**Product Design and Innovation**
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**Lecture – 04**
**Product Design – Part II**

Now, we will discuss about product design approaches, so there are 2 kind of product design approach, one is systematic method, another is intuitive method.

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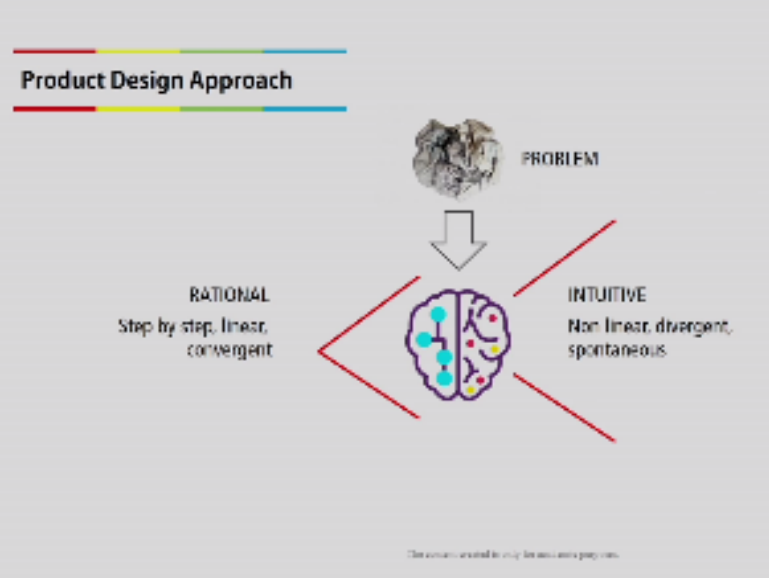


So, in systematic approach people who are right brain driven, they use systematic approaches to solve creative to come up with creative ideas, they use methods and tools throughout the design process. People who are left brain driven, they use their intuition to come up with creative ideas, the problem in the intuitive process is sometimes you may feel like there is a creative block.

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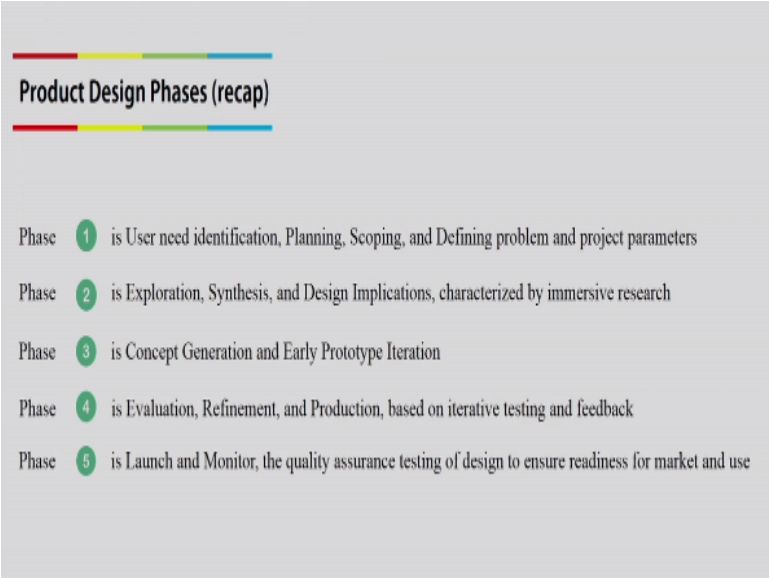


But in systematic approaches, methods and tools will guide you throughout the design process. Now, just a small recap because I will be using these icons next slides to explain design methods, tools and frameworks. The phase 1 is user need identification, planning, scoping and defining problem and project parameters. Phase 2 is exploration, synthesis and design implications, characterized by immersive research.

Phase 3 is concept generation and early prototype iteration, phase 4 is evaluation, refinement and production, based on iterative testing and feedback, phase 5 is launch and monitor, the quality assurance, testing of design to ensure readiness for market and use.

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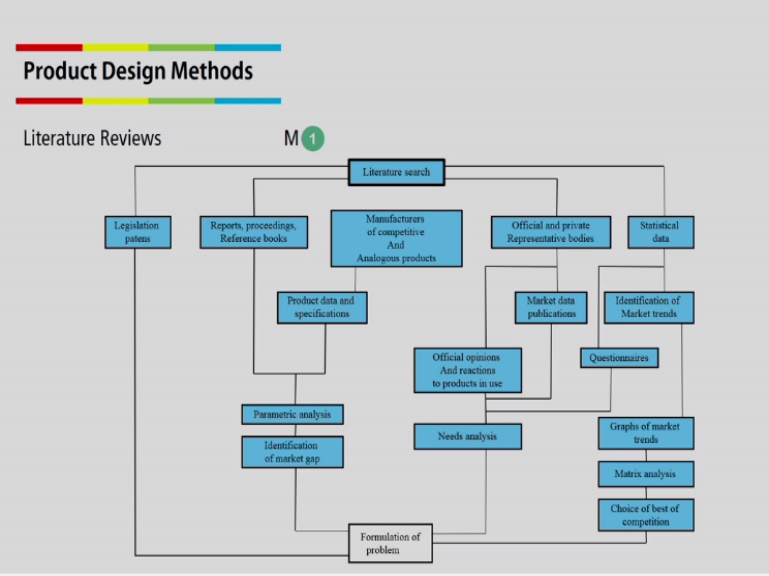


Now, we will be discussing about product design methods, the first method is literature reviews. In literature review, we go through different patens, the reports, proceedings, reference books

and also different manufacturer given, competitive and analogous products report, where we will get product data and specifications, which will help us to get parametric analysis and which will help us for identification of market gap.

In this step, we will also go through official and private representative bodies reports, different statistical data which will give us information about the different questionnaire is asked to the users, different market data's, market trends which will guide us for need analysis and at the end, we can formulate the problem.

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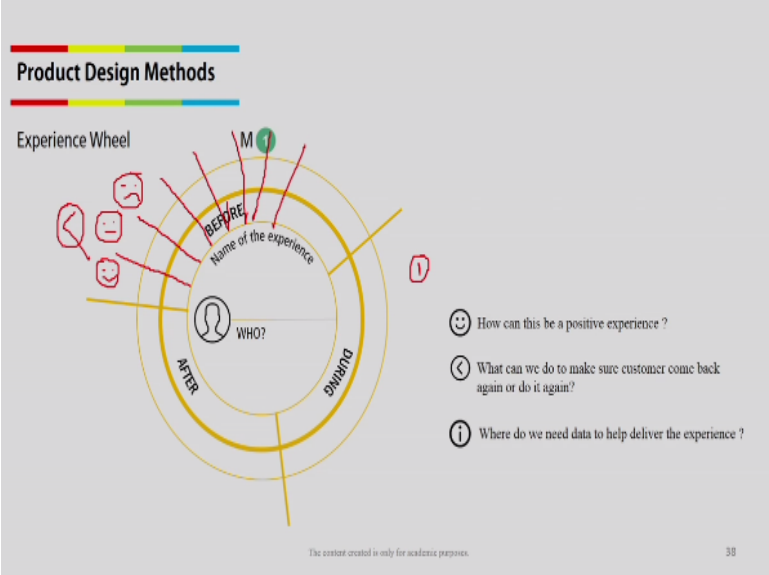


Next method is experience wheel, the toy manufacturer Lego came up with this kind of experience wheel method, where there are 3 part; one is before, during and after. Before using the product, what are the tasks you have to perform? During using the product for the task you have to perform that you have to see in this wheel for example, before getting the product, what are the tasks I have to do?

