Functional and Conceptual Design
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Lecture No. 18
Flow Method Examples

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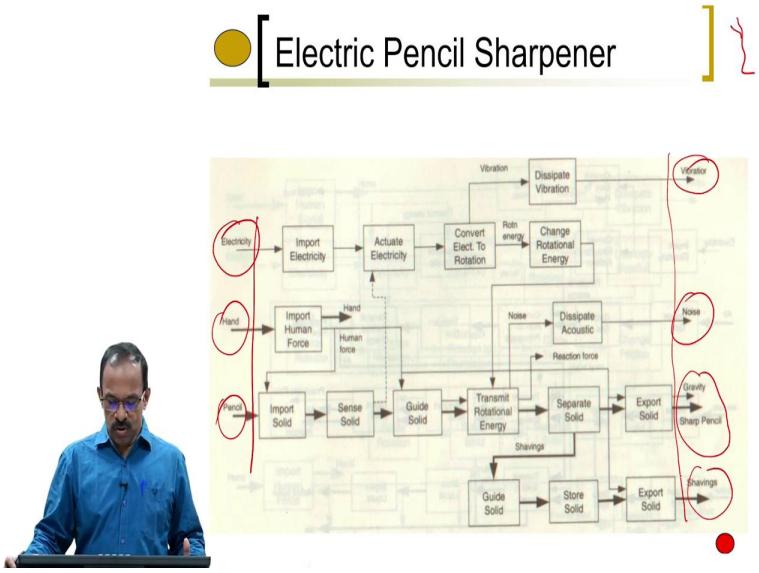

Good morning and welcome back. We are in the conceptual design stage of product development, and that is a first step in conceptual design, we need to go for the functional decomposition of the product. We need to know what the product is doing or what the product is supposed to do if it has to meet the customer requirements and the main product function. And we saw a few methods.

The first one was a FAST method, functional analysis and system technique, and the second one is Flow method or we call it as black box approach or functional structure methods. So, this method is one of the most commonly used methods, and many times the student finds it a bit difficult to understand and then implement this process. That is why I have taken a few examples to show how we can do functional decomposition using a functional structured approach.

In this approach, we consider the important flows taking place i.e., what are the flows going into the product and what are the flows coming out of the product. We saw this example of an electric pencil sharpener in the last class. And so these are the input flows electricity, hand and pencil and output are the vibration, noise, gravity, sharp pencil and shavings.

Whatever is happening in between the input and output, the functions of the product, and we need to understand these functions in order to make the product function as per the requirements of the customer. In this case, we started with the flow and then started identifying all the flows in the product and then looking at the or following the flows to understand what is happening to that flow while it comes out as a different form comes out in a different form.

One of the applications of this method is to look at the customer requirements and identify what functions to be modified in the product in order to meet that particular customer requirement. So, I will take an example and then show you how the customer requirements can be used or how the functional decomposition can be used to identify the functions provided to be provided in the product to meet that requirement, as well as to see which function can be modified to meet the requirements.

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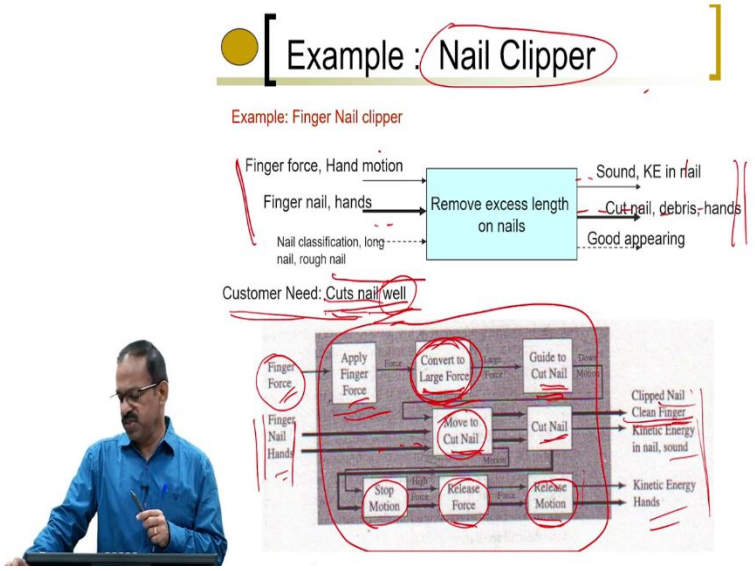

Let us take this example of the nail clipper, which again is familiar to you. I explain this a few times in the class for various other case studies. So, let us look at the nail clipper and then see how the customer requirement based decomposition can be done so that the functions which need to be improved to meet that particular requirement can be identified and the designer can decide to modify one or more sub functions to meet the specific requirements of the customer.

If you take this nail clipper again, we will be able to identify the function and then we will be able to identify the flows, the energy, material and information. So here, it is a mainly nail clipper so there is no external energy other than the human force, the hand force, so it will be the main energy going inside. And then we will have the nail as the material going inside.

