**Production & Operation Management**

**Unit-2**

**Product Design:**

Product design as a verb is to create a new product to be sold by a business to its customers. A very broad coefficient and effective generation and development of ideas through a process that leads to new products.[2] Thus, it is a major aspect of new product development.

Due to the absence of a consensually accepted definition that reflects the breadth of the topic sufficiently, two discrete, yet interdependent, definitions are needed: one that explicitly defines product design in reference to the artifact, the other that defines the product design process in relation to this artifact.

Product design as a noun: the set of properties of an artifact, consisting of the discrete properties of the form (i.e., the aesthetics of the tangible good or service) and the function (i.e. its capabilities) together with the holistic properties of the integrated form and function.[3]

**Product design process:**

the set of strategic and tactical activities, from idea generation to commercialization, used to create a product design. In a systematic approach, product designers conceptualize and evaluate ideas, turning them into tangible inventions and products. The product designer's role is to combine art, science, and technology to create new products that people can use. Their evolving role has been facilitated by digital tools that now allow designers to do things that include communicate, visualize, analyze, 3D modeling and actually produce tangible ideas in a way that would have taken greater manpower in the past.

There are various product design processes, and many focus on different aspects. One example formulation/model of the process is described by Don Koberg and Jim Bagnellin, in "The Seven Universal Stages of Creative Problem-Solving." The process is usually completed by a group of people with different skills and training—e.g. industrial designers, field experts (prospective users), engineers (for engineering design aspects), depending upon the nature and type of product involved. The process often involves figuring out what is required, brainstorming possible ideas, creating mock prototypes, and then generating the product. However, that is not the end. Product designers would still need to execute the idea, making it into an actual product and evaluating its success (seeing if any improvements are necessary).

The product design process, as expressed by Koberg and Bagnell, typically involves three main aspects:

Analysis

Concept

Synthesis

Depending on the kind of product being designed, the latter two sections are most often revisited (e.g. depending on how often the design needs revision, to improve it or to better fit the criteria). This is a continuous loop, where feedback is the main component. Koberg and Bagnell offer more specifics on the process: In their model, "analysis" consists of two stages, "concept" is only one stage, and "synthesis" encompasses the other four. (These terms notably vary in usage in different design frameworks. Here, they are used in the way they're used by Koberg and Bagnell.)

**Analysis**

Accept Situation: Here, the designers decide on committing to the project and finding a solution to the problem. They pool their resources into figuring out how to solve the task most efficiently.

Analyze: In this stage, everyone in the team begins research. They gather general and specific materials which will help to figure out how their problem might be solved. This can range from statistics, questionnaires, and articles, among many other sources.

**Concept**

Define: This is where the key issue of the matter is defined. The conditions of the problem become objectives, and restraints on the situation become the parameters within which the new design must be constructed.

**Synthesis**

Ideate: The designers here brainstorm different ideas, solutions for their design problem. The ideal brainstorming session does not involve any bias or judgment, but instead builds on original ideas.[

**Select:**

 By now, the designers have narrowed down their ideas to a select few, which can be guaranteed successes and from there they can outline their plan to make the product.

Implement: This is where the prototypes are built, the plan outlined in the previous step is realized and the product starts to become an actual object.

**Evaluate:**

 In the last stage, the product is tested, and from there, improvements are made. Although this is the last stage, it does not mean that the process is over. The finished prototype may not work as well as hoped so new ideas need to be brainstormed.

**Product Development:**

Product development process is expensive, risky and time consuming. Though world-shaping innovations have emerged from the ‘garages’ and will continue to do so, companies cannot depend solely on flashes of brilliance and inspiration to provide their next bread earner or even their next blockbuster.

It is too frightening. In absence of any better method to bring out new products a formal process with review points, clear new product goals, and strong marketing orientations underlying the process is being relied upon by companies to achieve greater success.

An eight step new product development process consists of new product strategy, idea generation, screening, concept testing, business analysis, product development, market testing and commercialization. New products pass through each stage at varying speeds.



### New product strategy:

Senior management should provide vision and priorities for new product development. It should give guidelines about which product or market the company is interested in serving. **It has to provide a focus for the areas in which idea generation should take place.**

By outlining their objectives, for instance, market share, profitability, or technological leadership for new products, the senior management can provide indicators for screening criteria that should be used to evaluate these ideas.