For that there are; there may be n number of steps, so for each step I have to divide the wheel and for each task, what is my experience; it may be good, it may be moderate, it may be bad and based on that I can put the emoticon. If it is good, then it is a smiley, if it is a moderate experience then I will put this kind of icon and if it is bad, I will put this kind of emoticon and for a particular task, if you feel that customer may come back again and do it again, then we will put this symbol called boomerang.

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And to carry out a particular task, if there is need for more data then, we have to put this icon I. Next method is competitive analysis; competitive testing provides design team with an opportunity to assess competitor's products from end users point of view. We have already discussed end users point of view towards product and in the competitive analysis, we have to analyse all those aspects.

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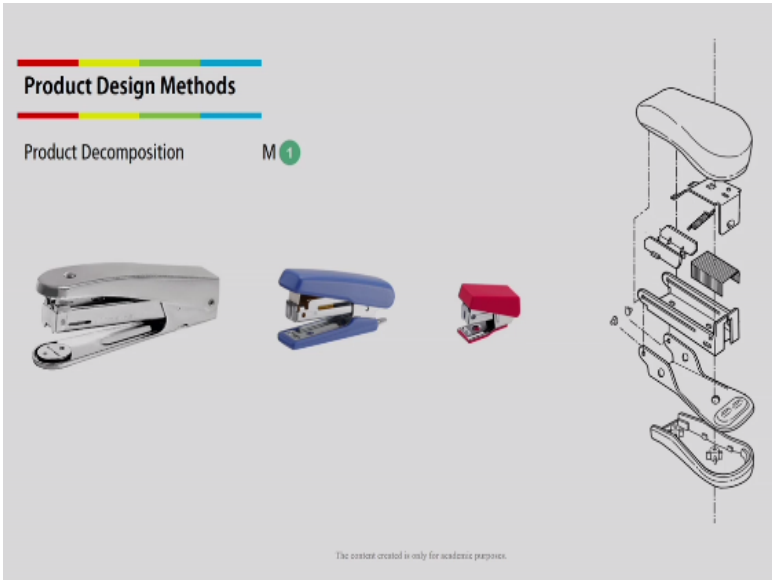


And we have to do analysis, which will give us an indication for a new product. Next method is product decomposition; in this method, we will see similar kind of existing products available in the market. We will open the entire product will basically decompose it, will see how to open each parts whether it is possible to open or not, what are the components used inside, what are the manufacturing process of those components and this information will guide us for a new product.

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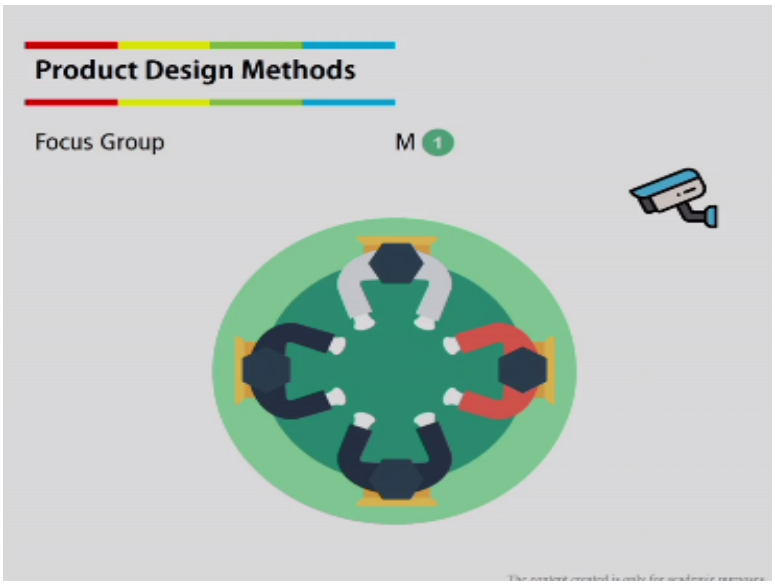


Next method is focus group, where there will be a moderator and we will call potential users on board and we will be discussing with them about a particular topic for example, if you need to know about toys, you will call parents and we will discuss about their experience with the toys then, parents will be discussing about their experiences, it may be good, it may be bad experience.

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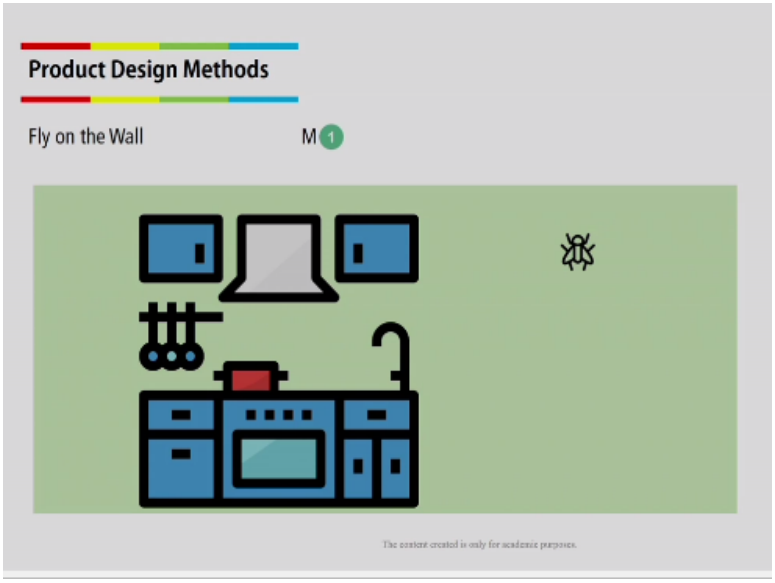


And from those experience stories, you will get some data which will lead you to a new product. Next method is fly on the wall; most of the time it has been observed that when designers are interviewing users, users become conscious and they do not give correct information, hence this fly on the wall method is very much effective where designers are observing from a distance.

They are not interacting with the users, they are just observing how they carry out a task, how they perform a task and they note down all those issues, this data will helpful for need finding.

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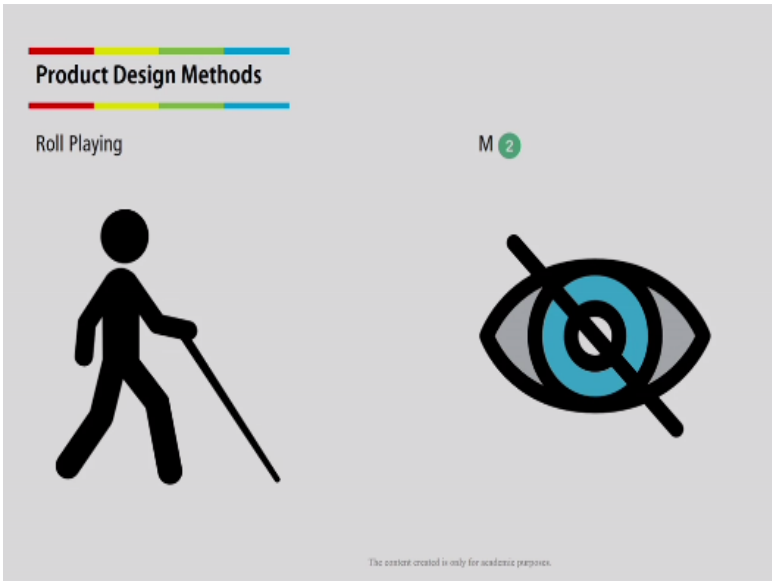


Another method is a role playing for example, you want to design a product for disabled people, it may be people who are blind, it may be people who need prosthetic leg, so in this case, you can fold your eyes and then you try to carry out different tasks, so you are empathizing, you are putting yourself on their shoe, if you are blind then how to carry out a particular task, if you do not have leg, then how do you carry out a particular task, so like this.

