Product Engineering and Design Thinking
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Module - 03
Design Thinking and Concept Development
Lecture - 13
Idea Generation

Hello my dear students, today we will be learning about Idea Generation.

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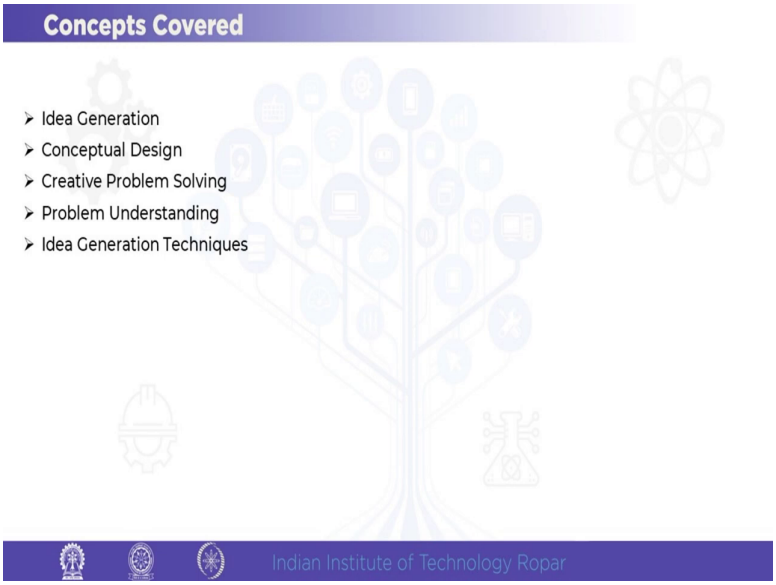

Idea generation is important for product design whereas, in this idea generation we generate ideas find out solutions.

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And we actually find out the means practical solution of this. So, we can use various techniques for this one and in this lecture we are going to learn some of the techniques which we can use in idea generation. This is one of the most important phase of product design.

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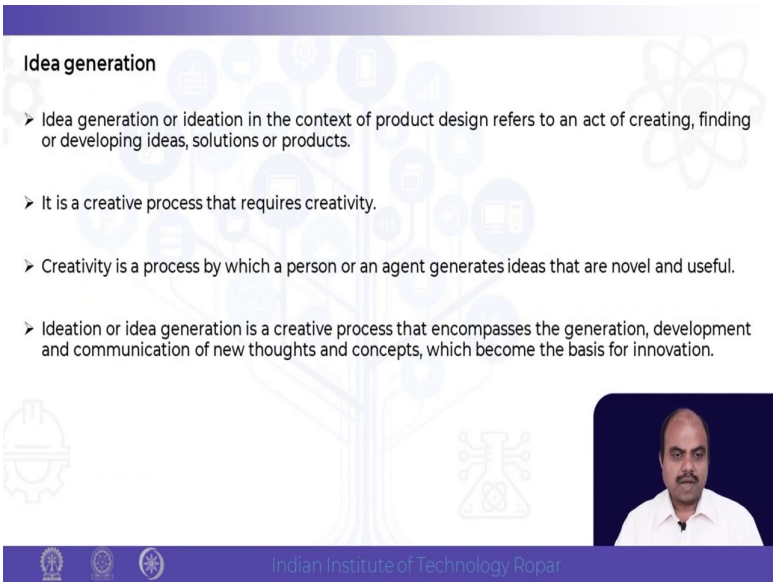

So, idea generation it is also called ideation. In the context of product design it refers to creation, finding and developing ideas, solution and products. So, what do you mean by ideas? Idea is something like you know something which you which you have in your mind ok this is this may be once one possible solution for a for this problem.

Solutions are where little bit more concrete in terms of a solution which may be sketched, it may be it may be CAD model. And products are purely minimum is CAD model, 3 model and then it could be virtual model and it could be physical product also testing also, ok. So, these are products. So, it is a; it is also it is a creative process that requires creativity. So, idea generation is a phase in which we generate a lot of ideas and it requires creativity and.

So, what is creativity? Creativity is a process by which a person or an agent generate ideas that are both novel and useful which means that in creativity we generate it will go to help a

person to generate ideas and solution. However, there are two things there that is one is this creative ability. A lot of people may have creative ability, but until they do creative activities they will not be creative right. How can you measure creative? How can you say that it is creative?

So, we have to actually solve a problem find a solution and it should be novel and useful novel is something which is new and useful as it should be societal useful. So, ideation or idea generation is creative activity which encompasses the generation, development, communication of new thoughts and concept which become the base of innovation.

So, creativity is important for idea generation and idea generation is one thing which is very important is a part basically for innovation to make something innovation. So, there is something called innovation and invention; invention something new and innovation is where you apply and make it something which is going to be useful to the society.

