Industrial Engineering
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Module – 1
Lecture – 2
Product Design and Development

I welcome you to this lecture on Product Design and Development part one, I am P.K. Jain Professor in the Department of Mechanical and Industrial Engineering, Indian Institute of Technology, Roorkee. The contents of this lecture are as follows…

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First I will introduce the topic, then I will discuss about the factors which we study for the product design and development exercise in a manufacturing organization. Third part is product analysis means, when the product idea is identified, we have to analyze it and finally the summary of the lecture.

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So, first of all I will introduce you to the topic of product design and development, as you see that base this is the basic need of every manufacturing company, but why first of all we know that customers want and expect new and better products, they want new and better products, which are good looking, which are technically superior than the other products available in the market and which are low cost. So, there is a need to develop our existing product range continuously, so that ever going demands of the customers can be satisfy to remain competitive in the market.

Note to innovate approach is becoming increasingly risky, because this approach may drive company out of the market, if your product is not able to stand the competition in the market, it is not able to meet the requirements of the customers, then you may pushed out or the company may be pushed out of the market and you may lose your customer base permanently. So, we can say, that innovating new product is expensive and risky, why it is expensive and risky reason is that, when we develop a new product, we have to invest in the research and development activities.

We have to create necessary infrastructure for the manufacture of that product and we have to create necessary infrastructure for the distribution of that product to the customers. So, if that product idea or that product is not successful in the market, then the investment made in the infrastructure, investment made in the development activities will go waste. Now, when we go for product design and development activity, there are three possible scenarios.

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One is that most product ideas which go to the development stage never reach the market, the reasons may be that we do not have sufficient funds, money for research and development activities to work upon that product idea; that means, we may have to abundant that product idea in between or we may not have require technology to give the required specifications, required surface finish, required quality that means again we have to abundant that product idea.

We may not have a skilled manpower to convert that product idea into a physical product, again there may be a possibility to drop that product idea or sometime there may be a change in the demand in the market means customers requirement may change in between. So, in that case there is no point in continuing working on that sort of product idea, so we have to drop that product idea again.

So, in that case, we take a product idea, we try to convert that product idea into a physical product, but we have to drop it because of, so many reasons which we have discussed. Second possible scenario may be that, many products that do reach the market are not successful, means they may be inferior on quality; that means, they will not able to stand the competition in the market our competitors are giving good quality products. Our product may be high in cost; that means, we may not be able catch customers or there may be a change in the customers taste again.

So, again we will see that our product will not be as successful as we planned in the beginning and the product may be poor in the functionality; that means, it is not able to meet all the requirements of the customers. So, it is not able to satisfy the requirements, it is not able to fulfill its functionality requirements or sometime we may be lacking in the marketing skills; that means, we may not have enough skilled marketing personnel to promote that product in the market to capture new market.

So, in that case again product do reach the market, but it is not successful, so the investment made on the research and development activities, investment made in the infrastructure will not be recovered fully in that type of scenario.

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Third possible scenario is that product is successful, but has shorter life cycle than expected, in that case, it may be due to the change in customers taste again means in between some new products with better functionality good features are available in the market. So, your product will be pushed out of the market in that case, there is change in the technology means superior technology has come.

So, in that case your product may not stand the competition, for examples in case of computer technology, in case of consumer electronic items, in case of you can say mobile sites or any such area where technology is changing at very rapid pace. So, there may be situation that product has shorter life cycle than the expected of the plan in the beginning or there may be a reason that there is stiff competition in the market and we

are not able to stand that competition; that means, we may not have enough skilled manpower to promote that product in the market.

So, in that case, we may be driven out of the market in between and again we may not be able to recover whole investment, which we made on the development activities, which we made on creating the infrastructure for the manufacture and for the distribution of that product. So, we can see here that management find itself in dilemma, it must develop new product, so remain competitive in the market, yet there is heavy risk against their success.

That means, we have to look at all these possibilities before taking up any product idea and before trying to convert it into a physical product, so heavy risk is always associated with the design and development of a new product. Now, when we go for the design and development of a new product because as I said, this is the basic need for every company nowadays, they have to compute their competitors, they have to offer new products new functionalities, new features in their products. So, they have the keep on developing their product, but there are certain factors which we have study for the design and development, exercise before taking up a new product idea.

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Product identification related factors are first is gap in demand; that means, there is a huge gap in the demand and supply of that product means that existing manufactures or suppliers are not able to meet the existing demand. So, in that case, we can take up that

product idea to fill that gap in the demand and supply, this is a favorable situation for any manufacturing company because in that case, they have to invest less in marketing efforts and ready market are markets are available to them.

Another possibility may be that, you have somewhat that company has some under-utilized or un-utilized resources, so in that case, they may look for some other manufacturers who may use those resources. So, basically idea here is to make existing resources fully utilized, so in that case we can go for contract manufacturing means we can take some contract from other manufactures and manufacture their requirements of their products in our organization by utilizing these underutilized resources or we can land over facilities to some other manufactures.

