Functional and Conceptual Design
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Lecture No. 23
Concept Development

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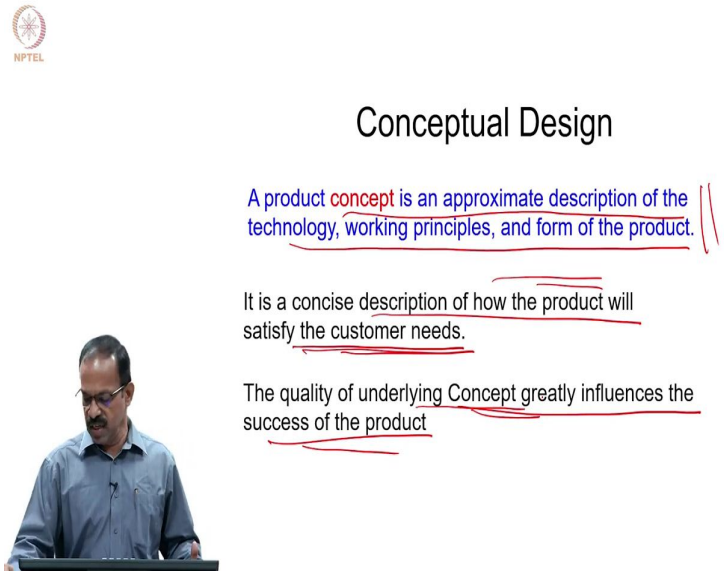

Good morning! Welcome back to the functional and conceptual design. In the last class we discussed or briefly mentioned conceptual design, how we can develop new concepts or what is the importance of developing concepts to solve the design problem. So, you may be having a product development task and while developing the task you will go through the various stages and identify specific functions which you want to improve.

Now, the question is how do we actually develop this, how do we actually develop concepts for addressing this function and improve the product. So, that is all about the conceptual design. So, we will look at the methods by which we can develop concepts and what are the standard methods available for developing concepts as well as choosing concepts.

So, last class, we mentioned that the product concept is an approximate description of the technology working principles and form of the product. So, at the end of this exercise you need to have an approximate description of the technology, the working principles, as well as

the form of the product, which is what we expect at the end of the conceptual design exercise. And it is a concise description of how the product will satisfy the customer needs.

So, you have some specific needs identified and based on the needs you identify the specific functions. Now, the question is how this concept is going to address those customer needs. The quality of underlying concept greatly influences the success of the product. So how good is your concept, how creative and innovative is your concept determines how successful your product will be? So, this is what that we are going to discuss in the next few sessions.

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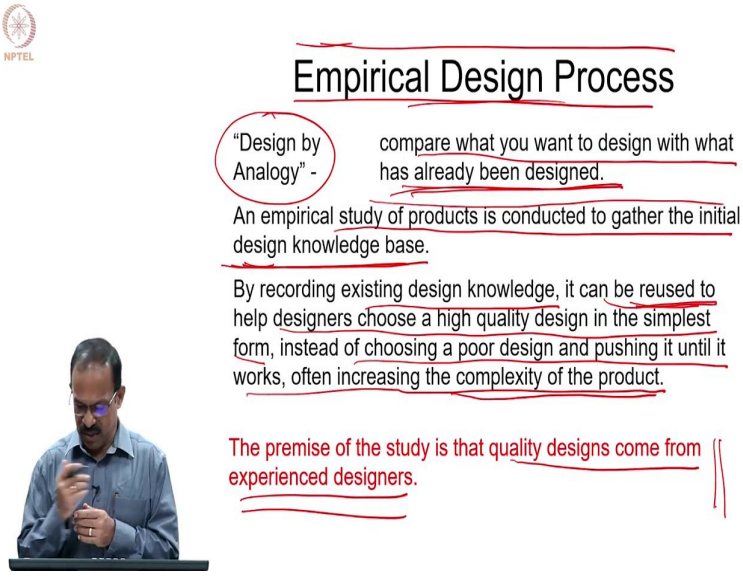

And we have something called an empirical design process, where we try to design by analogy. That is known as the empirical design process which we normally follow in the conventional design process. So, here we compare what you want to design with what has already been designed. So, this is one of the basic methods or basic strategies adopted by the designers in order to get the design done. So, this is known as an empirical design process. So, where we just look at the existing products and then see if something can be improved or modified to solve our problem. So, that is the empirical design process.

So, look at what has already been designed and then see what is to be done in order to get a particular function or a particular need satisfied. So, here an empirical study of products is conducted to gather the initial design knowledge base. So, any designer needs to have a good knowledge base to start with the design process.

If you do not have much of a knowledge base, you will not be knowing how to develop new concepts or you will be very limited in developing concepts. That is why we need to have a good design knowledge base and that will actually come from the existing design. So, you need to study the products, existing products and then try to understand how people have been trying to solve problems and then come out with products or concepts to solve the problems.

This information or this knowledge is very essential for any product designer and this can actually be obtained by studying the existing products. By recording existing design knowledge, it can be reused to help designers choose a high quality design in the simplest form, instead of choosing a poor design and pushing it until it works, often increasing the complexity of the product.

If you have seen very good designs and you have seen many products which are designed by expert designers or high quality designers, then you know how they are actually solving the problems and what kind of concept they employ in order to solve particular problems. And if you have this knowledge base, then it will be easy for you to get into good designs. And many times you will be able to reuse in some different form, not exactly the same thing you are copying but you will be able to reuse those concepts and then come up with quality designs for your product.

And if you do not have that kind of a database or knowledge base, you will be starting with some basic design which is very poor. And it does not meet many of the basic requirements. Since you do not know the existing design you will start with a very poor design and then keep on working on it. And probably at the end of, may be at the end of the process you may be getting a design. But you will be spending too much of time and sometimes the complexity of the product also increases.

To avoid all these things, you need to develop a good knowledge base before you start the conceptual design stage. Any designer needs to have a very good database or very good knowledge base about the existing designs, you should go through the products, existing products similar or different from the existing problem or the current problem. And then this

knowledge base should be generated and then see how to use this knowledge base to come up with better designs.

So, that is the requirement in the empirical design process. So, how is it done? We will actually do a lot of experiments with the existing products and then generate the knowledge base. And the premise in this case is that the quality designs come from experienced designers. And it is a fact that an experienced designer will be able to come up with a good quality design. The more the experience the more will be the quality of the product, the concept will be better and that is the basic philosophy of the empirical design process.