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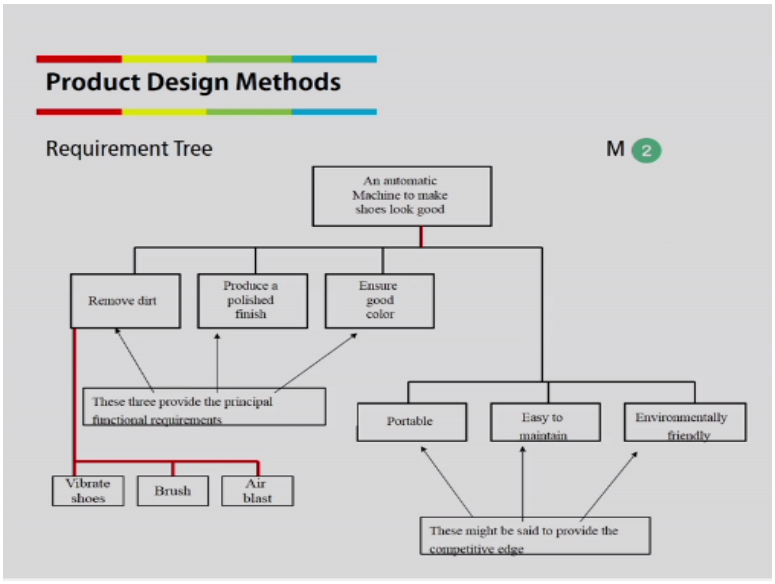


Next method is the requirement tree, where a bigger function is broken into smaller functions for example; you have a product vision where you have to design an automatic machine to

make shoes to look good. So, now you have to break this particular function into sub function for example, one is remove dirt, second; produce a polished finish, third; ensure good colour, fourth; you have to make the product portable, fifth; it should be easy to maintain, sixth; environment friendly.

So, the first 3 functions; remove dirt and making the shoe polish and ensuring good colour are the functional requirement and the fourth, fifth and sixth functions will give you a competitive edge. Now, the sub functions first one; the remove dirt can be divided into further more functions like how to remove dirt. One is vibrate shoes using brush, using air blast, so this way you are finding out sub functions.

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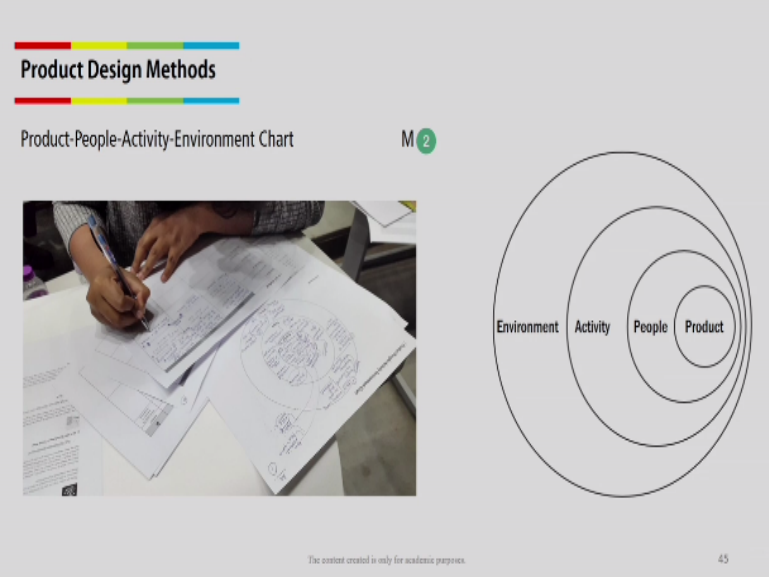


Next method is product people activity environment chart, where we will be observing within an environment what are the activities are done, who are the people involved in this process, what are the products in are there in the environment. So, here we are seeing the relationship between all the products, people, activity and environment.

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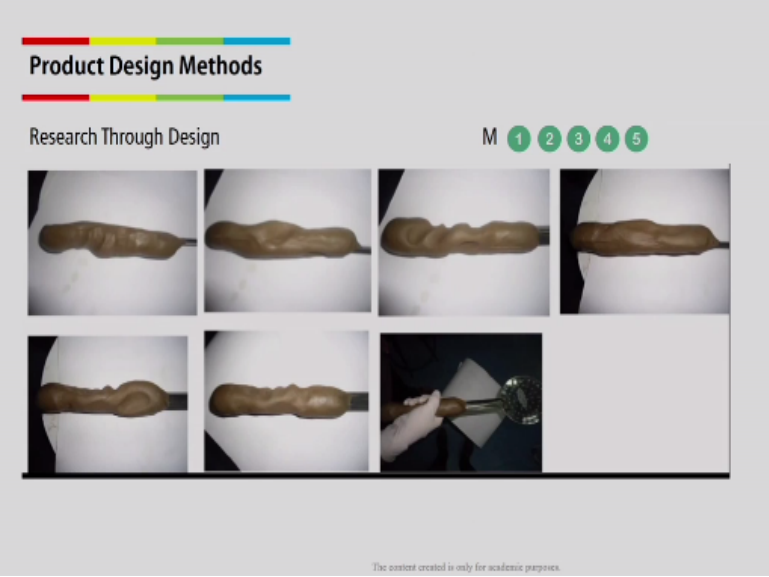


Next method is a research through design, where you will be making products or I would say making prototypes and then, you will be taking user feedback, user information experience data which will guide you for the further modification in the design process. Instead of pen and paper, you are actually making products and taking user feedback.

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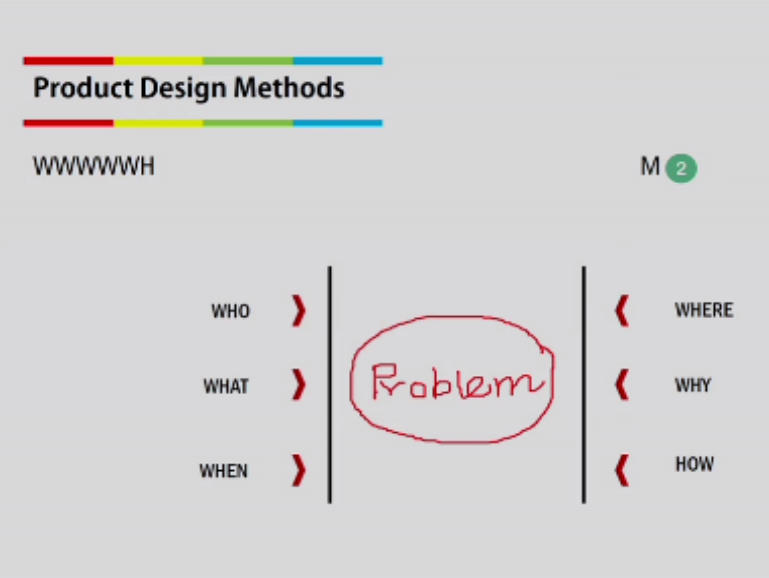


So, next method is 5WH, where you have to ask questions with those key words; who, what, when, where, why, how, so you will ask who are the people facing the problem, what is that problem, when the problem is occurring, where the problem is occurring, why is it happening, you can ask these questions multiple times also to get deeper understanding.