So, basic idea here is to utilize our existing facilities, so that the investment made on such facilities is recovered fully. Third possibility is the diversification; that means, if we have a select customer base, if we have a focus on a particular customer base or a particular market, then any fluctuation in the demand from that area will affect our revenues, sale of our product. So, to avoid that type of situation, there is a need to expand the existing product range or to launch some new products to capture new markets, new customer base.

So, in that case, there is a need to diversify of course, when we go for the diversification, we should try to make products which are of similar type, they fall in the same family, product family which we are already manufacturing. For example say in case of consumer electronic, goods manufacturing organizations, if they are manufacturing only television sites, then they can also add washing machines to their product range, so that they can diversify, they can try to capture new markets or new customer base.

Sometime, new product ideas may come just by chance from our friends, from our co-workers or sometimes from our environment. So, we have to work upon such ideas, we should not reject them out rightly, but we have to work upon those ideas to see the potential in the market and to convert them into the physical products, so that company can develop and offer some new and innovative product to their customers.

For example, say if you see the eatable cones, which are nowadays available in the ice-cream parlors this was the idea of a sweeper, so such type of ideas may come just by chance and we have to work upon, such ideas to convert them into the physical products. Another set of factors, which is important for product design and development exercise is marketing related factors.

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In marketing related factors, we have to focus on the marketing aspect only, we have to see the market for that type of product. First of all, when we go for the design and development of a new product, we have to look for the prestige of the company. The new product that we are going to manufacture, that should not dent the existing prestige of the company; means, it should be of similar or even better quality, it should be able to satisfy our customers both in terms of functionality, in terms of after sale service, in terms of it is shape and size and other aesthetic aspect.

So, it should be in line with the prestige of the company because otherwise, if we offer a product which is not meeting our or is not as per our the prestige of the company, then it may affect the sale of other products of that company because it will give a bad name to the company. And it will affect or it may affect the sale of other products of that company, so we have to look for that. Another factor that comes under marketing related factors is that, we should try to offer technologically sound products; that means the products which we are trying to offer to our customers should be technologically sound products.

That means they, we should try to make use of advance technology in our products, while offering the required functionality, required features and required quality to the customer, that will give some advantage to the company in the market place. As you might have seen many of the consumer electronics companies do advertise their products by giving a name to a new technology. For example say LG company, they give some golden eye technology as their focus, while advertising the product for the company.

Another important aspect related to the marketing is customers requirement; that means, when we go for the manufacture of a new product or when we try to convert a product idea into a physical product, we should always keep in mind the requirements of the customers. These customer's requirements, either may come through market survey by conducting some interviews, by asking them to fill up some questioners or sometime even may we may directly talked to the customers.

So, first of all we get a set of requirements of the customers, a large number of customers and then those requirements are converted into the technical specifications, which are required to meet those requirements And finally, we have to design a product, which can satisfy those functions those requirements. So, here customer's requirements are prime importance and as we know that the requirements of the customers sometime may be very large.

In that case, we have to focus on those requirements only which are essential and which will give some advantage to the product in the market place, but at the same time, when we go for the design and development exercise, product design development exercise, we have to look for the market potential means how much can be observed by the market. If we are entering a mature market; that means, we have to face a stiff competition some customers, some manufactures are already offering similar type of product.

So, we have to invest heavily in the marketing function, we have to invest heavily in the advertisement campaigns and we have to sometime offer some sales promotional schemes to the customers. But as I have discussed in the beginning, if there is a gap in the demand and supply of a particular product in that case we know that ready market is available, so there is a market potential to observe our product. So, when we go for

product design development exercise, we have to look for the potential of the how much can be observed by that market. Another important aspect related to market related factors is the product life, when we talk about product life; that means, life of the product in the market place; that means, how long that product will be or will remains successful. Let us take this graph which shows the product life cycle graph….

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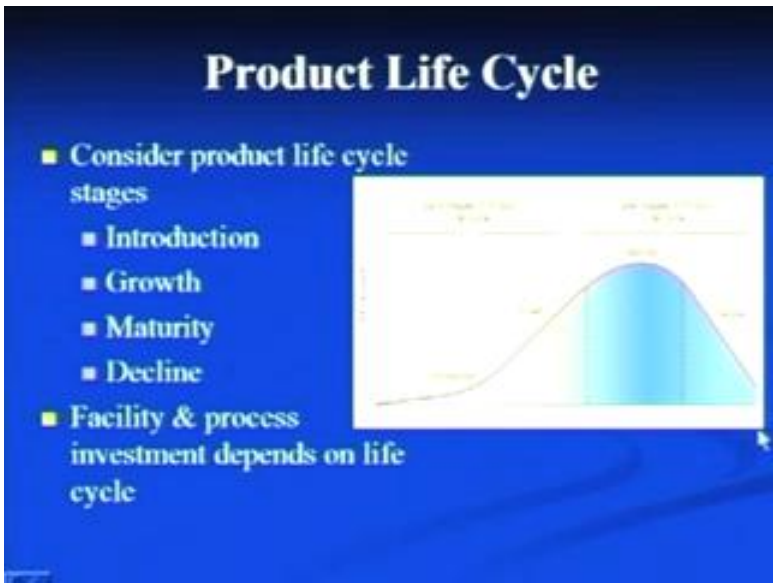

Sometime, we call this as inverted bathtub curve, in this we consider different stages of product life cycle, first stage is the introduction; that means, part is introduced to the market and demand is very less, but slowly demand will pickup and this is the second phase that we defined as growth phase. So, demand is increasing continuously, reason is simple that our product is new, it has some new features, new functionalities and may be better quality product, so that is why, there is a continuous increase in the demand.

