Functional and Conceptual Design
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Lecture 11
Product Specifications

So, we will continue the discussion on customer need analysis. In the last class we discussed how we identify the customer needs, what are the methods by which we can identify the customer needs, and how do we convert the raw data from the customer to interpret that needs. And once you have a large number of customer needs, we need to do a little bit of analysis of these needs in order to make sure that we get the top needs identified from the analysis.

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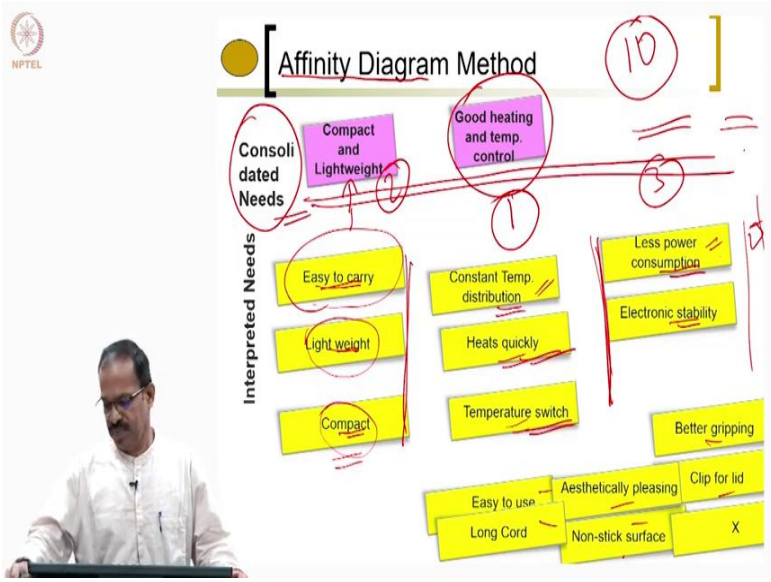

So, one of the methods we discussed for the need analysis was the affinity diagram method. So, in this method, what we do is to write down all those interpreted needs from the various customers. When you convert those raw data into interpreted needs, we will write down all those needs in this kind of post-it bed s

So, whatever you get from each customer will be converted to a post-it bed and then as a team, you will start sorting out these needs based on the affinity of each need towards a particular

requirement. For example, you see something like easy to carry, similarly lightweight, compact, so all this actually represents the same kind of requirement from the customer.

So we try to put all those things together and then find out what is the actual need given by these interpreted needs. Same way you try to take the next post-it beds and try to find out what actually there is in that, what is the interpreted need in that one. So right for example, you take constant temperature, you something have constant temperature distribution, and then you see something on less power consumption.

So since they are not the same kind of thing that we are getting, we try to make it a separate one. So this way you try to arrange all those post-it beds depending on the category, and then get all those categories that you can identify. So, for example here, constant temperature distribution, heats quickly and then temperature switch. These are all talking about a requirement of the customer, but it says that good heating and temperature control is needed for the product.

Similarly, less power consumption, electronic stability, this also talks about a requirement of low power consumption. And like this, you will be having a lot of other needs. So all those needs can actually be categorized, you can actually make another set of another group here and you can identify the need, the actual need that can be consolidated from the interpreted needs. So this way even if you have a large number of interpreted needs identified by the design team, you will be able to bring it down to a small number of actual needs of the customer.

So, probably you will be getting maybe 10 or 15 actual needs from the customers. So this is the requirement of customer need analysis from where you start with the raw data from the customer, and then this raw data will be converted to an interpreted need and then this interpreter needs will be sorted out and categorized and find out what is the consolidated needs that you can get.

And when you do this, you will also try to find out what is the importance of these needs also. So which need is the most important one? So this is again a decision to be taken by the design team, based on the information they collected from the customer, you try to find out what is the importance of these needs also. So, this way you will be able to say okay in this case probably

good heating and temperature control is the most important one and then compact and lightweight maybe the second one, then third one like that you will be able to get the important ones also.

So at the end of this analysis, what you are going to get is a consolidated list of needs along with their importance. So this is what is needed in the customer need analysis. So this is the first stage in the understanding, the opportunity where you start with the mission statement, then looking for the need for a product, you identify the need that is to be satisfied in the final product if you are going to make it.

So that is the customer need analysis where you get a list of customer needs with the importance of each need.

