Rapid Manufacturing

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Lecture – 6
Product Development Process (Part 3 of 3)

Welcome to the course on Rapid Manufacturing, we were discussing the lecture series on product development process and based upon the feedback which have got from students I have noted down some modifications which as and when I walk through in this presentations I will try to add those comments suggestions whatever they have given

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So, we have been discussing on Product and it is characteristics, Evolution of product development, Sequential product development, Stages in generic product development process and now we are more focused towards Design specification in the process.

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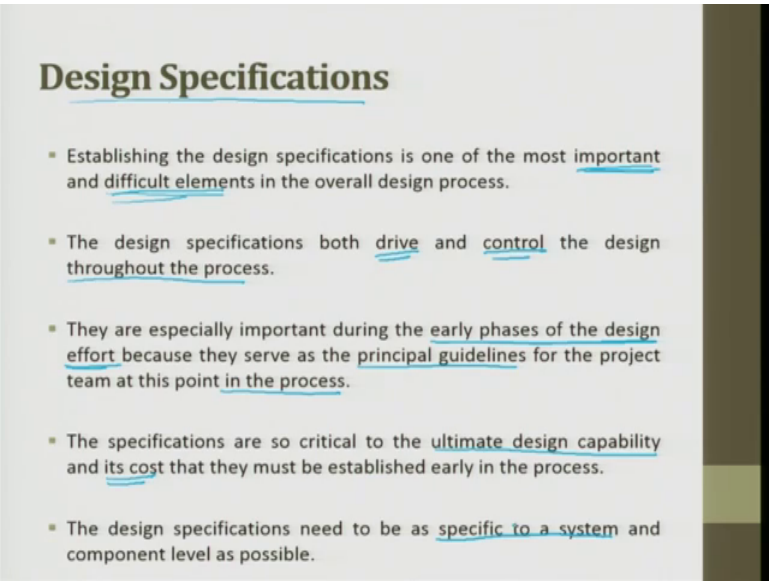

So, last lecture we were seen how do we take customer needs, then converted into engineering specification and then what we do is we try to develop conceptual details and then we go for engineering details then we will release it for production and then we go for marketing, so this is a sequence it follows right. So, now we will start focusing more on design specification.

So, it is nothing but establishing the design specification is one of the most important and difficult please understand these 2 terminologies you have to keep it in mind. It is an important as well as a difficult element in the overall design process the design specification both drive and control the design throughout the process; it drives and controls the design throughout the process. If the specification what is given is over ambitious or if the specification given is loosely given, so then the product development will be a big challenge or the developed product will not see success.

So, the design specifications both drive and control the design throughout the process, they are especially important during the early phase of the design efforts because, as and when you move towards the later stage of product life cycle money investment is going to be huge, time investment is going to be huge.

So, it is better we take a call do the corrections modify our design specifications at the early stage. It is especially important during the early phases of the design effort because, they serve as a principle guideline for the project team at this point in the process. The

specification are so critical to the ultimate design capability and it is cost that they must be established early in the process, the design specifications need to be a specific to a system and component level as also.

So, what are they trying to say is it has to be brought it has to be focused to certain points. So, it has to be liberal so it has to be liberal it has to be up to the micromanagement also it has to do. So, it is a mixture you should have everything put in the design specification. So, you can have a design specification running for 30 40 parameters.

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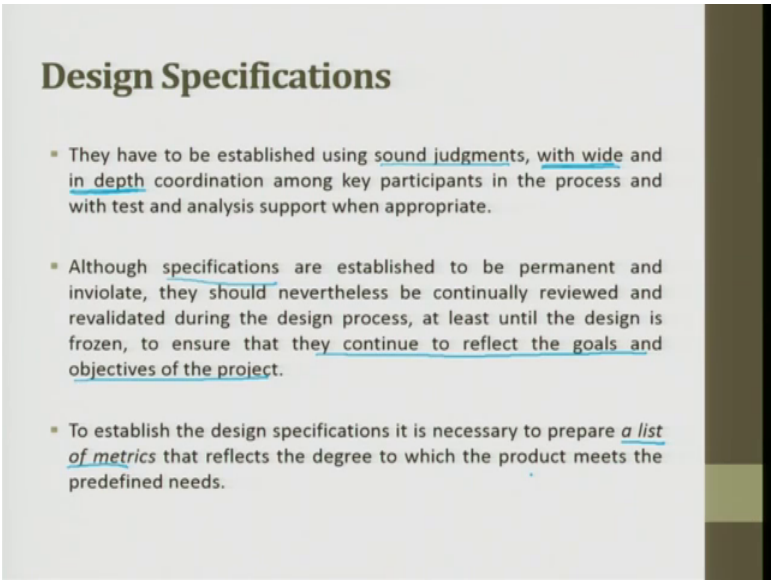

They have to be established using a sound judgment with wide and in depths, look at it wide and in depth coordination among key participants in the process and with test and analysis support when appropriate. So, this is very very important with wide and in depth coordination, although specifications are established to be permanent and in violated they should nevertheless be continually reviewed and revalidated during the design process.

So, once the specification is fixed that does not mean that is the ultimate you should have a scope for improvement. So, that is what it says to nevertheless be continually reviewed and revalidated during the design process at least until the design is frozen, to ensure that they continue to reflect the goals and the objectives of the project. So, they should continue the iteration should continue reflect the goals and the object to other projects, to

establish the design specification it is necessary to prepare a list of matrices that reflect the degree to which the product meets the predefined needs.

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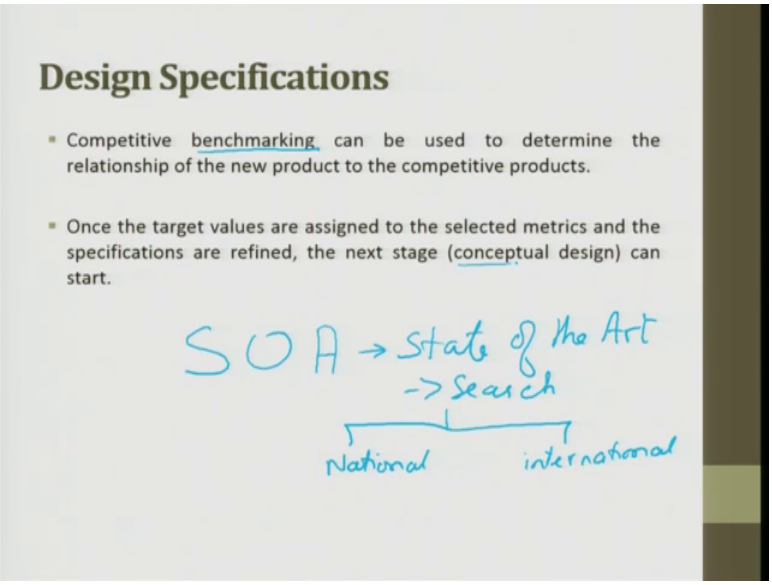

The competitive benchmarking can be used to determine the relationship of the new product to the competitive product. So, whenever you tried to develop that is why we always used to say do the state of art, so state of the art search that is nothing but state of the art search; that means, to say what is available nationally, what is available internationally. You should look at a similar product or almost the same product and then try to redefine your specifications such that you can meet out to the same customers in a better fashion.

So, state of the art search is very very important so the state of the art search tells very clearly what are the competitive parts or products available and then what you can do is you can do a benchmarking of it and try to come up with your product. Once the target values are assigned to the selected metrics and specifications are refined the next stage conceptual design can be started.

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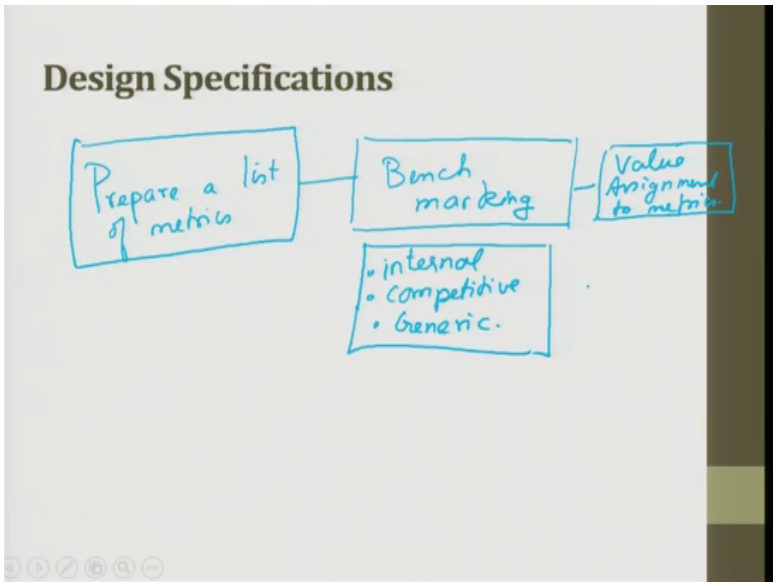

So, this is a block diagram which talks about design specification prepare a list of metrics then you do a benchmarking, then you try to do a value assignment to metrics. So, here you will have benchmarking should be done internally, it should be done competitive and it should be done in generic. So, your benchmarking should be done in all the 3 levels internal level within the company competitive level and in the generic level.