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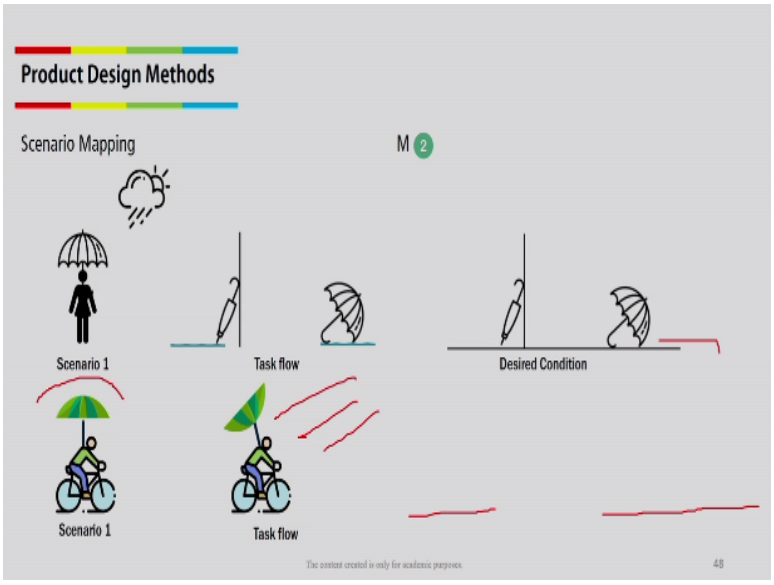


Next method is scenario mapping; here, you will be analysing the scenario that how user is performing a particular task for example here, user is using the umbrella but after using the umbrella when they are putting it, there may be lot of water on the floor, so what is the desired condition? In the desired condition, there should not be any kind of water, right. Another scenario is when we are cycling and also holding the umbrella.

Because of the wind, the umbrella most of the time gets inverted, so what is the desired condition and what is the desired product? This is also another tool in the analysis phase.

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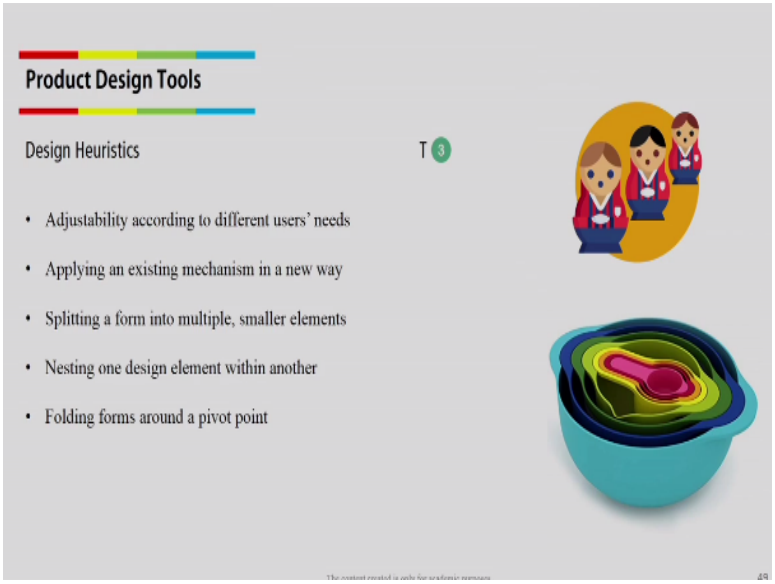


Now, we will be discussing about the product design tools, there are many tools, here I am discussing only about design heuristics which is very much effective. Heuristics are basically in simple words, the clues which will give designers and help them to generate new ideas for

example, here I am explaining only 5 of them because I will be explaining more design heuristics in the concept generation video.

The first one is adjustability according to different users need, so when we are designing a particular product, we should be careful enough that the product will be used by many people, in many context, so it should suit different kind of people. For example, different anthropometric dimensional people will be using a particular chair, so how they will be using that chair, whether that chair has adjustability to fit according to the sizes or not that has to be taken care of.

Second is applying an existing mechanism in a new way, so when we are doing this product decomposition task, we are opening a particular product, we are checking different kind of mechanisms inside it, this particular mechanism in the product can help you to make other product. Third is splitting a form into multiple, smaller elements basically, this is called modularity.

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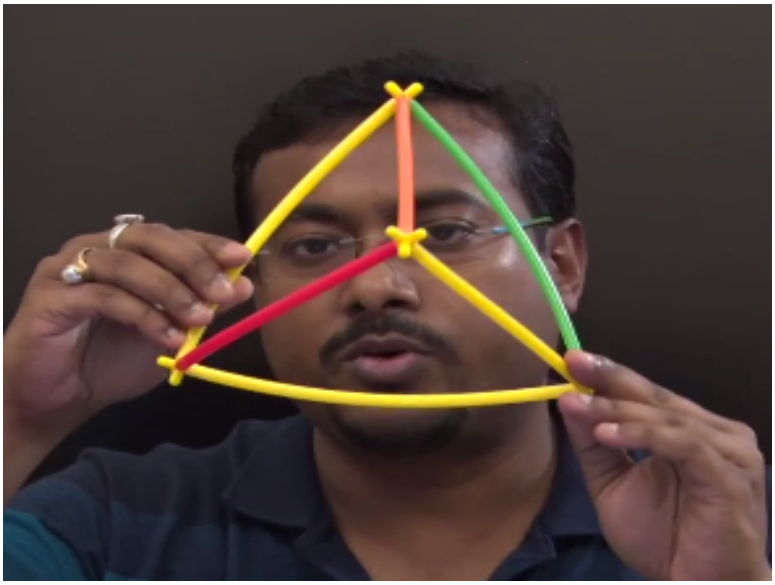

So, we can see this particular modularity example in many toys for example, we can see this kind of sticks and joining part, so you can join those components and you can get a 3d component. Similarly, in products also you can divide a bigger product in to smaller components, so that the people will assemble it and use it according to their own use. Next is nesting one design element within another one.

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Example is this kind of toys, if you open up you will see one more product, if you open it up you will see another product, so similarly there are many furnitures, there are many products like here given this particular example, so nesting can be used. Next one is folding forms around a pivot point, so using folding techniques we can to reduce the size of the product.

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For example, in this particular product you can see this is a particular bag but if I open this, we can increase the dimension of the product, it is a bigger product, so this kind of folding techniques are used in many products, you can search with foldable furnitures you will get lot many results.

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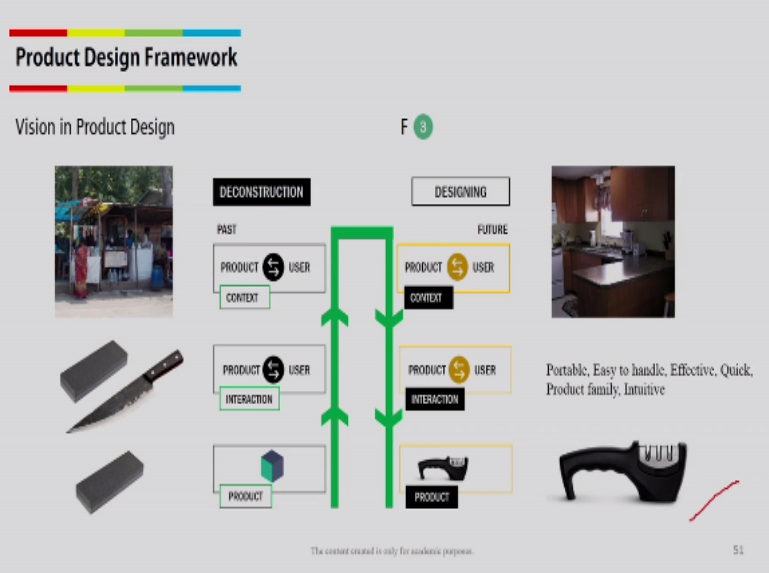


Now, we will be discussing about product design framework, one of the interesting and very famous product design framework is vision in product design, so there are 2 phase in this. One is deconstruction and another is designing. In the deconstruction phase, we have to see what is the current condition of the product, how product is being used by the user basically, the interaction between product and user.