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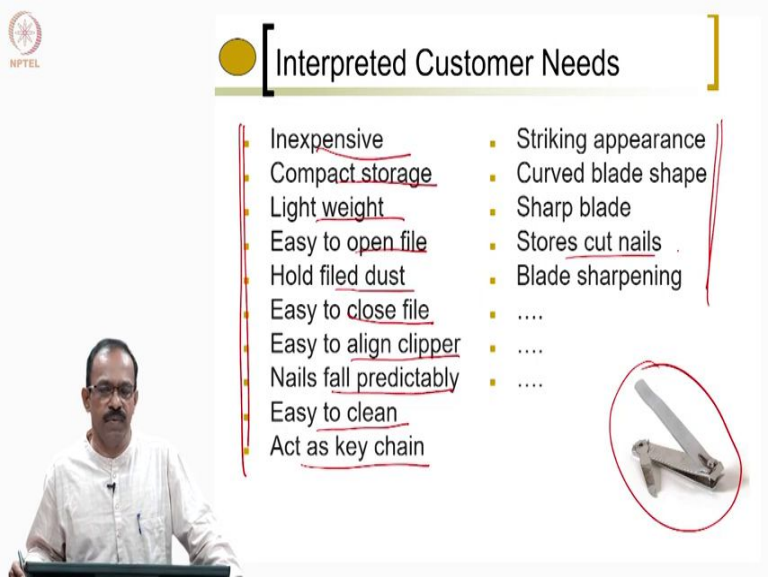

So these are some examples for interpreted needs or the final consolidated needs, for example, if you take this product of the nail clipper, you can actually do a lot of customer surveys like this like method or interviews or whatever the method, and finally find out the all the interpreted needs and then consolidate them based on using the affinity diagram method.

And you will be able to get this kind of needs that it should be inexpensive, it should be compact storage, lightweight, easy to open, hold filled dust, easy to close file, easy align clipper, nails fall predictably, easy to clean, act as key chain, striking appearance, curved blade shape, sharp blade, stores cut nails, blade sharpening, etc. So you can see, there are multiple needs that you will be able to see from the customer.

It is not necessary that you need to satisfy all the customer needs. Again, depends on the mission of your design project, as well as what is practically feasible by making a compromise on various aspects.

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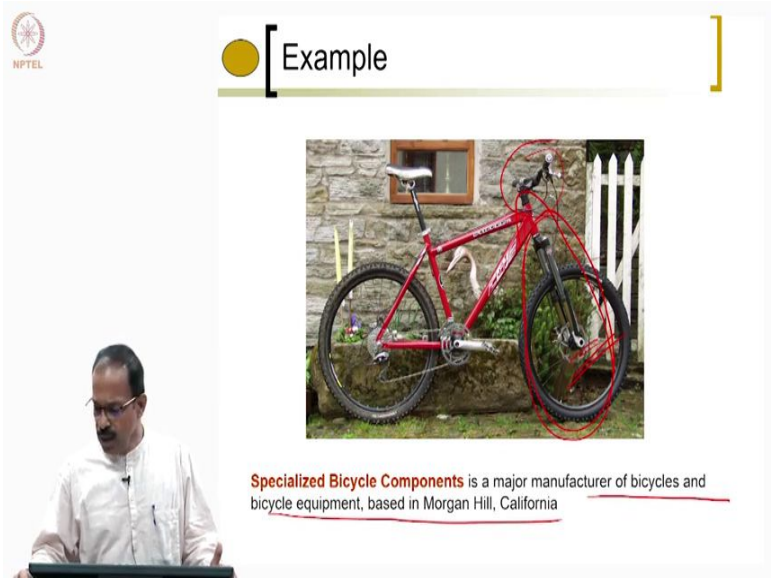

So, for example, you take another case here. So here you can see that this one company is trying to make a suspension fork for this cycle. So this company is a major manufacturer of bicycles and bicycle equipment based in California. Just for example, we have taken this case study. Now this company is trying to make a suspension fork for the cycle. So it is a underage cycle, it is a mountain bicycle, and mountain basically, they want to have a kind of a suspension fork which is not commonly available in other cycles.

So, this company is interested in making a new bicycle with a suspension fork. And they want to know what are the needs that need to be satisfied if they make the product. So some of them are

very obvious, but some of them we need to get from the customer because customers know them better. And therefore, we need to make sure that the customers understand the product and then they can tell you what actually their expectations are from this particular product.

So now if you look at this, some of them can be easily understood. So can you suggest or tell me some of the needs that you can identify? Anyone? So again, see that one of the most important aspects if you talk about a suspension, is that it should reduce the vibrations, one of the most important aspects of any suspension system is that the vibration should be reduced.