Then probably the hand also can be considered as the material which will be going into the product to provide the function. And the signal is basically or the information is basically the status of the nail, whether it is long or short or it is smooth or rough. So, that kind of information will be going as the input to the product. So, here the main function is to smoothen or shorten the nail.

So, that is the main function to shorten the nail or smoothen the nail edge and the output will be here maybe the sound will be one energy that will be coming out and then sometimes it will get as a kinetic energy of the nails flying out of the out after the after cutting the nail. There can be a kinetic energy and sound output and then this will be the nail out and then it will be the hand also.

And of course the signal will be again whether it is rough or smooth. This is the top level function and the flow that we can identify input and output flows. You can see that finger force and motion fingernails, hands and the nail and the nail classification long nail or rough nail. So these are the input flows and these are the output flows. So once we know this, we have a requirement list saying that the customer needs it that cuts the nail well.

That is a customer requirement and the customer says that it should cut the nail well. Now, as a designer we need to understand how this cuts nail well, cuts nail happens in the product and what

are the functions involved in cutting the nail, and if we know that, then we can actually see how those functions can be improved to get the requirement of cutting the nail well.

If you are interested in developing the product with these customer requirements or satisfying this customer requirement, we should know what function to be modified or what function to be improved to get this particular requirement. And to do that, we look at this function of cutting the nail and then find out what are the inputs needed for that and what are the outputs coming and what is happening in between this input and output.

We try to find out what kind of energy, material and information is provided and how this actually leads to cutting the nail. So we are not interested, we are not looking initially with all the inputs we look at only the inputs needed for this particular function that is cutting the nail, many other things are happening in the product. We will look only at this part and then see what kind of functions are involved in cutting the nail and then see which function can be modified to make it suitable or make it satisfy the customer's requirements.

Let us look at this. So, now you can see to cut the nail what we need is the finger force. So, we need to have the finger force applied to cut the nail and then we are getting this clipped nail, clean finger, kinetic energy and sound and hands also coming out. So, fingernails and hands are the material going inside. So, we do not worry about what is happening for orienting the nail, orienting the nail clipper to suit the finger position and all.

Those things are not part of cutting the nail percent or improving the quality of cutting the nail. We look at the finger force and what happens to this finger force and what happens to finger and nails while it becomes clipped nail, clean energy and clean finger and kinetic energy. So we look at ok apply the finger force, when you apply the finger force you are applying a finger force so you need to actually increase this force to cut the nail because whatever you apply from the finger, it may not be sufficient.

There is a force increase because of some mechanism inside. The next one will be to convert it into a large force. We need to convert this finger force to a large force. And then once this force is applied, you need a guide to cut the nail that is, you need to I mean, you need to move the tips

or the cutting edge to cut the nail, that is downwash and guide to cut nail and then move to cut nail.

You have to move this whole thing to cut the nail and then you get the nail cut and the cut nail will come out. When you apply finger force, first it will be converted to a large force and then it will be used to guide the guide to the blade edge to cut the nail and it will move to cut the nail and then cut. And what happened to the fingernail and hands?

It actually comes both fingernails and hand comes here and then it moves to cut nail and the cut nail will go out and this motion will actually lead to stopping the motion. So, we need to stop the motion. We cannot keep on playing the motion again to cut nail and move to cut nail these are actually motion involved. You have to stop the motion and then release the force and then release the motion and that actually completes the cutting cycle.

You have to in order to cut the nail edge we need to have these functions included in the product, product functions can actually be divided into these kinds of smaller sub functions. And you can see everything is actually using the functional common basis. And you will see that using the functional common basis, we can actually represent all these functions and see all the functions involved in cutting the nail.

Now as a designer you need to check which function of which of these functions can be improved to meet the nail, cut nail well requirements. Either you can look at the existing products and then see which function can be improved to meet this requirement or you can think of a totally new concept for each one of these functions to get the satisfaction of a customer.

For example, convert to large force. You must see in the existing nail clipper, there is a particular way of increasing the force. The applied force will be increased because of the particular arrangement of the lever and the edges of the blade edge. Now, if you feel that is actually a problem because we need to apply a large force and then we can actually reduce the force required from the user, you can think of a new concept to increase this, to get this converted to a large force.

Same way moving the move to cut nail or release force or release motion, you can think of a different concept for any one of these or more of these functions and satisfy the customer requirements. Same way you can actually go for different needs also. You can have other needs also analyzed in the same way, and you will find all the functions needed in the product.

