Design Thinking for Agricultural Implements

Design Thinking for Agricultural Implements

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Contents

Course Description

Design Thinking is an introduction to the process of generating creative ideas and concepts. It aims at finding ways and intellect used by the designers in order to initiate the method to finally develop a robust and sustainable product. Agribusiness looks towards innovation to counter the pressures due to drastic variations in climate and population density. Design thinking in building agricultural equipment emphasize on understanding the needs of the customers, farmers, workers and machine operators, to convert the ideas through a usable approach to develop a problem-solving activity or machine. The current course covers the step by step procedure to make agricultural equipment. Introduction to design, manufacturing, and product characteristics are catered in the starting weeks. This is followed by the design thinking process where creativity holds the key. Tasks for the students are given in the lectures, and examples and case studies are quoted for making the course palatable.

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Content

- Introduction to design thinking
- Product characteristics
- Design thinking model
- Empathize and define

- Ideating
- Prototyping and testing

Audience

- UG and PG students of Agriculture and Allied Sciences
- Faculty of Agriculture Universities
- Agriculture Scientists in ICAR
- Professionals in State and Central Departments of Agriculture
- Specialists working in KVKs
- NGOs in Agriculture
- Progressive farmers/ farming community

Expected Outcomes

- What is design thinking and when to practice it
- How design thinking helps to bring innovative ideas
- What are the functional and design parameters of a product
- Understanding customer & translating their needs
- Usability testing of a developed equipment

1 – 1 Introduction to Design Thinking – What is Design (Part 1)

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Transcript

What is Design?

Welcome to the course on 'Design Thinking on Agricultural Implements'. Let us discuss this lecture on defining design. What is design? Is this all about aesthetics. Do we give more emphasis towards aesthetics only? And is that called design? So this product what is displayed here attracts user's attention because of the sleekness in the design and the lustrous look. It is all more focused towards aesthetics. Is this the definition for design? This is a product. This is a machinery. This machinery is used for ploughing action and seed plantation. Do we call this as design? Do we call design as an experience? You would have felt this many a times when you use a service given by a taxi or given by a hotel. After you finish your service, you used to get a WhatsApp message or an sms message saying that how did you like the service. And there you have to put a star mark and then that gets recorded for further processing.

So here you look at it, it is more talking about experience. Is this design? We have given three different options. One is aesthetics focus, one was product focus, and the another was user experience focus. So there are three situations. And in the three situations we always get confused. And we always look at what is the definition for design. So let's look into the definition.

- Design is a process. Please keep it in mind. It is a very important word to note. It is a process. So that means to say, there is nothing called unique solution. It is a process. And in a process, every time the solution gets iterated and improved. So that is why we say, it is a process of what. Of envisioning and planning the creation of objects, interactive systems, building vehicles etc etc. Envisioning means to have a feel. How do you visualize it? And planning is also part of design. So that is why design is called as a process.
- And this process is always user-centric. That means to say, you will try to develop a solution to a set of customers. And these customers are your users. So it is user-centric. When somebody asks you, can you define design. So then you have to say that it is a user-centric process. So what is user-centric. Users are at the heart of the design thinking approach. So user will be kept as a center stage, and you try to go around looking for a problem. Try to develop a solution for the problem. And developing such solution is nothing but design. It is about creating solutions for people.
- It is a very broad concept and its meaning can greatly vary from one field to the another. So when we talk about computer science we talk about architectural design. When you talk about agriculture, you talk about agricultural design. So the definition is not the same for all. But what is same for all is, it is a process and it is a user-centric process.

I have given you the words of Steve Jobs. So Steve Jobs says design is not just what it looks like and feels like. It is how it works. That

is why you see Apple products are very successful. They always give more importance to how it works rather than giving importance to look and feel.

The goal of a design process is to guide you and organize your work, to turn ideas into product. So this is very important. The goal of a design process is to guide you and organize your work. Organize your work for what. To turn your ideas into a product. In our case this course is more focused towards agriculture. Because in agriculture there are a lot of drudgery problems. So human drudgery can be reduced by introducing technology. Okay, so here we go around the customer, note down the drudgery and come out with a technological solution. Giving absolute technological solution is not a very efficient way.

Today considering the socio-economics also in the technology is very important. For example if you try to come up with a technology and completely automate the field working. So then lot of people lose jobs. So now that should not be the solution. The solution should be; involve the people who are there, but improve their productivity. That is what is very important, rather than completely bringing technology. So the goal of a design process is to guide you and organize your work, to turn ideas into products.

A designer do research and collect information about the problem they are considering. For example in an agricultural field, who is facing this problem, whether male, female, animal. Why we need a solution? Suppose if the existing solution is very perfect. So then why at all we need to bring in a new product and the new solution. How are other people trying to solve it? Say for example if a similar problem exists in another country. How are they trying to solve the same problem in that country? And whether we can take that solution and implement it here.

I will share my own personal experience. There are bio-filters which are available today. So these filters work very well in South of India. When we tried to mimic the same thing, bringing it to North of India and trying to develop a same solution, the bio-filters failed miserably. So here what we did was we went to other place, took the

solution, but does not mean that the solution will work. So here you should also look for what is the problem and where all are similar problems available. What are the solutions they have. And finally you have to tweak those solutions to meet out the customer demand here.

So the designer do research and collect information about the problem they are considering. Who is facing the problem, why do we need a solution to the problem. How are the other people trying to solve the same problem. It's not you are the only person across the globe to solve. There will be many more people to solve and how are they approaching to solve the problem. From this research they make a general hypothesis first and identify the main features. That should be part of the solution. So there might be 100 different demands which is expected from a machine. So we have to find out the significant parameters and insignificant parameters. Give more weightages to the significant parameters and identify those things as main features. That should be part of the solution.

Keeping these key aspects in mind, it's time to experiment with different solutions and iterate. Iterate means it is several times revising the idea to go towards the solution. So keeping these key aspects in mind. What are the key aspects? What are the main features? And who are going to be the beneficiary. And then try to develop multiple solutions, and convert the multiple solutions into one or two feasible solutions. For this you undergo several iterations to go towards the closure.

This is a typical product design cycle, which influenced from design process. So you will have ideas. And these ideas, you will get multiple solutions. And once you have multiple solutions, you will have to go and identify, what is the definition of the problem. So you have multiple solutions. Ten solutions. All these 10 solutions will not be able to give the perfect results. So you now try to look at weightages and then try to define your problem. After defining the problem, you will try to test the solution, whatever you have developed. Then you will try to reiterate the design. Then you come up with a branding to the solution. Then you look for funding. Then

you try to make it in bulk. And then you launch it in the market. So this is the typical product design cycle, which is influenced from design process. So now that we have understood the design process, we will discuss an example which is agricultural based in the next lecture.

Thank You.

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PDF: What is Design Part 1

1 – 2 Introduction to Design Thinking – What is Design (Part 2)

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Transcript

Brief Introduction

So in the last lecture we were discussing about design. So we ended it very clearly, saying that design is an iterative process which is user-centric, and wherein which it is used to structure your thinking towards developing a solution for a given situation. So now keeping that idea in mind, let us start taking a live example in agricultural food processing and do a mapping study, with the definition what is given, and then see how do we go about.

What is Design?

Design Process

So let's take a simple example which we have tried to solve in our institute.

For example a team of students came together to design an amla de-seeding machine at IIT, Kanpur. So this is amla. So in this amla, you can see here, there is a flesh portion. It has the medicinal value of it. And in this fruit you will have a hard seed. This is the seed which is hard, and which does not have any value and this is the flesh portion which has medicinal value. So the problem which is given to us is, how do you remove this portion alone, the seed alone from the fruit.

That is the problem statement given. It looks very interesting. But if you want to de-seed it you will have to be having certain thought process in the mind; such that one, I should not damage the fruit in a big way, that is point number one. Two I should de-seed it with a reduced amount of flesh residue on the seed. If there is no residue, it is excellent, otherwise very less residue; it is also accepted.

So we have to start developing a de-seeding machine. So here what we did was, first we understood the problem, and the current state of the art is, people are trying to de-seed only using their hand. So there is no machinery available. They take every fruit and then what they do is they try to take a tool, which can prick, pierce inside, apply certain pressure and push it out. So that's the 'state of the art' available. So now we looked into the problem. So the problem was faced by the worker who used to do de-seeding amla; used a handtool. So when you use handtool, there might be lot of error, there is hygiene problem. And many a times due to fatigue, they don't do it properly. So it is less productive and it is also injurious to health. So here the drudgery level was very high.

So then the students decided to design a dedicated machine for de-seeding in three stages. One, they decided that it will have a feeding stage. Then it will have de-seeding stage. The third one, it will have a collection stage. So they decided they will have three stage. And these three stage, as you go back in the definition and see, how are the other people trying to solve the problem. The students here did not look at other de-seeding machines, which are

available in the world. They looked at other similar problems which are faced in the shop floor. So in the shop floor lot of parts have to be sorted out or has to be used for assembling. So there they use all the three mechanisms. One is feeding, then they do assembly and then they do dispatch of the product.

So here what they did was they tried to take as a concept of feeding. De-seeding is the place where the operation happens. And the collection is the place where the de-seeded fruits are collected. So they took the idea from the existing assembly line in an engineering factory and then mapped it to the amla de-seeding machine.

The Design Process

So while evolving in the design process. You see initially the concept which was made is they used a hopper. So hopper is a place. Hopper is nothing but a collector. So if you have lot of similar items to be fed inside, and you want to have to take them one after the other after other. So then what we do is we dump it inside a collector, or the collector is otherwise called as a hopper. So the concept was used. This is a computer model. So they created this using a computer model, and a hopper is a collection of amlas that is kept inside. So the, as and when during the de-seeding process, one after the other after the other will be released from the hopper such that you can do. So when they did this assumption, and they were trying to start developing the concept using virtual, they tried to have a hopper concept.

But when they were trying to make a prototype using economical material, or trying to use rough material. So they tried to develop a prototype. In that prototype, the hopper now is completely changed into a crank mechanism for de-seeding. So then this is from the crank. It is attached to a punching mechanism. So this is attached in turn with the crank here. So the crank is attached to the punching.

And this punching will be done at a punching station, and the fruits will be collected later.

But all these things we had a problem of tangling of the fruits. So then when the original product was developed, so we had an amla de-seeding machine, wherein which the amla was used to be fed one after the other.

What we have learnt

- So after several iterations in the final design, gravity assisted guideways was developed.
- The punch into the amla is performed earlier by hand. But then they figured out that doing by hand. Because while looking at the hand tool, and looking at the process now, the idea goes only using the hand and de-seeding it one after the other after the other. So but when we start looking at why don't we use leg, because leg has more strength and it does not bring in lot of fatigue so soon, like you do it in hand. So they always looked for foot.
- So in the final design, hand design is changed into a foot design, wherein which there is reduced effort. So the punching mechanism earlier was driven by hand is now driven.
- So in design thinking, the first solution may never end up to be a final product.

So this is a lesson which you have to learn, that design is a process. Design is a user-centric process. It envisages a thinking process in developing a product. Okay so for doing the thinking of, we should have a structured way of thinking. So that is where the design thinking tool comes into existence. And you should also know the solution what we started, and the final solution, there will be a drastic change. At the end of the second lecture we saw a clear example, how design process is used in developing the product. What we thought as a first step, after several iterations, there was a big shift. From hand tool we went towards foot. From hopper concept we went towards gravity assisted concept.

So with this lecture, I am sure you will be able to understand what is design process. And how does a design process get implemented in an agricultural product.

Thank You.

Download

PDF: What is Design Part 2

1 – 3 Introduction to Design Thinking – What is Design Thinking

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Transcript

What is Design Thinking?

Welcome to the next lecture focused on design thinking. As I told you design thinking is a very powerful tool.

- Design thinking is a non-linear, iterative process. Non-linear means it need not undergo step by step by step progressive movement to go towards a solution. You can do the 1st step, you can do the 3rd step, you can do the 10th step, and you can go to the solution. That's why it is called as non-linear. If you want to mathematically represent. This is linear and non-linear is something like this. So up to a certain point there is an understanding you require. And then afterwards you see a huge generation of ideas. Let's put it as ideas versus time. So you see a huge generation of ideas happen after a certain period of time.

So that is why this is called as non-linear. So non-linear, iterative process which seeks to understand users. I told you repeatedly in the beginning; human centric. So that's what I said, understand the user. Challenge assumptions. Many a time we just go by; okay if there is an assumption made, we will continue the same.

For example all the tyres which are there, available in the market are black in color. Why so? Can't you have a red color? Can't you have a green color? It is possible. When you see a child's cycle tyre, it is all green in color, yellow in color. Can't they make same color for the trucks. It is possible. But there is no functional use. So people did not challenge that. But like this lot of assumptions are made in reality and those assumptions, you should challenge it. And then redefine the problem. The example I said. See initially our start for amla de seeding machine is only to reduce the drudgery. What he was existingly using. He was using a hand tool.

So we tried to automate the handtool. But when we went back to our problem definition, and we said our problem definition should have been drudgery reduction. If he does it by hand or leg does not matter. So when we kept our redefining of the problem to that. So then we moved out of hand and came up with a better solution, using our leg for de-seeding. So it is redefining the problem can happen, and create innovative solutions to prototypes and test. So this entire thing is called as design thinking.

- There are 5 steps that are involved in design thinking. The first is empathize. We will see in detail, what is empathy study, just for the small understanding, what empathize means. You wear the shoes of the customer, undergo the same problem what they undergo or feel the same problem, so then you will try to understand what amount of impact it creates. So that is why the first step of design thinking is empathize. After you empathize you define the problem statement. What is the existing problem, and how are you going to solve the problem. So you define the problem.

For that define the problem, you try to develop several ideas. So the third phase in design thinking process is going to be, ideate. After you ideate you try to choose the best solution and start developing prototypes. This is the fourth stage. After you develop prototypes, you finally test. Each prototype whether it is matching to the requirement of the customer. And once you do this, does it mean you have reached the solution. No, what you have done is at the end of the first iteration you would have realized that, my problem definition was not correct, now I will redefine my problem; and then undergo the cycle.

So that is why I said design is an iterative process. So all these things are done for ill-defined and unknown problems. So the world has become increasingly interconnected and complex. And design thinking offers a means to hold on with all this change in a more human-centric manner. That is the powerfulness of this design thinking tool. So in design thinking process, this is how you will have a brain working. So in a brain you have several levels of thinking.

- First phase is analytical thinking.
- You will have one another thinking called as intuitive thinking
- A sandwich between or an in between solution, between analytical thinking and intuitive thinking is design thinking.

In analytical thinking you will have deductive reasoning and inductive logical reasoning. These things will be part of analytical thinking. Reduce, deduce, deductive. This word comes from there. Intuitivist have a gut feel towards the solution. So design thinking is a merger of the two, which is nothing but an abductive logic. Design thinking means use of both the extremes in an optimal manner. The intuitive thinking helps in invention for the future, whereas analytical thinking is to create something creative in the present, which is replicable. See in design thinking we also try to develop a product, which is repeatable.

Okay, the **abductive logic** is used in

- Business
- Information Technology.
- Education.
- Healthcare

All these problems are solved by using this abductive logic, which is nothing but a part of design thinking.

Design Thinking: Why?

- It tries to find out simplicity in complexity.
- It tries to produce a product which is appealing to the customer. That is why we use design thinking.
- It goes around with user experience.
- It tries to bring in innovative solutions.

Innovative solutions are solutions wherein which the idea is saleable, or the idea finds a customer wherein which he is ready to buy the product. That is innovation. Innovation need not only be new. It can be an evolution of several ideas when you develop a product. So it is innovation and it is also tries to be used for user needs

So simplicity in complexity, product appeal to customers, user experience, innovation and user needs; all these things pushed towards design thinking.

Analysis and Synthesis

How do we do the design thinking approach? We do two things. One is we try to analyze and we try to synthesize.

- In the process of analyzing, what we do is we try to break down a single big entity into multiple parts called as analysis. A big problem is taken. It will be split into several small problems, and we will try to analyze for solutions.

- This breaking down into smaller fragments helps improve our understanding.
- The process of combining the parts into a combined entity is called as synthesis.

So analysis and synthesis. Analysis, taking a big problem and breaking into several small steps. And then understanding each step to improve your understanding. Then what you do is, once we have understood, now we try to recombine several of these broken pieces. Process of combining the fragmented part, into a combined entity is called as synthesis.

- This activity is done at the end of an enquiry or need.
- The process leads to creation of complete bigger entities which is sometimes new and fresh.

Design Thinking: How?

Divergent Thinking.

We were talking about how there is something called divergent thinking. In divergent thinking, any idea which comes to your mind. Keep recording those ideas and keep displaying those ideas at some place. Anything that comes to your mind about the problem statement, should be put whether it is relevant or irrelevant. What are we trying to do? We are trying to diverge. Our thinking process expand. Our thinking process try to develop multiple solutions. In divergent thinking, you will have unbounded ideas, unexpected connections, non-linear thinking and different ideas. So all these things will be outcome of divergent thinking.

No idea is good or stupid. Please try to take all the ideas. Please record all these ideas. You are now diverging in developing ideas.

- The process of diverging more than one solution for a problem

statement is called as divergent thinking.

- It refers to the process of generating various creative solutions. Please underline, it refers to the process of generating various creative solutions.

Convergent Thinking.

- In convergent thinking the design thinker, is required to go through all possible solutions through during divergent thinking, and come out with a correct solution. That is convergent.
- Convergent thinking requires speed, accuracy, efficiency, logical reasoning and technique. So in divergence you try to create as many choices as possible. In convergence you try to make choices, among the developed choice, or the created choice to go towards solution is called as convergent thinking.

Design Thinking : Principles

The principles of design thinking is, it has human rules. It has tangible rules. It has ambiguity rules. It has re designing rules. In human rules, all kinds of design activities are finally social in nature. That is human thinking is also part of design thinking. Tangible rule is communication between design thinkers. Facilitates by making ideas tangible. So this is also part of design thinking. Re-designing rule. All designs are basically examples of re-designing that means to say improvising. And the ambiguity rule. In the process of design thinking all design thinkers should preserve ambiguity. Ambiguity rule is very very important.

Design Thinking Model

So in a design thinking model, you will have empathy states, you will have design states. First stage. Second stage, ideation third stage, prototyping fourth stage and testing fifth stage.

So in empathize develop a deeper understanding of the challenge. This is why we kept saying usercentric, human-centric. Defining, creating, clearly articulating the problem you want to solve. So the

example we will go. So where our clear definition was to reduce the drudgery of the person. So now you have clearly articulated the problem.

Next is ideation. Do brainstorming and develop several potential solutions. This is nothing but divergent thinking, and convergent thinking then follows. Convergent follows after this. And now with those ideas we try to make prototypes. To design a prototype. To design all or part of a solution, we do a prototyping, and then whatever prototype we did; we have to validate it and look for solutions

Enhance in continuous short cycle process. So to conclude. Design team uses design thinking to tackle ill defined or unknown problems. Because the process reframes these problems in humancentric way and allows designer to focus on what's most important for the user. Design thinking offers us a means of think outside the box. Because we are allowing to generate all sorts of solutions. Think outside the box and also dig that bit deeper into problem solving.

It helps designers carry out the right kind of research. Create prototypes and test out products and services to uncover new ways to meet user needs. The design thinking process has become increasingly popular over the past few decades, because it was key to the success of many high profile global organizations.

Design thinking improves the world around us everyday. Since it is a human-centric solution. Every time the customer changes, we will have to look at him from the empathy study and start developing solutions. So that is why it is written as 'design thinking improves the world around us everyday'.

And in design there is nothing called as a unique solution. Once you have developed a best solution or a product, then after some point of time you reiterate and then improve the product for the same customer. For example you take the mobile phone industry. It has been going a rampant change and every time the same customer tries to improve his product.

So that is what we talk about here. Design thinking improves the

world around us every day, because of its ability to generate ground breaking solutions. Why is that ground breaking solutions? Because we are allowing you to develop several solutions. Divergent, so that means to say all possible solutions you are looking forward. And as I told you there is nothing called a good idea or a bad idea. So that is why you are able to develop ground breaking solutions in a disruptive and innovative way. Innovation means you are having a new idea, and then for that idea you have a customer. There is a difference between innovation and invention.

I would request you guys to look into the difference between innovation and invention.

Design thinking is more than just a process. It opens up an entirely a new way to think. And offer a collection of hands on methods, to help you apply this new mindset towards a solution.

The ultimate goal is to derive an as deep an understanding of the product and it's user as possible.

Conclusion:

So in this lecture we were talking about design thinking. The stages of design thinking. Convergent thinking, divergent thinking, and developing the prototypes and testing the prototypes. So using the design thinking tool, there is always a possibility for improvement and developing an innovative product.

Thank You.

Download

PDF: What is Design Thinking?

1 – 4 Introduction to Design Thinking – Design Thinking Needs and Outcomes

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Transcript

Welcome back, the next lecture for today's discussion is going to be on "Design Thinking Needs and Outcomes". Last two lectures I have been emphasizing the need for using a powerful tool to have a non linear thinking to get to an output. So, today we will see Design Thinking Needs and what are the Outcomes? How has it impacted the society and the individual to a sky height? So, Design Thinking is becoming part of organization both big and small who are focusing towards efficient product of service development. So, here the Design Thinking tool is now used both for a small player as well as a big player. For an individual, for a small society for a MSME and for a very large company. MSME means small and medium enterprise, small industries who are trying to make job orders, who are trying to make very small batch product outputs. So, they also use Design Thinking in a big way. So, some of the reasons why we need to use the Design Thinking are:

Design Thinking solves problem. It can be a kitchen problem, It can be a garden problem, It can be a societal problem, It can be a water problem, It can be even large service providing problem.

Design Thinking reinforces innovations. Since it is human centric we are always going around doing empathy study for a human being or for a society and develop solutions for it. So, when you develop a solution who is going to buy that solution is the customer. So once an idea is bought by a customer then it becomes an innovative solution. And, here time is also a bound. So, that it means to say you have to deliver output within a stipulated time. Then Design Thinking strengthens leadership, so by using design thinking if you start using Design Thinking you will try to produce good products and you will even try to have a leadership quality. Design Thinking is not only for designers but for other users and common man.

Now, let us see some of the examples where they have used Design Thinking in agriculture based work. So, here Design Thinking solves problem. So, here is a design thinker who has created highly efficient solutions by developing products and services in a way that analytical thinker cannot make. What is Analytical thinking? 2+2=4 is analytical thinking, a Deltax step development is analytical thinking, a completely out of the box thinking is Design Thinking.

