Functional and Conceptual Design
Professor Dr. T. Ashokan
Department of Engineering Design
Indian Institute of Technology, Madras
Lecture 5
Stages in New Product Development

So, what are the 2 development processes we discussed in the last class?

Student: Stage gate process

Professor: Stage Gate Process and Spiral Design Process, right. So, when is the Stage Gate process used? Anybody? Or when a Spiral Gate process? Spiral process used basically when it is a time compressed industry where you need to bring out the product at a particular time you cannot wait or what or maybe the dealer you need to release the product; such kind of companies normally use Spiral Design process.

So, most of the consumer products or most of the other products, other than software normally go for a Stage Gate Design process. So, what is the Stage Gate process? As the name suggests, you have different stages and at the end of each stage there is a gate which will evaluate the progress in that particular stage and if it satisfies the conditions for going to the next stage, it will pass the gate and then go to the next stage and like that it will continue multiples stages and gates it will reach the final stage and the product will be released that is basically the Stage Gate Design process.

So, what is the main difference between Stage Gate process and spiral process? Yeah, in Stage Gates you have 100 percent complete product at the end of 1 Stage Gate process, and spiral process?

Student: Multiple stage gate process

Professor: Yeah. So, spiral is basically a multiple Stage Gate process. So, you will have 1 Stage Gate process completed, you have a product, but it may not be 100 percent complete then it will go through 1 more Stage Gate process and then you will have another product which is still not complete and like that it will go multiple Stage Gate process and finally, you will be having a product at the end of 2 or 3 Stage Gate process that is basically the Spiral process.

So, we looked at the Stage Gate process and then I talked about some of the most important stages in Product Development. So, we discussed 3 important stages in any product development and went for a Stage Gate process. We talked about 3 important stages. What are these stages? Understand the opportunity, develop a vision right or develop a concept and third one?

Implement, so these are the 3 stages in any product development. You take any new product development or a product which you want to modify. For example, all of you are using cycles, right. How many of you are not using cycle, ok, all of you are using cycle. Are you happy with the cycle? Yes or No. There are some no's also. So, when you say yes, you do not see any opportunity to develop a new product, right because you are happy with the products.

Unless somebody comes with a better product, you will be happy with this product, you are not going to design anything or you are not going to think about that new product. So, if you feel that this product is not good, or this product can be improved, then you are actually seeing an opportunity to develop new products. For example, you see that your cycle is very difficult to pedal in the morning, you are in a hurry and you are here to pedal all the way. By the time you reach here it will be sweating all the way and you feel very uncomfortable.

That may be 1 reason why you are not happy with it or you feel that you have to put a lot of effort to do the pedalling. Somebody will think that, ok why cannot we make a new product or a new bicycle which you do not need to put this much effort into. That is the starting point for a new design.
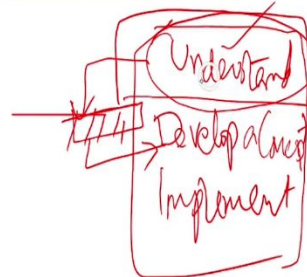
You may decide or you may tell somebody else someone else to design. But that is the first stage where you try to identify an opportunity to design a product, that is the opportunity where you feel that, ok, there is a problem with the existing product, I have an opportunity to design new products, but that alone is not sufficient to design a product because many people would have thought the same thing before you, you are not the first person to use cycle or you are not the first person to feel that there is a problem with the cycle.

So, there might be a lot of other people who thought about it and then dropped it because of various reasons.
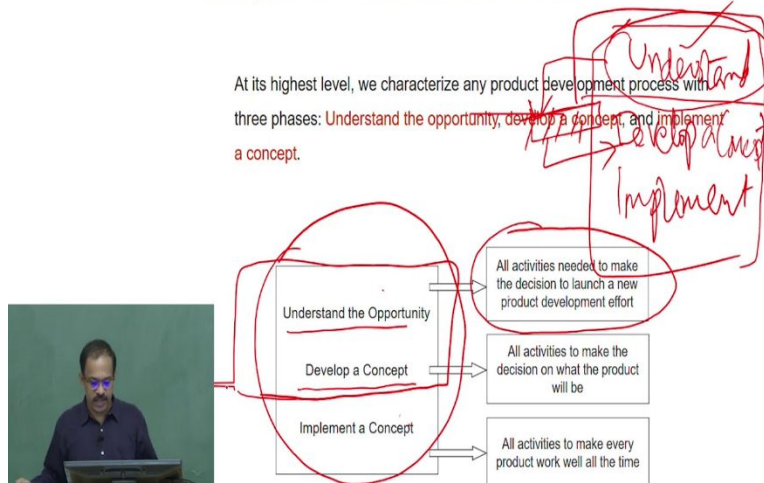
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Product Development Stages