So somebody is holding the, someone is holding the handle and riding the cycle, you should not get a lot of vibration on his hand, that is one of the basic requirements and of course that should not get transmitted to the seat and then the person should not feel uncomfortable in riding the cycle. So the company can actually decide to have one model or multiple models depending on the requirement.

But they need to know if they want to, they are going to produce it, what will be the requirement. Now, if they do a study, customer need analysis, they can actually go through the process of identifying the customer needs, either using a like dislike method or any other method they actually find suitable for this particular customer group.

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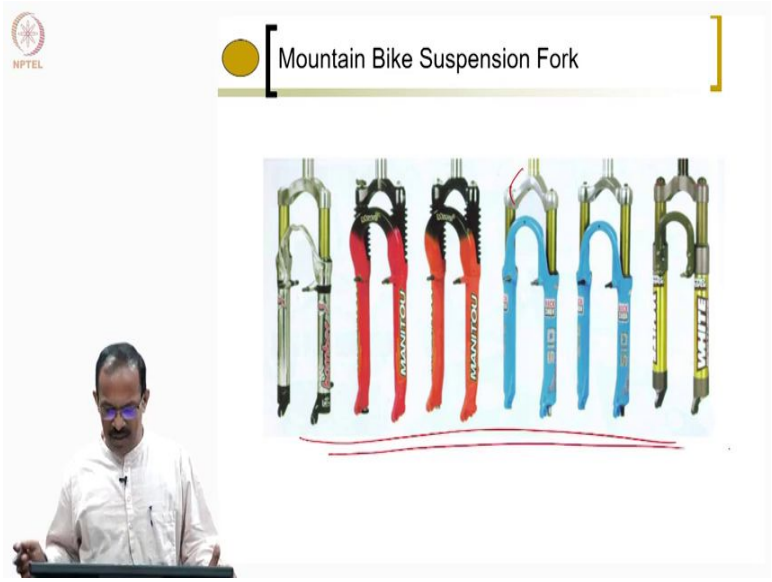

So, you can see, these are some of the different types of suspension fork that is available in the market, and then this company wants to have a new design for it.

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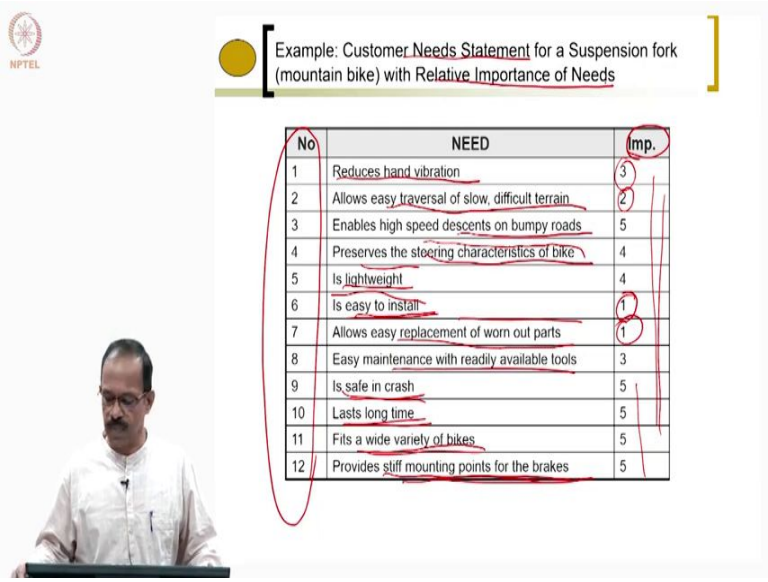

So now if you go through all this analysis and go through it like dislike method and then interpret and identify all the interpreted needs and then based on the interpreted needs you can actually go for a classification of this needs using affinity diagram and at the end of this, you will be able to get a list of customer needs and then you can actually find out the importance of each need also.

So in this case, the needs that can be identified would reduce hand vibration, so that is one of the important needs that you can think of and similarly, allows easy traversal of slow, difficult terrain. So it is a mountain bike and whenever using it for travel in the mountain area there will be a lot of difficult terrain. And so the customer or the person who is riding the bicycle, he wants to have a very easy traversal of terrain.

So there should not be too much bumpy travel because of the suspension also. And then it enables high speed descents on bumpy roads. So you should be able to get high speed descents on the bumpy roads, then preserve the steering characteristics of the bike. So this is one of the important one. So when you are adding something new to the fork, that should not affect the steering characteristics of the bike.

This is again coming from the customer, customer is interested to have the same kind of steering characteristics without getting affected because of the new suspension and of course, it should be

lightweight, Nobody wants to add more weight to the system and it should be easier to install, because the customer may want to change it too, for a normal ride on the city or town rides, they do not want to have this suspension system and whenever they go for a mountain ride they would like to add also.

