Functional and Conceptual Design
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Lecture 8
Technical Questioning and Mission Statement

Today we will start the Product Development Stages. As I told you there are 3 different stages in product developments, the first one being understanding the opportunity. We saw in the last class there are different stages in understanding the opportunity also. We will look at the first part of understanding the opportunity, how do we actually identify a good opportunity to develop a new product so that is going to be the discussion today.

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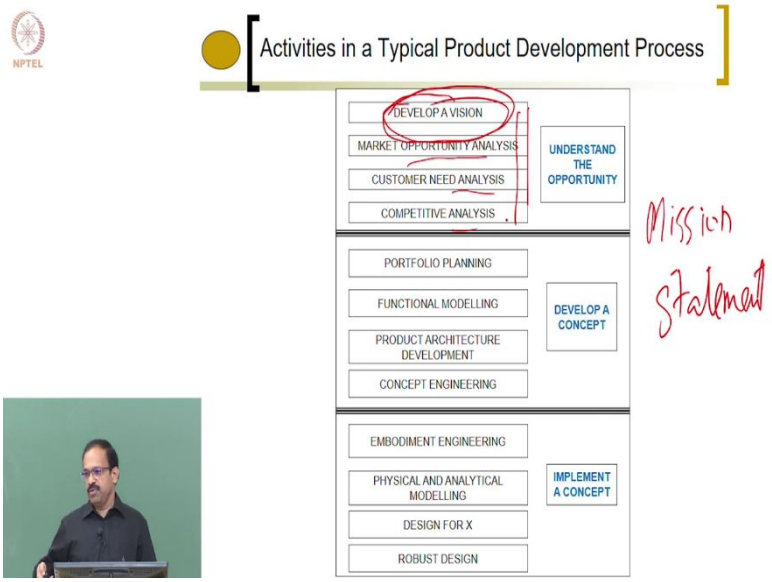

Here as I told you that there are 4 stages. Develop a Vision is the first part. How do you develop a new vision for a new product or a vision document for a new product? Suppose, I want to develop a new product, what should be my starting point or how should I convey my vision to other members in a team. Although if I want to discuss with others what will be the binding documents which will tell me for this is what I want to develop and these are visions for these products. That is basically known as to develop a vision.

At the end of this stage what will be having is a Mission Statement. We will try to develop a mission statement which will actually tell you what is the mission you have in developing

this product or why you are doing this, how you are planning to do this, and it is a very preliminary stage you do not have much data but these are basically you won't understanding about the product requirements, customer need, etc., and then later on you will go and verify this through different stages like market opportunity, customer need, etc., but initially you tell, this is what I am going to do. That is the mission statement to be developed for making a new product.

We will answer these questions, you can see what Albert Einstein said, making the problem clear is more important than finding a solution. Once your problem is very well defined, clearly, then you can find a solution. Product development should also be very clear about what you want to develop, then you can actually develop it without much difficulty.

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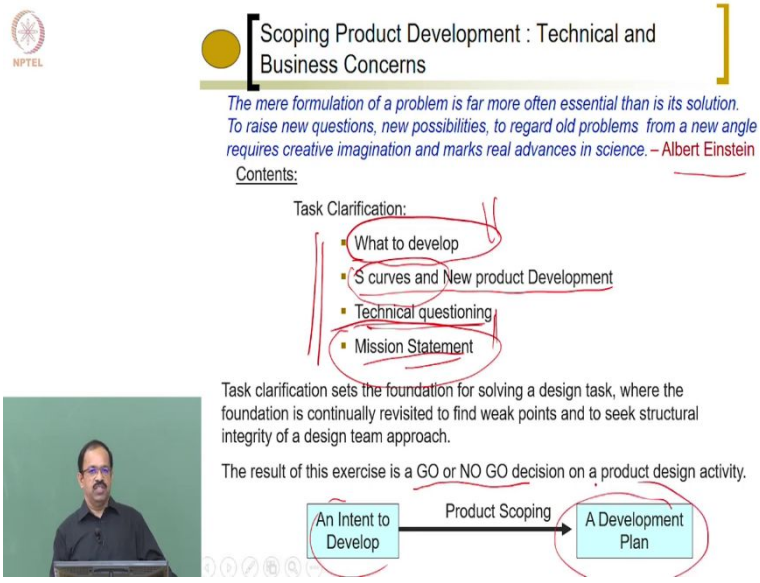

We will actually look at this in the mission statement. First what to develop, I mean you want to develop a completely new product, you want to develop a completely new technology, or you are looking for modifying an existing product through a different process of design, basically redesign or going for a variant design whatever it is.

What you want to do is basically what to develop and then we will look at how we decide, how do you say particular technology, there are different technologies available for doing

something. Can I say use a particular technology or should I develop a new technology. This can actually be answered by something called Technology Forecasting or S Curve.

How do we forecast the future of a technology and then see whether you can use the technology or you have to develop a new technology so, that is basically known as S curves and how the S curves can be used in new product development and then we will see how do you answer the questions that you have heard about the products and then compare to a mission statement.

This is known as technical questioning and developing a mission statement. You ask many questions to yourself or to others to understand the issues in the product and then use all these information and make a mission statement. This is the goal of this particular discussion, we will see how to develop mission statement based on technical questioning.

At the end of this stage mission statement you will have a gate analysis so this is 1 stage and then you will have a get analysis and you have to decide whether GO or NO GO, GO means yes you can continue, NO GO means no, no your mission statement clearly tells that it cannot be done or it does says it is a difficult task probably you do not take it forward that is a NO GO statement and this will be decided by an upper management, you do not take the decision, someone else will take the decision whether your mission statement is clear and it has got a feature to move forward.

Will be having an intent to develop and finally you will have a development plan at the end of mission statement. This is what we are going to discuss. But let us see how people start developing new products, so you might have seen products coming into the market.

