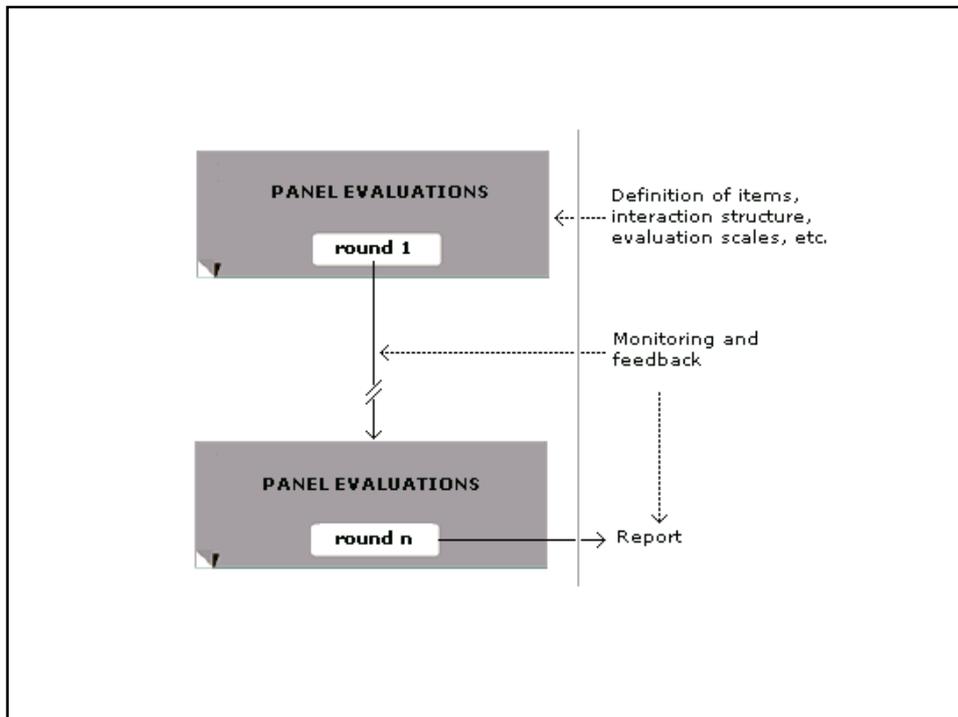
- Creativity refers to the ability to come up with new ideas, the ability to think widely, to have a free and open mind and to approach matters in a new way. Whereas innovation is the ability to confine the creative ideas and make them turn into reality so as to achieve successful performance.

Brainstorming Technique

- It is a problem – solving conference method based on the stimulation of one person's mind by the mind of another. An average group consists of 4 to 6 people sitting around a table, and spontaneously producing ideas designed to solve a specific problem. The following rules should be followed:
 - Criticism is ruled out.
 - Free – wheeling is welcome.
 - Any number of ideas is welcome and desirable.
 - Combination and improvement are sought.

Delphi Technique

- The Delphi method is a combination of qualitative and quantitative processes that draws mainly upon the opinions of identified experts to develop theories and projections for the future. A group of experts is drawn from several disciplines and professions.
- A multiple-round survey system is administered to this group over an extended period of time. The goal of this method is to reach a consensus among the group by the end of this multiple-round questionnaire process.
- The uniqueness of Delphi lies in its reliability, given the variableness of human opinion, and in its ability to be administered remotely and without direct participant interaction. It is best used for a fairly simple assessment of new products and developments, but it is one of the most complex methodologies available.



Reason for new product failure

- Lack of understanding of market needs – 44%
- Lack of internal support – 13%
- poor thinking and implementation – 17%
- Weak competitive positioning – 10%
- Inadequate marketing support – 8%
- Benefits of new product / service not perceived – 8%

References

1. Product Design and Manufacturing, Chitale A.K & Gupta RC., PHI Publisher, 1997
2. Product Design and Development, Karl Ulrich, Tata McGraw Hill
3. P. Narayana, Intellectual Property Law, Eastern Law Edn. 1997
4. G Dieter, Engineering Design - a materials and processing approach, McGraw Hill, NY, 2000.
5. Niebel BW & DraperAB: "Production Design & Process Engg.", McGraw Hill, Kogakusha, 1974.
6. Harry Nystrom, "Creativity and Innovation", John Wiley & Sons, 1979.
7. Brain Twiss, "Managing Technological Innovation", Pittman Publ, 1992.
8. Harry, B. Waton, "New Product Planning", Prentice Hall Inc., 1992
9. Google.com, wherever necessary for images and matter related to subject.