Functional and Conceptual Design
Professor Dr. T. Ashokan
Department of Engineering Design
Indian Institute of Technology Madras
Lecture 04
Stage-Gate and Spiral Design

Okay so in the last class we discussed various types of product design. What are the three types of product design we discussed? Yes, original design, adaptive design and variant design, right?

So, what is redesign? Yeah redesign, is designing a product. Suppose you have a product. You want to modify it or you feel that something is wrong with that product. The product is not doing what it is supposed to do. Or it is not meeting your expectations. You redesign the product or you make new products, redesign it and this redesign can be done through anyone of the three design methods, right?

You can either use a completely new design, innovative design you can go for or you can adapt an existing technology or an existing product to meet your requirements. Or you can change the dimensions and characteristics to get a variant design.

These are the three designs, three kinds of design that is existing which is normally used for designing a product. Today we will discuss what are the methods by which the products are being developed. We call it a method or process by which products can be developed. As I told you product design is a process. There are different steps involved in designing a product so we look at what are the different processes normally used by industries to develop new products okay.

There are different kinds of products. For example, you have consumer products, you have products which are very heavy or which are used for heavy industries. There are products

which are software in nature, software kind of products. So, there are different kinds of products and the same kind of product development process cannot be used for all the product development.

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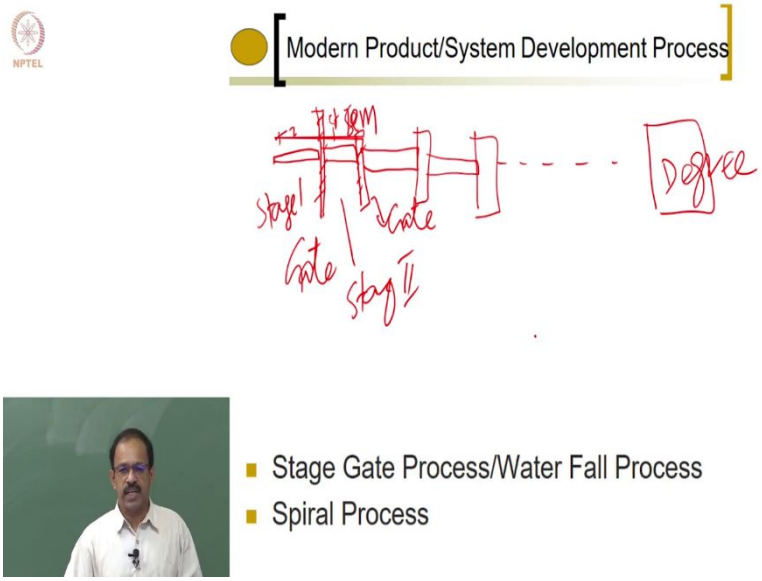

We will be discussing the two important processes normally used for designing a new product. The first process can be compared with what we normally do in all our activities or our routine things. For example if you take education as a product, though it is not actually a product. But you will take our education system. So what do we do? We will have… So what do you do before coming here, is basically you have plus two education, after plus two what will you do to come to IIT? You will write JEE, right? So I will say, JEE is a big gate for you. So what will you do? You jump the gate or you cross the gate? You will try to cross the gate. And then you come here, you are 1st year or 1st semester. Okay, you have your 1st semester. At the end of 1st semester what will happen? There will be an end semester examination, so I call this as a stage 1 and then I'll say there is a gate, then you have stage 2, and then you have a gate here, then you cross that gate, you come to your next stage, second year or second semester, there is a gate and then you come to the next stage, you come to the gate and at the end of this you have a degree. Right? So, every stage you have a gate and after you pass the gate you will go to the next semester, next year and finally when you cross all the gates you will get your degree, right.

So, on some gates there will not be any stopping of you. You will be asked, allowed to go forward even if you fail in that gate. You will say, okay, we will try to give you some supplementary examination or some kind of extra coaching or extra period. You go somewhere but at some point, fourth semester or at the end of fourth semester if you do not qualify your first semester it is not completed what will happen?

You will be sent out, right? You will be sent out and say that; no, you are not fit for this. Either you finish everything and come back or you can drop it. Do you know about that? Yeah, there is something like fourth semester, if you want to go to fifth semester you have to complete your first semester all the courses otherwise you will not be allowed to go to fifth semester, okay. Something like that is there.

Then every semester you have to complete some particular credit requirement. If you do not submit, complete your credit requirements, Dean will send you a letter you have been removed from the rolls, okay. Then you need to give a separate application, bring your parents, make a request then you will be readmitted.

So, every stage or the end of every stage there will be a gate which will stop you from going forward. So, this kind of process or in product design also we have this kind of a process where we go through stages and gates and that process is known as a stage-gate process. So, this is one of the most commonly used product design processes. It is known as a stage-gate design process.