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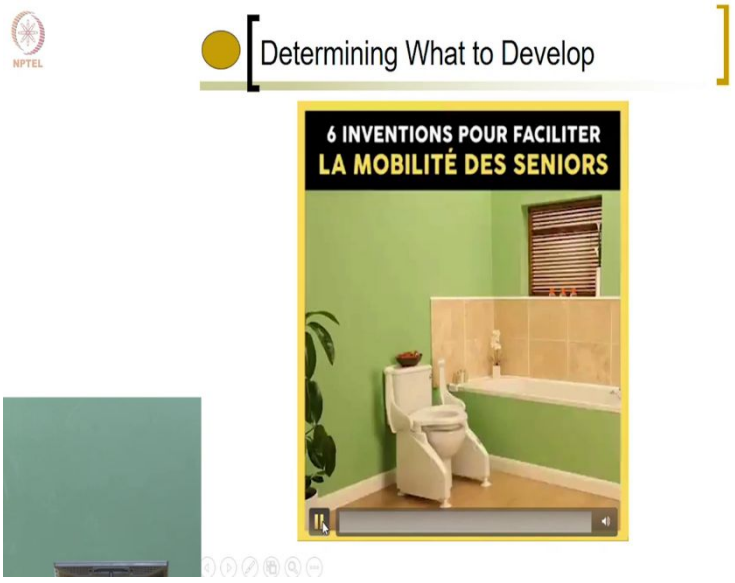

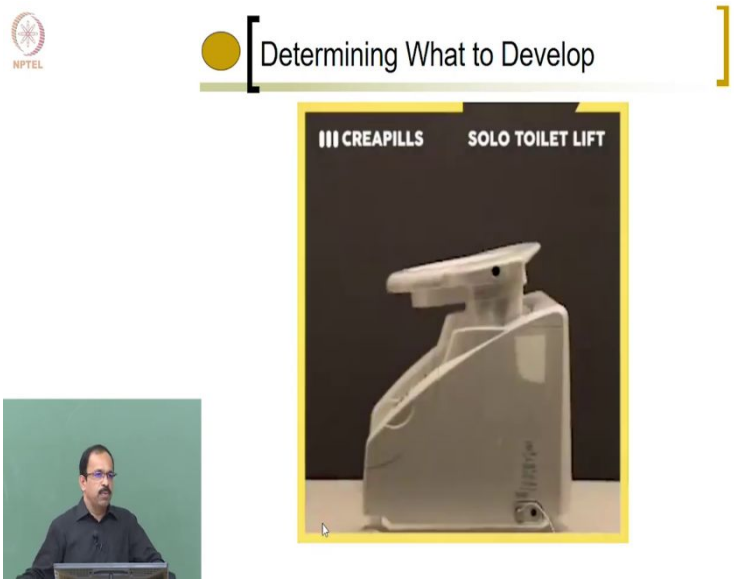

Determining What to Develop

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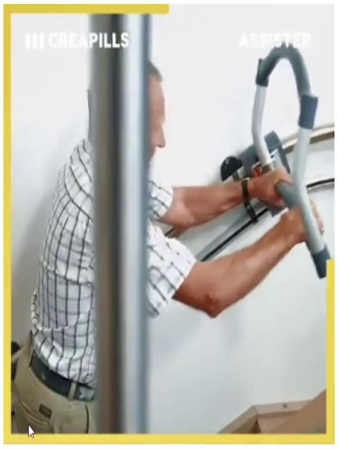

Determining What to Develop

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Let us see some of these products which are called the most 6 important inventions. You will see in day to day life, you will see a lot of need for new products, and how people convert this into products in the markets. This is an elderly assistance system for people who are very old they have difficulty in getting up, seating and getting up and they find it very difficult and there are not many products available in the market.

These are some of the products people have developed by looking at the requirements of the customer or looking around and then identifying the needs and then developing products.

You know what this product is, this is to prevent injury when they fall. Elderly people, they fall, they break their bone and if you break your bone within 2 months you will be alright but, elderly people there bone growths already stops. It is very difficult to get it back or get it cured, so you need to prevent the fall, and treatment is very difficult.

You try to prevent fall by developing different products for helping the elderly people. All these help elderly people in their day to day life, this is to help a person to lie down in the bed otherwise, somebody has to hold them to lie down but this device helps them to lie down. That is about some products, how do you actually identify, need for the product and then how do you go through them.

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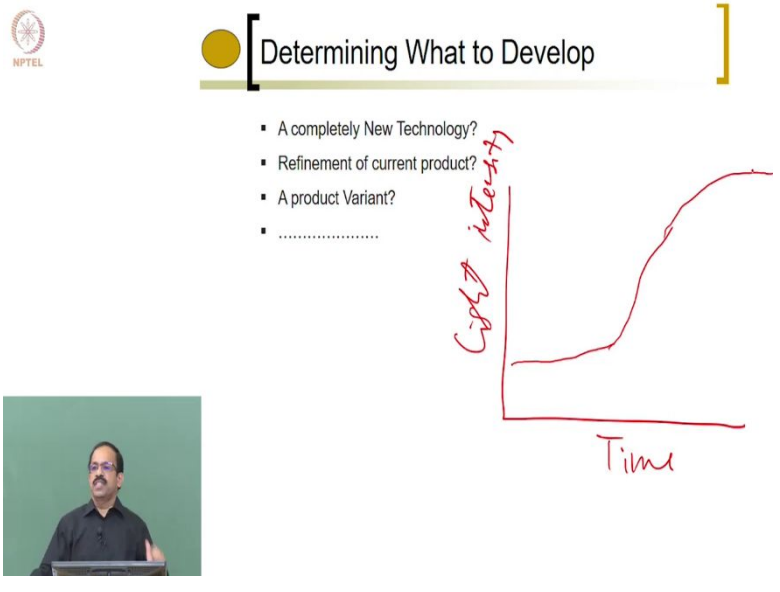