At its highest level, we characterize any product development process with three phases: Understand the opportunity, develop a concept, and implement a concept.

Understand the Opportunity — All activities needed to make the decision to launch a new product development effort

Develop a Concept — All activities to make the decision on what the product will be

Implement a Concept — All activities to make every product work well all the time

'The understand the opportunity' is basically looking at that opportunity and then see, is it really worth going ahead with that opportunity? Yeah, because you may be unhappy with the many products, ok. You may be unhappy with the teacher, you may be unhappy with the classes. But you do not have much of an option, right? You need to come and then listen. The point is just because you are unhappy with the product or just because you do not feel that the product is good, that does not mean that there is always an opportunity. You have to do a lot of analysis to see where there is a real opportunity or not that is basically known as understand the opportunity.

It is not only identifying an opportunity, but understand the opportunity based on various factors, that is the first part and the once that part is clear, you are actually working through a gate and this gate will actually analyze, is there a real opportunity and if it passes through this, then it will go to that develop a concept stage. These are the 3 important stages. They are understand the opportunity, develop a concept, implement the concept.

There are multiple activities and all these activities which are needed to make the decision to start a product design is basically the understand the opportunity and all activities to make the decision to which is what the product should do and what the product will be doing is basically

develop a concept and implement the concept is basically you make the product as state and then prove that everything is fine and then release it in the market.

These are the 3 important stages in the design of a new product: understand the opportunity, develop a concept, implement the concept, these are the 3 stages which you will be going through when you start designing a new product. We will be focusing only these 2 aspects. Because for implementing a concept, you require a lot of other engineering inputs. We will be talking about how to understand the real opportunity to design a product and how we develop a concept to design a product that is basically the functional and conceptual aspect of the design.

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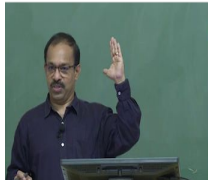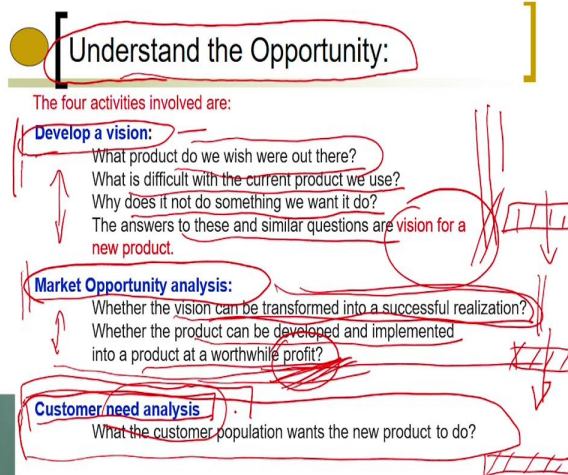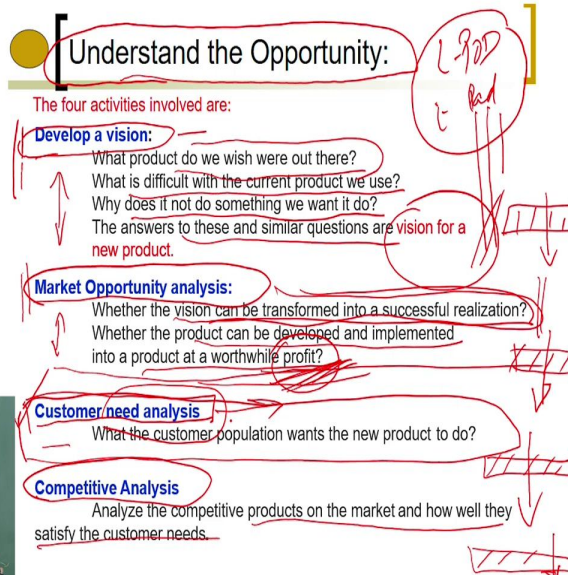
Let us look at the understand the opportunity and then see what are the different stages involved in that because as I told you, it is not just that you are unhappy with the product is not their opportunity always, but maybe that may be 1 of the opportunities one of the activities.