So, that is one requirement for the customer, it should be easy to install and allows easy replacement of worn out parts. So if there are any worn out parts in the system in the fork, it should be easy to replace. Then, of course, easy maintenance with readily available tools, safe in crash, important from the safety point of view, it would be safe in a crash and it lasts a long time. So the life of the product should be very high and fits a wide variety of bikes.

So there might be different kinds of bikes, so you need to make this fit to different kinds of bikes so that you can have one suspension fork which can actually fit into different bicycles. And of course, it provides a stiff mounting point for the brakes, just the brakes should be attached to the fork. And when you have this suspension fork, the normal fork replaced with the suspension fork, we still should be able to have stiff mounting points for the brake.

So these are the important customer requirements you can identify using the customer need analysis. The whole purpose of doing the process of customer need analysis is to get this list of needs. So the number of needs depends on the product. And finally, you need to get the important rating also. So which one is most important for this and which one is the least important, so the least important can be the team can actually decide not to have those least important needs satisfied in the product or if possible, they can actually have all the needs satisfied also.

And that is why we need to have the important ratings also. Now, if you get this important rating, again, it comes from the customers and the design teams on evaluation also. So you will be able to get this importance as the numbers like five, four, one, two, three, etc. sorry yeah. So you can see this one, two, three, four, five action shows the ranking of this requirement. So it says that easy to install and easy replacement is one of the most important one identified by the users because they want to easily replace it, again depending on various factors.

And these numbers come from the design team as well as from the customers. So we can see reduced hand vibration is the third one, but number two allows easy traversal of difficult terrain. And similarly, we can see these are all five safe in crashes, lasts a long time, fits a wide variety of bikes, provides stiff mounting points for the brakes like this, so not necessarily that each one should have a totally different ranking.

So you can have equal rankings and also can be given and the design team can actually take a call which one should be addressed first and which one can actually be made as an optional one in the descent. So at the end of all these exercises, you need to have a customer need with the relative importance that is the final outcome of this exercise.

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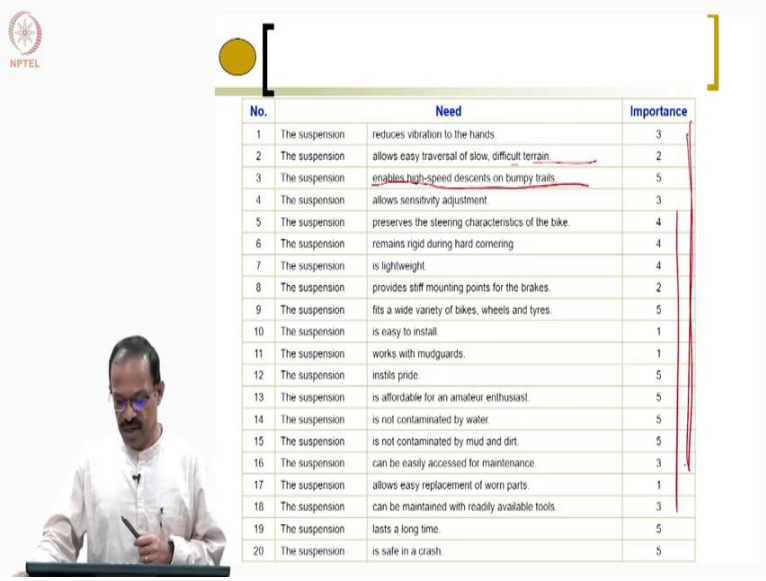

So you will be getting this as the need statement so you can actually write the need statement the suspension reduces the vibration to the hands, suspension allows easy traversal of slow, difficult terrain. It enables high speed descent on bumpy trails. So that is the way how you actually write down the need statement. So the need statement will be written, the design document saying that, okay, this is the one which has to be satisfied in the product. And of course, the important writings also here there are twenty needs identified, I showed only the small number in the previous slide.

But these are the total number of needs that can be identified from this kind of exercise. So that is all about the need identification in customer need identification in product design.