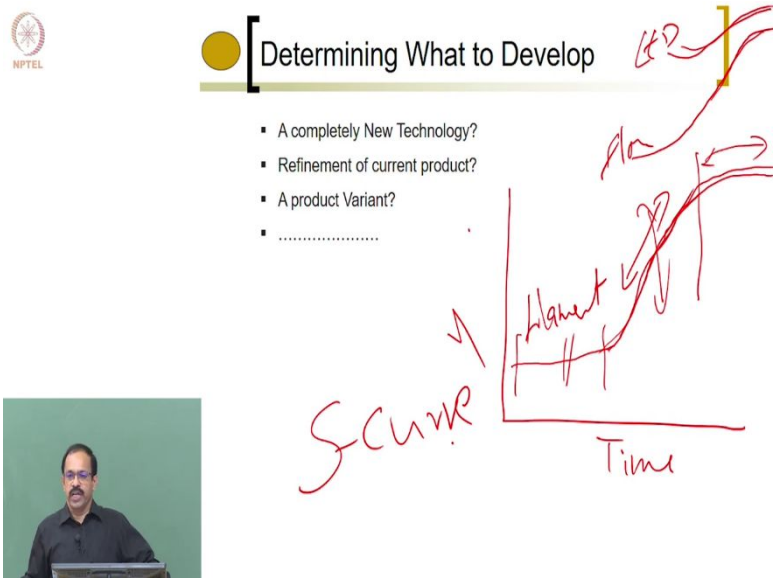

What to develop? is the first question you need to answer, what kind of thing I should develop. Should I go for completely new technology or refine a current product, or go for a product verbiage. For example, I discussed this in the last class hour. In one of the classes now you want to develop a Scooter will you go for an IC engine scooter or an electric scooter.

Pardon, electric scooter. What is the reason, technology has moved from IC engines to electric power. Now, if you look at the technology, any technology you take, you will see a particular pattern in the technology developments. For example, you take light, say the electric bulb as a product, what was the first kind of electric bulb pardon, what do you call that filament type.

If I plot the filament type technology against the time suppose, this is the time scale, and this is the light intensity of the filament type bulb, when was the electric bulb invented? Pardon, 19th Century. So, roughly you can say the end of the Eighteen Century. Now, when this was introduced the light intensity was very small.

Because the filament was very crude, the technology they were using for making the filament was very crude. If you look at the intensity of the light you will see initially when it started it slowly going up and the change in intensity was very slow over a period of time.

Then a lot of people started working on that technology and there will be a sudden growth in the technology of filament based electric bulbs and you will see that the light intensity keeps on increasing over a period of time. Because, a lot of people start working on developing new technologies, new filament materials and new ways of putting them in the Air types system etc.

And then you will see that it actually goes up suddenly like this because, there will be a lot of people working on it and then a lot of development will take place and after some time you will see that there is “efficiency” behind everything, we cannot develop beyond a particular level.

What will happen, it will slowly start venturing. That means, you cannot increase the light intensity of cans or bulbs for this filament bulb forever, at some point of time this technology will flatten that is you cannot use it for anymore improvement. This is the same case of IC engine also, if you look at the IC engine efficiency instead of light intensity you should look at the efficiency of IC engine the same thing when IC engine was invented it was very lower efficiency and people started working on it lot of new things came up, lot of methods bicycle changing and that reduce wall cut timing etc...

Suddenly, you will see that efficiency goes up and now what is the current efficiency of IC engines, anybody pardon 40. Somewhere I want 20, 30 percent is the efficiency of an IC engine. There people have been working for a long time in terms of improving the efficiency but they found that so from the initial 5 percent it goes suddenly and now it is only a small change.

Change in the efficiency has come down, now it cannot be developed further. This is the case with all kinds of technology, any technology you take, you will see that this kind of a growth pattern can be seen that is there will be an initial slow growth and then there will be a very fast growth of the technology and then the technology will starts flattening that you go beyond a particular value because, that is the physics of the system and what will happen at this point you will see that a new technology will start coming up.

When this is somewhere in the flattening stage you will see that something new will come up. After the filament bulb what was the next type of bulbs came into the markets, what is that? Fluorescence lamp. When this is slowing down something else will start coming like this and it will go.

The bulb like Tube light and all became after the filament type and fluorescence lamp. Now, that also came to a stage where you cannot do much more than that. They came up with a slim type, without choke, electronic choke. All those things tried to improve the efficiency of the tube light and they found that it is not possible to improve it.

What happened after that LED? When this is trying to flatten up, then somebody will start with their new technology and will go up so, you can see this is the LED technology and this is the fluorescence and this is the filament technology. So, every time when a new technology comes up there will be a stage where it is slowly progressing and then there will be sudden growth in that technology lot of people start working on it, lot of products will come out of that and then we'll see that, all the technology has matured and it cannot go further, something else has to start.

This is the way technology happens and this is basically known as technology forecasting or we call it the S curve or S curve of technology This stuffily you can say S slightly inclines. This is known as the S curve of technology so, whenever you want to develop a product you need to look at what is the stage of technology within the S curve. Is it in the beginning or is

the rapid growth or is it in the declining or saturation's stage and based on that you need to take a decision whether you want to use that technology for developing a new product or you want to go for a new technology which is coming up or emerging in the market. This is known as S curve or the technology forecasting in order to level up new products.

