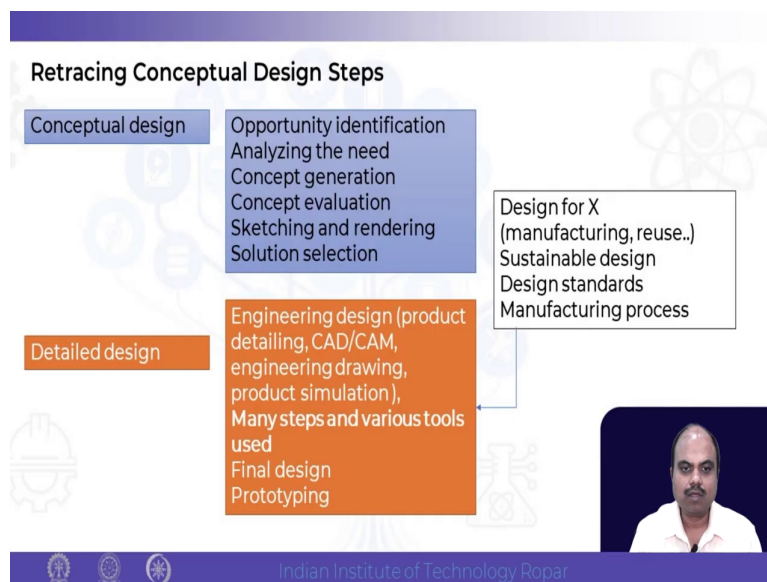**Product Engineering and Design Thinking**
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**Module - 01**
**Introduction and Prelims**
**Lecture - 04**
**Conceptual Design**

We will be having little bit of discussion on Conceptual Design. And then we are going to discuss about problem identification.

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So, whatever has been discussed, retracing the conceptual design stage steps, the first is opportunity identification and then analyzing the need and concept generation, concept evaluation, sketching and rendering and solution selection. Detailed design, engineering

design and then there are also other steps which are involved in product design, in detailed design. These are the basically the conceptual design stages.

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So, when, what do you mean by concept? The concept in conceptual design, when you have conceptual design, it is the need of the target is being identified and alternative with the product, concepts are generated and evaluated. And what are more concepts are being related further for the development and testing. So, what is the concept? A concept is a description of the form, function and features of a product.

Detailed design, we have already discussed that when we discuss about and identify the materials, then information, geometry other things. Then consumer need identification. Consumer need identification in consumer need, it is a process of identifying the and

determining how the consumer wants a product to perform and the customer needs are non-technical it could be.

And from there we have learned that how we are going to convert to a two more kind of technical specification that is called design specification. So, in this the outcome of this stage is a list of needs and wishes, needs are basically which is actually need of the user and the wishes are that is good to have ok.
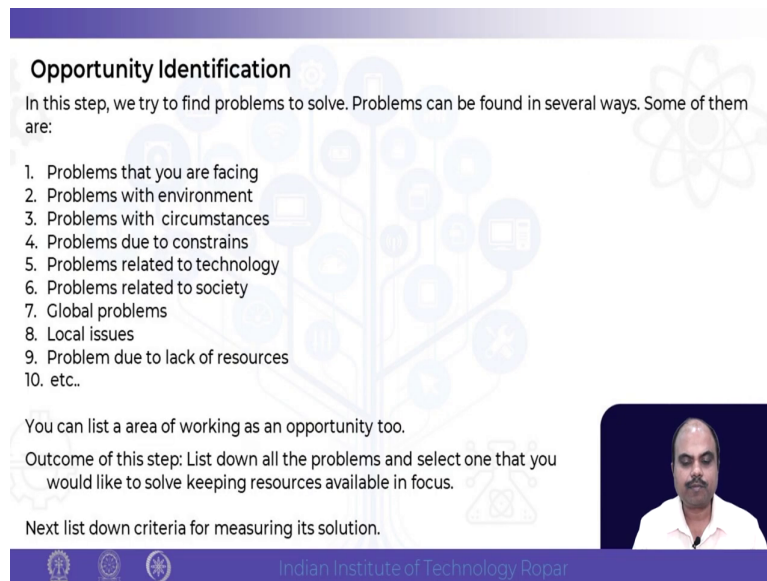
So, a lot of examples are there in the in this aspects and then product specification, product specification means technical document.

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So, in conceptual design the first thing is about opportunity identification.

There are several ways you can identify the opportunity where taking a problems that you are facing, what kind of problem which you are facing like in the students, they may facing with the hostel, maybe the mess is not giving them good food or maybe it is dark in to work from the classroom to the hostel during the night time.