A development team is likely to achieve better results if it concentrates its resources on a few projects instead of taking shots at anything that might work. Since the outcome of new product development process is unpredictable, a company might believe that it is taking a risk by working on only a few new ideas.

However unpredictable the new product development process may be, chances of success will definitely improve if the team knows precisely what it wants to achieve from the process, puts its best people in the project, and has enough resources to commit to the project.

**Idea generation:**

Developing an innovative culture that kindles imagination is a prerequisite. In such an environment every employee is alert to new opportunities. Great ideas come in a period of quiet contemplation, uninterrupted by bustle of everyday life and work.

**Idea screening:**

Screening of ideas is done to evaluate their commercial worth. At this stage, the company needs to ascertain whether the new products being developed fit in with the company’s strategy and resource availability.

Simultaneously, the company also evaluates the market potential for the new product by evaluating criteria such as projected sales, profit potential, extent of competition and return on investments. Unique designs that lower costs or give performance advantages are also considered.

Though it is difficult to accurately forecast the success of an idea at this stage, the process helps the company to check if the idea is in alignment with the company’s objectives and competencies, and that the idea has reasonable chances of success..

**Concept testing:**

At the developmental stage, every idea can be developed into several product concepts. Each concept is then tested with a small sample of customers from the target market to know their degree of acceptance. A product concept is a particular combination of features, benefits and price. Alternate product concepts are evaluated by customers.

Though it may still be a description rather than the actual product, customers have something tangible to react to. This process allows customer feedback to seep into the new product development process early enough for marketers to evaluate the degree of acceptance of the potential new product.

As the physical product may not be available at this stage, companies go in for a verbal or pictorial description of the product to let customers have an idea about the actual product. Prospective customers present feedbacks regarding the attractiveness of the features and benefits offered by the potential product. Usually, the intention of the company is to gauge the most desirable combination of benefits that customers are willing to pay for.

An instrument such as a questionnaire is used to know the likes and dislikes of customers, which customers are likely to find the product most attractive, what price point would best suit the customer, what trade-offs is the customer willing to make while evaluating the product, the immediacy of the product requirement and how frequently he would buy the product.

These features or benefits are then incorporated into the product development process, which is likely to lead to competitive advantage for the company.

**Business analysis:**

Estimates of sales, cost and profits are made. The company identifies the target market, its size and projected product acceptance over a number of years. The company considers various prices and their implications on sales revenues. Costs and breakeven point are estimated.

Sensitivity analysis is done in which variations from given assumptions about price, cost, customer acceptance are checked to see how they would impact on sales revenue and profit.

Optimistic, most likely and pessimistic scenarios can be drawn up to estimate degree of risk attached to the project. The idea is to test if the proposed product will generate enough revenues and profits to justify the expenses that its development and marketing will entail.

Though it is not possible to draw reliable conclusions from such futuristic analysis, it does force company’s executives to peep into what the proposed product can or cannot achieve for the company.

If they decipher that the proposed product has huge potential they can pump more resources and expedite the project. The process permits the commercial instincts of the executives to be put to test.

**Product development:**

The product concept that has found the best acceptance is then developed into a physical product. Components have to be designed in terms of length, width, diameter, angle etc., and arranged to be assembled in a manner which provides the features and benefits of the selected product concept.

Multi­disciplinary project teams are established to bring the product to the marketplace. The product development process is faster and results in the development of better, high quality products when

engineers, technicians, marketers, finance and production specialists work together in a synergistic fashion.

At this stage, the product is tested to analyse its functional performance and the degree of customer acceptance. Paired comparison tests are used to compare the new product with existing or potential competitors in order to give a realistic feel to the consumer decision making process.

Customers compare and judge the overall preference for the product, as well as preference for specific features or benefits offered by various choices available to them

In monadic placement tests, only the new product is given to users for trial. Experts can also be used. When testing products in business markets, products may be placed with customers free of charge, to check preference.

**Market testing:**

So far in the product development process, potential customers have been asked if they intend to buy the product, but have never been placed in the position of having to pay for it. Now customers are forced to vote with their money.

The company seeks to have a limited launch for the product in the marketplace so that it can gauge the initial customer response in true test conditions.

The feedback obtained from this launch guides the company’s decision to continue with the large scale commercialization of the project, or to abandon it.