So, here a **Power Reaper** for Rice and Wheat cutting machine was developed by HOPE India. Earlier, they used to do it manual and they used to have a human labour intensive and they were not able to that efficiency. And if you look for higher end machines if you buy, higher end machines they will just finish the entire job of one acre of land in no time. The capital it is highly intensive so the man becomes out of job. So, here in Design Thinking approach we are not only looking just at technology but a human based technology where in which we try to protect the human labour also and give them a benefit of it. The Design Thinking reinforces innovation here by creating new solutions, testing their efficiency and iterating until they are optimized, design thinkers create new opportunities to give their company a competitive advantage on the market. So, if you see here initially they develop this “Drum Seeder”. This Drum Seeder is used for sowing seeds at regular intervals so, this is called the pitch so the distance between one column and the other column, and the other thing is in rows also you have to uniformly

maintain distances. So, this was a drum seeder machine which was developed where in which the human luxury was reduced, the productivity was enhanced, and you see here, here they made a small handle and they were trying to pull and if you see look at it very closely you will see here the tyres are schrader if have a smooth tyre it will get merged inside the marshy land. In order to remove the concept of tyre was trying to copy here and they have made threads. These are not threads these are all studs which are all placed at regular intervals so that it can help in ease for removing from the marshy land. A small bit significant innovation like drum seeder would have happen if the design thinker would not keep pushing towards innovation. So this could happen only because he was trying to go around the human centric problem faced and the productivity has to be enhanced. Design Thinking strengthens the leadership. Design Thinking assures that the solution to the organization diverse problems are based on data generated by clients and not by uninformed design team. So here if you see here is a personality so, he has done lot of frugal innovation in agriculture by using Design Thinking approach and establish a several successes. He was in a state where bananas were never grown, today bananas are grown all across the state and it has become a staple food for people around and this is one of the cash crop for that particular state. So, he has done such a fabulous job, he has been appreciated by the country's president by giving this award. So, Design Thinking leads to also leadership. So the Design Thinking outcomes, I will show you some of the examples: the women used to carry water in the desert area for a very long distance they used to try to take this water. There was always a limitation in the water they can carry and what they carry is to be optimally used for cooking as well as their regular requirements for their complete family. They always used to have water scarcity and they used to have water bound diseases because of scarce of water so the disease which are related to that they use to get into. So, this problem by using Design Thinking approach was solved by converting this pot into a drum and this drum is held in a handle and then woman is

trying to pull through easily without much of effort. The amount of water quantity could be increased and this could be pulled. So here the thought process came to this from two places: (i) at similar time in Africa they have developed a similar machine (ii) while watching cricket they used to have these type of rollers to clean. So it was similarly, the idea was taken from cricket match as where in which the ground or the pitch be always be rolled with a heavy mass to make the pitch flattened. So, the idea of taking this roller, water inside the roller was taken from this and this is the Design Thinking outcome. The idea was seen in some other place, a person went around looking into the problem statement and then they have solved it. The other example is Design Thinking approach outcome is replacing a hand sickle with a hand held cutter. Using this hand held sickle, the hand is very flexible. So, it can hold, it orient itself towards cutting. So, now this operation is replaced by a machine where in which the flexibility is given to the hand and still you can do a large cutting by using a blade here. So this blade is again a flexible blade. So it is a wire which can rotate at a very high RPM and now the productivity of the process is improved. And this is again using Design Thinking approach. They have not illuminated a human, they still have a human, they have an improvement in productivity and it is also safe from lot of skin diseases. This is a Design Thinking outcome which has happened in an agricultural area.

The next one is when we are trying to feed a very harmful fertilizers. When the fertilizers are spread or spreading of the fertilizers by the hand, when they do it so here (i) it is random in nature, it is not uniform and it is hazardous to health. So these were the problems faced by a person when he tries to spread fertilizers by hand. So this operation again by using Design Thinking approach was converted into a tank where in which the fertilizer was diluted and then it is now spread or the insect. This is used for disinfecting the farm. So, here again what they have done is they have diluted it, put it inside a container, it has a hand held pump and it can spread uniformly as small atomized particle so that they have a better

efficient as compared to this. So, here there will be lot of wastage and residue of the fertilizer gets into the soil or which is very difficult to re circulate or remove this fertilizers. So by using this process they are able to reduce the impact of this fertilizers getting spread into the soil and exactly hit at the plants. So, this is again a Design Thinking approach which is been used and agricultural implements have been developed.

The next one is lack of proper drinking water. See today, there is a big challenge for water and they project that the mixed war across the globe only for water. So drinking water is now becoming a major problem. There is a proverb which they say all around water is there but no water to drink. So that is what is today's status. We have lot of oceans but these oceans water are not drinkable water. So, drinking water becomes a major challenge and here now lot of people get water bound diseases, so because of these diseases we have lot of people who die and who are affected very badly. So, in order to convert this water into drinkable water there are several solutions. You can use a UV cure filter, you can use a filter which is like rivers osmosis basis. But all those are not energy efficient and a sustainable process. So, here you can see people have done design thinking approach. They have developed filters, these filters are just like a pipe so, you can suck through the water and whatever water comes out of the output is drinkable. So, in this they have planned in such a way the filter will have a restriction for using it for one year and it is also used for somewhere around about 200 to 500 liters of water. So, annually you will have to throw this pipe and buy one more fresh pipe. It is in affordable price and again this is a design thinking outcome which has come where in which the dirty water is converted into drinkable water and that is outcome of design thinking.

The last one is converting muddy water in a slum area into a drinkable water. So in which they have used the concept of bio filter. And these biofilters are sustainable solutions and these are sustainable solutions and they does not use any power, it is a passive solution so the dirty water is placed and it is passed through a

biofilter. The output of this biofilter again is here it gives you a drinkable water. So all these things are design thinking outcomes which are demonstrator.

So, with this we will try to conclude the design thinking outcome. So till now what we have covered is – What is design thinking? How it can be used in agricultural implements? What are the different stages of design thinking? And few successful examples using design thinking.

Thank You!

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PDF: Design Thinking Needs and Outcomes

1 – 5 Introduction to Design Thinking – Introduction to Manufacturing

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Transcript

Welcome back, till now we saw very brief about design thinking, different stages about design thinking, now we will go to next important step in this design thinking process is Manufacturing. I have a wonderful idea, I wanted to convert this wonderful idea into a product or a prototype idea. So this prototype making comes part of manufacturing. So in this lecture we will try to see what are all the different steps in manufacturing and what are all the important things in manufacturing and how do you manufacture one product which we our self went through keeping an agricultural application.

So when we talk about design for manufacturing, so manufacturing involves first is Material, then we have to Process this Material to get an Output or, I can say the processed material is the output. So you start with a material, again here materials there are several materials available today you have metals, polymer and ceramics. Of course, today you have several hybrid materials like composix which are into existence, but the basic materials are metals, polymer and ceramics. To a large extent today polymer

materials are very much used. So polymer again they are classified into three – one is Thermoset Polymer (TP), Thermoplast Polymer (TP) and Elastomer. So, these are the three classifications. Today, we are looking at thermoplastics for making even prototypes and final products in thermoplastics because it is recyclable and then second thing it is light. Earlier, we used to have steel pipes today we get all these PVC pipes and today we have flexible pipes. So if you see all across the agricultural fields we see thermoplastic cubes which are flexible in nature. So, these are all some of the advancements happening in materials and these materials by choosing a proper process it will try to generate the required output. So, there are three important things one is Materials, next one is Processing and then you try to get the output. In Manufacturing again two things are there – single part can be a product, single part, product and then it can be several parts or several parts as products. So here you need to have assembly, here it is one shot. Whatever you try to produce a part it becomes a final product. So let us understand little bit of manufacturing. Manufacturing is derived from a Latin word called as manufactus, where manus means **hand** and factus means **made**. I repeat, Manufacturing is derived from the Latin word manufactus, where manus means **hand** and factus means **made**. So, earlier whatever is made by hand was called as Manufacturing. Of course today the same terminology is used. Technology has come into existence. Today machines are also falling under this category. The practical definition of manufacturing is – a process of converting or processing raw materials into usable product where productivity is maintained. So a process of converting or processing raw material into a usable product. So you can use the raw material and that raw material if you convert it into a usable product and we would try to optimize the usage that's why I have written this "where productivity is maintained". So productivity means using lesser input to get maximum output. Items used in manufacturing can be raw materials or processed part components of a large product. The manufacturing usually happens on a large scale production line with machinery and skilled labours.

If you look at **Manufacturing Cycle** – starts research and analysis first stage so, you do a market survey or you do understand what are all the process available from looking into the literature available, state of the art then visiting some factories. You do research and then analysis from that you try to develop **Design and Development** this is stage 2 from the design so here when I talk about design, design here we talk about is **Engineering Design**. **Engineering Design** – means where in which we talk about **dimensions**, **tolerance** and then we also look for **Materials**. So, that's why do design and development here and then comes production. So from the design and development now what we do is we get into a **Production** phase where in which here we try to talk more in manufacturing, but the entire process **Manufacturing Cycle** consists of **Research**, **Design** and **Development** , **Production** and from there we do **Marketing**, marketing to **Distribution**, distribution again the cycle keeps repeating. So marketing and distribution. So the **Manufacturing Cycle** will have 5 stages – **Research Analysis**, **Design Development, Manufacturing** or **Production**, **Marketing** and then **Distribution**. These are all part of manufacturing today. Please don't think manufacturing is only producing. Gone those days you are only trying to produce and keep it in your stock. Today, after producing it, how do you sell it and how do you distribute it. All these things come into existence. And when you are talking about sustainable manufacturing today from the distribution how do you collect the recycle and then how do you process once again into your cycle. So Research and Analysis – research and analyze your product need as well as other products that are already in the market. So that's what I said state of the art, looking into literature available, looking into other companies what are they that is research analysis.

The next step is **design and development**: making different models or prototypes that will satisfy the function and developing the model/prototype the future. **Production:** The process for making the product on a large scale or atleast economically feasible scale. **Marketing:** Marketing strategy and product marketing

techniques for selling is marketing and **Distribution:** is includes delivery methods from production to market. So, there are different types of manufacturing **– Make-to-Stock** (MTS): means factory produces goods to stock, stores and showrooms. For example all screws, nuts, or fasteners soap and then other fast moving consumable goods (FMCG). They all fall under the category of Make-to-stock. Why is this important because looking into which type of manufacturing you fall you try to decide what is your capital investment you have to do. By predicting the market for their goods, the manufacturer will plan production activities in advance. Hoping that there will be a customer you try to buy and stock and keep that is what is make to stock. If your product falls in this category you have to be careful you have to produce it in advance and keep it. So, if they produce too much they may need to sell surplus at loss and in producing too little they might miss the market and not sell enough to cover costs. So there has to be a trade of between producing more and producing less. You will have to find out an optimum and then start producing whatever you want. So, the category under this is called as Make to stock.

The next one is called as **Make-To-Order (MTO).** The producer/ factory waits for order before manufacturing stock. So moment you receive the order, you have every design in place, you will start now manufacturing after you get an order. In the previous case no, it was not like that. You produce it and keep it people will use it. Inventory is easier to control and owner does not need to rely as much on market demand. Customer waiting time is longer and the manufacturing need and constant stream of orders to keep the factory in production. So these are some of the difficulties which you will face but you have to be clear. If you take your product and if it falls under **Make-To-Order** category so, you will try to keep all the design ready wait for the customer order to come or purchase order to be released.

Make-To-Assembly – The factory produces component parts in anticipating of orders for assembly. By doing this, the manufacturer is ready to fulfill customer orders but if order does not materialize,

the producer will have a stock of unwanted parts. For example when you go to the food chain industry they almost follow **Make-To-Assembly.** They will have all the raw materials which is ready for the final product in the ready state so soon as there is a customer order they will try to do all the processing and try to get the required output.

So examples in manufacturing: We will now take a live example what we worked on. This is an example of manufacturing an Amla pricking machine which we saw a deseeding machine now we will saw a pricking machine which was developed in IIT Kanpur. The key points of this machine are – it is low cost, easy to operate, long life and increasing per person productivity. Productivity means as I told you minimum input maximum output. So that does not mean that you will try to produce with zero input produce 100. Whatever you are taking raw material for making 100 you will try to use it very optimally without loss or reducing the utilization of man, machine and material but still producing the output. So that is called as productivity. Today, if you talk in any industry they always talk in terms of Productivity. Following are the images of manufacturing involved in making this machine. So the concept of Amla pricking, amla is I told you last time itself so, it has a hard seed and it is almost spherical fruit where in which this portion is the flesh and this portion is the nut. So last time we were discussing about how do we deseed the nut. Nut of the seed, how do we deseed was discussed last time now what we are trying to do is we are trying to do a piercing operation. That is called as pricking. Piercing operation in this so that you can have diffusion of solutions. This is pricking why for diffusing solutions inside amla. For that we are trying to develop a machine. Again here if you do it by hand it is going to take lot of time so last time itself we thought if we could use leg it is going to be more efficient. So here then pricking one at a time is going to be a time costly so if we could do multiple things together then it becomes easy. So, following are the images of the manufacturing involved in making a machine. So, we started working on developing prototypes. So in this prototype first what we saw is here you can

see people are working around the machine so this is the frame of the machine. So, frame is nothing but the skeleton of the machine. So, here people have put all the other parts inside the machine and they are trying to do assembly, for assembly we were trying to do wielding technique. We were first joining it then we were grinding it wherever there were unnecessary projections we were trying to grind it and remove it. So here we were trying use in square tube tresses we were trying to make and now after this you see that this is a skeleton and now the amla whatever hop from the hopper feed impressions we are trying to make and here in which you can see lot of needles are been assembled in a dice. So what we did was we manufactured two dice were in these dice you will have needles, these needles will move back and forth. And in between you will try to feed it with amla. So, now whatever they did it with hand now, you can do it with leg and this up and down movement is attached to your pedal and then that reciprocates and now the amla can be pushed. At given point of time this is flat, here it is 2D, so you can see it is 3D so several of these amlas can be fed in at any given point of time. So, through this what we have done is we have used all the manufacturing processes for developing a prototype. So then we finally develop the product you can see whatever I was talking about the needle is here. So we just painted it and then converted it into a working model for amla pricking. So, in this lecture what we were more focused is towards manufacturing. When we talk about **manufacturing there are two stages,** one is **primary manufacturing and secondary manufacturing.** In primary manufacturing you will have costing processes, metal farming processes. In secondary manufacturing predominantly it will be subtract two processes and assembly processes. So subtract two process is to give a shape to it and the finally we assemble several of this small parts together to form a large part there we do assembly. So this is the basic technique, so using this technique you can make a final product or you can make prototypes where in which the fabricated prototypes can be given for market testing and validation, comeback, realitrate and then develop a final product.

So here in which we at every stage we have used this Design Thinking Approach – what should be the ergonomics, how should we place the pedal, where should at what angle should be the needle inclined, what will be the rolling velocity of amla and how what is the shape of it, how do you feed one at a time. So all these things were design thinking approach was done and finally we came out with a brilliant solution which is today used in several of the food processing industries.

Thank You!

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PDF: Introduction to Design Manufacturing

2 – 1 Characteristics of a product – Functions of Agricultural Implements

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Transcript

Brief Introduction:

Welcome to the Week 2 of the course on Design Thinking for Agriculture Implements. In week 1 we have introduced, What is design?What is design thinking?. This is explained with a few examples. Then introduction to manufacturing is given. Need and outcomes of design thinking, that has been discussed. In this week I will discuss about Product Characteristics.

Product Characteristics:

When I say product characteristics. The product characteristics could be thought of as specifications, dimensions or attributes. I am not talking about that. I would be talking about the design viewpoint, and in this I will discuss. When we design a product.

What we think of. What are the primary use or the primary function of the product? What are the other functions? Do we need to consider the cost of a product? Do we need to employ some aesthetics into it? Do we need to consider the maintenance aspects in that? These things we will discuss.

A product in general as Philip Kotler said. Product can be anything that can be offered to someone to satisfy his need or want. That is a general definition. Product can be a consumer product. When I say product, that can be a consumer product or an industrial product. This is a product. Now consumer products are the consumer goods that we choose like the grocery, that we have in our home. And the durables like refrigerator and electronics or electrical equipment.

When we talk about the industrial product. Industrial product is or can be a machinery or an equipment. It can be raw material. It can be services. It can be electricity and fuel. When we are talking about the product characteristics in this lecture, I will be specifically talking about the machinery and equipment. However to explain a few concepts here, I might take certain examples here from the daily use products; that we have been using, or we are using. Now what product characteristics would be discussed in this lecture. These are listed here. The major product characteristics are,

- Purposeful or performance aspects. When I say purposeful. What is the need for which the product is designed. Like consider this stylus. This stylus, the basic function is to provide marks on a tab. Now what is the need of this color. What is the need of this port here. What is the need of this cone here. These things are all designed based on certain design parameters. Those would come in operational or aesthetic aspects. The basic purpose is to provide marks. The basic purpose of different machines that we will discuss, different machines and handtools; that I will just discuss when I will explain this purposeful and performance aspects.
- Next is operational aspects. I have developed an equipment. I have developed or designed the machine that could reduce the

effort. But how to operate that machine. Could we operate that machine by just pushing a button? We will need some source of energy. Or could we operate it by using hand. Or could it be foot operated. What are the operational aspects? When we design the product. This we will discuss.

- Then we will discuss the aesthetics. Aesthetics is giving appearance or some appealing effect to our product. Can a product be sold without aesthetics? There is certain range or certain priorities when we talk about aesthetics, with respect to different kind of products. Like in case of jewellery; in case of clothing. Jewellery is just sold because of aesthetics, because that is the basic purpose of that. In case of nails and screws do we need aesthetics. The appearance in case of nails and screws is not at all important, is not at all required. This we will discuss.
- Then price to customer. How do we cost the product. Cost the product, I mean how does the costing of the product happen. When we will develop an equipment for the agriculture, we have to design, we have to see what are the various components of the cost. Fixed cost, variable cost, material cost, labor cost, what will be the operational cost. All those factors have to be considered.
- Then next is ease of maintenance. I have developed an implement. But I should also be able to maintain and repair it in a periodical manner. And sometimes corrective maintenance also has to happen.

So all these aspects have to be considered when we design a product. So these product characteristics I will discuss.

Purposeful Aspects:

From purposeful, here we mean the elemental. Or I could say basic or fundamental.

- What is the product design for? So after determining the marketing possibilities, the functional scope has to be carefully analyzed and properly exemplified.
- The fundamental reason for product demand is implied by the functional or operational aspects. This is also called as functional aspect. I will discuss this while taking a few examples.

There are often multiple functional aspects or purposeful aspects, and the uses of the product can be left to the customer's choice. The period to exploit these characteristics can be decided by the customer. These are a few hand tools. So just to discuss the purposeful aspects.

- What is the basic purpose of a pitchfork? This is a pitchfork. The basic purpose of this is. This has long handle. We can lift and throw loose material such as hay, straw, leaves.
- This is a trowel. The basic purpose is digging in a very small area. To dig in a very large area, in place of trowel we use a spade.
- This is a shear. Just to trim a few prunings.
- This is a watering can. The basic purpose of the watering can is to water the plants or to provide some humidity in those case, or some spraying of pesticides, also has to happen when mixed with water. That also can happen with these hand tools.

So there are certain hand tools which have some basic purposes. But if you see this pitchfork has a handle and this handle has a shade. This has a shape like this. You see this curvature here. Okay, you see this is a handle. What are the dimensions of this handle? This has certain functions in it. If I say purposeful or functional aspect. The function can be of two major types, when we talk about a product. One is use function, one is sell function. Use function is the primary function for which it is designed. Sell function is that makes it to sell. This green color, this is a sell function. This curvature. This is a use

function. This will come in ergonomics, that will come in operational aspects.

So the point I am trying to make in this slide is that. When we talk about the purposeful aspects, all these rake, then pitchfork, spade. They can come with a single attachment. This is a handle. This all can be attached here. So we can also have a multi-function product. Like in the case of Combine. When we say combine, it is a harvester that helps to trim or shear the crop. It has a thresher attached with it. Thresher makes the crops to reach or package finally. That is then sent to the factories for the post processing.

Another thing, an example I can take here. These are the different parts of a tractor. Tractor is the most common power tool that is used in agriculture. The tractor is the name given to this equipment because it has high tractive effort or torque set at slow speeds for the purposes of hauling trailer or machinery used in agriculture. This is very useful. So in these different components or different parts of the tractor, if you say the cab. It also has a function. So what I would like to say here is that in an equipment each of the component or sub-assembly has its own function. Like these mirrors, they provide protection. Protection from wind. Then rims and wheels, they provide rolling. Then PTO shaft, it provides transmission. Each of the component should or does have a function. If it doesn't have a function, then it can be eliminated. This can come when we talk about the cost cutting in products. So this is the purposeful or the functional aspect of the product design or the product aesthetics. I will discuss in lecture 2 of this week, the operational and other aspects.

Thank You.

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PDF: Functions of Agricultural Implements

2-2 Characteristics of a product – Operational Characteristics

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Transcript

Welcome to the Lecture 2 of Week 2. We have discussed the purposeful or the functional aspects in the first lecture. In this lecture I will discuss about the operational aspects. What are the operational aspects, I have given you an introduction in the first lecture. Operational aspects implies the ease to use or the easiness to operate the product. I have the taken the word 'ergonomics' here. When we talk about operational aspects the word 'ergonomics comes into play.

So what is ergonomics. Ergo means human and nomos means rules. So the rules concerning human comfort is known as ergonomics. So when I say the dimension of the pencil. This is around 8 to 10 mm. because the sensitivity that fingers could have, do very sensitive or very accurate work. Hands on and very accurate control. For a lesser accuracy we can this; palm control. If you need to write on a whiteboard, a broader pen is used that is around 25 mm in diameter. This is around 10 mm diameter. So these are the ergonomical designs. Height of the chair that you sit on. The desk

that I am standing on. That all are design. When we design the vehicles, the tractor, the control, where would the steering, all the things. I will just have a brief discussion about those aspects in this lecture.

Easy to use, easy to handle is the rule in ergonomics. So in ergonomics subjected to varying degrees of skilled or potential operators, and adaptable to various operational conditions, the product should be designed. The problem of designer becomes all more critical here, because the trend is rising of increased versatility because of characteristics, those employees using the basic attachments as elements for building combinations, that is suitable for special purposes. For instance they have installed a foot operated pedal here. So this is the design that is made. A foot operated pedal for threshing of the crops here. So this is the rice that is being threshed here. A foot operated pedal is doing this work.

Certain rules of Ergonomics. In ergonomics the controls that we use should be within our range, within our reach. When I say controls, controls mean physical controls. When I say controls, these are the controls. Button. This is a button. This is a pedal. This is a switch. This is also known as toggle switch. These are known as controls. These are also given; knob, crank, wheel, lever, pedal. These three are rotary controls. Lever and pedal are linear controls. If we need to control something using the fingers as I said, the accuracy would be higher. So in case of knob that is operated by hand I will put A for accuracy, S for speed, and F for force.