The third stage is the maturity stage; that means, product has reached it is maturity stage, so here in this third phase demand of the product remains almost same stable, so we can say that product has reach the maturity stage and demand is same or will remains stable. There is one more stage that we defined the declined stage or declined phase, here demand of the product will decrease continuously after third phase. Reason is simple that product may have become outdated, better and good quality products may have been made available by the competitors.

So, demand of the product may go down and slowly it may be phased out of the market, so we have to look for this time period very carefully, while we are going for the product design and development exercise. Because whatever investment we made in the development activities, in creating the infrastructure for manufacturing and distribution, that investment has to be recovered fully during this time period. And this graph can be divided into two life cycles, one is early stages of product life and second is later stages of product life cycle.

So, we can say, the facilities and process investment which we made in manufacturing that product, solely only depends on the life cycle, longer the life cycle higher may be investment because there is a longer period available to us for the recovery of that investment. Another important factor which is related to the marketing of their product idea is the competition in the market, as I said before during discussion on market potential, that we have to face sometimes stiff competition in the market.

If market is mature, naturally similar type of products are offered by many other competitors, many other manufacturers, so we have to meet the quality standard, we have to meet the functionality standards and we have to offer the new and better features to the customers. So, in that case, we have to focus on the competition and sometime to beat this type of competition, we may have to offer some sales promotional schemes like buy one get one type of a schemes to make our product successful in the market.

So, but that depends only on the capabilities of the marketing department, marketing personnel, how do they market that product idea to the customers. Another set of factors which we have to study for product design and development exercise is legal factors.

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Because we know, that when we for the manufacturing of any product, we have to sometime take some clearances from the government, there are some rules and regulations which we have to avoid by, one for them may be related to the environment pollution. This is particularly true in case of process industries, where we have to take, no objection certificate from the pollution control board, so that we can start manufacturing of that product.

Another legal factor, may be related to some important import restrictions on capital goods, so if you want to import capital goods related to the production of defense related products or the products related to the national security. So, in that case government may not give us approval or permission to import such type of goods, so we have to look for such type of restriction, while before going to the product design development exercise.

Another may be sometime there may be restrictions on the finance, that if we are going for this type of product, then we have to keep our finances below this limit, because some industries have been categorized as small scale industries or kutir udyogs, where that type of industry, we can say can be established or started by having a fix or low amount of investment. So, such type of restrictions are there and we have to abide by these restrictions, we should not violet any of these restrictions. So, all the legal factors or legal aspects, related to the production of that product should be taken into account, while taking a new product idea.

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Another set of parameters or the factors which are related with product design and development exercise is related with the finance, one of them is that we have to look for the capital investment, capital investment as I said before we need for the creation of manufacturing resources for buying the plant and machinery to convert that product idea into a physical product. So, we have to see whether, sufficient funds are available for creating that sort of infrastructure or not.

Another factor, which is related here with finance is that cash generation; means, we have to generate sufficient cash for the purchase of material, for the purchase of other resources. And there may be several options, which are available for the generation of cash, nene may be from government; means, government support that another may be in the form of some shares, which may of which we can offer to the customers or to general public.

And then third may be the fixed deposits, again this come from the public, they will deposit their money, we will offer them fixed rate of return, so all these we have to take care of while generating the cash. So, when we go for finance related factors, first and most important thing, we should focus on is that the sufficient money or funds should be available for that product idea, for the creation of the manufacturing resources, for buying the new equipments and machinery and for the investment on the research and development activities.

If sufficient money sometime is not available, then there are several options to generate that capital or sometimes there may be some borrowings from the market from other companies or from the banks or like that.