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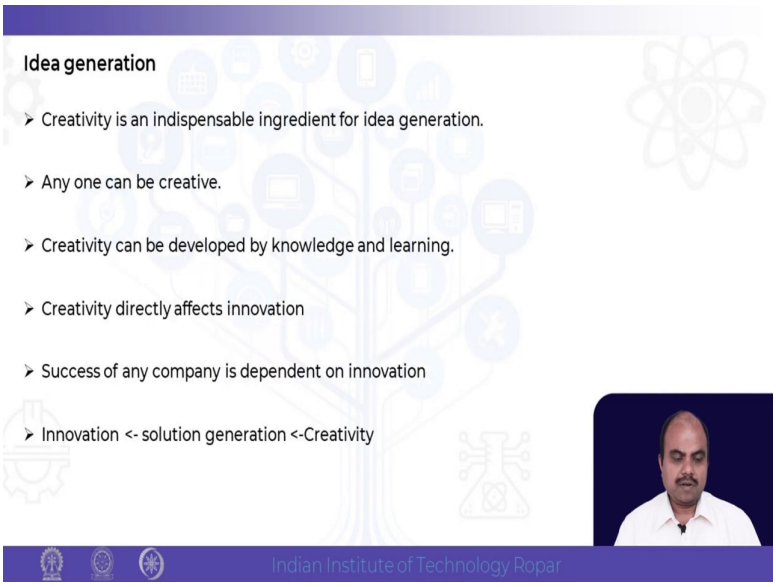

So, when we talking about idea generation creativity as it is indispensable for an ingredient for idea generation and anybody can be creative, ok. Do not think that ok your friend or colleague has done this creative work so, if he is more creative with actually internally we try will not know what is creativity right how much creative we are.

So, researchers has found out that if you practice use methods of creative methods are there brainstormings and active this idea generation then (Refer Time: 04:11) thinking then also group discussion. This there are several methods are there. So, all these methods are basically helping us in generating lot of ideas which are which some of the methods we are going to learn in this lecture itself.

So, anybody can be creative and try to be more creative as much as possible. Creativity can be developed by knowledge and learning which means that creativity if you say that I wanted to

design a aeroplane and I want to show my creativity there until unless somebody's knowledge which is difficult right.

Whereas, if you start designing small products which you very which is confident and you know the technologies of this take for example, you start designing some kitchen utensils start designing some mechanical systems, mechanisms ok some kind of small robots and then use Arduino to automate it and all these things.

So, this you have to learn also and this learning and knowledge is important to help us in generating ideas. Creativity directly affects innovation which means that innovation is important for sustaining the society for any business and creativity is important for this. Success of any company is dependent on innovation that we already know a lot of work has been done lot of research has been done I can also give a lot of reasoning for this, but this is not a focus for today's class.

However, success of any company as you know it is important that they are innovate innovative, continuously innovate, new product they; product they innovate. So, any company you see the Samsung you see there are innovation innovate innovation is there right.

Previous Samsung is to have this small mobile phone which is which is not touch screen ABC it will be written then then slowly we have this Samsung touch screen mobile phone now, we have this foldable mobile phone right. So, these companies are innovative they are in they are making lot of innovation and innovation not just about invention there are so many other things also there right.

So, invention; so, creativity is going to help in idea generation, solution generation that is going to affect the invention of or and that is ultimately you are going to have the innovation.

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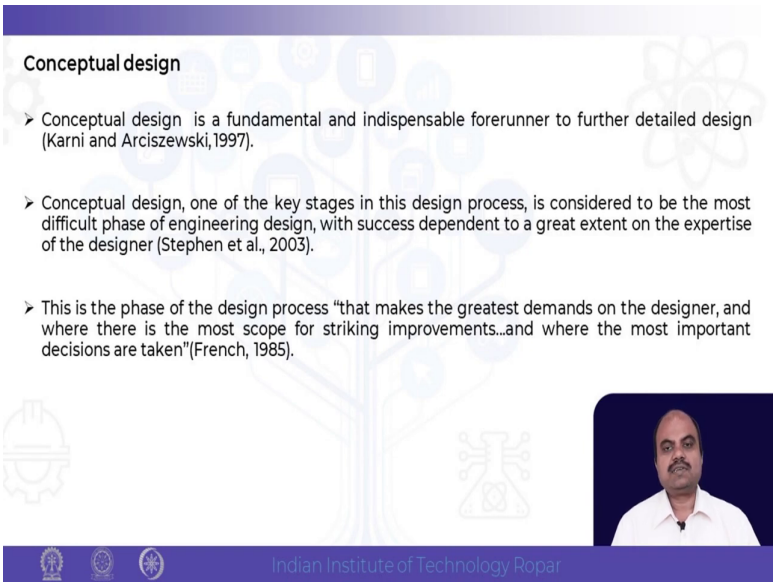

Now, there are a lot of research has been done in conceptual design there are many researchers who has told that conceptual design is important some of the; some of the research I am going to show here, but more research is can also be also be found out in the literature.

So, conceptual design is a fundamental and indispensable forerunner to further detailed design which means that if you think that detail design is important and ultimately you have to make the product conceptually design would give lot of importance because conceptual design is going to affect your detailed design.

And this is true for across from the student level project to the company level project and we want multi billion dollar bigger projects also. Conceptual design and yeah the previous statement was done by Karni et al in 1997. So, in Stephen et al in 2003 they are telling the

conceptual design is one of the key stages in the design process is considered to be the most difficult phase in engineering design with success dependent to a great extent on the expertise of the designer.