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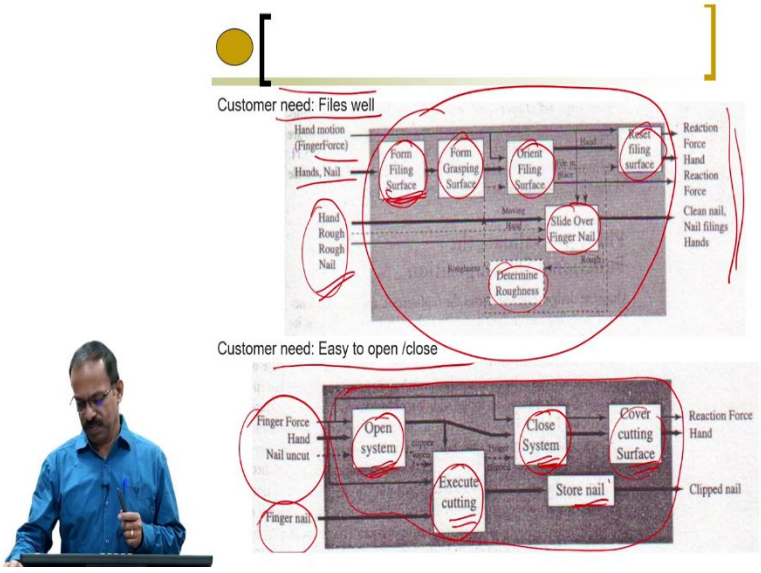

For example, files well, one another function of the nail clipper is to smoothen the edge of the nail. So, we can actually file the nail to make it smooth. And again, you can find out what are the inputs and what are the outputs and what is happening in between so form of filing, form filing surface, form grasping surface or in filing surface reset surface and slide over fingernail and determine the roughness. Determine the roughness is more of an information we collect and that will be actually coming as an output also, as a signal.

You can see here, it is the hand. Hand is used for sliding our fingernails and we take the information whether the roughness is more or less. And depending on that you will decide to stop the motion. And to do that, you have to form the filing surface because a filing surface may

not be readily available for use. You need to get the filing surface from the product. The product will be having the filing surface in some particular form.

You need to take it out or you need to make it in a particular orientation and then do it, that is the form filing surface, form grasping surface and orient the filing surface to suit the filing and then you move it for filing. These are the functions involved in filing the nail. Same way we can see that it is easy to open and close, that was probably the requirement from the customer that existing products are difficult to open or close.

Then we need to see, what are the functions involved in opening and closing and then see which function can be modified to make it easy. You will see these are the input finger force and nail and then finger nails and open system, closed system, close cutting surface, execute cutting and store nail. These are the things involved in the opening and closing because we need to have opened it first, then do the process, then close it and then store it but that is what is actually happening.

We will see what are the functions involved in the whole process in easy opening and closing and then see where actually it is opening and where actually it is closing and then see how these functions can actually be improved so that you will be able to have the proper cutting and then proper storage also later, cutting, cover the cutting surface and then close it down. This way you can actually take individual requirements and then try to identify the functions needed.

And finally, you can combine all these things and get the total functional decomposition also. These are the two ways in which you can do it. Either you start with all the flows and then try to decompose it together or you take individual requirements and then see what are the functions involved, and then you combine them to get the overall functional decomposition of the product.

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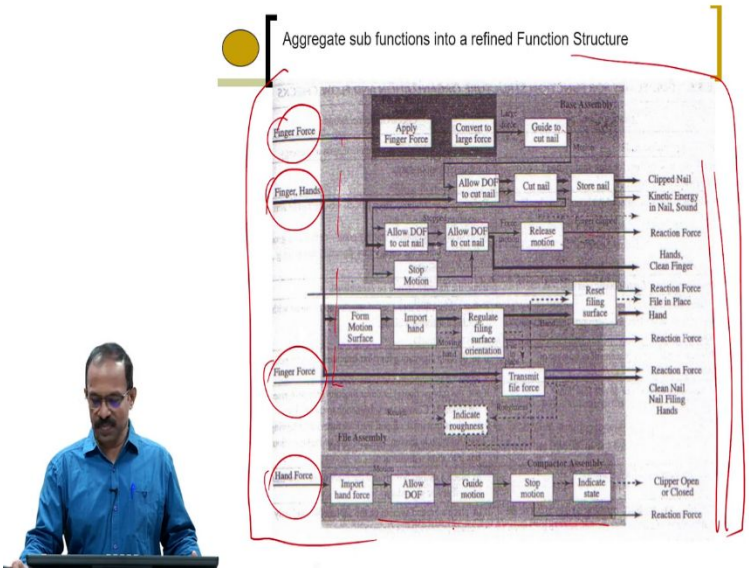

If you aggregate all these functions and refine the structure, it would be like this. So, you have the finger force given separately because for convenience only otherwise you can actually take it as a branch from here. But just for convenience just separately shown, and these are the output that you are getting with kinetic energy, sound, etc., etc. and we have this finger force, supply finger force, convert to large force, guide to cut nail, allow degree of freedom, cut nail, allow degree of release motion then form motion surface then filing surface, etc.

The whole or the complete function structure for the product can be obtained like this. So, the previous one let me show individual applications, individual requirements like that, there may be many, many requirements. Look at all those requirements and then try to get those functional… functions and then aggregate all these functions into a single structure that shows the complete functional decomposition of the product.

This is the way how we use the flow method to decompose the functions into sub functions and all those sub functions that you are getting are important for any product and then the designer has to look at these sub functions and then see how these functions can be provided in the product by developing appropriate concepts. So, I hope you understood these two methods, the FAST method and the flow method of functional decomposition.