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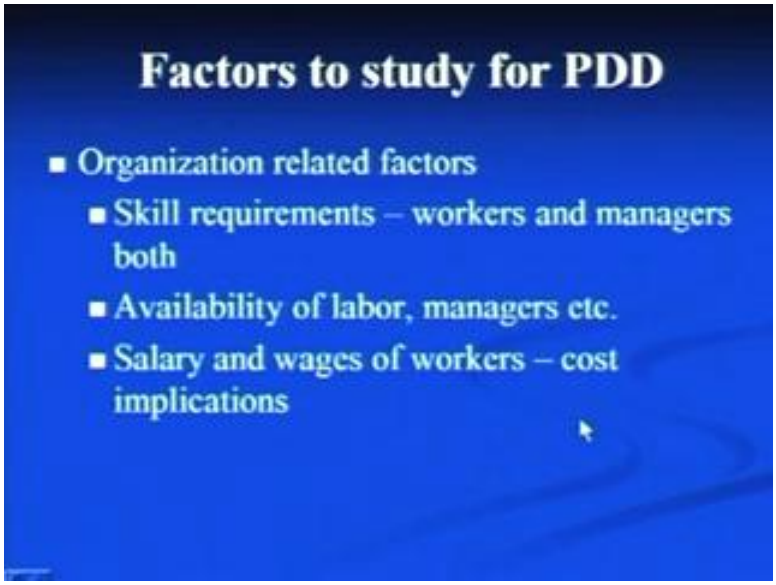

Another set of factors, that we study for product design and development exercise is related with the organizational structure of the company. First of all, we have to identify the skill requirements means a skill of the workers or operators or managers which we need for that product idea, workers are need for converting the raw material into the finished products. Managers are requirements to plan the whole company or the plan, they are required to offer that product to the customers to plan for marketing strategies and so on.

So, we have to identity what sort of people we need in terms of the skill requirements, second is the availability of labour and managers, do we have capable workforce and managers for that product idea, sometime we may have labour or workforce in the organization itself, managers may already be there in the plant or in the organization. If plant is just expand your organization is just expanding it is business activities, but sometime, if that type of workforce or managers are not available in that case, they have to be hired and we have to look for the salary and wages of the workers.

So, cost implications should be looked into, so sometime if availability is poor or we do not have enough workers and managers, then we have to hire them and in that case cost

will come into picture. So, cost of manpower or cost of creating that organizational structure should be taken into account during product design and development exercise, but please keep in mind that.

If we are starting a new product, if we are starting a new plan then only this factor is more important otherwise workforce and capable managers may be available in the plan, only thing is that they may have to work on new product ideas or some new technology. Another set of factors, which is important for product design and development is manufacturing related factor.

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Because we know that for any product idea or for any output of any organization, raw materials or inputs have to pass through a transformation process that transformation process is nothing, but a value addition process or some values are added to the raw material to make them sellable. So, that by selling those products and service to the customers, we can generate revenues for the organization to run our operations.

First factor that is important under this heading is availability of technological know, how its cost and related equipments. For example say, if you are taking a new product idea we may have to use a new technology for that product, so we have to see whether that type of technology is available in the organization, if it is, so that is well and good.

If that type of technology is available in the country; that means, we have to buy it or we have to pay some short of fee to the developer of that technology or sometime, if that technology is not available in the country even then we have to import that type of technology. So, all this has to be looked into cost and the related equipments which we need to make use of that technology.

Another factor, that is important here is cost of manufacturing facility that; that means, the cost of manufacturing infrastructure, manufacturing resources, equipments, machines, inspection devices, material handling devices. So, we have to estimate all these cost, another important factor here is the quality of manufactured product; that means, it is mainly governed by the customers requirement.

So, whatever we manufacture that should meet the quality standards because if we are working in a competitive environment, then we have to see the quality of the products offered by the competitors And sometime we should try to improve upon that type of quality. So, whatever manufacturing resources we create or which we buy for the manufacture of that product, we should see that the intended quality standard should be made, because they are driven by the customers.

We have to satisfy customer's requirements in terms of quality, another important factor here is the rate of production; that means, the rate of production should be in line with the market demand. As we have seen earlier that if we are going or we are operating as a mass production environment, then normally the rate of demand is very high. So, the equipments which we select should be able to give us very high rate of production, but if you are operating as a batch type of manufacturing environment, in that case we manufacture a small quantity of the identical items.

So, in that case, rate of production is not that high, so depending on the demand, quantity wise, depending on the pattern we have to identify the suitable equipments, appropriate equipments and then we have to work upon the cost of those equipments.

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Another set of parameters that is important for our product design and development exercise is distribution related factors, why this factor is important because if we manufacture a batch in our organization or in the company that batch should be dispatch as early as possible to the customers, to the market. Otherwise that batch will end up as the inventory in the organization and will increase the overall cost of the product. So, identification of distribution channels is very, very important in modern day manufacturing environment.

Here, first factor that we have to look into is availability of distributors, while we are trying to identify the distributors for our product, we have to see their reputation in the market. They should have good reputation in the market among the customers, they should have good infrastructure in terms of facilities because these distributors sometime are responsible for offering after sale service by supplying the spear parts to the customers.

And they should have able managers and sales personnel to promote that product in the market place, so we have to see the availability of the reputed distributors, good distributors. Sometime distributors or say good distributors are not available in a market place or they are not willing to take our product. So, in that case, we have to create our own distribution centers in such places or we have to convince the existing distributors to display our products in their shop in their distribution center and to cater to the market place.

So, in that case, sometime we have to offer them some incentives, some discount on the product and, so on. Another important factor here is availability of warehouses, we know that warehouses are mainly used for the storage of in transportation products. So, when we are dispatching our products from the company side to the customer, then we have to store then somewhere in between, because consignments will go to one place and then it will be distributed among several market places.