And third is the context, in which context that particular product is used, so and then we have to assume the future, the new context. In this new context, what will be the interaction between product and user and that then based on that we have to come up with a brief of a product for example, here in street food vendors, if you go and see most of the cases they use stones to sharpen their knives.

If I would like to design a product to sharpen knives in the kitchen; house kitchen, then what should be the key word, what should be the nature of the product, I have to see. For example, it should be portable, easy to handle, effective quick product family, it should go with other products in the kitchen, it should have affordance, people should use it intuitively, so what should be the product for example, it should be like this.

It is handy, people can hold it very nicely and use it intuitively now, we will see through a case study, the complete product design process.

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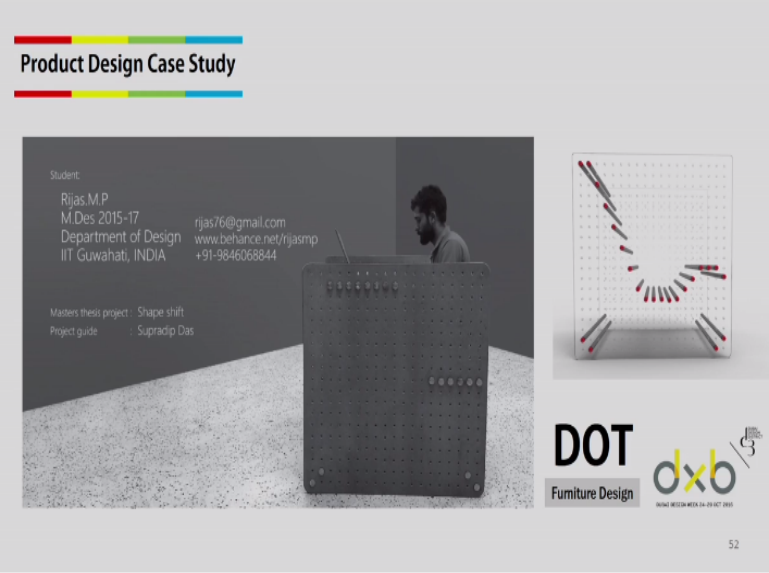


So, here I am showing you a furniture design designed by one of my students which has been featured in the Dubai Design Week in 2016. So, in this video you can see the modularity approach has been adopted where tubes are there and also side planks are there, by joining them you can get different kind of furniture, same furniture can be transformed into many furniture.

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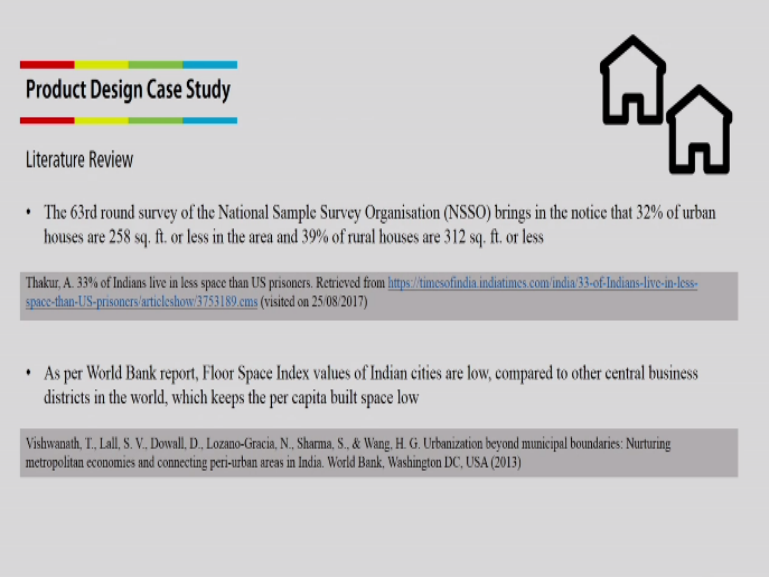


So, to make this furniture initially, we have done the literature review, like we found in the National Sample Survey Organization report that 32% of urban houses are 258 square feet or less in the area and 39% of the rural houses are 312 square feet or less. We also came to know that as per the World Bank report, floor space index values of Indian cities are low compared to others central business district in the world which keeps the per capital build space low.

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And we also came to know that one segment of the population are living in small houses because of economic condition and other segments of the population prefer small houses because of simplicity and sustainability. As a result of this growing consumer market, the tiny house movement have seen the development of houses approximately 800 square feet and tiny house movement also have seen development and implementation of novel space-saving techniques and technologies between industry and the do-it-yourself community.

Though this do-it-yourself community is not active very much in India but if we go to Sweden, we can see stores like Biltema and IKEA where products are designed for do it yourself community. So, from those literature reviews we came up with a brief that design and develop furniture for small houses, which is modular and usable for various purposes. With this brief, we started our concept generation face.

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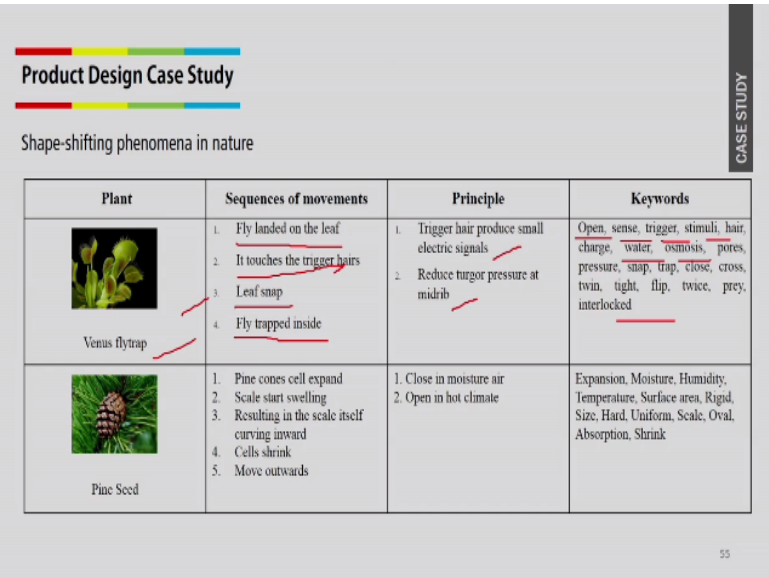


In this first we have done the analysis of the nature, where shape shifting phenomena we can see. For example, Venus flytrap, pine seed and others, here I am just showing you only 2, we have done more of this kind of analysis, where we have seen what are the sequence of movements happens in those kind of plants. We also have seen different kind of principles in those plants, we have noted down all those principles, why is it happening and then we have noted down the key words.

For example, in case of Venus flytrap, what are the sequence of movements, fly landed on the leaf and then it touches the trigger hairs and then leave snaps and then fly trapped inside that is how fly get trapped in this kind of plants. What is the principle? Trigger hair produce small electric signals and reduce turgor pressure at midrib, these are the scientific principle behind this.