And as part of lab work, you will be doing a few exercises by opening up a product and then looking at the main functions and then trying to understand the decomposition or trying to carry out the decomposition using the Flow method, so that we will be discussing it in the lab class also. I hope you understood this, and if you have any questions, you are welcome to ask me now, or you please note down the questions, and then we can actually have a separate discussion also.

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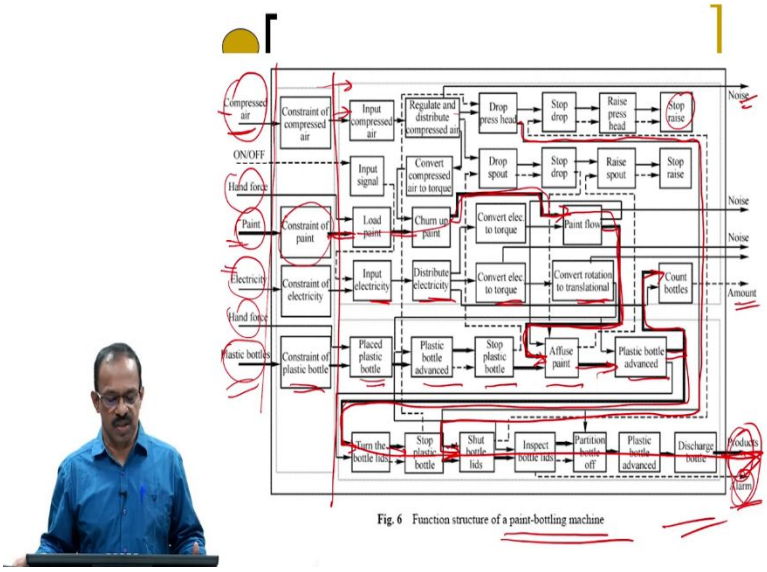

Fig. 6 Function structure of a paint-bottling machine

These are some more examples just for your understanding, so do not think that you need to remember this decomposition, these are not unique decompositions. You can have a lot of variations depending on the way people look at it and the way how people decompose it. This is a functional structure for a paint bottling machine. A machine which is used for bottling paint, so that will be a paint stored in a container and then a machine is used to fill bottles and then seal it and then send out, that is this machine.

You can see the input or the compressed air and hand force, paint, electricity, of course hand force and plastic bottles that are what for filling paint. You would be given empty bottles, paint, electricity and compressed air. Compressed air is for filling, generating the necessary head for filling.

Output is basically the noise then the number of the information about the number of bottles and the products filled bottles and then alarm basically for emergency situations or because of some other information you are providing and you want this to give an alarm then it will give an alarm. These are the outputs. Now, you can actually look at each one of these flows and then see what is happening.

For example if you take the page, you will see that the constraint of paint is that it is storing. You need to have some kind of storage and then it should not flow continuously. And then you load it and then churn up paint, that is you need to churn it properly and then that will actually again follow this. So, it is coming here then it is flowing here and the paint is flowing and then the flow is going to the fuse paint and go into the bottle and then the bottle is coming as count and then it is count bottle and then the bottle is coming out here.

This is to turn the bottle lids close and then it comes out and the discharge bottle is coming here. So, you can see that the floor is taking place like this. That is the paint bottle going here and then finally coming out. So, you can see all the functions involved in getting the bottle out where the paint is involved, it can be identified like this. Same way you can look at what is the plastic bottle and then the bottle is replaced and then moved, then stopped, then paint filled in a plastic bottle, moving along with the paint it starts moving out.

And electricity you have input electricity, distribute electricity, convert electricity to torque, convert rotation to translation and then that goes for the filling and then moving the bottles. So, up to here it is electricity. After that it is actually mechanical motion. And the same way you can see each one, this is the compressed air which is used for regulating and distributing it and it will be used for developing the press head and stopping and starting and stopping.

So, that will be used for filling the bottle here that we can actually see. This press head, the press is used for bottle caps, shut the bottle lids. So the caps lid, the closing of the bottle is done using a press and that is where you need to have a compressed air here. So, this way you will be able to decompose the functions, so basically the function from here to decompose the functions of this mechanism by looking at the individual flows.

Again you can see all these are using the functional common basis to represent the functions. Suppose there is a requirement for the customer to either do they want to increase the number of bottles produced, then you can look at where actually that function is happening and then see which function can be modified to increase the capacity of the plant or there is a problem with the lid or the lid is not properly sealed or there is a leakage that is happening.

Then you can look at what are the functions involved in sealing and then look at those functions and then try to improve those functions alone. So, the decomposition allows you to identify the functions to be modified in order to get a particular design objective. So, it helps the designer to easily identify the functions which can be improved to get the desired function.

