

**Design, Technology and Innovation**  
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**Indian Institute Technology Bombay**

**Lecture-12**

So today's class is on collaborative model for innovation. This is a culmination of all the three aspects of design, technology and innovation. So you will see this particular sort of development happened as a research project of mine while, you know, I worked in industry for nearly seven years and after industry experience, I joined IIT Delhi as a professor and then I started my PhD then, because I realised that innovation needs a different type of skill set and innovation was a very early stages in the country.

We did not see many developments in the country at that time. Even the cars, you know, were very few. If you look at that time you had two brands running in the country. So, in that stage I said let us workout a research program where I, you know, did a PhD theory of collaborative innovation. So, this whole journey I am going to show you, how we built this collaborative model from real case studies.

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## **Objective**

To develop a Collaborative Model for Innovation  
that will enable organizations to generate  
innovative product ideas.

So the main objective was to enable organizations to generate innovative product ideas. It could be organizations, or it could be students, or it could be non government organizations. Any of

them, if they have to come with innovative ideas. And these innovative ideas need not necessarily be product ideas. See for all of you I am telling you this could be communication ideas, it could be animation requirements, it could be interaction ideas, it could be anywhere but the methodology is the same wherever you take these ideas forward.

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## Real case studies with industry

- The model was built by undertaking case studies with industries.
- It was taken up as students' sponsored projects.

So here we specifically built this using real case studies. Then we actually took them as sponsored projects with students. And if you take them as sponsored projects with students, the industry is a partner to this. So when you call it a sponsored project what happens is the industry pays a large sum of money to the institute so that the professor and the student is part of the team. Ok. So, here, then only it will be called as a real case study, otherwise the case studies are not real. Ok, so that was done.

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## Real case studies with industry

- The live case studies helped in addressing the complexities and operational issues related with innovative product idea generation process.

And then these were live case studies which addressed the complexities and operational issues related with innovative product idea generation, because what happens if you are doing a fictitious classroom project, it is called a mock project, you will not get the complexities as clear as you do in a real project. So when you talk about a real project, the most important aspect of the project is that you will get an industry partner, which is the toughest stage. And most of the industry partners who are ready to come to satisfy their current small issues.

They will not come to work on an innovative next generation product using new technology and new materials or new design. They will just say, you know, redesign my product. So we have to find the right partner to do this project. We have to form teams, both in the industry and academia, that is, for example, I have a student, the guide was me and some of the colleagues from other departments who were part of the teaming process.

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## Methodology

- Identifying the industry partner and product requirement
- Formation of teams
- Situation analysis & Product brief

Then, where to come up with the product brief then the team would develop ideas and then build it into concepts.

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## Methodology

- Concept generation
  - Development of concepts
  - Selection of three concepts
  - Refinement of concepts

The concepts will come up with multiple three concepts. Then these would be refined.

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## Methodology

- Final concept: Selection of the final concept collaboratively after assessing the strengths and weaknesses from the point of view of product brief.

And finally the final concept would again go into the network group to see whether innovation can happen or not. So this is the total, you know, methodology be followed for the research. In research it is very critical to have very strict sort of methods because each case study has to follow the same method so that we can actually get them into a particular framework to come up with the model. Then this model will be very effective for everybody.

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## Hero cycle case study



So, here we come up with these life case studies. The first case study was the design of a bicycle, next generation bicycle for Hero Cycles. Hero Cycles is the largest manufacturing, you know, bicycle manufacturing company in the country and, you know, we were very lucky that they agreed to partner with us in this journey. Then the next project was a dual chambered bottle for a beverage

company. This company wanted the bottle to be manufactured which has dual chambers. He wanted to supply masala milk and the masala liquid should be mixed just before drinking the milk. If it was mixed before, the aroma, the taste, will all get ruined.

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## Dual chamber bottle case study



So that is called a dual chamber bottle. The top chamber will have the masala content and the bottom chamber of the milk so it can mix, and it can be used for various other Indian beverages. So he wanted the bottle design for that purpose.

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The third product was the petrol pump design. Before I joined IIT Delhi as a Professor, I worked on petrol pumps and the competitor came rushing to us and said we would like to work with you.

So this was a very easy client for us because he knew that we would work on innovation and this was a company called Midco which wanted to, you know, sort of wanted come with an innovative product.

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And the fourth one was from Hero Motors. Hero Motors was manufacturing a moped called Hero Pook and they wanted to sell it urgently in the market and they said we want to really work on the form innovation as well as user convenience innovation for this vehicle.

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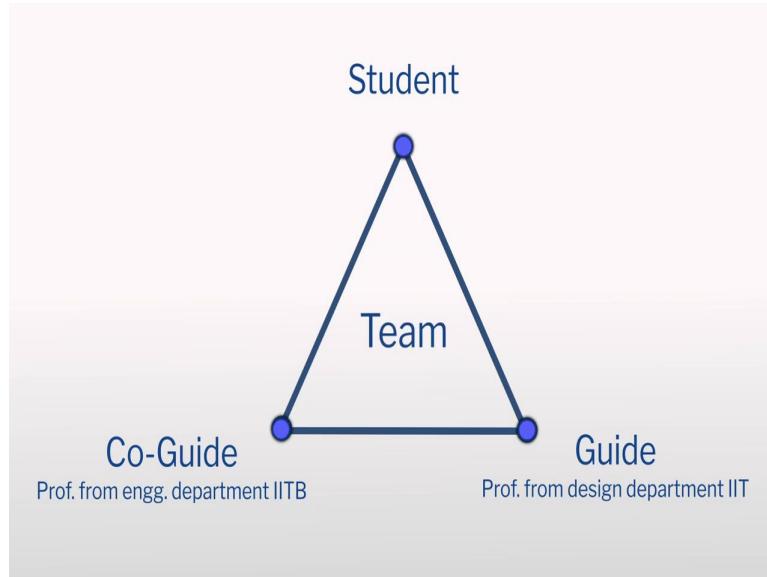
## Godrej lock case study



And the last project was from the Godrej locks division in Bombay. They say that we have a lock product which we like to do, you know, redesign at 50% of the cost.

So, each one had a challenge. So from these challenges we started our project. So why did we went ahead with our, you know, real case studies? We had a student who would work on the project earlier like, you know, we discussed this helmet case study.

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The student is the full team member, we call him as the person who is fully responsible. We had the guide, who was me, who was from design school and we had an engineering professor from another department who would be his co-guide and that was called the team at IIT. Then, we built a team which is at the company level, where the company would then give their person for marketing, one person from manufacturing, one person from supply chain and one person from finance.

That way we have 4-5 people from the Hero Cycles company and in this case, remember I was telling you, all these case studies have to have a particular framework. And what is the framework we used?

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**Frame work for case study  
SAP LAP analysis  
by Prof. Sushil DMS IIT Delhi**

**S : Situation  
A : Actor  
P : Process  
L : Learning  
A : Action  
P : Performance**

The framework was called Situation, Actor and Process: SAP. Learning, Action and Performance: (LAP). This is a SAP LAP and this was actually done by my professor who was my guide. My professor who guided me in my PhD is Professor *Sushil*. He was from the school of management in IIT Delhi. So he was my guide and he came up with this framework to assess case studies. You do a case study, you apply this framework and analyse, and you will come up with learning so that you can act on the learning. After acting on the learning, you can have your performance, you can make things happen.

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## **Hero cycles – case study**

### **SAP LAP Analysis:**

#### **Situation**

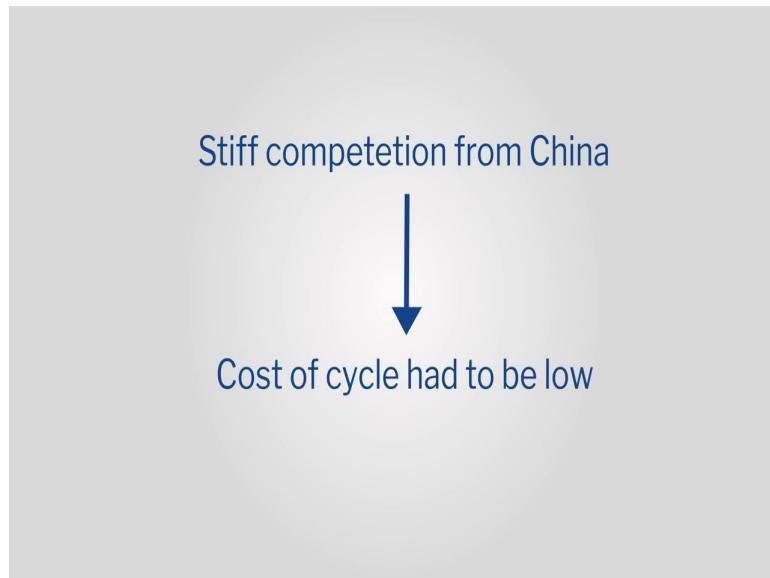
- Produced 24,000 bicycles per day
- Most of the work was outsourced to external vendors

In fact we were lucky. We were at the gates of Hero Cycles and my god, it was like a highway because they were manufacturing 24,000 bicycles a day. That is a huge quantity. Every truck used

to move around 200 bicycles. So if you manufacture so many, how trucks have to move on a particular day. And then on the top of it, if you are a manufacturer of so many bicycles, the parts have to come from all over *Ludhiana*, right?

Hero Cycles was in *Ludhiana*. So it has to come from various locations so all these people, vendors would start supplying the materials in their trucks. So the main gate of the company was like a huge, sort of, gateway of trucks going in and trucks going out. That type of volume they were manufacturing.

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And they were having this stiff competition from China. China was supplying bicycles in India at half the price of Hero Cycle. And Hero Cycles was threatened, they said that if they (China) started supplying in large quantities like, you know, what will happen to our business? So, they were really concerned and that was the assignment they gave us, that you design with your innovation. We want a low cost bicycle. You come up with innovative materials, you do whatever but our cost of the bicycle should be low.

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So here we are. Then you have to understand the situation, what all Hero Cycles is doing. They outsource a lot of pipe manufacturing, component manufacturing outside.

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## Hero cycles – case study

### SAP LAP Analysis:

#### Situation

- Not capable of producing high quality products
- Room for improvement indicated by CEO

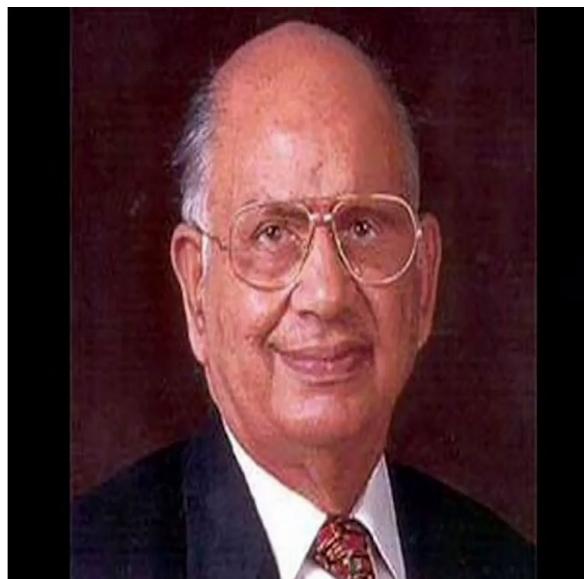
They assemble the bike in the factory. Not capable of producing high quality products that is very interesting. This information was also given by the CEO.

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You know, when you weld a frame what happens? When you weld something what happens? When you weld pipes together, the stresses develop in the pipes, right? And your pipes are never in one line. So your front wheel and your back wheel in all our cycles are never true. If they are highly true, they will be the best cycles. You will have a very little load to bicycle. There will be phenomenal. You will see the difference drastically.

So, here the biggest challenge was getting the pipes in one line and getting your front wheel and the back wheel in one plane in exactly one line. That is the most important test for a bicycles accuracy and cost.

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And we were very lucky, (*Brijmohan Lall*) *Munjal*, he was a senior guy who was around 75 to 80 years at that time. He came and gave us this very interesting one line brief saying that we need to innovate. We need to come with bicycle which can beat the Chinese competition, but also have a form factor, which is different from the current cycle. So very, you know, we were very inspired by him because at that age he could give that type of phenomenal direction to the project whereas all other people from marketing and all were talking about their current problems and looking at that.

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## Hero cycles – case study

### SAP LAP Analysis:

#### Actors

- Second team: CEO, Head of Design, DGM-Marketing and Head of Export Division

Here the Actors are the student, guide and the co-guide, I told you. The co-guide is from another discipline. For example if I am doing bicycle design, I will take a co-guide from applied mechanics. The professor from applied mechanics was our co-guide in the project. So we were 3 people team. Then the second team was from the company. The CEO, the top management support was very critical. So here we have the CEO coming in very, very closely. Head of design DGM-Marketing and Head of Export Division. This was chosen by them. Hero Cycle also exports a lot of bicycles all over the world.

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## Hero cycles – case study

### SAP LAP Analysis:

#### Actors

- Third team: Head of design at Maruti Udyog, Caparo-vendors and experts in deep drawing, Independent sheet metal consultants and two professors from IIT-D, expert in deep drawing and material

And of course the third team were, this third team was built after we started the project and this team included out-of-the-box vendors like Maruti Udyog who were designing products as a vendor to the car company, we had Caparo Vendors who were experts in deep drawing, we had some street metal consultants who came from outside and they were experts in deep drawing, professors from IIT.

So this is a new team, which was built up after we understood that we cannot handle this project without some more additional information coming in. So that was the third team which came up. So we did the data collection. We found out what all was happening and then we came up with a lot of ideas which were important for us to see whether we can merge all this cycle idea. And cycles have been, you know, very very phenomenal in their simplicity and use. So, what type of ideas can we come up was the biggest challenge.

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## **Hero cycles – case study**

### **SAP LAP Analysis:**

**Process: Concept generation**

- Evaluation led to understanding that existing problems can not be solved with pipe structure (especially if the bicycles has to be mass produced)

So, we want to solve the pipe structure problems, the pipes were the biggest problem because the welding was getting stuck, all of you know the bicycles.