So in this case the force required to operate this machine manually without any external source of energy or electricity. That was higher. So that is why foot pedal was suggested. So in this case a foot pedal the force is higher. So this means high. This low arrow means low. In case of button we have high speed, speed is too high. In case of pedal, the force is high. High force can be employed here, but the accuracy is lower. In case of switches both speed and accuracy are higher. Right in case of knob, accuracy is higher, speed is higher but the force is lower. So what happens when we employ

more force, we use wheel. In the case of wheel the force is higher. And the speed is higher but lower than what we have in knob.

So these are different kinds of control, like in crank, wheel; different kinds of control is used, crank and wheel. Prof Ram Kumar showed in one of the implements, gave a use case analysis in the previous lecture. For different kinds of controls are there. Other than this considerations like the normal and the maximum working area. The normal working area. In that we have the controls, those which are to be used very frequently. Like you consider the driving of the tractor. Steering wheel you have to use all the time and the horn button is there just close to your thumb. That has to be used frequently multiple times. The speed has to be higher in that case. In case of gear; gear could be kept at a reachable distance. That is known as maximum working area. Kept at a reachable distance, but you just change the gear after a certain time. The frequency is not that high there.

So in that case, suppose if here is the operator. I am taking the top view. This is the normal working area. This is the maximum working area. Then this is the total arm length. This is around 0.8 x arm length. Normal working area, like this is my normal working area, when I am moving my hand like this. This is my normal working area. This is maximum working area. So anything that has to be used for a maximum frequency or high frequency, that could be put in normal working area. We just have to do it multiple times. And those things that are to be used rarely could be put in a reachable but maximum working area.

And other things that you have to very rarely use. Once in a while. Those can be, you can take one step forward, and just pick and bring that thing close to you. So in this way, the workplace is designed and the equipment also is designed using the same phenomena. You see a few ergonomic designs regarding the shape. These are the incorrect ones, these are the correct ones. You see this is handsaw. Hacksaw we call it. Hacksaw or handhacksaw. This is our plier, and this is hammer. So better ergonomical design for the hands would be this. In place of holding it straight or horizontal exactly, this is

a better design. In case of plier this is a better design. In case of hammer this is a better design.

Why is this so? Because the human body would like to come into its natural state. Everything likes to come into equilibrium. So anything we need to pull, we design it in a way that. From left hand side we pull it to the right hand side. High force has to be applied from the right hand side. So the things likes to come to its equilibrium state. That is why also for transporting the material like in case of thresher, we use gravity. The crops or the grains fall, while making the use of gravity into the bins or the bags we collect them.

So these are the rules of ergonomics which we employ. The certain rules suggested by ILO. ILO that is International Labor Organization. We will provide you link to this and you can read regarding the rules of designing the workplace layout or used for the designing the equipment or various kinds of controls that are use. This you can read if you like, to have more information on operational aspects.

Thank You.

Download

PDF: Operational Characteristics

2-3 Characteristics of a product – Aesthetic Characteristics

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Transcript

Brief Introduction

Welcome to the Lecture 3 of Week 2. In the first two lectures I have discussed about the product characteristics, namely the purposeful or functional characteristics and the operational characteristics. In this week I will discuss the aesthetic aspect in product design. What is aesthetics? Aesthetics is the appearance of the product. The outer look of the product. So the first impression is the last impression as is generally said. So this is sometimes true for the product as well. So the products or the implements that we design should be appealing to the people who are buying them. The farmers sometimes like to opt for different colors of the paints to be put on the implements that they are buying. For instance they would like to buy a reaper that is green in color. Someone would like to buy a harrow that is painted red in color. So different variants of products are also available.

So what is aesthetics?

- The moulding of the final shape around the basic skeleton is the main concern of the aesthetic aspect. Now this basic skeleton is known as the junctional shape. If you recall I have mentioned two major functions of a product. Work functions and sell functions. When all the work functions are there. Product is able to perform all the functions for which it is basically designed. But the sell functions we haven't induced much. That is a junctional shape. That all links, all components, all the unit are working proper. But the outer covering is not yet ready to be sold. So sell functions here would be, painting it, covering it using a housing, doing some coating maybe chrome-plating, so as appearance also comes well. So that would add value to the product. I will come with an example for this as well.
- So there has been an increasing portrayal of aesthetics in design, and it has been convinced by study of gradual reversal in shape of these objects in the past.
- The one who believe in functional shape argue that it is logical for compatibility of function with shape, and should therefore be exploited rather than covered up. So the mechanical and industrial designers have different viewpoints. The mechanical design would more focus on the junctional way. The basic function say. The industrial designer because he would like to sell the product, he would also consider some aesthetics in that. Among designers functional shape is a concept in its own right.
- In many designs aesthetics is the governing factor and completely dominates it. I will take this example. Here which harrow you would like to purchase. This is a harrow used for the tilling of the soil. Tilling of the soil, what is tilling of the soil, overturning of the soil and breaking of the soil is tilling, so as to the soil is able to aerate. Soil is loosened so that we can sow the seed into it. So that is tilling operation. This is a very common tool. Harrow, used for tilling. So this is one harrow, this is harrow two. Suppose the cost of this is Rs 10,000. And

suppose this is Rs 10,500. Let me see which one most customers would like to purchase. Just adding 5% of the cost and improving the appearance. This one would have higher sale. This is the same product. So this is having aesthetics. You know this is given black color, this is given because this has to go in the soil or in the ground itself. And this is given blue color. This has to be tied just behind the tractor. That would provide the traction force into it.

So some aesthetic design recommendations.

- For the parts of the housing or as additional decorations, use of special materials is advisable.
- Notable is the use of chromium strips, glass and fabrics, plastics, wood for the purpose. This is just for appearance. You might have heard of chromium plated wheels. Sometimes wheels are not made of chromium, but those are chromium plated. That gives the feel that the wheels are shining and it would run very fast. Just because chromium has its own brand name I would say in the market of the wheels.
- So use of color, is the color catered by paints or natural color of the material, platings, spraying or even flaming is also advisable.

So to the industrial designer composition and contrast of colors is of a great importance in creating design, with convenient, operational and aesthetic characteristics both.

- So color is supplemented by texture as well. Either by appropriate treatment of given surfaces or coatings.
- The production process is affected due to the surface finish and requirement of the brightness as determined by styling in the finishing stages. So texture also come into play. With color, when we talk about color. Different kinds of colors might bring a texture. For this if you see. This is a texture. Here we have a

texture. This red color. In the yellow we have a texture, so the texture can have different kind of finishes, maybe mat finish, then we have mirror finish, then we have mottled finish. So these are varieties of surface finish, which are in vogue.

- Similarity to familiar objects and shape denoted by outer contours. Exploitation of shape can be done to provide some particular features. To create sense of spaciousness, illusions of size, dependability and richness. Certain suggestions are reserved for this.
- Use of line form breaking. Line form breaking in a case. This is a line. This is actually two different components, but this is given black color. So this breaks the upper housing from the lower housing. So use of line form breaking, scaling the product either into a small size or to blown up size. This is modelling. This is also advisable. So this creates scaling of the product, this creates novelty and sense of completeness in the design. So full size version, smaller version, there are different variations of the product. For instance if you see the tiller, the tiller or the harrow. Different variance of this harrow can be there. For instance one of the harrow could have this dimension, this width as maybe 500mm. and a similar product might have a width as 300 mm. that is a downscaled product, so those can be produced.
- So packaging is also. Packaging of small items. Novelty and enticement of packaging are often conveyed in the mind of the customer. Sometimes small components, hand tools like a plier or the shear that has to be lubricated as well. It has to be lubricated and packaged properly, and the name is put there, the company name is put there. So those things also happen. Those also happen. Packaging is a very important part in aesthetics. Sometimes a specific budget is put for packaging for some of the implements, to make it visible or make it appealing to the customer.

So this was the aesthetic aspect in the product characteristics. I

will discuss about the cost and maintenance and repair in the next lecture. Then I will give a short introduction if we need to design the products to sell it properly in the market. Because this course is just talking about design thinking for agricultural implements. We can design one or two implements for you using creativity. Or you can just try to build a business out of that. If you need to build a business out of that, you need to think some of the aspects which are important from the marketing viewpoint. So those also I will discuss in the last lecture in this week.

Thank You.

Download

PDF: Aesthetic Characteristics

2-4 Characteristics of a product – Cost Characteristics

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Transcript

Welcome to the Lecture 4 of Week 2 of the course, Design Thinking for Agricultural Implements. We have discussed about the characteristics of the product. The three major characteristics, namely

- Purposeful characteristics
- Operational characteristics
- And aesthetic characteristics

In the last three lectures. In this lecture I will try to discuss price to customer. This is a very important characteristic, because customer is going to pay something for that equipment to purchase. So the implement that we are designing, we need to design it in a way, so that the class of the customer or theclass of the practitioner or the farmer, those we are targeting should be able to use that and pay for that in a worthful way. In the next lecture I will cover Ease of Maintenance. Design for maintaining would also be covered. So

The Price to Customer

- The cost of the product ordains its selling price and decides its market attractiveness.
- Product cost is a function of both variable cost such as material and labor cost, and fixed cost such as tooling and capital equipment. Now when we are talking about price and cost. Priceis something that gives you profit as well. But if the cost is high, the profit remains same, the selling price would be high. The cost of the product that you are designing has to be within the product cost, that it is designed for. I will take an example here. See this is one tractor, this is another tractor.
- Because tractors come from the range of 30 bhp to 75 bhp. So different class of the farmers would purchase different kinds of tractors depending upon the area that they are working on, depending upon the number of hours they will have to continue work upon, and depending upon the output they require, they might even send equipment or the tractor on lease. So depending upon that they purchase the product. When we design any agricultural implement. First thing is we think of is what class of the customer would use that. So that is very important

So for that the elements of the farm machines can be seen. And these are divided into two major parts.

- One is fixed cost
- Second is variable cost.

Fixed costs include depreciation, interest, taxes, insurance and housing facilities. It is very interesting to know, when a farmer purchase something. Let me say he has purchased an implement costing 1 Lakh rupees. If we are considering that as purchase price. I will put P as purchase, then S as salvage. So generally the term 'life cycle costing of the product' is P+O –S. O is operating cost. So

salvage value is very important to determine the cost of the product as well. What is salvage, what would a second hand product, what would the economic life of a product, a service life of a product. For that, I will cover this in detail when I will discuss about depreciation.

Variable costs include repairs and maintenance, fuel, lubrication, operator-labor and timeliness cost. So let us discuss about the fixed cost in detail.

- The first element of fixed cost is depreciation. What is depreciation? Depreciation is the reduction in the cost of the equipment with time. There is some obsolescence. There is some usage of the equipment or the machineries that is being used by the farmers or the practitioners. So each year there is some reduction in the value of the product. So the next year the product further deteriorates. So each year some depreciation is happening. So there is a rate of depreciation. So this rate of depreciation can be dynamic, it can be linear, depending upon the equipment that is being used. But yes after complete depreciation for the whole life of the product, there is a salvage value.

So depreciation can be calculated as D= P-S (Purchase value minus salvage value) per unit age. So it is interesting to note here that when I am talking about age, generally the product is designed for its service life. Like you can consider the life of a tractor or any vehicles. Those are designed for 15 years. A general agricultural implement is generally used for 5 to 10 years. Okay if I am talking about vehicles. Vehicles are designed for 15 years because the road tax that you pay is for 15 years. After 15 years it cannot legally run, though the farmers are running that in the fields, it's okay, but the legal way to run it is for 15 years only, that is it's service life.

But there is another term known as economic life. What is economic life? Economic life is when you are running the product that age, for the economic life in a productive. In a productive, in a sense that for instance; for 5 years you have purchased a specific

tractor. The new technology comes. The new technology comes and the new tractor if you purchase, that might save your value, that might save your cost. So that is economic life. Generally it is seen, it is a trend there that the farmers who can afford, they trade their tractors in 10 to 12 years. In 8-12 years generally that has been seen. So this age can be your economic life. This can also be your service life. So depreciation is a cost resulting from, wear, obsolescence and age of a machine.

The degree of mechanical wear may cause the value of a particular machine to be above or below the average value of similar machines, when it is traded or sold. Like the tractor that is being used very heavily, intensive use is there. That might get a lower salvage value. That is very less used might get a higher salvage value. In comparison to the average value after 10 years. If I consider this that as my economic life. To study economic life and service life on when to replace the tractors. There is a concept known as replacement analysis. We might share the notes for that. You may read that for further information on when to replace the equipment.

Next element is interest or opportunity cost. Interest on borrowed money is the opportunity cost for the owned capital. The farmer if they take any loan. The lender; banks or any private lender, they put some interest on that. That is also considered fixed cost. If they had used their own money, there is no interest. Opportunity cost is there. What is opportunity cost? Same amount for instance if the farmer has purchased something of Rs 1 lakh. With the same I lakh, had he or she used somewhere else, what would be the interest, what would be the profit he or she might have gained. It is opportunity cost. So this is important to be considered. This is also a part of fixed cost. Though it doesn't seem significant, but it plays an important role.

So in general interest is calculated as. The purchase value + salvage value, divided by 2 that is average of this into I by 100. And this I is taken as from 8 to 10%.

Taxes and Insurance

Taxes to be paid and insurance of the equipment comes under the

fixed cost. Whatever theequipment you purchase, each year it has to be insured. Like combines, tractors; those are big machines. Small machines like small threshers, small harvesting machines, reapers all can be insured. For that 3 year plan, 1 year plan, 5 year plan is there. For that if you pay it once in a while, in the beginning only. That comes under the fixed cost. But if you pay it yearly, that might come in the operating cost. Because each year they find what is the insurance value of this. So that comes under this taxes and insurance.

Housing Facilities

Next is housing facilities. Cost of providing shelter, tools, maintenance equipment for machinery will result in fewer repairs in the field. So it is important to keep the equipment from the weather as well. Keep it safe from the weather and if the equipment is kept safe from the weather, the usability of the equipment improves. For that employing this housing cost is worth. So housing cost is in general 1% of purchase price. 1% of P. that may vary depending upon the different kind of implements that we are using. I took the example of crop duster vs drones. For crop duster big size housing is required, and also a long fleet is required. That also comes under this infrastructure cost only. But in case of drone, that can be flown from any place. So there is big difference in the kind of equipment that we are using with respect to the housing cost. This also comes under the fixed cost.

So totaling all these. Depreciation, interest taxes, insurance, housing facilities and the purchase cost gives us the total fixed cost.

Variable Cost

Next is the variable cost. Variable cost as the name suggests. It is the operational cost. The cost of operating, the cost of using the equipment. Something like this. The fixed cost is something that is fixed. If I put cost here. This is cost per revenue even I can say. This is the fixed cost. The variable cost depends upon number of hours. So this is variable cost and total cost is the sum of variable cost + fixed cost.

- So in variable cost repair and maintenance is a major factor. Definitely I am going to talk about the maintenance and repair in the next lecture, when I am going to discuss the types of maintenance that is being carried out. And the design for maintainability. That is including the maintainability aspect while designing the product. That is also important. But yes repair and maintenance is there and those come in our variable cost.
- Repair and maintenance. Routine maintenance, wear and tear, accidents come under this section
- Repair cost for a particular type of machine may vary widely. By saying that vary widely. From one geographical region to another, depending upon the type of soil, rocks, terrain, climate and other conditions, it vary. And even within a local area it may vary depending upon the skill of the labor we may have, depending upon the policies which the management, or which the farmer or the agriculturalist are employing. It depends and it vary accordingly.

So variable cost as I am saying, it is variable. It might be linear like this. This is one of the ways. Or it might follow some non-linear path. Like this or something like this, but it varies.

Fuel and Lubrication

So next is fuel and lubrication.

- Fuel and lubrication. The cost of fuel can be estimated by using average of its consumption for the field of operations. For instance tractors and some other implements. Combines or any electrical equipment. They use fuel and power. When I am talking about fuel, it automatically assumes power. So they use fuel and power for their operation. That depends upon the number of hours they are working on. So calculating the number of hours it takes for a tractor to tilling for one hectare. The cost of fuel per hectare can be calculated. So fuel cost can be estimated by using average of its consumption for field

operations.

- The total cost of lubrication on a farm is take as a fraction of the fuel cost. So in general it is 15%. So 0.15 x fuel cost.
- So next is operator cost or labor cost. Labor cost is an important consideration in comparing the ownership to custom hiring. Actual hours of labor actually exceed the field machine time by 10 to 20%. Because of the travel time and the time required to service and lubricate machines. By this I mean, for instance if I hire a labor or a skilled laborer to run the tractor or run the implement. Let us think that we have given him 1000 Rs to work for 8 hours. But for the whole 8 hours we will be seeing that the machine wouldn't be working. He will take some travel time. He will take some time off. Some time to stop, see or inspect the machine that he is working on. So labor rates are to be considered properly, while calculating. For the idle labor, highly skilled labor or the non-skilled labor. So that has to be considered.
- Next is timeliness cost. As it is said 'a stitch in time saves nine'. If the crop is not delivered timely. As we know the crops are perishable. With time the quantity reduces or the quality deteriorates. So this is timeliness cost and is to be considered. So in timeliness cost the reduction in quantity or quality of crop, in case it is not processed in stipulated time is covered.
- It is generally decreasing income due to the late delivery. So timeliness cost also plays an important part.

Summing up all these fixed cost and variable cost, gives us a total cost of the product. So this cost of the product is one of the characteristics to be considered, when we are designing the implements for the farmers. I will cover the Ease of Maintenance in the next lecture, and design for maintainability, what are the kind of maintenance those are carried out. Those will be discussed in the next lecture.

Thank You.

Download

PDF: Cost characteristics

2-5 Characteristics of a product – Ease of Maintenance

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Transcript

Welcome to the fifth lecture in Week-2, for this course. We have discussed about the characteristic of the product, we have discussed about the purposeful or functional characteristics, the operational characteristics, aesthetics price to customer. I will cover the last and very important characteristics that is designed for **Maintainability** or **Ease of Maintenance.** In this I like to start with that the selection of material and class of workmanship is closely related to two factors – design of the product and economic and analysis of its cost. This is discussed the cost is discussed in the previous lecture and quality is not an attribute to define the two responsible factors are **Durability** and **Dependability.**

Dependability is the reliability or the robustness with which the product is designed. **Durability** ends upon the maintainability or the ease of maintenance for which we have designed the product. The length of service life or endurance of the product is defined as durability, this is the Definition. Maintenance and repair are the aspects of durability. The preventive maintenance and requisite repair required for some product is closely back into quality and

design policy. Preventive maintenance an important term is there. Like preventive maintenance the other maintenance that I will just start discussing productive maintenance, corrective maintenance, breakdown Maintenance. What are these maintenance, let us see. There are different types of maintenance that agriculturists use to increase the availability of their Machinery. By availability I mean to say the productive availability time for which the machine should be able to work at the peak performance, that is very Important. So based upon the farmers budget and the amount of resources, level of combined experience and maintenance goals one or more maintenance types are Used. Number one is Preventive Maintenance, number two is predictive maintenance (Condition monitoring) also comes in the predictive maintenance, number three is corrective maintenance, number four his breakdown maintenance. The above two are known as Proactive, Proactive maintenance. The lower two are known as reactive. Why proactive? Before the failure happens we take the measure as the word preventive itself means we have some plan and we prevent the failure to happen. Preventive maintenance actually planned maintenance and we make a schedule for the maintenance for instance for the tractor you get it serviced in every three months or for depending on the usage. Of the new product that you purchase there is a service schedule for that given by the manufacturer. That is preventive maintenance. Before, anything happens based upon the schedule you just do that.

Next is **Predictive Maintenance.** In predictive maintenance what happens we predict something based upon that we do the maintenance before the failure happens. Various kinds of monitoring happen here for instance temperature. If you identify that your tractor that you are working on is heating much higher than the normal. If you identify that the vibrations are quite higher in the implement that you're using. If you are identify that the knives that you are using are not working that Properly. That means it has become a little blunt. It is prediction based upon this prediction you start doing maintenance. This is known as Predictive maintenance

and when we use some instruments for this-some temperature measuring instrument like parameters, some radiographic instruments, some vibration instruments like dial gauge. It is known as Condition monitoring.

Next, what is **Corrective Maintenance**? As I said Corrective and Breakdown maintenance are Reactive. Corrective maintenance is when some small failure has happened, Your tractor is giving some flashes, some beeps are coming from tractor okay, some jerks are there when instance your start would might have gone bad so there might be something stuck in the silencer some failure has happened then you go and get that repaired, this is corrective maintenance. But in case your machine comes to standstill the tractor completely stops then you have to do the maintenance before it starts working that is known as breakdown maintenance. So Corrective and Breakdown small introduction to them is given' the reactive are these two and the above two are the proactive.

Let us try to see all these individually-**Preventive Maintenance** is the most popular type of proactive maintenance. The objective behind Preventive Maintenance is to either repair or replace components before they fail **Periodic Maintenance** may be done at calendar intervals after a specified number of operating cycles as I just said and or a certain number of operating hours. Those intervals are established based upon manufacturer's recommendations because here we have the designer. So we are the manufacturer here, we are employing design thinking into agricultural implements, we need to see whether we are designing for the maintenance, or not. And when the maintenance has to happen that also has to be considered. When we were prototyping, when we are testing for in that phase also the maintenance would be checked. How about with preventive maintenance the agriculturists run the risk of over-scheduling. The maintenance tasks because tasks are scheduled based upon the time rather than actual conditions. So irrespective of the actual conditions sometimes manufacturer's instructions are followed. So there is a little drawback for preventive maintenance app as well it is now taken with a very well care. An

example that can be taken here is that the tractor that you have just purchased that has an instructor's or manufacturers manual in which you have to get that tractor serviced after six months. But maybe you might not have used the tractor for even 100 hours so in that case that maintenance might not be required. So there's a certain overscheduling is there. So that has to be taken care when we design the maintenance.

Next is **Predictive Maintenance** or **Condition Monitoring**. Predictive maintenance is what savvy maintenance teams aspire to have or already implementing. Major barriers to this is the time it takes to implement rather than the cost of the technology Itself. For instance a vibration sensor that can identify imbalance misalignment and resonance issues only cost rupees 5000 but time it's takes to install, integrate with each other maintain a software and adopt a culture around is not time that all practitioners are willing to allocate. So when I talk about condition monitoring specifically it used instruments. For those instruments are implementers has to be trained. So that sometimes takes some time which many farmers are not willing to do. In **Predictive maintenance** as I just said temperature monitoring is there when we see that the heat is a little higher than the normal then vibration monitoring is there then oil analysis for instance or your tractor that is consuming 50 liters for the specific hector's and now it is consuming 70 liters this is **Oil Analysis**. That the amount or the fuel that is consuming is quite higher or the oil the lubricant oil that you are using here is getting blackened very early, this is oil analysis. Then is Radiographic inspections you use radiographic instruments to find the radiographic waves for that. Similarly, electrical testing for the like changing the resonance, conductivity those are all technical things those can happen. Similarly, performance testing they just took the example of the tractor. If it is not performing properly all these monitoring can happen.