Otherwise, if you do not have this function decomposition, you do not know exactly where the problem comes and therefore you will be modifying many things without really understanding how the system works or how the functions are distributed in the product. So, that is the importance of having the decomposition. You will be able to identify the functions which need to be improved or modified in order to get the particular requirements, a functional requirement which is coming from the customer. That is one example for the functional decomposition using functional structure method.

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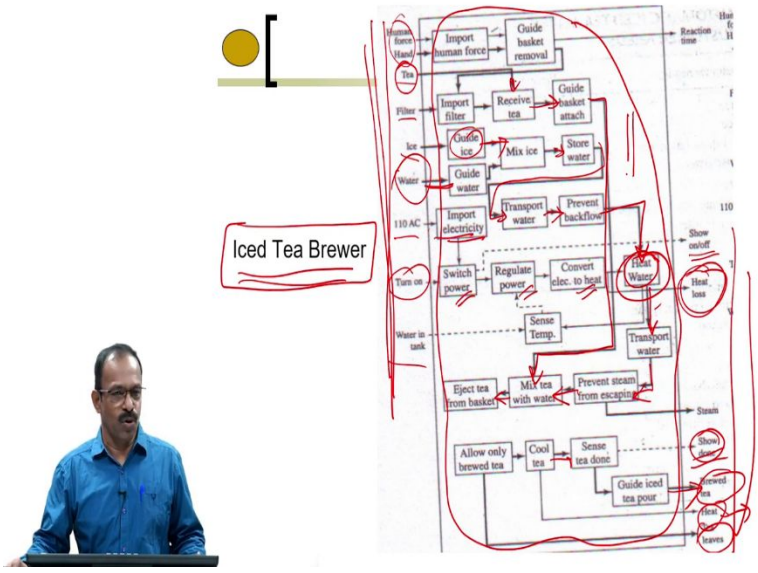

This is another one, again for you to understand it fully. I turned this here, the iced tea brewer. So here, this iced tea brewer, as you know, it is basically a tea machine and machine which can actually deliver tea, or you can add ice also and you get the iced tea and these are the inputs to the machine. So you can see water, then electricity, ice, then filter tea and the human force and hand.

We need to have somebody operate it, the machine that is why the human hand and force comes into picture. If there is no human involvement in operating the product then this will not be there. But in this machine, we need the human to do some work to get the product function that is why this comes into the picture.

Now you can actually look at what is happening to water. So, you have the water in a tank and this is here. So this is water, you need to channel the water to go somewhere and then it actually mixes with ice and then this stores the water and then transport water. So you are mixing water with the ice and then transporting the water and while transporting you need to prevent the backflow that there should be some kind of and walls to prevent the backflow and then you heat the water.

And transport the heated water and prevent steam from escaping, mix tea with water and eject tea from the basket. Actually, that is the brewed tea coming out of the eject tea from that basket, it is not coming from the machine. And then we will see how this has to be delivered to the customer. So, we will be actually seeing the brew tea is coming as an output here. And so from here, you take only the brewed tea through the filter and then cool tea and then sense tea done and then guide ice tea to pour. That is how the tea is coming out.

From water, this is a water loop and then you will be having the tea loop here. So this is the tea, we can see that received tea and guide basket attached, and then it comes over here mixed tea with water. So, that is the tea loop. And everybody will be using the human hand that is why the human force will be coming here and then basket removal everything will be there. And then similarly ice also, guide ice and mix ice.

And these are the signal path or the information, it is the turn on switch power and then it will show on off of that is the information going out and this is for the tea is prepared or not, that is the information going out. So, we can see some information is coming in and some information going out. Similarly the tea and then the used tea leave will be coming out and heat will be coming out here and heat loss will be there when you are heating the water and you have this electricity loop.

Electricity imports electricity and then switches power, regulates power, and converts electricity to heat. So then you have that electrical energy and after that, it will be heat energy becoming here. So, this way you can look at the input to the product and output to the product and then try to understand what is happening to all these inputs and how it is coming out. And whatever is happening inside this box shows the functions needed in this product.

If some of the functions are missing then we will see that you would not be able to deliver the product properly or the output properly. And if some functions are not there or some functions are not adequate, then you will be having problems with the product. That is why it is necessary to identify all those sub functions in the product using the functional decomposition methods. And as I told you, it would be a unique way of decomposition. People can actually have slight variations in the way they do the decomposition.

But the final objective is to see that there are other functions out there in the product to get the output, if any particular output is not I mean function is not there, and then that will actually reflect on the output. For example, if you want to ensure that the outside cover is not getting heated up, the machine should not get heated up. That may be a customer requirement. And then you need to see there is water heating and a heat loss.

We need to see how this heat loss actually goes into the surface and then get lost. So, is there a way to absorb the heat or cool the air and then take it out so that we can actually reduce the heating of the outside cover? So, this way the adjustment team will look at the product and then see what are the functions needed to meet the customer's requirements and provide all those

functions and then here it is only the function, we are just taking that this function should be there.

For example, you are saying that heat water. Heat formally is a function. There are multiple ways to heat water. Of course, you are using electricity, but do you think using electricity itself we can have different ways of heating water. So, we are not worried about what way we are going to heat water. We are simply saying that there should be a function to heat water and then we can say that there should be a function to reduce heat loss.