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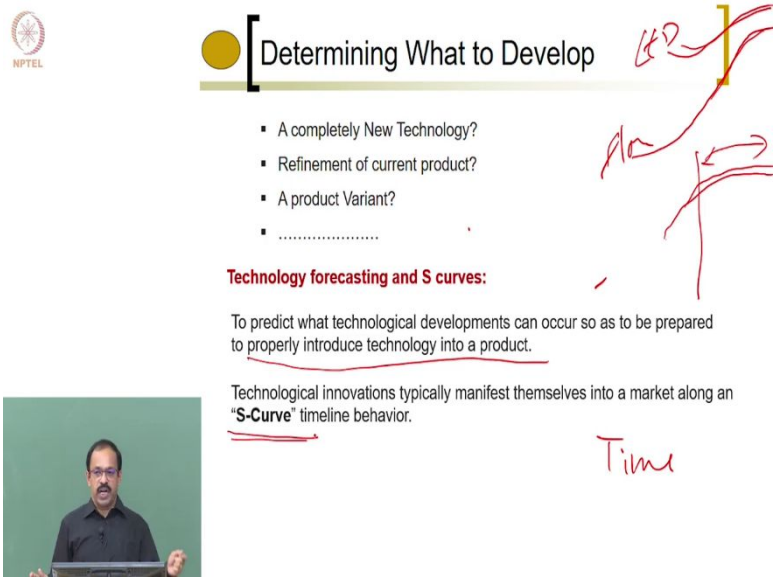

To predict what technological developments can appear, first to properly introduce the technology into your products and then typically manifest in a S curve timeline, any product you take, take your mobile phones or washing machines or whatever the product you want to take you will be able to see this S curve happening in the product technology, this happening in the IC engine that is going to the electric vehicle, now electric vehicle also you will see that after some time you have you cannot go beyond a particular level of efficiency for the system then we may not to look for fuel cells or whatever it is coming up slowly something else will come up and the technology will move forward.

This is something which everyone should understand and you are trying to develop a product, what is the level of current technology and how you can leverage on the technology now.

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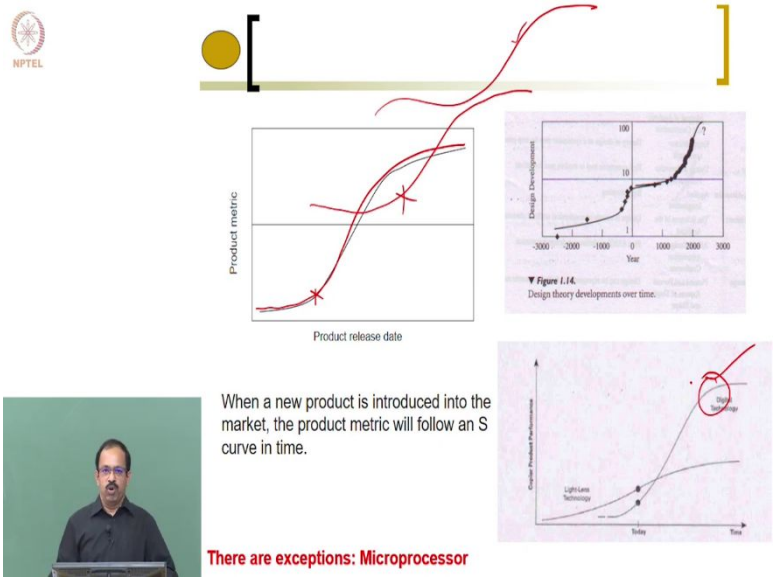

This is what I already mentioned, so product always follow an S curve or the technology or the products follows S curve and you see that it cannot how much more much improvement in that and then we will start a new S curve will start from here similarly, and the S curve will start technology will keep going forwards. This technology will become obsolete, this will become obsolete and this will become the parent level of technology.

You need to understand how this technological change is happening in the markets. I will explain about the different products. Something like a camera, if you take the camera as a product you will see the previous cameras were based on the unlock type cameras where you have the film and then printing. Later on, new technologies found that no more unlocked cameras are flexible. You can have digital technology. Digital cameras will come up and then after some time we do not know what will be the new technology coming up when the digital technology will come to a saturation, then you will get another technology for new products.

Whenever you want to develop a new product you have to look at the new technology, what is the level of technology in the market and accordingly you have to choose the technology for the new products. That is the first point we need to keep in mind what technology you should adopt for the new products. Any questions on S curve and technology forecasting

there is not us technology forecasting because you will be able to tell, what the current stage of technology is and what will be the next stage of this technology.

You will change rapidly, so it will grow for some more time and then mandatory somewhere in this region you should be careful not to use that technology for any product development. There is only one exception to this rule of the S curve that is basically the Microprocessor. All of you know what a microprocessor is, most of your computer uses a processor basically, a microprocessor.

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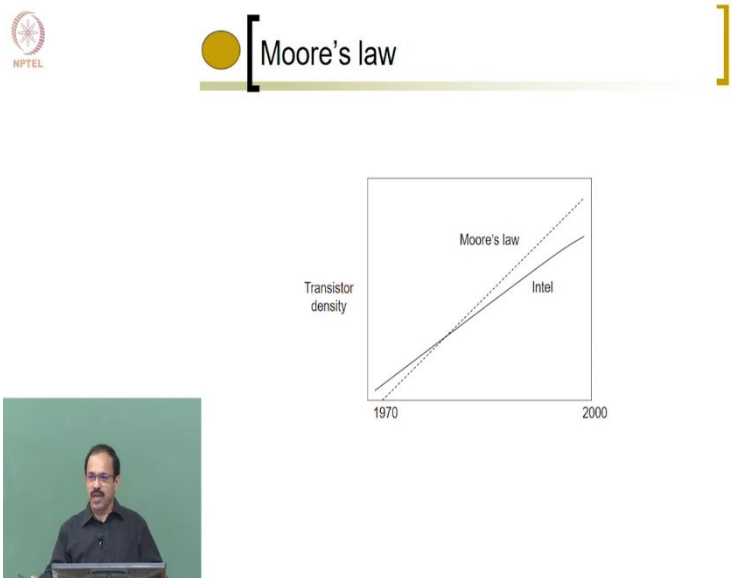

The microprocessor technology is still going straight. It is not yet saturated because, that is basically the amount of memory you can have in a size of chip, particular size of chip what is the level of memory that you can stack. So, somebody predicted by that, this will also follow a curve and after some time it will actually saturates but, this still going straight and but, we are predicting in another 5 or 10 years we will see a saturation that you cannot built more capability for a processor because, of the limitations in the chip and materials.