Next is **Corrective Maintenance**. Corrective maintenance is inherently part of Emergency maintenance because when there is an emergency something needs to be corrected or fixed. In this

way corrective maintenance is mostly reactive. However, it can be proactive as well if an asset with condition monitoring sensor detects an issue or work order is created and a technician is sent to corrected. In this case it becomes predictive maintenance. So this is corrective maintenance. Last one is breakdown maintenance also this is known as **Emergency Maintenance**. This occurs when an asset requires immediate attention in order to keep a facility operational or safe. This is the most reactive and intrusive type of maintenance. As it cools technicians away from other jobs and lowers scheduled compliance. In extreme circumstances emergency maintenance can set an organization back days depending upon the scope of repair, availability of the parts and asset level of importance. To reduce the amount of emergency maintenance that is both unplanned and unscheduled organizations adopt various forms of proactive maintenance so, it is completely undesirable to have a breakdown maintenance. If build on maintenance is there that means something is wrong with our schedule or with our planning. With this I'd just like to give some tips on design for maintainability. When I'm a designing the product what should we do? Maintainability is created during the design process it cannot be added later. This is the basic mantra for design for Maintainability. Once the product is designed then you cannot inculcate maintainability into that. So while designing only the number of components you are designing the number of a sub assemblies you are having those are all to be considered considering the maintenance that you are going to implement or to use further. Establish the maintenance philosophy in terms of repair versus disposal of the product of components do this before starting any Design. Repair versus Disposal are we going to repair the components time and again or we just gonna use the component once that is one time used and then dispose it away. This has to be considered freehand. Consider where maintenance will take place first, second or third line. Regarding first, second and third line maintenance first line maintenance is when the farmer himself is able to do some maintenance on line. Like in the field only some

vibration is there. He is able to screw or tighten some nuts that happens. Second line maintenance is when he has to stop the Machine and take you to the closed service center. The second service kind of thing happens so that is second line. Third line maintenance is when the complete overhaul of the machine is there , when these people took us to the further expert centre or the central point when the maintenance overall maintenance has to happen. So depending upon this level it is design. Consult the maintenance and engineer during the design phase and agree upon a set of documents to be handed over to the maintenance people. Keep it simple, very basic concept. Complex arrangements are usually harder to maintain, make it testable, reactive or fault running tests often reveal latent problems that will become false in near future. So to counter that one must include diagnostic test points in electrical circuits include mechanisms that provide early warning of impending failure. Design reliability into items that are difficult to maintain such as components, deep components within ensuring the components for which the reach is too Intricate. So that are to be designed very robust so that the maintenance for that is not required very frequently. Reduce maintenance frequency overall by ruggedizing and overspecifying components to withstand occasional overload. Provide warning labels wherever a maintenance engineer may be exposed to danger for example on hot or heavy items or any sharp items or any electrical items where electrical shock could come, so that is very important to provide symbols and logos and warnings. Provide maintenance instructions and information panels if the routine is difficult to understand or remember and fix them as close to the point of maintenance as possible. Design equipment to fail-safe so that risk of injury to maintenance engineers is reduced.

Fail-safe means providing fuse, providing emergency brakes, So that the big failure, big breakdown doesn't happen. So that the operator is safe all the time. Avoid the requirement of special tools. The normal or standardized tools, spanners, screwdrivers, pliers should be able to work on to carry out the maintenance activities.

This is also important. These were a few design tips designed for maintainability tips. With this the characteristics of a product are covered. Next, I will have a small lecture on key factors for a successful product. That is just for if you are a developing an implement to commercialize that if you want to commercialize some product you need to think about the market, you need to think about the trend in the market, you need to think about the demand, you think about the competitors, that is also important So, that I will cover a small lecture next.

Thank You.

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PDF: Ease of Maintenance

2-6 Characteristics of a product – Developing successful products

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Transcript

Welcome to the last lecture of second week. I have discussed the Product characteristics in the previous lecture. So, next is how do we find a or how do we launch a successful product in the market. There are certain factors that are important for the product to be successful, to find a market place, to deal with the customers and to also counter or compete with the present competitors. So developing successful products, let us recall the product development: In agriculture industry, successful enterprises constantly percolate in a state of innovation in terms of products manufactures; new products are frequently introduced or improving and modifying the existing products as desired by the customers. So the current product is an innovation, in addition to that a new product forms. So this course that we are right now working on is about designing a new product and also improvising or improving the present product while adding some innovation to it. This is a new product. The current product has some innovation you can definitely commercialized your product if you have something worth for the customers. The complete process of

conceptualizing a product and **designing, producing a**nd **selling** is known as a comprehensive and generalized process that is known as **Product development.**

A successful product development process produces a product that sells well and makes a healthy profit. So, it has to be high quality and low cost. So the cost has to be lower, this is already discussed. The cost of producing and developing both cost are to be included and I have discussed a fixed cost, variable cost, the oral product has to be acceptable by the customer depending upon the class for which we are launching. And the quality has to be there that is the worth of the product and time, time to the market, time to market is while assessing the need of the product and employing the whole design thinking and development process and developing the prototyping, testing that and finally launching the product. This time has to be very less so that the competitors are not able to make in that time. So this time is also important. If you take years to develop a simple product the competitors obviously will take the lead. And Technical know- how is following the proper procedure. So, I would like to introduce one term here value, Value is worth per unit cost. If the worth is higher, the quality is higher a person could be able to give high cost for your product. And if the worth is lower the customer would give low cost for your product. As we took the example in the cost characteristics of the product. The kind of the customer segment we are targeting and the kind of the class of the product we are producing, are we trying to produce the elite quality product or we trying to produce the medium quality product and trying to reach the more customers base so, that is important. Because in the next week we are gone to start on design thinking process, which the 5 steps in design thinking that we introduced in the first lecture of this course starting from empathy study that would be discussed by Prof. Ramkumar. Those 5 steps will take in the excessive weeks to explain them in detail and finally we will have the fun prototype coming out of those. Before, that I would like to discuss how the product is successful in the market, what are the various aspects, which one should ignore.

Number one is Market Study – The Distinctiveness: Excellent value is provided for the money spent, Enhanced quality perceived, and product should have unique features and meet the customer's needs. By, this we mean to say that more features than the competitors. The customer focus and market orientation, so the customer is always focus throughout the design process if we need to commercialized the product and we need to sell our product in the market we need to have the market base there. So, in that case in design, development, prototyping, testing and in final marketing all the time what is the need of the customer that we have identified in the empathy phase only that is kept in our mind. So, one has to be mindful all the time for this. In intensive understanding of trait of market is developed, competition is recognized. In relationship between the product attributes and the user is developed, this we will discuss when we will discuss about translating customer needs. It is **Quality Function Deployment (QFD)**. Quality Function Deployment we will discuss how to translate the needs of the customers into the design requirements. So when we are talking about market study, this is a **Research Triangle** that brings all the parameters which are required for a market study to launch on a product properly. We need to have proper preparedness and Sharp and early product definition has to be there. So for that what need to do Market Research Usability and User Research and Expert Design practice go hand in hand. Usability and User Research is the user interface and user experience. So, in this case all this three parameters interact with each other and provide an information to each other and the designer is here. This is the designer. So, when we design the product we need to have information regarding the customer, what user interface they are going to have, what are the experience that the user is having from previously. For Preparedness research before designing the product is important, market research has to happen and for sharpen early product definition the concept outline the framework of the product concept has to be there. The product features, the major features, the broader features, are to be given. The market attributes, what

are the competitors those who all are building the same kind of product. Then business strategy outline has to be there. So in market study, in preparedness the success of the product is determined by the work preceding the actual product design, market research, technical assessment of the capability and the requirements and financial analysis, the technical analysis would come later but financial analysis has to be done here, the capital is needed, the source is needed, the production sales, the budgeting, from where would the funds come so what would be the total fund in marketing, how will we distribute our budget. So those things are planned here only.

So sharp and early product definition: Benefits to be provided and an outline of the concept. A list of product features and attributes, ranked in order "essential" and "desirable". What is essential this we can't ignore, this may be eliminated. May be eliminated if I couldn't say may be ignored if the cost is rising very high. So attributes of the market like size of the market, demographic of the market, any description of the potential users, the business strategy outline, all those things come here in the market study.

Next factor after the Marketing or Market study is team work. The product development process couldn't be possible or is not possible without the help, or without the work done by different streams, different people, and different people from the production, from marketing, from finance, from design, all the people have to come together to work as a team and finally launch the product. The product has to find the market and the farmers o workers would be able to like and understand the need of the implement that we have try to innovate here. So, the team work has people from marketing, sales, engineering, procurement, and manufacturing. A collaborative concept generation is there so this is a design team. A design team has several ideas. As, I said the ideas are always there but not many of them are finally producible. So the ideas are kept in a pool. A lot of ideas are kept in a pool so these can be taken in future as well if not taken in the current status. So the execution of the activity and Project selection is the major part.

When we talk about a team, execution of the activity – A better job is done across the activities identified under homework and market orientation by product development teams. Market study's are not skipped by this teams, they undertake the trials sales using test market to see how the equipments that we have manufactured would be used by the users. I remember one of the cases, one of the student who work in a course project, he develop or he actually worked on the repair of the reaper. This reaper when they went to the developer or the manufacturer of the reaper who was working on that so they find a problem that the shaft of the reaper was deteriorating to early. So what they did, they made a collaboration with a close farmer. The reaper that they develop the farmer close to them used to test that reaper than they later launched it after it is finally be related. So these kinds of tests are always possible.

So project selection – the valuable resources are scattered among many candidate projects due to involvement of multiple projects. However, the materialization of all the projects is not possible but the choice of projects is narrowed down to project selection so that resources may be directed to the projects which are more likely to succeed and become profitable so, the most potential products which can be having the direct use or direct use of the customers those are taken first.

Now, the role of top management also comes in the team. The functional organization and project organization is different. In a functional organization the functional managers control their own function. This is the production manager, this is the finance manager, this is the design manager. But in a project these managers work in team so the team present people from the finance, production and design all come together to work as team to work on different products. So this is product 1, product 2, product 3. The kind of an organization is like this. So the top management has the primary role to support the product development team and provide it with the necessary resources. The lack of time, money, human resources, these are the main causes of failure and the management must realize that. The strategy for the business must be clearly

articulated by the top management as it pertains to the development of the new product.

Next is promote – this be mindful that I am talking about the factors other than the process. The Design thinking process we will definitely discuss in the forth coming weeks. The process has to be followed in that pattern only, other than that what are the key factors that we are discussing in this lecture. So, after the market study and teamwork an important factor is promoting. The first market study was the identifying the need of the customer, need of the farmer, of the worker, of the people who are working in the gardens, people working in the farms. Now, we need to promote the product that we have developed. For that the kind of collaboration, that is said the kind of the internal customers, the customers who are close to our location they can be used for test runs and finally, if they find our product very good they can also purchase our product. We need to promote our product telling the world you have a good product. So legitimate promotion of the product is important. For this, various we see various ways, online ways are there, (12:34) you can also have hard copy online recourses and all those ways are important for this promotion. Launching new product with adequate allocation of the resources for marketing and appropriate forums are also ways where we can launch our product. The professional staff must support the launch and marketing efforts that can troubleshoot and service the product from (12:54) So, after sales... services is also important, if I say promote, after sales services. Because product that we develop also need to provide them a brochure for the operations of the product and also we need to give them some service for some time may be six months service or may be a year also.

Next is Quality. Quality – obviously has to be important component when we talk about the successful product. Speed without compromising quality is an important point that I m trying to discuss here because speed or the time to finally make the product reach the customer is important. So in the bottom line the determinant of profitability is the quickness with which the product

makes it to the market. If it means compromising the product quality or the quality of executing the essential activities, then the advantage of speed is lost. So, speed is important also quality has to be part of that. Next, important factor is Demand. This is the last factor I like to discuss here. The growth of the market is rapid, the economic climate of the market is pro product (positive). The market demand is not cyclic or it is unstable for the new product. The customers are receptive to adopting the new products typically, young customers and can easily adopt in their life style, because the products that are coming these days in the market are technologically highly advanced for the people who are working on this one kind of product for years like for take an example of crop duster. Crop duster is an aircraft that is used to spray pesticides or to water the crops for the farm very quickly. So in that aircraft the pay load is there, water is kept there, pesticide is kept there, that can spray. But the crop duster has to have hangers for its launching, it has to have run ways, lot of things are there. Now we have drones. Drones we can just fly it from just our ground, any kind of ground we can fly from we need not to have run ways for that. And drones we have at IIT Kanpur at UAV (Unmelt arial vehicle) that can carry payload, payload is the weight that can carry upyo 8 kgs. So, new techological developments are happening which youngsters are very much willing to employ in their practice. So the demand is not cyclic but people are definitely ready to purchase new products so this is the product lifecycle. The product at introduction few people will purchase, the growth would happen at some point then product will mature and at this pint of time other product will take its place and the product sale would decline. So this is a general product cycle that is true for all kinds of product. This span can be lower or higher. This can be a few days or few weeks, or a few year or a few decades. But every product dies after some point of time or the sale decreases.

So, quickly, I just summarize Key features that I have discussed for a successful product. The product should have unique features, unique features could also have secondary features which is a

multipurpose product or a multi functional product. The feature should entirely offer new benefits that existing products do not have or if the existing products do have they offer it at a very high price. So, the product should have market competition ready or should be market competition ready, so the product should be completely comparative to what is competitor offer. The quality management is higher, the understanding of demography of the customers is important, to harness contemporary societal trend is also there then economical product has to be there. The price of advantage should be given to the customer. With this week 2 is over now Professor will discuss the design thinking concept and I will also take the prototyping testing in the forth coming weeks.

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PDF: Developing successful products

3-1 Design thinking model – Empathize

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Transcript

Brief Introduction

Welcome to the Week 3. Last week we have covered, characteristics of a successful product in terms of functionality, aesthetics etc etc. We also studied about market study before we start the product development. How do we understand, what is the market. Suppose you find out that there is only one product need, then there is no point in developing the product and no point in applying design thinking. So if there are a huge potential, and if you find there is a huge market for the product, then you start developing it, then there is a worth in terms of innovation and cost benefit.

How to build an efficient product development team. We should always understand, a product cannot be built by single person. It has to be a team. And in this team also; how are you forming this team is also very important. For example if a father, wife, mother, son. If they all start forming a team in developing a product. Their thought

process for all the four will almost be similar. So it is better to have expertise from different areas in joining hands together and forming a team, so that there is a positive approach as well as people who present something, you should have counter to those positive you have, then it becomes a very good team.

So how to build an efficient product team, we saw. How to work on promotions, we saw. And finally we saw how to work on process and quality control. Though these things are very seldom talked about, but quality control and the process. Process can be even in terms of protocol development. So this is very important. So we will also see the 5 steps in product design. One is empathy which we saw as part of design thinking. Design thinking is a tool. So we saw all the 5 steps as part of design thinking.

1. Empathize
2. Define
3. Ideate
4. Prototype
5. And testing.

So let us start discussing each topic in a little elaborate manner. So step 1 is empathize. So please understand there is a difference between empathy and sympathy. Here we are more focused towards empathy study or empathize. So when we have to do empathy study, we should have these four points. So generally we divide it into four quadrants and we start discussing it. So first is,

See Their World

So when do we do an empathy study. When we want to develop a product. So the product is developed for whom. For a customer. Now what is the problem a customer faces. So that is what is 'See their World'. Suppose if I tell that here is the solution for the problem and the solution is very expensive. A common man or the normal below the middle class, or below the poverty line agriculture farmer could never ever think about the solution. So if you want to solve a problem for him, please try to go, wear his shoes, stay

in a place what he has, live a life what is he doing and then try to develop a product for their drudgery. So see their world. That is very important.

Appreciate Them as Human-Beings

And the next thing is, appreciate them as human-beings. As I told you in the beginning, design thinking approach is human centric. So your problem-solution should be for a set of human-beings. So appreciate them as human-beings. Treat them with respect. So then what happens, the solution whatever you develop will have that touch in it.

Understand Their Feelings

The next one is understand their feelings. Many a times feelings cannot be quantified. So it is something like a love. So many a times we would like to use a product, because we love that product. Many a times we like a color. So we would like to purchase all of the products in that particular color. So it's understanding the feeling.

Communicate Your Understanding

The last one is communicate your understanding. Finally what have you understood their problem. Please communicate with them. And communicate means you negotiate with them. You involve them in the understanding of the problem. That's what is communicate your understanding. So many a times when I teach a class, I keep iterating my understanding with the student's understanding. I ask them okay I have covered up to this. Are you all with me. So that's basically to understand what their level is and if they have not understood. I will go one step down and try to explain the same concepts so that they can pick it up. So communicate your understanding with the students or with the customer to get to know more about the problem.

So empathy can be divided into four quarters. One is see their world, appreciate them as human-beings, understanding their feelings and communicate your understanding. So the effort of a designer, to understand the way a user do things and why.

- So their physical and emotional needs for the solution.

- How they think about the world?
- And what is meaningful to them is called as empathy.

So this is what I told you in a very crude sense is wear their shoes, stay their life, understand their problem. That's is what is empathy. Design thinking cannot begin without a deeper understanding of the problem, you are designing for. So if you don't do this empathy study, then you will not be able to solve the problems. For example there was or there is a famous mobile company.

They developed wonderful products. Mobile products very rugged which is very robust. So this product was flourishing all across the globe. When they were trying to enter into the market of underdeveloped countries. They were looking forward for how to solve some problem of the customer in the underdeveloping country, such that they have a breakthrough in their sales. They tried several tricks, but finally they came out with a very simple problem understanding that in the underdeveloped countries, there is always an infrastructural problem, that is electricity. So they found out if I could integrate a torchlight with my mobile phone, then I will have a huge breakthrough in business. So that could happen for this big company, because they did a very thorough empathy study.

The development of this mobile company was happening alwaysin the developed countries, where there is no power cut. So until and unless they did this empathy study they were not able to do. Second thing when we recently visited a marshy land in a close by agricultural farm, we were not able to quantify what will be the marshiness. We were always thinking it will be slightly viscous and we will try to drag our equipments there. But moment we entered the field, we realized, that okay it needs lot of energy to do it. So that type of understanding comes from your empathy study. That's what I said, a deeper understanding comes from empathy study. In order to gain those insights, it is important for a design thinker to empathize with people, we are designing.

So this is you can see a designer is spending time with a customer

to understand the problem what he faces. So he can have an interview; he can have a casual chat. And while doing this interview you can't go stand in front of them and say. I am from so and so. You are from so and so. So can we start discussing on these problems so and so. No, you have to first make the customer feel comfortable with your questions, with your background, with your understanding, and then they start opening a doubt and you should start developing products.

In fact if you want to develop a successful product, you have to bring a vow! effect to your product. That means to say you are supposed to develop a solution to a customer who has not thought about a solution in that similar lines. That's the way people think today for successful products. So interviewing is a very basic step. So you should spend a lot of time in interviewing and understanding the problems what the people face.

How to Empathize

- So interviewing can be one to one interview.
- Or it can be talking directly to the people you are designing for. It can be one to one or it can be talking to a set of people, a group of people
- So, that's what I said, people and then on top of it, it is also insisted that we do video recording or audio recording of the conversation, so that we start building the interview, and when we come back and sit and replay, we get to know more insight about the problem.

And please do understand just by one day, half an hour interview, you will not be able to understand the problem. You have to spend hours together, maybe days together, to understand the problem more in clarity.

Ask questions like What? How? and Why?

These three questions are very important, while doing empathy study. What? How? And Why? So what are we trying to develop. How are we trying to develop? And why are we trying to develop? So these three questions you should ask in the empathy study itself to have a better understanding of the problem.

- So by asking the three questions. What? How? Why? We can move to concrete observations, that are free from assumptions.

Many a times we try go by assumptions. And then we try to solve problems based on the assumptions. A simple example. All tyres are black in color. Who said it has to be black in color. It can be red in color. It can be green in color. But people said that okay it is black and they said that it is part of vulcanization, it is done black, so then even today we follow it as black. The assumption has still continued. Can we have a red tyre. Yes you can have a red tyre. Nobody stops it. Can you have a yellow tyre? Yes, the kid's cycles come with varying colors, but not with a truck. So that's basically an assumption, the color black.

Right! So What? How? And Why? We can move to concrete observations that are free from assumptions.

- During our observation for an instance, we might find separately recording that "What's", "How's" and "Why's" of a person.

So that means to say when you have an interview, you are trying to divide the interview into three questions, and ask him what, record their conversation and how, record the conversation and why, do the conversation. So you have three different recordings. One is for 'what', 'how' and 'why' from a person to understand more about the problem.

- In "What" we record the details of what has happened. So 'what', we will ask what has happened. Why are you facing this

problem? Why is this drudgery? And because of this drudgery what happens. So what has happened.

- Then "How". We analyse how the person is doing. What he/she is doing in the existing situation. For example if you are cooking food. If you are cutting shrubs. If you are cutting sugarcane. So then how are you doing it now.
- Then the next question is "Why" we may educate guesses regarding the person's motivation and emotion. Why do you want to solve this problem?

For example today we don't have flexible sugarcane cutters available in the market. Sugarcane cutting is manual intensive. It is human intensive. And today the cost of human employment is going very high. So people are looking for low cost automation. So in low cost automation, they are looking for cutters. There are grass cutters. But there are not many sugarcane cutters in low cost. So that's what is why. Okay so what, how and why are three very important questions which has to be filled up in the empathy study

Observe

So the next important thing a person should have is observation. Observation skills are very important for a human-being. Moment you have a very good observational skills. I am sure, you take it from me, that you will become a very good designer. Your observation skills should always look at, why is it done this way or why cannot I do in that way. So moment you observe, then you can come for multiple solutions. So observation is very important. **O**bserve.

- The user and their behavior should be viewed in the context of their lives.
- The most powerful realization comes from noticing a disconnect between, what someone speaks and what he she does.

Many a times if you ask, everybody says I have read it. I have read the book 10 times. But when they come to the examination, they

don't perform very well. So while doing the reading you should just watch; what are they reading, how are they reading. Maybe they read, but they don't get into their mind. Or they don't acquire or absorb the knowledge what is there in the book. So this what we say observe. So the most powerful realization comes from noticing a disconnect between what someone speaks and what he/she does. Doing will be completely different from what we speak.