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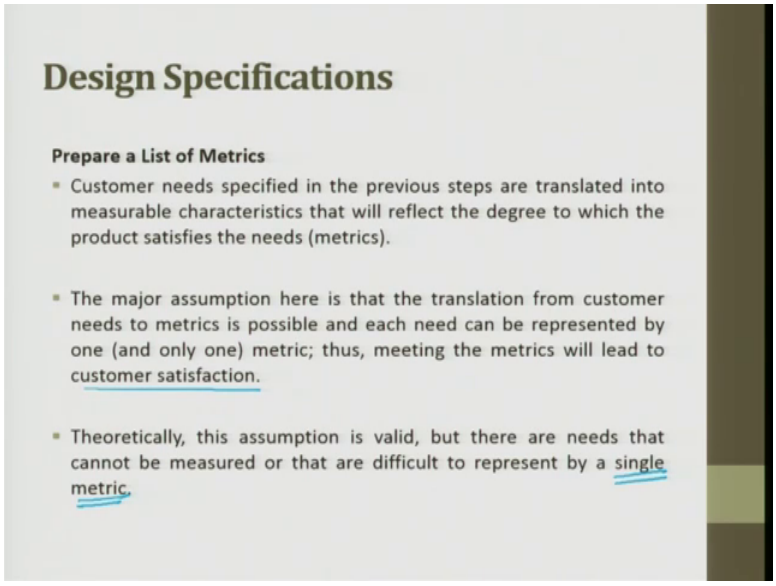

Prepare a list of metrics. Customer needs specified in the previous steps are translated into measurable characteristics that will reflect the degree to which the product satisfies the need. So, it in the crowd fashion understanding customer need and converting into engineering requirements, so that is what is measurable characteristics are there.

The major assumption here is that the translation from customer need to metrics is possible and each need can be represented by one metrics, thus meeting the metrics will lead to a customer satisfaction. Theoretically this assumption is valid, but there are needs that cannot be measured or that are difficult to be represented by a single metrics. So, it is very difficult have a single metrics, so what we will do is we will try to have a combination of metrics and then try to prioritize and then try to make your prepare the metrics for the specification.

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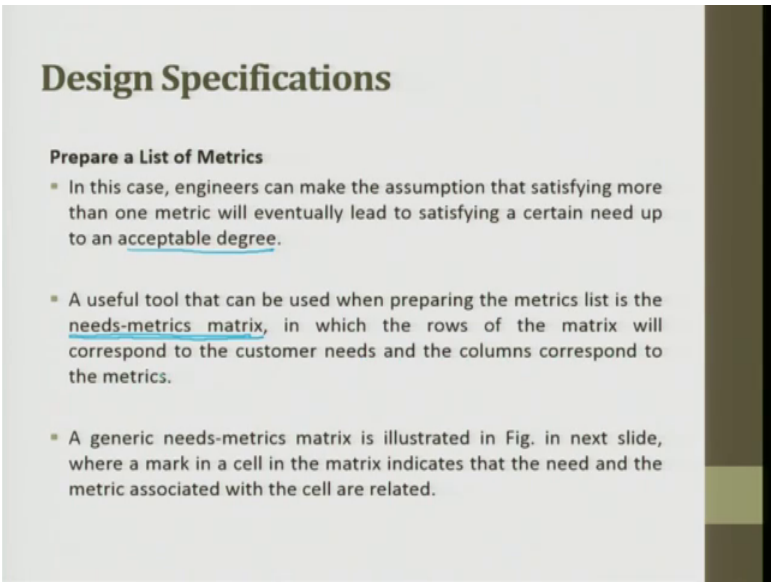

So, in this case engineers can make the assumption that satisfies more than 1 matrix will eventually lead to satisfying a certain need up to an acceptable degree, a useful tool that can be used when preparing the metrics list is the needs metrics matrix in which the row of the matrix will correspond to the customer need and the column corresponds to the metrics, a generic need metrics matrix is illustrated in the next slide. So, we can understand more when a mark in a cell in the matrix indicates that the need and the metrics associated with the cell are related.

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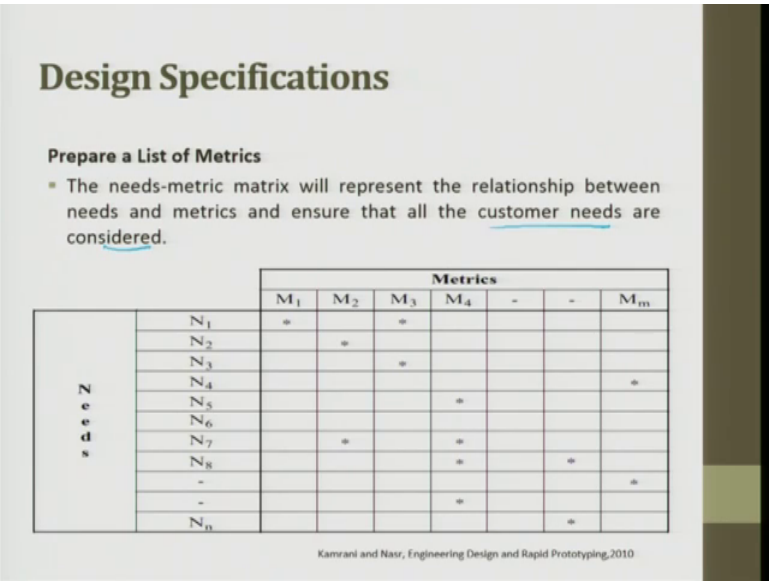

So, this is how is the need metrics graph look likes here are the needs, here are the metrics ok. So, the need metrics matrix will represent the relationship between the needs and the metrics and ensure that all the customer needs are considered in this matrix. So, moment you start putting on a piece of paper and start assigning it in table form, so you can give more data you can try to cluster data you can do more amount of logical interpretation of the data which is available in front of you. So, here the data which is available is need and metric matrix we are trying to develop.

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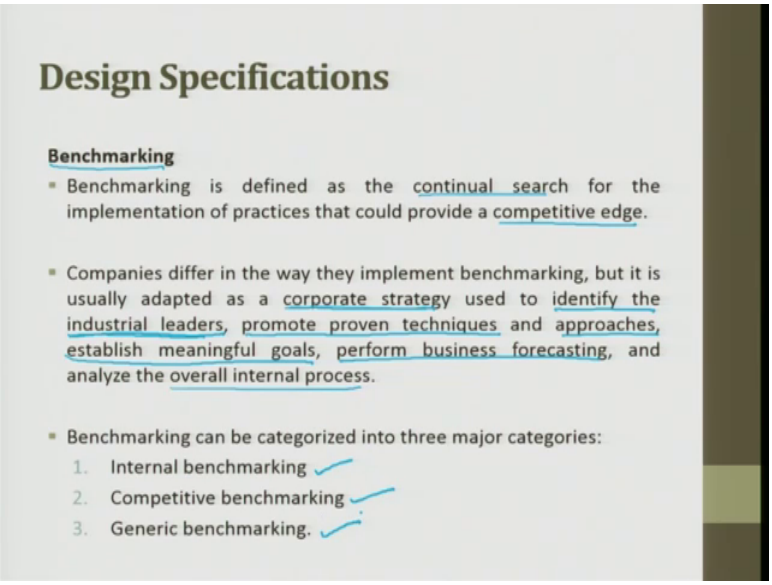

Next is Benchmarking, Benchmarking is defined as the continual search for the implementation practices that could provide a competitive edge that is what is benchmarking. So, we always do benchmarking and today when you ask a psychologist they say please do benchmarking with yourself that last time you perform this, now you should perform much better that is what they try to do all the sports mans are clearly given an instruction that they should benchmark first among for them self. For example, you are running a athletics 400 meters first you clock your time.

So, it was for example, it was 20 seconds today next day if you can do it at 19 18, so those are benchmarking improvements which you can see. So, benchmarking when you talk about sports and individual personality they say do for yourself, but when you talk about a product it will always be with the other competitive products in the market ok, so that you get an edge. Companies differ in the way they implement benchmarking, but it is the usual adopted as a corporate strategy used to identify the industrial leaders promote proven techniques and approaches establish meaningful goals perform business forecasting and analyze the overall internal process.

So, corporate strategy is to identify the industrial leaders. For example, you are making a t-shirt, so in a t-shirt you have buttons you try to look at the buttons which are available from a successful or from a very very successful product or very proven product you take those buttons and then start looking and what are the problems faced in those buttons and if you are developing how is your product superior or inferior to that work.

So, that is what is you always try to compared with the industrial leaders promote proven techniques approaches establish meaningful goals, you should not copy and repeat the same when you do benchmarking you always surpass the standards whichever is available. So, you will try to go more than the product which is also perform business forecasting and analyze the overall internal process. Benchmarking can be categorized into 3 major categories Internal benchmarking, Competitive benchmarking and Generic benchmarking.

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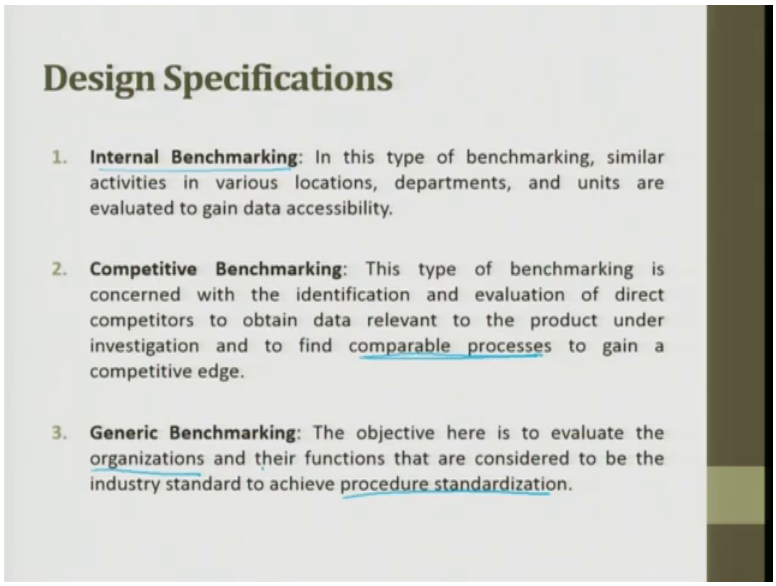

When you talk about Internal benchmarking in this type of benchmarking similar activities in various locations departments and units are evaluated to gain data accessibility that this internal benchmarking. Competitive benchmarking this type of benchmarking is concerned with identification and evaluation of direct competitors to obtain data relevant to the product under the investigation and to find comparable processors to gain competitive edges.