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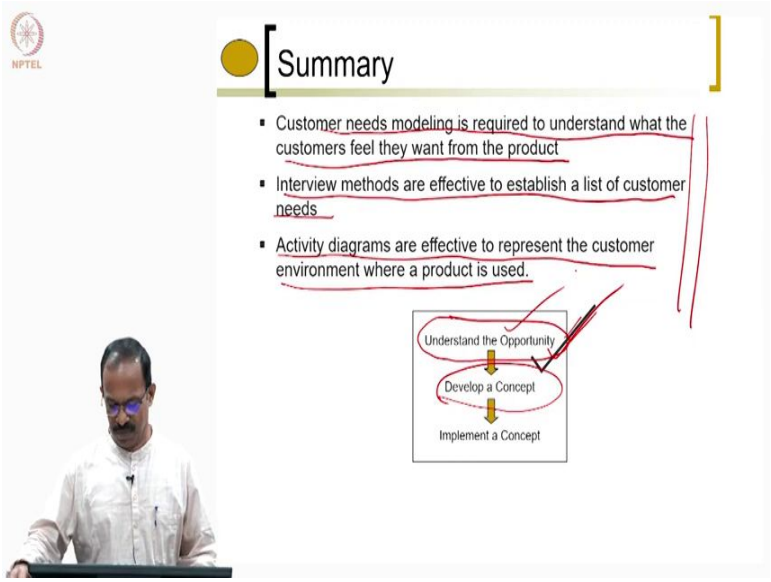

So to summarize the discussion we had in the last few classes, we found that the customer needs modeling is required to understand what the customers feel they want from the product. So this is the most important one because we need to know what the customers are asking for in this product.

If there is anything the customer is asking for, it is a city for the designer to look into that and then see if they can provide it. And then we found that interview methods are effective to establish a list of customer needs. So the dislike method is one of the interview methods we discussed. So that is one of the most effective methods of need identification and activity diagrams are effective to represent the customer environment where a product is used.

So that actually will tell you the latent needs also. So we identify different types of needs like direct needs, latent needs, Nish needs etc., and we need to look at all those needs whether it is, if that is applicable to a product, whether the Nish needs is applicable to that particular product, you need to identify those needs also. And at the end of this, we are actually getting the needs list with its importance.

So that actually completes the first stage in the product development, which we call it as understanding the opportunity. So, as I mentioned, there are three stages in product development.

First one is to understand opportunity and then it is to develop a concept. Understanding the opportunity is basically going through all the stages of what we discussed and making sure that there is a good opportunity to design a product.

And we understand what the product should do in order to meet the customer's satisfaction. So finally, we need to satisfy the customer or delight the customer. And what is to be done to make the customer delighted can be obtained from the need for identification. So we need to ensure that we understand all those aspects and that actually completes the understanding of the opportunity stage of product descent.

The next stage is basically, once you understand all the customer requirements, how do we make sure that we can satisfy this customer or what we need to do to make sure that the customer is satisfied with the product. So that is the next stage where we try to develop a concept for satisfying the customer needs or we try to develop the product concepts or the product ideas to satisfy the customer requirements because there are multiple requirement from the customer and we need to look at each requirement and then see what can actually make the customers happy with that particular requirement of the customer.

So, if a customer has a requirement, for example, he will say it is easy to use. So as a designer, you need to check what will make the customer feel happy to use the product or whenever when the customer will feel easy to use the product and what should be the features in the product to make it easy to use. So this is the stage where actually we need to go into the concepts of the product and that is known as the develop a concept stage.

So we will be moving to this stage now, the second stage, the first stage is completed with the needs list, with the relative importance of the needs, and then we go to the develop a concept stage.

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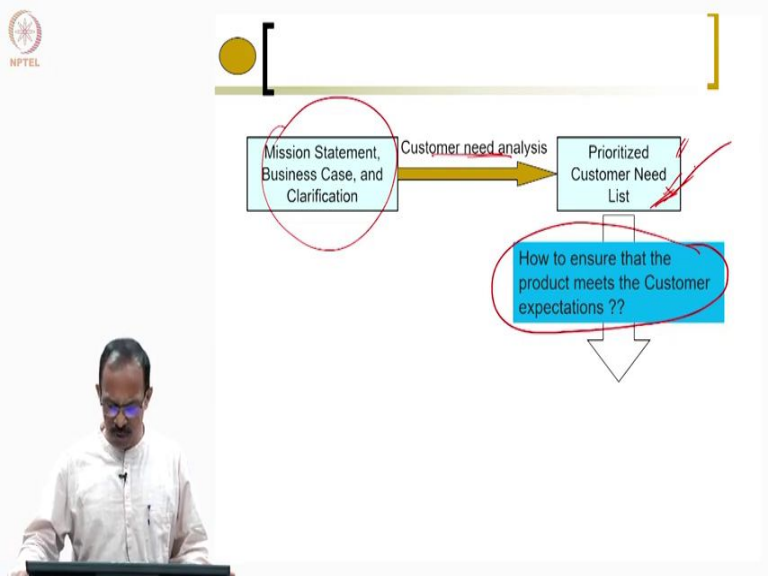

So we found that we have this in the previous last few classes, we found the mission statement, business case and clarification and then through the customer need analysis, we get the customer needs list. The biggest question as I mentioned, is how to ensure that the products meet the customer expectations?