Which means that it is difficult phase because, the solutions are not straightforward right. New ideas are need to be generated. So, it is one of the difficult phase and experience designers are required for this. So, it is not the novice designers cannot do, but they need to understand that the lot of factors which are going to affect the success of a any design process especially in conceptual design.

So, experience knowledge of designers is play equal to play an important role. Then French in 1985 he expressed that this is a phase of product design that makes the graded greatest demands on the designer and where there is most scope for striking improvement and where the most important decisions are taken.

Again French is telling about the importance of conceptual design here we it is demanding for the designers to think what kind of solution we need to find out which is most suitable and also satisfy all the factors which are related to the product design specification that we have already learnt right.

There are so many factors we need to take care. And even after taking care of all these factors we are not 100 percent sure that the customers are going to like this right. We also we also do not know when the company is doing parallel in a innovation other companies are also doing innovation.

And now what is many companies even if they can even take and purchase some products from the foreign market and maybe modify them and try to sell it right. So, things are not that straightforward and that is the reason we have to be very very focused and innovative in the especially in the product conceptual design stage itself.

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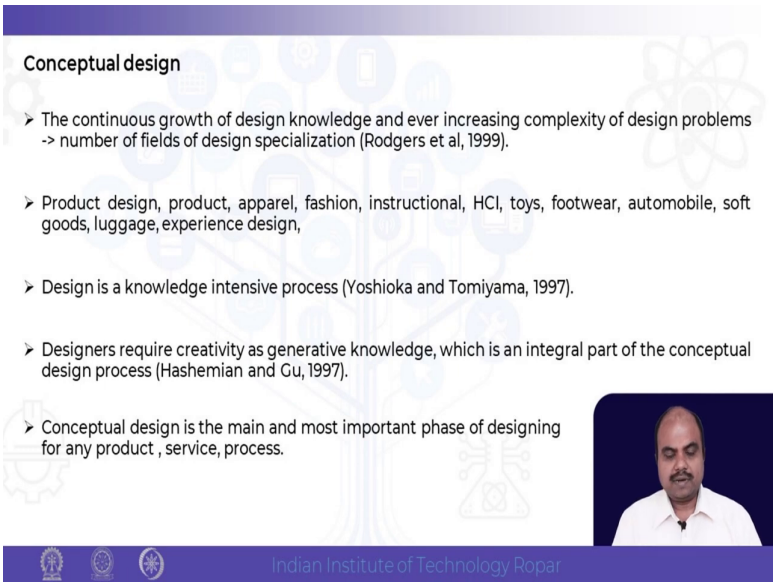

Rodgers in 1999 Rodgers et al they tell the continuous growth of design knowledge and ever increasing complexity of design problems and that is going to that has really generated lot of fields of design specification specialization. So, what does that mean probably that there are so many design knowledge is coming you can see nowadays people are designing footwear, people are designing car, people design automobiles, luggage's, soft goods, experience.

There are so many different kinds of products they are designing, people are designing, components companies are designing. Apart from there are also know that experience design, design of HCI, design of toys, the variety of designing and that is required there are number of areas, new areas of design and design specialization.

So, there is no like you know this is exactly required for this kind of a specialization. So, there may be some differences in in terms of the requirement for this. Of course there is some

general flow of problem solving across the design different discipline. However, we should understand that there is there are lot of differences in the focus.

Like you know there are some designers who will be focusing on soft good design, luggage's, experience design and some people will be designing computer and some people will be designing the in the mobile itself, there are designers who are going to design the outside casing of the mobile, there are designers who are using the GUI. There are also people who are designing or each and every like when you click a app what is going to happen? Ok.

What is the first thing that design the users are going to see? What kind of buttons one should use? What kind of icons one should have? So, there are varieties of designing which are required for each and every product which we have. So, design is a knowledge intensive process. Designers require creativity as generative design knowledge which is an intricate part of the conceptual design process.

And conceptual design is a most main and the most important part of designing for any product or services. So, what you see here this time and again there are various researchers who are talking about the importance of conceptual design.

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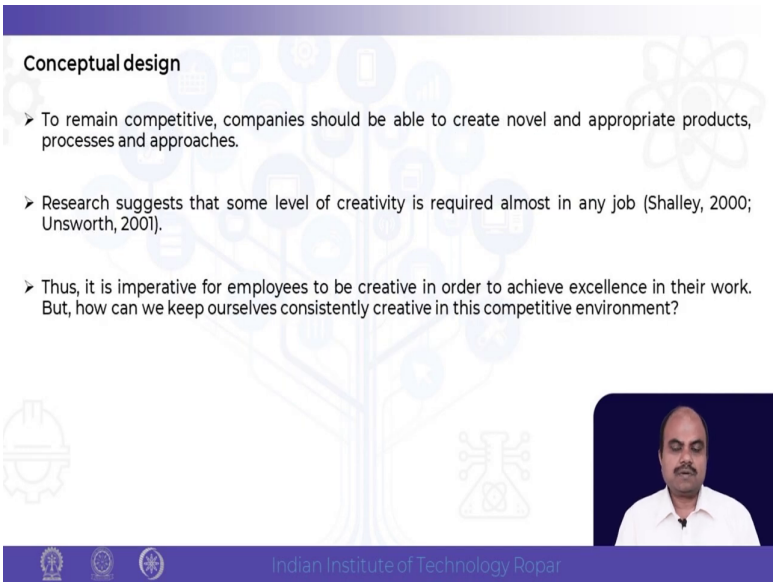

So, to remain competitive, companies should be able to create novel and appropriate solutions, appropriate products, processes and approaches. And research suggests that some level of creativity is required in any job and not only for conceptual design, but any phase of design creativity is something which is very important.