So, you look at the existing process design and try to develop the knowledge base to help you to come up with better designs. It is not to copy the existing concepts, but basically to understand what is existing and how, what is the current level of knowledge, data, and technology and all in a particular field. And then see how you can actually utilize that information or that knowledge to come up with better designs.

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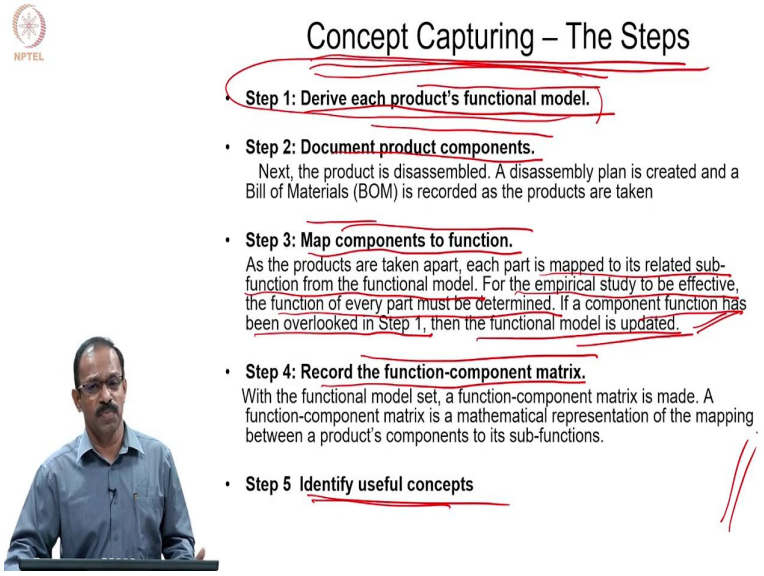

This is what actually you are doing during the lab exercises also. We are actually asking you to open a product and then try to identify the components and map the components to the functions and then to get a particular function what concept is used by the designer. So, by going through multiple products, you will know that for the same function you can have

multiple concepts and then you can have an understanding of what are the different concepts that can be used to achieve a function.

So, that is one of the reasons why we have a lab session or we are having multiple lab sessions as part of this course. So, what we do, this is the concept capturing stage. If you want to capture the concepts from the product, you need to open up the products and then try to understand. Then you derive each product's functional model. So, once you have a product, you can actually derive a functional model of that product. And then you document the product components by opening up the product.

So, when you get a product, you open up the product and then identify different components within the product. And since you have a functional model already developed for that product, you will be able to map the components to function. Any component you take, there is a shaft or there is a gear or a belt drive whatever it is, it is actually a product. But when you look at the functional decomposition then you will see that, there is a mapping, okay this particular function is satisfied by this particular component.

So, that is a concept, when you have a component that basically says that the function has been converted into a physical form and that is the concept employed for converting that physical form you will be able to identify. So, that is the reason why we need to have this mapping of components to function. As the products are taken apart, each part is mapped to its related sub function from the functional model.

For the empirical study to be effective, the function of every part must be determined. So, the function of every part need to be identified to complete the study. And if a component function has been overlooked in step one, then the functional model is updated. Now, this functional model was developed based on your own understanding of the functional structure or the functional decomposition.

Now, you will see, go through these functional decomposition and then look at the product components and identify the functions of these components and then look at your function decomposition, is this function identified in the functional decomposition or not. That is basically the updating of functional decomposition, you update the functional decomposition based on the components you identify in the products.

And record the function component matrix. So, finally, you will record the mapping of these functions and components in a matrix form so that you will get a clear idea what kind of concepts are used. Based on this you can identify the useful concepts employed in the product. Like this if you do for multiple products, you will be getting a large database and this database will be highly useful when you have to solve your own problem.

Because once you have an experience of seeing something, you are not really designing the product, but you are actually looking at that product, existing product and trying to understand how a designer has come up with the concepts to solve the different functions needed in the product. So, that is the empirical design process where you try to learn things from the existing products and then use this knowledge to develop new concepts for the product.

So, every designer has to go through this, unless you do this exercise, you cannot be a good designer, because good designs come from experience or good designs come from experienced designers.

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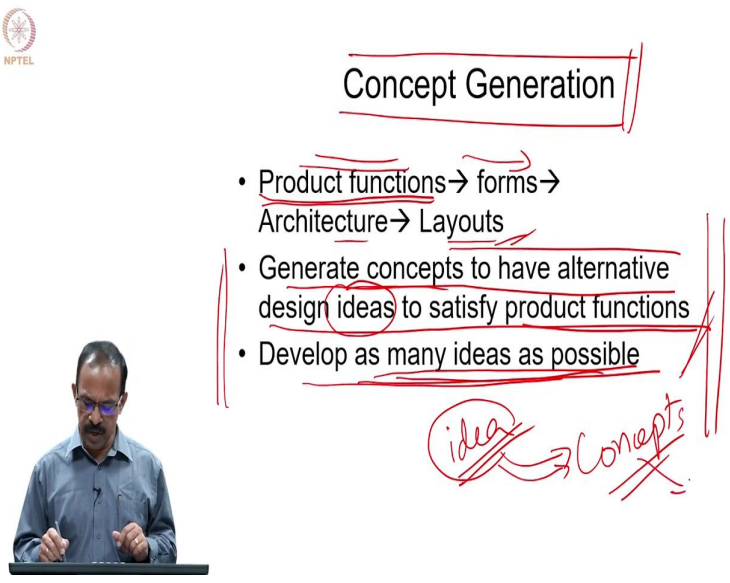

And finally, you need to go for the concept generation for your problem. So, you develop a database and then use that database as a starting point and then start generating concepts for the problem that for the current design problem you have identified. So, you may be studying the design of a product, for example, you take that you want to develop a new washing

machine, which can actually reduce the water consumption, that is the requirement. The design objective is to reduce the water consumption.

Now, you will start the process. So, you look at what are the functions needed in the product. You need to do a functional decomposition of course, you have the customer needs identified and based on all those customer needs, one of the top most need is reduce water consumption and then you try to get these functions. And we need to convert this into the form made through architecture and layout of the product.