So, understand the opportunity can actually be divided into 4 important activities : develop a vision for a new product. That is, you need to have a vision for a new product to come to the markets. That is the first stage in understanding that opportunity. What product do we wish were out there? That is where actually you are interested or you are on imagination or you are on understanding you are not happy with the existing product or you feel that there should have been a good there would have been a good product which will meet your requirements.

This is how we actually load new products when I say that I am not happy with this projector. I feel that ok there can be a much better product than this that is actually a starting of my vision for a new product. Similarly, and you feel that your specs are not good. So, having specs is not that convenient, most of you are using facts, you know that it is not that easy to use as practice you have a lot of difficulties.

And sometimes if it is broken, you have a difficulty in reading, or you need to maintain it or you need to change it every 2 or 3 years. But there are a lot of problems with the specs. Like this, when you have such things, you will see that ok, well there should be a better product to handle these things. That is the first part. What product do we wish were out there? The second one, what is difficult with the current product we use?

What is the difficulty? What are the difficulties that we face? When we are when, when have current products? And what are the difficulties we have? And why does it not do something we want it to do? What makes it not possible to do things which we want it to do? Again, taking the example of a projector, I do not want to connect this and then look for the compatibility issues. So, that is the problem that I am facing with this and why is it not able to do that?

Why cannot it directly connect to the projector or can we have something else to do this? So, these are the things which actually will lead to having vision for a new product, the answers to these questions and similar questions are vision for a new product. You are either not happy with the current products or you feel that the current products are not able to do things which we want these to do.

Or there are some difficulties with the current product in executing what you are expecting. All these will lead you to think about a new product or vision for a new product. So, that is the vision for a new product or the call just 'develop a vision'. So, we want to develop a vision for new projects. But all of us can have hundreds of visions. We can always think about a lot of things as vision.

I just want to fly from here to the hostel. It is a vision for me. I do not want to cycle. I do not want to walk. I do not want to run. If I start from here, I can just fly. Yeah, with my backpack by pressing a button on my backpack I will be able to fly. That is a vision, right. You can have like that you can have hundreds of visions, but then are these visions a feasible one, is there a real opportunity into developing that or is this a feasible thing that is the second stage, which we call as the market opportunity analysis.

You have a vision for developing new products. Yeah, that is that vision you feel that, yes, the current products are not good, they are having a lot of difficulties in, I mean, meeting our requirements or our expectations. So, I want to develop a new product, somebody says I want to make an electric cycle simple. So, you are not happy with your bicycle. So, you want to say that, ok, I do not want to pedal every day from my hostel to here.

If it is an electric cycle, it would have been much better for me so that I do not need to pedal. I just get into the cycle and press a button, you just take me. So, I will just simply sit there like any other automobile, let us say, vision. But then the next question is, ok, so if I develop this, this is someone going to buy this or it will be only me who will be buying this or using this. And then there is no point in making it.

Because whenever you develop a product, you have to sell the product in the market. And if you are not able to sell it, there is no point in making it as. So, the second aspect of designing the product is to check, is there a market for the product? The market opportunity analysis that includes whether the vision can be transformed into a successful realization. So, in the case of a cycle, it is not that difficult to convert their normal bicycle, electric bicycle, many people are that right?

It can be transformed into successful realization. It is not very difficult but then if you have a vision that I want to fly, I do not want to use a cycle. I do not want to use any other thing. I just want to fly from here. It is not that easy realization. So, you need to check whether your vision can be realized or can be transformed into a product through some realistic means. Is there a realistic way to transform your vision to reality or to your products?

That is the first question we need to answer. And whether the product can be developed and implemented in a product that they are worthwhile profits. So, any development, any design or any product coming into the market, the ultimate aim of the designer or the person who actually developed is to make profits because it is not for a charity, not a charity work. Any business or any entrepreneurial activity should lead to profit.