And this is why it is imperative that companies to we create even order to achieve excellence in their work. So, it is not that manufacturing people do not require creativity, they also require creativity. They also need a need planning. But how to keep our say consistently creative in this competitive environment which is very important to understand.

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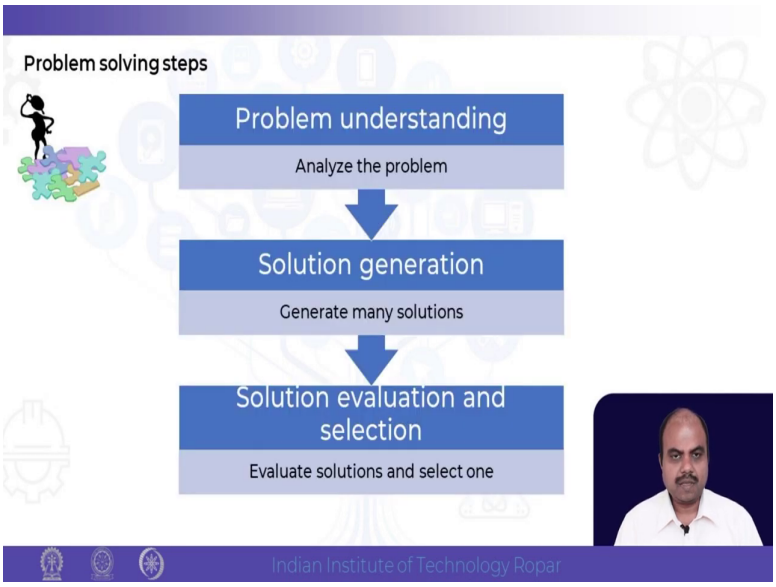

Now, we are going to the problem solving stages, steps. In this slide we see that problem understanding, first is anything else we have learnt about problem understanding, how to analyze the problem.

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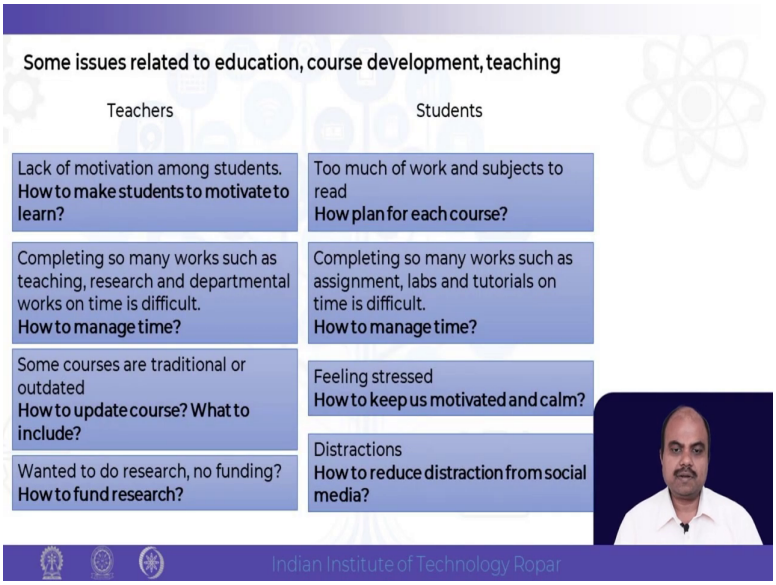

There are methods, methods are there and we try to find out what exactly the problem is and the solution generation, solution generation we generate lot of solutions right and this is what we are learning now in this lecture. Then solution evaluation selection we are going to learn later on that we are going to evaluate the solution for the right kind of product design specification and the requirement of the customers.

And select the best one or best two and make the prototype and then find out the best one and then go for only one solution of this process. If required for the next problem we will do this, I can do it again right. So, when you are talking about 3D problem solving the generally we our mind generally think that ok 3D problem solving what kind of; what kind of problem which you which we are facing and what kind of problem do require creativity right.

So, if you see that there is a beam and you keep some few weight some particular weights and the 50 kg at the end of the beam and this one beam is going to be locked and then put the force and find out what should the deflection. This is very specific engineering problem. So,

if a group of designers solve this problem and find out deflection another group of designers you want to solve the same problem most probably they will have the same kind of solution.

Whereas so, this is very this is the and there are a lot of problems which we come across which requires very specific engineering knowledge and the solution of them will be same or very similar irrespective of the which group they are which we are using. Because it is very mathematical in mathematics involved analysis involved. However, there are certain problems which is like you know difficult to define sometime and it requires creative understanding of this things.