I have problems with the environment, environment is very sometimes it is hot, sometimes it is cold and what is the things we should do and what is the best way should we should do. These are the problems which we are having. Problems, circumstances, circumstances means take for example, somebody has missed the for the student level, somebody has missed the attendance. So, what can be done and then circumstances like sometime there may be some examination got delayed and it is very near to the another examination or in the same day.

So, these kinds of circumstances are also there. Then problem due to constraints, constraints are time is one of the biggest constraint, students may not have time to study all the subjects equally in all the days and so that can be a constraints. There may be other constraints also that family constraints will be there; many people are having to travel from one place to another place to come to the college that can be another constraint.

So, I am trying to give some examples of students and in academics, but it could be for applicable for any of other areas also. So, problems related to technology, technology means if you see the technology means there are so many technologies which are available. So, somebody may have a tablet, somebody may not have tablet, somebody may use laptop, somebody's a laptop may be old. So, there can be issues with the with the technology.

Somebody may do not may not have a good mobile phone. So, those things are the problem with technology. Even technology sometime we would like to have certain technology which is not available right now with us that maybe automatically should be the recording should be there in the classroom. So, those kind of technologies maybe we expect to have, but not does not have that easily.

Not the technology not there, but those things are not accessible to all of us. The problem related to society. Society there will be so many problems which the students will be facing. They will be facing about what kind of issues in society there may be. There maybe some people who are not good in the society problems take for example, like students may be going out at the night.

So, and that is not acceptable in many many times. So, this can be problem. Global problem; global problem is like climate change is a global problem. The security is a global problem, food security is a global problem. Local issues, local issues like take for example, some cities may have very high emissions then; so that can be some of the issues. Then lack of resources is another big issue.

So, what is the thing is these are the some of the kind of ideas which we can explore to find out the problems which you need to solve. And you can list down the working as an opportunity too and outcome of the steps, list down the problems and select one of them which is which can solve and keep the resources available. So, next is list down the criteria for measuring the solution.
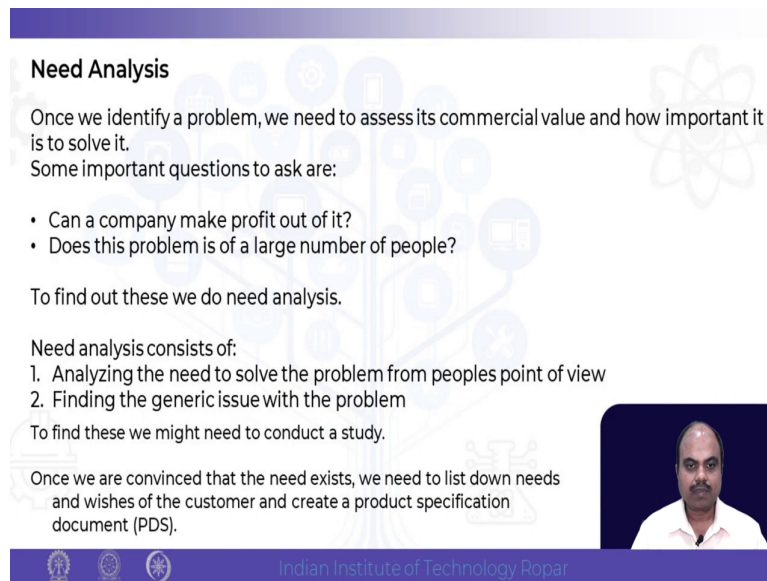
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So, now we can have exercise on this one and see what kind of solutions are coming for a particular problems.

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So, now need analysis. Once we identify a problem, we need to assess its commercial value and how it is important to solve it. So, can a company make profit out of it and does the problem is for larger number of people and to find out we need to do need analysis.

So, analyzing the need to solve the problem people's point of view and finding out the genetic issues of the problem and to find out we may need to contact a conduct a study and once we are convinced with the need we can list like you know need and wishes.

So, need and wishes take for example, in the for a like take for example, in a laptop, students laptop what are the needs. Need is that one should be able to record the one should be able to do computational work or one should be able to type the things. One should be able to view the videos which are shared by the by the by the college faculty.

However, these are needs. Wishes are what are the wishes like you know sometime (Refer Time: 07:57) and many think ok I wish that my laptop will be having big screen. I wish my laptop will have 5G connectivity and I wish my laptop may have something like 2TB hard drive. Those things are wishes is not required. 500 GB hard drive is also fine. 2TB may not be required.

Somebody may have a very high HD display screen or full 4K display screen. That may not be required for a student right. So, those are all wishes. So, we have need and wishes. So, the product must satisfy all the needs and may satisfy the wishes. However, people purchase a product not only just for wishes.