So what is that to be done to make sure that the customer's satisfaction or customer expectations are met in the product. So this is the challenge for the designer and then to see how we actually convert these customer needs into product specification or product features. So that is the requirement now.

And this is addressed through something called product specifications. So we need to convert the customer needs into some design goals, and that is known as the product specification. So we will look into that and see how the customer needs can be converted to the product features or the features in their product, which will make the customers happy to use the product. So let us see how to do this.

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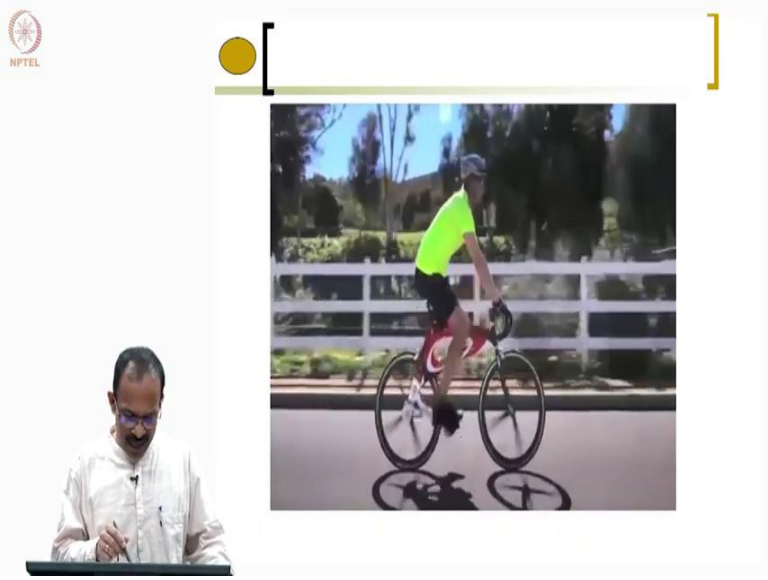

So let me take this example of the cycle which we discussed in one of the classes also. So you know, we already discussed this in the class on how to modify the existing cycle. We have to put a lot of effort in riding the cycle. But now we can see that a new design like this has got a particular new feature where the efforts needed to ride the cycle has produced.

So moving forward from the conventional pedal chain and sprockets move to a reciprocating kind of a motion which can be converted to a rotary motion and therefore you will be able to make a totally new cycle design. So, this is the way people should think about new designs, so you have an identified problem with an existing bicycle and want to move to a new cycle design. So suppose you want to make this kind of a cycle or want to make any product like this, you have an idea that yes this has to be modified.

Now you need to see if you modify the product and come up with a needed product, what features need to be provided so that the customers will be happy with that. So that is where actually the creativity of the designer comes and then he sees or he develops a need concept in order to meet the requirements or design requirement. And to know this we need to know, what is the requirement to be met in the product and how that requirement can be converted into a feature in the product.

So let us look at this and see how we can convert the customer requirements into the design features in a product.

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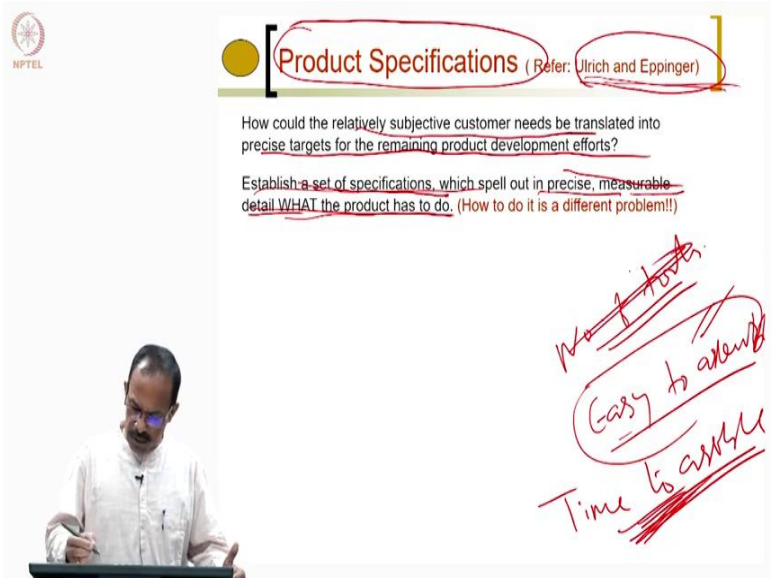