But, if someone comes up with new materials, this is known as Moore's law that every 2 years your processor capacity increases by 2 times that is known as the transistor density within a particular size of the chip. There is only one exception for the S curve parameter.

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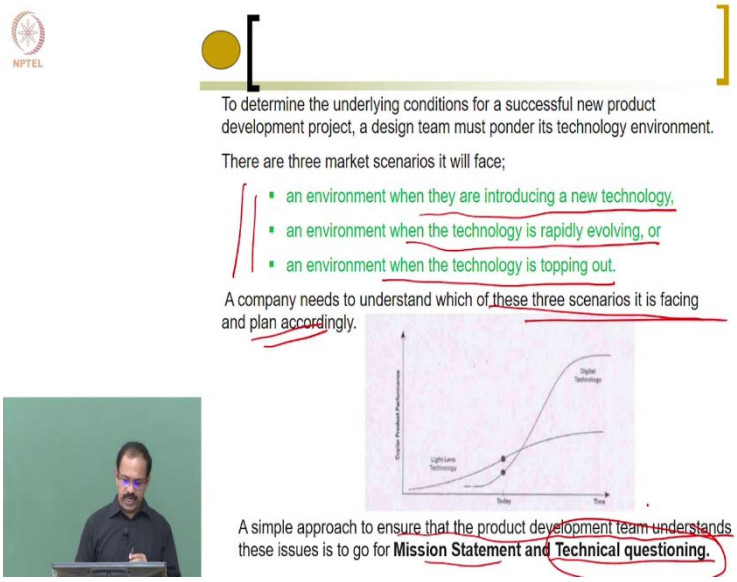

Let us see what are the implications of this so, you need to know the three scenarios of product development: the environment when introducing a new technology, when the new technology is rapidly involving and the technology popping out, popping out means saturated out. These three stages you should be able to understand based on the scenarios you need to take a decision or you need to plan accordingly. That is the basically the need for need in this case of product development where we are trying to identify the technology to be used in the product development and you should know what is the current level of technology available.

If you want to design an electrical power system or an electrical lighting system nobody will go for camps and tourists centre there will be a booking for a LED technology only now a days but, we need to know what is future of LED technology is it going to be there or is it going to be replaced by some other technology to understand that you need to know what is stage with the technology is.

Now, a simple approach to ensure that the product development team understands these issues be go for a technical questioning and developing mission statement. The technical questioning will try to answer these questions: what is the current technology, what is the

technology going to change etcetera, etcetera., so we will see how we can change the technical questioning to develop a mission statement for a new product.

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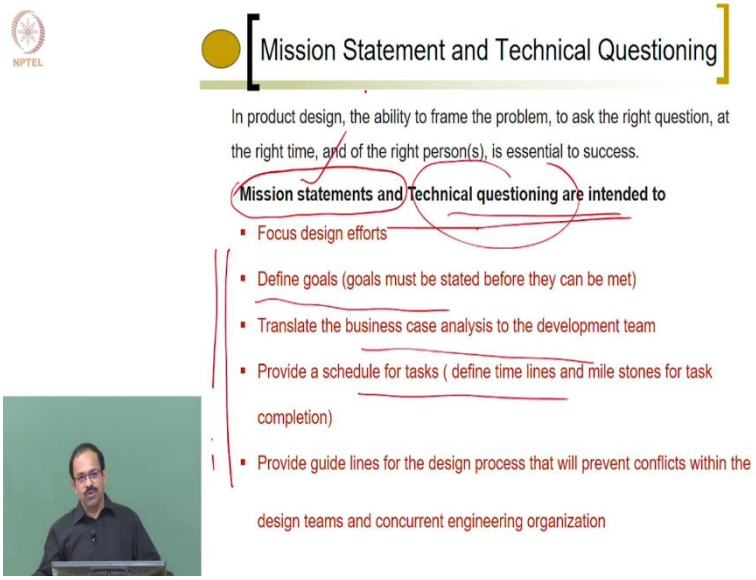

What is the mission statement, these are basically to get these things done. Basically we want to focus our design efforts, we want to have clear goals, the goals to be defined and we need to have the business case analysis, what is the deal of task etc., Can these things be done having a mission statement, and this mission statement comes from the technical question.

So, first we will look at how we can do the technical questioning and then how we can convert the answers of these technical questions to a mission statement. When you do the lab experiments, I used to ask you some questions basically, some of them are part of technical questioning why he is doing something, what is the problem of the product, why he is not able to do something. These are some basically part of technical questioning and we are giving you some questions but those are the only questions you can ask. You can ask any kind of questions and then try to find answers that will form your mission statements.