Suppose, I do not want to lose heat so we can say reduce heat loss, that can be another function which takes care of loss of heat onto the surface of the container or the product and make sure that the product is not getting heated up because of this heat. So, this is the way we should look into the product's required functions and the required customer satisfaction. Also by combining all these things, you will be able to develop a proper functional decomposition for a product.

Developing this decomposition chart is very important as we move forward, because most of the things we do after this stage we will require this information because we are to know we need to know what are the functions needed in the product, then only we can actually take it to the next level of product structure development or the product architecture and development. And that is why we need to make sure that we do a good job in developing the functional decomposition. I hope you understand this concept, but as I mentioned in case you have any questions or you feel that some more explanation is needed in any one of these, please feel free to contact me.

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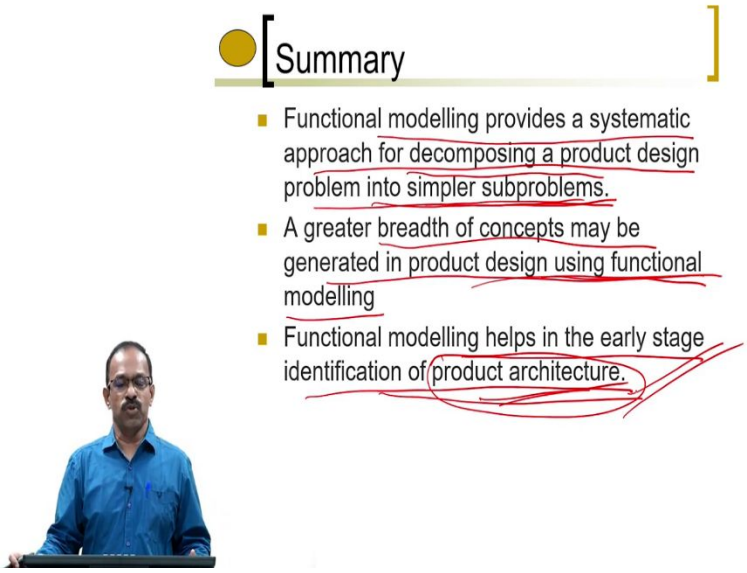

To summarize the discussion that we had in the last few classes about functional decomposition, this functional modeling provides a systematic approach for decomposing a product design problem into simple sub problems.

What we have done is that we had a problem of designing a tea brewer, or ice tea brewer. Now, we have decomposed that into small functions. And now the question is how a particular function can be provided in the product or how these functions can be provided? So, we are actually dividing this into small, small problems. And then by solving all these problems sub small problems or small problems, we will be able to solve the big problem.

We are actually making it into simple sub problems and many of those sub functions, you do not need to do too much work because that is already solved by many people. So, you can either accept it or modify it and then use it. So, only very few sub functions we need to really solve to get a new product. That is the importance you do not need to take the whole problem and then start solving everything together.

So, you divided it into some problems using the functional decomposition and the greater breadth of concepts maybe generated in product design using functional modeling. So, this actually says that when you have divided it into subproblems, you can actually take each sub

problem and then develop many concepts for each one of these and then choose the best one. So, that way you will be able to decompose the big problem into a small problem and at the same time this small problem can be solved with multiple concepts also, that is what it actually says.

You can actually use the functional decomposition to generate multiple product design concepts so that will meet the requirements of the customer and it helps in the early stage identification of product architecture. This is the next topic that we are going to discuss, the product architecture. When we convert this functional decomposition or once you have the functional decomposition, the next step is to see what way we can actually have an architecture for the product.

The architecture is basically in what way we can organize these functional blocks in a product so that we will be able to develop it as a complete product, so that is basically known as an architecture. So, once you have the functional decomposition, you know, so what are the functions needed? And there will be many things common to some of these functions, so probably we can actually arrange them properly so that will get the proper architecture.

The requirement of functional decomposition is one of the requirements of functional decomposition in the product design is to have an early identification of the architecture of the product. We will be discussing this product architecture in the next chapter and will be basically on the design of product architecture. So, that completes the discussion on functional decomposition.

To summarize, the functional decomposition helps you to divide the big problem into small problems or small sub functions and then these other functions can be solved to get the product concept. And this decomposition also allows you to identify the different possible architectures in that product.

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We discussed the product functions in the previous chapter. Now, this chapter is basically how to transform the product functions to a form of the product. That is the conceptual development, conceptual design of the product. We need to see how these functions can be given a form that is how we can give it a particular shape or what kind of an architecture can be there in order to have the product meeting the requirements.

So, that is basically the product architecture development. The previous chapter we are looking more at the functions. Now we are trying to see how these functions can be given some shapes and in what way these functions can be organized to get a particular product architecture.

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Before going to the details, let me show you these pictures here. You can see here a lot of products, so here you see a set of screwdrivers. And here you will see a set of toasters, and here you see different cameras, you will see different printers.