Engage

So then we try to engage ourselves into solving this problem.

- Sometimes this technique is also called interviewing. But it should really feel more like a conversation.

Engage. So for example if you want to try to solve a problem for a farmer. Go get into the field. Star cutting. Suppose he is trying to develop a cutting device. You also start cutting along with him. Engage yourself. Do conversation. Try to acquire more knowledge. You have physically got now over the conversation; what is that and then you try to solve the problem.

- Listen to stories from people you interact with. And always ask why to uncover deeper meaning.

So this why is always very important. There is a Japanese philosophy which says ask 5 why's continuously, so then you will go to the root cause of the problem. So that is what is why. Why are we trying to develop this? Because we wanted to have a comfortable life. Why do you want to have a comfortable life? We want to become more productive. So you see, every time you ask a why it tries to go towards a deeper understanding.

Benefits of Empathizing

What are the benefits of empathizing?

- Empathizing attempts to enhance the design team's understanding. As I said earlier itself. You will have to have a team to solve a problem.

So when we have this team. So the team should have an understanding of the problem. So for the better understanding of the team and asking the team to work towards a target solution. So we try to do the empathize study. So it tries to have an understanding of the target user and the market, since observation methods are not meant only for gathering of raw data, statistics and demographics. So that's where we do an empathy study.

- We must to an appropriate degree, 'become' our user. If we are to offer them fine-tuned solutions that lead to the market.

So if you just record the data. If you start recording the data. Yes you will have all the points. But you will not have a deeper understanding. So empathy is much more than recording of the data. That's what we are trying to say. Until and unless you have done a thorough empathy study, you will not be able to solve any problem in a judicious manner.

Empathize— Case Study of Cashew Processing.

So here is a case study for you. So the case study is cashew nut processing. Cashew processing. So cashew what happens. It comes with a husk. So you have to de-husk, so that you get the cashew out of it. And when you start doing this process, you have to de-husk. And this husk whatever is there. The cover, whatever is there is very hard. So it is not so easy with low pressure you can open it out. You will have to hammer it with a load. So the current practice in underdeveloped countries. They try to hit it with a stone. Or they try to hit with a rod or with a small other device. So they manually

feed it, hit it and then they try to remove the shell rim and take the cashew and process it further. So when they do that, many a times there is enough of damage which is done to their fingers.

- So here is hand displayed by a lady who does this process. Invariably she gets lot of cuts in a day while processing. And apart from that the cashew has an interesting property. It has both cardol and anacardic acid. This acid is very reactive to the human skin. It tries to create lot of burns. And over 5 lakh women employees are involved in this business.

Until and unless you break the cashew for a full shift of 8 hours, you will not be able to understand their drudgery problem. And this is only one part. And then live a life everyday like what they live. Then you will understand what is the maximum costing you can give for the device. So this is a typical empathy study which we conducted on cashew processing industry.

So now you will understand. If you have to do empathy study. Get into their shoes. Become like themselves. Spend days to gather, to understand their socio-economical problems, and their drudgery problem. Try to solve their drudgery problem within the cost what they can afford. At the end of the empathy lecture I would like to consolidate. The three important questions are going to be. What, How, and Why. So these three questions are very important as part of empathy study. The designer has to undergo these three questions along with the customer to identify the problem.

So thank you very much.

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3-2 Design thinking model – Define

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Transcript

Brief Introduction

So in the previous lecture we went through empathy study. Hope that you have understood in totality empathy study. So in empathy study you would have really enjoyed if you would have tried some small examples with your friend, relative, father, mother or anybody, so that you really undergo the process. If you don't undergo the process, you will not be able to understand. And as a designer it is always necessary that you undergo each and every stage and start appreciating it.

Definition of the Problem

So today's lecture we will move towards the definition of the problem. Definition of the problem is very very important. So you have done empathy study. You have now got lot of data with you. This data whatever you have, there is a possibility; you will have

signal, you will also have a possibility of noise. Sometime noise dictate over the signal. So now you have to identify where is noise, where is signal. And then take the signal. Process the signal, such that you try to develop a clear definition for the problem.

For example if you say, I want to buy shoe. It's only a part of the problem. You want to buy a shoe which is for dash environment. And the maximum affordable cost is dash. And its life has to be dash. Now you have defined the problem very clearly, that you have to buy a shoe. But now you have also said the shoe should work for what season and then what is the costing you can give. And how long will be the time period, that means to say the life of it. So now accordingly if you start filling up the data there, then the problem definition is very clear. So when you go to a shop, you will also have a very clear clarity in thought.

Define

So a definition is a second step of design thinking, which is again a very important step. So define here the state user's need and problem.

- So in that definition stage we accumulate the information created and gathered during the empathy study.
- We analyze our observation and synthesize them to define a core problem and our team have identified so far. So we would like to look at the core problem.

Many a times we will not even understand the core problem. We will try to understand a peripheral problem. Try to solve a peripheral problem and give a solution to it. But no we should understand the core problem. And then the understood problem should be shared with the team, and the team starts working on it

- We should always seek to define the problem statement in a human-centric manner.

See right from the beginning I was trying to tell you, design thinking

means human-centric. You are trying to solve problems for human-beings. So at every stage when you develop, you should have a humancentric touch towards the solution.

- It is our responsibility to define the challenge we are taking on, based on what we have learnt about the user and about the context of their problem definition.

As I told you, definition is not only looking forward for their problems. You should also look for their socioeconomy. You should also look forward for the longevity. You should also look for maintenance. Because in agriculture the important challenge comes in maintenance.

- This is perhaps the most challenging part of design thinking processes defining. As the definition of a problem requires to synthesize our observation about our user from the empathy study.

So this is very important.

- What we learn, how to master the definition of the problem, problem statement or design challenge. It will greatly improve our design thinking process and result.
- It will bring about clarity and focus to the design space.
- On the contrary, if we don't pay enough attention to defining our problems. We will work like a person stumbling in the dark.

How to Define: Analysis and Synthesis

So in this we have two steps. One is the analysis step, the other one is the synthesis step

- Analysis is nothing but breaking down of complex concepts

and problems into smaller easy to understand constituents.

So we take event and break this event into several small small events, and try to find a solution for small small events, and then assimilate the data, try to get a bigger solution for the problem.

- We do have during the first stage of the design thinking process also, when we observe and document details that related to the user.
- Synthesis involves creatively piecing the puzzle together to form a whole idea. That is synthesis.
- This happens during the definition stage when we organize, interpret and make sense of the data we have gathered to create a problem statement.

This is what is analysis and this is what is synthesis. So there was a bigger event. I split into several small events to have a better understanding. Now I have got all the several small events. Now I assimilate to get to the definition of the problem.

How to Define: A Problem Statement

- So a problem statement is important to a design thinking project, because it will guide us and our team to provide a focus on the specific needs that left uncovered. This is very important.

Specific needs that is left uncovered.

- It also creates a sense of possibility and optimism, that allows team members to spark off ideas in the ideation stage. So a clear problem definition leads to sparking of several ideas in the next stage of ideation.
- I will repeat. A good problem statement should be again

human-centric.

"Creating a low cost solution for extracting and processing cashew from cashew shell without any direct exposure to human skin". Is a very clear definition of the problem statement for the case study what we discussed. So you look at it. Create a low cost solution; why because the person who is involved cannot afford to buy a heavy capital intensive equipment. So that is why we said 'low cost solution'. And in fact if I want to be more precise, I should say low cost and low maintenance. Maintenance solution for extracting and processing cashew from cashew shell without any direct exposure to human skin. Why is that important? The acid which is coming out there has to be prevented, or it should not come in contact with the skin.

So you look at the problem definition. How clearly it states. Now I know that it has to be low cost, so I cannot give a device which has lot of gears and other things. So I said low maintenance, and then I said it is extracting from the cashew shell. So this device is not supposed to cut a tree. It is not supposed to do something else. But to do only this job. Okay, without any direct exposure to humans. So it has to happen in a slightly far off from the hand accessing point. So you develop a device. So this is a problem definition for a case study which we discussed during the empathy study.

Conclusion

Coming to the conclusion of the definition lecture. There are two important points we have studied today. One is analysis and another one is synthesis. Analysis is, taking a complex problem, breaking down into simpler ideas. Try to solve each simpler idea. And then what we do is collect all these small ideas, and then try to solve a bigger problem. So analysis and synthesis of data which you generated through empathy study will be used for defining the

problem. And in the definition of the problem you should keep it in mind that it has to be as narrow as possible, as well as, as wide as possible.

So these two things are contradicting but you should have a tradeoff. For example you would like to have a very high performing machine at a low cost. So but in the problem definition, you should put all those key words and define it so that henceforth the definition of the problem only will be used for further analysis.

Thank You

Download

PDF: Define

3-3 Design thinking model – Ideate

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Transcript

Hope you would understood the Empathy study and how to define a problem? Now we will move towards the Ideation stage. So in ideation stage you should keep in mind there is nothing called a unique solution. So, there will be multiple ideas, how do you generate these ideas and, how do you process this idea that will be discussed in this lecture.

In Ideation you should have one thing in mind no idea is good or bad. For all ideas which come out at this point of time among the team members has to be processed. And later, we will think of filtering it out but first, you should allow them to process the definition and generate as many ideas as possible. In the design thinking process Ideation stage follows the first two stage: which are the Empathy stage and the Definition stage.

There is a significant overlap between the Definition stage and the Ideation stage of a typical design thinking process. Interpreting information and defining the problems both derive the generation of problem solution. For example, when we do Brainstorming session we always ask 'How Might We' questions are often used in both the stages like in definition stage as well as in Ideation stage.

How to Ideate: there are questions asked. Ask the right question

and innovate. When we say innovation, innovation is what you have to have a customer for a problem. So, that's why every time I say it has to be human centric. Ask right questions and innovate. Next, step beyond the obvious solutions. Currently, there is a possibility for a solution, go beyond it, stretch yourself beyond it and together increase the innovation potential of your solution. Next, bring together prospective and strengths of the team members. If there are 8 people, 8 people giving 8 different ideas, you cannot take directly their idea but take part of a, part of b, part of c and part of d, 4 people and now you are similar you get a new innovative solutions. So this is what it is. Bring together prospective and strengths of the team members, Uncover unexpected areas of innovation, create volume and variety in your innovation options, get obvious solutions out of your heads and drive your team beyond them.

So, the other thing is 'How to Ideate?' You should have time limit. You can't have infinite time because no customer will wait for infinite period for a solution to that problem. So, there is always a time limit which is set. Then start with a problem statement, point of view, possible questions, a plan or a goal and stay focused on the topic. So, the definition of a problem is clearly related in front of you. Low cost, low maintenance, the cashew nut removing from the cashew shell without touching the skin is a very clear defined problem. So, for that problem statement you will try to say what are all the possible questions, planning and goal.

Next, defer judgment or criticism, including non-verbal. So, in the ideation stage we should not say it's a bad idea and stop it here or it is infeasible so stop it here. No, you try to take it, move further and later we will see what is to be done. Before, judgment or criticism, including non verbal, encourage weird, wacky and wild ideas, aim for quantity, build on each other's ideas, be visual, one conversation at a time is very important. So, these are some of the possible ways of generating ideas. So, what is that one conversation at a time is – it's 8 people are there and all 8 people keep talking, we will never go towards a solution. So, the better thing is you should say one at a time, one talks the idea and it is also better when one starts

talking about the idea, the next person acquires the idea and he starts developing on top of it. So, that's what we said build on each other's idea. So, it's very clear from the ideation stage the team has to be critical, the team will look at definition of the problem and then start working on it and in the team there has to be always a harmony so that each tries to do a complimentary work for the other in developing new ideas. So, this is how in reality it happens. So, the problem definitely is defined and many at times people start using a transparent glass at where in which they start writing all the different ideas which strikes them. So, people write here whatever ideas they get, write it on the stick paper and then they stick it on the glass panel. So, then what and here also what they have done is they have given different different colours. So each colour can be for an individual or each colour can be for a theme. For example cost, better solution in the cost, so then all the solution or ideas which comes towards under costing they just write it in pink colour paper and stick it. So, then what happens later it becomes easy for them to assimilate the data and see how do we go further.

So, the benefit of Ideation is: Uncover implicit knowledge happens. Get to know how you think, Purge your mind, Get different perspectives, Recover enthusiasm. So, all these things are benefits of ideation. So, may be for one problem it is better to have minimum 10 solutions. Infact, when I take a class I try to give an assignment to the students saying that take a common product which is therefore for example, taking a cup or a spoon or a pencil. Try to develop 25 different solutions for the same pencil such that it can attract new customers and I will also say to the students that please make sure that no two ideas are very similar. So, it's really very difficult to work to develop so many ideas. Many at times what happens is we have a problem, we develop only one idea and we think that, that is the best idea,we start working on the idea and finally, we see a failure. So, in order to get out of that failure we try to have multiple ideas flowing inside for the same problem statement.

So, today we have studied the lecture on Ideation, which is very abstract. So, in this abstract session the end of it we should keep in

mind that there is nothing called a good or a bad idea. All ideas are good, collect all ideas and now start processing all those ideas by putting a filter. But while at the generation stage please don't put a filter. You write down all the ideas, then bring it to the table, start discussing, then put a filter, then try to bring down. And when you come to stage at the end of the ideation stage, I'm sure you will have atleast 4-5 ideas which will all meet out to the solution.

So, then the next stage is going to be prototype making. We will discuss it in detail in the next lecture on prototype.

Thank You.

Download

PDF: Ideate

3-4 Design thinking model – Prototyping

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://opentextbooks.colvee.org/designthinking/?p=46#oembed-1

Transcript

Welcome to the lecture on prototyping. Prototyping is the fourth stage when you are going through the ideation stage you would have realized that there are four or five ideas with me now. Now, how will I choose the best idea out of it. So, the easiest way out to that problem is try to develop prototypes. In this lecture we will start going through what are prototyping and what are different types of doing prototypes to pick out the best solution.

So prototyping is an experimental phase and the aim is to identify the best possible solutions because in the ideation stage what did you do you had multiple ideas now, you can't work on all these multiple ideas to develop products for one single problem. So, what you do is you have multiple ideas now you cut down this multiple ideas putting a filter and go towards the closure. So, this is an experimental phase and the aim is to identify the best possible solution for each of the problem identified during the first three phases. So, it is an experimental phase, it is not necessary whatever prototype you develop that goes to the final phase. In fact, when we finish the prototype we realize that oh we did not define the problem correctly that is why we have got the solution.

So, it is an experimental phase and the aim is to identify the best

possible solution for each of the problems identified during the first three phase. The first three phases are **empathy, definition,** and **ideation.** The design team will produce a number of inexpensive scaled-down version. So when you would start developing prototypes we should not keep in mind one is to one scale. We should look for scaled down model and try to solve it. For example if you are trying to solve a problem for a mosquito then we will go for scale-up model and then start working on it. So, basically the idea is to develop a physical prototype very quickly and try to evaluate with the customer and understand what is it supposed to do, or whether it is doing, what is supposed to be done. So, that design team will produce a number of inexpensive scaled-down versions of the product. To investigate the problem solution generated in the previous stage. It is an iterative generation of artifacts intended to answer questions that gets us closer to the final solution. It is an iterative generation of artifacts.

So, why we need to have a prototype to solve a problem and ideate. We need a prototype to interact with the customer we need a prototype, to start a communication we need a prototype, to fail quickly and cheaply, this is very important point whatever, idea you had if you think that that will work and you don't even try to make a prototype you make a final product so then you realise it is a failure you have invested a huge money in it. So, now here what we are trying to say is the prototyping is going to say fail quickly and cheaply then to test features and possibilities and the last one is to manage the solution building process. So these are all the needs for prototyping. So start building prototypes with raw materials which is available with you or with an economical raw material. The act of picking up some material will be good to get you going. For example, here it is all made up of paper, these are all paper chairs. So, the act of picking up some material because paper is available will be good to get you going later on you can get creative ideas while building it slowly. So, at the first stage you try to build so many things and then you try to evaluate these prototypes and then you try to get a solution for this solution, and then start slowly using that and create

multiple ideas around that to go towards the solution. Don't spend long time on one prototype. So it is long time and the cost also. So if the prototyping itself is going to take a year to make then it is better to avoid making prototypes using such material or such processes towards the solution. So you need to let go before you find yourself getting too emotionally attached to any one prototype. So if you are trying to develop a prototype first you try to see the functional aspect of it, don't start working on the aesthetics in the first round. The moment it is meeting out all the functions then you start looking unto aesthetics. So that's what is it. You need to let go before you find yourself getting too emotionally attached to any one of the prototypes. The disadvantage of this is that you will spend a huge amount of time on it while you could have worked on a better idea.

Build with the user in mind – What sort of behavior do you expect from the user? What do you hope to test with the user? For example you have developed a sofa so, what would you will expect from a customer? Do you expect them to go sit peacefully when kids are there they jump so, now what is that is what sort of behavior do you expect from the user while showing the product? So that is also there what do you hope to test with the user so these two questions are to be kept in mind the answer for these two questions will help focus your prototype. So, what sort of behavior do you expect from the user? what do you hope to test with the user? So, identifying variables, identifying what's being tested with each prototype, when tested your prototype should answer your particular question. So identifying a variable, so variable in the sense it is varying diameter, varying lengths, varying some modular fitting, all these things identify what's being tested with each prototype, when tested a prototype should answer a particular question.

So first, we try to develop Low-Fidelity prototypes, and then we will try to develop High-Fidelity prototypes and then go towards the solution. So the Low-Fidelity prototype involves use of basic models or examples of the product being tested. So, it is basic model, it's not the higher and final version. For example, the model might be

incomplete and utilize just a few of the features that will be available in the final design. Suppose, if this itself tells to tell you that oh it is not working then you will not work further on, on developing this idea. So, the model might be incomplete and utilized just a few of the features that will be available in the final design or it might be constructed using material not intended for the finished article such as wood, paper and metal or a plastic product. So, you can use any or it might be constructed using materials not intended for the finished article such as wood, paper, metal for a plastic product. LowFidelity prototype can either be models that are cheaply and easily made, or simply a recounts or visualization of them. So, here is a automatic seed, seed sowing machine so which is developed using a low fidelity prototype. So here material used is a metallic box then, Arduino board for control, then toy parts we have taken, then the purpose is testing the automation, capability and control requirement of sowing seeds. So this was the purpose. So, we are not considering for material or strength of prototype. So here we are only looking at how does it look? How do you build the conversation, and the next one is what all are the possible errors it can happen? So, that is also seen when you start making a prototype.

So, then we try to produce a High-Fidelity prototype. High-Fidelity prototype are prototypes that look and operate close to the finished product. So, in the low-fidelity it can be partial of the functions but when you are talking about high-fidelity it is almost 1:1. For example a 3D plastic moldel with movable part allows the user to manipulate and interact with the device in the same manner as the final design, is high-fidelity Fi in comparison to say the wooden block. So, what is developed here is a high-fidelity prototype. So, this is a rice planter so, a rice planter we have made all the links a scaled-down version. All the links and we have made it almost exactly like the final version. So now we know by looking at the dimensions, by looking at the structure, by looking at the loads, by looking at the thickness, we will like to see where all are the possible failures and we can try to avoid it.

So benefits of prototyping – Prototyping helps to eliminate ambiguities and improve accuracy in interpretation of the system requirements and functionality. So, when I try to show a clock, when I try to show a phone, when I try to show a product, so when I try to show it tries to have an understanding and then it will try to also communicate with my team members first, that this is what we are planning to develop or this is what is the outcome of our development. So, prototyping is very very important. Yes, you can always do a virtual prototyping, but many a times the virtual prototyping does not give you a feel for it. So it is advised to do, develop a low fidelity prototype in the first go, use with the raw material which is available or the low cost material which is available and then try to go for a high fidelity prototype which will help you to communicate your idea to the customer as well as to our team members. Prototyping helps to ensure that the solution does what is it supposed to do. Many a times we start aiming at one solution but we you start developing prototypes we get into a different domain or in a different space and we start developing in that space moving towards the solution. And when I was talking to you about high fidelity prototype I said that it has to be almost one is to one close. So in the low fidelity prototype if you start working on aesthetics so sometimes you might even
forget the functionality of the prototype. So, that is what it is supposed to say here, ensures that the solution does what it is supposed to do and not what the developer thinks it ought to do and how. I am sure at the end of this lecture you will now realize there are two prototypes to be made one is called as – Low Fidelity prototypes the other one is called as High-Fidelity prototypes. These two will try to help you in polishing your idea to meet out to the customers solution.

Thank you very much

Download

PDF: Prototyping

3-5 Design thinking model – Testing

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Transcript

The last stage of the entire design thinking process is the **Testing Phase**. Testing phase is very important. In this phase we will see how do we test and how do we report, the testing whatever has got evolved from the customer. Testing and Validation is very very important. What you have developed? What customer want and how is he rating, all these things come under the testing phase. If you don't do testing or validation it is not a good product what you develop, and many times today we have challenges that we are not able to validate what you produce. In that situations the product development becomes a big challenge.

So, **Testing is Try Your Solutions Out**, is nothing but testing. Designer or evaluator rigorously tests the complete product using the best solution identified in the prototype phase. So, you create, you test and if the test fails you repeat, you recreate the modification and then you test. So, this figure is very important which tries to convey the testing phase. So it is also looks like the testing phase is going to lead you towards the next iterations. In design you should understand there is nothing called unique, nothing called the best solution, and the first solution is never the best solution, it always undergoes a reiteration so, that you

try to develop the best product. So, design itself is an iterative process. Please keep all these things in your mind and when you start developing prototypes or when you start developing products keep it in mind that the first step is the towards the solution will lead towards an iteration and then you try to develop the next level where in which you will have an improved version.