So, you develop the functional decomposition, then identify the modules needed in the product in order to satisfy different functions and develop an architecture and a layout. So, that is the stage where you have the product layout. Now, for each module, you identified modules, there is one module which actually takes water and then passes water through different elements and then finally, it mixes with soap and then uses it for rinsing the clothes and then comes out as dirty water.

Now, that is the module that you identified, a water handling module. You need to look at the functions needed in the water handling module and then see which function can be improved to reduce the water consumption. So, that is the particular function you identify. Now, you need to develop a concept to address that particular function. So, in a product you may be addressing one or more functions, but you will not be doing the total product as a complete new concept.

That will be applicable only when there are no such products and it is a completely new one and there is no concept which can be employed for the existing one, then only we will go for the complete development of the complete concept, all the concepts for the other function. But in most of the cases you will be doing concept development for a few functions which you identified are critical. And then generate concepts to help alternative design ideas to satisfy the product functions.

So, I take one or two functions or a few functions and then generate concepts to have alternative design ideas. So, we start with the design ideas and then move to concept. So, ideas and concepts are slightly different, they are not one and the same, I will tell you the difference. So, you develop a lot of ideas, and then a concept needs to be worked out from the

ideas which you find as the most feasible idea. You should develop as many ideas as possible, that is the requirement.

You need to have a large number of ideas to solve a problem. Suppose, there is a problem of reduction of water, you cannot just have one idea, you need to have a large number of ideas and then you need to choose the best idea and then develop the best concept from that, that is the requirement in concept generation. So, in order to have this stage you need to have the design database.

So, we will, as a designer you learn a lot of, you go through a lot of products and then generate a lot of idea, I mean, capture a lot of ideas from those products. And with this background, you will start attempting to solve this problem. So, that is the concept generation stage where we tried to come up with ideas first. A large number of ideas to be generated to solve the problem.

So, that is the idea generation stage and then this idea, so, idea will be more of an abstract form of solving the problem. For example, I want to fly is an idea, but how can I fly, so what is the technology I can use, what will be the form of this and what kind of issues are there identifying all those things are basically a concept. So, I can fly is an idea, but if I say that I can have two wings and then I can flap the wings at a particular frequency, and then I can overcome the drag forces or these forces will be overcome by the flapping of the wings.

And so, giving a more detailed description of what the idea is and how it is going to function and that is known as that concept. So, ideas are a more abstract form of a way to solve, but concept is a clear definition of, a description of how this can actually be implemented. So, that is the difference between an idea and a concept. So, moving from idea to concept is a big exercise, but the first thing is to have an idea first of all. So, you need to have ideas to get the concept.

So, you start developing large number of ideas, and then many ideas will be not feasible. But look at all those ideas and then see which other ideas which seems to be possible, and then start converting that into concepts. And then you will be getting lots, again, you will be having, it is not one concept, you would need to have many concepts so that you can, even if

one fails, you would be able to go with another concept to solve the problem. So, that is the way how we will be going in the concept generation exercise.

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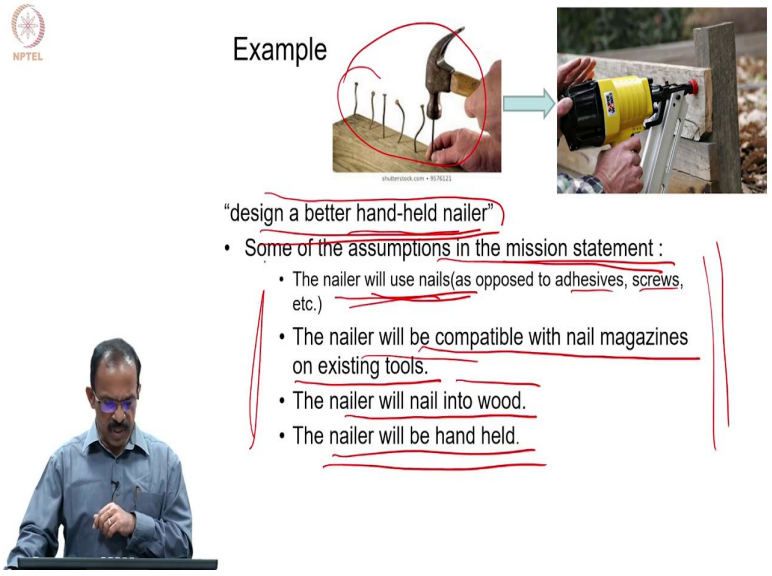

Just to explain the empirical design process, which I already mentioned, so we will just take an example and then go through the stages and then see where we reach, how we reach the concept development stage. So as I mentioned, in the empirical design process you look at the problem and then try to function decomposition and then see how to solve it. So, let us take a very simple example of this, designing a better handheld nailer. And then see how the concept development can be approached from the basic problem and then moving through the problem at different stages, reaching the concept development stage.

So, you know that I mean this I had already explained in the previous class. If you are using the conventional hammer for nailing, you have a lot of difficulties. If someone wants to make it a handheld nailing nailer or electrically operated handheld nailer. This is the requirement. Now, you want to solve this. Then we will have the basic assumptions in the mission statement.

You go back to our initial classes where we talked about the mission statement and other things. In the mission statement, we will talk about all those assumptions, basic requirements or fundamental things that we saw, I mean, provided in the product. So all those things we will identify, we will say that the nailer will use nails. So you are saying that, I want to

replace the nailer, I do not want to do this nailer, can have many solutions, I can actually say that, no need to use nails, you can instead you can use adhesive or screws.

But that is not the problem that you are trying to solve, you are saying that the nailer will use nails and then we need to join different components or different parts. And it will be compatible with the nail magazines on existing tools. So you are saying that, there are existing tools available in the market to solve this problem. So I will be using the same kind of nail magazine, I mean, the set of nails that can be inserted into this product, and then I will be developing the product.

The existing nail magazine should be compatible. The nailer will be compatible with the existing nail magazines. And it will be used only for nailing into woods. So you are telling that is only for wood not for other applications, metals or any other, we will not, we are not considering. And it will be a handheld nailer. These are the things which actually come from your technical questioning.

When you have a technical questioning in the beginning, you will identify many things and then that will be put into a mission statement and this will be a part of the mission statement. So, it is not exactly the full mission statement, but some of the assumptions in the mission statement.