Of course the phones, multiple models of phones and others like iPad and then washing machines, cameras, etc., etc., every manufacturer or any company brings multiple products to the market. So, for example, if you take Sony, they want to bring cameras to the market. They just do not bring only one model. They will be having multiple models in the… in their product portfolio or the product list you can see there will be multiple products.

They will be different in multiple aspects. Either the price may be different, the features may be different, the color may be different, and some will have very attractive features and will have very basic functionalities. That is the way almost all the product manufacturers bring products into the market. You might have seen that a mobile manufacturer or mobile phone manufacturer will be bringing mobile phones in different categories.

They will be having a product which is low cost and a product with very high cost, with high features. And there may be some companies which actually bring products only in the high end features, for example, Apple and other companies, their products would be a place of very high

cost, very high quality. So, they will be having a particular way of bringing products. And there will be other companies which actually look for other segments of markets.

For example, if you take Maruti Suzuki or Hyundai, their car segments are mostly for the people who have low income or medium income. But if you like Audi or BMW or any other high end cars, their cars are very costly and they are designed for a particular segment of people. Then again if you like to take a product like this, a screwdriver set you can see in this screwdriver set each screwdriver is an independent one.

But if you have seen this screwdriver set where actually you can have this tip replaced, you can have the handles common for all the screwdrivers and screw tips can actually be replaced. So, you will be having that kind of screwdriver set in the market. So, the point is that any manufacturer who wants to enter into a product domain or wants to consume a product, they need to see what the customers are looking for and then how do they bring multiple products into the market and satisfy the customer requirements.

The functions needed in the product may be the same, but there may be many requirements which cannot be provided directly as a function in the product is more constrained also, for example customers will say, I need a low quality, I need a low cost product, and some people will say I need a high quality product. And these two are actually not going together very well. So, when you have a high quality product, naturally the prices also will go up.

So how can the company satisfy both the requirements? The company can actually decide to have ok, I will have a low cost product and have a high cost product so they can actually decide to have two products in the market. And when they want to bring two products to market, they cannot really have both of these products completely different. Then the cost of manufacturing, cost of this and of everything will go up.

They need to decide, I can actually change a few things in one product so that it can actually become a high quality one. And all other things remain the same in the low quality and high quality product. So, these are the ways in which a product designer, product design team need to

look at the customer requirements and customer segments and then decide to have multiple products in the market.

Arranging of functions or the components in the product in order to meet the customer requirements is basically known as the product architecture. So, every company will decide to have an architecture for a product saying that, I will have these all as the functions in the product and these are the components in this product. But by changing some of the components to a new better one or a lower one, I will be able to bring multiple products to market.

That is known as the architecting of the product. So, the company needs to have an architecture for producing an individual product as well as a set of products in the market. So, if you bring a set of products in the market, the company needs to decide how many products will be there in the market, what should be the architecture of each product, and how this needs to be provided to the customer.

For each individual product, the company has to decide which are the things which can actually be replaced, which are the things which can actually be there for all the products, and that is basically the individual architecting of a product. So, whenever we talk about the architecture of a product there are two important things coming into the… into this domain. One is known as the portfolio architecture.

We call this as a portfolio architecture, so portfolio architecture is the family of products or how many products there are in the family of a product is basically known as the portfolio architecture or what are the products the company wants to bring out in order to meet a particular customer segment or a particular population. And that is basically the portfolio architecture. The other one is known as an individual product architecture.

So, within the portfolio you may be having 5 products, for example, Maruti is providing a car model. They will bring at least 3 or 4 models or 3 or 4 variants in the same model. For example, if you take Maruti Ciaz as a model car, Ciaz itself will be having three or four varieties. So, they will call it VXI CXI etc., CXI plus etc. to meet different requirements. The basic platform will be

the same. There will be many things common in both of these models. But there were a lot of variations also.

That kind of variation and how many products in the family and what these were different, those things will be decided by the portfolio architecture and how each individual product needs to be designed. What kind of modules to provide, what kind of features to be provided in an individual product that is known as the product architecture.

You have two things when you talk about the architecture. One is known as the product architecture and the other one is the portfolio architecture. So in this chapter, we will be discussing how a company can actually decide the portfolio of products, and then once we have this portfolio of products defined, how we can have the individual architecture for a product. So, these are the things that we will be discussing in the next few classes.