So, we have to identify the availability of warehouses in that particular region or in that particular market, so when we go for this sort of check, we have to see our space requirement, how much space we need for the storage of our products, what type of facilities we do need for the storage of product. Sometime product may be very sophisticated, fragile type of job product, so in that we may need control temperature, control humidity and so on.

So, the facility should be available for the storage our product at the warehouse side and as along with that we have to look for the cost aspect; means, how much will that cost for the company because ultimately that will add to the product. So, this is another important aspect, if product has to travel long distances before reaching the customer. Another important factor here is after sale service, which is normally very important factor to capture to grab new market place or new customer base.

So, this function sometime improves customer satisfaction is it also helps in improving the prestige of the company and when we go for after sales service, we have to see that there should be trained manpower for the proper maintenance of the products, spare parts should be easily available and they should be of low cost. So, this function is very important for the companies in a competitive environment to offer after sales service to their customers.

Another important factor related to distribution channels is the sales personnel, which are at the disposal of the our distributors because they are basically the interface between the customer and the company. So, they should have good marketing skills, they should be able to implement sales promotional schemes of the company and they should be able to create mark base in that particular reason.

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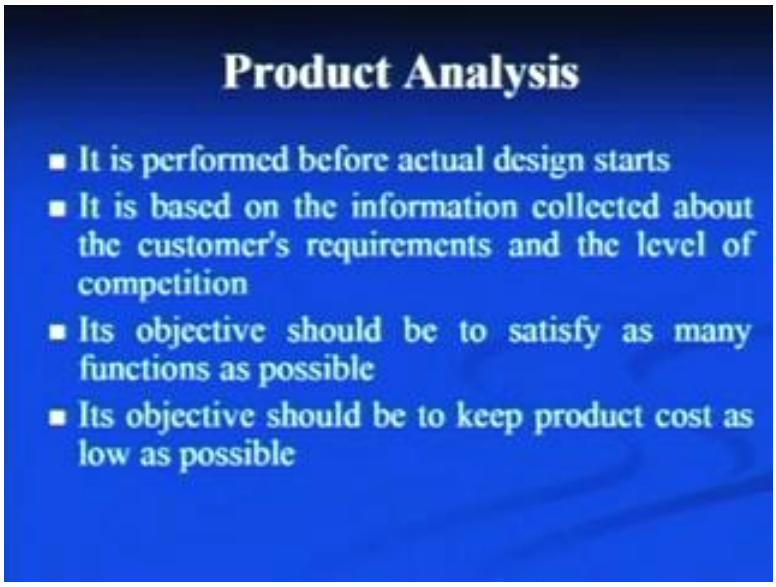

Another important step, in product design and development exercise is product analysis, product analysis is performed before actual design starts; that means, before we start assigning some technological specifications to the product or before we start making the part drawings of that product. It is important to analyze that product idea, this product analysis is based on the information collected about the customer's requirements and the level of competition.

So, when was go for product analysis, we have to look at two aspects, what are the requirements of the customers and what is the level of the competition in the market, because if say requirements are very high. Naturally, when we go for functional analysis or when we go for operational analysis of the product idea, we have to meet those requirements. Another thing is that, if level of competition is very high our competitors are already offering very good products with lot many features, good functionality, good surface finish and quality.

So, we have to improve our quality, we have to offer them as many number of features as possible, so this is sometime is governed by the requirements of the customer as well as by the capabilities of the competitors or level of competition in the market place. And the objective of product analysis should be to satisfy as many functions as possible. Though there may be unlimited number of functional requirements of the customers, but we should try to satisfy as many functions as possible in our product.

And the objective of product analysis should be to keep product cost as low as possible, so in this case, we have to try to accommodate as many functions as we have discussed earlier, in the low cost as much as possible.

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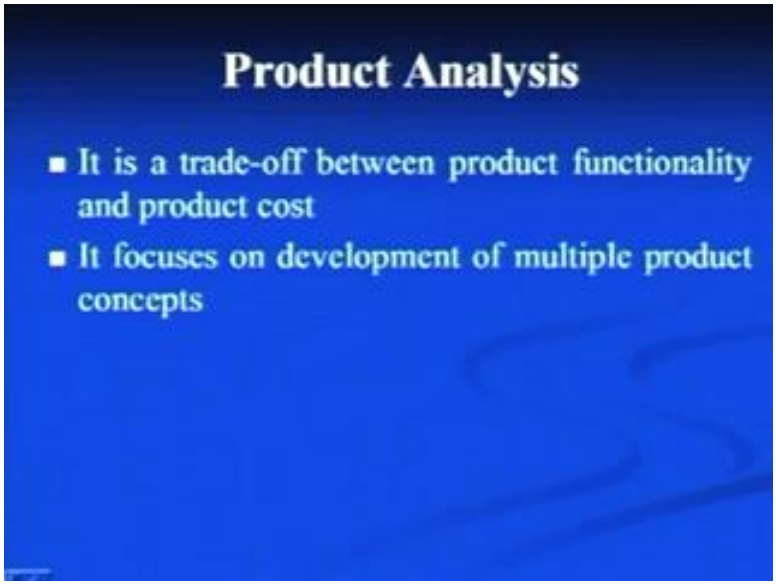

So, we can say this is sort of trade off between product functionality and product cost, so number of functions should be large, that are satisfied or that are performed by the product. And at the same time the cost of the product should be as low as possible, this is very important in case of a competitive market place. And when we go for this exercise, it focuses on development of multiple product concepts, so basically before going to the design, actual design of the product, a number of product ideas or concepts should be developed and presented to the management for their approval.