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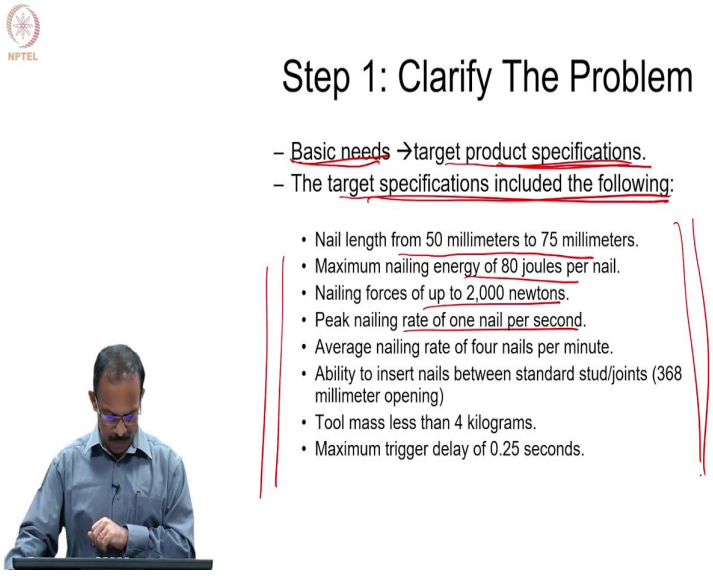

Now with these assumptions, we will go to the problem clarification. So what are the needs, the target product specification, so we need to look at the needs and the product specification. Again, going back to our old earlier slides, we talked about identifying the customer needs, and then converting those subjective customer needs into objective specifications. Then, after going through this, we will get the target specifications which will be coming through your house of quality or QFT analysis and we will come up with the product specification.

We will say that nail length from 50 millimeter to 75 millimeters and maximum energy 80 Joules, nailing force, I mean, these are all the specifications that you can identify going through the various stages in the design process. Basically in understanding the opportunity we will do all these things and then we go for the developing the concept stage.

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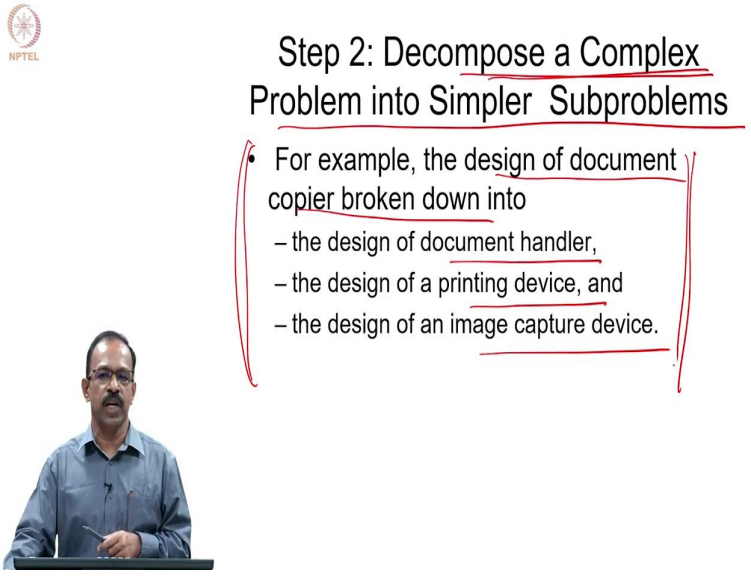

Once you have the specifications, you need to look at how we satisfy those customer needs. Because you identified that you need to increase something, you need to provide this much force. Now, how do we provide those forces, how do we ensure that the nails are moved at a particular speed or force is applied at a particular point, all those things need to be provided and to provide that we need to see what kind of functions are to be provided in the product.

We will do that through a simpler sub problem or saying that we can reduce the function problem into subproblems, that is the decomposition. Now, the main function of the nailer is decomposed into smaller functions. So, the design of, this is not an example for the nailer but in general we are talking about. Suppose you have a design of a copier, that is the photocopier then we can say, actually say that document handler, printing device, image capture device. So, this is the way we can actually decompose the functions.

Same way in the case of a nailer we can identify how we actually provide the function of handling, that is, it should be manually handled. So, manual handling is one problem. The other one is moving the nails at a particular rate for nailing and then providing a force to the nail head. So, these are the sub problems that we can identify in the nailer. So you decompose the problem into subproblems through a functional decomposition. And there we can use the function structure method to decompose it and identify the functions.

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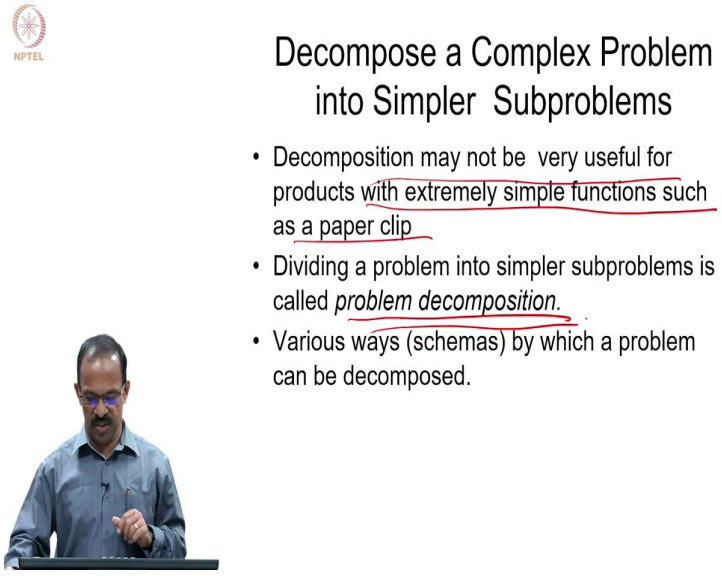

So, the decomposition may not be very useful for products with extremely simple functions. So, when you have a very small problem or very simple problem that you are trying to solve, then you do not need to go for the functional decomposition. But whenever there is a complex operation, better to go for functional decomposition because you will be able to solve the subproblems first and then move to the higher level problems.

So, a problem decomposition or sometimes we call it a functional decomposition also. Though we are trying that, saying it as problem decomposition, we are saying that providing a function is the problem now, and then we are trying to decompose into sub functions.