This type of benchmarking is concerned with the identification and evaluation of direct competitor I make a shirt you make a shirt I see how better is my shirt the new. So, identification concerned with the identification and evaluation of direct competitor to obtain the data relevant to the product under investigation. So, my shirt your shirt and to find comparable processes to gain a competitive edge my, my shirt your shirt how is my shirt better than your shirt in terms of whatever 1 2 3 4 5, so that is what is comparable process.

Generic benchmarking the objective here is to evaluate the organization and their functions that are considered to be the industrial standard to achieve procedure standardization. So, generic benchmarking is generally done for industry level. For example, rather than looking at one product you look at the complete process of the company complete process of whatever happens. So, the objective here is to evaluate the organization and their function.

For example, I am running an education institution you are running an education how is your institute better than mine. So, what are all the good practices you do and is and I try to customize the good practices whatever you do there to my requirements ok. So, that is what it is the objective here is to evaluate the organization and their functions that are corresponding to be the industrial standards to achieve procedure standardization.

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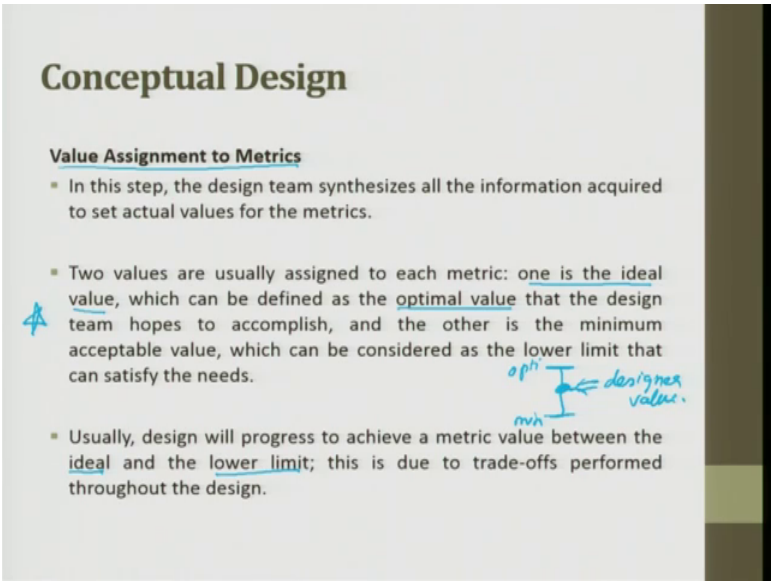

The last one in the process is Value Assignment to Metrics, in this step the design team synthesizes all the information acquired to set actual values for the metrics. Two values are usually assigned to each metrics: one is the ideal value which can be defined as an optimum value that the design team hopes to accomplish and the other is the minimum acceptable value which can be considered as the lower limit that can satisfy the need. So, are you able to understand this I will put you an example, I have an examination where and which I have to get marks it is a competitive exam I am writing it.

So, if I wanted to qualify the examination I should get 60 percent marks, if I wanted to get a good rank admission in a good school I have to get 90 percent marks. So, that is a differential one is the ideal value which can be defined as the optimum value that the design team hopes to accomplish 90 ninety here is higher, but that is what is optimum if I want to get a good admission and a good college and the other one is minimum acceptable always can be considered at the lower 60 marks in a examination.

So, if I will get 60 I will get an admission; if I get 90 I will get a good college admission that is what is given a value assigned to matrix usually design will progress to achieve your metrics value between the ideal and the lower limit. So, you will this is the top level this is the bottom level, so you will always try to have somewhere around here. This is what designers look out this is optimum this is minimum designer will always try to designers value in all cases the design team should have the ideal value as their primary objective.

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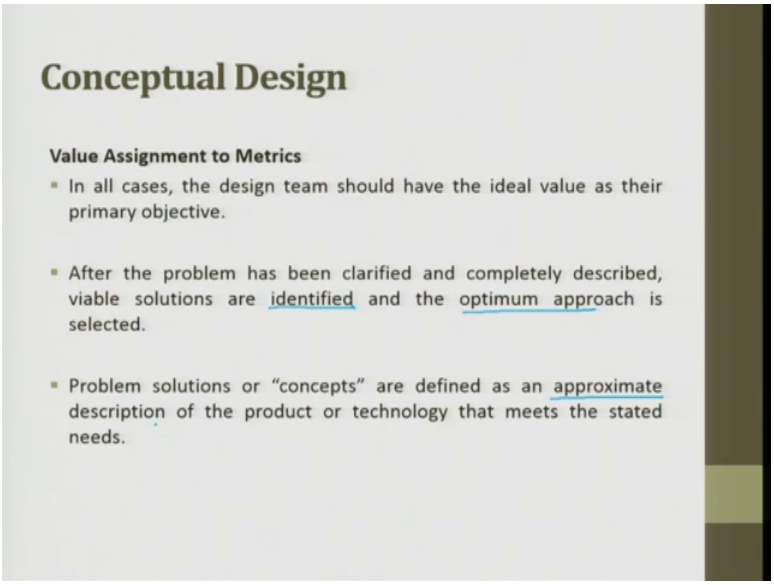

After the problem has been clarified and completely described the viable solutions are identified and optimum approaches are selected the problem solutions or concepts are defined as an approximate description of the product or technology that meets the stated needs.

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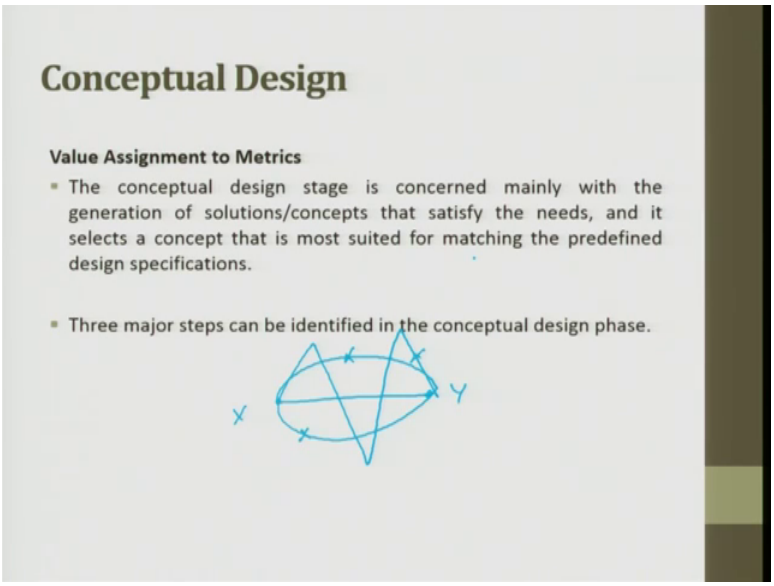

The conceptual design stage is concerned mainly with the generation of solutions and concepts. So, this are multiple solutions for example from moving from X location to Y location I have to go to X to Y, so I can go like this I can go like this I can go like this and I can go to Y.

So, there are multiple solutions generated some are feasible some are infeasible, but you start generating conceptual ideas and later you can kill some ideas which do not even come in the optimum viability zone ok. So, the conceptual design stage is concerned mainly with the generation of solution let it be viable not viable we are least bothered that satisfies the need and it selects a concept that is most suitable for matching the predefined design specification.

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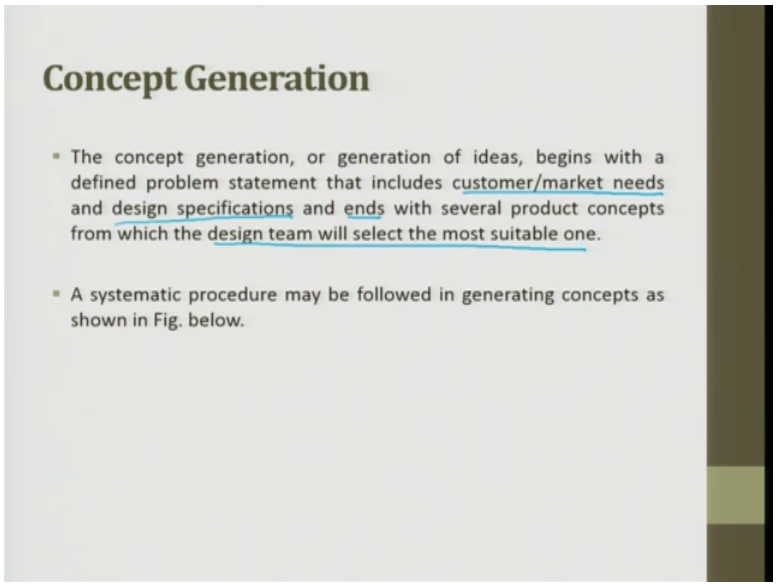

The major steps that can be identified in conceptual design phases are the concept generation or generation of idea begins with the defined problem statement which you have already done. That includes customer market need design specification and ends with several product concepts for which the design team will select the most suitable ones. The system it to the systematic procedure is given in this slide.