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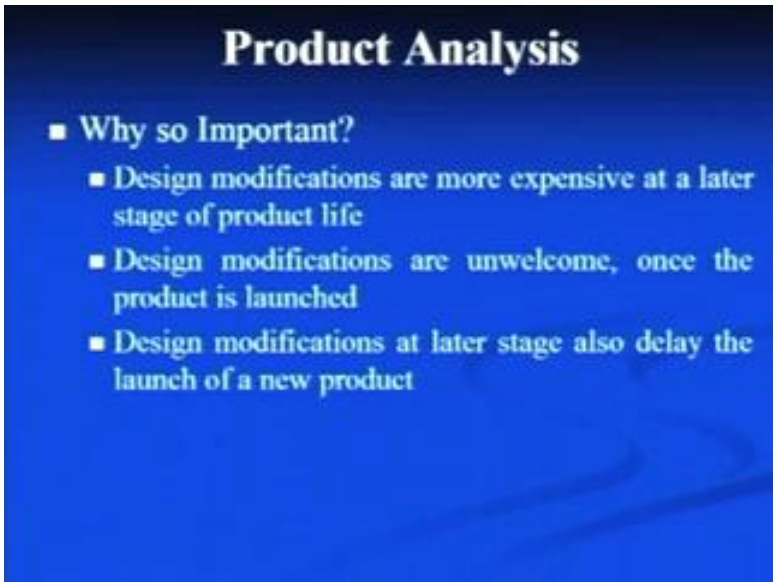

Why this product analysis is important in product design and development exercise, the first reason is that design modifications are more expensive at a later stage of product life, If our product is not functioning as per a design a specifications, if it is not able to satisfy customer's requirement, both in terms of functionality, operationality and maintainability; that means, there may be some problem in the product design. So, in that case company sometime may modify their designs and ask the customers to go for those modifications or to buy new products.

So, in that is not good for the company, reason is very simple, that will dent the prestige of the organization in the market place and your customer base may be affected, so it is not advisable to go for design modifications once the product is launched in the market, because sometime you may have to recall, the entire batch or entire lot for such type of modifications. Another reason may be that design modifications are when are unwelcome, once the product is launched.

So, this is similar to the first one; that means, your product is not functioning properly and you are getting some complaints from the customers, so in that case some modifications may be suggested again by the designers and those modifications are unwelcome, once the product is launched because again that will dent the prestige of the company and that will result in extra investment or expenses, which are made by the company in accommodating those modifications in the product design.

And third possible reason, while this analysis is important is that design modifications at later stage of product design and development cycle also delay the launch of a new product; that means, you have already or you have almost design your product, you have finalized the drawings, but suddenly you find some problems in the design and you go for the design modifications at that stage; that means, you have to redesign the whole product.

So, that will again is not good for the company, it will result in some extra investment in the development exercise and at the same time, that will also delay the launch of that product in the market place. If you are operating in a competitive environment and if similar type of products are manufactured and launched by the by the competitors. In that case, the delay in the launch of that product will be detrimental to the companies prestige and company may not be able to grab the market opportunity and they were not be able to grab the new emerging markets.

So, we can say that product analyses is very important and here we have to analyze our product idea for functionalities or operational aspects for maintainability and for so many other things. So, that when it is converted into the physical product, it has no design problems, no design modifications are required at design stage, at manufacturing stage or even during its use by the customers.

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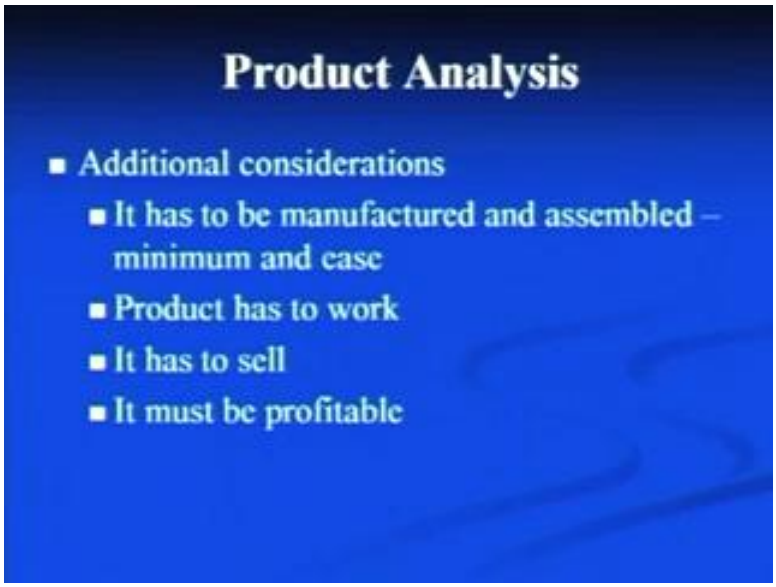