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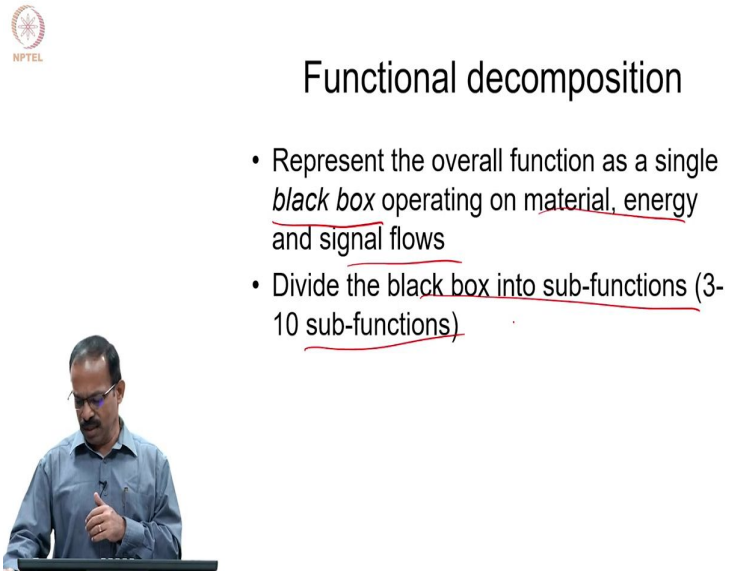

So, make it as a black box and then based on the material energy and flows, we will try to do this and divide the black box into sub functions. You can actually have multiple steps in this depending on the complexity of the problem you may have 3 or 4 steps or more steps in the decomposition. So, that is functional decomposition.

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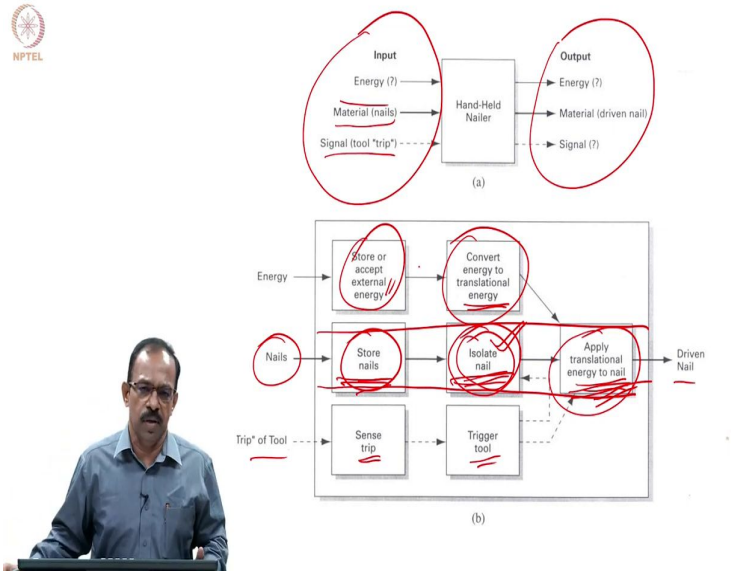

For example, if you look at the nailer, you can see these are the input energy, material and signal. So, the energy is electrical energy if electrically operated plus the manual energy will be there. And then you have this material that is the nails going inside and then the signal is further tripping or dispatching that or that kind of information that you are getting. So, you

have this input and output, now you look at what is happening to the input and how it is coming out as output.

So, for example nails need to be stored in the machine. That is a magazine, the nail magazine that you say it can be used for storing and then you need to isolate the nails. So, you have 10 nails or 20 nails stored, you need to take one by one. So, that is how to isolate the nail and then how to apply translational energy to the nail. So, you isolate one nail and then apply a translational energy to the nail, so that it can actually move forward.

So, that is the function needed for this in the case of nails. And similarly you have the energy whether you store or accept. If it is a storage battery type you store, if it is not a battery operated then you accept energy, then convert energy to translational energy and then apply the translational energy. Here is when it is tripping or not, then if it is a tripping then you have to trigger the tool accordingly. That is basically the information.

It is a very simplified decomposition as shown. Now, we know that store nails are a function. But how to store nails? Now if you are going to use the current existing magazine, nail magazine, then it is a question of how do we actually provide a space for holding it in this magazine? So, that is the concept to be developed for that. Similarly isolate the nail, how we actually take the nail one by one from the magazine, so that is another function to be provided.

Suppose you are developing it, it is different from the existing one then you need to develop a concept to do this. How can I take nails one by one from the nail magazine? So that is where you need to develop a new functional concept to do that. Similarly, applying the energy, translational energy.

So, depending on the way you isolate as well as the current methods of providing this kind of energy, you can look at that and then see how you can come up with new concepts to come up with a new concept to get this particular function. This way, you look at each function and then see which function needs to be improved and how can we develop a completely new concept for this. In some cases, you will be able to use the already existing concept.

For example, to store energy, you do not need to come up with a totally new concept, what you need to provide is a battery. So, the battery is a concept for, already existing concept for

storing energy. So, what you need to do is to provide a battery and then provide a provision for the battery to sit inside the machine. So, that much only you need to have it in this one. So, you are not worried too much about developing a totally new concept for storing energy because that is not the focus.

That is how we should look at the problem and then try to solve. For example, convert energy to translational energy. So, converting mechanical electrical energy to translational energy is the problem here and there are multiple existing concepts. So, if you feel that I can still use an existing concept I am not interested in completing, developing a completely new concept for this. You can actually adopt an existing method and then fit it into your design problem.

You may have to make some changes, you have to adapt that particular concept to suit you, but you do not need to come up with completely new concepts to solve this problem. So, that is how we need to start looking at the problem and identifying which function you want to improve and then you develop the concept for that. So, this is the way we do it and then the question is how we come up with a concept for this. So, isolate the nail or whatever the function you identify, you can come up with the nail.