The market opportunity, we will look at it this way, is there a way we can get a profit in this business? That is the ultimate goal of market opportunity analysis. So, you do a lot of surveys, market surveys, cost analysis, development costs etc. And finally, check, can this be developed? What profit can we get out of this business? When you feel that there is a good market for the products? There are a lot of people ready to buy this and the cost of production or cost of the product will be reasonable and can be, it is an affordable one, then only you will get profits, ok.

Therefore, you need to make sure that there is a profit possible in that, you know, that actually depends on the type of investment you make. But normally, consumer products will be within 2 years you should be able to make profits, but then medical devices that someday it will take 5, 6 years. So, depending on the product, then the level of investment you make may vary from 2 years to 5 years, 6 years.

Of course, you do not get the profit immediately. But the question is that is there a way I mean, you will see that the product naturally be market debt with their ultimate profit at the end of 1 or

2 years depending on them, but this will be actually understood when we do a market analysis and then we prepare a project plan it says that, ok, first year to invest this much money and you will be having only very less income the first year, second year investment may come down, but your revenue may go up and that of 2 or 3 years you will start seeing that you are getting money.

That is the way how you do the analysis. So, that is the second one in understanding the opportunity. First, you need to have a vision, second you need to look at the market and then see whether it can be sold in the market with a reasonable profit. The second 1, ok now, you did this analysis and then you found that, ok, your vision is very great and your market opportunity says it is good and there is a good profit that you can make.

This is the stage and then you will be having a gate here then you analyze and then you come to this stage and then again you will be having a gate here and the market opportunity also tells that it is a good opportunity there is a good profit possible, then we take you to that next stage. That is the customer needs analysis and this seems to be the most challenging task because so far you talked about your own vision only.

You had a vision. That is why you thought that ok, it is a good product and you wanted to design it and then you looked at the markets. Looking at it from the commercial point of view only, what is the commercial aspect of it, how much money you can make? And now the question is once you decide to develop the product, it is not that you are going to use it or you are not the only person going to use it, it will be used by a large number of people.

You need to know what they are looking for in the product that is the most important because you need to provide what the customer is asking in the product the customer is expecting in the product. That is where we need to do a detailed customer need analysis to know what the

customer population is expecting in that product. And this will be the most interesting part. Because whatever you thought about this product.

When you go and ask the people, they will say oh, this is not what I want. I want something else, or I am expecting this in this product. I do not want to just look for an electric cycle. You thought that the electric cycle would be the great thing. But then people said no, I am not looking for an electric cycle. I am looking for something else. I do not want this to be a 2 wheeled 1 because balancing is an issue or my problem is not about the electric pedalling my problem is with respect to the tire getting punctured or the maintenance I need to make or the theft of my cycle, these are my problems, why are you worried about electric cycle.

Similarly, you will see that there are hundreds of needs for the customer, which you thought is not at all important. So, this is where you will get a lot of insight on the product, saying that what you need to give providing the product may be completely different from what you thought of providing the product. And the important aspect is that if you are not able to provide this in products, the customer is not going to buy the products.

So, understanding the customer is 1 of the most important and sometimes most difficult parts of product development in the first stage itself, that is we are in understanding the opportunity, you guys with the customer say something and you are not able to provide, then there is no opportunity to develop products or opportunity is lost. So, what the customer population wants the new product to do is very important in understanding the opportunity.

And there are different ways to do this. There will be a lot of methods, which we will be going through in detail later. What are the different ways in which you can develop the product? So, his question was, can we have the customer need analysis first and then put it under the vision? That

was your point. Yeah, see this one is? See first you, you try to start the products. I mean, you have to have a vision for a new product.

Then only you can go to the customer and ask whether you like this or not or do you want this or not? If you simply go to customer you do not know what to ask the customer because you do not know what product you are going to make unless you have a vision for a new product that is why you need to have a vision for a new product you should have an idea yes it according to my own understanding this may be the right product for the people may looking for.

And then only I can go and find out from the customer what they are looking for in that product again. So, if you are saying that ok, I can go to the first customer and then ask what they are looking for. Then it is not for the need to analyze the thing, it is more of what kind of products they want in the markets, ok. So, we are not looking, asking about what kind of products you want in the market.