Now, additional considerations which are important in this step are the protect idea of first has to be manufactured and then assembled. Now, here we have to evaluate the manufacturability and assemblability of the product, what we mean by manufacturability that is use of manufacturing, so if say product idea is converted into the part drawing and that part drawing is used to convert raw materials into the physical products So, we have to evaluate the manufacturability of that product idea.

So, if manufacturability of that product idea is good; that means, it is always easy to manufacture that product idea is low cost. Similarly, we have to look for the assemblability aspects, so if it is easy to assemble all the components together to get the end product. So, the cost of assembly will be less and the overall cost of the product will be reasonably low. So, we have to work for manufacturability aspect and assembling aspect in the product analysis.

Another important consideration is that product has to work; that means, it has to satisfy all it is functional requirements. It has to satisfy all the requirements of the customers, it has to satisfy all the future requirements of the customer. Another important factor here is it has to sell; that means, it should be able to capture the market, it should be able add some new customers to the customer base then only company will be able to generate revenues for running the operations.

So, it is very, very important that product should be sellable in the market and that is possible only when your product idea is new, it had some new features, it has good quality, it is low cost and it has better functionality over the similar products, which are available in the market. Some time to some extent, it depends on the marketing strategy of the company, sales promotional schemes offered by the company. So, all this will contribute to the salability of the product in the market place and it must be profitable of course, because if it is profitable only then we will be able to run our operations. So, we have to look at the profitability of that product idea. Now, there are several aspects which are covered in product analysis…

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One of them is functionality aspect, here in this aspect we analyze the function requirements of the product, functional requirements come from the customers, these are collected through market survey, through the personal interviews, some questioners etc. These functional requirements are first converted into the technological requirements of the products, then we convert them into the concrete functions or features that should be accommodated or incorporated in the product idea.

So, here we have to go for the functionality analysis; that means, how many function must be satisfied to make that product sellable, to make that product profitable and to satisfy as many customers as possible, but at the same time while providing the function by incorporating the end over end products we have to look at the cost aspects also. More about these aspects we will discuss in part two, second is the operational aspect; that means, it is basically related with the ease of operations.

So, the product which we manufacture should be easy to operate, it should not require any sort of a skill on part of the customer, some time that may be self explanatory notes may be provided with the product, some guidelines may be provided with the product. So, that any user any customer can operate that product in varying conditions, so operational aspects are also analyzed in product analysis.

Another aspect that is important is quality aspect, when we talk about quality; that means, it is a relative term and we say our product is better than the other products

available in the market. So, we define a short of quality of our product, when we talk about quality we talk about cost of quality; that means, the investment encured in providing that quality in meeting that quality standard.

Second is the value of quality; that means the return which we get on that quality and the third one is the rate of failure of the product because the quality of the product is very high. So, naturally the rate of failure of the product will be very less, so we have to strike a balance between cost of quality, value of quality and rate of failure while deciding about the quality standards. And of course, you are inputs from the market are very important, because we have to collect information about the quality standards offered by the competitors in the similar products available in the market.

Another important aspect to be covered in product analysis is reliability analysis, our product should be reliable enough to perform it is indented function over a period of time. Reliability is defined as the probability of success over a period of time, so we have to look for the reliability of the product as a whole, we have to look for the reliability of all components and sub assemblies which go in the end product.

And then we have to decide a reliability for the end product and warranty or and say to our customer that this is the probability or reliability of products to serve it is intended purpose over a period of time. Please remember, when we talk about reliability, we always assume that product will be operated as per the instructions given in the operation manual of the product. Another important aspect is durability aspect, how durable and how dependable our product.

So, it is sometime very important if we do not use that product regularly, so if sometime we define as the self life and active life of the product, so that product should be durable and dependable, more about these we will discuss in part two. Another aspect is related with the maintainability of the product; that means, ease of maintenance, availability of the spares, cost of the repair, cost of the repair person. So, all these aspect are covered in maintainability aspects, sometime product may be maintained by the user itself, if some guidelines or instructions are provided along with the operation manual.

Sometime you have to go to the repair person, so all this is covered in maintainability aspect and last is the aesthetic aspect; that means, how that product looks, how is the texture of that product, what is the shape and size of that product, what are the dimensions of that product, what are the surface finish of that product, form of product. So, all these aspects are covered in the aesthetic aspect, sometime packaging of the product is also very important in case of toys, in case of fashionable goods.