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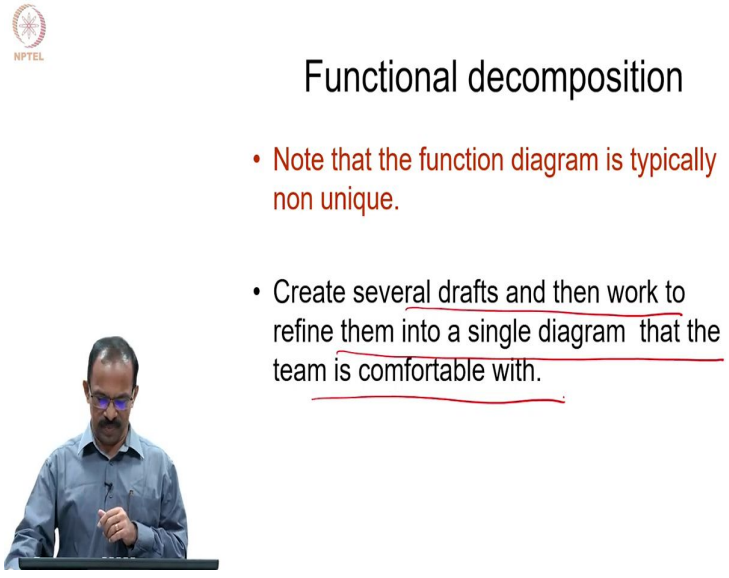

This functional decomposition which I had shown you, may not be unique. Again this we already mentioned, that depending on the person and depending on your focus, you can have a different decomposition. So, you can create several drafts and then work to define them into a single diagram that the team is comfortable with. If it is a complex one, then there will be

multiple ways you can do the decomposition. So, you can decompose it in different ways and then consolidate that in a single decomposition.

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So, once you have done that, then the question, the next step three is to develop concepts for sub function. So, I took that example to tell you where actually this fits in the, developing the concept fits in the whole process of design problem solving. It is applicable to any design problem whatever, maybe you are design problem, you have to go through those steps and then identify the function or the sub function for which you want to develop a concept.

So, what I am going to discuss in the next one or two classes is the methods by which we can actually develop concepts. Because concept development is again a creative design process. But still we need to go in a systematic way so that you will be able to get a large number of concepts, good quality concepts. So, how do we ensure a good quality concept at the end of this process, that is ensured through a systematic concept development and selection process. So, this is what we will be discussing.

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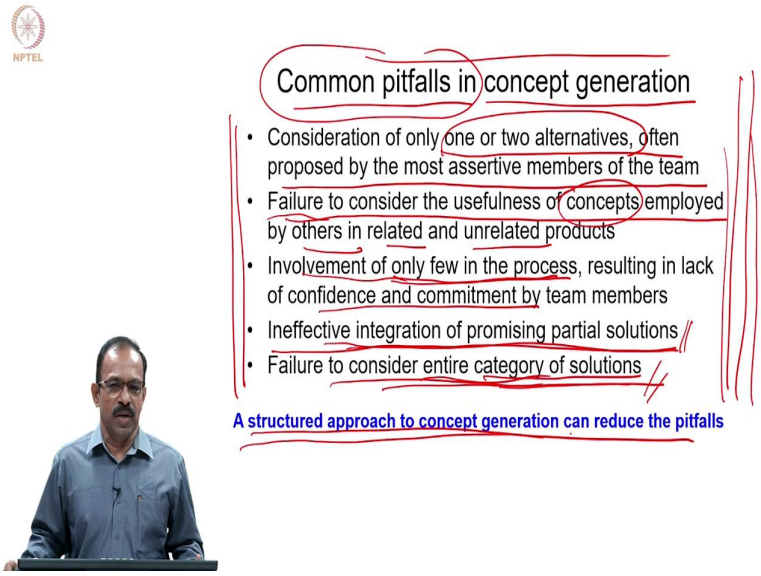

And before we get into that, let me tell you what main issues you will face while developing concepts. Because when somebody says okay I want to solve this problem, let us have some ideas, we start making ideas or start developing concepts. But many times, all these fail mainly because we have many pitfalls in the process that we follow. Or when we do not follow a systematic process, you will most likely fail in coming up with a good concept because a process which is not systematic, has got a lot of flaws. And that may lead to failure.

So, let us see what these pitfalls are. So, one is that the consideration of only one or two alternatives often proposed by the most assertive members of the team. Suppose you are designing this, I mean you are solving this problem as a team and then you start developing the concepts, you will start with only very few concepts, you say that, very few alternatives. You will say this can be done in this way and this can be done in this way.

And that will be proposed by the most assertive member or the team leader or whatever his position is and that person says and many others will simply listen, they will say, let us try. That is a very bad approach, you cannot have only very few ideas, you need to have a very large number of alternatives to start with. And this has to come from everyone. It is not only from the assertive member or a few members, everyone should be given a chance to come up with alternatives.

Whenever there is a need to develop concepts, make sure that you have a large number of alternatives to start with. And another problem is the failure to consider the usefulness of concepts employed by others in related and unrelated products. Many times because your

experience or your background information or knowledge is very limited, you may fail to consider the usefulness of concepts already employed by people or in the products which are related or unrelated to your problem.

For example, you are looking at the water conservation issue or reducing the usage of water, then you will be looking only at the washing machines, how other washing machines are using water and what kind of method they are using to reduce water. But there may be many other situations where people try to reduce consumption of water, it may not be in washing machine, it can be in a chemical industry, it can be in a paper industry, it can be in a food industry or it can be in general household, how people try to reduce the use of water.

You need to look at all those alternatives employed by people, whether it is related to the product or not related to the product, you should be able to look into those alternatives and also. If you fail to consider that, then again you will be failing in getting a good solution. So, that is the second point. The third one involves only a few. Suppose you have a 6 member team, only one or two will be actively participating in coming up with alternatives.

So, the rest of the people will not be having any interest in these ideas that the others proposed to me. And therefore, their commitment and confidence will be very low with respect to that concept or that alternative. And this is why we need to have the participation from everyone. And everyone's views should be taken into account so that everyone will have the confidence or confidence in that particular alternative and then we will be able to take it forward. So, Make sure that everyone is involved in the development stage.

And ineffective integration of promising partial solutions. And this may be difficult for you to understand now, but I will explain it later when we go through the stages of this concept development. But, suppose you are developing a concept for, or alternatives for a particular problem, there may be many solutions coming up. People will be suggesting many alternatives, some of them may not be really good, they may not be feasible, but there may be some elements which are good in that particular idea or the alternative.

So, you need to look at every alternative and then see what is good and bad about that and then see the good things from that particular concept idea can be taken forward to some other thing and combine them with others, so that you will get a better idea. So, this is what

actually says that ineffective integration of promising partial solutions. So, there might be many partial solutions which are promising, but we do not take it forward because they are not complete or they may not fulfill all the requirements, but there may be many promising features in those ideas.