Ideally, the feedback that is obtained from the test sample should be as realistic as possible, i.e., the profile of the sample of respondents should closely resemble the profile of prospective customers in the actual marketplace, and they should be buying the product from a realistic retail setup as they would actually do.

For instance, a sample of customers may be recruited to buy their groceries from a mobile supermarket which visits them once a week. They are provided with magazines in which advertisements for the new products appear. Key success indicators such as penetration (the proportion of customers who buy the new product at least once) and repeat purchase (the rate at which purchasers buy again) can be found out.

**Commercialization and diffusion of innovation:**

Choice regarding target market to whom the product should be sold first and product positioning that will be attractive to the first target market has to be made. The fundamental process that defines the success of an innovation is its diffusion rate.

Therefore, the target market for the innovation has to be decided by understanding the process of diffusion of innovation. The spread of an innovation is called diffusion, and when an individual customer unit buys the new product, it is called adoption.

Thus, when many customers adopt the new product quickly, the diffusion is fast, and the diffusion rate is high. The new product is successful. And when either the number of customers who adopt the new

product is low, or the process of adoption is slow, the diffusion rate is low. The rate of diffusion depends on:

i. The characteristics of the innovation, i.e., an innovation having a relative advantage over existing options in the market, that fulfill the same needs of the customers, is more likely to be successful,

ii. The social system or the target market where the innovation is introduced,

iii. The channels of communication used by the marketer to explain the innovations to prospective customers and,

iv. The amount of time that has lapsed since the introduction of the innovation.

**Product Life Cycle**

We have a life cycle, we are born, we grow, we mature, and finally we pass away. Similarly, products also have life cycle, from their introduction to decline they progresses through a sequence of stages. The major stages of the product life cycle are - introduction, growth, maturity, and decline. Product life cycle describes transition of a product from its development to decline.

The time period of product life cycle and the length of each stage varies from product to product. Life cycle of one product can be over in few months, and of another product may last for many years. One product reach to maturity in years and another can reach it in few months. One product stay at the maturity for years and another just for few months. Hence, it is true to say that length of each stage varies from product to product.

Product life cycle is associated with variation in the marketing situation, level of competition, product demand, consumer understanding, etc., thus marketing managers have to change the marketing strategy and the marketing mix accordingly.

Product life cycle can be defined as "the change in sales volume of a specific product offered by an organization, over the expected life of the product.

**Stages of the Product Life Cycle**

The four major stages of the product life cycle are as follows :-

**Introduction,**

**Growth,**

**Maturity, and**

**Decline.**



**Introduction Stage**

At this stage the product is new to the market and few potential customers are aware with the existence of product. The price is generally high. The sales of the product is low or may be restricted to early adopters. Profits are often low or losses are being made, this is because of the high advertising cost and repayment of developmental cost. At the introductory stage :-

The product is unknown,

The price is generally high,

The placement is selective, and

The promotion is informative and personalized.

**Growth Stage**

At this stage the product is becoming more widely known and acceptable in the market. Marketing is done to strengthen brand and develop an image for the product. Prices may start to fall as competitors enters the market. With the increase in sales, profit may start to be earned, but advertising cost remains high. At the growth stage :-

The product is more widely known and consumed,

The sales volume increases,

The price begin to decline with the entry of new players,

The placement becomes more widely spread, and

The promotion is focused on brand development and product image formation.

**Maturity Stage**

At this stage the product is competing with alternatives. Sales and profits are at their peak. Product range may be extended, by adding both withe and depth. With the increases in competition the price reaches to its lowest point. Advertising is done to reinforce the product image in the consumer's minds to increase repeat purchases. At maturity stage :-

The product is competing with alternatives,

The sales are at their peak,

The prices reaches to its lowest point,

The placement is intense, and

The promotion is focused on repeat purchasing.

**Decline Stage**

At this stage sales start to fall fast as a result product range is reduced. The product faces reduced competition as many players have left the market and it is expected that no new competitor will enter the market. Advertising cost is also reduced. Concentration is on remaining market niches as some price stability is expected there. Each product sold could be profitable as developmental costs have been paid at earlier stage. With the reduction in sales volume overall profit will also reduce. At decline stage :-

The product faces reduced competition,

The sales volume reduces,

The price is likely to fall,

The placement is selective, and

The promotion is focused on reminding.