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## **Hero cycles – case study**

### **SAP LAP Analysis:**

**Process: Concept generation**

- Possibility of making bicycles with other materials

The welding was not proper. The weldings were taking a lot of time. Then we also looked at the possibility of use of other materials.

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How many of you have ridden aluminium bicycles? Aluminium alloy bicycles? Very good. They are very light right? What happens when the cycle is light? It moves faster with lesser effort right? But the aluminium alloy is so expensive that the cycle generally costs 3 times the regular cycles. 3-4 times the regular bicycles, because aluminium is difficult to weld, and the alloying, you know, is a special process.

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## **Hero cycles – case study**

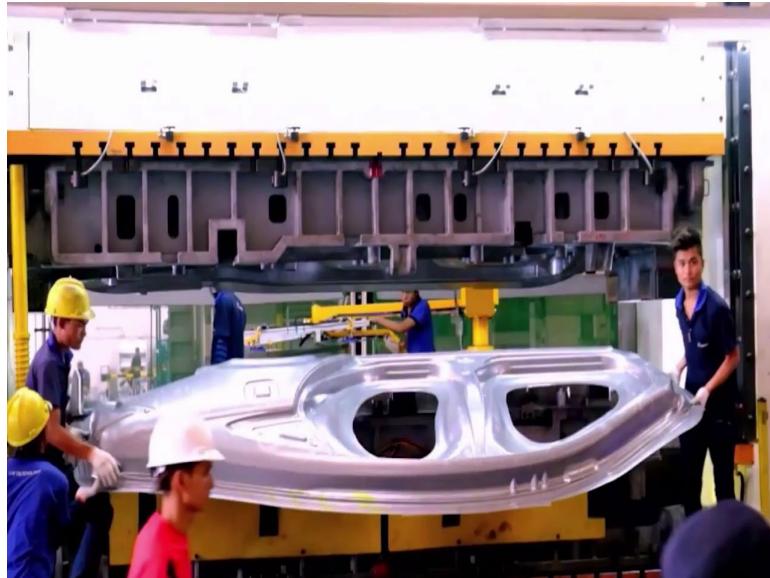
### **SAP LAP Analysis:**

#### **Process: Concept generation**

- Use of deep drawn sheet metal for the purpose of manufacturing**

The biggest breakthrough came when we did the idea generation for a deep drawn bicycle.

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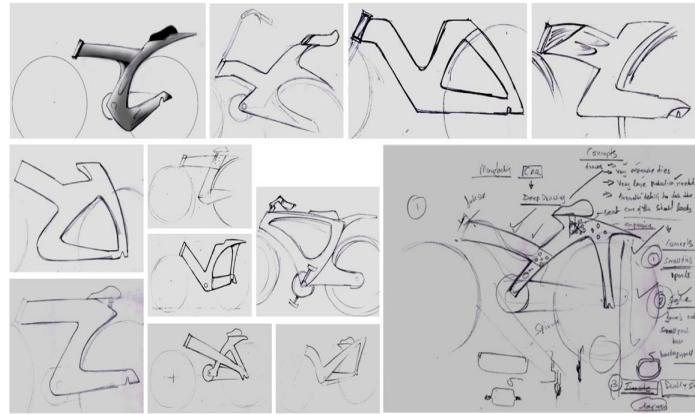
How they were manufacturing cars? They are manufacturing cars by sheet metal draw, right? The car body is drawn by large presses. You may have seen it on videos. So, when the large press is pressed you get the whole part in one go. So, can we manufacture bicycles rather than pipe welding, you manufacture by the deep drawn process.

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That is a very big insight and we will show you how that insight went forward.

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## Idea generation - Hero Cycles

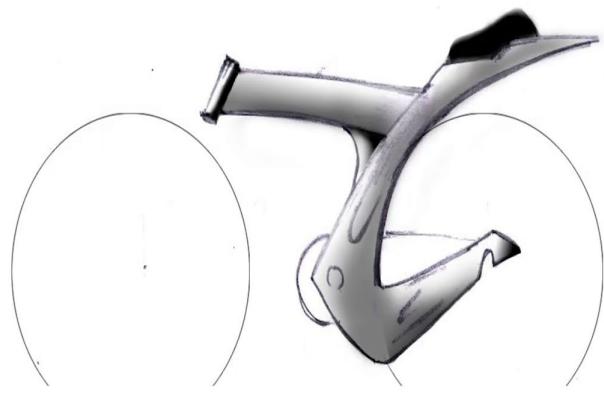


So a lot of ideas came up with, you know, aluminium. Dye cast materials.

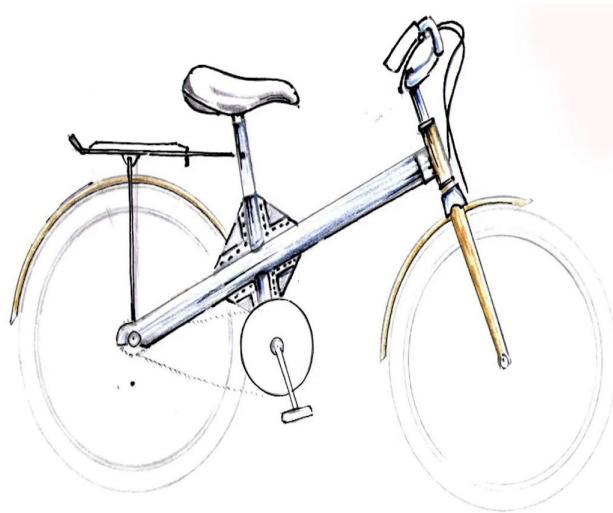
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Aluminium pipe structures, mild steel structures.

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Riveting the structures together rather than welding because that was taking a lot of effort.

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## Focus cluster of concepts



And here finally you come up with your focus cluster. Here you have, you know, three focus clusters with three different types of materials here.

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This first concept is a sheet metal drawn bicycle. Isn't it interesting, as soon as it becomes sheet metal, what's happening to the handlebar, it has become very long, because in sheet metal if you gotta get the same stiffness your length of the fork, will have to increase otherwise it will start wobbling. So this is a very interesting characteristic of a sheet metal and all this is drawn at one go in a press.

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So, you get a one single frame bicycle. And this single frame bicycle you can have special alloys to make it very light weight.

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Here for example, you have box pipe frames made up of aluminium. Aluminium box frames are so light weight and cost-effective in welding. Easy to weld. So this is one box frame welding. And here it was again mild steel structural welding which was again being used over here.

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## CAD models - selected concepts



And the sheet metal concept was selected as the best concept, because the advantage of using sheet drawn concept was that it would become very very cost effective. The prices will straight away drop by 75%. Because what happens in a pipe bicycle is pipes are actually sheets originally.

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They cut the sheets, and they are rolled into pipes and that is how pipes are manufactured. Pipes are not extruded. Cast iron pipes are extruded. Most of the pipes are sort of rolled and welded. So just imagine if I directly take the sheet and use it, my cost will be very low and because of the manufacturing process of deep drawn it is a very very fast process.

You get, you get no welding, no cutting. So it will become very, very cost effective. You can see how the whole frame has been built in one go. And then, further development happens.

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## Exploratory mock-up models



And then in the same process, we have something called the mockup model, remember I always talk about mockup models here.

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So you build mockup models of this to understand how they design would work.

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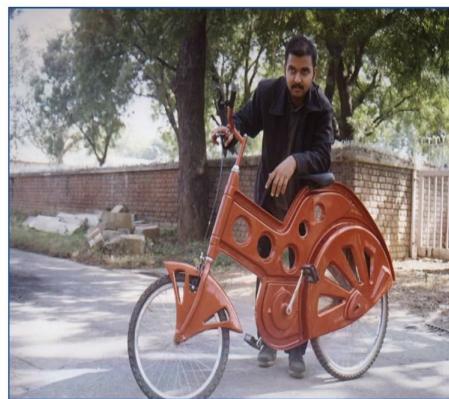
## Full scale mock-up model



And from these mockup models we built one full scale mockup, non-working mockup because, you know, you need special steels to make a prototype.

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## Full scale mock-up model



And it was very difficult to procure the sheets at that time and you needed tooling which will become very, very expensive to do. So this became the option for us to show to the company. And of course, the company was very thrilled to see this product because the cost was actually finally 75% of the current cost of material. Whatever material they were using. But the biggest challenge here was the tool cost was very high. So they have to invest around 50 lakhs in tooling produce this bicycle which will be 25% cheaper.

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## Hero cycles – case study

### SAP LAP Analysis:

#### Finalization of concept

- Interaction of the first team with the team of experts was iterative in nature
- In the concept detailing stage one concept was preferred over others

So, what did we learn from this journey was that interaction with the first team, with the team of experts was iterative in nature. So, this interaction with the experts who were doing the sheet metal drawing and all became very iterative and the concept development happened with experts from

the manufacturing sector in sheet metal. The concept detailing stage 1 concept was preferred over the other. In all the concepts why the other concepts were not chosen because of the focus. The main reason for our journey was that we needed to start with the low cost aspect whereas all other concepts were not low cost so we chose the concept which would result in low cost production. So that was the reason.

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And the main learning was, solutions to existing design problems will lie completely in new paradigms. What is the new paradigm? Car manufacturing. A car paradigm of deep drawing and cars are cheap only because of deep drawing and because of the large manufacturing base, which they have. And special partners that can be selected. What is the learning for us, for the collaborative team? You have to select special partners, like the people who are experts in deep drawing, the people who are professors, experts in alloying of sheets.

So I need to produce, I would have to go to Tata Steel and request them to produce the special grade of steel which can be deep drawn and which will be stiff, because your bicycle cannot wobble right, the sheet has to be stiff, right?

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Of course the form factor is there, we made the form which is the rib, so that it would be stiff but the materials also have other properties. So that was the major, you know, the learning in this case study that you need to really bring experts into the field during the design process.

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## Dual chambered bottle



So here, this is a dual chambered bottle. The same journey. A lot of ideas were built.

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## Dual chambered bottle



After a lot of ideas were built and each Idea was taken from a creative analogy. So the first idea was, if my opening is like the shutter of a camera. There is an opening and closing, right? So if you take inspiration from the shutter, the dual chamber, for example, the top masala can get mixed with milk by moving the shutter, right? So I have taken the analogy from a camera to design my dual chamber bottle. So, here you have the shutter in this and you move this lever and the shutter opens and only when you want to drink the masala milk you're mixing masala with the milk.

So here we have this, second idea, was taken from these dispensers, the tubes for ointments, where there is a layer of silver foil and you press with the end of your cap, the ointments. You reverse the cap and you press and punch a holes. (**Refer Slide Time: 17:23**)



This was like a puncturing like mechanism, you have a foil here and you have a button. So this content will get in by puncturing the foil. So this is a puncturing mechanism, which cannot be reused of course.

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And the third option was inspired by traditional soda bottles with the ball. So this soda bottle you press the ball out of its location, it goes and settles somewhere else and the channel becomes open for you to drink.

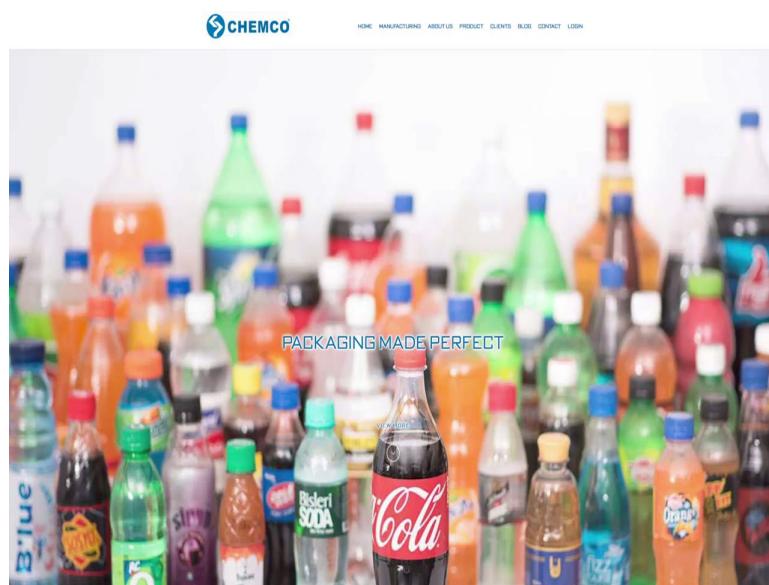
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So here, for example, you move this ball and automatically a channel opens, because the ball is elliptical and then the channel opens, the top masala will, liquid will mix with the bottom. This

was a live project. The beverage company was on our back. He wanted a patent for this. When you want a patent for such a product. You would, you have to go and look at your patent thing. We found 500 patents for a dual chambered bottle and my student went, you know, haywire, he said, ‘Sir, how can I make one more which is good.

But that was the beauty is here. For example, we found out that the need was very critical here. The client said that this particular bottle should not be more than 10% more expensive than a regular beverage bottle like a pet bottle which is used for Coca-Cola or Thumbs Up. If those bottles are costing you 10 Rupees this should be equal to 12 rupees, not more than that.

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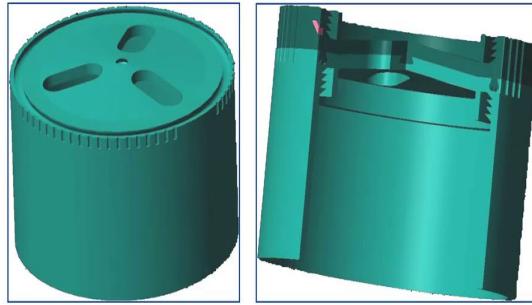


And when you went to the web to see how many patents were there, all those bottles were for different, different purposes. They did not have that type of, you know, cost aspects. As soon as it came in, the pet bottle, we talked to the pet manufacturers straight away. And he said, he told us that we are coming up with a new material which is 10% cheaper than the current material. So you design with a new material you will be able to come down to your cost by 10% and then you come with your other designs which can work.

So those bottles you put them together and finally the whole team decided that they would like to go ahead with the shutter one, because that is more simple and more easy to operate and more cost-effective.