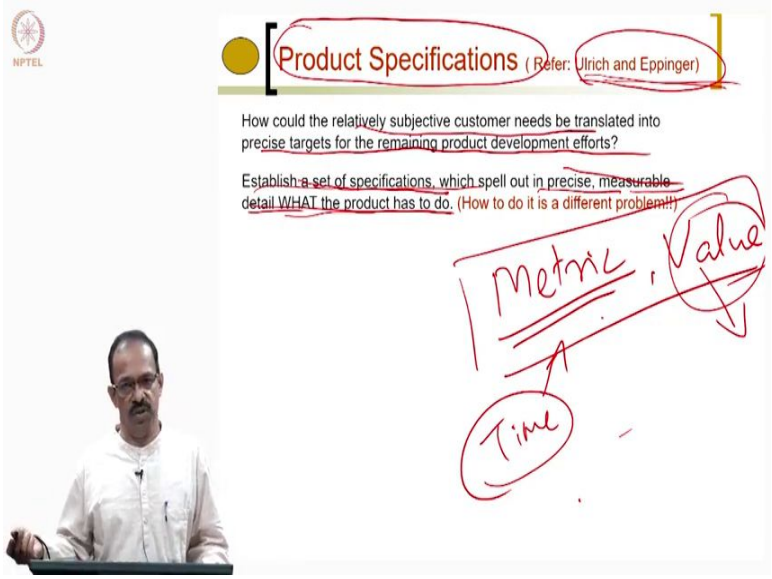

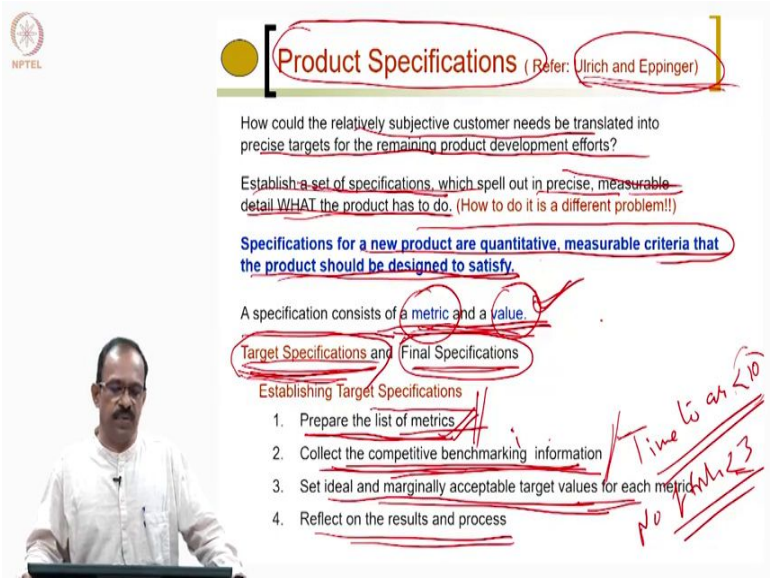

And this is basically done using something called product specification. So, for example, I mean, in this case, if you see the requirement of a customer, customer's requirements are always very subjective. Your customer will say it would be lightweight, customers would say it would be easy to use or the customer will say it is easy to assemble.

So these are all highly subjective because easy, when you say easy to carry, what do you mean by easy to carry? Is it because of the weight? Is it because of the size? Or is it because of something else? What is actually the customer is asking for or how we can actually convert this subjective requirement of a customer to a very objective design specification, that is we need to have something to be measured and say that, yes, if I make the weight less than a particular value it would be easy to use.

So how can I say that this objective or how can I make this subjective requirement of a customer to very objective design features or the product features is known as the product specification development. So what we are trying to do is to convert the relatively subjective customer needs into precise targets for the product development efforts. As I mentioned, when a customer says easy to use, what the designers should do with that when the customer is telling it should be easy to use, he has no nothing to say that, how can I make sure that it is easy to use.

So it is necessary for the designer to see what objective values can be used to measure the easiness of use, and then how can you improve those objective measures and make sure that if

you meet those objective measures, it will be easy to use. So this process is known as developing the product specifications.