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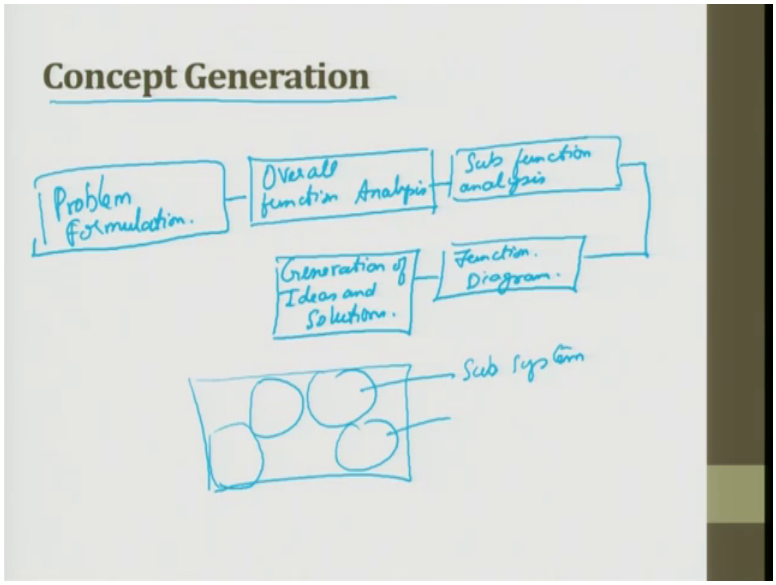

So, here you will have problem formulation then you will have overall function analysis, then you will have sub function analysis, then you will have function diagram, then after

that you will have generation of ideas and solutions. So, these are all the steps which are involved in concept generation.

So, first is problem, problem formulation then overall functional analysis then sub functional analysis, say for example if you take a product then each the product will have subsystems. So now, what you do these are subsystems like that you will have some functions. So, each subsystem is going to a sub function of the main function subsystems and then you will try to for each subsystem, you will try to draw a functional diagram and then what you will do is you will try to generate ideas and solutions.

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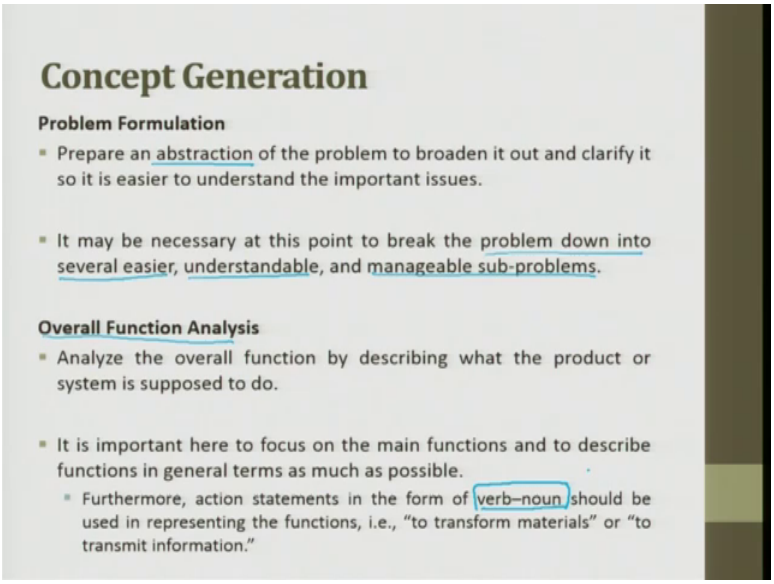

See the problem formulation prepare an abstraction of problem to broaden it out and clarify it, so it is easier to understand the important issues. So, in the problem statement you should try to say the issues which are attached prepare an abstraction, that is what I told last time also an abstract has to be done I need to I need to buy a sweater. So, I cannot say please try to buy a sweater I cannot say I should try to same please try to suggest a protective layer such that I can maintain the body temperature, if my things should be as abstract and as broad as possible.

Then there are humpty number of solutions out of which one solution is wearing a sweater or buying a sweater. I can buy a jacket, I can buy a sweater, I can buy a shawl or I can come up with today lot of technologies are there. So, I can come up with some technology which can keep me internally heated or warmer ok.

So, you should have it as abstract as possible and as broad as possible such that you can try to solve the issue it may be necessary at this point to break the problem down into several easier understandable and manageable sub problems, that is what we do in mathematics also suppose you have some ten variables which has to be solved first what we says we take one variable and say rest are the variables are 0. So, why you will try to solve 1 variable, then we have solved 1 variable, then we will go try to take the other variable and then machine all other things are 0.

So, like this slowly we will try to take 1 at a time start solving 1 variable get the solution and then start doing, so that is what is the same approaches used in the designer also. So, it may be necessary at this point to break the problem down into a several easier understandable and manageable sub problems. The overall functional analysis, analyze the overall function by describing what the product or the system is supposed to do ok.

If I am going to buy a system I should very clearly in say what is this system expected to do. So, once I say this system is expected to do this job, for example with your car I am expected that it will help me to move my mobility is enhanced the function of automobile is to enhance mobility.

So, that overall function must be very clearly given, it is important here to focus on main functions and to describe functions in general terms as much as possible. Further more action statements in the form of verbs nouns should be used in representing the function that is to transform material or to transmit information. So, we have to use this pattern this is very important furthermore action statements in the form of verb noun verb noun should be used in representing the function.

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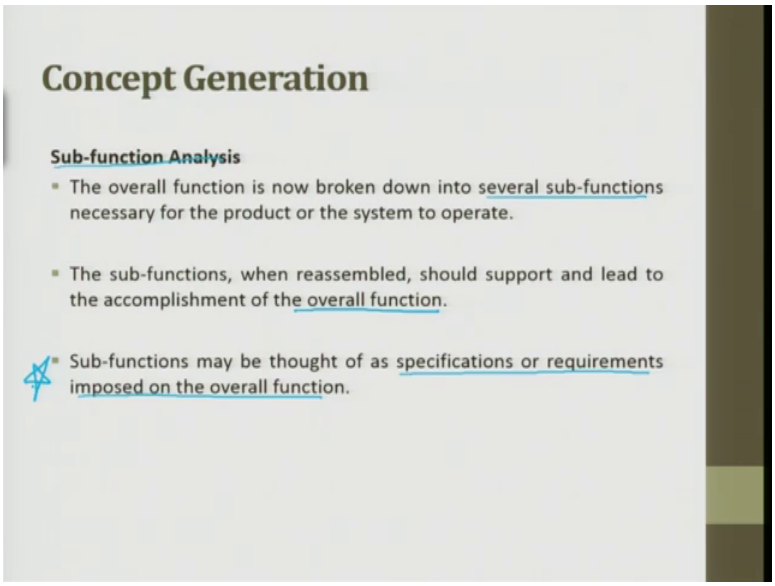

Sub function analysis as I told you main function divided into several small function, such that it is easy to solve the overall function is now broken down into several small functions necessary for the product or the system to operate. For example, I was recently amazed because there is a shirt which has buttons and you have to wear the shirt like a t-shirt, so that means to say along the shirt you will have buttons all these buttons are just placed you cannot open the shirt it will be a t-shirt. So, every time you have to use the t-shirt and you have to you have to you have to wear it from the top right.

So, now if you see a shirt which is now blunt which looks like a shirt but it is a t-shirt right. Now if you see what do you expect from a t-shirt then you will try to write down all the all these statements right will try to say I expects the t-shirt has to do this action, the t shirt button should not fail or the t-shirts should have you should you should know you should try to absorb all the sweat so all these thinks that.

So, earlier you are trying to talk about a shirt t-shirt right which is only to protect you to give a glamorous look or to give a very gorgeous look, but now slowly after the that is over, then what you did? It has to give me cool comfort it has to absorb my sweat, it has to it has to be as drop table along my body as possible. So, all these things come into picture why did the t-shirt come this they it came because of the adoptability property t-shirts are adoptable tries to take a shape of your body and shirts to some extent yes, but predominantly it tries to have pre structured shape in it ok

So, now what did we do shirt t-shirt blund with the function was to give a rich look, but later then when you see it is used to for you have added several more subclasses to it so that it can be used in the fullest form. So, the overall function is now broken down into several small functions necessary for the product or the system to operate.

The sub functions when reassembled should support and lead to the accomplishment of the overall function, the sub function should not dictate and sub function should not be independent. The success of a sub function should lead to the success of the overall function sub functions baby thought of as a specification or requirements imposed on the overall function this is also very important.

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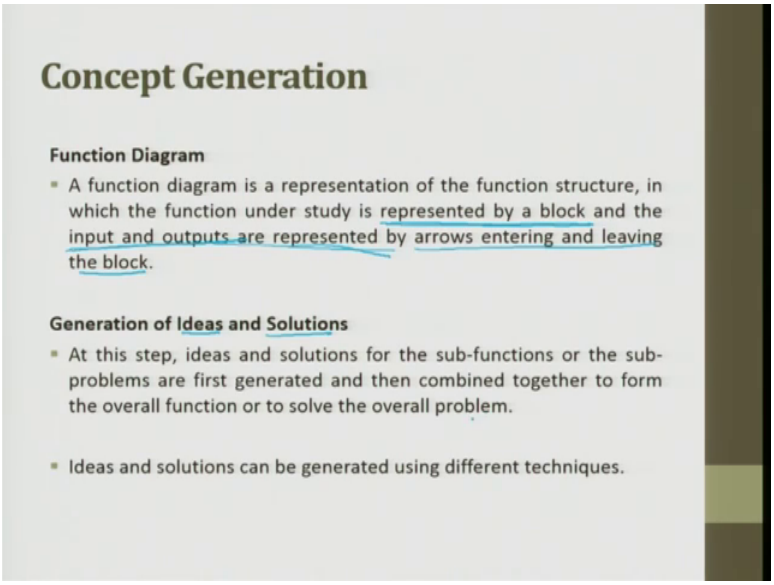

Then functional diagram functional diagram is represented as a functions structure in which the function under study is represented by a block and the input output are represented by arrows entering and leaving the block So, if the function diagram is a representation of the function structure in which the function under study is represented by a block and input and output are represented by arrows entering and leaving the block.