They also purchase products which are satisfying the need we are sorry those who are satisfying the need only, but apart from that people also purchase products which are not only satisfying the need, but also the wishes. So, good to satisfy the wishes, but the wishes need to satisfied later first is the need of the product should be satisfied first. So, now if we wanted to identify the problems and the first thing is identify the aim of the study.

So, take for example, I wanted to understand what is the need of a laptop in a student's area. So, then the first thing is the aim of the study is to understand the need of a laptop what kind of specification we should have, what can laptop student need and that can be done that is the aim of the study and what kind of student population we are using. Then gather of the data.

Gather data means there are various ways which you can gather data like we can ask the students or the students we can ask face to face telephonic, computer assisted. Now it is computer assisted lot of data is being taken. There are observation studies. Observation studies means where we observe the students and see what kind of work, they are doing.

So, they may be taking notes in the class, they may be doing some assignments, they may actually sometime maybe during the off time they may watch movies. Also see something which is something which is they can learn some of the courses online in YouTube, they can learn and NPTEL, they can learn ok other courses MOOC courses they can learn. So, these

are the things which one can actually understand if you wanted to understand the need of the students you have to do observation studies.

Interventional studies; interventional studies means the designer or the person who is looking for a solution they actually mixing the group of students. So, they act as if he or she or she is also student and then do the activities of the students from the morning to evening multiple days and then see what kind of things they need what kind of questions they ask what kind of problem they are facing.

And then the next thing is also literature search. Literature search is maybe there are some other people who has already done this studies, published in some kind of some journals or conferences or books and there we can refer those books and identify what kind of need they have identified for the students for this particular product.

Another thing is questionnaires that is nowadays very common. They make a questionnaire take away take by them will asking, what kind of laptop you need what are the specific and those things and give it to the students. Then we are going to get gather data more data is better, but it is sometimes not possible to collect lots of data. So, we need to use statistical analysis to find out how many participants we need.

Then we will take the data analyze it, we can put in a spreadsheet we can put it in other ways you can do the software also there are so many software are available for analysis data analysis and then some are here trained analysis we can do statistical analysis you can do.

So, maybe there some maybe some for laptop maybe the trained analysis may not be showing anything, but take for example, somebody wanted to design a you know kind of bicycle for students. So, then the use a statistical usage trained analysis will be depending upon the type time some time requirement will be high some time requirement will be low.

So, this kind of analysis can be done. The summarization need; summarization need means all this needs you are going to summarize categorize into need and wishes and then we are going to understand what exactly the students are going to need. Then express it express it as I told that need and wishes.

So, need of the need for a laptop for the students we can list these are the needs, these are the requirements which need to be satisfied. Then wishes are this are the wishes which need to be satisfied by the user which means the here it is the students number of students. And then once we have this is going to get we need to convert into product specification or product data specification and that we are going to learn little later.

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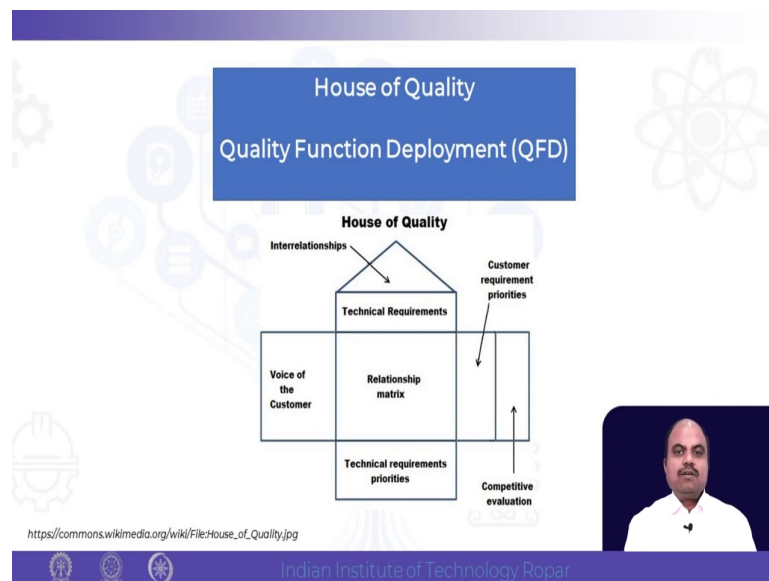


House of quality or quality function deployment. To understand the problem in depth especially to identify the requirement of the customers and also to make and convert these two technical requirements, how is the quality or the quality function deployment is one of the method technique which is company used. There are of course, many various other techniques this is one of the technique which one can use.