So a designer or an evaluator rigorously tests the complete product using the best solution identified in the prototype phase. This is the final phase of the model but in an iterative process such as design thinking the results generated are often used to redefine one or more of the future problems. So now you see after finishing the testing it might lead to second stage you might even redefine the problem. Designers can then choose to return to the previous stages in the process to make further iterations, alterations and refinement to rule out the alternative solutions. So how do you conduct the tests? Let your customer compare alternatives. So for example if you have developed your prototype you are showing it to him you should also show it to him what are the other prototypes which are available in the market. So let him try other
and let him try your prototype and let him tell what is his feedback. So create multiple prototypes each with a change in variable so that your user can compare prototypes and tell you which they prefer? So here it can be two ways you yourself develop multiple variations and throw it in front of him or you try to have various other companies and your product in front of the customer and ask him to say please try and let me know your feedback. So let your user compare alternatives don't show only one and ask him to talk about it you will be saying this is the best. Okay, next when you try to show don't try to talk, don't try to tell anything to the customer, you say here is a product please try that's all. So it is show don't tell to the customer let your user experience the prototype and when he experience he comes out with the open mind and it gives you a feedback. A wide over explaining how your prototype work or how it is supposed to solve your users problem. Don't tell it. Allow the customer himself to enjoy and then he will come up with a feedback

what is it. Ask users to talk through their experience while using the developed new product let him keep talking his experience. When I first tried to lift it I expected it should be very heavy or I thought it will be very light. Looking at the red color I thought it will be very difficult to use this. So these are all his experience now, I have put in front of you the color, place and impact on the psychology. The psychology tries to have an impact on the product which is developed. So when user are exploring and using the prototype ask them to tell what they are thinking. What are you thinking right now as you are doing this? So this question you should keep asking in the testing phase so that he gives his feedback to you, then observe. Observe how your user use either correctly or incorrectly, your prototype and try to resist the urge to correct them when they misinterpret how it is supposed to be used. Ask the following questions, always follow up with questions, even if you think you know what the user means. What do you mean when you say this? When you say wow it is very comfortable! Oh it is light. So when you say we should ask that what do you mean when you say it. Then how did that make you feel and most importantly why did you feel like that

whatever you say.

So these are some of the questions which you should ask to the customer in the testing phase. So in the testing phase you will have these four quarter's to be filled. What do you like and naturally there will be another thing which you says what don't you like? So this is another quarter which you have to fill you can ask the customer to fill or you can ask questions and you can fill, and more questions on this you have any more questions on the product whatever is it so that becomes one quarter and the last one is new idea based on your work. You have thrown a product in front of them, they are using it and while using it the customer himself generates a new idea and he says why can't it be like that. So that is what is told about. Okay, so do you know which of these four columns will be more interesting to fill and which the customer will fastly fill. It is what don't you like is the first quarter which a customer will be filling in a very

quick manner. It is the psychology if you ask anybody to tell – tell five things good about you, they will think and say if they ask tell five things bad about it then you will quickly say so, you should be very clear you can have negative comments also more in the testing phase. As a designer please record it don't get disappointed. So if you get disappointed you are missing out information. So you will try to fill all the four quarter's and then try to analyze what is this customer fields which is part of the testing phase. So we have now gone through all the five stages of design thinking and this week will really would have been a hectic week because we have discussed all the five stages of design thinking.

So I would suggest if you could do a small exercise for yourself and you should have walked through all the stages then you will start understanding how each stage is easy or difficult. When you finish the testing phase keep in mind that might lead you to redefining or redoing the empathy study.

Thank you very much

Download

PDF: Testing

4-1 Empathize and Define – Understanding Customer

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Transcript

Brief Introduction

Till now we have been discussing about different stages of Design Thinking. So we were discussing about empathizing, then we were discussing about the definition of the problem. Then ideation. Followed by ideation we had prototyping. And then finally we were discussing about validation or testing your idea, with prototype, with the users. This week we will try to discuss more in detail about empathy study.

Understanding Customer

This is the first step in the entire design thinking process. So we have to identify and understand our customer. Identifying our customer is also a very important task. So we know that design

thinking is more human centric. We might have a cluster of data. This cluster of data or customers have to be segmented. And we try to focus only on a particular segment, and that segment we call it as customers.

Who is Our Customer?

So who all can be our customers as far as agricultural products are concerned.

- It can be an agricultural science student.
- It can be a faculty member.
- It can be an agricultural scientist
- It can be a personnel, who is working for State and Central Govt, Dept of Agriculture
- It can be an NGO who is working for it
- It can be even a progressive farmer or a farming community.

All these people can be a customer for us. So to understand this customer we have to use scientific tools, and with that tools we will try to go more focused towards the problem. Anyone who wants to do something for improvement of current agricultural practice to either increase yield or decrease efforts of the workforce employed in agriculture is our customer.

So there are several empathy tools which are practiced today. There are many out of which I have taken 5, more significant and prominently used tools.

Empathy Tools

They are,

- Blueprint
- Then, Persona
- Story telling
- Map of empathy
- And, taskflow.

Blueprint

Blueprint is nothing but the physical resources provided by the customer, it can be by telephone recording or it can be by transcript. Generally in blueprint we use four of these points.

- The actions performed by a customer. So in blueprint what we do is, we note it down and it is noted down step by step by step. So first what we will do is, we will go to the customer. Ask the customer about the current problem they face, or if they don't even have a product, we ask them what are all the problems they face. For those problems or drudgery what they face, can we come up with a solution. So the first thing will be. If we have a product. If we wanted to improvise the product, we are discussing about that here. So what we do is we try to give it to the customer, and ask the customer to execute the operation. And while execution, we try to record, the operation how they do. So that means to say we are trying to find out the practice. What is involved by using this current tool.
- So next is the material evidence of the service. So we try to look at what all happens to the material point of view, the responses.
- Next we try to note down the complaints and go back and contact the front office with the customer problem.
- And then we finally try to contact the technical support.

Live Example

I have given a live example. Here is a tea plucking machine, which is used nowadays, while tea plucking operations. The current state of the art is, people use their hands. They pluck and then they drop

it behind the basket, which they carry with them. The process is inefficient and it is fatigue. So people have come out with a tool which is very flexible tool for plucking of the tea leaves. So here it is very handy and this handy tool is having a cell, a battery attached to it. So it is energy portable device. Wherein it does the same thing what a hand does. But here the plucker has to use his hands, only to orient the plucking device, such that he gets a maximum yield.

So considering an example of a tea plantation worker in Assam who has been provided with a novel innovation of leaf plucking; which is designed for worker in plantation for China. So this is designed by a worker who is doing the same job in China. He has developed this device. So we wanted to take this device, give it to a Assam, so a particular focus of customer and ask him to try and see this, whether the same device can be used, or does it need some improvisations.

Next depending upon the whatever problems he faced. We are going to contact the front office of the company to solve our problems. If we have more technical problems, then we go back to the source fabricator and ask him to solve the problem. So here, step by step by step, what is to be done, how are we going to execute is given in this blueprint. So that means to say, you have an algorithm ready, you will have to follow this algorithm, note down whatever is undergone by the customer. And how he will try to solve the problem. That is what is done in blueprint tool.

Persona

The next tool is a persona.

Persona means you go to the site, note down all the problems or the action whatever a customer is undergoing. You have noted it down. Now after noting it down you would like to have a narration of all the points and then you would like to link these points. So many a times when we have it as very abstract and if we have it point wise, we might miss out. So in order to have a connection between all the points, what we do is, we try to develop an imaginary persona.

And for this imaginary persona, what all we have noted it down, we try to add characters to him and we try to add problem

statements to him, Why is this done? This gives a better understanding of the problem. And when you try to narrate the same to yourself or to your colleagues, who are there in the team. So then they have a better understanding of the problem.

- Persona is an expected target to create an innovative solution.
- Persona is an imaginary model used for designing.

It's an imaginary model. You have undergone a blueprint study. You have noted down what all the actions the person is undergoing, and now you have abstractly noted it down. Now this persona gives a more understanding about the problem.

- They are invented from scratch by practitioners.

So here let us go back to the cashew example. You can see here a woman, cashewnut shelling operation she does. So she wears a saree, and when she, while she picks cashew out of the shell, the cloth which is covered in the black spot, where the cashew acid has squirted out from the shell. It tries to hit, react and try to make holes of it. So it is prone for her to have injuries.

So here we have noted down the keywords. They are

- Women worker
- Informal segment
- Work hazard
- And then, acidic environment

Because when you try to note down a scene, we try to note down only the key points. Now with these key points if you start thinking it is your thought process, becomes very difficult. So we try to give a persona. So that is called as persona.

Storytelling

Then next thing is completely storytelling. I don't put a fictitious character. But I tell the entire points which I have grasped into a story

- So here the customer history of using a service or a product through a reliable source can be created in the form of a story.

Once you start telling an entire event in the form of a story. It becomes more interesting. Your thought process goes more appealing and while narrating the story you can add individual characteristics or characters who come into the scene. So here in which you see a scene, wherein which two women are used to plough the field. So now if you tell, oh! They while ploughing, they undergo a major hurdle or there is a huge fatigue on them, rather than saying that, if you say oh! They undergo a pain. This pain is equal to a labor pain. So now what is happening, you are trying to give more emphasis towards the pain. And you are trying to correlate the pain with another pain. Or it is, as though lifting 100 kilos of weight by these two ladies. So now when you say 100 kilos of weight by these two ladies, then you have a feel for it.

- So here the emotion expressed by the customers and their successive states of mind can be very easily told in the story telling tool

Story Telling of a Cotton Seed Plantation

- In Gujarat, small and marginalized farmers are dependent upon cash crops like cotton
- Depending upon monsoon, plowing can either be a single or deep depending upon the moisture of the soil.
- Since most farmers have less resources, they are dependent upon the frugal agricultural implements such as plow shown in the figure.

So depending upon the moisture content, the amount of load what they apply has to be decided. So if you say they are asked to pull heavy load. But this does not tell what is the customer mind state. Okay, so storytelling is the third one. Till now we have discussed three points. One is blueprint, another one is persona, and the

third one is storytelling. In fact I would suggest if you have a very difficult poetry to be memorized, you can try to make it into a song, add a music to it and go through that poetry for ten times. The eleventh time you will be able to memorize and reproduce the same, with the musical intervention up and down. So this is almost like a storytelling. So you try to remember all the characters, you try to remember all the states of mind. Why is this very important, as I told you earlier.

Design Thinking is more focused towards human-centric. And of course this problem solving is all possible, if you have a product. But if you don't have a product, still you can narrate the entire empathy study, using a story telling approach.

Map of Empathy

The next one is map of empathy.

- So here, map the emotional status of the user, while performing some action. You have given him a tool. We have given the customer a tea plucking device. A tool is given. Now what you do is while operating the tool, you look at the face of the customer. If he is happy, if he is sad, if he feels it is more of pain. Then from there you can try to realize; okay, these things are emotional study. This emotional study can be converted into engineering spec, and we can start working on engg spec, moving towards a better solution.So here the map of the emotional status of the user, while performing an action will be recorded. So that is done as map of empathy.
- Note down which part of the activity is creating a stimuli to his or her emotional status. While cutting, where is he getting this happiness, where is he getting the frustration. Who creates this? So that is what it is. How is it created? So all these things, note down with which part of the activity he is creating. While holding the plucker, or halfway through the plucker, or end of the plucking operation. Where is it.
- What he or she is doing while that emotion state is triggered. For example if your battery is drained. So now you should look

at, he has to run back to the charging station, put it on charge. So these are some of the status, emotional status. Once it is over, an event, the battery is over. Now still the machine is there. The machine is heavy. Half way through the field he is cutting. So now you try to record his emotions.

So that's what. What he/she is doing while that emotion status is triggered. So transcript that thought process. So we say,

1. User is satisfied with the activity.
2. User is extremely delighted with this activity.
3. User is unhappy with this activity.

While giving you the plucking device. So while plucking he is doing an operation and he is extremely happy, he does it with a smiling face. His productivity is enhanced by 20%, 40%, 100%. So he is extremely happy. So that's what is. User is extremely delighted, by you doing this activity.

Task Flow

The next one is task flow. This is very important. Task Flow is also a tool which is used in the path of empathy study. So here we record every event. And each event its flow is done sequentially. So that while we try to understand the problem. We see the flow and we make it much more, precisely understanding the problem.

- So a journey with task performed by the user in a chronological order. Time dependent is given here. For example this is a cashew, which is there, a fruit which is there in the tree. And then we try to break this part. This is a cashew with a shell. Then we try to break the shell, wherein which we are talking more about it. There will be acid which comes out. This acid when it falls on the skin, it tries to react, when it tries to fall on the cloth, it tries to react. And it has to be hammered by a stone, so when we do that the finger get damaged. So then after this we try to get the cashew nut. So this is the sequence

of events. If the sequence of events are not known, so many a time you will not be able to define the problem clearly.
- Recording successive tasks can help in dissecting the amount of resources consumed at each stage.
- It helps in prioritizing solution to the problem if there is any.

So first, maybe before even doing the de-shelling operation, it is better you soak and do it. This is one alternative. In the sequence if there is a provision for water, then we can say please add water, soak the cashew and then try to remove. If there is no, then we will have to record this prior and then start doing along with this.

Conclusion

So to conclude this module.

- We have understood the customer more. Understanding the customer to create a user-centric design is an idea that is needed to be explored, in order to create most creative and effective solutions. So for this there are several tools. We have seen five tools. So they are. First we saw about a Blueprint, then we saw about Persona, then we saw about Storytelling, then Map of Empathy we did, and then sequence of events. So these are the five prominent tools which are used as part of empathy study.
- Engaging with our user emotion, by putting our self in their shoe can help us in identifying the problem, that hid from an organization and keep affecting the product acceptance to its potential user. So it is also better, apart from doing the only recording of the event, we our self practice the operation what is to be done, after learning it from the customer.

So I was teaching my son yesterday. While teaching my son, it was

pretty interesting. I just told him 2+2 = 4. But it is easy for me because I have memorized it. But for my son who does not have a feel for a number 2 and then add another 2. So if I don't understand him, his level of understanding about the Maths subject. His level of understanding about number 2. Physical existence of number 2, adding number 2. Then I will not be able to solve the problem. I will not be able to teach him. Many a time when a teacher teaches, we try to teach in one way and we assume that is the unique way of solving a problem. But there are N number of ways to solve the same problem to lead to the same solution.

So until and unless we undergo the customer shoe. Or we understand the customer feeling. We will not be able to do empathy study more. Go through all the steps that our user walks throughout his/her working period. This is the other thing which is done, when we try to understand the customer.

Thank You.

Download

PDF: Understanding Customer

4-2 Empathize and Define – Voice of customer (farmers/operators)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://opentextbooks.colvee.org/designthinking/?p=52#oembed-1

Transcript

Last lecture we were understanding different tools which are used for empathy study. So now, we will go through this lecture about Voice of customer. We are now focusing, what are the voices of customer? How do you capture the voice of customer, how do you classify them so that you can come out with some engineering specification. Ultimately, we will have to work on engineering specification so, that we can make a product to take it to the customer. So, this lecture is more focused towards Voice of the customers. The voice of a customer is a term used in business to describe the process of capturing customer requirements. Customer requirements are very, very important without properly understanding the customer requirement. I always used to think this time my son will like, this saree my wife will like, this tool will be useful more to this farmer. But no, I have to go understand what really they want.

And then if I come back and find you on my solutions, I can develop something which is useful for them or which they will easily accepted. Many are times sitting in an AC room or sitting in a closed

room trying to solve a field problem is very difficult. Recently, when we were trying to develop tools for our amla pricking or for grapes crimping, we just sat in our lab and we were just thinking that, okay, the weight of the bunch of grapes will be hardly 200 grams. But when we went to the site, we realized that it will be close to a kilo. And second thing is when it is to be crimped, we tried to do a crimping exercise when we tried to crimp because of the weight, it just drops down, when it falls on the floor, the fruits gets shattered. So now we realize that, Oh, there has to be a device which is to be held.

So all these things I can understand more and more and more when I go to this site. And other thing is today, we see lot of robots which are used for plucking. So where in which all these robots work on image processing. So in image processing, it is pretty interesting, the fruit will be still in a raw condition but it would have got ripened, until and unless you touch and have a feel for it, you will not be able to analyze the status. So here my understanding is one side, but understanding the voice of the customer is other thing. So, we will focus on voice of the customer.

There are four aspects of VOC, customer need, hierarchy, hierarchial structure, prioritizing and customer perception of performance. So there are four steps, understanding customer need and then what we have to do is we have to make them primary, secondary, tertiary, we will see them in detail and then we have to say which are all important, which is not important. For example, if you want to take the tree plucking device, the most important thing is going to be the weight of it. The second thing is going to be the tree life. The third thing is going to be the cut leaves, scoop quantity, right? And the fourth thing is going to be the color. So if I don't prioritize then I will not be able to get to the solution properly.

A customer need is description in customer's own words. So this is very important when you try to talk, when you try to capture, you tried to put your thought process and then you put your objective you, try to put a filter and pick those words what you like, but you are not recording what is the description given by the customer.

So description in customers, own voice is very important. Next is customer need is not a solution, not a physical measurement. A customer does not need to have a solution to it. But if you can have an improvised advancement in the existing product, that is also okay. So how the customer want is his or her product to help him completing his tasks. This is also to be noted from the customer.

The next thing is the distinction between physical measurement and customer need has proved to be one of the key to the success of designing. So this is a very, very important point. So the distinction between physical measurement and the customer need, both are trying to be put together to form a very good product. So once you have collected the customer voice, now you have to put them in a hierarchial structure. So hierarchal structures, you have collected lots of data now. Now this lot of data has to be structured. So once it is structured then it becomes easier for you to put some strategy in solving the problem. So the hierarchical structure is nothing but a simpler structure which needs to focus both on strategy and practice. The voice of the customer structure needs into a hierarchy of primary, secondary and tertiary needs are done.

So from the voice of the customer, now I am trying to classify the data into primary needs, secondary needs and tertiary needs. Primary need will have a basic information. Then this basic information will be split into several small milestones or objectives. That will be the next secondary level. And how do you technologically solve the problem will be that tertiary one. So, primary need also known as strategic needs that are used to by the team to set the strategic direction for marketing. Each primary need is elaborated into 3 to 10 secondary needs. Primary is now split into secondary. The secondary need indicates more specific what the designer must to do to satisfy the corresponding primary need. The tertiary need, also known as operational or detailing needs, provide greater details so that engineering, R&D and perhaps the advertising agency can develop a detailed set of product characteristics. And then now what have you done?

You have collected data. This collected data is now arranged into

primary, secondary, and tertiary. Now, we have to classify that data and we have to give them priorities. Some need have higher priorities for customer than the others. The designer uses these priorities to make the system that balance the cost of fulfilling a customer need with that desirability of fulfilling that need. So this is a very important point to be noted. The designer uses these priorities to make decision that balanced the cost of fulfilling a customer need with the desirability of fulfilling that need. In the voice of customer these priorities applied to perceive customer needs rather than product features or engineering solutions. This is very important, perceive customer need rather than product features or engineering solution.

The customer perception of performance – the customer perception is also very, very important. The customer perception are also derived from quantitative market research about the customer perceived the performance of the product that compete in the market being studied.

If there is no product available or it is yet to be developed, the perception indicates how customer now fulfill those needs. Okay. Ask the customer how the presence of the power toll affects their life and how they perceive the performance of this tool.

To summarize the voice of the customer, what we studied, we studied a detailed understanding of the customer requirement is done. Common language for the design team for going forward from this point. Key input of setting of appropriate design specifications for the new product or service. Highly useful design board for product innovation is developed from the voice of the customer.

Thank you.

Download

PDF: Voice of customer

4-3 Empathize and Define – Translating customer needs

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://opentextbooks.colvee.org/designthinking/?p=54#oembed-1

Transcript

Hello, welcome to the next lecture on translating **Customer Need**. So till now what we have seen in this module, we saw first what are all the different empathy tools. Then we were looking into voice of customer. Voice of customer is very important. We have to listen to the voice of the customer in his own voice. So rather than we negotiating or advocating for him, we record whatever he says, we understand his plight with and without the tool and try to record what is his priority rather than we assuming that this will be his priority. So, that is why in design thinking tool it is very important to do a thorough empathy study. So, now we will move to the next lecture on translating customer needs.

So, if you look at the **Generic Product Development Process**, there is here planning. Next, one is **Conceptual Development, System Level Design, Detailed Design testing** and **Refinement** and **Production Rampup**.

So, till now we are more focused only on the conceptual development. In this conceptual development itself if you see there is identifying customer need, establishing targets specification,

which we will do next. Then generate product concepts, select product concept, testing, then set final specification plan for downstream. We are more focused towards identifying customer need in this lecture. While this is undergoing, you will have parallely performing economic alliances, bench marking competent products and build and test models and prototypes will happen while this evolution is happening parallely. So customer need plays a very vital role in developing concepts for the product.

So there are four steps for translating customer need. One is gathering the raw data from the customer. So whatever he says, let that be a useful data. Let that be a noise data. Let that be an original signal or a noise signal. No filtration should be applied at this point of time.

Collect all the raw data, whatever he says, whatever she says, whatever a group of people say you collect it, you record it. So, no corrections. So gather all the raw data from the customer. Next, interpret the raw data in terms of customer needs. Don't try to put your need and then try to interpret. Interpret the raw data in terms of customer need, what he wants, what she wants. In the case of cashew nut shelling. So it is what she wants while doing agricultural ploughing operation. What does a lady she wants while trying to do a tree plantation or while doing tea leaf plucking operation, what he, she thinks and what she thinks interpreting the data for his requirement. Then organizing the need into your hierarchy of primary, secondary and tertiary needs. The last one is establishing the relative to importance of these needs.

These are the four steps which are to be followed in translating voice of the customer to proper customer need. So while gathering the data, it can be having a single person or a group of person and trying to have an interview and while doing interview, if you just go in front of him and tell him that I am here to record the details for developing a product, then they will be feared and scared to share their feelings with you. So first you have to spend enough time, make the customer as comfortable as possible and then start asking your needs and asking him about the product. Then he will relax and

share maximum data with you even as subtle point, a non significant point also will be shared with you so that you can note it down and you can use it for further processing. So interview can be one or two hours per person.

So this one or two hours is trying to establish in first contact, understanding bringing him to our platform, where he or she is comfortable and then start interviewing. So that's what it said, one or two hours per person. The focus group, your moderator facilitates your two hour discussion with the group of 8 to 12 customers. This happens when we do it for agriculture implements. We go to a village, sit down with the panchayat or the head person along with the head person. We also call a group of farmers. Sit with the farmers, understand a group of farmers, what do they want? Because many a times when you try to get input from only one farmer, he might miss out some salient points when that is a group amongst them they discuss amongst them they themselves try to prioritize, they try to give the significant non significant parameters and for a designer it is very much required to get all these insights through the customer.

So observing the product in use. So while this interviewing is going on, this is one way. Suppose, you already have a product and they wanted to improvise the product. You can give them the product, ask them to work and you can keep talking while they are working. So watching the customer use an existing product or perform a task for which a new product is intended. If you see this graph, this graph talks about the percentage of need identified with respect to a number of respondents or groups. You can see here if you do one at a time interview, you get a lesser magnitude of need identified rather than comparing with a focused group. The Quantitative study graph shows that more need can be extracted from the user if your focus group interacts with a customer/user rather than one to one interaction.

So what are the questions generally we ask. Then and why do you use this type of product? If there is a product available, if you want to improvise, you will ask. Otherwise you will ask when and

why do you need a product? Then walk us through a typical session using the product. What do you like about the existing product? What do you dislike about the existing product? What issues do you consider when purchasing the product? What improvements would you make to the product? So these are some of the questions which you ask a customer while taking the needs.