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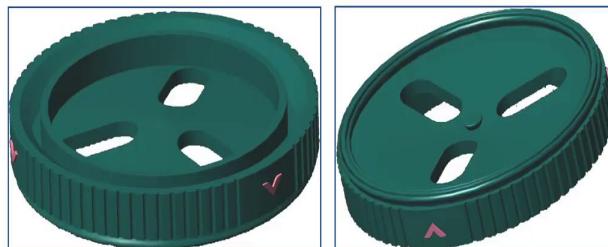
## CAD models for details



And then the actual work started off of detailing. So here how will the shutter work?

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## CAD models for details



Here you have this, you know, a very interesting slope given. Without the slope what happens is your sealing is not perfect. So you have the shutter, when this turns in these locations, it is closed and when these two match it opens, a very simple mechanism. But the biggest challenge here you should be leak proof. That is the big challenge. Where do we get the inspiration for leak proof you tell me? Have you seen these leak proof taps, stainless steel taps with the rod.

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What happens in them? It is just a taper, right? And in that they put a brass receptacle. It goes, because of the taper, it goes and locks. There is no rubber there. So, we took that inspiration from that design and we used this taper over here. So this is no longer flat. This is tapered like this, so when you lock with the taper, you get a very good waterproof design. so these got designed. And then finally it goes, you know, implemented in the bottle and the bottle, you know, was actually just 15%. It was not 10 of course, 15% more expensive than the current bottle.

Because, this piece of the plastic is what is extremely low cost. So the bottle had the turn in the middle. So you hold the bottle, turn the whole ring, the ring on the top, this ring and top content will get mixed with the bottom content. And the dual chambered bottle was ready. So, the client was wanted to get a patent, so we got it patented and after that we really do not know what has happened with the product. We are hoping that he has manufactured it.

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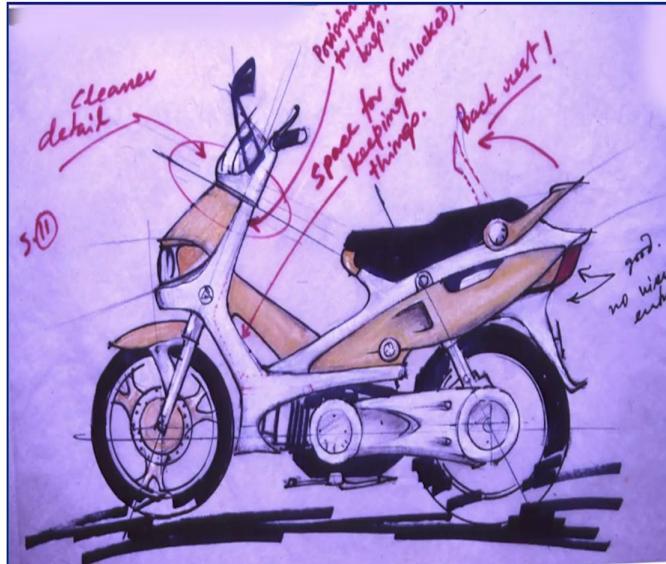
**Lecture-13**  
**Collaborative Innovation Methods Part 2**

## **Step through bike**



Then the third project was Hero Motors Step through bike. And this step through bike was for Argentina. It was for an export market, so we had to really work very hard with their export team, with the clients in Argentina.

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The student was sitting in IIT Delhi and, you know, with a lot of sketches.

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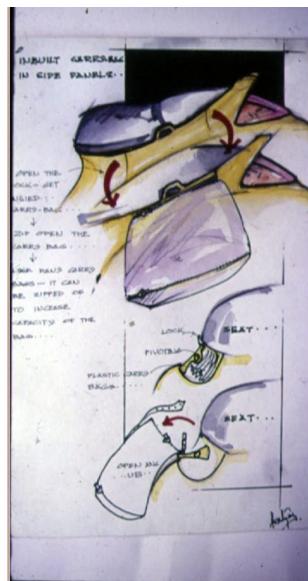
So this came, gave us a very important inspiration that your visual sketches become very very important for your design journey.

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Visualisation of sketches helps you in the collaborative model for innovation.

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And you can see how the client wanted, in a hidden tugged bag inside the side pocket. So this bag actually would go and the side pocket would close. Grocery was very, very important for the step through bike. A lot of women would ride these bikes in that country and they wanted the styling to match their perceptions. They sent us a lot of image boards for this work and you know that is how the whole product had come up.

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And then the student built a small scale model. It was just a 1/5<sup>th</sup> scale model, very small. And with this model a lot of inputs came. When you make models, the biggest advantage is the collaborative team can give you a lot of comments. They can give you a lot of inputs to how things will happen. Using those inputs, the student then built a full scheme montage. Why it is a Montage? What is a montage over regular, sort of, model? A montage, only has half of it.

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You can notice it? Everything is half. You do not have a back side of it. So, because it is a montage. When you build a half, by layers, you can also build, like, layers. This is a foam montage and then this is a full scale montage so you can really stand next to it, take all the inspiration and everything can happen. And this is a full-scale, a non-working prototype. And all done within a span of 6

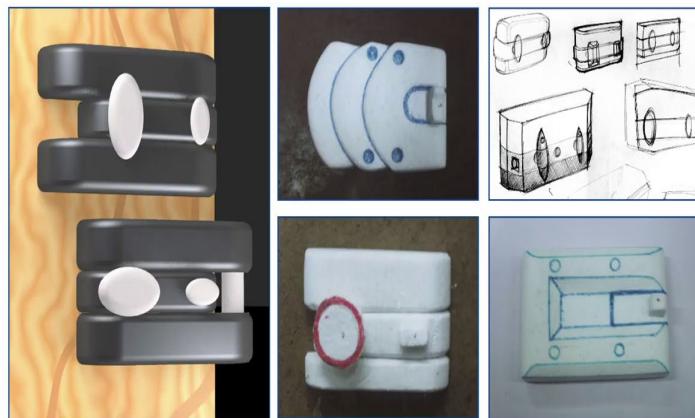
months. And the company, Hero Motors was thrilled to see this progress because in their company they take 3 years to build such a thing. And we finished in 6 months. This happens because the collaborative teaming because of the type of intensity the Core Team works on the work.

And here for example, you can see every part, you know, including the special review and stands, basic stands, the stands for the pillion rider, the seat design, the grab rail. Remember this tug away pocket. You open this box, you get a large bag which will come out of this pocket, and you can put groceries on both the sides. A lot of storage was done which was a very important thing and this was completed in that time. So while doing all this we were actually, what we were doing at the back? We were actually assimilating all the learning.

What is happening? Whom are we talking to? How are we working on this project? What are the inputs we are getting from the team? What are the inputs we are getting from the external team? All that we are logging, I am not showing you that log, but I will show you at the end, how the log helped us to build the model.

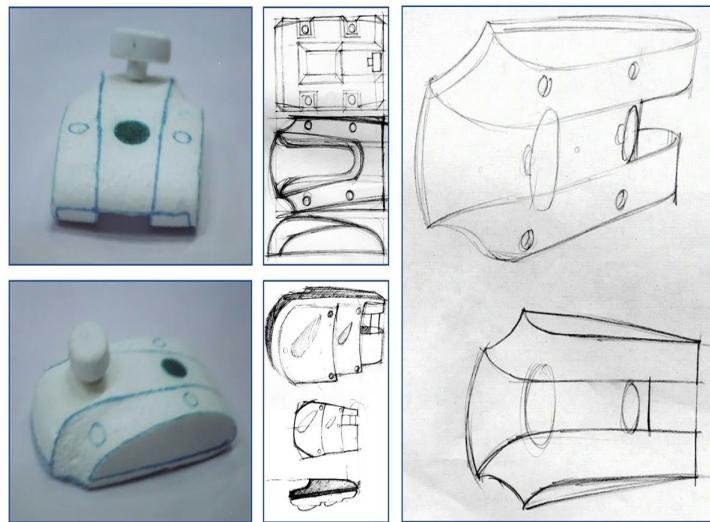
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## Design of vertibolt lock



And then the fourth model was the lock for Godrej. Again Godrej said, ‘We want a lock, we are the largest lock company but we are threatened again by foreign brands coming in with low cost. So we make a vertibolt, which is 50% of the cost of the current product’. So again the same phenomenon of making a lot of ideas.

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Choosing one idea which could be an integrated design. Because, what is the best way of reducing the cost? You reduce the number of components right. And then this student actually did shadowing of a lock repairer in Bombay. We actually went behind a lock repairer, worked with him for 3-4 days. Then he came and told me, 'Sir it is really unfortunate that the lock in Bombay, because of the breeze, the door closes and if the vertibolt is on the lock breaks.'

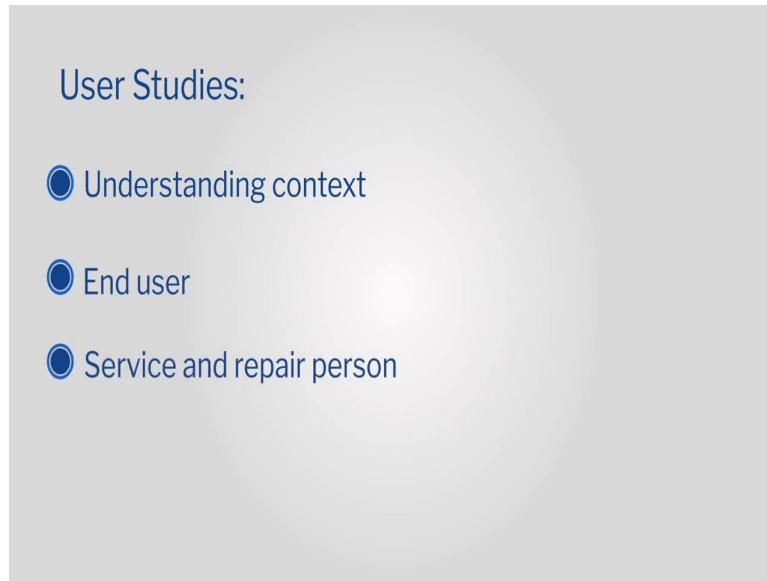
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The lock breaks inside because it is made up of aluminium casting. The inside part is made of aluminium cast. And because of impact, they can break. So he was saying that even if the repair

guy comes, he has to replace the lock rather than repair it because everything is broken inside. So, that was a big learning from the user study.

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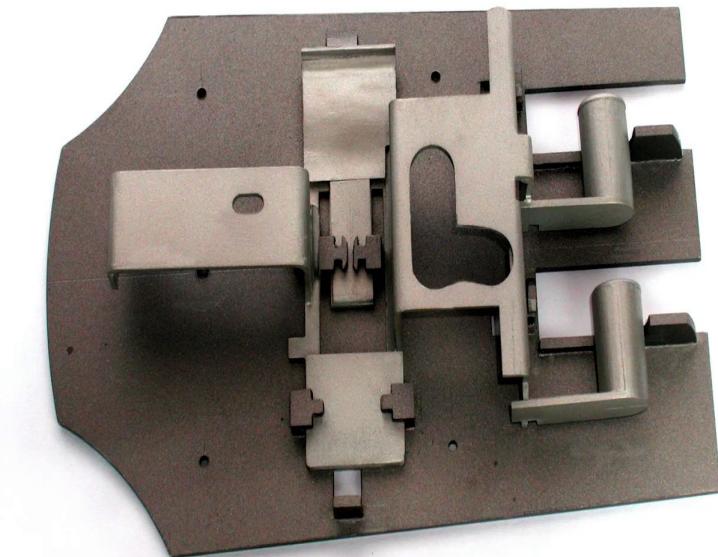


The User study became a very important domain of learning from a design point of view. So the user study became critical. Understanding of the people, understanding of the end user, understanding of the people who service your product. All that became very critical. So with that we did this whole journey. And here you can see this vertibolt lock.

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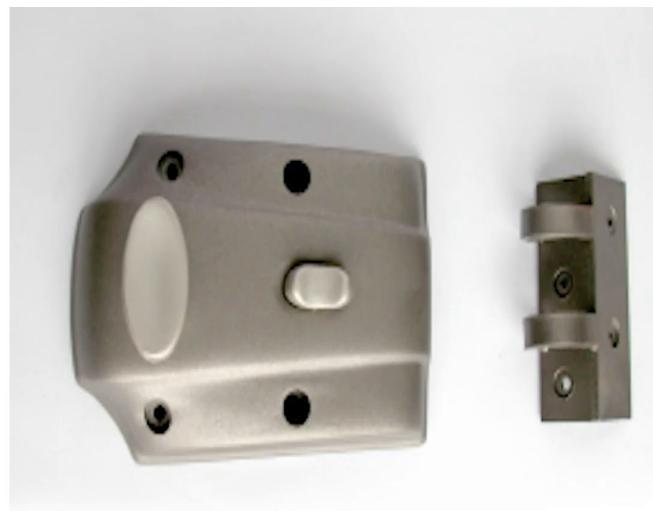
And the best part of this was again collaboration, between the teaming of Godrej locks division as well as the teaming at IIT Delhi, who are specialist in sheet metal manufacturing.

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You can see here, this whole thing is one piece. Because the whole thing is in one piece, it became extremely low cost and that was using alloy sheet metal and this alloy sheet metal would, you know, really give you the complete, sort of, one single shot mold.

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Here the product cost came down by 50% of the total journey. So this is the final product.

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## Final models



Again, Godrej also was fully excited about this project and we submitted the project to them and we, you know, did all the work forward. So the fifth one was the most interesting one for me, because I think some of you will ask some of the questions with the fifth one. So out of the 5 projects we took as the live projects, we wanted all of them to become innovation, right? But our journey in research was to come over the initial sector of the innovation journey which was the seed, the innovation idea, right?

The idea is also as important as the total journey which takes forward, I think by now you know because of the other case studies.

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So here, for example, this company, completely, sort of, out of the market because of the L&T petrol pump and they wanted to come with a new product with new systems and new services. We built the same type of teaming, with the student, with the experts, with the company people. We build this whole pump.