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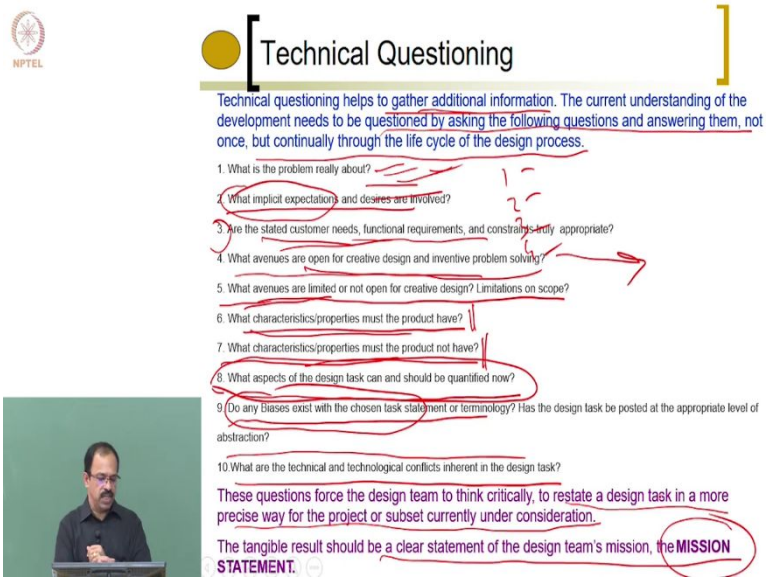

We will see what questions are to begin with, we will look at the technical questioning. It helps to gather additional information, the current understanding of the development needs the question by asking the following questions and answering them not once but, continuing through the life cycle of the design process, that is if you want to develop a product you need to keep asking questions and try to find answers those questions and then you will have only clear idea is it a good effort to go forward with the product development.

Assume that you are going to develop a new product, what product you would like to do and develop any suggestions. It's one we have discussed in previous class assuming that you want to design a cycle which is one which you commonly use. What will be the first question you ask? The first question you want to ask is, are there some problems in the existing cycle? That is why you want to design a new cycle otherwise you do not need to decide.

The first question you should ask is, what is the problem really about? What is the problem that you are having with the current product or what is the problem you are facing without having a product? There is no product that might also be a problem. In the case of bicycle design, how do you answer this question? What is the problem really about, the cycle chain

comes out, no back supports, and you will be exposed to sun and rain, you have to put some effort, there are so many problems in the bicycle.

These are the things which you should write: you are not going to solve all the problems but, see what the real problems of using a bicycle are. You will see that there are 1, 2, 3, and 4 many problems with the existing bicycle. That becomes a reason for you to start a new design, you know that there are some problems with the cycle.

So, I want to redesign. Fair enough because, you know there is a problem you do not know about the commercial issues, technological issues and all but, you know there are issues that is why you want to buy if you are not able to answer this question that means you do not know why we are going to design it.

The first question you should ask whenever you want to design something is there is a problem, what is the real problem if there is a problem, the first question you should answer. Then, the second one is, okay, what kind of expectations are there or designs are involved in the designing the products. So, many people will have many expectations so, what is your expectation or what the expectations you have understood to have are. For example, you are saying that the cycle is difficult because you are exposed to the sun and rain.

Are you expecting this to be a car? Are you planning to have a car instead of a cycle? No, that is not the expectation, the expectation is that you should protect this person from sun and rain keeping it still as a cycle, you are not going to make it as a four wheeler, or you are not planning to make it as a fully electric or whatever the implicit expectations that is basically driven as an implicit expectations it cannot make it as a completely new product by to solve all these problems then it becomes a completely different product not a cycle.

It should remain as a bicycle, it should remain as a one which is driven by the passenger but, can you provide the additional features, that is basically the implicit expectation or desires. Then, are the customers' functional requirements and constraints truly appropriate? This basically, comes from the first question.

You answered this many questions here but then you should try to answer whether are these needs really good, can they be really achieved, or what are the constraints that may come up in this developing these product that is basically the customer needs, of course you do not have too many customers' needs at present you have very few but, are the appropriate are you looking at, ok that somebody is telling it should protecting me from sun and rain is not it good need or bad need, is it constraint in the development or not.

These are the things which you should answer in this question. The next one is more important is there any avenue for creative design and development in this case, what are the areas where you can be very creative and come up with the solution, is there an avenue to make it a very innovative development exercise and what are the areas which are open for creativity sight. So, for example in the cycle you are saying the chain coming out is a problem.

Probably you can come up with the innovative design of transmission where either the chain is not there or the chain slip can be prevented, there is an area for you to be creative in designing the product. Like any other areas for example, there is no back support in bicycles. Is there a way I can come up with the innovative design to support the passenger or back support for the rider. That is the avenue for creative design and innovative problem solving and if there are none, that means may not be a good product development exercise there is nothing much you can do with the product.

Next one is, what avenues are limited or not open for creative design that is some implicit expectations are there. You cannot really change that one so, if you say that the cycle

somebody has to pedal or it has to be made electrically. So, sometimes you can say no I am not interested in an electric bicycle. I am interested only in a manual one, so the avenue for converting to electric is not open.

That is limited you are not going for an electric one, we are going for a manual one. These are the avenues which are limited which you cannot have a creative design and then, what characteristics, properties must the product have. So, every product when you try to develop you should have some expectations like it should be lightweight, it should be low cost, it should be very efficient.

These are things which are characteristics which the product should have then only it will be successful otherwise you would not be able to succeed in designing the product. This must have and what the product should not have some characteristics that again depending on the products, some products will be having some specific things which you should not have, some products should have some characteristics. We need to answer this question what properties the product should have and should not have.

What aspects of the design task can be quantified now? Can you make some consecutive assessment of some of the characteristics for example, what should be the speed that the cycle should be driven at the maximum speed, oh, it could have the maximum speed of 15 kilometre per hour and the weight of the cycle should not be more than the 20 kg and the maximum weight of the person who will be riding cannot more than 80 kg or expected to be around 80 kg.

These are the things which you can qualitatively specify. What are the design tasks that can be qualified at the stage? A very preliminary estimate you will be doing this again and again, I see you progress with that design but, these are the things which should answer. The next

one is do any bias exist with the chosen task statements or terminologies? This may be slightly difficult for it to understand.