Generation of ideas and solution which is the last part of it at this step ideas and solutions of the sub functions or the sub problems are first generated. So, we try to solve each sub problems each sub function and moment you start solving each sub function, we have already made a relationship diagram that if I solve this for sub function my overall

function of the system is going to become ok. So, the so the sub problems are first generated and combined together to form the overall function or to solve the overall problem the ideas and solutions can be generated using different techniques.

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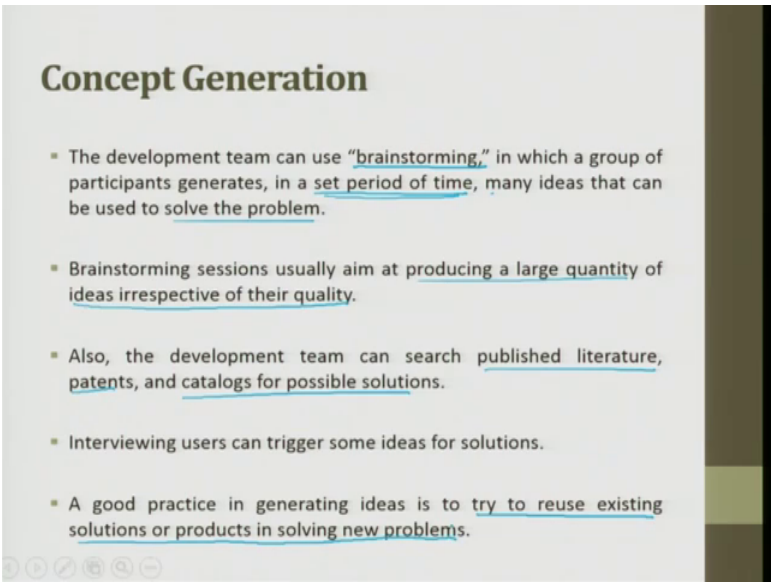

So, one technique is brainstorming technique, in brainstorming technique we follow concurrent engineering. So, lot of people sit together and then think of variable solutions to solve the problem and development team can use brainstorming in which a group of participants generate in a such period of time please understand brainstorming is not infinite time. In a set period of time many ideas that can be used to solve the problem the set for half an hour the set for one hour keep talking and finally, they do not get a solution for the problem they stop the discussion and then they take a break they say ok. Today we are not able to get any solution for the problem of so let us stop but let us keep pondering let us meet tomorrow.

So, then the entire team comes tomorrow and again the start pondering it different there will be a delta x improvement, again if there is a failure no problem they come for the third day, but they do not set together for 24 48 and 72 hours and try to get a solution and know they break. So, that every time when you come you come up with the fresh though fresh idea and then we really look and then we do a brainstorming session.

In brainstorming session what happens it is not that one minds ideas fully accepted, many a times it will be a cut paste idea of several participants in the group giving the

solution. Brainstorming session usually aims and producing a large quantity of ideas irrespective of their quality they do not look whether it is feasible or not feasible first write down all the ideas which comes write down write down and then what we do is ok.

Then we start putting a full filter or a lens we such looking at it and then we cut down all those things which has not serving any purpose also that the development team can search published literature patent and catalogs for possible solutions.

Interviewing user can trigger some ideas for the solution; a good practice in generating ideas is to try to reuse existing solution of the products in solving new problems. What is known to you what is your expertise use that tweak that customize it and try to solve for the particular problem.

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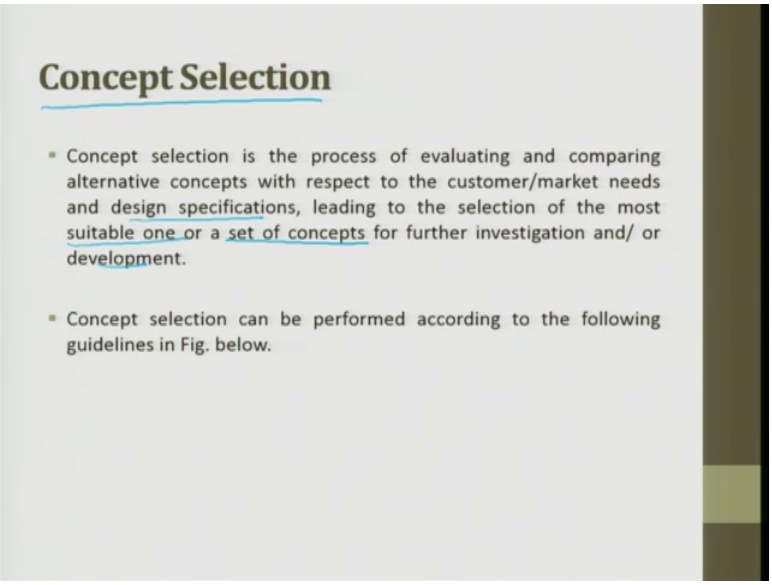

How do you select concepts because you are generated so many concepts, so now the selection of this is very very important. Concept selection is a process of evaluating and comparing alternative concepts with respect to customers slash market needs and design specification. Leading to the selection of the most suitable one or a set of concepts for further investigation or development, concept selection can be the toughest job also see in design every stage I say it is tough. But concept selection is also really tough many a times ultimately the take a judgment based upon another get value, some disable come a I think it will work very we do not we try it starts it starts working by accident also lot of technology is develop lot of interesting products develop so it happens ok.

So, you should give values sometimes you should also give values for the get field what comes to you ok. So, this concept selection is something great because, you have you it is like a menu card you have generated. So, many items and all those items are listed in the menu card. Now you are going to hotel in a hungry mood, so looking at the menu card you have to spend 10 minutes of time and pick exactly what can shoot you for that hunger.

If you go by random choice and do your stomach will be fooled, but you are you will not feel happy and comfortable after eating and after event paying. So, concept selection is something you have to put (Refer Time: 31:04) you have to see the feasibility, viability, customer wants, market demand everything what you do if you put together look at a design specification and then try to make a proper choice the concept selection can be performed according to the following guidelines given.

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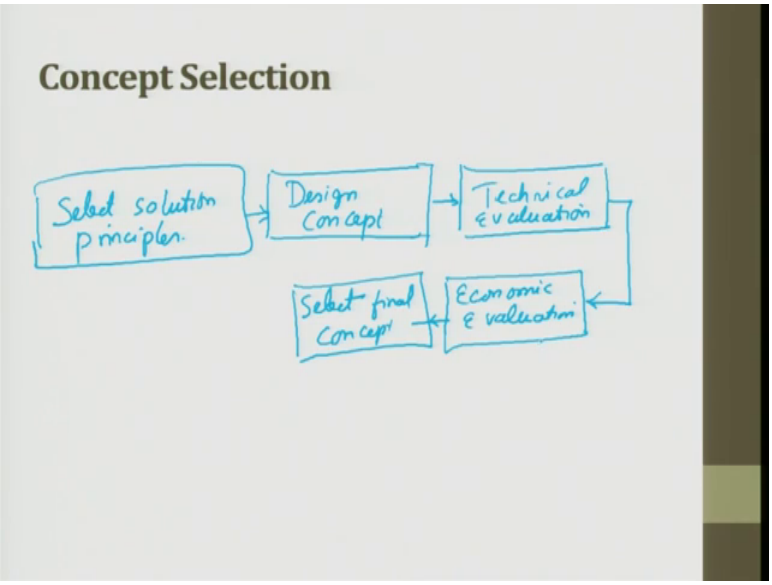

So, first select solution principles then we try to do design concepts, then we try to do technical evaluation then we do economic evaluation and finally we select final concept these are the steps which are involved. So, first select solution principle and then you start looking at design concepts then you evaluate it technically and then economical evaluation is done and finally we try to select a process.

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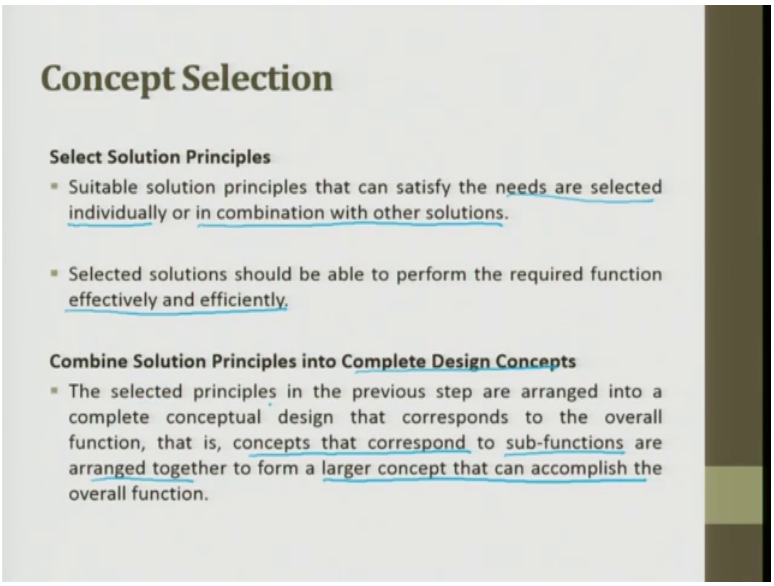

So, select solution principal, the suitable solution principal that can satisfy the needs are selected individually or in combination with other solutions, the selected solution should be able to perform the required function effectively and efficiently combined solution principles into complete design concepts.

So, what they say is they try to combined design the solution principle, there are several principles will follow and that everything is combined into a complete design concept. The selected principle in the previous step whatever we select in a selection of principal or arranged into a complete conceptual design that corresponds to the overall function, that is concepts that correspond to the sub functions are arranged together to form a large concept that can be accomplished in the overall to the overall solution.