So, quality function deployment quality function deployment is a process used to define customer requirements and convert them into detailed engineering drawings engineering specifications. QFD is used to translate customer requirements or VOC that is voice of customers into measurable design targets and derive them from the assembly level through the sub assembly and component level production.

So, there are levels different one level 1, level 2, level 3. Today we will be learning about level 1 in more detail. QFD there is quality function deployment was first developed in Japan by Yoji Akao in late 1960s while working for Mitsubishis shipyard. It was later adapted by many companies especially Toyota and especially for the supply chain.

So, why this is used often customers tend to express their likeness like you know mobile phone or camera or laptop they want something like looks good then fast acting for something

like remote should be ergonomic. But for companies this kind of little bit slightly vague statement is difficult to actually make a product out of it. So, they convert this into quantitative requirements and QFD is going to help in this regard.

So, it is a comprehensive house like structure it is having house like structure on it and that is the reason it called house of quality. Basically, manufactures and production faculties can use this quality assessment and for also prioritizing the need and technical details.

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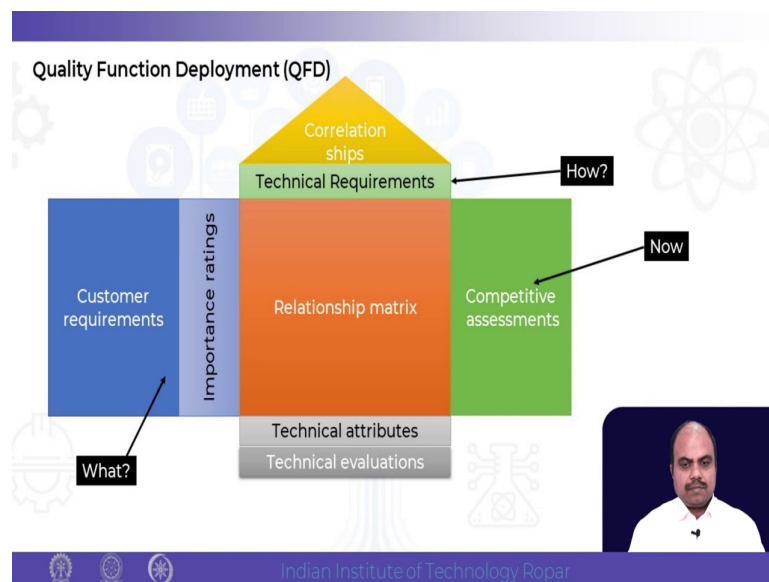


So, first thing is in the since in the slide that QFD the first thing is the customer requirements. There are multiple requirements of the customer list down them you will see in the in a short while a complete example of this one. Then these requirements which are given by the customer is ranked in terms of importance ratings.

Then the technical rating or a requirements, technical requirements is a requirements or the technical specification or technical terms which are there with respect to the product which you are trying to analyze. Once we have this technical requirement we are going to list it down and then we are going to have a relationship matrix we learned about this metric now.

After this relationship matrix we will have a also a correlation ship between this matrix between this technical requirements and how these are related to each other; how this are influencing each other. Apart from this, we will also have competitive analysis in the right and down the technical attributes and ultimately we are going to have technical evaluations. So, if you say the customer requirement is what?

Technical requirement is how? Competitive assessment is now and ultimately the technical attributes are what we are going to do later, what we are going to get the actual attributes. So, let us take an example. Let us take a bike design. So, when you when you try to find out the requirements of a bike the mind of the user the user is going to tell various requirements in terms of qualitatively.

So, customer requirements can be some something like they want speed, high bike speed in their bike; if you do fast, you should have good mileage because most of the customers are college graduates or recently who got job. So, they want mileage is very important for them. Cost is also actually very important another term is here which is important the maintenance it should be low maintenance.

Now, if you wanted to convert this so, we have to convert this into importance rating. So, importance ratings is take for example, you ask the customers there what should be the most important. The most important is mileage. Next main importance is out of 5 basically.

So, you can get 5 out of 5 is mileage speed is 3 out of 5, cost is 4 out of 5 and because cost is also important and maintenance because people know that now a days maintenance some not that very big deal; I mean many of the bikes new bikes there may be various maintenance in a

low. So, they may giving it 3. Now, this is the importance rating. If you want to convert this into percentage you total it up is coming to 15.

So, (Refer Time: 20:00) so one is high one is low and 5 is high. So, if you want to convert this into percentage so, 3 divided by 15 into 100, it comes to 20 percent. Similarly, 33 percent, 27 percent and so on. So, this is the relative importance of the customer requirements. So, now we start making this house of quality. So, now we draw a this line straight lines template kind of thing, we put the customer requirements.