Because, whenever I try to define something I will be biased towards something and hardly have something in mind. So, I am telling all this based on this bias. So, I will either say that basically I am a Mechanical Engineer. So, my designs will be more mechanical oriented, so I am not interested in electronics, somebody who is electrical or electronics based will be always looking for something as an electronics solution.

Is there any such bias exiting in the chosen task or if it is that I want this to be only in this particular way I do not want this in a different way so, that is known as any bias exists in the design of the product and the last one what are the technological and technical conflicts inherent in the design task. What is a technological conflict? How do you define a conflict? What do you mean by conflict?

Conflict is the same thing to oppose you want everything with the high feature in the mobile phones but cost is less, you want your display very big but you want your phone to be very small easy to carry so, this are technological conflicts somebody will say that my display very big and my keypad should be very big so that I can easily type but then they say ok my total size of the phone should be this much.

It is a technological conflict where you cannot have both satisfied so, can you identified some technological conflicts like that for example, you want to have the life of cycle 10 years and then you say that the cost of cycle should be or the component should be less but, if you want to make the life more you need to used better material, good quality material and cost will grow up so, these things is known as technological conflicts in the design of the products.

Is there any technology where such technical and technological conflicts are inherent in the design task? That is the next question? If you can answer all these questions or much more than this; these are the questions for the design team to think critically and we state the design stack in a more precise way for the project of the subject under the current situation.

And the tangible research should be clear of statements. Mission statements that are you try to answer these kind of questions not necessarily only this ten you can have many more questions based on the type of product and try to answer all these questions and then see can you convert all these answers into the proper consolidated statement which we call as the mission statement.

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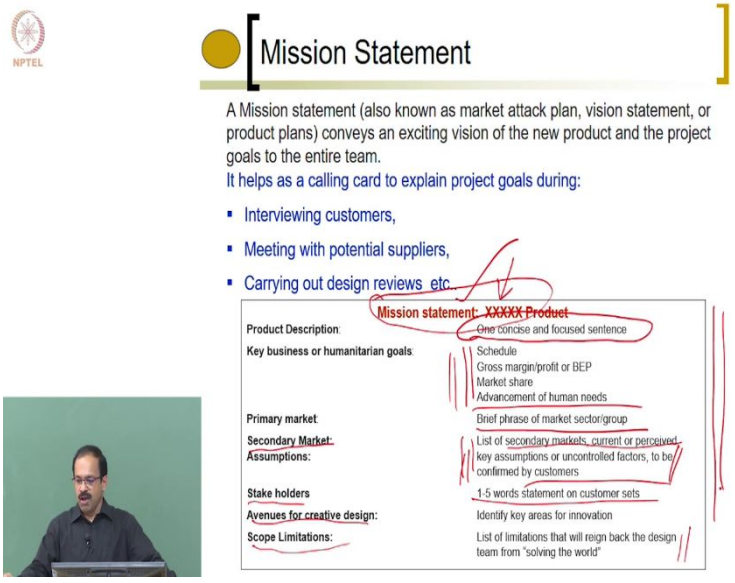

That is the purpose here, we will be developing a mission statement based on the technical questioning. I will take an example and then tell you how to do this but, first see how to develop a mission statement then we will take an example and see how to develop a mission statement for a new product.

These are the things the mission statement will be something like this so, you have a product that is like product X, what is the product description and how do you describe the product? What is it doing? What is the purpose of the product? This is known as a product description.

We describe the products new transport vehicle manually driven cycle for short range community, that is the statement that you can have for cycle similarly, you can write something the product and then what are the key business goals you have, you want to make some money, you want to serve a particular community, or a particular group of customers and how much time it will aspect to take place these are basically known as the humanitarian goals.

And then what is your primary market who will be the primary customer for your product is it going to be the college going students or is it going to be the people who are going for job to the nearby areas or who are going to be primary customer for your products and then, is there a secondary market, secondary market is that in addition to this you can get some other people also buying your products, this is known as the secondary market.

Who are the secondary market in this case, secondary markets expected secondary markets. Then what are the assumptions in development for the product? These are basically coming from the technical questioning you will be having many thing coming out clear as a basic assumption about the product and then you have the Stakeholders who are the important people who will be involved in the whole process of design and development, sales and purchase everyone is the stakeholder anybody who has got something to do with the product will become a stakeholder.

Who are the stakeholders in your case? Customer sets and then avenues for creativity and what are the things which you can modify in the product creative or innovative design coming from the technical questioning and the scope limitations. What are the limitations

which we cannot change and some of the things which are implicit and which cannot be changed? These are basically coming under the scope limitations.

Once you write down all these things in a proper way that becomes the mission statement for developing the new products and this is the first thing we need to have if we are going to develop a new product or a modifying a product or redesigning a product. The first thing we need to have as a document is known as the mission statements, which will clearly tell you what you are trying to do and what are the basic goals of these design processes? Who are the primary people who will be buying the product? What are the ways in which you can improve the product? All those things are listed here, that becomes your mission statements.