So, the selected principle in the previous steps are arranged in 2 year complete conceptual design, the principal selected principles that corresponds to the overall function that is concept that corresponds to the sub function or arrange together to form a large concept that can be accomplished the overall solution.

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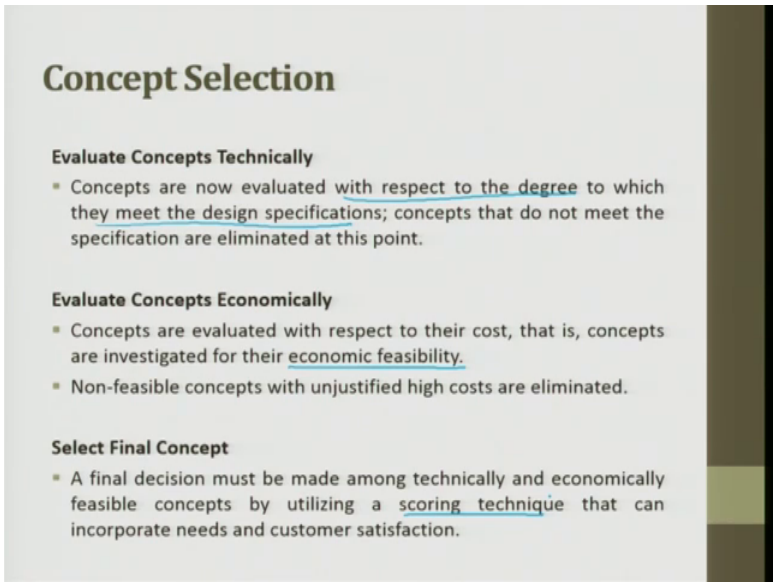

Evaluation Concept technical is that concepts are now evaluated with respect to the degree to which they meet the designer specification. The concepts that do not meet are eliminated with keeping a economics concepts are evaluated with respect to their cost that is concepts are investigated for their economic feasibility not feasible we drop it your. Select final concept a final decision must be made among the technical economical in the previous two steps of feasible concepts by utilizing the scoring techniques that incorporates all the customer needs and satisfies.

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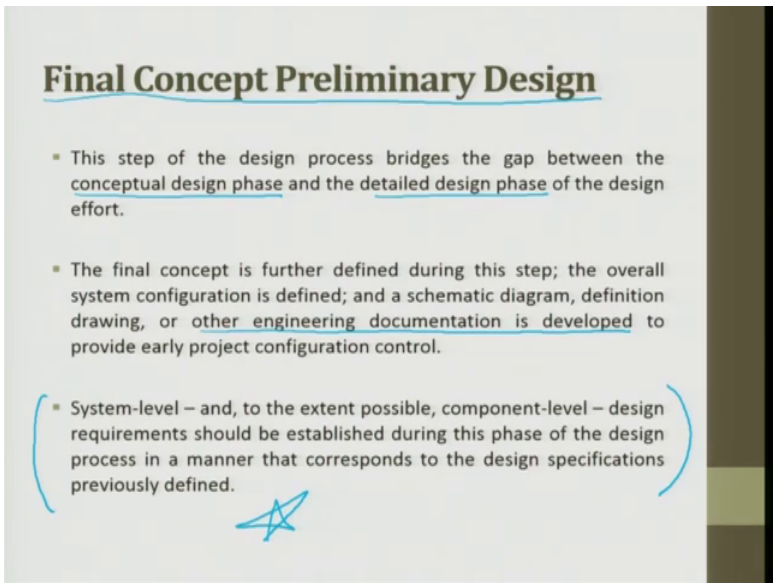

So, the Final Concept Preliminary Design this step of the design process bridges the gap between the conceptual design phase and the detailed phase, so this is final concept preliminary design. The final concept is further defined during the steps the overall system configuration is defined and a schematic diagram definition drawing or the other engineering documentation is developed to provide early project configuration control.

So, other engineering documentation is developed system level and to the extent possible component level design requirements should be established during the phase of the design process in a manner that corresponds to the design specification of the previous definition, so this is also very important. System level and to the extent possible component level that is what I said the as liberal as possible give 25 30 specifications for a small component. So, system level you give all and you also make sure it is given to the concept level also requires should be established during this phase of the design process in a manner that corresponds to the design specification.

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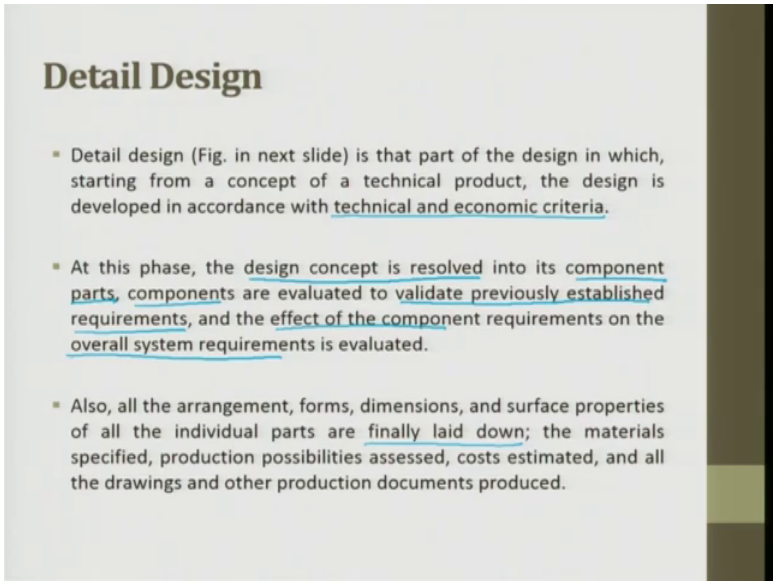

So, the detailed design is a part of the design in which starting from the concept to the technical report, a technical product the design is developed in accordance with the technical and economical criteria's. At this phase the design concept is resolved into component parts components are evaluated to validate previously established requirements and the effect of the component requirements on the overall system requirements is evaluated.

So, you see here the design concept is resolved into component parts and the components are evaluated to validate previously established requirements and effect of the component requirements on the overall system. So, you see here so design concept is resolved is broken into component parts and these components are evaluated for validate to previously established requirements and the effect of component requirements to the overall system ok.

So, all the arrangement form dimensions surface properties of the individual parts are finally laid down, if I want to make a system it will have subsystem, is subsystem will have parts. Now the parts should be made to such a level such that wants it gets into the subsystem and once the subsystem gets into the main system it should be able to perform it is task, whatever it was supposed to do from the customer requirement. Suppose if I make a mistake in the part or if I do not do the part properly naturally the sub function is not going to function and if the sub function does not function the main function is last.

So, that is what is told here all the arrangement form dimension surface properties of all the individual parts are finally, laid down the material specified production possibility assessed cost estimated and all the drawings and other production drawings are produced.

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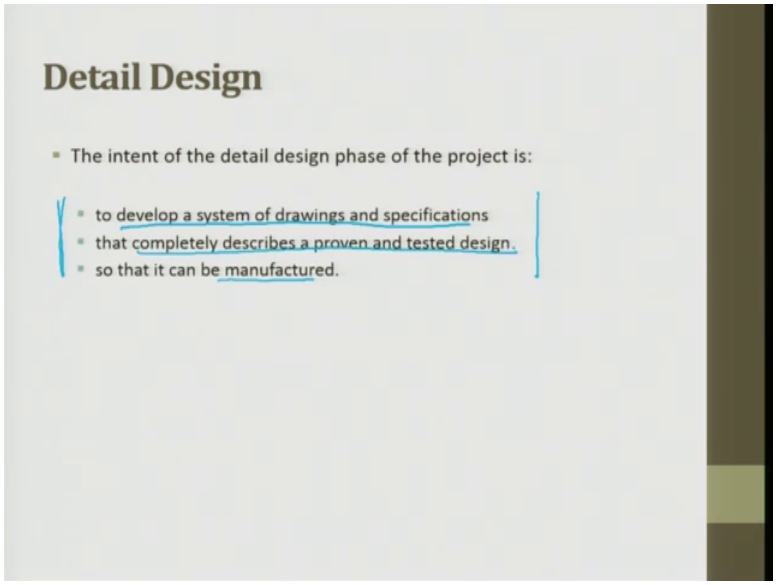

The intent of detailed design phase of the project is to develop a system of drawing and specification that completely describes a proven and a tested design, so that it can be manufactured.

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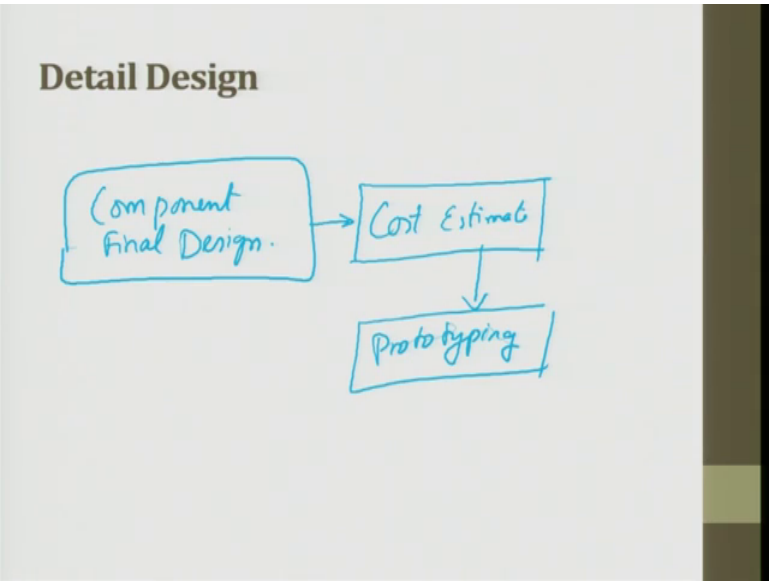

This is very important to develop a system of drawing specification completely describing a proven and tested design that only can be so that it can be manufactured. So, here we will have component final design which will have cost estimate and this will lead to prototyping, whatever you develop finally cost component has to be added to it. So, component final design will lead to cost estimate cost estimate to prototyping.