Next one, If you see the customer response. So these are the questions. Typical use if your take in terms of a Tea plucking device, we say we need to pluck tea leaves fast. So, the interpreter need is device pluck leaves faster than hand. So now, when we talk about this fast is a relative term.

It was a fast with respect to what? So now, when you put it in a interpretor need, we say faster than your hand plucking. For example, if you can pluck 20 leaves in a minute. Now if you can do 30 leaves in a minute by this plucking device, it's good. So at least it should have 21 as compared to 20. If you say just by looking at the customer statement, it has to be fast. Then immediately if you think of a number of hundred then the device becomes itself a little complex. So that's what is told here. Then likes of this device. Why do you like this device? What is so special in this device? Which part of the device you like? Many at times when we have food we try to say, Oh the topping is very nice, the base is very good.

So, we ask the customer what likes of this device is appealing for you? So here, they have said, I like the smallness. So here the interpreter need will be portability of the device is a factor when a worker has to carry it out. So then dislike the device. That is also very important. Tell me what do you don't like in this device? So gripping is very awkward. We have to carry charger every time. Then suggest improvement. You can ask him, please tell you yourself tell. Though he might be an illiterate, but he is a customer. But he is also using it regularly so he can have suggestions. For example, if this tea plucking device can it be like a pistol, which is the gripper of a pistol. So this is a suggestion, this can work it may need not work. This we are just trying to get his opinion, his suggestion.

Maybe if there is a merit in it we take it further if there is a no merit, we just drop it there. So now this is customer response.

So next is, interpret raw data in terms of customer need. What do you want to solve? And you will also keep in mind, you will not ask not how that means to say. You will not ask him, How do you solve the problem? You will ask what do you want to solve and not how. So that means to that. Don't try to fix the end product and then start doing our analysis. So why don't you create a pistol shape handle for gripping.

So a pistol shape handle is more catchy to the user. Ergonomically holding a tool in a certain way is better than the others. This is the need statement which comes out in a very right fashion as against to that of this – Customer statement, Needs statement are wrongly interpreted, and need statement rightly interpreted. So like this, you can also have guidelines for Specificity. You can have Positive and not Negative. You can always say it should be light, it's easier rather than, say it should not be heavy. Okay, so and then you should also try to have in the guidelines attribute of the product. For example, I would like to charge this plucker from sunlight. So here you are talking about the Tea plucking device, a battery is here, this battery gets discharged. So, I would like to use solar power because that is more talked about today.

So that's what it is. So these are the guidelines. So for interpreting raw data in terms of customer need, we use this guidelines and we start developing it. What is what is to be solved and not how you will not ask him the end solution upfront, you will ask him what all problems he faces, and what are the significance, and what are his suggestions. We will not ask him tell me what is the ultimate solution.

So organizing the data, whatever we have got from this raw data interpretation, we organize it to like primary data here like making a tea plucker portable is a primary data, using solar power to power the device is a secondary data, using the motors and it's specification, the rating and the battery storage is a tertiary data,

which is a technical data. So you have organized them into hierarchy.

Next, we ask them to do a relative importance within the needs. For example, portable battery charging you have given 4, Change the handle orientation to eliminate. reduce fatigue is 5. Importance is given maximum. Then increasing scoop size is 3. Then making the device all weather is very important is 2. 5 is the highest rating, which is very important 2 is the is a low significant rating. So you can even forgo or try to do little later. The first thing will be given to changing the handle orientation and the battery portability. So these two are very important, which has to be solved. So now what have you done? You have established. Here the Importance of the need.

To conclude... We ensure that the product is focused on customer need. We identified latent or hidden needs as well as explicit needs. We provide a fact based for justifying the product specification. We create and archived records of the need activities of the development process. We ensure that no critical customer need is missed or forgotten, develop a common understanding of customer need among members of the development needs.

So in this chapter we saw what are all the importance of the customer needs? Translating customer needs towards definition of the problem.

Thank you very much.

Download

PDF: Translating customer needs

4-4 Empathize and Define – Design and Specification requirements

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Transcript

Welcome to the next lecture on Design and Specification Requirements. If you look at the design tool whatever we have, design thinking process we have used, in this process there are five stages **Empathy**, then we have **Definition** of the **Problem**, then we will have **Ideation** then we will have **Prototype Development** and the last one will be the **Validation** and **Testing.**

So this week what we have seen is Empathy study tools and today we will see more about the definition of the problem. We were discussing till now about voice of the customer, customer Needs, and here we are going to convert the customer need into an engineering Specification. Till now it was all I need a lighter tool, I need a heavier tool, it has to collect more leaves. It was all qualitative now this qualitative has to be converted into a quantitative one such that the design team can work on solving the problem.

So, now today we will focus on Design and Specification Requirements. Engineering Design – so once the customer wants and the needs have been identified the design team converts hem to engineering requirements for the product. The engineering

requirement becomes part of the design requirements for the product. So engineering requirement is now converted into design requirement. Successfully converting the customer wants and needs to meaningful engineering requirement needs good communication between the design and engineering group will happen and this will try to help us in developing good products. An engineering technique that is used for helping design team convert customer wants and need to the engineering requirements is done by a tool called as quality function deployment tool (QFB).

So what are the benefits of QFB. So it is basically customer driven so, creates focus on customer requirements, uses 02mpetitive information effectively prioritizes resources, identifies item that can be acting on. Reduced Implementation Time, Decreases midstream Design Changes, avoid future development redundancy, identifies future Application Opportunity, Surfaces Missing Assumptions and Promotes Teamwork and Provides Proper Documentation. These are all the benefits of quality function deployment (QFD). So it is otherwise called as **House of Quality.**

In a house of quality first thing is you will have customer requirement. This is nothing but the **voice of the customer** which is done. So now this customer requirement, how are you going to technically describe this voice of the customer? Now between the customer requirement and the technical descriptions you try to have a relationship matrix between the requirements and the descriptors, you will have a relationship matrix and if you see the top triangle we will try to have a relationship amongst these technical descriptors amongst the technical descriptors we will try to have a relationship that is done in this Triangle. Then we try to take the customer voice and then we try to ask them to get the prioritizing their requirements. And then we try to prioritize technical description, so here what we do is we try to take this detail and amongst them what are the important technical descriptors to be solved that's what we do here ranking them one, Two, three, four, five. So customer requirements to technical description there is a relationship matrix and then you try to prioritize the customer

requirement and prioritize the technical descriptors. So here also you can have ten descriptors you try to prioritize and then try to attack them first so that you can try to solve the Problem. So building a House of Quality is nothing but WHY. So list of customer Requirements -you try to ask, what are your wants?

Next, list of technical descriptors – how are you going to achieve the customer requirements? This relationship is what and how is the relationship between the requirements and the descriptors. Then development interrelationship is in the top. Then you try to do competitive assessment which is not here but if one product is already existing we try to take that product and then we try to strip that product right on all the significant requirements and then we try to assess our product whatever is there or whatever is there in your mind with respect to competitors so, that is called as **Competitive Assessment.**

Then we try to prioritize the customer requirement, then we try to prioritize the technical descriptors. So, now what I have done is I have split the QFD matrix into small Small, small modules so that you can better understand. So customer requirements as we studied earlier Primary, Secondary, Tertiary so we try to write down what is primary? For that primary you will have I said 3 or 10 thought process will be there. So then we try to write down primary. Secondary thought process and then here we will try to write down the technical descriptors Right, and then after writing this technical descriptors we try to write down a relationship between the customer requirement and the technical Descriptors. So, here in the relationship we try to give weightages we try to give dark and dot where it is all nine points which is highly important, then which is medium, and which is very weak. The differences between the three has to be when you give a magnitude you try to give a larger magnitude difference. So that when you try to multiply you try to see a heavier impact on the ultimate Solutions. So this is only a mathematical representation you can have one, two, three or ten, 20, 30 or 10, 30, 90 whatever it is okay. So the relationship so

here we try to draw between the customer requirement and the technical descriptors.

So now this is what is customer requirement, technical descriptors, primary/secondary. Now, what we are doing is the second stage. This is the relationship amongst the technical descriptors. How strong is this relationship between the first technical descriptor and the ninth technical Descriptor. So we say strongly positive, Positive, negative, strongly negative. So again here you try to give the values. So this is mark and then this values are given. Why are you more serious about these values because finally we try to multiply these values as a weightage factor or we try to sum up and then try to get some quantifying values. Moment you have a quantifying values then it tries to easily give you the importance of that particular technical descriptor or the customer requirement. So here the relationship between the customer requirement and the technical descriptor is What Vs How. What the customer wants and how are you going to make it? Now we will see little more in detail so the first front half till this we, now we will see the bottom portion of the QFD. So in the bottom portion of the QFD, what we do is we try to write down what are the Customer Competitive Assessment. Customer Comment and Technical Competitive Assessment with two different competitors to this product what is our thing what is customer. The Product A what does it do? Product B what does it do in terms of technical Descriptions.

So here we will try to full this data and this data. From this what we do, is we try to write down the degree of technical difficulty in achieving the technical descriptor, then target values of absolute values then relate to weightages. So these are all again we try to get and this try to prioritize the technical description and as far as the customer importance we try to note down the customer importance, target values, scale up factors. Then you will have scale points then absolute weightages you multiply and then you get some values. Let us look at a simple example we have done for a Drone. Drone is a unmanned air vehicle which is flown above the

ground surface for various applications like recording, surveillance taking, agricultural or image processing, So we use drone. So here we can see that we have put the customer requirement. We have put the technique acquirements are it has to be stylish, it has to be Lightweight, it has to be quiet, it has to have a hard a super HD camera, it has to have it has to have a high quality finish. so all these things now you see what we
have written as customer requirement or it is not written as per the priorities. We have written all and then we are trying to do the ranking. Then how do we achieve it is the technical descriptors we have done so now this technical descriptors we will try to see a relationship, amongst them we will try to do here in this top Triangle. Then what and how relationship is drawn here.

Then we have customer the competitor assessment is done and then we try to convert all these things into magnitude values such that we try to get more understanding towards defining the problem from the customer needs. Customer need was qualitative now you have converted into an engineering quantitative values. So a product development cycle if you see it starts from customer requirement, design Requirement, what you get is that design requirement. So you do the relationship between these two what finally you get is a design requirement.

Now, this design requirement you try to have a relationship with part quality characteristics. So then what you have you get the relationship between design requirement and part quality characteristics, what is the output you get is a part quality Statistics. This is the first HOQ, this is the second HOQ, the third HOQ and the fourth HOQ. So from the part quality characteristics we try to do Key Process Operations. So from this relationship we try to get the importance of key process operations.

Now with the key process operations you try to have a relation with production requirements and what you have is the production start which comes out. So this is how a typical product development cycle flows and we try to have relationship between customer Requirement, design requirement, design requirement to part

quality, part quality to key process operations, key process to product requirements. So in conclusion in a house of quality HoQ we saw QFD gives orderly way of obtaining information, it shortens the product development cycle, it is considerably reduced startup cost, fewer engineering changes will happen if you follow QFD. Reduce the chance of oversights during the design process, environment of teamwork always behind HoQ together, then consensus decisions and preserves everything in writing. So all these things are advantage of HoQ. With this lecture we are completing four weeks of our course. Till now we saw Design Thinking, various stages of design Thinking, we in this design thinking stage we saw Empathy study as well as definition of the problem. We will now in the rest of the course see Ideation tools used for ideation, frugal innovation, then what are the different types of prototype, how do we make low fidelity prototype, high fidelity prototype, and then finally we will conclude the course with the case Study.

Till now whatever we have seen we have given lot of live examples. Please try to use these live examples to your own and then start customizing a problem, start solving it you will then appreciate the use of Design Thinking tool for developing agricultural implements or products.

Thank you

Download

PDF: Design and specification requirements

5-1 Ideating – Practicing Creativity

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Transcript

Basic Introduction

Welcome Friends. We are now half way through the course. Till now we have been going through, understanding Design Thinking, which is a very powerful tool to solve agricultural drudgery problems or in developing innovative solutions in the field of agriculture. Design thinking has 5 steps.

1. So the first was empathy study
2. The next was defining the problem, which we saw in detail.

So the next two steps are going to be

1. Creating solutions
2. then prototype testing
3. And finally we will do validation.

Topics Covered last Week

Till now what we saw was

1. Understanding customer through various communication tools, such as empathy mapping
2. Understanding voice of the customer
3. Learn how to translate customer needs
4. And how to define design specification using House of Quality

This week we will try to explore idea generation process for product design through creativity mapping tools. So creativity is something which people always think it is very difficult. But if you have a wellstructured process of doing an empathy study and defining a problem, which is in a broad way but trying to capture minute things. Then creativity which is the next step or ideation which is the next step becomes very easy. So in this presentation we will see, how do we practice creativity, or what are all the stumbling blocks towards our creativity.

Introduction

Creativity is a combination and recombination of previous experience that form a new combination, thus satisfying the needs. So the development of an idea, that are new to a person, leading to the discovery of different or alternative design, methods, systems or processes, that will accomplish the basic function at minimum cost can be defined as creativity. So in creativity we try to explore all possibilities. Try to choose the best possibility. And then we also keep minimum cost as a constraint and solve the problem.

So if you look at this diagram. It is an inverted or it is a funnel diagram.

- So here we have a preparatory phase which we have already gone through
- Next one is the induction phase, wherein we try to use a tool called as brainstorming, which we will see in the next lecture.

Blocks to Creativity

There are several blocks to creativity. We will see those blocks one after the other after the other.

Habitual blocks. Always try to use **tried and tested** solutions. This is called as a habitual block. We always try to solve a problem in a known way. And why is that. That is because of our habitual. So here we try to find the habitual use. And after we try to find out the habitual use, we try to codify, understand the commonality. And then we try to adopt the habitual, which we have understanding. And then we try to modify it to go towards a creative solution. So many a times when we try to, this habitual block tries to even dictate. For example everyday morning getting up at 5 o'clock and going to or doing a routine. Going to the field, doing this, doing that. That is habitual. If I wanted to disturb that habitual cycle, it is always a big mindset and a block. Moment you have a mindset and a block, then creativity cannot be thought of in a big way. So this is a big block towards creativity.

Next one is **Perceptual block.** These are the obstacles that prevent the problem solver from clearly perceiving either the problem itself or the information needed to solve it. So here this is a perceptual block. I try to conceive like this and I try to solve the problem. But your conceiving, whatever was it need not be what was customer choice. Your perception is also a block in solving a problem, wherein which you put in your thought process and not the customer's choice. So here this is also an obstacle that prevents problem solvers from clearly perceiving either the problem itself or the information needed to solve it.

So here you will have stereotype solutions will come, because you thought this is how the problem to be solved, this is how the problem is. So we always try to have a stereotype idea, and then we also have limiting the problem unnecessarily. So this is the problem statement. And for this problem statement; you understood this. And now what you have done is, you have limited your problem understanding and tried to solve. But whereas the customer requirement was a large. Was a large area, but you have perceived it over the small area of the problem. And you have tried to solve

this and then get the solutions. The next is saturation or overload of information is also something which quite happens in this block.

The next one is a **Cultural block**. We always think culture is good, and culture tries to teach you many things. In the same way it also comes with a block. So the creativity is blocked by habitual. It is blocked by your perceiving. And it is also blocked by cultural.

- Desire to use the proper pattern, customs or methods. This is a cultural block.
- Thinking, that indulging in fantasy is a waste of time. So that means to say that if somebody says, I am thinking. We always say, thinking is a wasteful job. So don't waste your time. This is a cultural block. Start working rather than thinking. Okay, this thought process is something which is a cultural block. And this not many people accept it.
- Having faith and confidence, only in reason and logic. So this is also a cultural block. So they don't think wild. Think, go out of the box is not possible. So this is also a block for creativity. For example let us go back to the Amla pricking machine.

So people always thought, while doing grating, it has to be done on a flat plane grating. So they were not even allowing us to think of a process, why don't we put it inside a conical grating, and tried to grate the Amla. Amla is gooseberry, so which is a fruit where inside you have a shell. Hardcore shell and this shell is covered with a pulp, which is going to be used for medicinal value or for food consumption.

The other important block of creativity is going to be the Emotional block. Emotional block is something very dangerous. If I do this, I might fail.

- So fear of appearing foolish or of making a mistake is an emotional block
- Second thing is fear of distrust from supervisors or colleagues and subordinates

- Over motivating oneself to succeed quickly
- The next is, in achieving an objective, refusal to make any rerouting. So that means to say you have moved in this process. So suppose in between you realize there is a mistake. So we don't take a detour and then understand what is the mistake, and then go back to finding the solution.
- Next is failure to reject choice which are satisfactory, yet which are clearly sub-ideal. So these are emotional blocks, which is also part of blocking from creativity.

If we are able to remove all these 4 blocks. Habitual block, then we are looking into our perceptual block, then we were talking about cultural block, then emotional block. These are the four major blocks, which tries to affect us, moving towards creativity.

So some of the factors which support to creativity are orientation, motivation and permissive atmosphere.

- So orientation is development of an attitude that is best suitable for imagination. This is a factor which has to support creativity. Allow people to think beyond the box. Allow people to make imaginations. That's why if you go back to our empathy study. We were talking about narrating a story; persona. For example if I want 100 characters, and all these 100 characters have to be memorized.It is very difficult for you to just memorize the 100 characters. So that is why in storytelling what they do is they try to link each character. And when they try to link each character, they also try to give an event or a small anecdote, such that all these characters are connected. When a reader reads through it, he has a understanding of the complete problem.
  So here imagination. Orientation for imagination is a supporting factor for creativity.
- Then next one is motivation. There has to be an incentive given for creativity. So an essential vitality is summoned to work towards an objective and accomplishing it. So there has to be a

motivation which is given. So this motivation leads to creativity.

- Then permissive atmosphere. An atmosphere, wherein which we don't put any of those 4 blocks, which we talked earlier. So then there is a lead for creativity.

Summary

To summarize,

- Creativity is a process which combines and recombines our previous experience.
- There are 4 blocks
  - o Habitual block
  - o Perceptual block
  - o Cultural block
  - o Emotional block
- And permissible atmosphere is an environment in which new thoughts are motivated.

Thank You.

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PDF: Practicing Creativity

5-2 Ideating – Brainstorming

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://opentextbooks.colvee.org/designthinking/?p=60#oembed-1

Transcript

Brief Synopsis

Welcome to the next lecture on Brainstorming. So we are now discussing in this module about various creative thinking tools. The first lecture what we saw in this module is what are all the various blocks, which happens to our creativity. Now we will see a tool which is used for enhancing the creativity. The most powerful tool for enhancing the creativity is 'Brainstorming'. Moment I say brainstorming, there has to be a team. So I would reiterate, it is very clear, that when you are trying to work on a design problem, you should have a team. A team of people coming from multiple backgrounds, who can complement each other towards a solution, is what is brainstorming.

Introduction

- So brainstorming is a name given to a situation. When a group

of people meet to generate new ideas around a specific area of interest. The specific area of interest is nothing but the problem definition which you have defined in the previous stage.

- Using rules which remove inhibition. People are able to think more freely and move into newer areas of thought, and so create numerous new ideas and solutions. So here what happens. You have just put the problem definition in front of maybe 8 people in a group. So now all the 8 people are allowed to think for a solution in their own thought process. So here when they are thrown a definition, then they all work on their own thought process. They come up with multiple ideas. And these ideas can be strange. Can be all similar. It can be also out of the box, which is completely imaginative.
- The participants shout out ideas as they occur to them and then build on ideas raised by others. So what they say is, "please do not stop any idea, please don't evaluate any idea, allow everybody to talk about solutions". For example we go back to the tea plucking device. If you can develop a tea plucking device wherein which it weighs 500 grams, and which has infinite energy; portable energy with it, and which can maneuver and which can have sensors to exactly pick the leaf which is to be cut. So that will be a very vague idea. But there can be some merit in that idea. Now we are to just accept the idea. So you allow the individuals to shout their idea.
- All the ideas are noted down and are not criticized. Only when the brainstorming session is over, all the ideas are evaluated. So it is something like, okay there is a time start now, the problem definition is thrown in front of everybody, and then they start giving their thoughts. And there is a person to record all the ideas or they video record their ideas. And they say, okay there is a time which is given for 1 hour, ½ hour, 15 minutes. And then they say, at the end of 15 minutes they stop the clock. And now they have listed down all the ideas. They look at individual ideas. And then what they say is, they say

> okay let's take this idea. Then we will try to take one more idea. Try to merge these two ideas, and then try to develop a solution.

When we started looking towards this developing of prototypes for agricultural implements, we had N number of ideas. And these N number of ideas, we finally what we did was we merged 2 ideas, 3 ideas into one idea, and started working on those ideas. And when we took forward to the next step, several of these ideas of its own got filtered out. When we had 4 to 5 ideas which we took to the next level of prototyping. Here in the brainstorming session what we say is, you don't put any filter. You allow everybody to participate. Then you try to create a conducive environment. People even go ahead and argue that the room should be conducive in terms of lighting, in terms of ambience. Give them proper food such that their thought process is more provocated. So all these things are conductively done in an environment. Such that the brainstorming session becomes more successful.

Brainstorming Techniques

- There is an incitement of an individual's brain by the psyche of another in this process
- In the normal gathering of a brainstorming session, 4 to 6 individuals are present lounging around a table, perceptualizing creative thoughts intended to tackle a particular issue or a problem.

So the rules are

- Criticism is not allowed
- Free-wheeling is welcome. Free-wheeling means anybody can talk anything during that time.

- Any number of ideas is welcome and desirable
- Improvements and combinations are sought. So that means to say, one idea, 2nd idea, 3rd idea. They will take 10% of the first idea, 50% of the second idea and rest 20% from the third idea. Merge these three ideas and come out with one idea.

Important rules

- Newly generated idea should not be judged simultaneously. They should be separated by time, space and people if possible. This is only for newly generated ideas.
- A large quantity of possible solutions should be generated.
- As ideas are generated watch for opportunities to combine and improve them. Even apparently impractical ideas should be considered.

This is how a scene which is created. And you will see a table. As I told you a conducive environment, you will have a round table, wherein which you will have 8 people, 10 people, 12 people participating. And mind all these people should be complementary to each other. That means to say, not to have all 12 people expert in one area. When you are trying to develop an agricultural implement,

1. you should try to have mechanical engineer,
2. you should try to have industrial engineer,
3. you should try to have economics person,
4. you should have experts in material,
5. you should have experts in market,
6. you should have few customers also participating in the discussion.

So when you have all these things happening together, then a brainstorming session happens at a very full; effectively happens.