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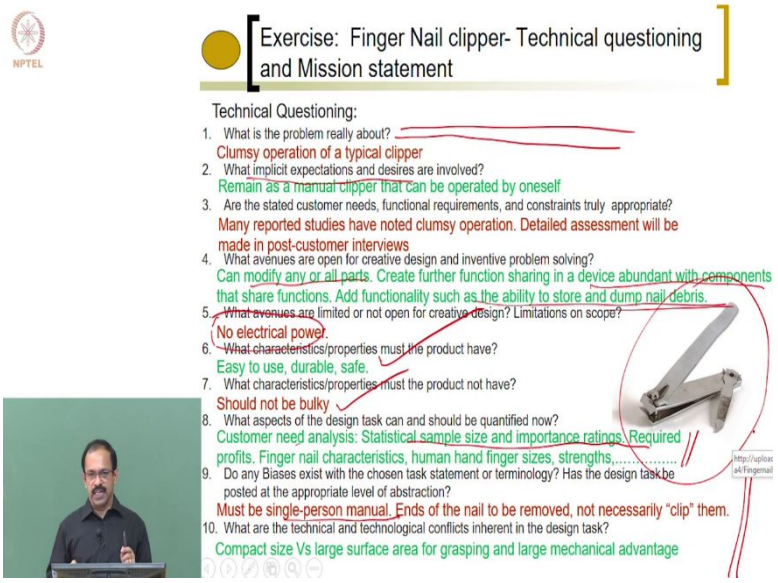

Any questions? Alright take an example, just quickly go through an example how do you use this technical question for a new product. How many of you use these products? I asked this question earlier. How many of you use these products? All of you, is there anyone who has not used it. How many of you felt that it is not a useful product, or any problem with this product have you felt that there is a problem in these products.

Speaking about a nail clipper. Do not get the shape, then the chance of getting cuts, injuries then left hand and right hand cutting is difficult then? What will happen when the nail cuts? It

will fly away, you do not want to search for it than any other problem too small, you have to apply some force it may rust and if it is nail then blade is not shape then through it you cannot increase the sharpness.

All of you know there is a problem. Do you want to redesign it? How many of you will be interested in redesigning it. We will answer this question first and prepare a mission statement for that redesign. What is the problem really about hearing you, we can write many problems, do not give a proper shape, force is an issue then nail flying away is an issue, it may become rusted forces in some problem, we have to carry it. So there are many problems so you can actually write down those problems as the issues with the current product you have multiple problems.

For the time being I will simply say a clumsy operation, it can also be specific for the time being “the clumsy operation”. Next question is more interesting, what implicit expectations are involved? what you can say in this case?, what will be the implicit expectations of clipper from the customer.

Student: Long life

Professor: Long life there is no other customer need but implicit they do not tell you that it should be like that

Student: Safe to use.

Professor: Safe to use but, the important thing is if you want this to be electronic, actually have an electronic camera which will have size of the nail and apply force to moderate all those things and do you anybody accept the product.

Implicitly people expect this to be mandatory. They do not expect you to come up with a big machine and there you put their nail there and cut them. That is not the expectation of the customer. The implicit expectation is that it should be a manual one and it should be, it should not be very bulky and all these things are.

The main expectation is that it should be manual and I should be able to use it with both your hands, you do not want this to be used by another person, to cut you should be able to use it yourself. So, manually operated single person use is the simplest expectation of a customer. That is basically known as implicit expectations, no need to express it remains as a manual clipper that can operate by oneself. If you said that I have a new design where you need to have a 230 volt power supply you have to plug in nobody will say I am not interested in that kind of a clipper. These are the implicit expectations of a customer. Then the customer needs functional requirements and constraints truly appropriates this. Actually basically you do not understand many of the reports there which are telling this is not good, there is a problem in that and therefore I think that this can actually improve.

What is the time, it's time to stop, so I will just go through these questions and then answer the probably will discuss this in the next class again. This is important what avenues are open for creative design. Can modify all parts sharing in device and additional functionality to store and dump nails. You can have an additional functionality where the nails will be stored and you can actually collect it and dump it.

And what avenues are limited you cannot have an electrical power you have to be a manual one, easy to use, durable, and safe are the requirements product must have and it should not be bulky and then statistical sample size and important rating you can say what is the approximate size of the nails, what is the approximate force needed. And it must be a single person manual that is the bias, you are saying that bias towards a manual one not an electrical one?

And what are the conflicts? compact size versus large surface area for grasping and large nail cutting, these are the expectations or the questions to be answered before we disperse and based on these answers you can actually develop a mission statement. In the next class we will do one more exercise. Doing yourself for this and explaining this I will ask you to do in the class.

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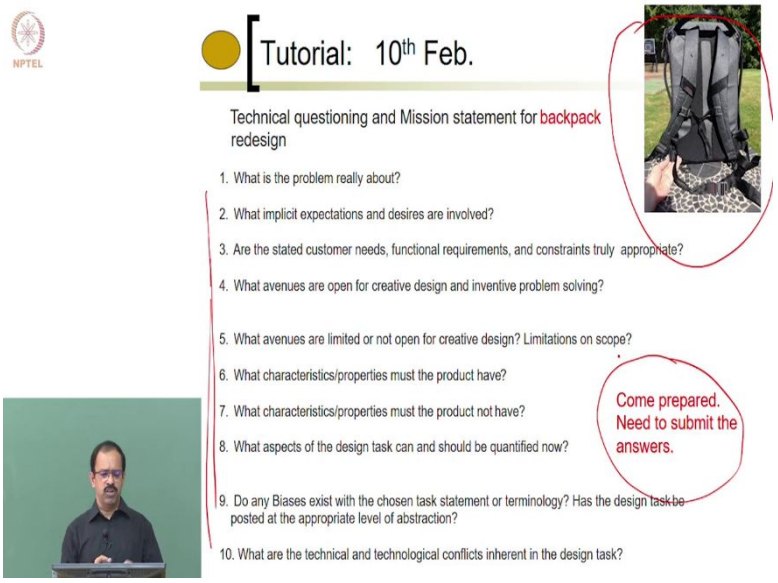

That will be for this one so on 10th February there is on Monday I think. So, I will be asking you to redesign a backpack. You have to come up with the answers for these questions: what is the problem, what are the issues and how do you answer this question and based on that how do you prepare a mission statement. This will be a class exercise. Please come up with

the A4 sheets and then you have to submit the answers in the class. You will get 20 minutes to do this task and you have to submit so it becomes your first tutorial in the class. Thank You.