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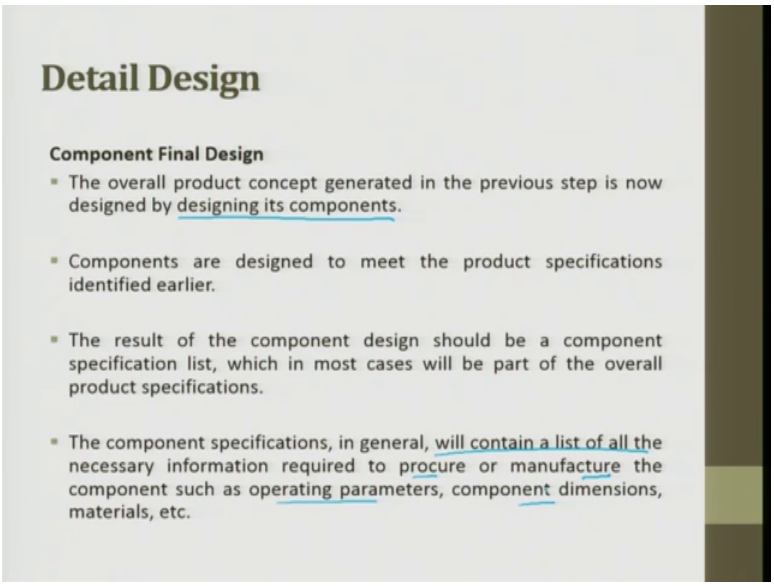

So, component final design the overall product concept generated in the previous step is now designed by designing it is components, the components are designed to meet the product specification identified earlier the results of the component design should be component specification list which in most cases will be part of the overall product specification. So, individual product specification whatever you give it make sure that the overalls function is also met, the component specification in general will contain a list of all the necessary information required to procure or manufacture. The component such as operating parameters component dimensions materials are all given in a detail design.

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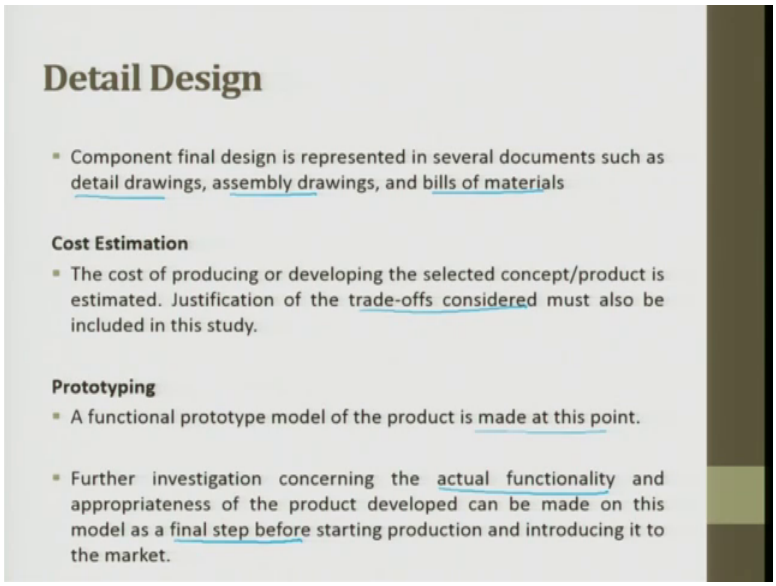

The component final design is represented in several documents such as detail drawing assembly drawing and bill of materials and those of who are not mechanical, they will not understand bill of materials, bill of materials is nothing but the list of all parts which are getting into the final product to be made.

The cost of producing or developing a selected concept product is estimated from the costing. Justification of the trade off considered must also be included in this study and once it is all turned and then we try to make a function prototype model of the product at this point. So, further investigation concerning the actual functionality and appropriateness of the product develop can be made on this model as a final step before start starting production and introducing it into the market.

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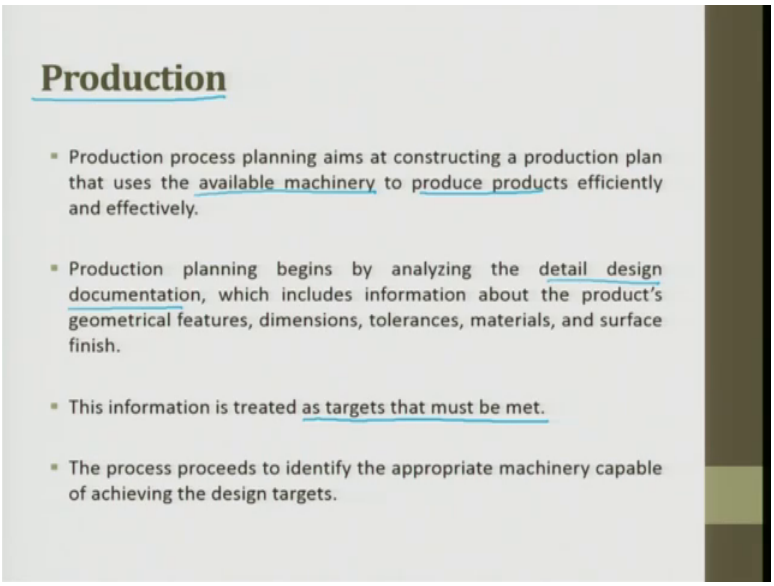

So, the next step is Production, the production planning aims at constructing a production plan that uses the available machinery to produce products effectively and efficiently. The process plan begins with analyzing the detailed design documentation which includes information about the product geometric features, dimensions, tolerance, materials and surface finish this information is treated as a target that must be met. So, when it comes to this level the customer will not even realize that are we demanding these drawings are we demanding these specifications, the customer will look at only the n functional part right.

So, from there you see concept devolution detailed and then from the detailed design only production can be made because, the detail engineering release whatever it says it gives you all the drawings assembly drawing it also give you part drawing and from the part drawing you will try to see whatever it is the process proceed proceeds to identify the appropriate machinery capable of achieving the design target.

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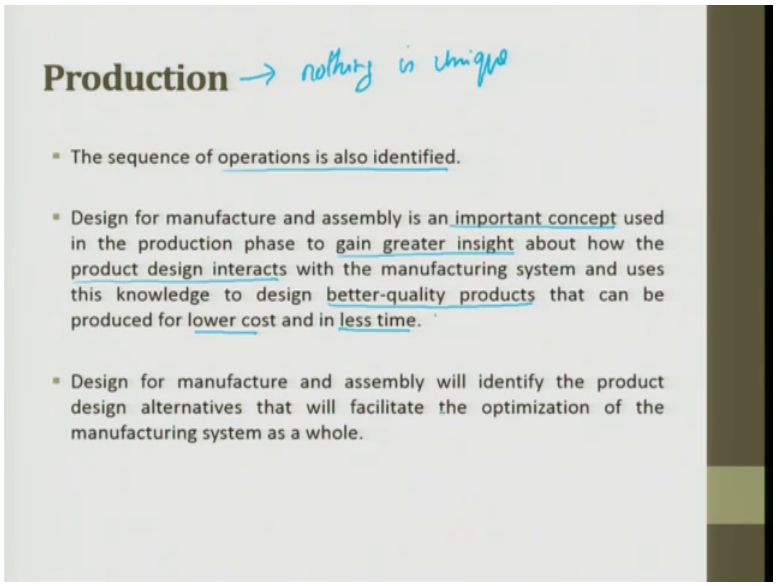

The sequence of operation is also identified in production there is nothing called unique solution nothing is unique. So, you choose looking at the machines available, looking at parts available, looking at the constraints available you try to choose a feasible solution that design for manufacturing and assembly is an important concepts used in the production phase to gain greater insight about how the production design in interacts with the manufacturing system and uses this knowledge to design better quality products that can be produced for reducing the cost and producing it in a faster time.

So, it is nothing but the life cycle time is reduced, the design for manufacturing and assembly will identify the product design alternatives that will facilitate the optimization of manufacturing system as a whole.

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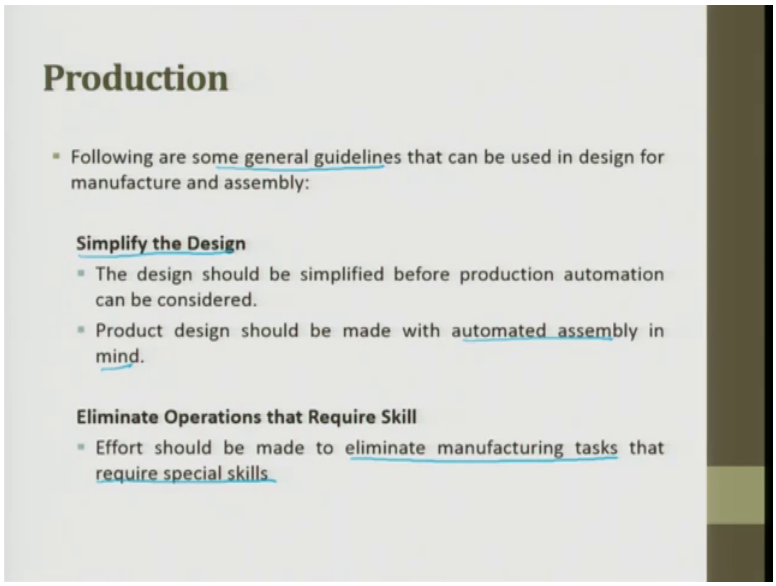

So, the production follow some generic rules or guidelines simplify the design as much as you can, the design should be simplified before production automation can be consider if the design is very complex them automatic, it becomes very difficult. So, if you are thinking of automation make the part drawing as simple as possible make it symmetry make it you have a mirror image of it.