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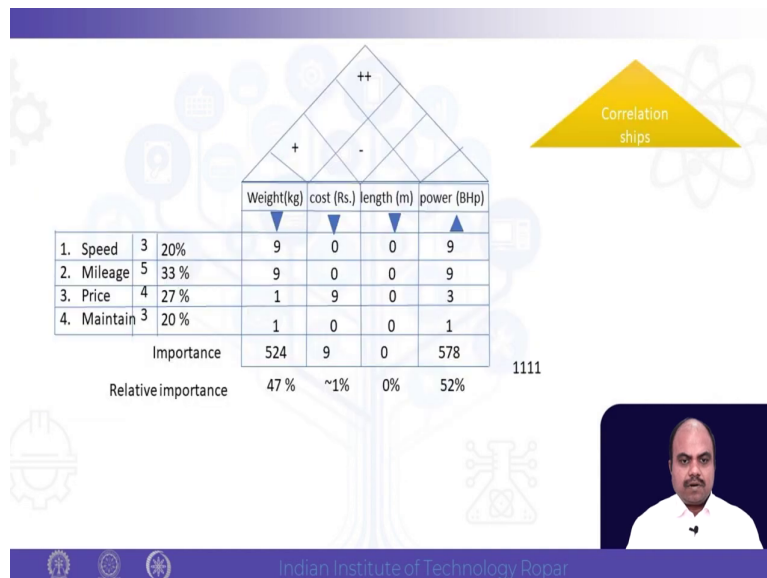


And then importance and then we are also when we have the customer requirements, we are going to put speed mileage price and maintenance and percentage 20 to 33, 27, 20 like this and the technical requirement is weight. Weight is the vehicle cost; length may be another technical requirement and engine power there will be another thing.

And then next thing is we have to also understand that what is our goal in terms of design, ideally the weight should be low as low as lower as low as possible certain So, (Refer Time: 21:35) to reduce it. Cost we want to reduce it because there is more customers are going to buy it.

Length you can increase or decrease you can say here decrease in engine power. We need to increase the engine power so it should be more. So, now, if you want to have the importance so, take for example, the speed is there is 3 and weight with respect to first is we will make the correlation ship. Correlation ship is plus plus is highly correlated and influencing positively.

Minus is less and minus minus is the negatively correlated. So, influencing negatively. So, now if you see that this is again based on little bit of experience is required to make this one. So, cost and so, cost and weight. So, generally the weight is increased cost is going to sometime increase because of the material cost is involved.

However, cost and length sorry weight and power has relation because more weight it will require. So, if the weight is increased power requirement is also going to increase and cost and length is minus. So, all these things you can do this as some of the exemplary, exemplary, relationship between this, but it depends upon the different product to product.

Now, when you want to convert weight and now you are going to put this matrix and then weight if you see that in terms of speed the relationship between weight and speed means it is very high, 9 is the 10 is the highest, 0 is the lowest, 1 is less and 3 is in between kind of. So, weight and speed; so, weight and speed means so, these are these are related to each other and it is going to get influence and similarly weight and mileage cost and speed that is not much no relationship is there among them.

So, similarly we will put all the data as per our understanding of the product and then we are going to multiply. So, 9 into 20 plus 33 into 9 plus 27 into 1 plus 20 into 1 that is 524.

Similarly, we are going to multiply with the importance weightage and we are going to get 524 9 0 and 578 power under power.

Now, now if you total this it will come to 1111. Relative importance into found out that is 524 divided by 1111 into 100. So, relative importance is 47 percent, next one is 1 percent, next one length is 0 percent and power is 52 percent. Just an example, I mean it is not that it is like you can change it according to the requirement.

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So, if we now see the new which is we are going to get in terms of the speed parameter hours the new vehicle which we are plan to make we are going to keep as 5 as speed and mileage is little less price is 3 and maintenance is 3. But the competitor they are also having A and B assessment of unbiased assessment of competitor.

So, you have to know exactly what is the speed is of the new vehicles which we are trying to develop. The competitors vehicle what is the speed and then relatively importance of this. So, here what we see here that we assess the competitors values also and we put values on this one. So, 524 like this.

Now, if you want to compare this, we will see that there is the vehicle which we are trying to make ultimately it is better in some sense for the competitor, but not in all sense. So, there are scope and improvement and the improvement especially in the in terms of price in terms of mileage.

So, this is where we have to we have to give more importance and similarly this is we have to also multiply and find out down of it the weight cost and other factors and the slowly we will be identifying the most important factors which are required technical requirement for this product. So, these are the competitive analysis.