So the fundamental objective is to convert the subjective customer requirements to objective measurable design features or the design specifications, which can be used to measure the satisfaction of the customer or to see how much that meets the customer requirements. And this is what we are going to discuss in the next few classes. And you can refer to this book, Ulrich and Eppinger, for more details on product specifications.

Of course, other books also will give you the details, but most of the slides I have presented here are taken from this book Ulrich and Eppinger. Now to do this, to convert the subjective needs to objective values, what we are trying to do is to establish a set of specifications which spell out in precise, measurable detail what the product has to do. So we are saying that if you have a requirement of easy to use in the specification, we will clearly tell what the product should do to make it easier to use in measurable quantities.

We will say that, okay, if this is the case of, for example, in the case of a mobile phone, somebody says it should be easy to use, how can you say that it is easy to use? One, maybe, okay, how long it takes to switch on or when it is in sleep mode and how much time it takes to come to on mode. And then how many keystrokes do you need to press to make a call? Or how many keystrokes you need to make to move from a phone mode to a video display mode?

So this kind of objective measure, if you can tell and then you can say, okay, probably if you make the number of keystrokes less than three, then it is easy to use or if the time taken to switch on is less than a particular value second, then it is easy to use. So this is the way we convert the subjective requirements of the customer into measurable detail saying what the product has to do, so how many strokes it can take, how many keystrokes the phone should take in order to get that particular feature on.

So that is the way we convert the subjective needs of customers to objective requirements. And that is known as the specification development design specification or the product specification development. Now, look at this situation so there was a customer requirement which says that it

is easy to assemble. Easy to assemble is a customer requirement. Now a designer is trying to convert this into some objective measurable values and say that, okay, if I do make this so then it should be easy to assemble.

So can you tell me if I have an easy to assemble as a requirement or a customer requirement, what should be the way I can actually measure this easy to assemble? Can you tell me something which can quantitatively tell if I modified this, it can actually be easy to assemble? So, for example, if we have something as easy to assemble, I can say that one may be time to assemble is something which likely I can say.

Time to assemble, if I can reduce the time to assemble, then we will know that it can be a measurable quantity which can measure the easy to assemble assembly requirement. So if I can reduce the time to assemble, then it will become, if I can reduce time to assemble, it will be easy to assemble. Similarly, I can say the number of tools needed for assembly, number of tools needed for assembly, if I can have a number of tools less than also, it may be easy to assemble.

So this way there is a way for me to convert the objective needs of the customer, sorry subjective needs of the customer to objective values, and this is known as the specification, so the product specification has got two important parameters. One, we call it a metric and then the other one is known as a value. So a metric and a value from the specification. For example, if I say time to assemble, that is the metric to be used to measure the easy to assemble requirement and how much is the time is the value.

So if I have this time and its value, then I know that if I make the time to assemble less than five seconds, then it is easy to assemble. So this is the way how we convert the subjective need to objective value. So we have something called a metric and a value and this metric and value forms the specification. So the specification for a new product or a quantitative measurable criteria, the product should be designed to satisfy.

So you have a quantitative measurable criteria that the product should be designed to satisfy. And as I told you, there is a metric and a value to be used in order to get the specification. So easy to assemble, I can take the time to assemble and the number of tools, maybe the two metrics

that I can use in order to quantify the easy to use, easy to assemble requirement, and using this metric and value will be able to get the target specification for the product that is, I can say my design goal is to make the time to assemble less than or equal to sorry less than or equal to ten, that is my target.

And similarly, the number of tools I can say is less than or equal to 3. So this is the way I can say that the target, so that is the target specification. Now, after considering all the requirements of the customer, we can say some of them may not be possible, some of them you may have to make some compromise. Then finally, you will get the final specifications.

So in the coming lectures we will try to see how to develop the target specification for the product and see how this customer requirement, the subjective customer requirement can be converted to quantitative measurable criteria. So that is known as the target specification and we can actually do this by four steps. I will explain this in the next class in more detail.

So, the first thing to do is to prepare the list of metrics by looking at the customer requirement, we try to find out what are the metric that can be used in order to get the convert all the customer requirement into metrics and then collect the competitive benchmarking information because once you have the metrics you need to get the value and this value can be obtained by using something called a competitive benchmarking information that is look at the existing products and existing features of the products and then see whether you can use some of the values.

And then once you have this information you can go for ideal and marginally acceptable target values, so the ideal value and the acceptable target values and finally reflect on the results and then see how this information can be used to get the final specification of the product. So that is the way how you convert the subjective customer needs to objective measurable quantities that can actually be provided in the product in order to meet the customer satisfaction. So I will stop here, I will continue the remaining discussion of product specification in the next class. Thank you.