So, you also analyse that how these kind of scientific principle can be achieved in the real world. We also noted down different kind of key words like open, sense, triggers, stimuli, hair change, water, osmosis and others.

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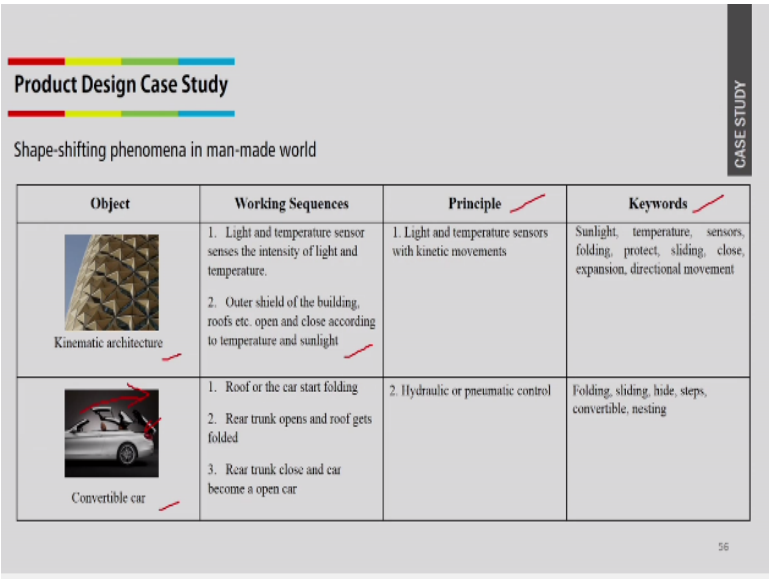


Similarly, we have also seen shape shifting phenomena in manmade world for example, kinematic architecture, convertible car, so what is the working sequence, how is it happening and what is the principle and we also noted down different keywords. For example, in the case of convertible cars, roof of the car starts folding, then rear trunk opens and roof gets folded with rear trunk closed and car become an open car.

So, what principle is used in this hydraulic and pneumatic control, so what are the key words? The folding, sliding, hide, steps, convertible, nesting these are the key words we can get from this.

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Then, actual concept generation stage started, where all those key words had been grouped based on 3 key words; one is action and activities, objects and others. Then in the second phase,

with those key words we have randomly associated different kind of products around us for example, open; how we can open a bag, how we can open a lock, how we can open fridge, how we can open a door, so this had been noted down in a table form.

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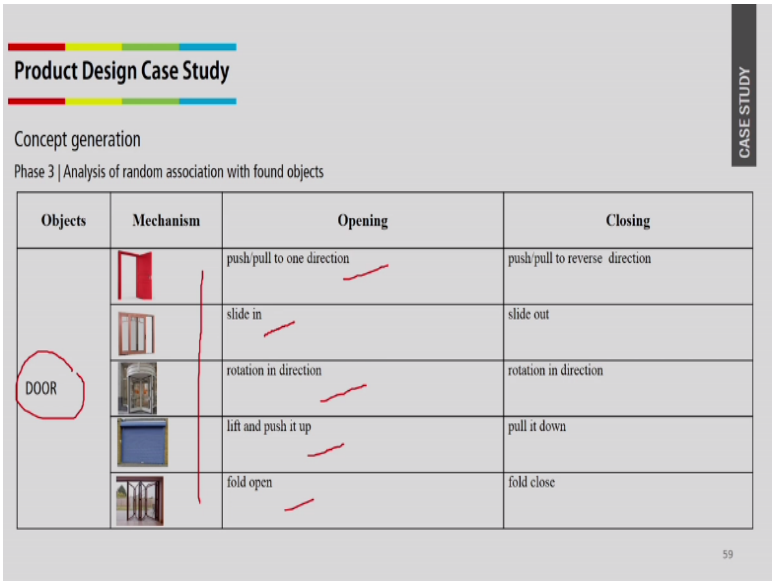


So, for example door; so there are many kind of door where we can open doors with push, pull, we can open with slide in action, with rotational action, lift and push it and foldable doors also we can see.

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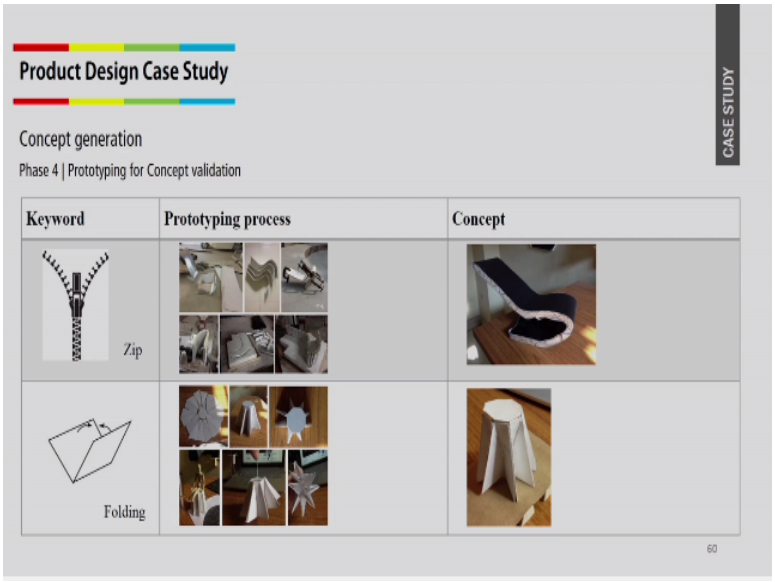


Using those actions, we have started making our prototypes for concept validation for example, using this zip action where two sides are coming and joining, using that action we have started making prototypes, using that what are the kind of furniture we can use where initially it will be a sheet and whenever required we will be joining them and it will take this particular shape.

Another key word is folding normally, it can be used as carpet whenever required, we can pull it up and it will take this kind of form as a stool.

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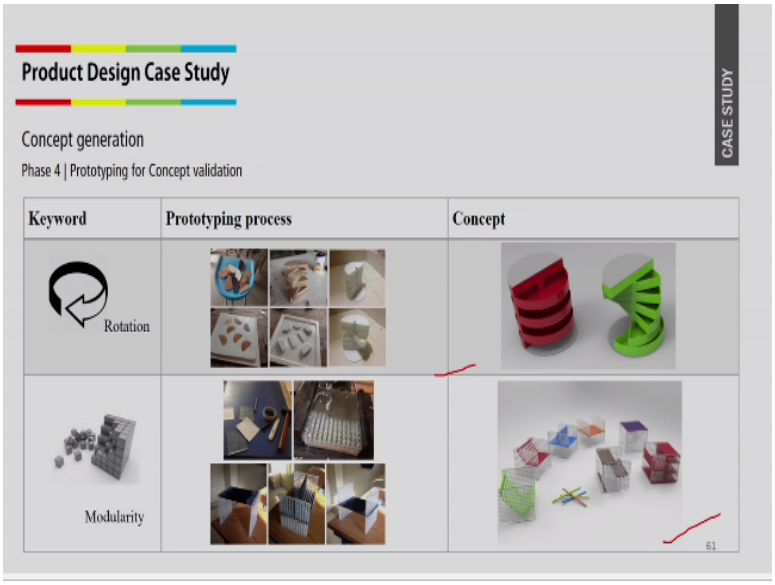


We have used other keyword like rotation and how rotation can be used and what are the other kind of different kind of furniture we can make, so we came up with a concept and we made the prototype. We use the concept of modularity and also made furniture out of it, where tubular modules are there and also side planks are there and side planks has lot of holes we can put all those tubes on those holes and adjust in such a way that we can get different kind of furniture form.

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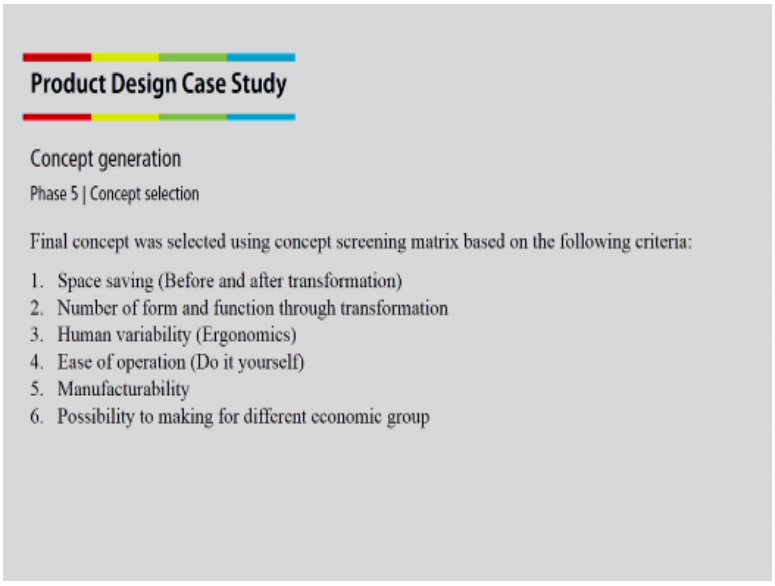


In concept generation, phase 5 is concept selection. The final concept was selected using concept screening matrix based on the following criteria. One is space saving like before and

after transformation, how much volume it is occupying, number of form and function through transformation like how many ways I can use one particular product, third is human variability; can different anthropometric dimensional people use this particular product, ease of operation; can user assemble it and disassemble it easily or not, manufacturability; can it be manufacturable easily or not, possibility of making for different economic group.

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Can I alter material, what are the different kind of material I can use, so that this particular product can be used for different economic group, so this is the final concept. So, here we have discussed a particular product and how we have designed, what are the tools and methods we have adopted for example, for concept generation we have adopted the design heuristics called modularity and human variability and we have started with literature review.

And then, we have analysed it and then we have made prototypes for concept validation and then the final concept has been selected for 1:1 product making. So, now we will be discussing about form and functions in design, so you might have remembered we have discussed about the design space. In design space, there are 3 things, there are 3 sides; aesthetics, ergonomics and function.

Aesthetics can be achieved by form strategies and there are another side functional strategy and third is ergonomic design strategies, so ergonomic design strategies are discussed in the module 3. So, now in this lecture I will be only discussing about the different form design strategies and functional design strategies.

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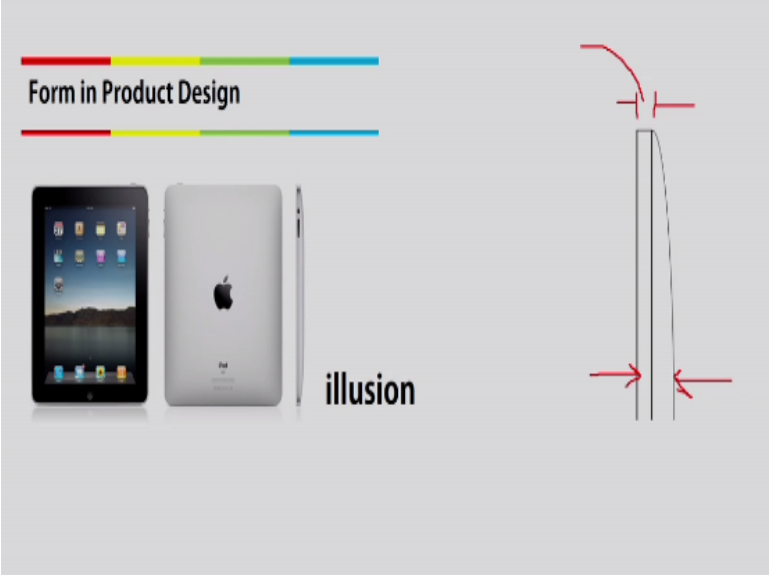


Form in design is very much important and here now, we will see what can be achieved with the help of form exploration. We can achieve elegance with the help of form exploration, simple, slick and neat forms give the quality of being pleasingly elegant, elegant product exhibit will find grease and suggest maturity that is how elegance and product design is very much important.

So, in this particular product, slick and clean line radius used in the corners is giving elegance, with the help of form, we can create illusions also. So, in the earlier models of the iPad, we can see how illusions had been created, so here the actual thickness is this but when you are keeping this particular product on a table, you will only observe this particular thickness, so with the help of form they have created an illusion.

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So, user will perceive this as the actual thickness not this, with the help of staccato lines, good grip can be achieved in this particular case, we can see how staccato lines are used to create a good grip. In this process, material also reduced.

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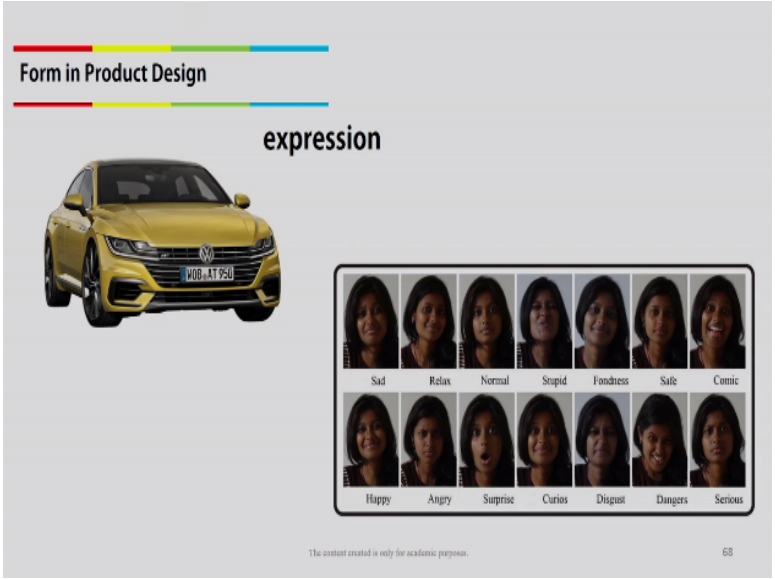


With the help of form exploration, we can achieve expressions. While playing with lines, we can achieve various expressions; it can be happy, angry, cute, comic, danger, serious, with attitude etc. so we can see this kind of form and expression in the front fascia of automobiles.

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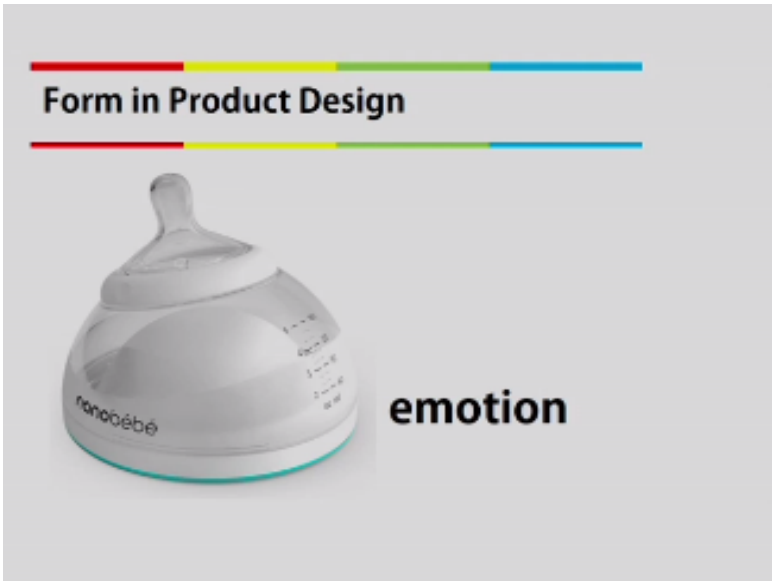


With the help of form, we can achieve different kind of emotions also earlier, we have discussed if the product gives sense of adventure, feel of Independence, sense of security, sensuality, confidence, power then, it is emotionally design. Form gives us the liberty to achieve

emotion through exploration. Here in this particular product, babies will not feel that they are away from mother, so it is giving the sense of security.

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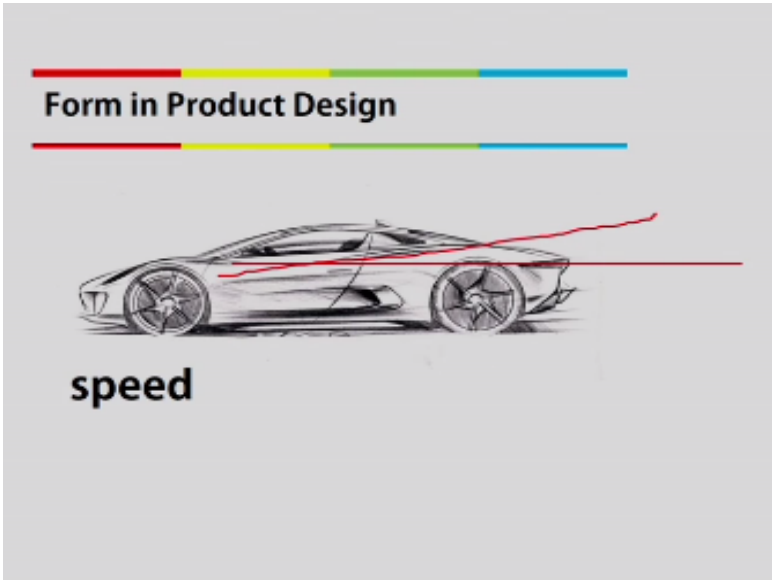


With the help of form, we can achieve speed also, a message of speed can be conveyed by a product form having sloping lines that meet at a point, it has an association with an arrow, it is therefore possible to convey the message of movement by using sloping lines at a relatively slight angle to the direction of movement.

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With the help of form, we can achieve affordance also, so through form we can give affordance to a product, the form giving the user an indication to rotate or press in this particular design.

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With the help of form, we can give perception of stability and heaviness here, in this case extra material had been added to increase its overall volume and thus it seems it is heavy and stable.

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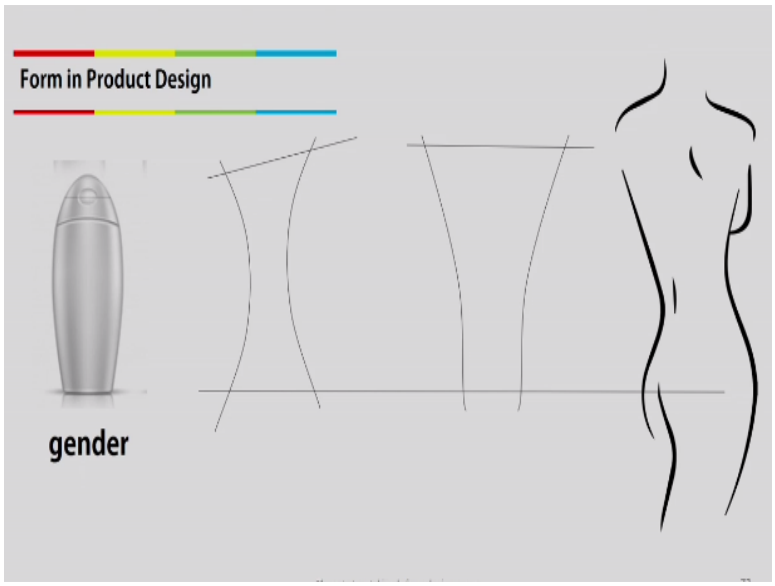


Form also gives us indication of the gender with the help of concavity and convexity; we can achieve the gender in products.

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We can get the sense of hierarchy also in products by altering the form we can achieve this, the size of the form dictates the dominance and sub dominance, so here it is dominant, this is the main functional unit and because of the size, this is the sub dominance. So, in design hierarchy can be achieved by altering the dimension of the object.

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So, now we will be discussing about the pleasurable form in product design. First is aesthetic form, so before discussing this let me discuss about what is pleasurable form. A pleasurable form is defined as one that elicits consumer pleasure simply by its visual appearance, so beautiful materials, attractive colours and delightful shape, all 3 of this can associated with aesthetic qualities.

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Therefore, products having these keywords are under the category of aesthetic form. Next is BIOS form; product forms mimicking animals, human figures, objects or natural elements tended to interest and fascinate the viewers, so keywords related to organic form or objects mimicking natural life are under BIOS form.

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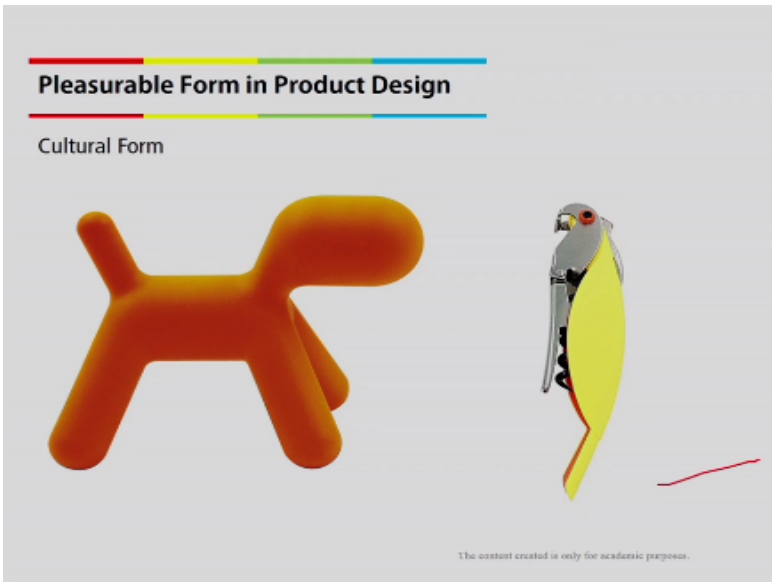


Cultural form is the form that suggests social meaning and that fits well with the social belief, system, values and customs, style, fashion, literally meaning, status, nostalgia, playfulness, sharing and display effect are the keywords for cultural form. For this kind of products, so playfulness is there and display effect are there in this particular products.

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Next is novelty form; novelty is a product characteristics that places unique emphasis on unique appearance, structural innovation, creative concept, unique appearance refers to the creation of new shapes, unique colours and creative material. Structural innovation addresses the creation of new structure particularly, when it is structure that relates to the customers interaction with the product. Creative concept refers to a new solution to a product's operation or function, thank you.