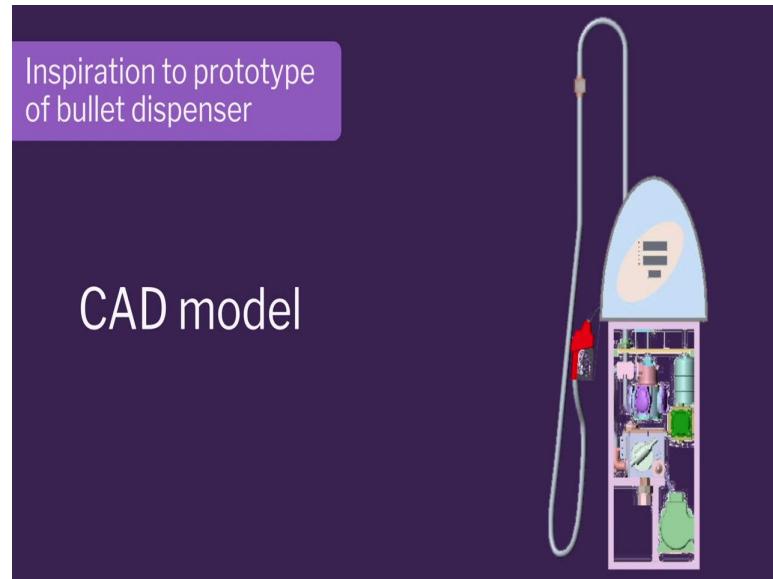
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You can see here this was inspired by a mobile phone. This is an old Nokia mobile phone inspiration.

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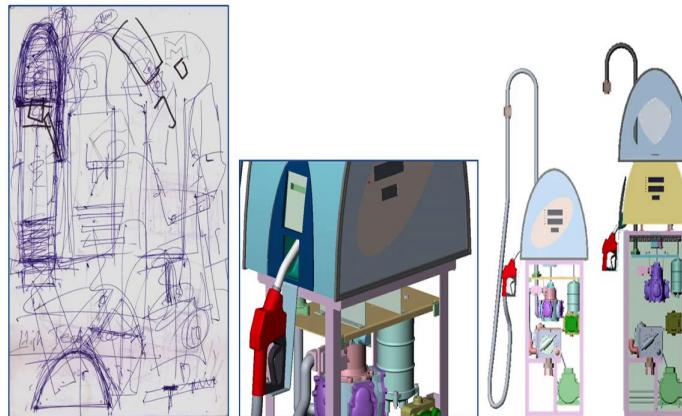
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An interesting thing was that the hose was coming from the top because of that inspiration.

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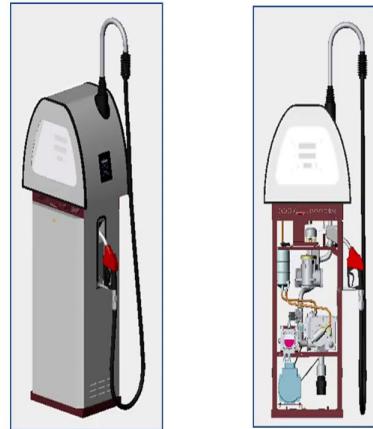
## Modular petrol pump



And that became a very big USP (Unique Selling Proposition); a Form inspiration became a unique selling proposition for this product because this product was able to deliver more petrol per minute than any other product because of very smooth flow of petrol from the top.

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## Modular petrol pump



Again because of the use of contemporary materials, contemporary technologies, contemporary idea generation and collaborative team, we could come up with the prototypes.

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Again, within a year the prototypes were built and were installed in Bombay.

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The customers, who were the oil companies, were extremely glad to place orders.

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And we became a runaway success,

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and became the largest selling petrol pumps in the country during those 3 years of its production. So, here we have one case out of all our 5 cases which saw the light of the day.

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What is the learning from the real case studies? We got a clear understanding of the effective functioning of the Collaborative model. We built a Collaborative which is rough. How do we need to collaborate with everybody? Because if you take a project here in IDC, when you do projects. What do you do? You are the only guy who is working on the project. At the most you go to the guide to get your inputs from.

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## Learning from real case studies

- A need to have three separate teams with distinct responsibilities in the collaborative model came up.

Then you need to have, we very clearly came up with three separate teams with distinct responsibilities. We realized that there are three teams of people working.

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### Three Teams:

- Team which is working 100% (students, guides, co-guides)
- Team which gives a lot of support in the middle (support team)
- Team which gives creative inputs (creative input team)

There is a team which is working hundred percent of the project, like I told you, the student and the guides who are 100%. There is a team which would give a lot of support in the middle. So the support team was very important. And finally the team which would give a lot of creative inputs to the whole journey, was the creative inputs team. So, that was happening with the three teams.

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## Learning from real case studies

- Roles and responsibilities of the teams in the idea generation process could be ascertained.

And the roles and responsibilities of the teams in the idea generation process had to be specified and ascertained. So, we will show you the models now, from the learnings.

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### Proposition 1

A collaborative network working on new product idea generation with members from diversified areas would lead to innovative ideas.

Mock	Involving experts across disciplines helped in cross fertilization of ideas.
Sheet metal bicycle	Expertise from external sources aid in generation of new product ideas.

So each of these learning, like you know, as I was showing you the case studies, built up some proposition, like for example, the collaborative network, you know, can work on idea generation. So if you have to build up a collaborative network, you must have experts and people from diverse areas to lead to innovative ideas, so that you can come up with innovative ideas.

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## Proposition 2

Dividing the idea generation process into steps would lead to better control over the various stages of idea generation resulting in identifying and nurturing of innovative ideas.

Mock/Real	Thorough situation analysis provided new insights for idea generation steps, especially that spending time on initial steps helps in later stages.
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The proposition too is, you have to divide your idea generation process into steps that will lead to better control in the process as well as generating and nurturing ideas. So when I say steps you cannot say that I need one idea you immediately go back and build a model. You have to have a lot of ideas, you have to build concepts. Out of the three concepts you have to choose the right concept by the stages, and after choosing that you need to refine the concepts. So those types of steps become very very critical and that is a part of a design process anyway.

So that step by step process, when you have a step by step process, what happens? You can actually get very good inputs from your Collaborative team. You can get inputs from your industry. You can get inputs from your partners' very effectively. Otherwise you won't get inputs. Because if you show the final result, how do you build their inputs into your results? It's not possible to build their inputs. So that becomes very, very critical.

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## Proposition 3

Visual representation of ideas would lead to effective interaction between the various members of the network resulting in evolutionary development of innovative ideas.

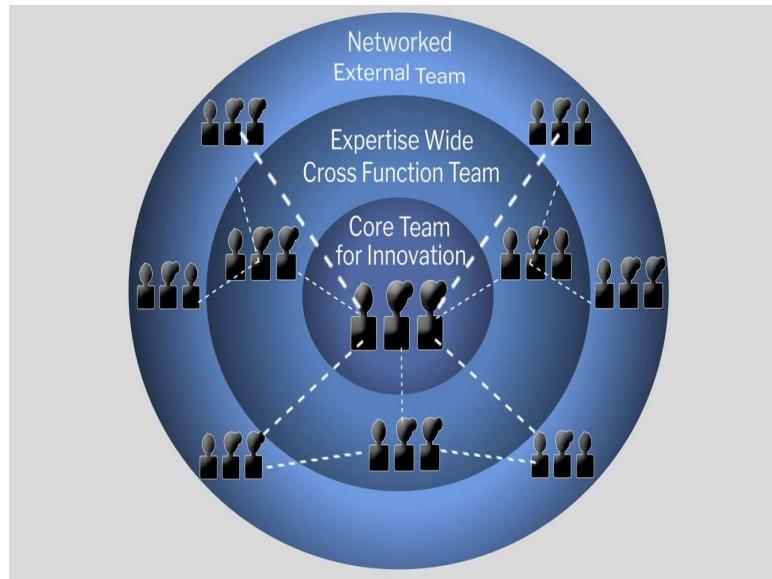
Mock case studies	Visual representations of generated product ideas resulted in very effective communication
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Proposition three, remember I was talking about, visual representation of ideas. You remember the step through bike, where because of the sketches, we could get a lot of creative inputs from all the partners in the Collaborative team. Let it be the industry partners, let it be the marketing partners, let it be the partners-IIT professors. That was happening in a very, very strong way and that resulted in evolutionary development of ideas.

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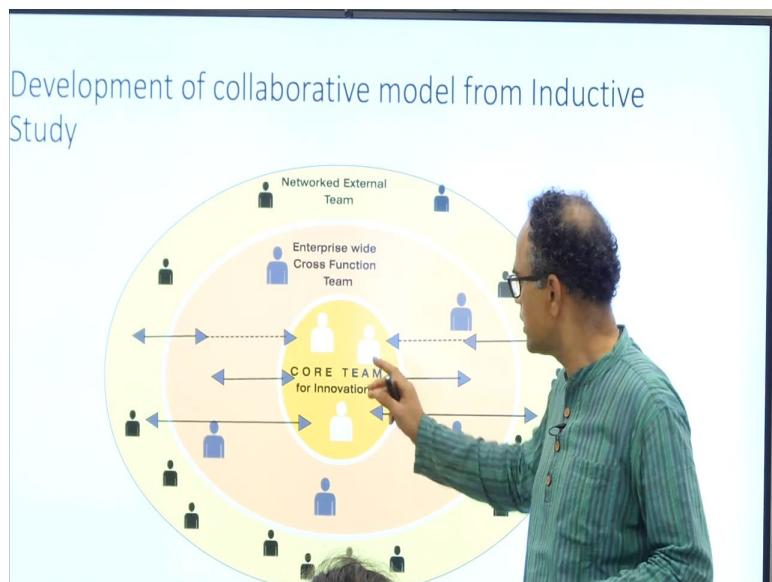
And the fourth proposition was the flexibility. You have to be very flexible in your idea generation stage where you should be open to ideas and open to the changes in the design process. So, those changes are also very critical.

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Let me now show you the model which is generated out of all these case studies. So this is a very very simple model, called the Collaborative model for a new product innovation.

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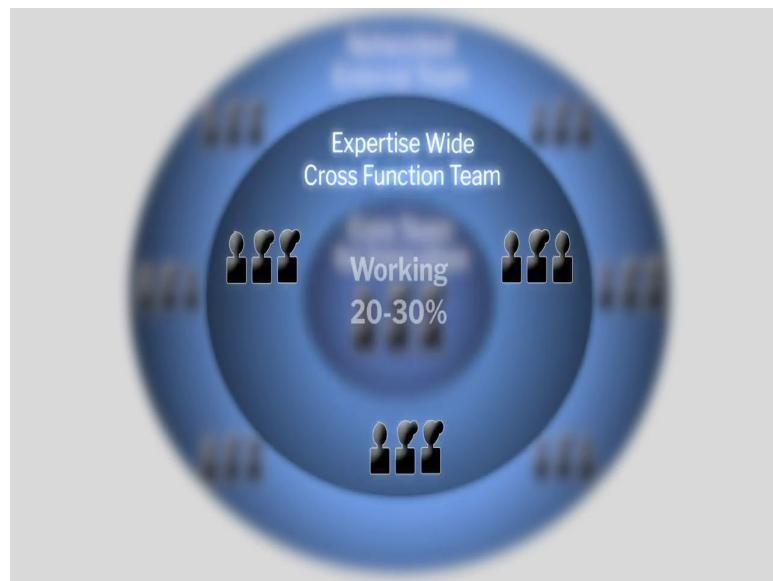


So in this model, you have the Core Team who has the full responsibility of innovation, that is they are working hundred percent on the project. If you are doing a design in a company, the core team would be like the team which is working 100% time on it.

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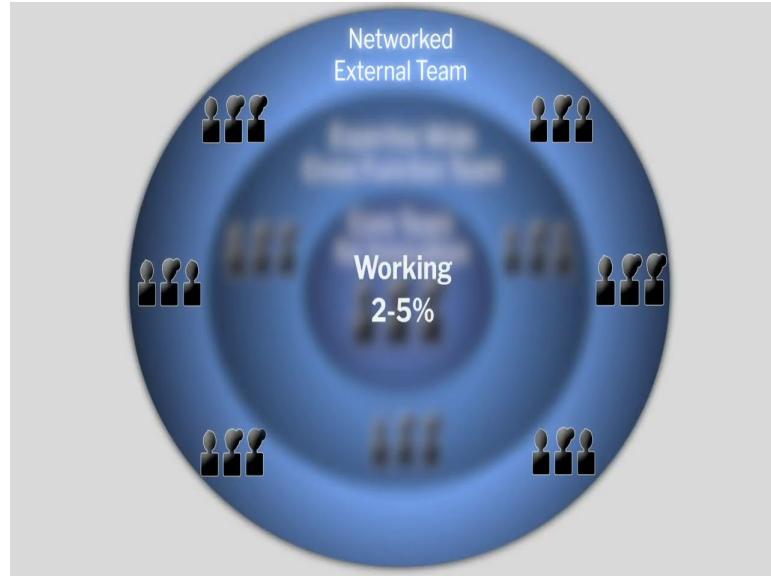


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The enterprise wide team would be the team which will be working around 20-30% of the time they would spend on the design.

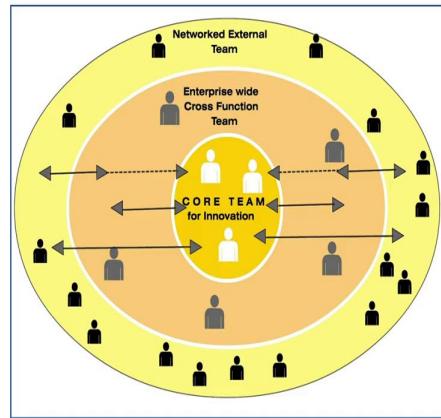
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And the network team would be the ones who just give you simple ideas, they would be just spending 5% or 2% of the time. They will be just available for your meetings.

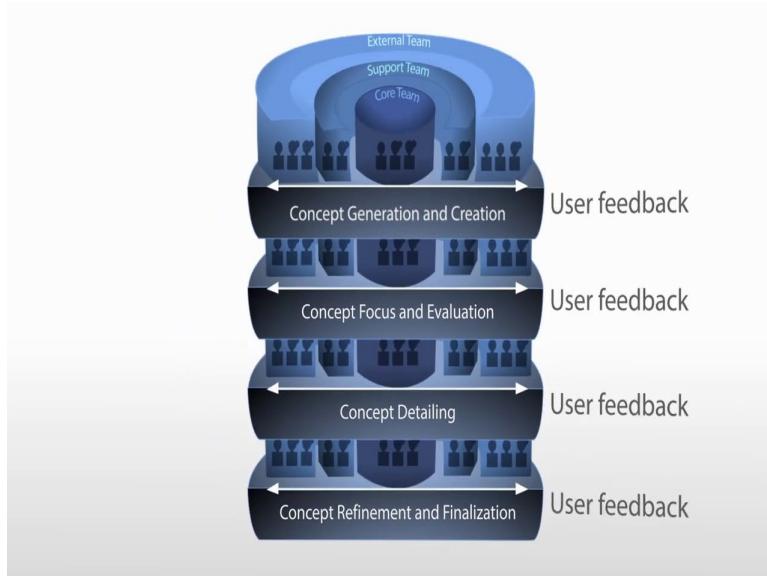
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## Development of collaborative model from inductive study



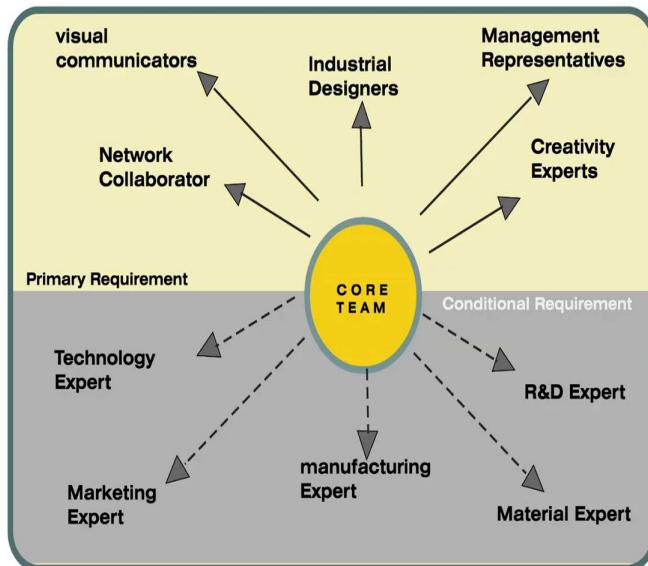
They will be your vendors, they will be your technology providers and all that. So, these simple ideas of dividing your processes into 3 teams can lead to, you know, a successful innovation.

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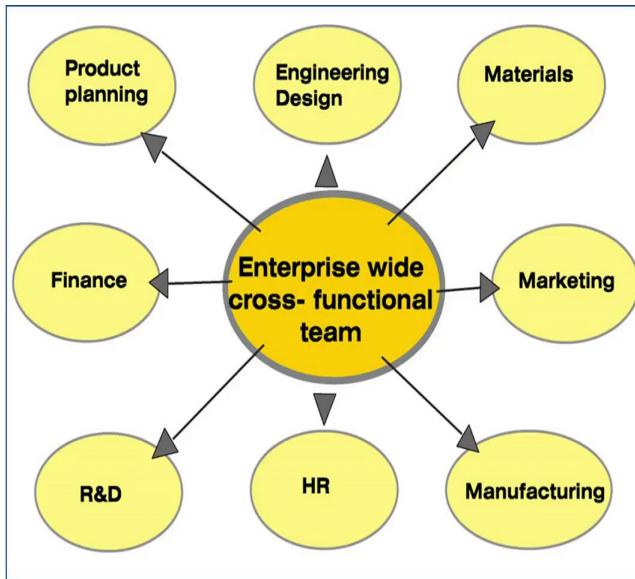
Remember I was talking about the stages in the process. So you have the idea generation here. Then you have the concept focus. You have multiple concepts here, three concepts. You can do the concept detailing, and then you finally do the refinement. So, when you have these stages. You can get inputs from various members very, very effectively into the team.

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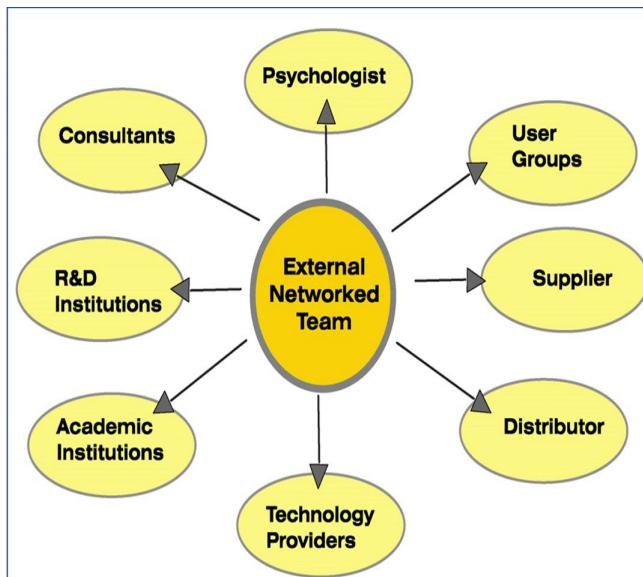
And here we have the core team. The core team has people who can be in the core team. It can be designers, R&D experts, management representatives, creativity experts. Depending upon your project. You can choose the type of people who will be in your core team.

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Similarly, in the enterprise-wide team, you have finance, because finance is a very important aspect of it, right? you have to make tools, you have to make processes. You have product planning people. Your engineering design people will be, you know, part of your enterprise wide, your manufacturing, HR, R&D. So, depending upon your project, you can choose the type of enterprise wide cross functional team, which will be there with you.

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And then of course the most creative inputs came from the network external team. Remember I was talking about the dual chamber bottle where the pet manufacturer gave us a lot of interesting ideas about material. Similarly, in the issues of the bike, we went to a, sort of, Maruti which was

manufacturing deep drawn parts, to give a lot of input to the parts, so that becomes very, very critical. And then there can all be, you know, technology experts. They could be academic institutes to do research in the areas. They can become your very, very great source of innovation, innovative ideas.

So this is the composition, all put together. See, these are all the people and here you can see this cross at every stage, you are meeting everybody. At every stage of your design process, you're actually collaborating with your enterprise wide team and you're getting input from your network external team because of those inputs your design would map much more carefully.

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So in the Collaborative model, now putting all the slides together, we, we see how the composition works. So here we have the core team, and the core team is represented by this pipe over here. Then we have the enterprise wide team, which is this, this colour over here and then the external team here. So there is a complete network across these teams and the functions of each team is mentioned over here.

The composition here is the supplier, the distributor, the technology provider, the institutes which are giving you various inputs, the R&D institutes, the consultant, the psychologist and the user groups which help you to build your model. And the enterprise wide team would be the part of the team which is within the company. The product planning, the finance, the R&D team, the

engineering team, the materials team which will support you with new materials, the marketing, manufacturing, human resource.

The enterprise wide team is very critical in the design phase because you should do what type of company synergy is there, because without the company's synergy you cannot do innovation, and they are the ones which, because they are part of the company, they will give a lot of support for the innovation to go forward. So, that is a very interesting team, and of course we talked about the core team with all the designers and collaborators in that. Once the composition is their, a very important aspect is the function. What should each team function?

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So the core team, these are all the core team functions.

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The core team has to conduct creative workshops across people.

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They have to capture good ideas across the various teams.

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They have to nurture ideas, once you capture ideas you have to make sketches and nurture those ideas and create value. Then you also have to evaluate ideas. For example it is very difficult for idea generation across the team and when you generate ideas, what type of ideas will you select and reject is a very important challenge here.

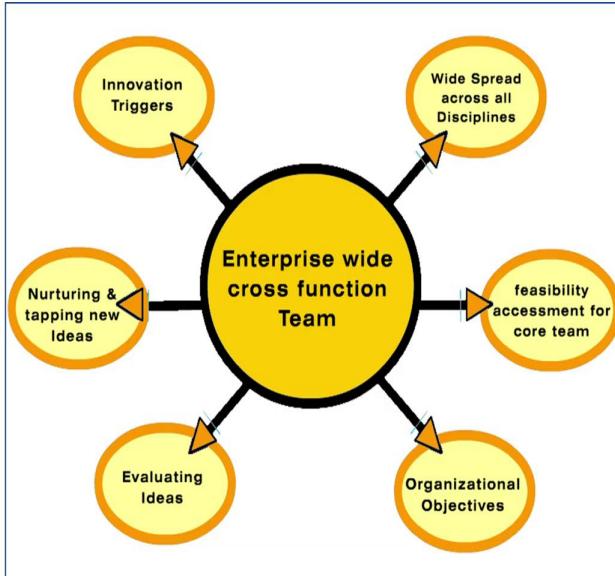
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### Functions of the Team:



Then you have to make ideas work, you have to do knowledge brokering, bring knowledge into ideas, you have to collaborate with other team members, that is a very important function. And of course visualisation, collaboration is part of the functions of the main core team.

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Then you have the enterprise-wide team. We also behave as innovation triggers because, see enterprise wide team is within the company, they have a lot of problems in the current products which they can become like an innovation triggers, ‘Oh! The cost should be low, or the product should be more user friendly, the product should be lightweight’. So all those innovation triggers come from the enterprise wide team.

There are, you know, across the disciplines, they look at the feasibility very closely. They will help you with the feasibility. And of course, they will help you with evaluating ideas, which is very, very critical. And then we have the external team, they provide you with beautiful ideas and various inputs for coming up with the creative ideas. They act as a knowledge broker. There is also a user group which is your external team. They will evaluate your product and tell you how your products will work.

And of course, there will be a lot of people who would be material suppliers and other materials and new manufacturing for their ideas to sell their materials to you.

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But they give you a lot of input to build your functions. So, these are, you know, by putting the functions now into place, you again build your, you know, the whole model. So we have a model for the composition and your model for the function. So putting these two things together, we have done a lot of projects.

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And these projects have been very, very successful. Remember I was telling about the postbox project.

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We exactly used the model and our letterbox became successful.

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We did a *Palki* design for *Vaishno Devi*. Now, 100 *palkis* are supplied in *Vaishno Devi*.

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That became very, very successful. So we have been using this methodology and we also did this methodology training for companies like Ashok Leyland and for outside sources. And they have also used this model and considered it effective. The advantage of a model is that you can actually year mark and pin point and take care of all the steps so that innovation can happen in the best possible way, because they are involving the CEOs very early in the phase what's happening is, and because of the success stories now, people have much more confidence in using a model to take things forward in the right direction if you have come with new innovations in the field.

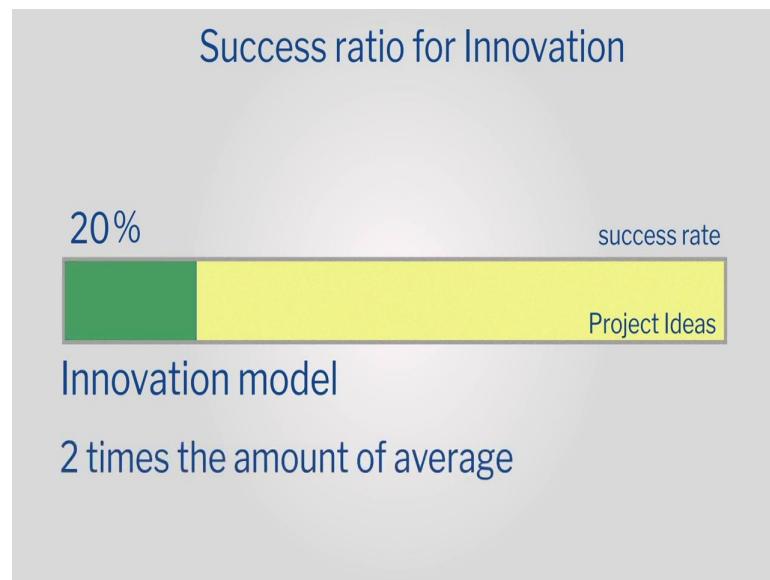
I think one of the questions which was asked was out of the five projects, which of them went into the market. So as I told you the petrol pump, the bullet petrol pump did very well in the market because the company management was very, very keen in spending the extra resources on tooling and taking the product forward. Whereas the other project for example, we didn't see so much traction from the company side. After the project got over they never followed up with us to take the project forward.

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But we were happy with the type of progress because generally across the domain they say that, generally there is 10% success out of, out of an innovation journey.

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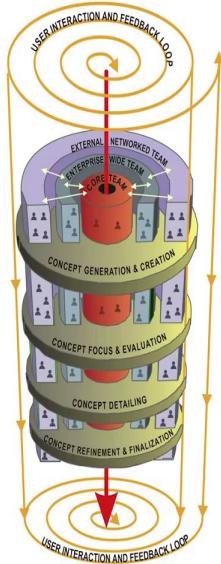
Here we have achieved, in this, while we worked for the model, we achieved 20% success because one product became a runaway success, a very good count in innovation success. **(Student Professor Conversation Begins: 16:58)**

Student: Why is it like that some companies, even after knowing it's a very innovative product, why do not they take it up?

Sir: Very, very good question. In fact that is a big challenge that we all know that this is good, they know that it is going to give them a good market but the biggest challenge comes to, what

happens to the current line? What will happen, and then the biggest challenge is, what will happen to the investment which we gave? Because it is a new product right they do not know the market. They do not know whether it will sell.

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That is the reason why we were saying that the collaborative network should help us to link with the users very early in the phase, so that the uses become part of my journey. So, for example, in the Hero Cycles, clearly it was a risky proposition. See, innovation is always risky, right? So, the risky proposition, they were not ready to spend the money, but they were ready to spend money on their current welding robots, for example.

So, these are the challenges which we face when we take the innovation journey, but where as very clearly, when you look at the Nano story, top management like Ratan Tata said, nothing doing. this car should be a car, but it should be half the price. Then things can go forward in an effective way. So, you really have deep pockets to take in the innovation journey forward.

Student: Can you explain more on the features of the bike you made?

Sir: This bike was very interesting. This bike, the main features of the bike was that they gave a lot of style requirements from Argentina.

They said these are the types of bikes which are running currently. They should be like one of them. If you make something completely drastic then nobody will use it. That was the major aesthetic consideration and then other considerations was that you needed to have utility which will not hamper the aesthetics. For example, if you put a basket to carry vegetables but the bags should be hidden inside the bike. All the bags which were coming out or jetting out, which were flexible bags were hidden into the flanks of the bike.

So if you use the bike normally it will look beautiful and then when you are carrying vegetables, they are, the bags are pulled out of their hiding and you can put things. And especially the rear view mirrors, all of them were stylized. They want every component to be stylized in a way to have impact in the market for the rider. And the step through was an important component of Argentina. Step through was a popular concept there and they put a dove tail into the step through concept by taking our product over there other, otherwise most of the products were from Japan, OK? Come then we will head to our class, thank you.

**Design, Technology and Innovation**  
**Prof. B. K. Chakravarthy**  
**IDC School of Design**  
**Indian Institute Technology Bombay**

**Lecture-14**  
**Collaborative Innovation Methods Part 3**

So, in today's class we will talk about the concerns for innovation. I have been working for the last 20 years in this field, trying to work and see how innovation happens across various domains. I was, you know, also in L&T earlier where, you know, we could see, you know, in the industry, innovation happens because of a number of people in the organization.

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So, when I moved to IITs I also realized that, you know, professors have a lot of research content. Some of them are able to take it to the innovation and others are not. So, then I had to also work on our own projects in IDC to see why some projects go to the market. One of the most common products in the market of our professors' is the voting machine.

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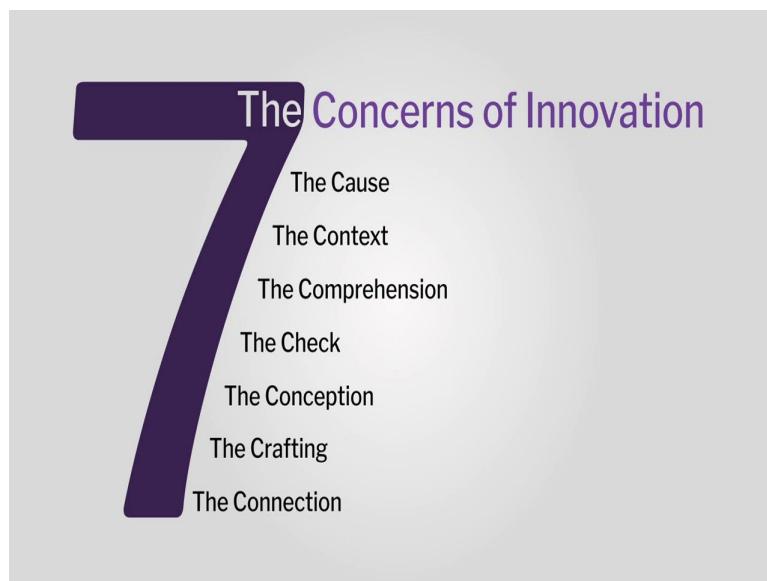
I must tell you, I was a student at that time, 1988 and I was watching Prof. Roa and Prof. Ravi Poovaih, working on these machines, and I will see them, you know, shaping them using plaster mock-up models before they could go for their meeting with BEL to take this to the level of implementation.

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So, there is something which is very very critical in an innovation. And what are these critical aspects of innovation is when I, you know, conceived my book the design of the postbox for India Post is when I came up with the concerns of innovation.

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I call them the Chakku's 7 Concerns of Innovation. And these concerns are very critical in the innovation journey. And it does not necessarily belong to only the designer, it could be a professor who wants to go to innovation, it could be an entrepreneur who is doing innovation, it could be an NGO who is working on innovation, but the concerns are there and then only innovation can happen.

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## 1st C: The cause

The concern to solve a problem



So, let us see the first concern. The first concern is the Cause. The Cause is like an activist, that you are standing and saying that, 'I am going to solve this problem'. So, sure you are really, really standing and saying that, 'I am going to solve this problem and see to it that all the users get the benefit out of it'. If I am just saying that 'I am solving the problem', 'I am' is not going to the market, right?

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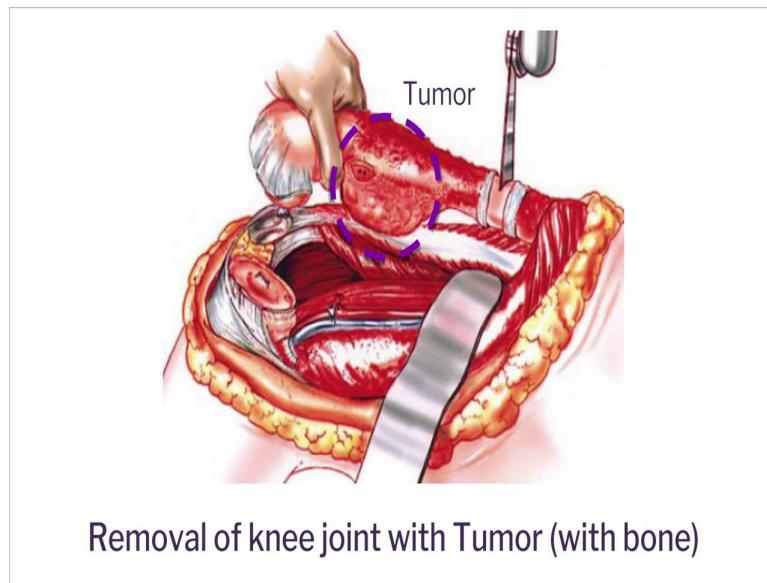
So, here the designer is taking this cause saying that, 'I am going to see to it that it is going to get implemented', and that is what is the most important aspect in my case or in the case of the professors you saw. Professor Ravi, Dr. Manish Agarwal and NFTDC, you know, Dr. Balasubrahmanyam, who decided to take the prosthesis, the mega process to the people at an

affordable cost, so that children and people suffering from cancer do not lose their legs if they get bone cancer, right?

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So, the cause becomes a very critical aspect of the total journey to begin with.

## 2<sup>nd</sup> C: The context

Understanding the user and the scenario



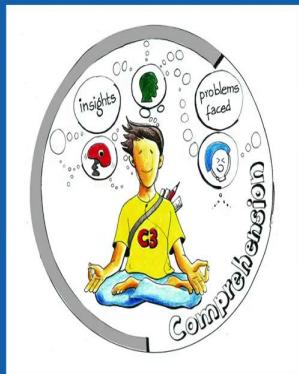
And then the interesting aspect is that the context is as important as the cause. Sometimes we do not understand our context. Our context in our country for helmets is, our country is a tropical, a very hot country. I cannot use helmets coming from England. I cannot use helmets designed for motorcycle racing. Today in our country two wheeler riding motorcycles is a necessity for going to the office, right? it is no longer if, you know, evening ride or a passion ride or a trekking ride. Like 90% of abroad, in Europe it is meant for that purpose, where hardly it is meant for the commuting purpose and a necessity.

So here our contexts are very different from anybody else's context, so the context for any innovation becomes very, very critical and addressing the context and the environment becomes the next important concern for innovation.

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## 3<sup>rd</sup> C: The comprehension

Arriving at the design insights



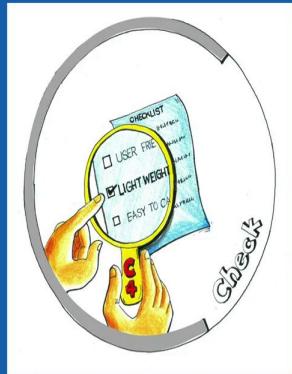
And after you understand the context and you stand for the cause, we noticed that a number of times we lose out on the insights. You will gain insights only when you are completely involved with the scenario and with the users. So, all your issues of user studies. All your issues of ergonomics. All your issues of understanding similar products. All your issues of understanding. What is happening today in the market? Why are people not using or if they are using, what are the current problems in the product? Everything becomes a Comprehension.

And when you draw insight from this comprehension you get a whole list of what is critical. So, without those insights you just cannot go ahead in your project. So that becomes a very important stage where you build insights. Where you document studies of insights. You do videography of users. You do photo documentation of user problems or user situations and come up with a complete list.

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## 4<sup>th</sup> C: The check

The blue print for design, a clear plan of action



And then build something called the direction which is the Check. The check is to have a complete list, and you want to stick to all the lists, and all your ideas and development should happen with that check. So, we will come, and then it is something like a product brief and, you know, you are actively making everything happen. Because you should know the direction you are going. Very early in your phase, because your insights are there, your contextual information is there, your comprehension is very, very clear. You need to create a clear direction of how your design should go.

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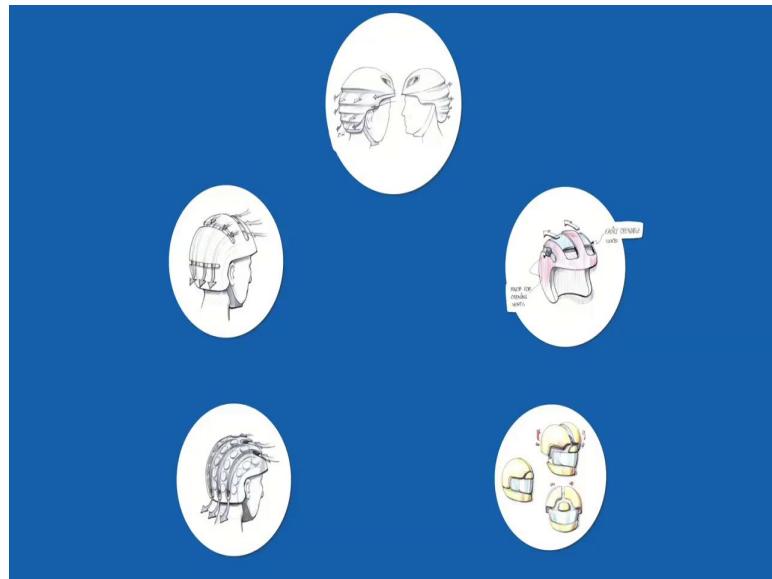
## 5<sup>th</sup> C: The conception

Creating multiple ideas and combining them to general concepts



And, you know, then of course, you know, very, very creative aspect of, you know, idea generation and creating concepts, so generating ideas. Are ideas concepts? What is the difference between ideas and concepts? Ideas address a particular problem in a product or in a service.

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Whereas a concept addresses all issues of the, so a number of ideas will form a concept. That is very, very critical in conception. So, you develop the ideas, you develop the concepts and you develop your final, you know, concept, which will match the check. Now that is why we call it a check. We take the check at whichever concept matches the check the most will be the concept which will be selected for your next stage of deployment, which is the Crafting, which is a sixth C.

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## 6<sup>th</sup> C: The crafting

Making mock-ups, functional prototypes and pilot production



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So here what are you doing? You are quickly building mock-ups, 3 dimensional mock-ups. you are quickly building the prototypes, because you can do some user study with markups. You can do some user study with prototypes. And you can of course do a lot of work when you have multiple pilot production.

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## 7<sup>th</sup> C: The connection

User testing and feedback



And then comes the connection where you go back to the user and connect with him and check whether all the aspects you started with are matching or not and maximum number of, you know, users are benefited. So that the connection happens.

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### Innovation methods assimilated from

- Industry experience
- Guiding Student project
- Live projects in IDC and IITB

So, this has synthesized from my industry experience, from my student project experience and from my live experience in the studio and watching other professors all across IIT. So, this is the innovation journey.

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A number of times you repeat these processes. For example, if you have gone to the users at the concept stage and a prototype stage, you failed there, you go back to your comprehension, context and check and come back again with ideas. So this whole thing is a cyclic, you know, till your innovation happens.

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## The 7 Concerns of Innovation by Design

- **The Cause:** The concern to solve a problem
- **The Context:** Understanding the user and the scenario
- **The Comprehension:** Arriving at the design insights
- **The Check:** The blue print for design, a clear plan of action

So, the Cause is the concern to solve a problem. The Context is to understand the user and the scenario. The comprehension is arriving at the design insights. The check is the blueprints of design. Remember we talked about it, a clear plan of action.

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## The 7 Concerns of Innovation by Design

- ① **The Conception:** Creating multiple ideas and combining them to general concepts
- ② **The Crafting:** Making mock-ups, functional prototypes and pilot production
- ③ **The Connection:** User testing and feedback

And then the Conception is creating multiple ideas and combining them into concepts. And Crafting is making mock-ups, functional prototypes and pilot production. Because pilot production also is Crafting because you are spending a lot of time and effort. And then you have the Connection where your mass production and you reached a large number of users and you connect it back with the user and the benefit has reached the people at large till you are saying that you got the benefit addressed to the people.

So let us put this on a very interesting platform. After I finished my PhD and I came to IIT Bombay, I saw this rusted post box just next to IDC.

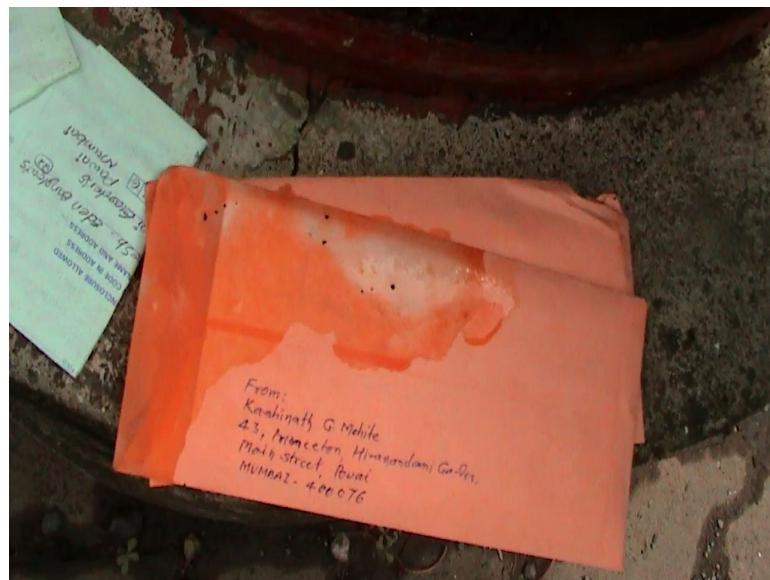
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It was rusted and after some time even the door fell down and I said, you know, we all, you know, sitting in such great institutes, the best professors in materials, manufacturing and management is available here. So why cannot we change one product in the country. So, my cause was, 'I will start this journey and not stop till I have large-scale deployment, and, you know, see to it that I, you know, solve this problem'.

Because it is like, you know, very unfortunate that water gets in, the letters get soggy and I myself watched some letters being very, you know, sort of wet in this box which was, you know, next to IDC under a tree.

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So, that was the first thing the Cause. And then luckily I got a student who said, you know, he went with my call and said, 'I will work with you', and it was a student project and we started our journey of understanding the Context. And we found out that the context is very different from what we thought.

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But then we found out 1000s of issues about these boxes. They were difficult to open during the rainy season. The postman could not hold his umbrella when he was taking all the letters and then the box would be wet. So, the letters would be wet. The children cannot reach the letterbox because the height is very high. So, multiple issues and then we also checked, in understanding the context, you have to check the management principles of India post.

So, we went to the GPO to check what are they based on. And then we found out that the lowest division clerk is the one who works on these post boxes. The order post boxes is a tender system where the rates are old, 20 year old rates they give for making the boxes. So, what would people do? How will they manufacture these boxes at a 20 year old rate? They of course recycle material. They use old, you know, those steels that are already rusted.

So what happens when you rusted, already rusted steel and painted it? Will the rusting stop? Paint gets, go off because the rusting will start to progress a little bit and the paint will chip off and further rusting will happen. Now we are on an innovation journey right? I am just not making a fancy-looking nice, you know, post box and, you know, saying my job is done. Here I am saying that I am going to look at the total context of what is happening in this scenario.

So that I can make an impact and change all this, so now I have to involve the management of India post also in this. Who is the head of the India Post organization? It is a Government

organization right? It is the Ministry. Ministry of Posts right? Who is the head of the Ministry of Post. Minister! We will have a minister as the head right? Minister calls the shots. After the minister, who is there in the ministry, the Secretary, the IAS officers, right?

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The highest level is the Secretary, and then comes the Member Secretaries, and then comes the Postmaster Generals or the Chief Postmaster General and then the Postmaster Generals. So, where did we reach first? My student reached the Postmaster General in GPO. He reached somewhere around 4th level already. Till the time I reach the top level, you know, what will happen? Implementation will not happen. And you need to understand the problems of all the levels otherwise things would not happen.

So the context becomes very important. And then we understood the insights very closely and all the things I was mentioning was the insights of the context together.

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## 3<sup>rd</sup> C: The comprehension

Arriving at the design insights



So, here we came up with very, you know, even the postman does a lot of interesting things, you know. He puts plastic inside so that the letters are not wet. And they have flat tops in some other boxes. This is not rocket science, the flat top will always rust right? Water will stay over there and rust more and, you know, we built a lot of insights in this and that is called the Comprehension and came the Brief. The brief is very clear. What is the cause I stood for? Maintenance free postbox right?

It should not rust. Why did I start the whole journey? I should not forget that. Generally, people forget and I am no exception. So, you see how we failed a little later.

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## 4th C: The Check

The blue print for design, a clear plan of action

- Maintenance free for 20 years
- Long life
- Use of contemporary materials
- Robust manufacturing

So, we said maintenance free for 20 years, that is the checklist. Use of contemporary materials. Standard phenomena of innovation, use current materials, do not use dated materials. Robust manufacturing because I knew these boxes have to be really strong right? Because in the field there, it should have robust manufacturing.

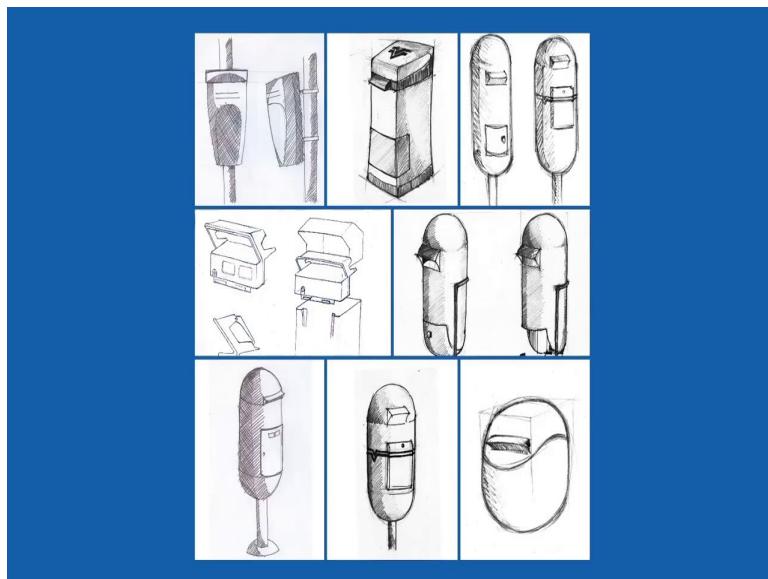
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It should be user convenient. People should be able to easily post, because in our Comprehension, we realized that children are not able to post, that it is too high, some of them are on pedestals, so we said this. Modular design, there should be a small and large box because the volumes are changing. So, we need, you know, two designs. And create and identity for India Post. That came last.

Generally all my design assignments, creating aesthetic identity will become number one right? Now in our innovation journey design and aesthetics, you know, came last. But to my surprise when I offered this brief to the Post Master General along with the student, they said, ‘We are a growing organization. We have also bought a jet now for transporting our letters. They bought a jet. They have a jet now, you know, private India Post jet.

And we want to have a new identity. So he himself asked for a new identity for the postbox. And then we said yes, we will work on that. But, you know, our checklist is very clear, you know, the direction is happening from wherever it is happening.

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So, here we have the 5th C, the Conception. So we then generated a lot of ideas. You will see online, you know, more details. So, lots of ideas were developed.

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Then 3 concepts were built right? And by applying the check, the first concept was, you know, the most, you know, close to the requirement list from all aspects of the, you know, like maintenance-free aspects, the manufacturing aspects and the aspects of easy installation and multiple aspects.

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## 6<sup>th</sup> C: The crafting

Making mock-ups, functional prototypes and pilot production



The first one was the best and then we went into Crafting, where a prototype was built by hand. And then using CNC machines, a small pilot of 5 were built. And then a large pilot production of 20 were built. And they were put in or put all over the country in 5 different places, Delhi, Bombay, Patna and Chennai. And very, very happy feedback. The papers were having articles saying, ‘Past imperfect, future good’, you know, multiple things like that they were saying, you know.

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And then they were saying, ‘New box changing the whole landscape of India post’.

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And then the India post celebrated their 150 years Celebration, and they launched the box,  
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during that celebration.

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## 7<sup>th</sup> C: The connection

User testing and feedback



This is the first prototype they launched. So there we just reached the stage of, this was the pilot stage right? We reached the pilot stage of production and they launched the box. And then an interesting thing happened. Suddenly we found a lot of money in IITs bank. They (India Post) said we have given you this money, now manufactured 200 number and give it to us, and I told them, 'I am no manufacturer. I am a professor and I can go till pilot'. They said 'No, no. We cannot help it, we need this badly. Now the ministers, who were these guys who are sitting over there.

The Secretary of India Post. So we reached the highest authority now. So, the Secretary has inaugurated it. So now they want 200 numbers and then our journey started. We manufactured 200 numbers by collaborating with 5 different industries. We collaborated with Jindal manufacturer, Jindal stainless steel for the stainless steel, Jindal architecture for the architecture, you know, there are the manufacturing and the prototyping. Locks, whom did we go to? Godrej. Very good, Godrej locks. We went to Godrej because the locks should not rust right? We used the non rusting locks.

For bolts we went to Hilti, the bolts. Because we have a new design which is bolted to the floor. The earlier design was, you know, casted. it would go into the floor. So, we wanted a bolted design and we went to Hilti. So we went to, and then for the plastic top, we went to the best manufacturer at that time called GE Plastics and we used geloy which is a combination of polycarbonate and ABS. Very, very good material for the tops, and we manufacture 200 numbers.

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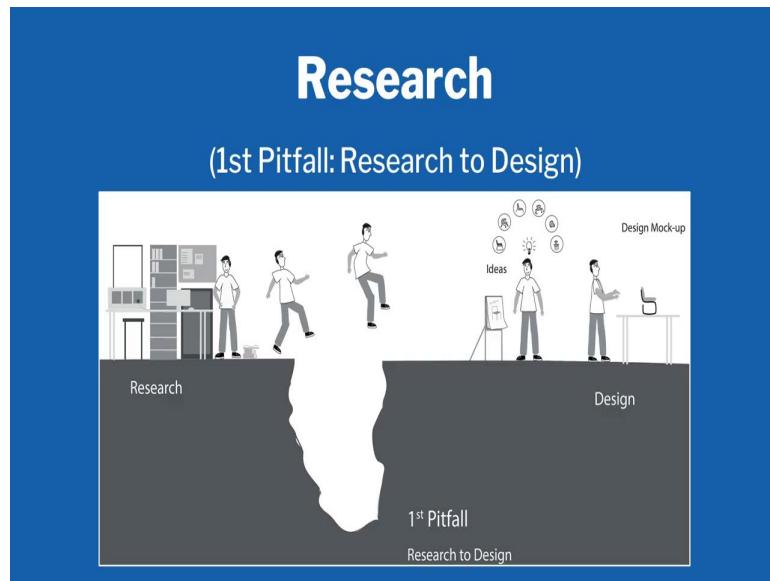
So, this was made out of geloy. Very, very good opening, very easy to post letters, height is also, you know, perfect, a lot of space was there for advertising on the side so you can make revenue out of advertising. Stainless steel box, 'scrotch-brite' finish. We also insisted on 'scrotch- brite' so that no light, if you have a headlamp it should not shine back right? in the cars. So, you know, that was given in. And then we had a nice change of timing schedule. And the location addresses and all done well. And then, you know, I like to now take you to a new journey to show you what exactly happened after this.

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## Pitfalls of Innovation

So, let me now take you to the pitfalls of innovations. We have done so many cases right? On design, technology and innovation.

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So, were all do we have the pitfalls? Let us start with the first pitfall. A lot of my professors in IIT, we have got around 500 professors, do research. When you do research you need to write a research paper. Research paper is the outcome and the research paper is published in research journals which are very noted and the IIT professors are given promotion if they have so many research papers in so many journals.

And the journals are also created. I cannot put in a Tom, Dick and Harry journal. I had to put only in the journal which is reputed. So, a reputed journal will have another 10 professors on the panel. They will not accept the paper till it has got quality research. So, that is the whole yardstick on which you survive in IIT Bombay right? So that is the whole level of research. So, what happens when some new material for a chair is developed?

I developed a new plastic for manufacturing chairs or a new metal for manufacturing chairs. I made a research paper and I did not use it so it has got to the pitfall.

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# Design

## (2<sup>nd</sup> Pitfall: Design to Prototype)



If I leap-frog from the pitfall, what happens in the second stage? Comes a design. So what have we done? In the design stage, you make a mock-up of the chair. See, small size. You use the new material, which is a very thin and very like, lightweight and which is very low cost, not rusting. Whatever research you did, you use all that research to make a chair. And then if you have not taken it anywhere else, which is most of our, 99% of the projects at our IDC, are in this pitfall, right?

So, if you take this pitfall, look at the, you know, pole-vault. You need to do a pole vault, pole vault is skill-based, right? So, you need a lot of practice, a lot of skills, a lot of knowledge to take any mock up to a prototype stage to leapfrog this, right? So, now, you know, and for taking the prototype stage I need a lot of support structure. I have special people who know welding. I have special people who do fabric stitching for the clothes and, you know, special fabrics.

I may have people who are doing fixtures for main, building the product and I just built one prototype. What is the cost of a prototype in compared to the final product any guess? 100 times, very good, 50 to 100 times easily, or 20 to 100 times. Because you are making one and you are putting in a lot of effort because it was not existing and I am getting that material from the research. What happens then I get material from the research, tell me?

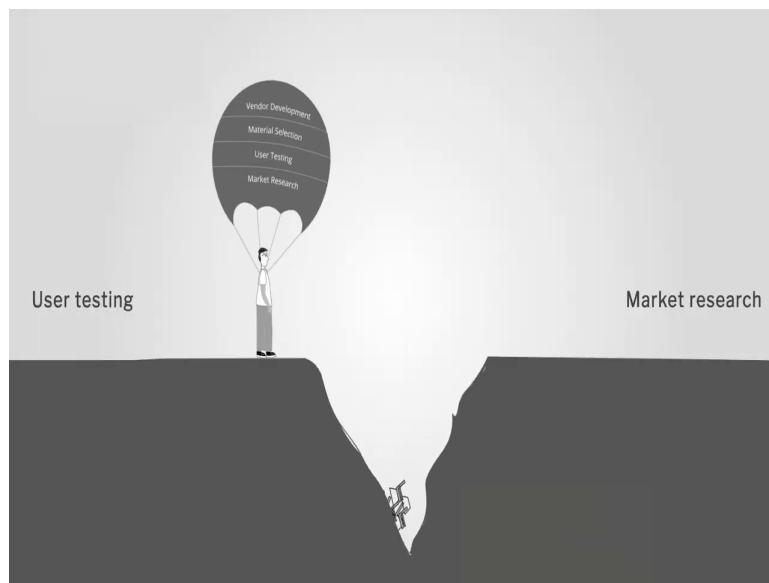
No manufacturer is manufacturing. So I will do all the production using a plant and a rolling mill to produce that pipe. Now we come to the working prototype. So what happens when you have a working prototype?

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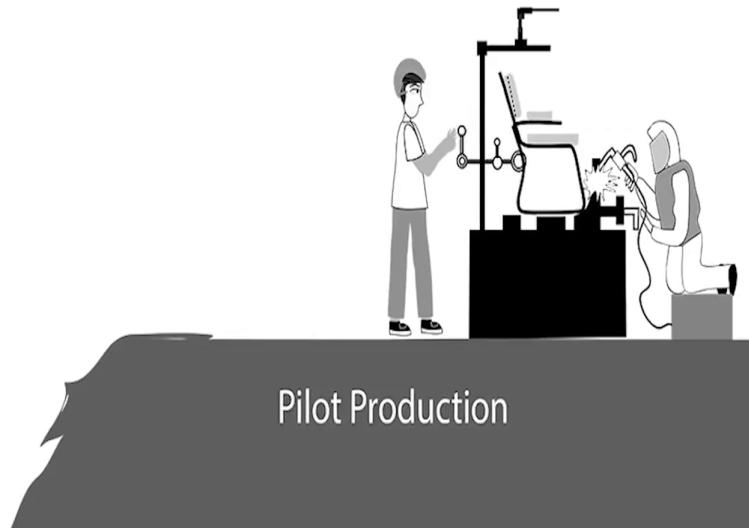
You can test it right? You can get a lot of users who can sit on it, check whether it is good, not good, all the things. And then you take to a pilot production.

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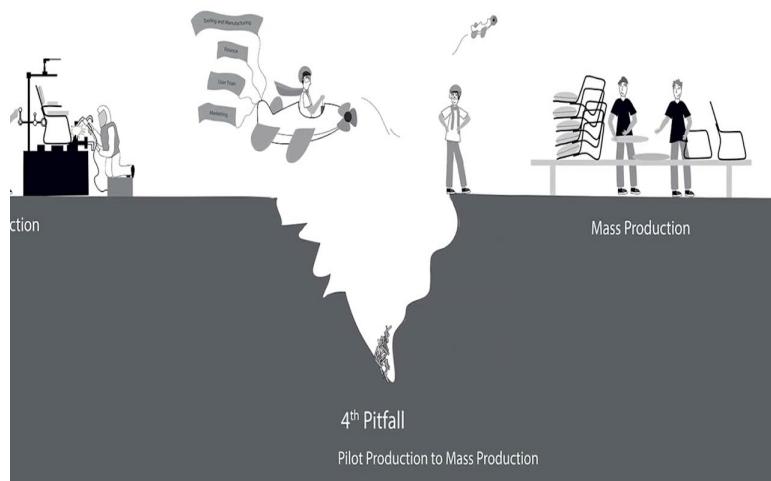
chair. So multiple things are there and you then leap up to pilot production. And in the pilot production you can look at,

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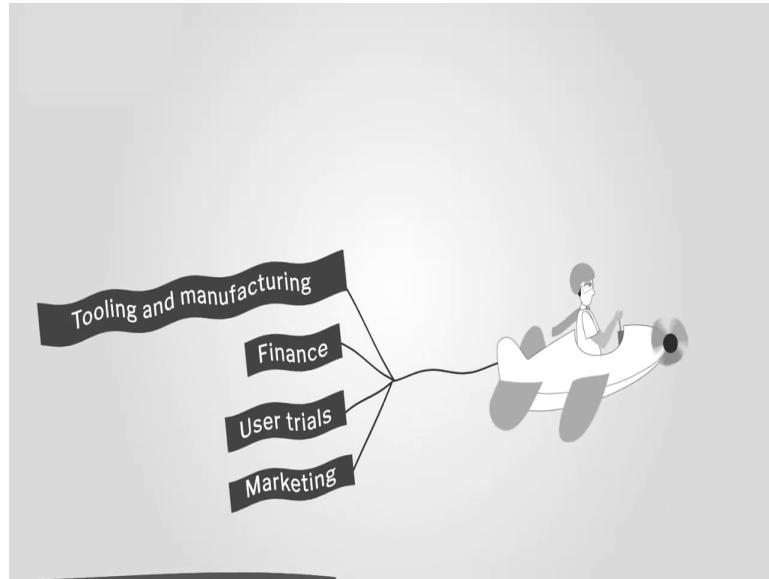
see how now it has become a special-purpose fixture, to now make the pilot of 20 or 200 numbers. And what is the cost of pilot production, 20 times to 50 times, if that is 50 to 100 then this will be between 20 to 200. So piloting is also expensive because you are not producing too many and you need to have a lot of skilled people working on that.

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start-up they did a prototype, from prototype they can somehow garner the money to do the pilot and after the pilot, is the biggest leap where you need to reach large scale to make innovation happen.

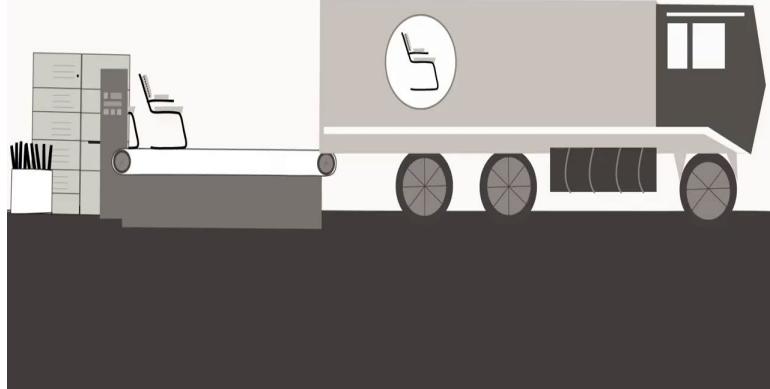
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And for that large scale you need tremendous, you know, you need an aeroplane to fly, right? See, here you are, it is like, you know, much, much more difficult, much more expensive, right? So you have the, you know, specialists in manufacturing, specialists in tool makings, specialists in understanding user needs and aspirations because you are looking for a large number of users. For a large number of users you need to have social research, socio-economic structures coming into picture. Whether this product will run or not? They will do a lot of benchmarking. They will go and do user studies in locations, market research in locations to come and say you can invest this 100 crores in this business. I think it is a good product.

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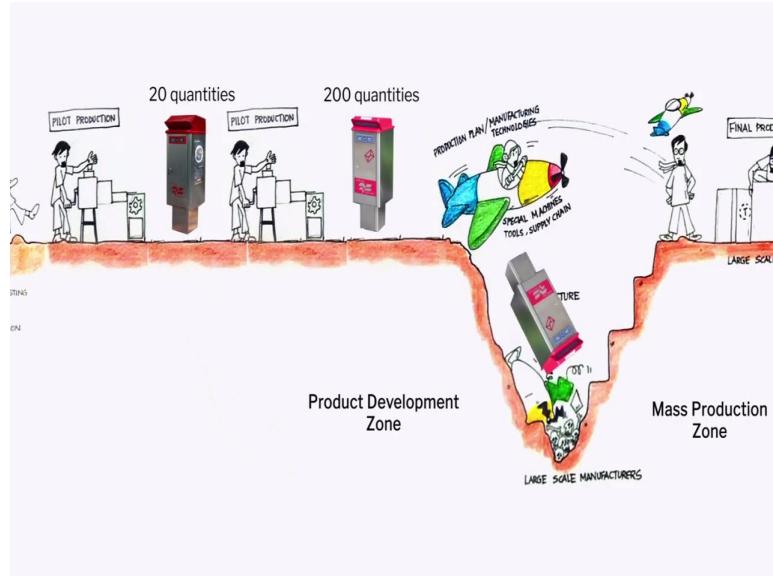
Mass Production



And then only it will go to mass production because mass production needs a lot of tooling. And then you have, you know, multiple pieces assembled and, you know, take it for production. So, this is the whole, you know, journey which I wanted to show you. So, in this stage when we did 200 numbers on it went to all, the first 20 went to where? The Metros' (cities). All educated people, you know, it was big, and the journalists were happy. And when the 200 were made, the pilot was made, it went to all the areas which required post boxes and most of them were rural areas.

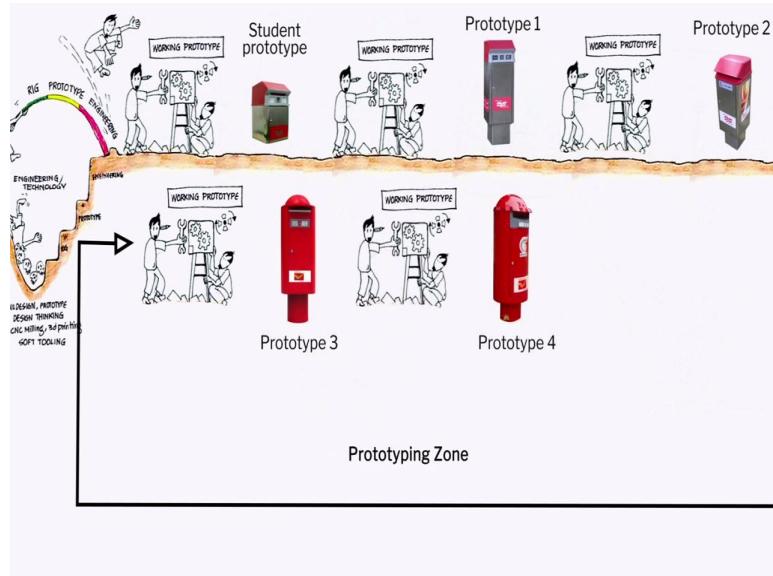
And what happened with the boxes? Nobody recognized the boxes. They thought it was garbage bins. We said a red color top is enough, it was not enough. They wanted a rusted box but red color. They wanted a rusted box but round top. So, what was the most important thing, user perception of the product. Because this is a legacy product. This product was there for ages right?

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So, we fell flat on our face. We failed, we fell into the ditch again, that pilot ditch, and we had to go back to our drawing boards.

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Make the sketches again. Now we had a new brief: Marry the old and the new, right?

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There is an old form. My form cannot be novel and completely out of box. It has to be coming out of the old form, so that people can recognize it and then came this round top and red color. And then, you know, they said, ‘Oh yeah, this is recognizable and then we did an actual user testing to find out whether people have accepted it as a box and they said yes.

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So, here we have, you know, and now by this time the project moved to IIT Bombay here at the Design Innovation Center. So, that is the Secretary of MHRD now. My Secretary post, already retired and a new Secretary came in and he (the former Secretary) was very unhappy when we failed. Unfortunately Ministries do not know that failure is good for design or failure is good for innovation. Once you fail you do better right? They would not let me stand in front of them.

They would say, 'How did you do this? How can you fail?' I said, 'I am also a human being although I am a professor in IIT' so I got so much criticism at the Ministry that, you know, I had to keep quiet for a couple of months and then start working on it again and here we have the job. So, now the project is from the Secretary Minister of Human Resource the Innovation, the Design Innovation Centre is from the, it is a project by MHRD. So we took it under that, we developed the prototypes.

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And we now are, you know, in the race and then, you know, then we showed it to the Prime Minister saying that this is the box which is going to work. He was in, you know, IIT for the Convocation a year back and then we showed the box to him and he liked the box. So, now we are back in the India Post with the new Secretary, asking him to take him to take it to the market. So, the Cause remains right? We thought we nearly succeeded right?

So that is the interesting journey of innovation that till you do not do user testing, you can again fall into the pitfall of, you know, of the innovation cycle and things will not move. So, that is the whole journey of the, you know, the Pitfalls in Innovation and the Seven Concerns of Innovation. So, if you look at the 7 Concerns, it happens in all the aspects. Here also when the concern is there, you will be able to leapfrog the pitfalls.

If the concern is not there it dies. And the concern can be from various quarters. It could be from the Ministries concern, it could be the concern of the funding agencies. Here for example in the case of the prostheses (Total knee prosthesis), the funding agencies were also concerned that the product should go to the people. Yeah

Student 1: Sir, so how did you prevent rusting?

Sir: We used stainless steel and we powder-coated it. We had to, it looked foolish right?

Stainless steel, that is why we did not paint it. We said stainless steel is a good material. It shines, it looks modern, because remember, even though, you know, who will mislead you the most? The clients. They wanted a new identity also. They said, 'We should look new. We should be..' that's what I said this is your new identity. Yeah.

Student 2: Is there something on the inside of the box as well which helps take out the letters easily.

Sir: In fact that is a very interesting, you know, point that point actually came from the users.

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They actually said, 'Why don't you tie a bag inside?' The users gave this suggestion in the first meeting itself. The PostMaster Generals across Maharashtra came, so they just grab the bag and they take it. So that suggestion was theirs, not ours which is wonderful. So we put a bag inside with four hooks and, you know, the letters fall directly into the bag and they just grab the bag and put a new bag and go away. And the bag was also recyclable so it does not, you know, affect us in any way.

Student 3: What was the reaction when they saw the red box, like, the post office people?

Sir: In fact, you know, I must tell you, you know, that after we failed once. They were not ready to accept anything other than a round (shape). And as new manufacturing techniques developed, round was earlier the manufacturing technique. They used this in everything, they were using the rolling processes. Today everything you see around are boxes. Our washing machines, the cupboards and all. So we used a folding process which is much more cost-effective in manufacturing and saves a lot of material.

And then it also, you know, helps us put more volume of letters inside than in a smaller volume. Round (cylindrical shape) takes less volume of letters. So, you know, like after showing the red one, you know, because of the older reaction, they were not very keen in taking it forward. Even after making it red, even after giving it a round top. So, I had to go to the Prime Minister to make him like it, hoping that, you know, they would, you know, they would go forward.

Because the first box which was designed, was designed by my professor, Prof. Athavankar. And at that time the box was put opposite Indira Gandhi's house, the Prime Minister's house and she liked the box and that went into production.

Student 4: At what stage are you now in, in the sense, like, are you still taking this forward?

Sir: Yeah we are still taking this forward. We are, like, you know, again requesting them, 'Please give us the pilot order'. And if they give us the pilot order then we will put a pilot.

Then we will again go for mass production which is much, much larger. This time the pilot itself will be 200 and then the mass production will be 20,000. Because we need around 5 lakh post boxes in the country and in the meanwhile what is happening is technology is going forward. You need more, you know, more things in the box maybe. So, we still do not know how things will move but, you know. But this is a landmark product for them. This is a, you know, total pole on the wall.