And we are trying to find out. Yes, I am going to make an electric bicycle. What kind of things you expect in the electric bicycle is basically the need analysis. I am not asking whether you need an electric bicycle or what do you call a separate modern mobile phone? I am not asking like that I am not asking whether you need to have a better washing machine that does not need analysis that is more of a customer's vision for the product.

So, you are not working on the customer's vision for the product you are working on your own vision for the product and then trying to see whether that vision has an opportunity or not. Yeah, so the only thing is there is no misunderstanding customer need analysis basically, we are doing in order to find out what should be there in that product. So, that the customer will buy it, ok.

No, no see market is basically is there a market for electric bicycles or not? There is a market analysis we are doing. Yeah, how many people are using cycles, how many people will be interested in buying an electric bicycle but your own estimate on me, and then what will be the approximate cost of a bicycle and security to cancel? Is there a way to make a profit out of that. So, we are focusing on that particular segment of the market and then we decided to make an electric bicycle.

Now, we need to find out what are the things needed in the electric bicycle, we are only focusing on that electric bicycle product and whether they like to have it as a combination of both pedalling and electric or only electric and if it is electric, what should be the duration of charging or what kind of charging to be there what kind of battery to be indeed and will approximate cost they are expecting.

These are the basic customer needs of that product, ok, not for multiple products we are trying to find out. This needs analysis basically to ensure that whatever you develop will be sold in the market because it actually meets the expectations of the customer. Got it? Yeah. So, that is the customer needs analysis for the existing product you wish to bring into the market to understand what kind of expectations are there for the customer in this particular product.

And finally, we will do a competitive analysis, analyze the company's products in the market and then see whether you can really compete with the other manufacturers in the markets. If at all there is a competitor, if there is no competitor, of course, you do not need to do it directly, but you need to do an analysis to check whether someone can actually come into the market and then start a new product like this.

Is there a potential competitor coming up in the future or how easy or difficult it is for a competitor to come to the market? That is the competitive analysis, analyze the competitive

products on the market, and how well they satisfy the customer needs. So, if there is an existing product, you can find out whether this is actually meeting the customer requirements or not if it is not meeting the customer requirements, what are the issues and how you can address those things.

So, that is basically the competitive analysis of the product. So, if you do all this analysis and at the end of this gate, so you have stages and gates and you cross this gate, then you are saying that, yes there is a good opportunity to design a new product that is the first stage of product development understanding the opportunity. You need to have a good vision for a product. You should be able to analyze the market opportunity analysis to say that ok, you will be able to make the product and sell with their reasonable profits.

And once you are sure of that, do you look at the customers' needs and then see whether you will be able to meet the customers' needs or not. And then finally, you look at the competition in the market, how many people will be competing with you? Or how can you compete with the existing people and still make profits. So, these are the steps you need to go through or the stages you need to go through to come to the next stage of developing a product.

I will be discussing it separately. There are 2 ways to look at the product design 1 is that the customer does not know what we are capable of. I will make a product then sell in the market, ok. The other 1 customer is asking for something, let me satisfy that one, ok. These are the 2 ways in which you can do but in whatever the issue is, whatever maybe the methods, it is always good to know what the customer is looking for.

See, for example, you know, iPod. iPod, you can say iPad also the customers were not asked for iPad or iPod right they never did that and looking for an iPod or there is but the company thought

that there is an opportunity for that, that is their vision. So, they had a vision of developing a product, which will actually change the way people listen to music or people use the computers.

So, that was the vision of the company. Then they did not simply make it and then started selling in the market. So, they went through the market opportunity they tried to find out is there a reasonable profit that you can make, but then it is they also go through a customer need analysis, basically, they know what they are going to make. So, they will try to find out what will be the approximate requirements of the customer.
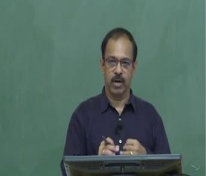
So, these customers will be a select group of people who can actually be told about the product, what they are trying to bring in and what they, what is their requirement? If something comes up in the market like that, whether you will be able to buy it or whether you will be what kind of things you want this 1 to be available in that product. So, what kind of a market survey do customers need to analyze?

The reason is that they do not want to make the product and then later on realize that oh we missed that 1 because people were actually looking for this, they did not we did not get it or we could not provide that. So, to avoid that there will always be a customer needing analysis, ok. So, if you look at the end of any product, now you can see there are many products which failed in the markets mainly because they could not capture the customer news properly.

And sometimes because of technology changes and many other things will happen but mainly when the customer's needs are not properly understood. Then the product may fail. In the market, there are a lot of examples for past products failing because of no focus on customer's needs. So, there are methods to analyze the customer needs, we will go through some simple exercises later

on how to analyze the customers' needs and then try to convert that into product requirements. So, that is the first step understand the opportunity.

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At the end of these 4 activities, the design team understand the state of the company to market the customer population and any available technologies. A gate evaluation can be done. So, gate evaluation will be done at the end of this to decide whether to proceed in the development of new concepts.

That is the outcome of this understand the opportunity, you will have a gate analysis and the team and the higher management team will analyze all these findings and then decide whether to go for it or not, and they find that the market is not there. They may stop it also. All of you know about Nano cars. Was it a success or a failure, failure? Success. How many are saying success?

There are many people who say it is a success. And many say that is failure, so tell me why do you think it is success? What is the reason? It was cheap, cheap, affordable, and popular. Yeah, that is the word actually you call their success, Yeah. Somebody said failure now. Yeah, why was it a failure, so why does he say it failed.

Student: Design is bad

Professor: So, he says it fails because the design was not good. And the advertisement was not proper.

Student: Not affordable

Professor: It was not affordable, So, see affordability was 1 customer need, they thought that it would be a better thing and probably they did a customer need analysis to find out what is the approximate cost of the car that can be that is considered to be affordable, So, they put it as 1 lakh in the beginning. I think now it is 2.5 or something like that. But see 1 way in terms of innovation that was a good product. Yeah.

Because no 1 nobody in the automobile industry ever thought that you can have a car for 1,500 dollars. I mean, in terms of US dollars. Nobody thought that and they actually went through a lot of design processes. Which actually made it possible. They redesigned almost all the components of the car to make it cheaper, affordable because all Indian designers, Indian companies, rework their designs to get the product at an affordable price.

So, in terms of innovation, it was a good product. In terms of course, it was good. I think in terms of performance also, it was a good car, no doubt about it. I mean, people could actually accept that the good part in terms of power and all that up of course, the sound was a bit arrogant, I mean, not that comfortable. But why does it fail?

Student: Not safe

Professor: Safety, so safety was 1 concern. Yeah. Not profitable. Yes. Pardon? They could not compete with other cars. There was no other car in the same segment actually. Yeah, but see a very strange reason probably you can find the failure of that car. So, when they advertised the car, the advertisement was a poor man's car. That was what they advertised as a poor man's car. How many people will like to call this poor? See, nobody says that I am poor unless I get some money from the government.

Otherwise everybody will say I am not poor. I have money, I think why I should be called a poor man. So, when you drive it, Nano, others will think that you are a poor man. So, nobody wants to get that tag of a poor man that actually adversely affected the markets. Many people thought, 'Oh, that is a poor man's car, it is not for me'.

And nobody really wanted to be tagged as a poor man, whether they have money or not, independently, I mean, if you ask anybody, they will say I am not poor, I am also rich like you can because it is very related to the term poor and rich right. So, 1 of the reasons why it actually could not capture the market though it says what are the performance and everything only they tagged it as a poor man's car.

And then people did not really want it to be tagged as maybe that might be 1 of the reasons why the people, I bet people did not go for that car. So, that was just to tell you that many things will affect the side such as a product, the second stage in the product development, develop a concept. So, once you are sure about there is an opportunity to design it to make a new product, then you start to start developing the concepts.

So, you have the customers' requirements, are they understood? So, you need to see what the product must do to supply the customer satisfaction. So, to supply the customer satisfaction through customer need analysis, you try to find out what are the requirements of the customer and once you understand the requirements of the customer, it is the job of the designer to see how to satisfy the customer.