You have stages, then you have a gate, then you have another stage, you have a gate, another stage, and you have a gate, like that. For example, if you want to design a product, you feel

that, okay I have a fantastic idea to design a product. What will you do? You immediately go and make the product? No.

What will you do? You try to find out, okay I have an idea but is there anyone else interested in that idea? Or if I make a product, somebody will be buying, ready to buy it? Or is there any real use for the product? We need to do some kind of a market survey or identify the real need for the product.

Okay and then if you do all this and you find that oh, yeah I found all these things are really good and there is a good market and then you go to the next stage of developing concepts and go further, like that. So, the first stage will be analyzing the market requirements and market needs, then you have a gate, you analyze it. And then if it is crossing then you go to the next stage, like that you will keep moving forward in the gate. So, this kind of design is known as the stage-gate design process.

Okay that is the first method that we will be discussing about the product design process. And there is another kind of product development which is known as a spiral process, a spiral design process. So the spiral process. So, these are the two important methods or the process by which products are developed by industries.

If you go to any industry as a designer you will see that they will be following any one of these methods. We will see what these methods are and then see how these methods are different or how these, what is the difference between these methods and when do you use a stage design, stage-gate process or a spiral design process, okay.

Sometimes the stage-gate process is also known as a waterfall design process because it actually falls step by step so we call it a waterfall design process. These are the two

processes, stage-gate process and spiral process. So, let us look at what is a stage-gate process.

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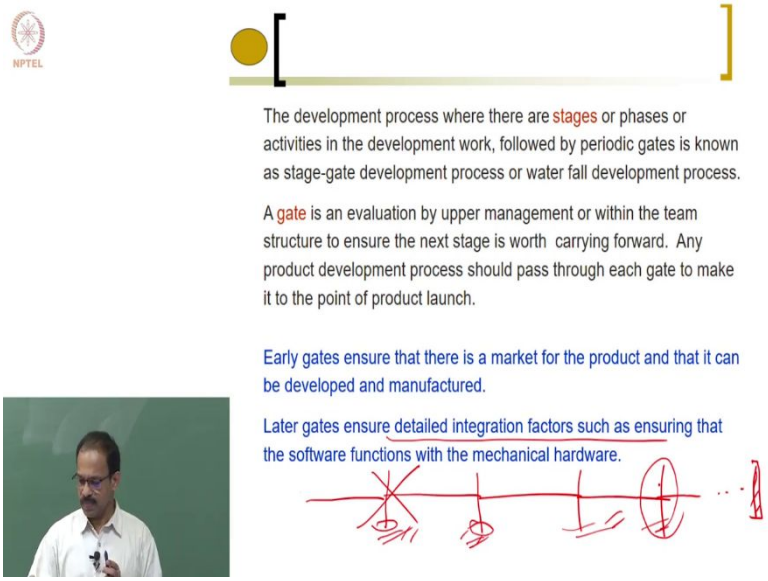

So, the development process where there are stages and there are gates where at the end of each stage somebody evaluates the stage and then decides to cross it or stop it. If you cross the gate you go to the next stage. If you do not cross the stage you stop there. That means you do not take the product to the next stage. So, this kind of process is known as the stage-gate process.

A gate is an evaluation process where a higher-level management will check the findings in stage 1 and then say, yeah your findings are good, and your progress is good so we go to the next stage of development. So, that kind of a design process is known as the stage-gate design process.

Any product development process should pass through each gate to make it to the point of product match. And only at the end of the process you have a complete product which can be used for, used by the customer or the user. That kind of process is known as the stage-gate design process. Got it?

Okay, so now I said there are multiple gates. So, you have a stage, you have a stage then a gate, then a stage, gate like this it will be going. And at the end of this you have a final product. So, there will be multiple stages. The initial stages or gates, these are the initial gates, these stages are basically to ensure that there is a good market for the product, it is feasible to develop a product, there are people to buy the product and the cost of the product will be suitable for the customer.

All those things will be analyzed in the initial stages; that is to ensure that there is a good market for the products. And if there is no market there is no point in developing the product, right. So, the initial stages are basically to ensure that there is a good market for the product. And then the later gates, so the gates after that will be more on the design of the product.

So, identify the important requirements of the product and try to develop concepts then make a prototype, testing all those things. So later stages, they ensure that the proper integration of electronic, mechanical system, power supply all those things are good. It is working well. Its appearance is good. All those things are ensured in the later stages.

And normally initially stages if they feel that the markets are not good then they will actually stop the product development there itself. Means that okay, there is no market. Let us stop the product. Let us go to the next product. For some products they will cross this and then reach this stage and then some stage here, they will feel that, oh no, the technology has changed suddenly. Now, if we go with this product nobody is going to buy this product. Let us stop this or let us modify the product to something else.

So, they may stop the product here but they do not completely scrap the project. They will try to see how this can actually be modified to a better product. So, that kind of analysis will be done at the later stages. So normally, early stages product will be scrapped, product will be,

they will decide not to continue with the product but after some time, or it has to go through a particular level then it is not that good to scrap the product. So, they may modify the product to some other thing else.