How do we actually take those promising features and integrate them with others to get a much better idea is this one. So, we need to look at that part also, how we integrate promising partial solutions to get a better solution. And failure to consider the entire category of solutions. So, this again, to some extent depends, I mean, I mentioned those alternatives. So, you need to look at all possible alternatives in different domains. So, that is a category of solution.

So, a solution can be categorized into different categories, based on from where this solution originates, the idea originated. For example, some of the solutions may be based on some chemical processing, some of them may be coming from electronics based features. So, all these domains need to be properly understood. And we need to consider all categories of solutions. It is not that, if I am a mechanical engineer, I will have a bias towards all mechanical solutions and electronics people will always talk about electronics based solutions, a software person will talk about software based solutions.

So, we need to look at all these categories, and then see whether we can combine them or use them properly to get the solution. If you do not consider a particular category, we are actually missing out an opportunity to have a better solution. So, try to get an entire category of solutions. And to do all these things, or to avoid all these pitfalls, we need to have a structured approach in concept generation.

So, these are the pitfalls that we mentioned and how we can avoid this is by going through a structured approach to concept generation. And what is the structured approach, is the discussion we are going to have. So, any idea generation process or the concept generation process should be very well structured and a structured process only can avoid this kind of pitfalls. So, most of the pitfalls discussed can be avoided by going through a structured approach. Let us is see what are these structured approaches existing in order to solve the design problems in order to come up with better design ideas.

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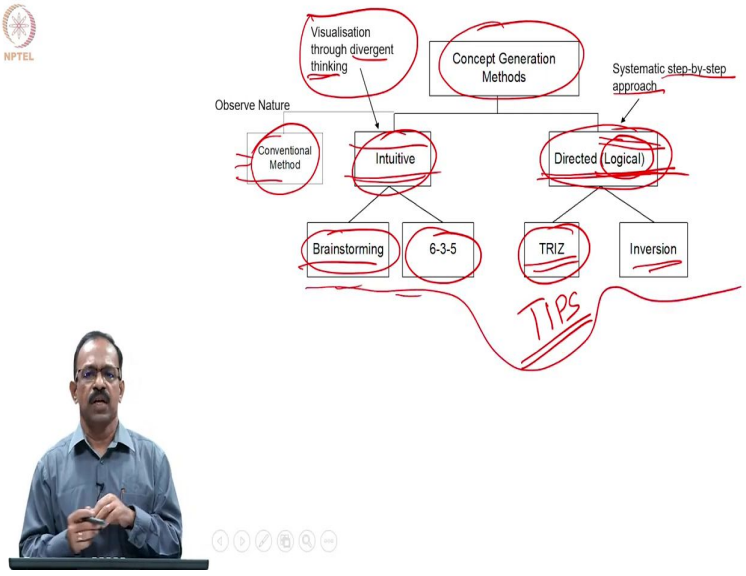

The concept generation methods can be classified into mainly 3 categories. So, one is the conventional method, the other one is known as an intuitive method, the third one is known as a directed or logical method. The conventional method is the one which actually we normally follow without really going through a very structured method, we will look at nature and then see what are the ways in which the natural source is a particular problem.

Try to copy that or try to see whether our problem can be solved using that one. That is basically the conventional method of design observing nature. The other one, the intuitive method is the most commonly used method, which is visualization through divergent thinking. The way in which it works is based on the individual creativity and intuition. So, many groups of people will start trying to solve the problem in a systematic way and then try to come up with a large number of ideas that are the intuitive method of problem solving.

And there are different methods again in this category, you can see brainstorming is one of the most commonly used methods for intuitive problem solving. It is not only for product design, whenever you have a problem to be solved and you do not know what kind of solution can be arrived at, you want to have a creative and innovative solution, and then we go for a brainstorming. So you might have heard about brainstorming, you might have participated in brainstorming.

Again, it is a structured process, we will see how it is done. But this process helps you to generate a large number of ideas in a very short time through divergent thinking and

visualization. So, a group of people think in different ways, different directions, and then come up with ideas that it is feasible or not, without worrying that creating a large number of ideas is the brainstorming method.

Then another method is known as 6-3-5. Again, it is a creative idea generation method. We will see what it is later. And there are other methods called gallery methods also to generate ideas. That is the intuitive method. And the next one is known as the director or logical methods. So, this is intuitive, but this is logical. So, here there is no logic in coming up with a solution, you cannot say that what is the logic in which you can actually solve the problem, it is not based on logic but it is more on creativity and intuition, that is the solution comes up.

But here it is a logical process, we are saying that if you have a problem between this and this, and this could be the solution, so that is a logical one. And there is a process to do that or there is a method to do that, and that is why it is known as a logical problem solving method, where we have a systematic step by step approach to solve the problem. So, we will say that, you have a problem of something happening then you look at the problem and then say okay, what is this, what is this.

If you can tell me these two, then I know what the solution is. So that is the way how it works. And we will see what it is later. And one of the very famous or very effective methods in logic is known as TRIZ. So, TRIZ is a Russian acronym for theory of inventive problem solving or it is known as, also known as TIPS, theory of inventive problem solving. And the method is known as inversion. So, we will not go into all the methods, we will look into these 2-3 methods, brainstorming, 6-3-5 and TIPS, and see how these methods can be used to come up with creative solutions for design problems.

As I mentioned, it is not only for design it is used, it can be used for many other applications, but in the design product, design stage we will be able to use it for the concept generation. So, the whole idea of all these methods is to get a large number of ideas to solve a design problem. So, that is the whole purpose of these methods. We will go one by one of all the methods which can be used for solving or used for getting solutions.

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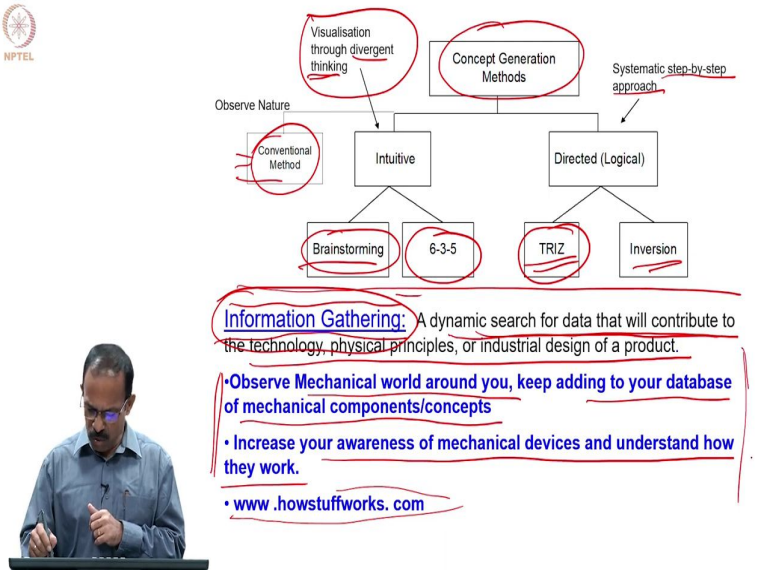

But all these methods will apply only if you have enough information gathered, or you have enough knowledge base to come up with new ideas. If you are completely new and you do not have any experience with products, or how it works, you do not have any idea how products work and what is, how the functions can be mapped to products, I mean the components, then it is very difficult for you to contribute effectively in idea generation exercises.

Before participating in any idea generation exercises or concept generation exercises, you need to have enough information about the problem as well as you need to have a back database, not only for this problem, but a very wide variety of other problems also, then only you will be able to contribute.

So, a dynamic search for data that will contribute to the technology physical principles or industrial design of a product is essential. Any person who is participating in this kind of exercise needs to have a very good database and he or she needs to be doing enough search for collecting data information and then developing the database. And how can you do this as a designer, there are a lot of forces that are available to collect information.

The first thing is to observe the mechanical world around you, keep adding to your database of mechanical components and concepts. So, if you look at the existing products or the systems around you, you will see a lot of concepts being employed for various applications. For example, if you look at this product, you can see a lot of concepts that can be feasible for

many other options. Not only for this product, will you be able to identify many useful concepts being employed in this product for application.

For example, you take the chair or you take the camera stand or you look at the displays, anything you see in the world around you, you will be able to see some concepts being employed to get something done and try to understand what is that and how it is being used for a particular application. And this would be useful for you when you are trying to solve a problem of a different kind. It may not be in the same kind of a problem you are solving, but it will be useful in many other situations.

And that is why you need to develop a large number of concepts or you need to develop a database with a large number of ideas taken from the world around you. Increase your awareness of mechanical devices and understand how they work. So again, look at the products and then try to understand how they are working. Any product that you see, whether it is a sewing machine or a washing machine or a mobile phone or any other product that you see, try to understand how is it working, what is the basic principle and what are the concepts employed for this to work or what kind of mechanism is used in order to get a particular motion.

For example, sealing machines are a very good example of too many mechanisms being used inside. So, if you try to open the product and then try to understand the way these components are assembled and how they are providing different functions, you will be able to learn a lot about different kinds of mechanisms. I am talking from the mechanism point of view only, like any product you take, you will be able to learn a lot.

And there are a lot of resources available on the internet also. Like now there are a lot of YouTube videos about all those products. If you want to know how a particular product works, you can go to a website like howstuffworks.com or you can go to YouTube and then search for it, you will see a video explaining the principle of operation.

So, this way try to develop a good database of products and the mechanisms and the concepts being employed, which will help you to contribute well for, well in a concept generation exercise, whether it is brainstorming 6-3-5 or TRIZ whatever it is, this database is very

important. So, try to ensure that you have a good knowledge about the related and unrelated products; that is the basic requirement to be part of the team.

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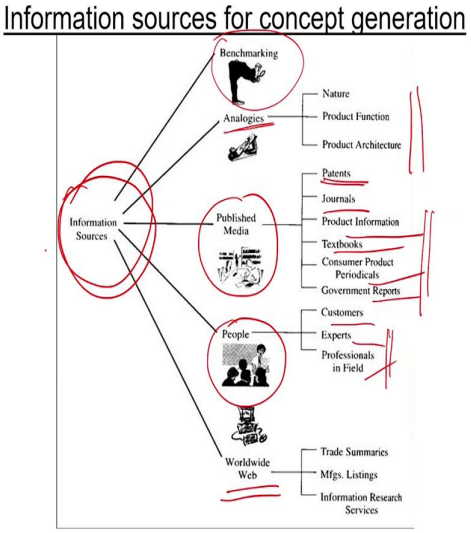

Alright, so, these are the various sources from where you can actually collect information. So, you can look at the benchmarking that is similar products or you can look at the nature for analogies. Different kinds of analogies you will see with nature, any product you take you will be able to find some analogy with nature. And look at the published media, you have the patents. So, there are large databases on patents, there are Google patents.com or you take the USPTO you will be able to see the patent details for a large number of products.

Then there are journals, product information catalogues, textbooks, periodicals, government reports, etc. about the products, which are of interest to you. And then get the information from people, basically the customers, experts and professionals in the field. If you want to know more, talk to the customers, experts, professionals, and then generate your database. Of course, the internet, the World Wide Web, is another resource where a large quantity of information is available, which you can use for getting your information. So, once you have all this information and you have developed enough of a database for design, then it is time for you to be part of an exercise which can be used for generating new concepts.

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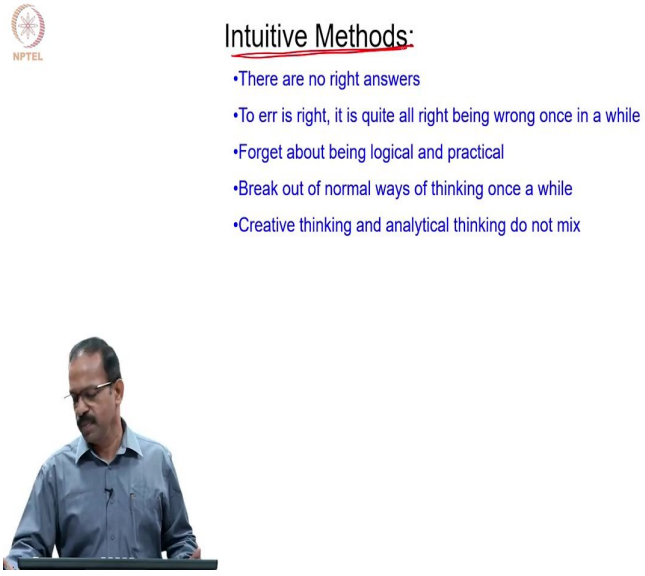

So we will start with the intuitive methods in the next class, we will see what are the, how we can use the intuitive method for generating concepts. So we will discuss this in the next class. Thank you.