This is where the creativity of the designer comes into picture. Because customers will tell, "oh it should look nice, it should be affordable and I should feel proud of using the despite product." So, this kind of very subject to customer needs will be mentioned. It is the job of the designer to see how we can convert the subjective requirement of the customer to object your design needs and then put that into that product when the customer says, it should look nice, what do you do as a designer?

You only the outer part you want to make it very attractive or the customer says should be very comfortable to use. What do you mean to be comfortable that comfort basically depends on various factors? So, the designer needs to check what the product must do to meet the customer's expectations or meet the satisfaction of the customer. And this can actually be done through something called the functional modelling of the products.

We need to see what kind of functions there are in the product to meet the customer satisfaction. Customers say it should be comfortable to use. It is the job of the designer to see what functions will make the customer this comfortable? What are the functions that can be in the product to make the product comfortable to use for the customer? So, this is a challenge because customers will not be telling you what you should do in the product, they will say it should be comfortable. Yeah.

And the cycle when you ask the cycling user, he will say it should be I should use less effort simply he will say the effort to be to drive the cycle should be very less or it should be almost 0 efforts. Now, it is the designer to find out how to make the effort 0 or how to make the effort very less. And that is where you try to identify the functions in the product which will make the efforts 0.

So, this is basically known as functional modelling of a product. So, under the functional concepts designs we will be going to that functional modelling later once you do the opportunity analysis, then we will look into that functional modelling and then we will look at the architecture of the products that is and there will be multiple components in the product, how do you actually bring them together?

You have electronics , you have electrical parts, you have mechanical parts, we have displays or you have some other safety features, how do we arrange them properly in order to get the product suitable for the customer that is basically known as product architecture development. So, the functional model and alternative product architectures set the stage for effective concept engineering. So, that is that conception, development of the product and sometimes you do not develop many concepts to implement the functional specification and later on, you choose the best concepts to take to the next level of implementing the concept.

You develop you look at the customer's needs Develop the functional models and then look at the architecture and based on these develop a lot of concepts to for the new products and out of these many concepts, you take the best concept out of it and then develop it as a prototype, prototype development, testing and then taking it to the market. So, that is concept engineering. So, the second stage first was to understand the opportunity, the second was to develop a concept and the last 1 is basically implementing a concept.
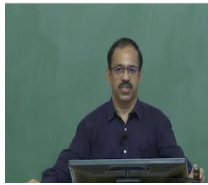
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So, this part is more of CAD modelling, stress analysis and making sure that these meet the requirements and then making a prototype testing all those things. So, we will not be discussing these in detail in this course, but that is to tell you that is a third stage which you will be learning later as a separate topic and design of mechanical systems or electronic systems etc you will be understanding these things. So, that is basically the 3 stages of product development, understand the opportunity, develop a concept and implement a concept.

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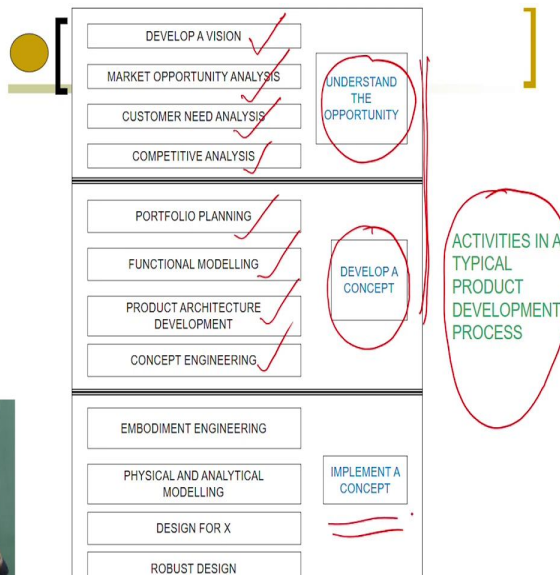
So, to summarize, so, these are the 3 stages activities in a typical product development process, you have understand the opportunity, and there you have developed a vision, market opportunity, customer need analysis and competitive analyze these 3, these 4 will be the part of understand the opportunity, then you have a developer concepts.

These are the different state things we will be doing: portfolio functional modelling, architecture, concept engine. So, we will be discussing these in detail in the classes. The classes are coming up next week. Yeah. Most of these will be discussed in the next 2 months. And this 1 will not be discussed in this course that will be done later.