So, all these things we have to cover in aesthetic aspect, so we see that product analysis, product analysis is not just to evaluate some product ideas, but to convert, the requirements of the customers into a part drawing, into a set of set of specifications which are further used to convert raw material into a physical product. Now, there are few things which we a few option, few strategies which we use for the design evaluations, once the design is available then we have to evaluate it.

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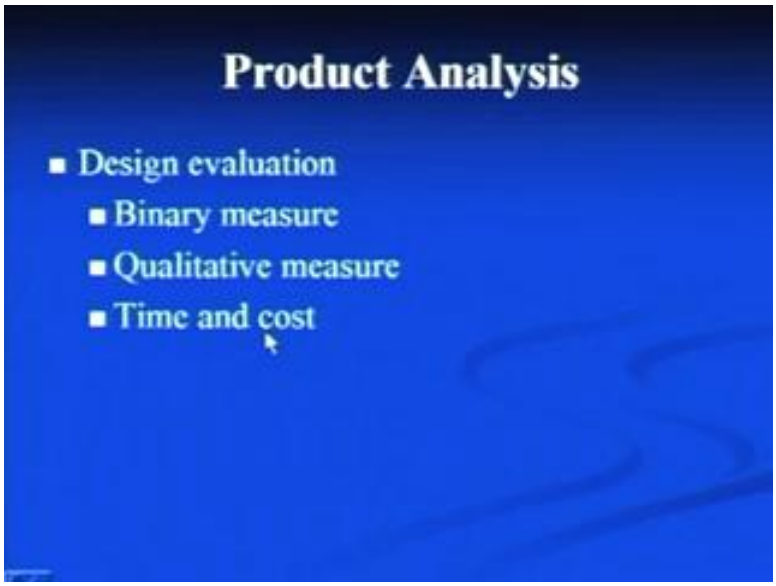

There are three possible measures which we use for that purpose, one is binary measure means zero one type of rating of the product ideas. If it is given zero rating; that means, that product ideas is rejected out rightly. If we give it one that mean, it is accepted to the management. So, all the product ideas or concepts or alternatives which are offered by the designer, they are evaluated and one of them is given rating of one; that means, it is selected, rest are given zero so; that means, they are rejected.

Another method of design evaluation is qualitative measure, so instead of giving zero and one, instead of just rejecting some of the product ideas, we try to assign some qualitative measures like excellent design, very good design, good design, average design and so on. So, we can say on a scale of say ten, five or hundred depending on the method used by the company, every product idea is rated and we define a range.

If say on scale of hundred, if you are if that concept is able to score more than eighty points; that means, that design is excellent is rated as a excellent. If total score is between say sixty and eighty we can say that design is very good. If between say forty and sixty we can say it is a good design and below that we can say it is average or below average type of design.

So, here the thing is that we do not reject our product concepts or alternatives are out rightly, but we try to give them qualitative rating and sometime that is important because even if you are not selecting a product idea, say very good or good type of product idea. We keep that product idea or that drawing in our database for future use. So, we can work upon those product ideas or those pro concepts to develop them further and to bring them to excellent or very good range.

Another important method which we use for the design evaluation is time and cost, so we are basically for each product concept or idea, we try to determine how much time will be required to convert that product idea from design part, drawing to the physical one. That means, how much time will be required for it is manufacture for it assembly and how much time will be required for the transportation of material from one stage to another stage.

So, basically here we try to determine the manufacturing retime and every product idea or concept will have different manufacture retime, because they may have different type of products inside, they may have different shapes and sizes they may required different types of operations. So, naturally the manufacturing it time or time to manufacture will be different, so that may be one criteria to rate the design concepts. The concept with lowest time value may be rated as the best and the design with highest time value may be rated as the worst.

Similarly, we can use cost factor, to rate our designs if say for example, cost of that product ideas is very low; that means, we can say that design is an excellent design, the cost of that product idea is very high that design may be defined as a worst design or sometime even it may be rejected out rightly. So, we can say here again instead of just rejecting or accepting any product idea, we try to assign that time or we try to determine the time and cost factors and again we do a short of relative rating of the product idea.

And the product idea with lowest time or the lowest cost is selected for further analysis in the organization. So, this all about the part one of this lecture on product design and development, here we have learnt why exercise in an organization is so important particularly in case of competitive manufacturing environment. We have also discussed about the factors which we consider in identification of the product ideas, starting from the demand and supply gap.

We have discussed factors related to the marketing, distribution, organizational structure, and other aspects and we have also discuss about the product analysis. Why product analysis is so important in this exercise because we have unlimited requirements, sometimes from the customer side and here we have to narrow down to a number of functions in reasonable cost, which must always be satisfied to capture a growing market, to capture a customer base and to add some new customers to the customer base.

We have also seen, how do we go for product analysis, what are the methods, which we used for design evaluation like binary time based and qualitative techniques, which we used. So, we will continue in with product design and development exercise in part two, where we will discuss in more detail about the functional analysis, about the operational analysis maintainability another aspects.

Thank you very much.