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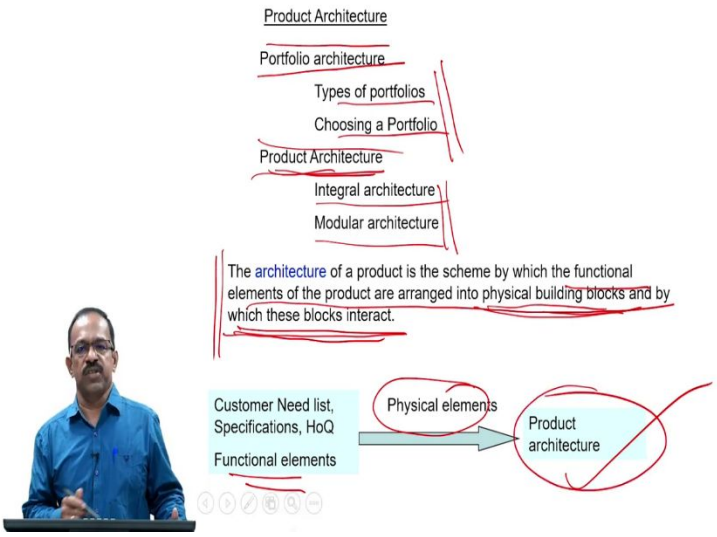

We will be talking about the portfolio architecture, as I mentioned portfolio architecture talks about the types of portfolios and choosing a portfolio. There are different portfolios available and then the company has to decide what should be the portfolio to be chosen. So that is the portfolio

architecture. So, a portfolio is basically the family of products coming in a particular product category.

And then we go for the Product architecture. Product architecture is how the individual product to be developed or what whether the product features to be provided or features to be arranged in a product is known as the product architecture. And in this one, we will talk about two architectures. One is known as the integral architecture. The other one is the modular architecture. So, this is going to be the discussion.

How do you decide the portfolio and then how do you decide the individual architecture of a product. So, the product architecture is the architecture of a product is the scheme by which the functional elements of the product are arranged into physical building blocks and by which these blocks interact. So, that is the way how the architecture is defined. It is the scheme by which the function elements of the product are arranged in the physical building blocks and by which these blocks interact.

We saw the functional building blocks for the product and the functional decomposition. All these building functional blocks need to be converted to physical building blocks. So, basically the components which actually provide those functions. So, how can these physical building blocks be arranged? And by which these blocks interact, these physical building blocks, we need to know how this can be arranged and how these actually interact. That is basically known as the architecture of a product.

When we convert from these functional elements, we make it to physical elements. We get the product architecture. So, from the customer requirements, we have moved to the functions and from the functions we are moving to the physical building blocks. It is basically the product architecture.

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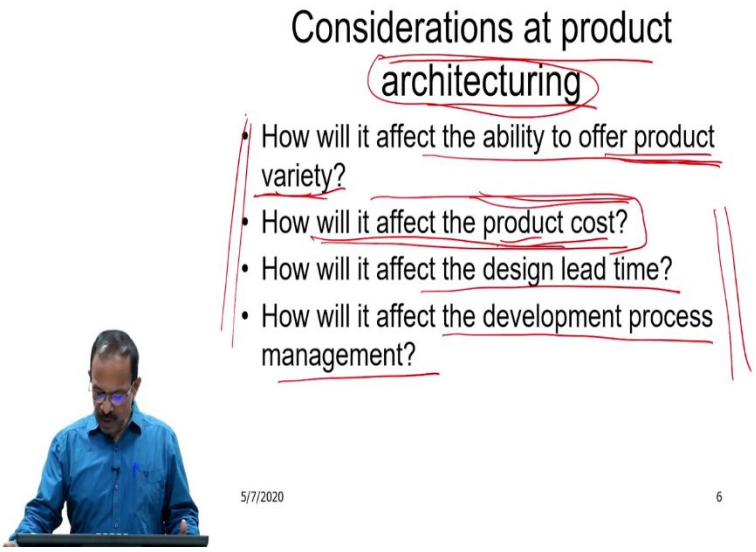

We can see that you have a product. Suppose you have a product you will see that there are many elements within the product. We can call those modules or chunks or whatever it is. So, there will be multiple components or the set of components or subassemblies in the product. So, how these can actually be arranged in a proper way is basically the architecture. And when you properly arrange them, you will get the product ready.

That is how we get the product and the product or family of products also. So, we can have one product or we can have a set of products which actually becomes the family of products or becomes the portfolio architecture of the products. The considerations that are needed at the product architecture are the following. How will it affect the ability to offer product variety? So when we try to develop the architecture of a product, we need to check if that particular architecture can provide you a variety of products because in many cases, as I told you, the manufacturer needs to provide a set of products, not a single one product will not satisfy all the customers.

We need to have multiple products. So, the question is whether there is an ability to offer multiple products in the market? So, the architecture should allow this variety and how will it affect the product cost? If you make products completely independent, then the cost may go up. So, if you provide a particular architecture or you think that everything can be completely separate, then no need to have anything common in the product family, then the cost of the

product will go up. We need to see how this particular architecture is going to affect the cost of the product and similarly how it affects the design lead time and how it affect the development process management because when you have more number of products in the family or when you have a product architecture which requires a lot of time for processing or development, those things will actually affect the cost of the product as well as the process time also, the development time also.

The designing of a product architecture depends on these factors and we need to keep this in mind when we decide to have a particular architecture for a product. So, we will discuss these things in the next class. How do we develop the portfolio architecture and then how do we look into the individual product architecture and what are the ways in which we can develop these architectures so all these things we can discuss in the next class. Thank you very much.