That is why you see many companies; it starts developing products and then halfway through they will decide no this cannot be taken forward or there is a competitor already came up with a product so you will not be able to compete with the product. So, like that they may decide to scrap the product. So, that is basically the later gates that they will be doing.

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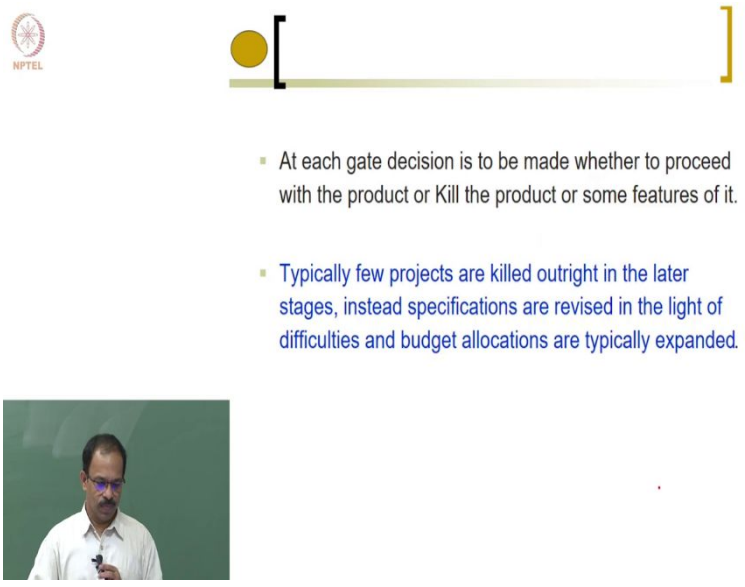

So, at each gate the decision has to be made whether to proceed on further and as I mentioned typically few projects are killed outright in the later stages. Only very few projects will be killed in the later stages because they may modify it to a new product or a new design. That is what will be happening in the stages, later stages of product development. Okay, any questions on the stage-gate process? We will find out what are the different stages in product development later but this is one of the processes you do.

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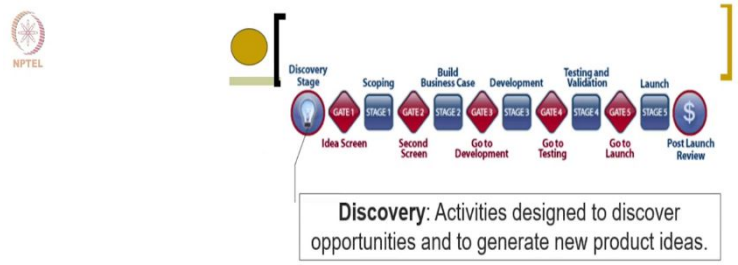

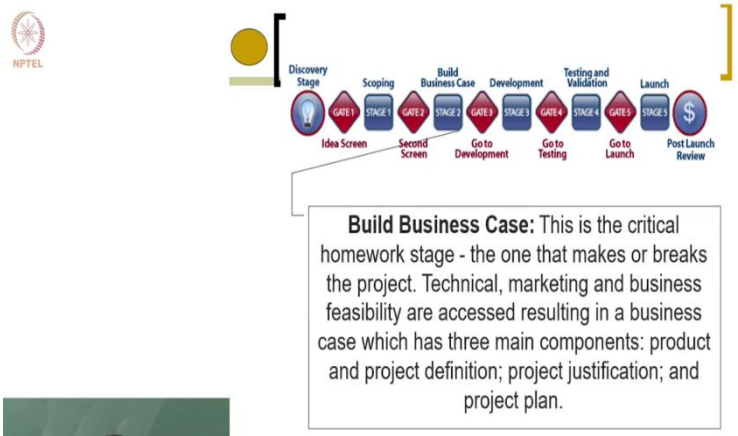

Okay so if you look at a typical product design cycle, it is a very typical one. So, first you have an idea of developing a new product. That is the first stage we call it as a discovery stage. First you have an idea, oh I have a new method, a new technology or a new idea to develop a new product. That is the first stage. Then we will screen that. That is the gate.

We will screen, if the idea is good, if it is a feasible idea where it will work it can be converted to a product that is the gate 1. And if the management, or the top-level people who analyze this, find it is a good idea then they will say okay, let us look at the market, the scope

of the product. If it is feasible to make a product out of this and then it can be sold in the market, whether there is a good market for it, so all those things are known as the product scoping.

We will do the scoping, stage 1 okay. In stage 2, so stage 1 is product scoping and again there will be a gauge. Then they go to the business stage, how much investment you have to make and how many employees may be required to develop the product and what will be the total cost of the product, and things like that is basically known as the business case study.

And again, there will be a gate which will decide if the business stage is good. Good market is there. Let us develop the product, or go to the next stage of development and then go through different stages of testing and validation, product launch and finally you will be getting the final product.

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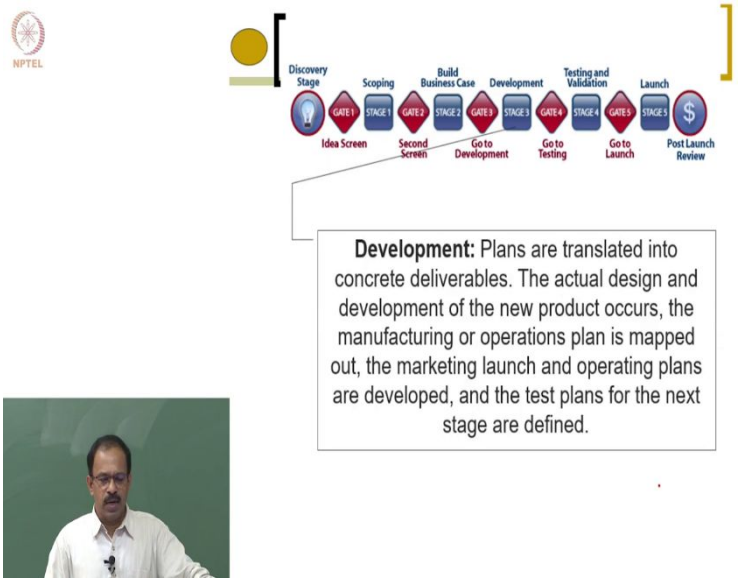

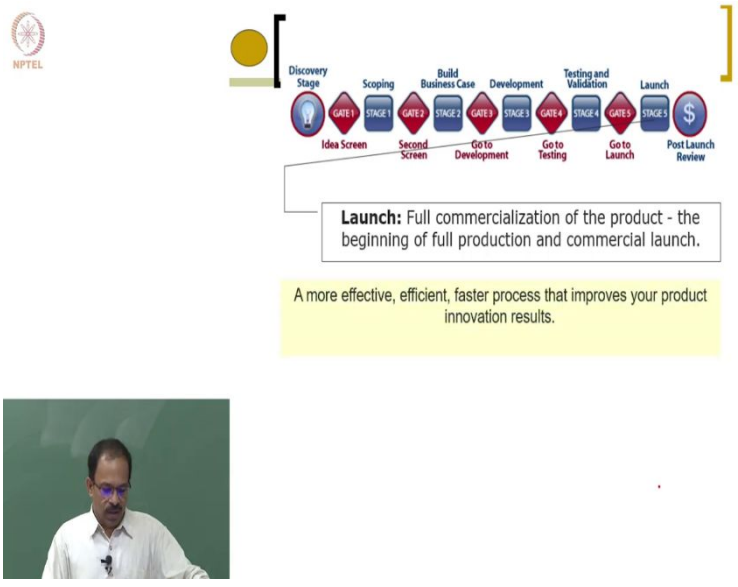

These are the different stages it will be passing through in order to get a new product. So, whatever may be the product, any product which, the company which follows the stage-gate design process will have clearly defined stages and gates and what are the things it should meet during the gate evaluation?

Once it meets it will go to the next stage and finally you will be having a product coming out of this which will be fully ready and fully useful for the consumer or the customer. So that is basically the launch and full commercialization of the product okay.

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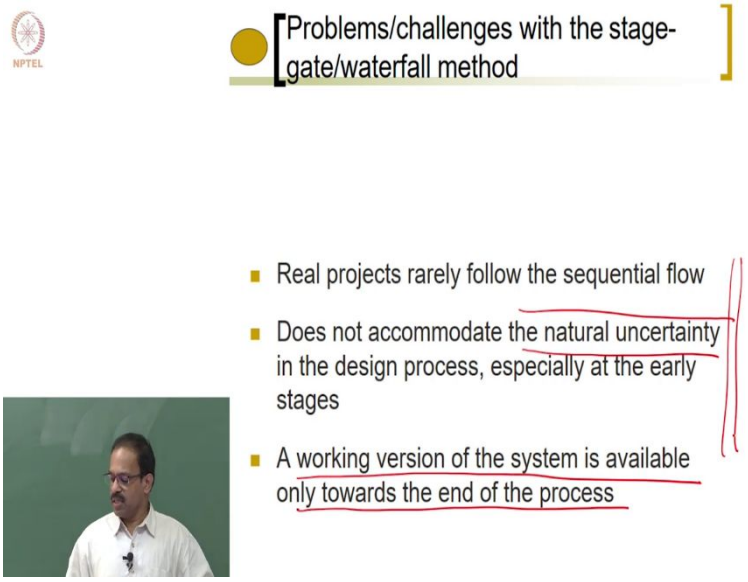

Okay so we found out what these are, what the stage-gate process is and how the stage-gate process works. So, what are the benefits of having a stage-gate process in product development? Or what are the difficulties if you go for a stage-gate process? Can you tell me some advantages of having this kind of a design process, pardon?