So, all those things are simplifying the design the product design should be made with automatic assembly in mind. See automatic assembly what it does automatic assembly does not try to have multiple access of approach in making assembly. For example, if take p c b it will all be in one direction only from the top to bottom gravity will be used as a force of advantage and the entire assembly happens.

So, when you think of developing the design itself try to think of developing very simple and parts which will be automated later, eliminate operations through requires to required skills efforts should be made to eliminate manufacturing tasks that require special skills. So, do not make try to tolerance do not try to have a complex freeform surface try to make it as simple as possible.

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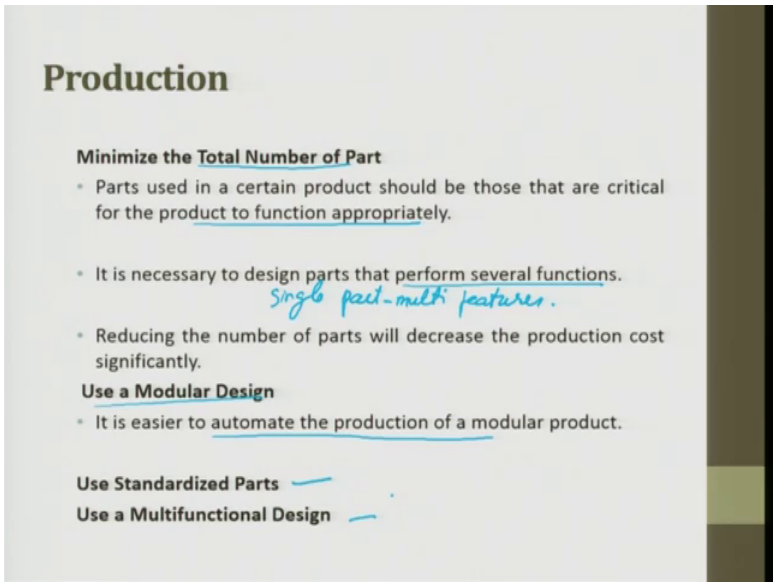

So, even a semi skill labor can be used to make those parts number of parts has to be reduced. So, the number of parts are reduced assembly time is reduced number of parts are reduced reliability is increased and then maintenance is reduced. So, the parts used in a certain product should be those that are critical for the product to function appropriately. It is necessary to design parts that perform several function, so it is a single part with multiple single part multiple features multiple features. So, that so that each feature can do several functions reducing the video number of parts will decrease the production cost significantly used modular design.

So, modular so what is so system subsystem, so if you can use some subsystem which is commonly available in the market. For example, the adaptor for laptops it is commonly available if you make it, so specific only to your laptop then sorry you will not be able to get you will not be able to attract the market right. So, batteries which are used for several domestic applications, the battery will be AA battery triple A battery whatever it is a standard size it is modular in nature ok. So, it is easier to automate the production of modular products use standard parts use multiple function design.

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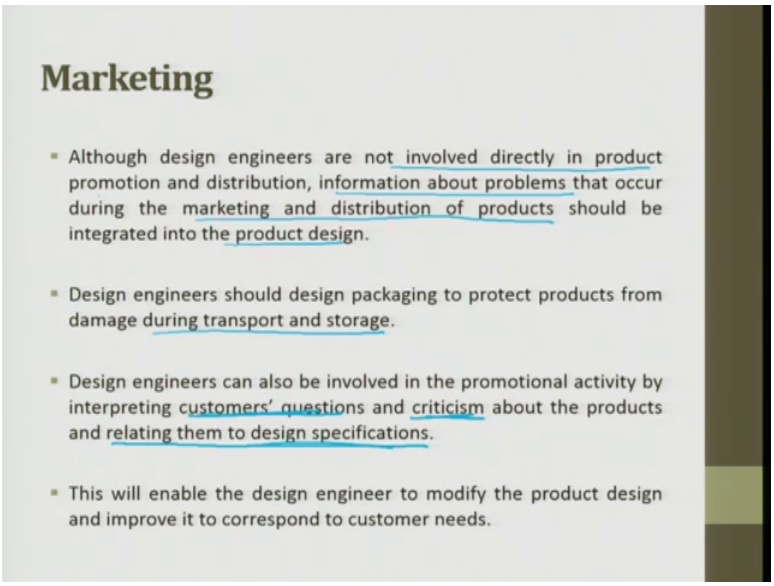

So, these are some of the guidelines which are given in the production or in the design for manufacturing. So, the last step is manufacturing sorry the last step is marketing; marketing is although the design engineers are not involved directly in product promotion and distribution. The information about problems that occur during marketing and distribution of the products should be integrated into the product design.

The design engineer should design packaging to protect products from damage during transport and storage, design engineer can also be involved in the promotional activity by interpreting customers question and criticism about the product and relate them to the design specification. So, you see from the criticism and customer question you relate it to the design specification, this will enable the design engineer to modify the product design and improve it to the corresponding needs.

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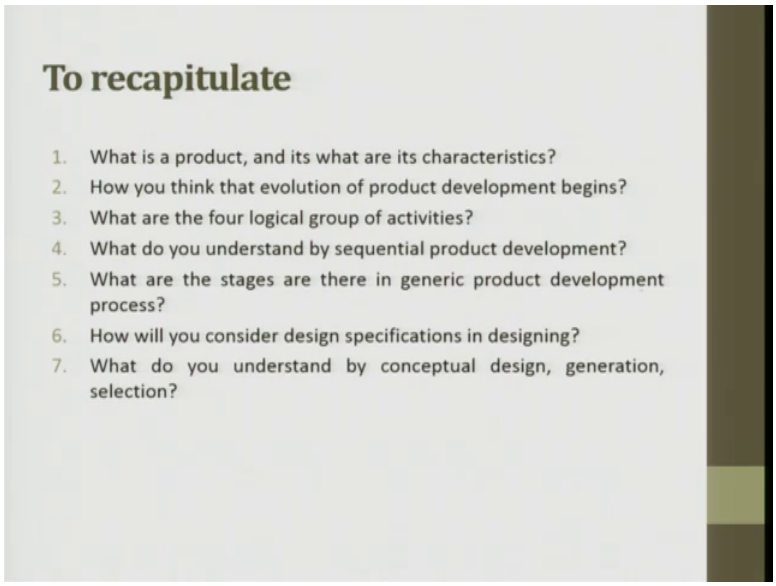

So, in this lecture series of product development, we saw what is your product and what is it is characteristics we saw how can you think of evaluation of a product development, then what are the 4 logical group of activities which are generally there, what do you understand by sequential product development, what do you what are the stages that are in generic product development, how will you consider design specification in designing, how do you what do you understand by conceptual design and generation selection. So, these are the things which we saw in this lecture.

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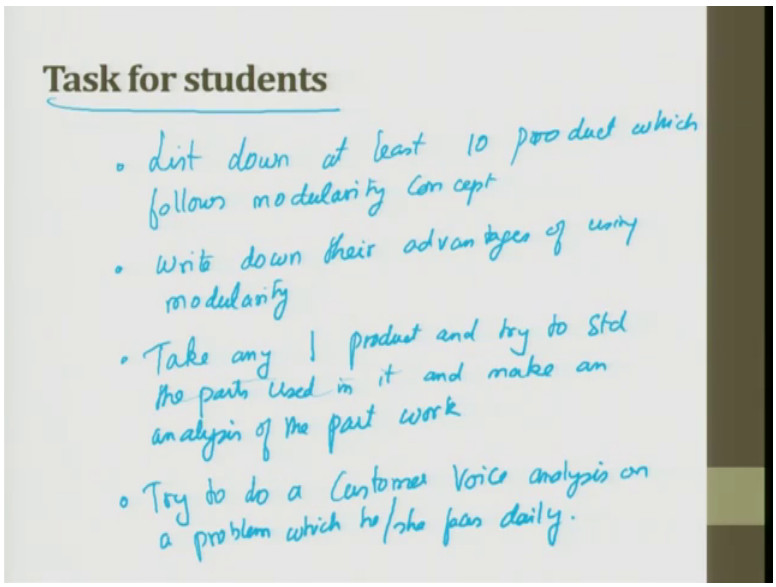

So, now a small task for the students which you do not have to submit, list down at least 10 products which follows modularity concept. Write down their advantages of using modularity ok. The third question is take any 1 product and try to standardize the parts used in it. Try to standardize the parts used in it and make an analysis of the part working. So, we have now take a part which is which has lot of non standard things and then you put standard parts and then you see what is their performance and other things ok.

The last one is try to do a customer voice analysis on a problem which he she faces daily, can be anything mobility it can be mobility it can be taking heavy load to the school huge baggage of books and notebooks taking to the school and walking a long distance cycling a long distance and then preparing food after coming up after travel, so these are some of the problems which are there. So, all I want is you talk to a customer (Refer Time: 50:02) you feel like and understand what is his problem which he faces daily and try to look for a solution for it ok.

So, with this 4 problems whatever I have given these are all tasks. So, you try to solve this and then come out to the solution so that you yourself will do the ten products which I have listed you can take up even a ballpoint pen you can take a battery you can take a torch you can take a mobile phone you can take a anything then write down there advantage.

What is the advantage because of modularity you are enjoying in it take one product and try to standardize that is what I told you try to take a product which uses non standard things and you try to put some standard parts and then try to see what is the efficiency of the product. Then customers voice with this I come to an end of this section of the lecture series on product development, so we will continue next with another topic.

Thank you very much.