How to Brainstorm

So how to brainstorm

- Step 1 is Defining the Issue which we have already discussed.
- Step 2 is Layout the Context very clearly. Layout the context. We are trying to develop a tool for economically backward farmers.
- Step 3 :-The next one Is pick an Appropriate Facilitator. So a brainstorming session, if you make everybody as a leader, then there is a setback in the discussion. So it is always better to identify, one amongst the person as a facilitator, who tries to give chance to everybody. Though freewheeling is allowed but giving proper chance, giving proper mentoring and recording the ideas in a sequential manner, and then consolidating it for the next step of evaluation, you need a facilitator.
- Step 4:- then Invite the Right People. That's what I said, complementary to each other. Then you should not have a critic, who comes and criticizes every idea. So he should not say, whatever idea you say, "this is infeasible". Because we have said very clearly, at this point you are not supposed to evaluate any idea. So you should have right mentality people in the brainstorming session. That is Step 4.
- Then Step 5 is Set the Agenda.
- Step 6 is Holding the Session. Say for example giving the appropriate time, giving importance whatever it is. And then you start allowing them to generate ideas.

So these 6 steps have to be followed for doing a brainstorming session. Brainstorming always happens as a group. Brainstorming on your own is not permitted. If you think I am the expert. I know everything. I am the customer. So I can develop everything, no. You are a customer. You have understood the problem very clearly. But until and unless you discuss the idea with a group of people and

evolve new ideas. Then only your brainstorming session becomes more effective.

Brainstorming Benefits

So what are all the benefits of brainstorming session.

1. Improves:

It improves

- initiative,
- innovation,
- quality,
- profitability,
- efficiency
- and morale of the customer.

2. Problem Solving:

- It tries to solve issues.
- Through problem solving it tries goes towards the root cause,
- alternative solution,
- impact analysis- impact analysis is, you have 10 different ideas. What is the idea of this, whatever your idea is given, in terms of feasibility, and how good it is. According to the gut feeling. Still you have not gone to the prototype.

Let me give you a simple example of impact analysis. When the plastic bags; carry bags which came into existence. People were happy and people were just looking at producing at a very economical price. So today you have technology which has got so mature, which produces plastic bags at an economical price, but the impact what it has created is, it is trying to kill mother earth. So because these polymers are not biodegradable. So they are going to sustain in the environment for a longer time. So that is impact

analysis. By developing the solution, what is the impact it is going to create for the environment, for the individual. That is impact analysis

- and decision making

These are all the problem solving which happens while using this brainstorming sessions

Team Building: it is a team building where you try to share and discuss.

Project Management: and then project management also comes.

So for receiving all these benefits, we always try to do brainstorming sessions.

Summary

Brainstorming is an activity by a group to generate ideas. A typical brainstorming session can be executed by the following steps.

1. One is defining the issue
2. Then layout of the context. Layout of the context is very important. If I just put the definition of the problem alone, without giving the context. The context can be the emotional pain. The context can be happiness. The context can be sad. Context can be the plight. So that if you don't put then the brainstorming session cannot happen with that impact. For example if I say, double up a tool for a farmer to pluck leaves, to pluck fruits. If I don't say, poor man has to carry 50 kilos and when he walks it is too heavy, it is equal to his weight. If I don't tell the context properly, then the brainstorming session will not happen to the fullest extent.
3. Next pick an appropriate facilitator, that is very-very important.

4. Next one is invite right people.
5. Next set the agenda
6. And hold the session properly

So brainstorming is one among the several creativity tools, which has proved to be very successful. There are N number of tools out of which in creativity, brainstorming is one of the best tools which is used.

Thank You.

Download

PDF: Brainstorming

5-3 Ideating – Checklisting

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Trancript

Welcome, to the next lecture on Checklist. In this module we are seeing how to – what are the creativity blocks? What are the creativity tools we can use? Now that we have created 'n' number of solutions and now we have to go to the next level to improvise our creativity thought process. So we would see this in this lecture about checklist.

Introduction:

Question check listing is a simple but effective problem-solving activity. It is straightforward to use and easy to adapt to any specific circumstance. Using a set of structured question encourages both broad and deep analysis on a situation or a problem. See you have to be as broad as possible and deep as possible. People say we will go broader and, broader and, broader when you go broader and broader and broader in your problem so then you miss out a deeper understanding. So, this check listing is a very powerful tool which will try to have a broader as well as a deeper understanding of the

problem. The question themselves may be simple but when used as part of the checklist they become a powerful management tool. We would insist that those people who are working in the area of developing agricultural implements to follow this check listing procedure. The tool uses your question hierarchy. In this hierarchy what broadly states the situation or the problem although, why is the arguable we the most powerful question you can ask. "What" broadly States the situation "Why" arguably sets the most powerful question you can ask. Asking 'Why' forces you to consider the significance of the problem and thus the nature of your response. Repeatedly asking why can enable a deeper understanding of the problem, essentially for getting to the root cause.

Next, you should use "**how**"," **where**"," **who**" and "**when**". These questions are designed to both deepen and broaden your analysis. "Why" are used to go towards a deeper understanding "how"," where"," who" and "when" helps you towards broader as well as deeper understanding. When combining into your question checklist they become both a tool for analyzing and the solving problem. The following image in the next slide shows the structure of the question checklist and includes some examples for more detail, follow-up questions, it is easy to develop a checklist to suit your own situation. So I was talking about "why"? So, let us ask a simple question for ourself. Why am I not able to perform this task? Because I don't have an understanding of the process. Why you don't have understanding of the process, because nobody has taught me to do this process in a systematic manner. Why nobody has taught you because you are the first customer to use the product. Why are you the first customer, because this product was developed exclusively for you now. Now you see we have gone step by step by, step by, step asking why and we have gone almost to the root cause. So asking five times why is very powerful. When a child is born it always starts asking you questions – Why is it so? How is it so? Many a times we don't have solutions to it, we try to avoid giving answers to these questions. So, asking why is to be encouraged. If you ask

why then you will understand the problem more in clarity. So, these are the questions which are structurally arranged.

First, is "What" so, what do I want to achieve? Next is, What are the facts? Next, is what would happen if no decision was made or solution found? You are trying to solve this problem. You are not able to get the solution. So, if this still this existing solution if you are happy then why at all to solve this problem. Next, what do I need in order to find a solution? First, of all you should ask so, that all I have to solve this problem if you have to solve this problem, what do I need in order to solve this problem. Why do I want to achieve a solution? Why did the problem or theopportunity arise? Why do I need to find a solution or a way forward at all ? Ask five Whys. This is all a structured thing for why. How will the situation be different ? Suppose, you are trying to use a product on a sunny day. The same product when you use in a fog day or on a cold winter day, how does it respond? Does it still work? For example, if you use this tea leaf plucker your hand is exposed to the environment. So, you will start shivering, when you start shivering you will not be able to achieve the product output. So, that's what I said how will the situation be different at different seasons ? How relevant is this information I am gathering? So suppose if they say for every 15 minutes we will take a break, and then we used to relax for some time and then start doing it. Is this information very important? Yes, it is important because that tries to talk about the fatiqueness which the employee undergoes. Suppose, if they say green color if you have then it becomes more appealing. So, is this information really required? You can ask right. Next, is how can I find out more? If something is stopping ,or if they don't give more reasons, or if they don't give more insights, so then you should ask how can I find out more? So, that means to say I asked 10 people, and whatever the ten people saying are contradicting each other, I need to have more information. How do I do it? I can start looking through the internet browser for data, I can talk to experts and collect more, then I can go to another village and collect more, or I can try to go understand . What is the practice in another country? How can I

find out more? Then, how can I involve relevant people? So, these are all the different house which is to be taken to understand in a structured manner. Where, where did the issue arise? Where does it impact? Is this where important? If so why? Next, Who am I trying to please? Who care about this situation? Who is affected? Who is involved in, that means to say information help action. Who need to be informed? So these are the different "whose" which you should ask or after doing the brainstorming session you should put all these questions. Then, last "When" did the issue arise ?When do we need to act then, by when must it be resolved? So, these are the things where in which it talks about time which is getting integrated into the solution.

So, five W's What – what this is really the first question you ask when you are trying to gather requirements for projects to define the scope. It gets no simpler than what do we do? That is the first W. Next, is Why, as I told you why am I doing it and ask five times why to go towards the root cause. Next, who are your stakeholders, team, customer, that will work on sponsor and ultimately get benefited through your project. "When" sometimes this question, gets asked before all the questions, we discussed about get to discuss about to get the answer. You need to know "Why", "What", and "Who", will be part of your project before you can adequately answer when it will get completed. So, "When" is time-bound. As, I told you in the previous slide also, "when" is time-bound. The next, one is "Where" where did you get this data? Where are you going to implement? Who is going to solve it? So then, after all is said and done, where will your project be done and how will it be done ?

To summarize:

Checklisting is a whole proofing tool for covering all the questions that are needed to be answered in the ideation process. So this can

also parallely happen during brainstorming session itself. But after the brainstorming also you can do this. You structure it. S checklist should have five W's (What, Why Where, Who, and When) and finally you should have and How will you execute it.

Thank you very much.

Download

PDF: Checklisting

5-4 Ideating – Webbing Techniques

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://opentextbooks.colvee.org/designthinking/?p=64#oembed-1

Transcript

The next topic of discussion in the Ideating process is **Webbing technique**. Till now what we did? We have collected lot of ideas now whatever ideas we have collected, we have asked questions so now these question will try to help us in structuring. Now, we are trying to use a technique called as **Webbing technique**. Webbing technique is nothing like mind mapping. Several parts come, how are these parts linked with each other together. So, that technique is called Webbing technique.

Webbing:

Webbing, sometimes refers to as a mind mapping. Why? You have several parts, all these parts has to be linked so that you have a structural thinking towards the solution refers to as a mind mapping typically involves writing down a number of thoughts and ideas. Whatever idea it came now all those ideas you are writing it. Now, after you write those ideas. I say 10% of this, 20% of this, 50% of this idea. So, now how did you do it? We try to do a mind map.

We try to do a webbing technique. Then, you return to what you wrote and connect the dots to create a web that links together all your individual parts. So, if you remember, I was talking to you about primary requirement, then secondary requirement, then tertiary requirement. So, all these things if you see, they are all thought process that are linked with each other. Then, this can actually be a very chaotic process, because you are writing so many thoughts which come into it. I will show you finally how does a web maps looks like or mind mapping looks like. You have to be willing to let go your organizational mental structure. This is what I told the mental block, the habitual block, the emotional block, the cultural block and environmental block. So this is what it is. So, you have to be willing to let go your organized mental structure more than in other brainstorming methods. But if you're successful at webbing, you can develop a number of ideas that are instantly applicable to each other and the topic in question.

To start, grab a sheet of paper and write down our focus topic in the center.

Then, simply jot down every other idea, concept or consideration you are thinking about that relates to the topic. If I talk about a product – I should talk about weight, I should talk about energy, I should talk about color, I should talk about shape. Then, when I talk about energy – I should talk about drive, I should talk about mechanism. So these are all coming. So, ignore placement and formatting for the dumping stage and focus on getting the idea down to a paper. Writing down on a piece of paper gives you more, and more, and more clarity. Moment somebody is very angry with you, somebody has lot of thought process with you. You ask him to peacefully sit down and write down his thought process. Now, many thoughts will simply get eliminated because he or she himself is it is not practical. So, once your sheet is covered with ideas, start to identify the ideas that relate to each other by circling, starring or otherwise making marks of them. Then, connect the circles with lines. So, if you see this is the typical webbing thing. You may want to use different types of lines, different colors, or even a second

sheet of paper or sticky notes to group and regroup your ideas. The end result will be a number of clustered ideas that are connected through a web of lines. So if you see this is the typical webbing thing. So, manual thinking so, it is linked with techniques simple, then you write about some techniques , then you write about approach collaboration, then you see approach, you see design. This is a Web mapping which is done. So, where the centre theme is your problem statement and several other things which comes to your mind you write it down and then it goes to the periphery and then you start linking them.

Benefit of Brainstorming Webs

So, the benefit of brainstorming webs is it helps people to develop and improve the ideas and thought process. Allows people to discover new ideas and relationships between the concepts. Get the mind going to generate and organize thought processes, so that the new ideas and in formations can flow easily.

Summary:

To summaries Benefit of Brainstorming Webs – Webbing is a process of connecting dots. We list down all the ideas, and then try to connect one with each other. So it should be one idea become as separate vertical standing there. You should try to link that idea with another idea so that you can see the mapping happening properly. It is a process of classifying individual thoughts into groups. These groups can have commonality between them. The process helps in organizing the random thoughts created while brainstorming session into a structure thought process. So, what are we trying to do? We are trying to improvise our ideas such that

in the next stage when we want to make prototypes we are able to make only feasible prototypes. If you have thousand ideas you can't make thousand prototypes. You will have thousand ideas from there by doing all these web techniques you will try to reduce thousand ideas into ten practically possible solutions for the idea. So, this webbing technique is a very very powerful tool.

So, first we went through blocks, then we saw brainstorming, after brainstorming we start at looking into the various house and voice that is the checklisting process. Now, once the checklisting process is done, then we try to undergo this webbing techniques so, that we try to organize our thought process.

Thank You.

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PDF: Webbing Techniques

5-5 Ideating – SWOT analysis

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Transcript

The next analysis in the Ideation process is **SWOT analysis**. SWOT analysis is generally done by business analyst. While doing the Ideation process also it is better to do a SWOT analysis.

The SWOT analysis is a very simple tool. This SWOT is an acronym so each letter has a word attached with it. The SWOT 'S' stands for the Strength, 'W' stands for the Weakness, 'O' stands for the opportunity and 'T' stands for the Threats. This analysis can be done for every decision you take in your real life time. Suppose, you are trying to get a promotion, you are trying to invest money, you are trying to develop a product so, it is better we do a SWOT analysis. So, when we do it we try to see what is our strength, what is our weakness, what is our opportunity, what is our threat? Suppose, you try to develop a product which is delta x improvement and already 20 companies are already there in a similar product. Then they are all going to be a threat for you. Strength suppose you have a strong hold or an understanding of the problem and you try to find out you are having a set of people whom you can convince so, that is called as strength in solving the problem. So, Strength, Weakness, Opportunity and Threats are the four important things which is to be considered before taking an idea or before taking a decision.

Strengths and weaknesses are internal – which is more towards your company or towards your thought process whatever it is. Strength and weakness – Examples includes who is on our team, our patents and intellectually property right, and our location. These are all part of strength and weaknesses.

The Opportunity and threat are external—things that are going on outside your company, or the market. So. It is very clear strength, weakness which comes in the top is internal, what is your strength in developing the product, what is your weakness in understanding the problem. The other two which is opportunity and threat which is controlled by external environment. So, for SWOT analysis to be effective the company founders or leaders need to be deeply involved. This isn't a task that can be delegated to the others. You have to sit down and write. You have to understand yourself. You have to understand the strength. If you have a team the strength of your team, the weakness of your team. You are trying to develop a product where in which in the development of the product you decide that it is a product which has some electrical components and you don't have any electrical expert, that is your weakness. And many a times a people think that an individual can develop a complete product and he can be successful, it is very difficult. When you try to develop a product and when you try to use the design thinking tool, you should always have a team. But, company leadership shouldn't do the work on their own, either. Select people who can represent different aspects of a company, from sales and customer service to marketing and product development, all of them involve together in developing a solution to the problem.

How to do a SWOT Analysis

- Doing a SWOT analysis is similar to brainstorming meetings, and there are right and wrong ways to run them.
- It is a general suggestion to give everyone a pad of stick-note

and have everyone quietly generate ideas on their own to start thinking off.

- This prevents groupthink and ensures that all voices are heard.
- After five to 10 minutes of private brainstorming, put all the stickier-notes on to your wall and group the similar ideas together. Allow anyone to add additional notes at this point if someone else's idea sparks a new thought.

Strengths

So, this strength as, I told you strength is internal, a positive attributes of an organisation. What processes are successful? What assets do we have in our team, such as knowledge, education, network, skills, and reputation? What physical assessment do we have, such as customers, equipment, technology, cash, and patents? What competitive advantages do we have over the others? These are all the strengths.

Weaknesses

Weaknesses – Are there things that the organisation needs to be competitive on ? What processes need improvement? Are there tangible assets that our organization needs? Are there gaps in our design team? Is the location ideal for success?

Opportunity

Opportunities are external factors – Is our market growing? Are there upcoming events that the organization should participate? Are there upcoming changes to regulations?

Threat

Do we have potential competitors? Will suppliers always be able to supply? Could future developments in technology change the existing product? Is customer behavior changing over a period of time?

To Summarise:

A SWOT analysis organizes our top strengths, weaknesses, opportunities, and threats into an organized list and is usually presented in a simple two-by-two grid. So now you will have in a two-by-two grid, so now you can try to see, okay we have this idea, these all are our strength, these are all our weakness, this is our market threat, these are our opportunity. Now, let us start working on the idea. So, many a times people say I have developed a product there is no customer because you have not done this SWOT analysis properly. SWOT analysis is a very very important tool in developing your ideas. Suppose, you look from the business yes, this is also important. SWOT analysis will force us to look at our business in a new way and from a new direction. You'll look at your strength, weakness, and how you can leverage those to take an advantage of the opportunities and threat that exist in the market. So, this analysis is very very important for taking the product to the market.

Thank You.

Download

PDF: SWOT analysis

6-1 Ideating continued – Prototyping-Part 1

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Transcript

Welcome to the course on Design Thinking for agricultural implements. So, in this course we are discussing about a tool which is used in developing agricultural implements more focused towards customers. So, in this Design Thinking Tool there were 5 stages: First stage was, the Empathy study, the next stage was Definiton, third stage was the Ideation, the fourth stage is Prototyping. Prototyping is very important so in this week we will try to cover in detail about prototyping.

Introduction

The prototype mode is the iterative generation of products intended to answer questions that get you closer to your final solution. So, till now we were writing in words, we were try to compare with customers in terms of quantitative parameters. We have here very basic schematic diagram about what all functionality should there be in a product. But, now we are going to make something and show it to the customer this is how your products

look like. Ofcourse, virtually also you can do a prototype and show it to the customer, but virtual prototype has its own problem. For example you can draw an object which cannot be fabricated or you can try to have a colour which cannot be produced in real time. In that case making a physical prototype is very important. And that is what is dealt in this line **"The prototype mode is the iterative generation of products intended to answer questions that get you closer to your final solution".** While making the prototype you might feel infeasible features. Infeasible functions which you thought could be done easily. For example you could have thought about mechanically moving object which is attached to your battery and this battery is the energy source is the portable energy source. Definitely, with is the portable energy source if you have a mechanical energy part the energy drained out is going to be very fast. So, now when you do the prototype and when you take it to the customers you realize the customers will say..Oh! this is accepted or not. So, prototyping is a very very critical stage. Like all other stage you have to give enough emphasis on physical prototype.

In the earlier stages of the project that question may be broad … In later stages, both your prototype and the questions may get you refined. As, I told you in the beginning the 5 stages – whatever we have studied as part of design thinking these 5 stages we move step by step by step. So, at every stage please keep it in mind that you can go back to the previous stage and re-alternate your problem. When you make a prototype that does not mean you are going towards the solution. When you make a prototype it can give you a lead for redoing the empathy study. So, that is we are trying to say that a prototyping is trying to treat very close to the customer or very close to the final solution what the customer wants.The production of a prototype, i.e. the method of prototyping, is used to visualize ideas, to explore aspects of a solution or to test a preliminary result. **Prototyping is used to evaluate, iterate and improve**. This is very very important. Prototyping does not means that you have reached the solution. Prototyping is only to evaluate,

re-iterative your idea and improve your idea such that you can go towards a better solution.

Definition (s)

- A prototype is an intangible idea brought to life to create an experience that can be put in front of the user
- A prototype is an experimental model of an idea
- Prototype is a question, it's a way to gain confidence in your idea. At its core, a prototype is a way of trying something out with your design's audience before investing in its full development. So, prototype can also be made part by, part by part, function by, function by, function and then you can start integrating it.

Why Prototype

To use as few resources as possible means less time and money is invested up front, on the idea whatever you have made on screen or on paper. To be able to fail quickly and cheaply. So, this is very very important. To fail quickly and cheaply. So fail quickly means before going to the final product and then making this product, developing it into the fullest extent, giving an aesthetic look, giving a form to it, everything you give and finally you realize that the product did not work. For example one point of time in developed countries more emphasis was given towards aesthetic of the vehicle, rather than the functionality of the vehicle. But later people started realizing aesthetic is one part but functionality is very important. So, if you give lot of importance towards aesthetic form and make everything then you realize that its not going to functionally well you have invested lot of time, you have invested money and that is what we

say when we make a prototype we are able to fail quickly and as well as economically.

To test possibilities. Staying low-res allows to pursue many different ideas. So, this resolution or the risk whatever we say. So, it is staying low resolution allows to pursue many different ideas. To make it quicker to see if further improvements are necessary. To break large problems down into smaller, testable chunks. S0, as I told you system, several subsystem, inner subsystems, several functions, develop prototype for each function, integrated into a subsystem, look for 4- functions whether the subsystems is working and then you integrate several of this subsystems to take a main objective to see whether it is working or not. So, in that case Prototyping becomes very handy and it is very very essential.

Thank You

Download

PDF: Prototyping-Part 1

6-2 Ideating continued – Prototyping-Part 2

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Transcript

Welcome to the next part of prototyping and lecture. So in this lecture we will see different types of prototyping. It will be very interesting to know that is something called as low fidelity and high fidelity. So, let us start looking into what is low fertility, what are the functions of a low fertility, how is it going to make an impact towards the end product? And then we will see about that high fidelity prototype. So, when you look at prototyping, **there are two types of prototypes**. One is called as **low fidelity**, the one is called us **high fidelity.** Low fidelity prototype is a prototype that is sketchy, and incomplete, that has some characteristics of the target product in order to quickly produce the prototype and test broad concepts. So for example, low fidelity, there are several ways. So in low fidelity we make a half scale model, we make a sketch, we make a simulation, we use miscellaneous material, not the original material required. We use some other material and see putting these materials still. Are we able to get the function and demonstrate our idea to the customers? So simulated materials you make lot of mock up here and we are trying to move from some functionality, like form is also given importance to final usability, we tried to look. So, here we use story broadening, paper prototype,

paper prototype is also used to so many at times in the festival season you can see lots of prototypes of characters are made out of cardboard. So why they use cardboard and wood is because it is easy for carving and it is available. It is an economical material. It gives you the flexibility of shaping to whatever form you need. So paper prototyping is nowadays exhaustively used to express your ideas.

Then wire frame, wire frame is you make a sketch, you put some nails and pass a wire through all these nails, try to give a form like whatever it is. So wire frame, sketch models, creative toolkits, generating the researches. So, then you also have mockups, body storming. