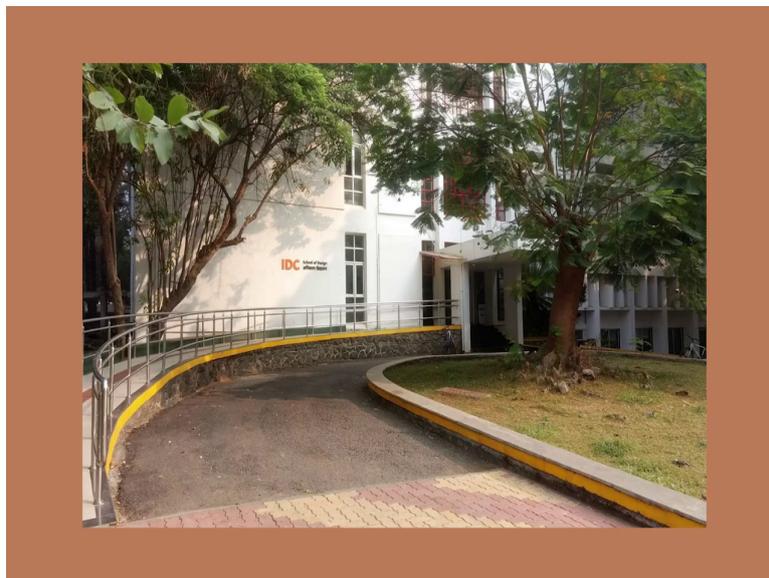


Understanding Incubation and Entrepreneurship
Prof. B. K. Chakravarthy
Department of Engineering Design
Indian Institute of Technology, Bombay

Module - 7
Innovation and Entrepreneurship
Section - 1
Humanising Technology

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Good morning all of you, this is my Design School, where I studied called the IDC School of Design now, earlier it was the Industrial Design Center when I was studying. Now, it is got you know a multiple programmes and you know it is become a school now with you know like with B. Des, M. Des, Ph. D and of course, the minor programme for Engineers.

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Programmes offered at
IDC School of Design

B.Des
M.Des
Ph.D.
Minor Programmes



So, we are a full circle now. I study in the year 1988 and then you know as soon as I you know like finished my education, I was you know placed in L and T.

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And Larsen and Toubro was one of the best things which happened in my life, because you know Larsen and Toubro is known for Imagineering. Remember, they write those big billboards L and T is about Imagineering.

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So, a designer in an engineering enterprise can do wonder, right, that is how you know like I could really you know, do well and learn the innovation process. So, I would have learnt all my design in the School of Design and all my innovation in Larsen and Toubro. And of course, then after I you know like sort of came back, to academics, in IIT Delhi, where I taught for 6 years.

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IIT Delhi

After my 6 years in L and T, I learnt the aspects of education very strongly, because, teaching innovation is very different from practicing innovation, that is a most important thing which I would like to clearly mention to all of you and when you practice, when you teach innovation you have to work on all the nuances on how innovation can happen.

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Humanizing Technology

Making technology work for users. Being **empathetic** to the needs of the customers.

And of course, I call my you know lecturer a Humanizing Technology, because, what are we doing?

You want to make sort of technology, you know like work for the people, technology work for the users, we want to be empathetic to the user. So, that you know our people, whatever technologies around us is actually you know helping us, support helping us take things forward.

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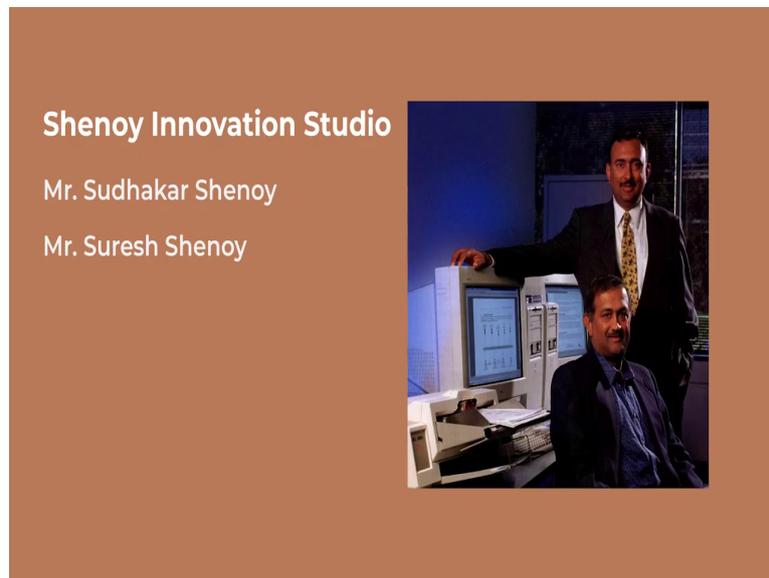
And then you know I came back to the Design School, where I studied in 2001 and I wanted to sort of you know establish Design Innovation Center you know take things in the area of research.

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And I am very fortunate with my two alumnus, I was in the U.S. in 2005, after I joined IDC.

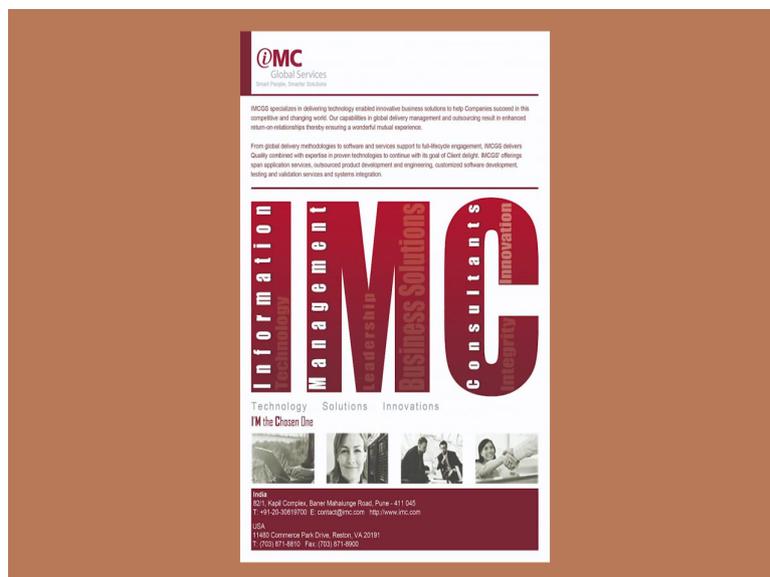
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And these two alumni are you know like wonderful Entrepreneurs, Sudhakar Shenoy and Suresh Shenoy, you write to them they would always reply to you. And they are like passionate about design, passionate about manufacturing, passionate about technology you know these wonderful alumni who went to the area of 1970, you know to the year 1971 to the U.S. and established this company called the IMC..

Where they do a lot of you know the new things what we call, Data Science and all that they did in the year, you know like 1971.

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They work for the Federal government; they work for all the government agencies in the U.S. And I must tell you when I was there in the U.S., they had given such a stamp of IIT alumni there in Washington D.C., [FL] computer [FL] maintenance [FL] IIT alumni [FL] [FL] IIT [FL] company [FL] like that type of [Laughing] wonderful you know enterprise they started. And then when I met them, in 2005 in Washington D.C. in a Pan IIT event.

Students I must tell you, this Pan IIT event has a euphoria, where all the alumni from across the IIT's meet. Earlier, each IIT was like a silo, they would be very very close knit. But, then when all the IIT alumni met, my God, they realize that, no other university in the world, has contributed to the economic prosperity or to the entrepreneurship activities in the U.S. other than the IIT alumni.

The President actually you know sort of you know called the Pan IIT team and he facilitated them saying that the contribution of IIT in building U.S. to what it was you know is because of IIT alumni. So, you can see, how entrepreneurship can lead and every big company you know, every big university had our alumni, you know teaching or researching or enterprising.

And of course, as I told you, I told them I have got a dream to set up a Innovation Studio and both the alumni were very happy, they immediately sanctioned 100,000 dollars.

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You know like, and they said you know you have to bring in you know like very good funding back from the ministry, back from everywhere.

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So, that is how you know I am sitting in this Shenoy Innovation Studio, we built it in 2008 and then you know like, both Suresh and Sudhakar kept on visiting us multiple times and you know we had lot of inputs from them.

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So, here in the innovation studio, you know we call ourselves Innovation by Design. In fact, you have to design the innovation process, we hardly do that. Because, innovation is not at all easy, it is one of the toughest things because you are head up on the wall, blank wall, you have to create paths.

Why entrepreneurship is so difficult? Why only people who can dream become entrepreneurs? Because they dream, they do not look at the problems. If you start looking at problems, you can never be an entrepreneur. So, the biggest thing is, you dream. An entrepreneur dreams [FL] I will take my product to the market. I will want to solve this problem.

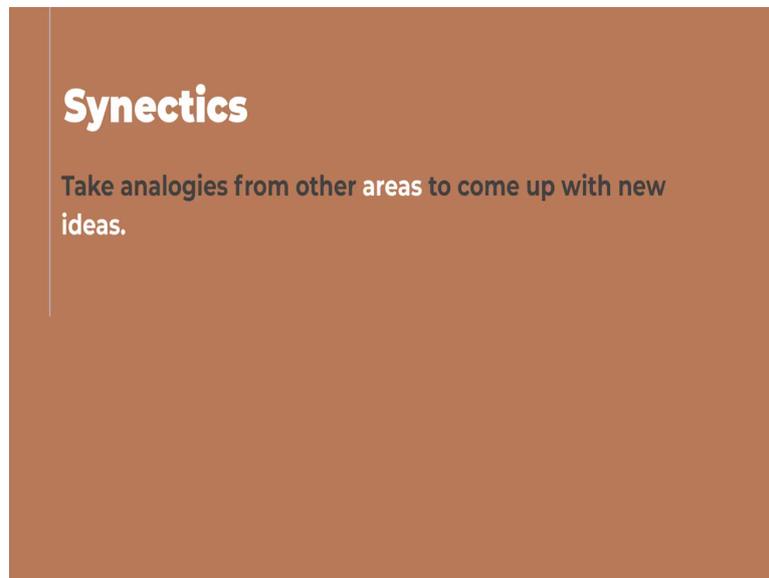
So, then your you know enterprise starts. And that is the whole best thing, that you design the innovation process. And then, I keep saying if you have design thinking, it will help you a lot in the entrepreneurship and innovation.

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And hence I say, it is a it is a you know loop where you know you design the innovation process and you use design for innovation and entrepreneurship and that is the key for any development. So, that is our logo and of course, I am going to show you some key projects and you know like also take you through some multiple examples. My first case study in my Ph.D. was to work on innovative idea generation, right. And for innovative idea generation, we use this technique called Synectics.

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In Synectics what you do, is you actually take you know, analogies from other areas to come up with new projects and new ideas, product ideas. When you take up analogies, it is very easy to build ideas. So, let me quickly show you you know this very interesting case study.

So, the all the whole bunch of students were grouped into you know groups of 4 - 4. And they were you know they were I think 5 or 6 student groups, and each group was supposed to you know go and you know go into the departments of IIT, Delhi.

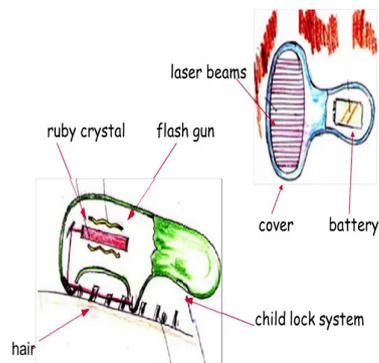
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And ask them, if they can design this wonderful next generation shaving device for men, where the shaving device is as simple as wiping my hands and my hair is gone. Remember, in idea generation and dreaming you have to dream, right, you have to dream the best project. So, if I you know it is as simple as wiping and my you know hair from the face should be gone.

Shaving device, the next generation shaving device. And one of one team of students went to my neighbouring lab in the in Instrument Design Development Center which was the Physics lab, Professor Chandrashekhar was the you know professor in charge there.

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Synecotics

Take analogies from other areas to come up with new ideas.

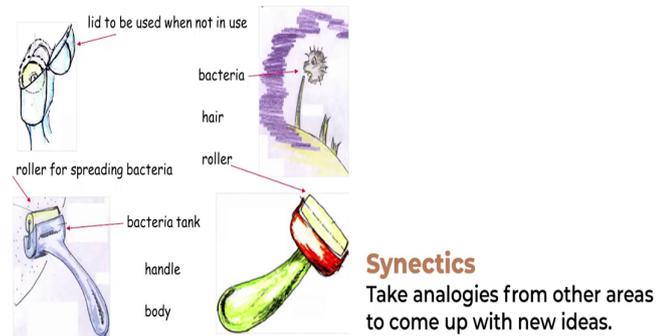
And he said, you know wow it is very very simple, eczema laser, it is very easy to chop off the hair you know from anywhere, at very fine you know quality and there you see analogy, first analogy technology. So, you have a nice vend, with a laser there look at the sketch, which is you know nicely shaving away the hair like the way you wipe your you know face, very interesting, right.

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And on the other side, students went to the Biotechnology and Biosciences department and they said wow it is so, simple.

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We can you know we can have the best bacteria you know to eat away the hair and there you can see the small sketch students and colleagues, the bacteria eating away the hair. So, you have a applicator and you apply and the hair is gone and that is more easier than wiping your you know wiping your face.

So, there we get the next technology and of course, my colleagues in the physics said [FL] what is there in removing hair from you know from your face.

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Ultrasonic method

Synectics

Take analogies from other areas to come up with new ideas.

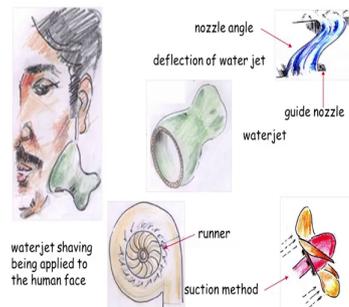
We ultrasonically shake the hair so that the hair just breaks at its root. And there we have the Ultrasonic mechanism and the break mechanism and you have Ultrasonic shaving device.

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And then of course, our colleagues in Mechanical engineering said, [FL] we can cut slabs of steel, 5 millimetre to 10 millimetre steel using water jet.

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Synecotics
Take analogies from other areas
to come up with new ideas.

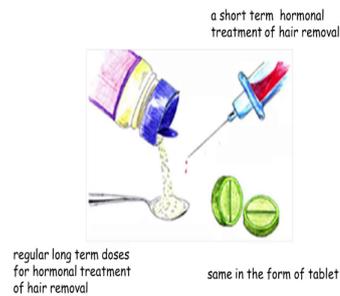
And what is this hair on the face, you know we will have water jet cleaning mechanism and you just go to your bathroom, use you know sort of you know wipe this water jet, you know on your face and the hair is gone, fabulous.

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And of course, our you know the best department Chemical engineering people said, oh we have so many patches and you know chemicals which can prevent the growth of hair first of all, why to get hair at all.

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Synectics

Take analogies from other areas to come up with new ideas.

So, that is also possible. So, is not it interesting that you know, like if you just look around as analogical interpretations, you can come up with fabulous ideas. And all these ideas are possible and all these ideas today we have products for all these ideas. And these ideas you know came up in the year you know like as early as 95.

And then, you know we were looking at the context of Gillette, which was adding blade on blade, you know gliding on gliding, you know and then trying to make the money and spending crores rupees on building you know building the machines which are the size of this you know auditorium here.

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Where you know, like they would have this you know automatic blade strip coming from one side, polymers coming from another side and all the injection molding mixed with the steel machine, mixed with the grinding machines and together [FL] the blades are coming out and getting packed and you are getting all over the world.

So, that is the lot of engineering there. So, you are digging deep, you are not digging wide. If you dig wide across technologies, you have all these technologies possible and if that much money was invested in any of these, we would had a new shaving device by now.

So, you got the whole idea of creative ideation students. Any of your problems, if you want to get creative ideas, you ask at least five people, five different enterprises, five different and that is what is the analogical representation.

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Synectics

- To be creative, put the watchman in your mind to sleep.
- The mind tends to take the **path of least resistance**.
- Untrain your mind by using **analogies**.
- Can use **direct and indirect** analogies.

Synectics teaches us that to be creative we have to you know, put the watchman in our mind to sleep. The watchman do not let us creatively think. They make us think deep in the same area, because remember, the mind is very smart, it does not want to tacks itself too much. It wants to take the path of least resistance; it also wants to go.

Just remember, if you were to like for example, if I have to go to my house, from my, the School of Design to my house, in you know like Aravali, I always take the same path. [FL] doubt [FL] same path [FL] path [FL] that is what is the thing. Because I when I went on that path there was no accident, there was nothing. So, it is easy.

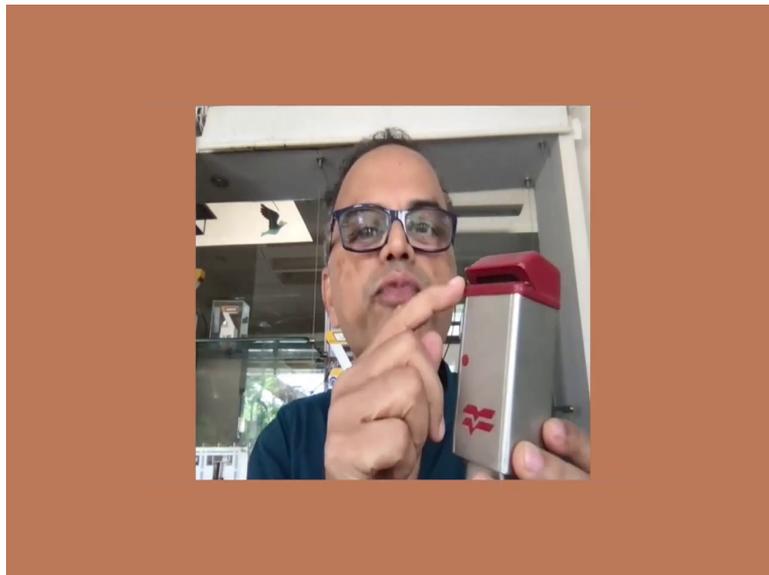
So, I am know it is safe. So, I keep going on that path, [FL] safe path. Why all of us in industries do not innovate? Safe path. It is safe, the mind does not let you think new. If it

thinks new, it is too much of work, it could be risk. So, we are trained like that, the human mind, human evolution is trained like that to be safe. So, you have to untrain it.

And that untraining can happen by analogical associations. A lot of my design students use direct analogies. If they are designing a water bottle, they take you know they take inspiration for water waves for example.

And come up with this wonderful bottle which is you know inspired by waves. If I am designing a letterbox, postbox for India Post, I take the inspiration from a beak of a bird.

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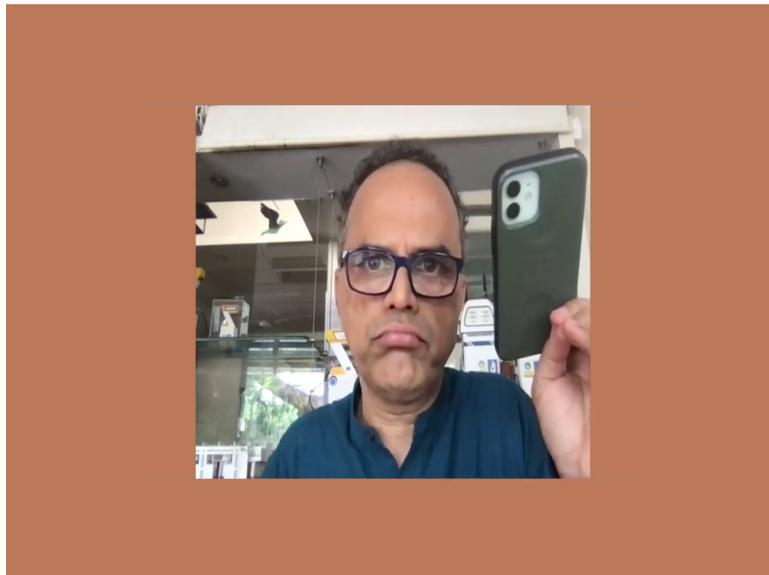
So, the beak of a bird, sort of you know because the this big bird feeds the small bird oh then I do not need to tell people where to post their letters, things like that. When there is rain, for

example, all the letterboxes were rusting, then I said this should be sloping [FL] who is rocket science [FL] all the houses of the roofs are all sloping, why should there be a flat roof.

[FL] there is a sloping roof. So, no water stays over there. Water is getting inside the letter box and all the letters are getting wet, make a cap design. So, all my you know sides of my letter box are cap. [FL] cap [FL] tiffin box. Analogy, simple simple analogies.

In all my success stories, in innovation are all because of the simple analogies. In fact, I have a PG student Sharmila Sinha, you know what she did? She said do not even take direct analogies, take analogies which are completely alien, for example. If you are designing a car, think about a mobile phone.

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It looks foolish right. I am designing a car, [FL] mobile phone [FL] inspiration [FL]. If I am looking at interface design of a new car, I look at interface design of my phone. Oh, how do I open a phone, oh, now it has face recognition, oh, I can think of face recognition in my car door, why should there be a key? Just now it is already happening, but I am just saying.

It does not need to be in the same product. It can be a completely different product. It will be a completely different product and then we realized, that the creativity jumps by four times. You take direct analogies like you know like I was designing my sort of you know like hinge for my door of the letterbox and I took inspiration from my spectacle hinge for example, this is direct analogy.

But then, we if you consider completely indirect analogy which is not related at all. So, for example, can I design a hinge from the leaf. Oh, how to design oh the leaf goes in the breeze up and down. So, can I have some flexible rubber, which will you know flex the door, that is see that is more creative than creating a hinge in the letterbox.

And then what will happen? This rubber is full length, it will not even leak, water also will not go in. See, I got double advantage. But I have not done it, I have taken this analogy and I have hinges there. So, if I put a hose, water can go in. So, that is what is the creative ideation and I think we can go forward now.

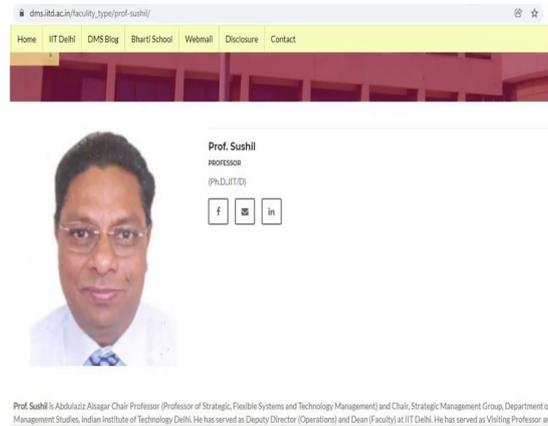
So, then what happened, I finished this you know I thought that [FL] I have done such wonderful work in the industry for 7 years and Ph.D. is generally 5 years.

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So, why they cannot give me a Ph.D. with the story of the Z line? So, went to my there was lasting credit of my guide, Professor Sushil from IIT Delhi, he said Professor Chakravarthy you done some wonderful work.

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The screenshot shows a web browser window with the URL `dmu.iitd.ac.in/faculty_type/prof-sushil/`. The page features a navigation menu with links for Home, IIT Delhi, DMS Blog, Bharati School, Webmail, Disclosure, and Contact. Below the menu is a header image of a building. The main content area displays a portrait of Prof. Sushil, a professor with a Ph.D. from IIT Delhi, and social media icons for Facebook, Twitter, and LinkedIn. A detailed bio at the bottom identifies him as the Abulhasiz Ahsagar Chair Professor and Chair of Strategic Management, with a list of his various roles at IIT Delhi.

Prof. Sushil is Abulhasiz Ahsagar Chair Professor (Professor of Strategic, Flexible Systems and Technology Management) and Chair, Strategic Management Group, Department of Management Studies, Indian Institute of Technology Delhi. He has served as Deputy Director (Operations) and Dean (Faculty) at IIT Delhi. He has served as Visiting Professor and

But that cannot count as your main research. It can only count as your exploratory research, to begin your research. So, I analyzed my you know whole study of how I built the petrol pump? What happened in the industry? What type of collaborations came up?

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And then they realized, my God, Collaboration is the key to innovation. So, my whole topic became Collaborative methodology for innovative idea generation. Then what happened, I finished this of this case study. Then I said sir I have done this case study where we collaborated with Professors from other departments.

And you know we came up with this you know nice ideas. And remember, in research you all to you have to look at a small part of your research and research is very narrow. So, my research is narrow to the level of, only idea generation.

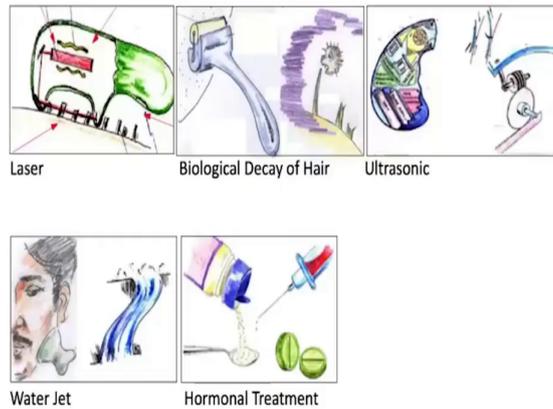
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“Idea generation is the seed to innovation.”

Because, idea generation is the seed to innovation. Right? Your idea is very important. So, we said, ok sir, I have come up with these multiple case studies, 5 case studies.

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The they we selected, 3 ideas you know, 3 technologies and went to the professors again and I must confess with you, that when we went to the central library of IIT Delhi, we had the complete research papers and technology needed to build this laser device. It is all available, within 2 days the students came up with all the research papers of, how the laser dump will be created? What type of laser to use? How the laser will work? What will happen? How to put an safety features in that? Everything.

So, that is the type of speed you can work on, even on the innovation level if you come from the research point of view. Of course, we picked up all that and then they created this wonderful product, you know the laser shaving device and it was looking like a hair drier; it was big. And then I said we are all design students. So, they said [FL] this cannot be, you know.

This is not our first thing where we said, wiping of the face your hair should go. So, then with this with then we came up with this you know interesting idea of separating the laser production and the laser application and then there is a there is a you know on your you know like wash basin you have this hanging laser you know generator and you have this you know small like your you know small you know wiper, where the laser is in your hand.

And in this wire connected to that and you actually you know sort of you know clean and there are two part you know technology you are there. So, then, in IIT's you know some of you have done Ph.D. you know there is some there is something called the Annual progress seminars and you know I thought you know this itself took me 1 year to analyze and make things happen.

Then, the Professor said that, Ok, this is very nice, but this is completely academic. You need to work on something where you taken a lot of knowledge from across the world, across the country from research papers and come up with a methodology which could be applicable to industry. Then, being you know naive as I told you, you know having the confidence of industry, I said I am going to do live projects, which is never you know unheard of because live project in research is very difficult.

And some of my friends in the research area said, you know like Chaku, your you know like your Ph.D. will take at least a decade, at that time I was not ready to listen to them. I said, No. I am going to work on live projects, because I would work with industry, I would make them part of the innovation process and I will take this forward.

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So, let me show you that one part here. So, that was this wonderful project of Midco Petrol Pump, which is what you see over here in the sketch. And I call this serial innovation. So, you know like what is interesting is after designing the petrol pump, the CEO of Midco company, which was not able to sell any petrol pumps of their you know design, came back to me.

And said you know you have designed this product when you are in L and T, now you are a professor, you design one more product for me, I said, wow, that is a good idea for my Ph.D. So, we took it up, and like you know to the everlasting you know credit of my student, Mister Manoj Dubey, who is a Entrepreneur now.

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Bullet Pump for MIDCO



He has a wonderful furniture company, in Bombay now and we started this as a student project and as my research topic too. And you know we went in that journey and here it is you know this is the you know product, we designed and that was his first prototype which was there. And this product you know then later on, luckily you know Manoj Dubey joined the company, he worked there for, I think nearly 7 years.

And then we produced these you know pumps in a very very big way. Actually, then I realized, that it was already 6 years and there is something called the Product life cycle. And again, I am very fortunate for some of our top management of L and T who used to always say, that when you design a new product, when you launch a new product, you have to obsolete your old product.

And we used to give a life cycle to a project. And my product life cycle was 6 years. And it already crossed its life cycle, it was doing so well, even at the end of its life cycle in 6 years, that the you know that the company was not ready to shelf it and design a new product. So, we started designing and of course, we came up you and the mechanism was same, analogies.

So, we took inspiration from the Nokia mobile phone, which had this big antenna on the top. [FL] display [FL] phone [FL] display [FL] linear form [FL]. Linear form was very useful, but [FL] phone [FL] analogy we are taking an analogy of a phone and I have got tremendous amount of benefits for every aspect of the petrol pump. Let me tell you, begin with number one.

Number one advantage of taking the hose from the top was my litres per minute, my delivery rate improved by nearly 10 to 15 litres per minute. And litres per minute means, my petrol pump is doing more business, my petrol station is doing more business, they will change their petrol pump day one. Just because of laminar flow through these pipes which are going from the top and coming down.

Number two, because the hose is coming from the top, the person who is actually filling petrol is not even doing 90 percent of his work. Earlier, he had to drag the hose with full petrol inside, which is nearly 3 kilos or 4 kilos of petrol inside the hose and now all the job is doing being done by the top. So, extreme user convenience for the operator. Large display, tell me what is the advantage of a large display?

When my car is parked very far off from the petrol pump also, when I look back, I am able to see the display; it is not hidden. Earlier they used to be little narrow openings [FL] excellent user interface. A slim petrol pump wow, very good, I can save space in my petrol station, instead of 4 petrol pumps, I can actually have maybe 5, in the same space, because my footprint is very low.

Can you imagine? [FL] Nokia phone and engineering advantages, user friendly advantages, business advantages. Do not think it is by accident or do not think [FL]. This is happening

every time to my projects, it is not once or twice. Because, you are concerned about your project, see the project is not happening out of the blue. You have taken that inspiration, an analogy which is indirect, but your mind is actually working for your project. Right?

So, when you develop concepts, they automatically build advantages. And this petrol pump was actually so popular and of course, you know the bonnet opens like a car bonnet you know, bonnet falls down, the assemblies are very easy, the you know the hose placements are very easy, you got very good sort of you know like gaps inside it is a chassis design. So, it is a silent product when compared to L and T.

We had at every level; it was innovative. Remember, this one advantage L and T had their own CNC machines. By the time it was 96, 97 there were 100 vendors in Bombay, who were doing CNC fabrication. So, the advantage is lost. The competitive advantage of the big company was no longer there. It became a competitive disadvantage, because when I went to vendors, they gave me at much less price than building a product in house.

Are you following, some of the guys who are from industry? So, do not think your competitive advantage will remain forever dear. Always be agile in thinking, always come with new thoughts, always look at new products. Look at our alumni Bhavish, he is doing very well with Ola cars, but now he is coming up with scooters which are he is entering the market of scooter; electric scooters.

Because, he knows today's you know traffic is going to be terrible and people may want to you know zip up in a scooter and of course, environment friendly scooter, there will lot of you know advantages. So, he is got into scooters now, he going to go to cars which are electric cars maybe. In fact, he wanted to do cars, but I do not know why he went into, last time I met him, he said [FL] you know we were looking at car, but suddenly we see that he is making scooters.

In fact, very interesting Bhavish came to IIT Bombay and I stood in the queue, which was how long? The queue was around half a mile long to meet him. And he is our student, right, 2003 - 2004, he passed out and I met him once when he was a student. But then, when I met

him it was wonderful, he was like feeling very you know like, sorry sir [FL] line [FL] line [FL], interesting know?

So, you are learning back from your students. The students are the ones who are doing wonderful work in the market. So, I am always ready to learn. I am always ready to learn and I am always ready to practice new things, you know learn from the students. So, I love to meet students. [FL] student [FL] alumni [FL]. Because they are the ones who are future.

It is a big advantage to have interns who are young, who are coming from colleges, they are bringing you new knowledge, listen to them intensely and implement whatever they say. I tell all the industry there is a lot, it is very very important. Anyway students, so then like finally, we got runaway success in this petrol pump.

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Z-Line Pump for L&T

- 75% cheaper than previous designs
- Display made for better angle of vision
- Inviting shape
- Became the largest selling pump of the decade
- Customers felt they got better petrol and better mileage



And of course, my Z-Line also had tremendous amount of advantages. 75 percent cheaper than the earlier product, in sheet metal cost. My earlier product had such, a you know lot of sheet metal, it was a huge box. And we and at that time we were importing sheet metal from Japan. And of course, it had user convenient display panels, it had wonderful innovative shape. Our shape was so popular that, all across the world people stood up.

But, will U.S.A buy my pump? [FL] multi hose pumps, [FL] fuel, [FL] self-service [FL]. They did not want to look at this product [FL] product [FL]. Single hose, [FL]. You know for them, they used to this very refined form [FL] boxes, [FL] hoses, [FL] they did not want this pump at all. But in the Indian market, my God, it became the largest selling pump in one decade.

[FL] features [FL] for example, when you trigger the nozzle [FL] pump [FL] nozzle [FL] trigger [FL] flow [FL] sensor [FL] vibrate [FL]. When the sensor is vibrating, engineers will know, the optical sensor will count two pulses, for one and then you get less fuel. [FL] meter [FL] liter [FL] 950 ml, because, he is doing this triggering.

So, I was like doing my user survey. And another very important lesson for all of you let you be from industry or from academics or from entrepreneurship, entrepreneurship [FL] customer discovery [FL] important [FL] and how much you need to be with the customer and how much you need to be friends with them and how much you need to stay with your customers for a couple of days to understand how the product is going to work with them.

So, I was you know doing the same thing in the petrol pump. Because I wanted to you know do threadbare design and I when I stayed on petrol stations I realized [FL] cheating [FL]. So, when I went back to L and T, I told my colleagues [FL] can we do something about this, you know and then, can we put a unidirectional bearing?

So, that this disc the sensor disc which has these pins and the optical sensor does you know sensing does not turn back at all it always goes front; even if you trigger it will not go back, it will go front. Can we do this? They said that is very easy. We just imported that bearing, unfortunately, that time that fine bearing was not available in India.

We imported that for if I am you know not mistaken, around 25 rupees and that we implemented in the product. So, my new pump for example, any new product you know like we have to have new materials, new technologies wherever possible and contemporary manufacturing very important. You cannot use something which was used 6 years back, a lot of us our mind keeps saying.

In fact, remember student, when I was making this product in L and T, my there was something called a Product development division, which would always think that I would fail and they would keep alternative old material ready. For example, if I am designing gaskets,

inspired by Maruti car, at that time Maruti car was in the market. And they had wonderful EPDM rubber gaskets around.

Fabulous, the windshield of the glass would be on a gasket, which was made out of EPDM. And I said, I want to use that in my pump. I do not want to clamp my pump glasses. Because when they clamp the glasses, all the glasses used to break; during transit, out of 10 pumps, 4 glasses used to break. It is terrible shame, company like L and T is sending a pump to the station and then they drop the pump on a tire to unload it.

And when they open the pump, they see that the box is open and then the glass is broken. I took inspiration from the cars, from the Maruti car, went to Daman, got the gasket designed for my specifications.

And before I could come my colleagues over there had already bought the old gaskets, the rubber you know natural rubber you know like gaskets there, saying that in case Chakravarthy fails, we have to have an option, right. Safety remember, I was telling you, efficiency and safety is the hallmark of any manufacturing enterprise.

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"Efficiency and Safety are the hallmark of all the enterprises"

They are right at their level. And I am right at my level. Innovative product and my because of this glass change, I saved nearly 3 percent of the cost of the product.

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And I saved nearly 40 percent cost of maintenance on-site maintenance, 40 percent, it is huge.

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Because not even one glass broke, after that in the whole history of the Z-Line pump, not even one. So, these are the things we have to learn, you know in our innovation, entrepreneurship and problem solving. Everything is our problem. Everything, that is very very important. For example, another very simple thing I want to mention to you, when we say problem solving. These petrol pumps have a meter below and the meter has a small link, which goes to the sensor there is a small link.

The meter is the one which is metering the fuel and it is rotating a small wheel and there is a small link which transfers this to the sensor you know electronic sensor.

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Because of you know, like casting and defects and things like that, the meter housing would shift and you know for example, the brackets would break, because of transit damage or whatever.

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We took inspirations from auto rickshaw suspension, at the back. I keep watching this auto rickshaws going from the back. [FL]. What is he doing there? Why is his link not breaking? Why is his casting not breaking? We just implemented the same thing back in our pumps, you know, what my design team would keep saying? [FL] it is that fellow's problem, he is not unloading correctly, why should we bother?

This is a big challenge in industry [FL]. Blame [FL]. They will always say it is somebody else's problem. Design should be able to take every blame. If it is not being, you know dispatched correctly, you solve that problem, because it is not possible to solve, I cannot put a forklift in the rural area where petrol pump has you know like unloaded, nobody will spend on a forklift there, which is 5 percent the cost of your product.

Why will I spend 5 percent of cost of product just to unload the product from the truck? And the truck guys will always have some big tyres, [FL] tyre [FL], he cannot you know spare his time over there. And our people have solved the problem in the automotive industry. So, we got that rubber link, we mounted all the meter on suspension bushes and my meter is now you know like on the suspension booths and my link will never broke, my casting never broke.

And that is not my problem at all. I am an industrial designer. I am not even an engineering designer. Though I am a mechanical engineer, I have like trained myself as industrial designer, I only do product design. I look at the external I do not look at strength of materials, I do not look at you know like casting you know like processes. But, I look at organization of the product, right.

So, these are the interesting things and you know the biggest satisfaction is that the auto drivers the second day of operation realized, that these petrol pumps are giving you correct fuel. They are getting more mileage and you could see queues and queues of auto rickshaws lined up on the Z-Line pumps, everywhere in the in Bombay.

And as soon as auto rickshaws lined up, other people realize that [FL] petrol [FL]. And because my shape was novel, they then attributed to the Z-Line shape giving you better quality of petrol, better measure of petrol and you know that is interesting. Right? How a new product feature and form, can generate an perception in the users that is giving better. And then the whole 6 years, the market you know like nobody gave any orders.

And in the history of Indian oil which is the government enterprise, Indian Oil, Bharat petroleum and all these people gave special tenders calling it the Z-Line gasoline dispenser tenders. So, there is no chance for anybody else to participate. Because, Z-Line was my design registered product. [FL] single tender. And you know when there is a single tender, what happens?

All the order is given to L and T and in case somebody else wants to you know supply, they have to supply the price which L and T is offering. And we had already you know because our

overheads are high. But even then, our product was cost was so less, even the small manufacturer which is one-hundred the size of L and T, could not compete with us and could not even give us give the oil company 20 percent of production even if we were not able to supply at the same price of L one.

So, that is an interesting journey, sorry, I am talking about lot of business here, but you know it is very important for us to understand. So, there we go. So, we have you know like the bullet petrol pumps which did very well. And of course, very interesting after that you know this project came to NID, where you know they were requesting Pradyumna Vyas.

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Who is also our alumnus from IDC, you know like you know said Professor Chakravarthy, like I have this request from ONGC should design, the next generation petrol pumps, can we

do it together? The concept design you know came from you know NID. We worked on the product development, product detailing and the complete concept design and took it forward.

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And these were the prototypes installed in Mysore you know, of this is the third generation.

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So, you look at the serial innovation happening. And of course, you know we had this wonderful project where we had you know display which can go on to the windscreen of the car.

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We had you know like, special logos glowing, easy maintenance all features you know put together you know all of our learning into one product. So, just to now tell you about my research journey.

So, of course, the you know I was a professor at IIT Delhi and you know thanks to Midco it did so well, that the you know like all the oil companies moved on to you know the bullet dispenser after that. And of course, like my colleague said, it took me a long time to finish my Ph.D.

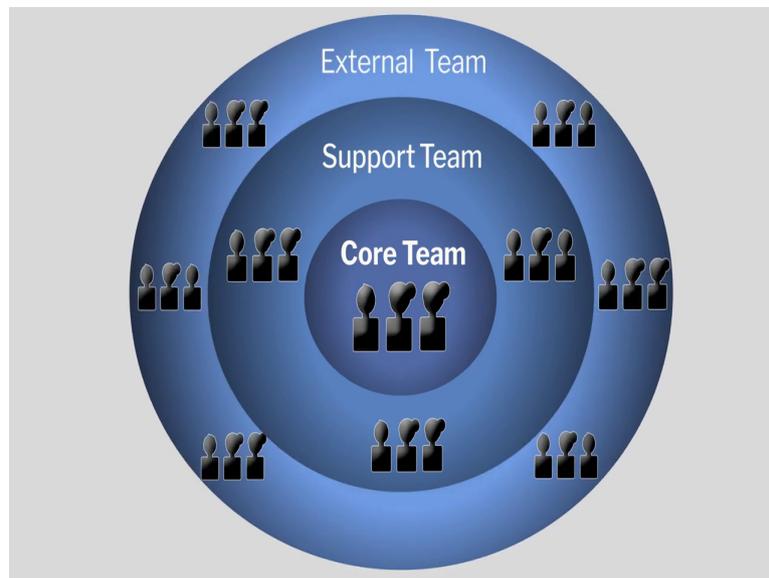
And it took me 9 years and you know finally; we came up with this very very simple model for innovation and entrepreneurship. What is this model? This model is a Collaborative Model.

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Collaborative Model for Innovation

All entrepreneurs should have a Collaborative Model. [FL] Idea [FL].

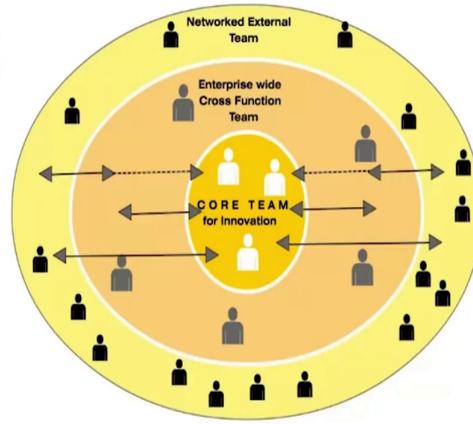
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It is not easy to take an idea and make a product. Please, never be in that myth. You get people together, share resources, share profits, share royalties. Of course, now today we have even employees are given shares in companies, when they were working in startups and software industry which has grown so well in the country has taught us this. Network, collaborate you know, for example if there is a project which comes in they collaborate with 6 or 7 people together and they assemble that and give.

They do not make new software every time. They assemble it, they will put things together, they will rationalize it, because they have they collaborate they collaborate heavily. And, how does collaboration happen? Let me tell you. So, my whole Ph.D. was about generating this model. And it is a very very simple model. The people who work on innovation, the core team of a company has to be given only one job; that job of innovation.

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Innovation by Design (Flexible Collaborative Model for Innovation)

Whether it is a new product or a new service or a new enterprise and that is the core team. You know, when I was doing my Ph.D. when I did my survey for my research, I found out, that the busiest man in the company is the innovation head. Because, he is good, in his work. But, he would be a very very poor innovation manager, because he is busy firefighting manufacturing. What type of effort he can put in innovation? Tell me.

So, I go back to all these industries tell them. [FL] have your innovation manager, who is very different who has experience. You know where I learned this from? I learnt this from Toyota, you know what Toyota did?

The top guy was the busiest guy, you know last year was taken out from the company and he was put into an association which is like an industrial designer's association or it will be an

association of engineering AOTS you know association. And what they would do? They would send the association across the world to see what is happening.

And this guy came to IDC once, completely free, completely brainstorming and I asked him, where were you working? Well, I said, Toyota, I was the head of you know like production. Then, what are you doing now? I have you know they have sent me on this job, to see the world, to learn, to learn from people, to learn from perceptions, to learn what is happening across the world.

And then when he goes back, he will become the Innovation chair in the company. And he will take the next level of product for the world, he will be the in charge for that. We have to learn a lot, from Japan of course. So, it is very very important for us to be having a team. And you know again Bhavish and Ankit from our Ola story, very clear. The two core team, the two Co-founders of the core team.

And they of course, brought in other people as partners and they all worked 100 percent on the project. And some I still remember some of my other TA's were my design TA's in IDC did the website for him, did the Ola site for him. It was fabulous. But, he was just a consultant. But the core team is core team. The consultants and all are your support team which is outside, look at the core team core team is 3. Whereas, consultant teams can be 6 or 9.

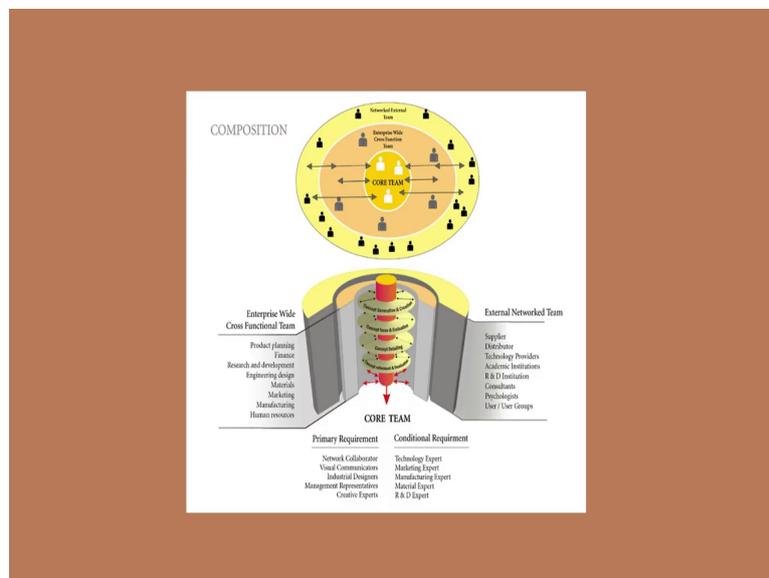
That we call it the support team. If it is a startup and an enterprise, if it is a startup your core team is small, your support team is big. If it is an enterprise, your core team and your support team which is around you is also from your enterprise. Because the support team will spend around 20 percent of your time in innovation and then of course, you have the network external team.

Like the way I will tell you about analogies and creative analogies from outside sources, your network team will give you phenomenal amount of creative ideas. And those are very important, they will give you, they will only spend 1 percent of the time in your innovation

and they are keen on your innovation, because they are your vendors, they are your suppliers [FL] future business [FL].

[FL] they will be in touch with you and they will you know always come and you know support your activity. So, such a simple team. And I was a consulted to Mckenzie. Mckenzie called me once, you know like why they were working on some you know on a large oil company project. You know on retail business and they invited me and they said you know Professor Chakravarthy like to see your model.

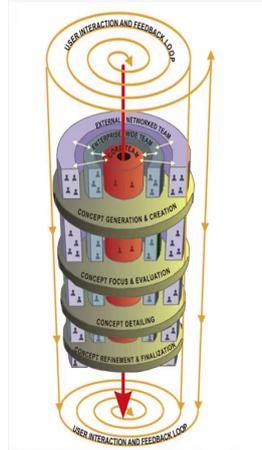
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And I showed these two simple models, you know the composition of the team, the function of the team and of course, the model of innovation.

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Innovation model



And they were shocked. They said, how can such a simple model be effective? I said simple models are the best implement. And then I presented this model for entrepreneurs and you know like with Professor Anil Gupta of National Innovation Foundation and they was very happy. Because, you know this gives a structure to a very simple collaborative effort.

And we are also mapping the collaborative effort. And of course, you can map the financial you know efforts also. In fact, to the everlasting credit of you know Amit Jere of our Atal Innovation Mission at the Ministry of Education, he recently conducted a hackathon in across the you know institutes. And in that hackathon, he had invited industrial designers from the companies and he offered them 1 percent royalty. Can you believe it?

And I was so happy, I would go and meet all these designers who came from industry and what they were doing with the startups for this hackathon.

Maybe only 2 companies out of 100 came out of that hackathons but never mind. You have that credibility, because financial inclusion is very important. And in fact, I must also tell you about Poyini our CEO of the Society for Innovation and Entrepreneurship it is called SINE in IIT Bombay.

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It is one of the best incubators in the country. And I am sure I think it is going to you know be also as good or better than us, but we do very very thorough contracts between employees, between Co-founders, between investors. And those contracts are the best sort of you know

contracts, because even if you leave the company after 3 years, you still have the stake, you put your heart into the company.

And even when you are outside, then you are a friend of the company, you are no longer you know hurt. In fact, you know like Poyini is a banker and she comes from you know like the banking but she is phenomenal in this. And we have got wonderful success stories just with 4 to 5 percent royalty, you know and success of just 5 percent of the companies and some of them become unicorns now.

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Sine Board of Directors

We are able to run the whole you know incubator, I was on the board you know just stepped down from the board after my 3 year term and it was very very exciting to see this journey. And of course, the innovation by design journey, the most important aspect is the user insight.

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In fact, again to the everlasting credit of our you know GDC team, Gopalkrishnan Deshpande Centre at IIT Madras, they only do one thing. They call it you know evidence-based entrepreneurship, where is the evidence of your customer when you do a start-up? Very early they put you on a evidence trip, where you have to go and spend time with your customers. So, that is very very you know interesting about user I am calling it user here.

Because we are talking about design process, but if it is enterprise it is about customer. Insights from the customer. I have also told you about new technology, the contemporary new technology and you will realize how you know Bhavish and Ankit who started the Ola, rode on the success of the smartphone technology. If they had come 5 years before they would be nowhere, exactly rode on the technology.

And today they are riding on the electric scooter technology, see, they are not sleeping, they are not they are not waiting. So, that is very very important on how we take new technology forward. And remember my lesson on Creative Ideation, be very focused on ideation and keep thinking, am I working creatively? Am I doing things differently? Am I making sambar the same every day? Can I make sambar differently?

And explore and taste sambar in a different way and it will be better than my old sambar. Can I be creative? Can I push myself in my industry to be creative? Can I push my employees to be creative? Can I push my students to be creative? So, please ask yourself these questions. Put the watchman in the brain to sleep, when you are working on new ideas? When you are coming up with new thinking?

And of course, you know when we are in when we are in pressure of deadline, automatically they go to sleep, because you have to complete the job, right, that is why creativity is maximum, in war-like situations, creativitiy is maximum when there are deadlines.

So, these are all known to us. And of course, you know in my you know team you can see this user feedback loop, where the core team, the support team and the external team are all you know interacting with the you know with the customers and the user and the you know users very very collaboratively and very intuitively and you know today, you know I started my Ph.D. very early, at that time internet was pretty slow.

But, today it is much much more easier we have got fabulous platforms for collaborative works. Like for example, today we teach our students using the mirror boards and like it is really so good, each of them is learning from each other in a very very big way and you know all this is happening for our benefit.

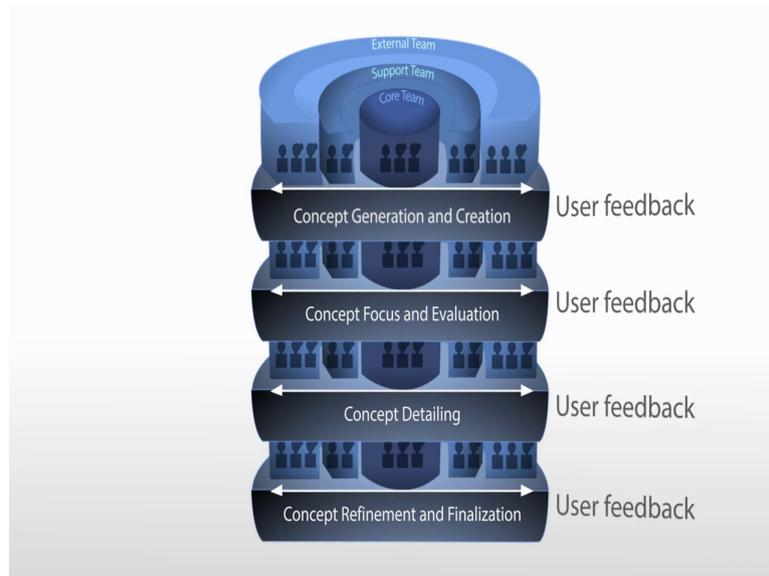
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And of course, you know, this is my very you know interesting slide, I call it the Sunflower model of innovation. Sunflower is the innovation. All the petals are various components of my you know like of my enterprise, you know and my features, like technology, user interface, you know attributes like cost, miniature, all the petals.

And like the sunflower directs towards the sun. My innovation flower has to see the user. Appropriates this to the user. It always should turn towards the user and that turn is very very important. The technology should be for the user, the manufacturing should be user centered. The management principle should be user centered. The cost should be centered about my customer the who wants to buy.

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I cannot make the cost costly. So, my cost technology manufacturing all put together, my flower should look towards the user.

And my user, will be delighted to use the product. Because, he is getting so much benefit, at he gets more value for the you know for the money he pays. And that delights the customer and that you know makes the project successful.