Time taken be more or less? Time taken will be more, okay because you have to do an evaluation at every stage. Okay that is a difficulty, then? When new technology comes up, Okay so is it good or bad? Stage-gate process, so time duration is more and new technology comes we have to kill the product, yeah, then?

So you may not be knowing all the details in the beginning. So, if you want to do an analysis you need to get all the information in the beginning to do a gate analysis. Some, many times that may not be available. So, these are some of the problems. Another important problem is that you do not have the product till the end of all the cycles are completed, stages and gates so it may be taking 3-4 years and at the end of 4 year only you may be getting a good product.

For example, if an automobile company is trying to bring a new product, they may take 2 or 3 years to bring a new product. And by that time technology may change. What we, they anticipated 3 years ago may not be the same as what they face in the market. So, these are some of the issues with the stage-gate process.

That is, real projects rarely follow the sequential flow. I mean it may not be always possible to go in a very sequential way, you do this then you do this, then you do this. Sometimes many times parallel activities may take place. That is one of the main challenges or main difficulty we will face.

This is what I told you, the natural uncertainty because there will be a lot of uncertainty in the design stage. You may not be knowing all this in the beginning and therefore it will be very difficult to predict what is going to happen and that may affect the design of the product. And finally, a working version of the product system is available only towards the end of the process.

Till then you do not know really what is going to be the outcome of this product, what is going to come out of this because you have to wait till all the stages and gates are completed in order to know what is the final outcome of the product. So, these are the main difficulties with a stage-gate design process, okay so to overcome this somebody came up with another method which we call it as a spiral model.

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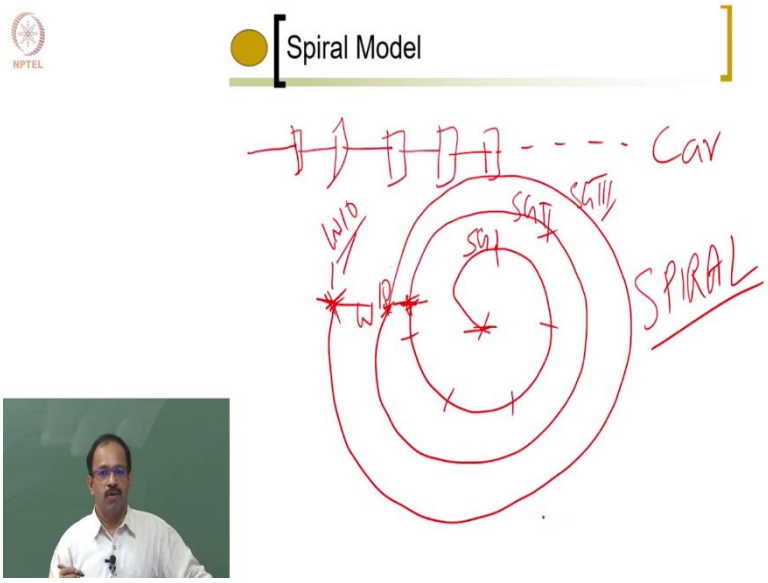

What is a spiral? What is a property of a spiral? Keep on revolving around a particular point, yeah. Now, let us take the example of Microsoft products. When Microsoft introduced Windows, what was the first Windows version, pardon? Windows 95, and then Windows 97, Windows 2000, then Windows XP, Windows. Now, it is Windows 10. But all are Windows. All are Windows and Windows 95 we use, Windows XP also we use. And almost the same thing it is doing.

Take the example of Microsoft Word. What was the first version of Microsoft Word, any idea? Okay Microsoft Office, we take the Office as a package, we will be having Office, okay, if you start from 2000, Office 2000 was there, and then they go to 2005, 2010, 2020 and then Office XP like that.

Now, what is the difference between that Microsoft product and a car company's products, a car manufacturing or a car company bringing different products in the market? Is there any difference between these two products in the time of, in the way, the way we use the; or the way that is being developed?

The software gets less expenditure, that is what you are saying, so from an economic point of view, pardon? Okay so if you look at a car manufacturing company so the car manufacturing company will start with its initial stage saying that okay, is there a good model to be developed? Somebody will say yeah, there is a need for a good model.

Then they will start analyzing the market and again they will say there is a good market and they start design and then analyze the design, do the analysis, safety everything and you have the car coming out, right, in the stage-gate process. Microsoft will announce that Windows 95, or Windows 2000 will be released in 2000.

It was released in 2000. When we say Windows 2000, it has to be released in 2000. Car manufacturers will never say that okay Car 2000, he will release cars in 2000. They may announce that okay it will be released but there is no guarantee that it will come in 2000 or 2005 or 2009. But Windows will say, okay.

They had an urgency to release the product in 2000. So, what will they do? They will develop the product. Okay so they will work on the product and then they will say, oh we have completed one cycle of development. Okay consider this as a stage-gate process. I just put it in this way. Stages and gates, so they have a Windows 10 here.

What will they do? They will release the Windows 10 to the market. It is not necessary that it is 100 percent complete. There may be many things which are not available in Windows 10. So, what they will do, they will release this, ask people to use it and they will say in the next version we will be having addition.

So, they will continue developing this further and then release the next version, okay Windows 10 version 2. And then they will go, okay one more cycle will have Windows 10

version 3. They will say, oh this is a complete product that we wanted to release but because of the time, we did not get enough time to release this here so we released the product here and we asked people to use it because it can be used.

It has got all the basic features to be used. And then they will work on it again and then add new features to the software and then release the next version, and then again work on it and finally they will say, oh now have completed the complete design. So, this is our Windows 10, the final version of Windows 10.

That is the way the software companies work. If you look at the Windows Word or any software for that matter, the first version will not be having all the features. They will say that okay, this feature will be added later and something will be added later, some other features will be added later and only at the end of many such processes will you be having a final product.

This kind of process is known as a spiral design process because it goes through a spiral design cycle. They go through the first stage-gate so this can be called as stage-gate 1 where they will be having a process which completes here and then you have another stage gate 2 which goes through another development and then go through another stage gate 3 and you get this.

This kind of process where multiple stage-gates are involved in designing a product but at the same time, at the end of each stage-gate you have a product which can be used. That kind of process is known as a spiral design process, okay. This cannot be used in products like consumer products or Car Company because a car company cannot say that okay, I have developed my car but the steering system is not working but anyway you take it. Or they cannot say the brake is not working, I will, next version I put a brake. They cannot do that.

They need to have a fully functional product at the stage-gate, normal stage-gate process but in the spiral design process they can still release a product at the end of the first stage-gate though it is not complete, it can be still used and they can work on it and develop the product through multiple stage-gate process. That kind of development is known as the spiral design process. Got it? What is a spiral design process?

A spiral design process is a multiple stage-gate process normally employed by software industries or where there is a pressure on time. We call it as time-compressed industries, time-compressed industries specially software.

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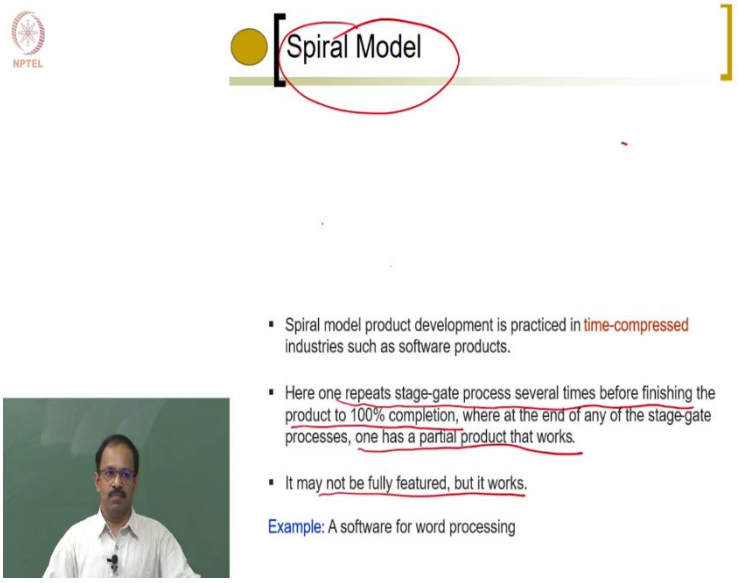

When there is a pressure for them to release the product but at the same time they have an option to improve the product as they, as the people start using the product. That kind of process or products are normally opting for a spiral design process. So, it is practiced in time-compressed industries.

So here one repeats the stage-gate process. As I told you the stage-gate process is repeated many times. So, this is what you need to understand. It repeats the stage-gate process several

times before finishing a product to 100 percent completion where at the end of any of the stage-gate processes one has a partial product that works. These are the important differences between a spiral process and a stage-gate design process.

At the end of each stage-gate process it may be working but it may not be 100 percent complete, okay. There is a, may not be fully featured but it works, okay. A software for Word processing, for example, a word processing software Microsoft Word the first version may not be having all the features, you may not be able to add a picture. You may not be able to edit a picture.

You may not be having the spell-check or grammar-check and later on they added in the second version or third version. So, it will still be working. Words will work. The word processing will work but may not be having all the features. So, this kind of product development we call as a spiral design process. Okay, any questions?

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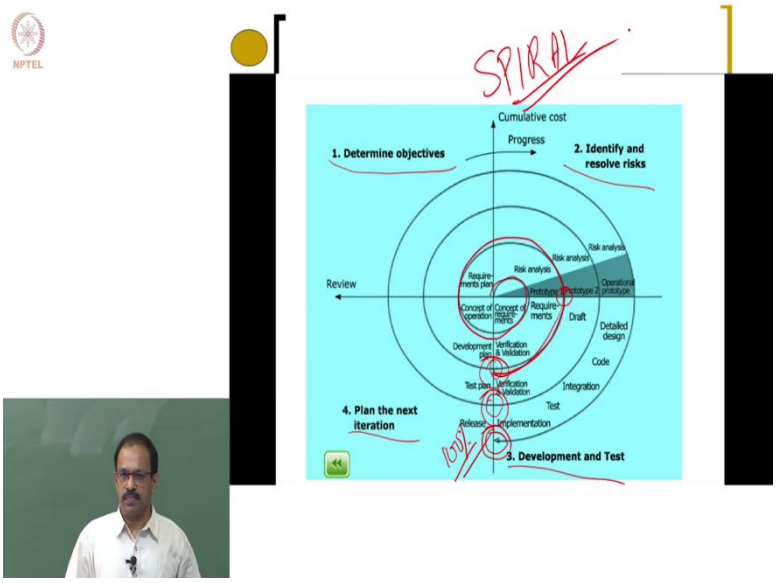

We can actually represent it using this animation. You can see there are different objectives. So, you can see there is a stage 1, stage 2, stage 3, and stage 4. So, it will go through 1, 2, 3, 4 and gates and at the end of 1 you will be having a product here. Then you will be having... okay sorry a product like somewhere here and then you have a product here, then you have a

product here. So, you will be having four products coming out of this process, the same product but with the additional features and additional capabilities so each product at the end of this one cycle, so this cycle, sorry here yeah.

Okay so this will go from here and then reach one cycle. You have a product and then again it will go through another cycle. You have a product and then you have a product. So, you have products at each of these stages. At the end of these stages you have a product coming out but you may not be having the full feature of the product. The product may be coming; full features will be coming at the end of this cycle.

Here you have a 100 percent good product, fully functional product but here maybe 80 percent, 90 percent product. This kind of product development is known as the spiral design process. So, what are the two different processes? Stage-gate and spiral, which one is good? Depends on the product so, most of the consumer products or probably 90 percent of the products coming in the market normally follow a stage-gate process because they cannot have a 80 percent product coming into the market, 80 percent complete product coming to the market.

If they are bringing a product it should be 100 percent complete. And then they can rework on it for any failures or something but normally these products need to be 100 percent complete before they can deliver it to the market. So, those kinds of products need to follow a stage-gate design process. Others will follow; mostly software companies will follow the spiral design process.

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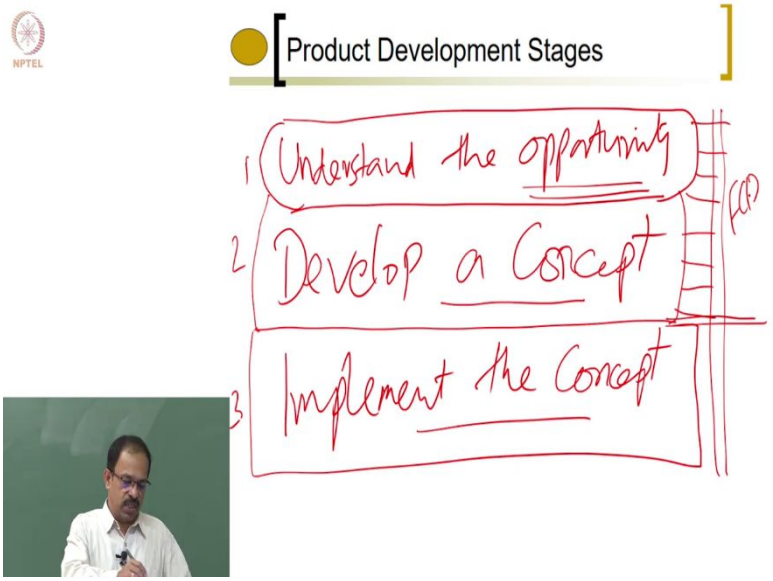

Got it? Okay. Now, we will not be discussing the spiral design process in our class. We will be following the stage-gate design process and then we will look at, if you want to develop a new product, what are the different stages we need to go through and then how do we pass each stage through a gate in order to make the final product. That will be the discussion that we will be having in the coming classes.

Let us look at the product development stages. If you identify, I mean if you look at general product development you can actually see there are three important stages in any product development. As I mentioned in the examples earlier, whenever you have an idea or you have a process or you think of developing a product you need to go through some process to say that it is a good idea, there is a good market. That is the first stage of product development. So, we call it to understand the opportunity.

So, we need to understand there is a good opportunity to develop a product. That is known as the first stage in any product development activity if you understand there is an opportunity to develop a new product, okay. Any activity that ensures that there is a good opportunity to

develop a product comes under this one. So, you can actually have different subsets or sub-stages here but the main stage is known as understanding the opportunity, okay?

Once you understand an opportunity is there, there is a good market, there is a good demand and there is economic feasibility, all those things you have ensured so all those things are ensured here under understand the opportunity then what you do? What is the next step we need to do?

We will develop a concept for the products. Developing a concept is the most creative stage where we come up with creative design ideas to meet the customer requirements for that particular product. So, develop a concept, here again you have a lot of activities to be done in order to ensure that the concept is good.

You will be going through different stages and different gates and ensure that there is a, this concept is good. Concept can be implemented. It has practical feasibility, all those things will be ensured in this stage, developing a concept. And the last one, basically you implement the concepts, concepts. This is the stage where you do the detailed design, prototype, test, modify, all those things will be done. So, these are the three important stages in any product development activities.

That is, the first one is you understand the opportunity to develop a new product. We say that there is an opportunity, there is a real demand and there is a real opportunity to make this product and sell this product is known as ‘understand the opportunity’ and then you have to develop the concepts and implement the concepts. These are the three important stages in developing new products.

In the whole course what we will be doing is how to analyze these three stages, basically two stages. The third stage we will not be doing, i.e., implementing the concept so here these two stages, understand the opportunity and develop the concept are the focus of this course we are seeing.

That is, how to analyze the opportunity to develop a new product and how to develop new concepts to meet the opportunity. Means the demands of the customer is going to be the focus of this course. And each one we need to analyze separately or each one we need to see what are the different stages to develop these concepts or to develop these three stages.

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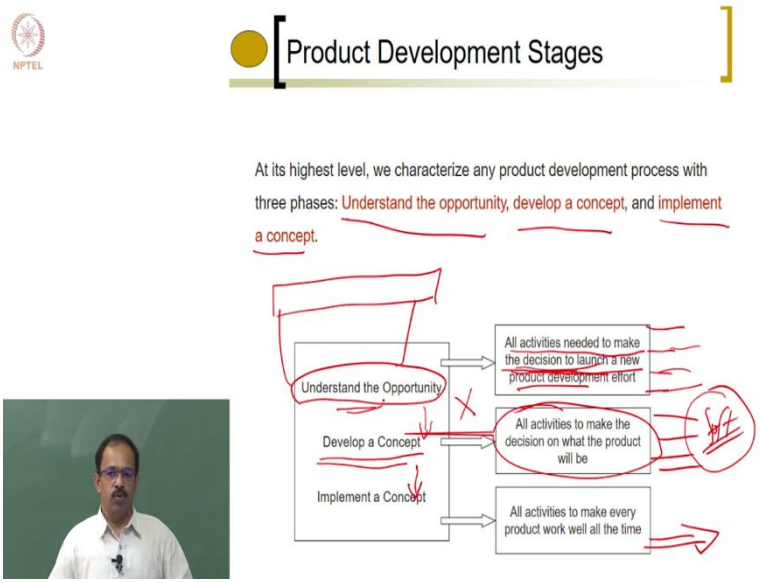

At the highest level we characterize any product development process with the three phases, understand the opportunity, develop a concept and implement a concept. So, these are the three stages we need to go through in developing a product. And all activities needed to make a decision to launch a new product that is the most important part.

All the activities needed to make the decision for launching a new product is coming under 'understand the opportunity' stage. There may be many activities as I told you. There may be many activities which we need to do to make the decision to launch new products. Any company, if a company wants to bring a new mobile phone or a new laptop or a new car, they need to make sure that there is a good opportunity and this decision comes from multiple stages and gates.

So, there will be multiple stages and gates and they feel that this opportunity is not there then they will not go here. They will stop here itself. Okay there will not be any going down from here. If the opportunity is not here, there is a gate analysis and the gate analysis says that the opportunity is not there. They will stop the process here and then do not continue the product there.

And once the gate is crossed, they have already identified a good opportunity then go to the develop a concept and all activities to make the decision what the product will be, how the product will function, what are the different features to be involved in the product, all those things will be discussed and well this will be processed in this stage which is the develop a concept.

Here you have a soft product available. Basically, soft product in the sense, not a software product, basically you have the design ready, you have the details of elements, all the components to be used, and their CAD model, all those things will be ready. So, you have a concept and the detail of the product already available.

And then that is passed through the gate and the gate says that it can be taken forward then we go to the next stage of implementing the concepts where we will try to make the prototype, do the SPACE analysis, strength analysis, capabilities all those things, prove this with the use of test and finally the product will be released at the end of this. So, this is going to be the three stages of any product development activity.

Okay, so we will start with this in the next class. Understand the opportunity we will start; how do we understand the opportunity to design new products? What are the various steps we need to go through in order to understand there is an opportunity and then decide; yes this product can be launched. That is the first part of your discussion on how to understand the opportunity to design a new product, okay?