So, in terms of education let us take some examples where we see the problems are very open ended like you know lacking motivation of the students how do you make student to motivate to learn this is one of the challenging problem for any faculty members of any good engineering college sometime you will see the students some students who sit in the front of the class they are very active and then some of they not. So, how do you motivate everybody?

And then completing so much of many faculty members any task is very important all this teaching, research, departmental work and managing time is difficult. So, for any faculty member in in top engineering college in India they find very difficult to actually find out time for doing all these things teaching which is very important, which is minimum thing which we need to do, but apart from research, departmental work.

So, so how do you manage time for all the all of them right. Then if you somebody some faculties are new some faculties are maybe multiple years they are you know in organization in institute they may find that some of the courses which has been taught before are need to updated need to be updated. So, what updation is required what to include and what not to include because time again for the lecture is limited right you have so many number of classes, so many number of weeks.

So, what exactly you will do? Will you which portion of the syllabus which will modify. So, this is again a difficult task to decide and this requires some kind of not only just planning it also need to need to think a little bit more. Then funding nowadays any organization for any

top level IISc, IITs and NITs and other top government organizations many of the faculty members are more inclined to research and publications.

So, further funding is required how do you get funding. However, this kind of problem which is there for the faculty members are little different from the problems which is there in from the students, but they are also having a lot of problems as some of them are similar some of them are little different.

So, from the student point of view if you see that the problem like you know too much of work and subjects to read. If you ask any 1st year, 2nd year student as a student if you ask are you happy with the number of courses which you are taking. They say this is something will say there are so many courses there are 6 courses they have take and there are course assignments, tutorials so, but they need to give importance to all the courses ok almost not always equally, but depending upon some kind of logic which they can use.

So, it is not that you know it is difficult to plan for these courses. Then there are also assignments labs, tutorials, online lectures sometime, offline lectures, then that visit labs also, do some exercises. So, again managing time is something which is difficult for the student how do you manage time. And sometimes students feel stressed so how do you keep them motivated?

How do you keep the students motivated? How do you keep themselves motivated and calm? Because so many so much stress is there. Then distractions this is one of the; one of the most common thing which is there for the student distraction. Nowadays many students are getting distracted. So, the question is that how do you have stop themselves from distraction from social media.

So, sometimes social media may be useful, but not always right there is a limit for that how do you going to make things working.

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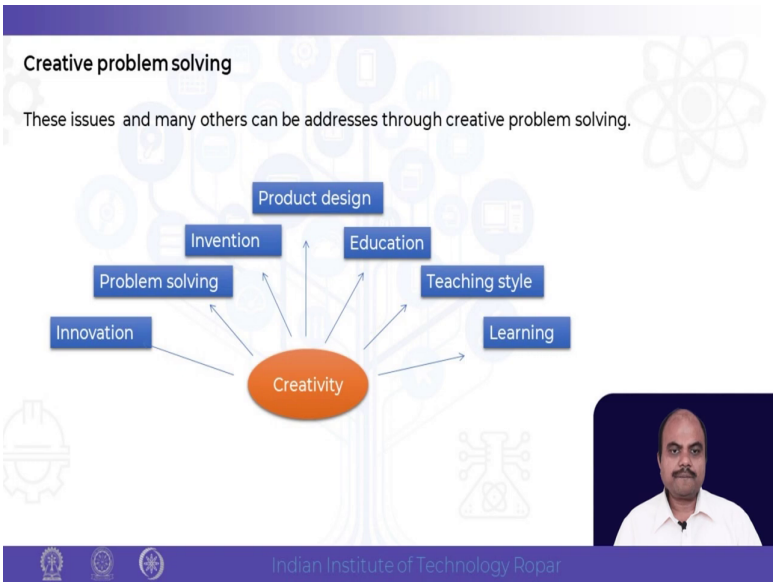

So, now so, all these problems which you see that these are there is no straight forward answer right I am I was talking about the beam example where irrespective of the group which they want to solve the solution the values which you going to come is almost same sometime is exactly same, sometimes a little bit different because of the other reasons.

However this problem which just now I spoke this is not a straight forward if you give two different groups the people having different ideas solutions are different right. So, what is required is creativity and creativity leads to innovation, it helps in problem solving, it helps in invention, it helps in product design, it helps in education, it helps in product teaching style, it could be used in learning also so, all these things are important for creativity.

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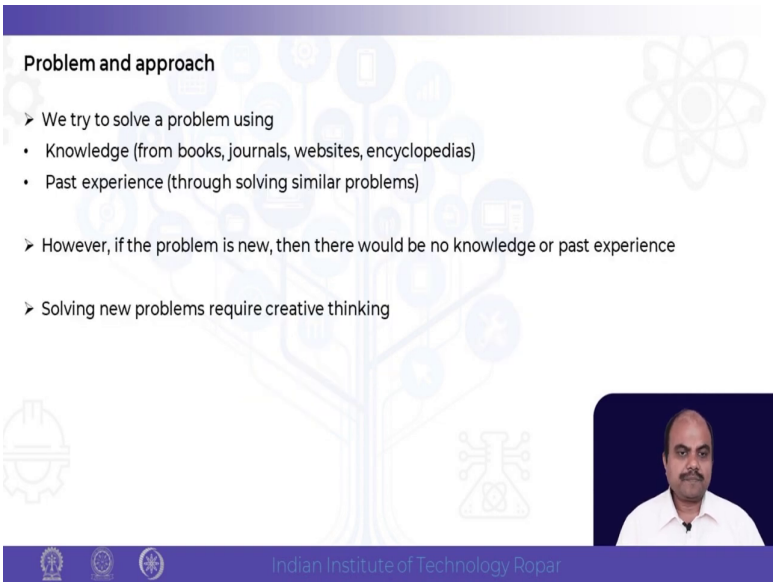

Next is now we are going to think about solving a problem. When you try to solve a problem what we should do? What is the best approach? There is no one side is fit all it depends on the type of problem which you are having type of company? Which you are working for and also group which you have? So, the first thing is coming out of mind is that you we can take the problem and to solve it and knowledge we gathered the knowledge from this existing solution.

Can we solve this problem? If it is already solved can we take it from the available resources like books, journals, website, encyclopaedias. So, some problems we can solve easily using the available solutions. Past experience; so many designers may have experienced designed maybe a water bottle and again he has to design. So, he is going to experience the past knowledge, somebody would have designed casting machine.

So, they have experience, so, they are going to use their experience to make another casting machine. So, this is going to be useful for those people who have experience. However if the problem is new so, neither the designers nor the experience people can have you have to generate new ideas. So, no past knowledge is there, no experience is there so, here is a place where creative thinking is coming in a real requirement that is creative think is required.

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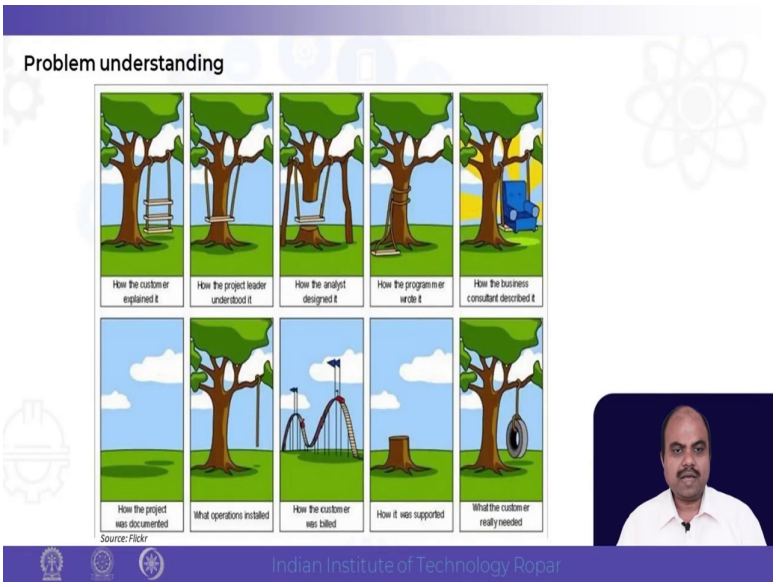

So, when you have a problem understanding you will see that for creative solution first of all the problem understanding which we have already seen. So, problem understanding is where you understand the problem nicely. So, when we go about understanding the problem so you should see that we have understood the problem very nicely because our mind is getting influenced by the people by their own knowledge.

Like in a customer; customer if you see this image customer is explaining this way, project leader understand that way and it is somebody designed it in some other way. Programmer is going to write. So, people and then business consultant they are going to make it a bigger way, in a very different way.

So and billing section will build high. So, in the customer really need is just a simple solution. So, different people it is not just always there they are not interested solve the problem sometime their own experience is going to influence their solutions.

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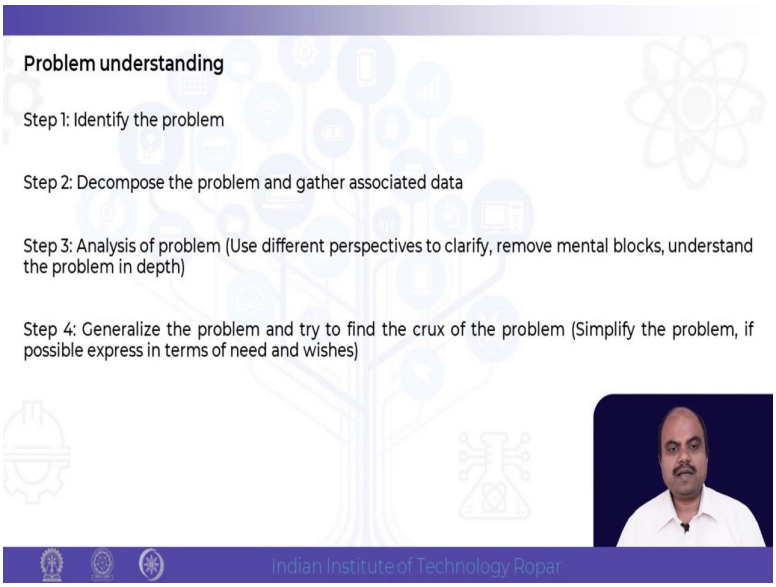

So, when you have problem understanding especially in conceptual design. So, first thing is extremely important that when you after identify the problem a decompose the problem and gather the associated data. So, so problem whatever is there we have to find out the sub

problems and gather the data and analyze the problem use different perspective to analyze, clarify and removing the mental blocks understand the problem in depth.

Then generalize the problem and try to see there is some commonality and what are the crux of the problem and can it be expressing in terms of needs, wishes. Needs means what is exactly required by a user, wishes are what if it is there the customer feel more happy, but it is not there then also the product is going to serve the requirement of the customers.

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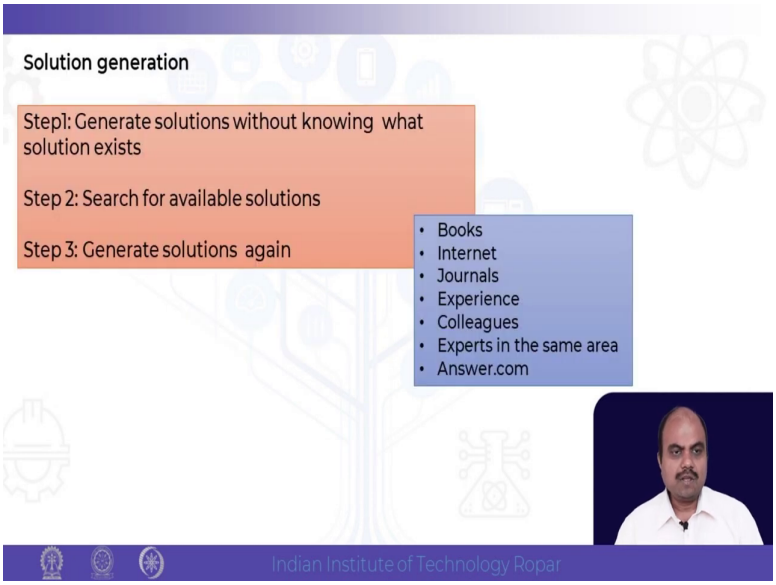

Solution generation there are several ways to do solution generation first of all it is better that we solve the problem without knowing the solution exist a solution, then we will get a new and just new solutions because otherwise you will get influenced. Then search for available solutions and that can be done from books, internet, journals, experience, colleagues you can

ask experts you can ask and there are so many websites are there where you can ask also. And generate the solution again.

So, this is going to help and for generation with a lot of methods are there some methods we are going to discuss in this lecture. However the generation is important and we go and generate a new ideas and then we go to the next phase is the solution evaluation and selection.

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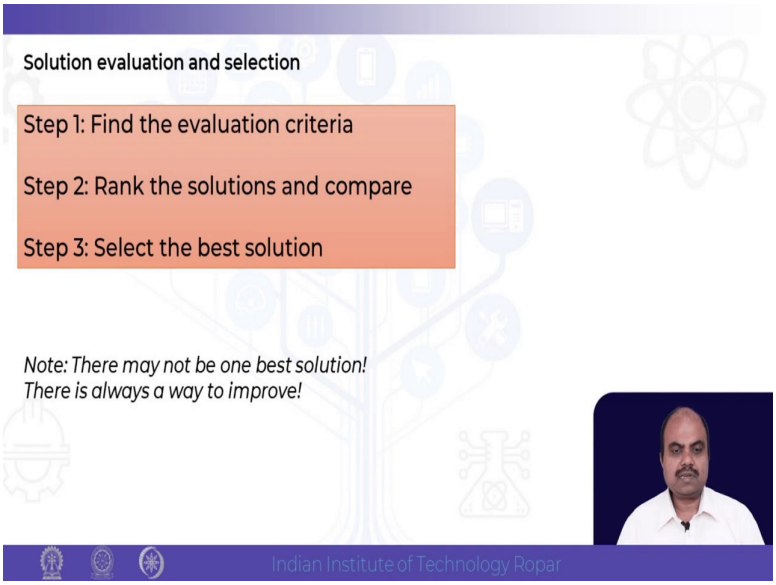

So, in solution selection and evaluation solution evaluation and selection the first thing is we have some evaluating criteria and how we are going to have this criteria we are going to take some of the criteria which is which are there in the design problem understanding that is product design specification and the rank the solutions.

So, when we have the rank we are going to; we are going to have a ranking method and then ultimately we are going to select the base solution. So, more details will be there later on and there may not be the base solution there may be way is to also improve it is just that we are going to tell this is the solution, this is one of the solution which has been found out.

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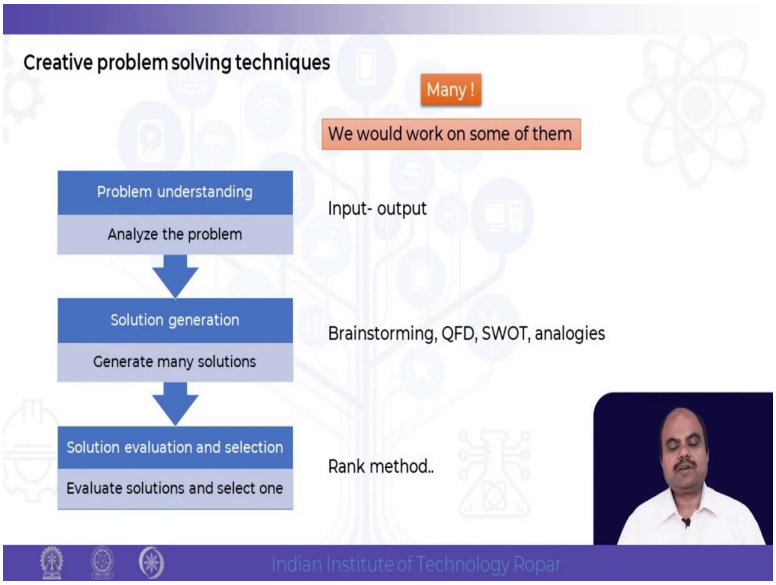

So, now coming to methods there are several methods, many method not only several there are many many methods. Most of the methods are focused towards problem solution generation. However there are also methods like input output analysis for problem understanding, QFDs are there SWOT analysis there, for solution generation, for rank method, rank method is there for the solution evaluation there are so many methods which are available.

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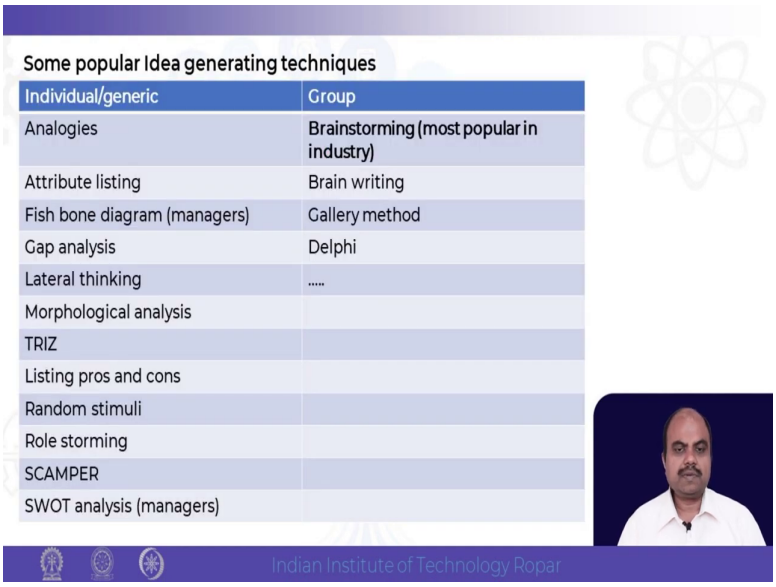

So, some of the methods I have listed down in this slide analogies. If found out the analogy between this problem and another problem I try to get some idea from this. Attribute listing this is what is the attribute of this of this problem. Fish bone diagram this we are going to detail work on. These are mostly used for managers by managers who try to understand what exactly the main cause of a problem is.

So, cause and effect analysis is with done gap analysis. So, is mainly used for researchers. So, find out the gap of and research area, find out take the literature, find out the gaps and then try to do research on those gaps. So, that it will have a more impact on the understand knowledge gap.

Lateral thinking is another way of style of thinking, then there are morphological analysis Triz Theory of Inventive Problem Solving made by Altshuller there the idea is that he actually

he made a lot of analysis of the patents and then find out some solution, find out a method. So, this this method is very really very good method to use.

But this is also it is difficult method long time process time is required and is mostly suitable for highly technical problems. Then list is list pros and cons. Pros and cons is what are the advantages, what are the disadvantages of this of any product and then try to reduce the disadvantages and modify it and those things.

Random stimuli there is another interesting method where research is found sometime when the problem is very difficult and you put random stimuli to the designers sometime not always they have they can find really innovative solutions. So, this method is very very innovative; however, it is not suitable for all the I mean it is a very difficult to predict also what kind of solution we are going to find out.

So, lot of research is being done in this area. Role storming; role storming is where you imagine somebody as a role playing for some somebody as a customer and then you find out solution. Scamper this we are going to discuss more on this. Swot analysis is again used for manager's strength weakness opportunity threat.

However, in the brain storming is one of the most popular methods in group I was some people somebody small groups also can be used it use this we are going to work on this brain storming method we are going to use this brain storming method in this course. Even though brain storming method is found that sometime it does not give a very specific solution.

However across industry they are going to use it and people are going to people has found that this is one of the most widely used technique and its and its often useful also. Not only it for technical solutions, but managers are using for even solving non-technical problems ok.

And solutions which are does not require any technical effect then also the people have found the brain storming is helping solving a problem. So, it is really popular technique we are going to learn this. Brain writing is where you write your ideas and then generate solutions.

Gallery method is where you we can take solutions generated by difficult different people and put it in like you know sticky note in the gallery format and then you discuss each other's idea and then generate another form of brain storming, but a little different. Delphi is where you people use experience designers and experience people this one. So, many of these techniques are there we are going to discuss some of them all day.

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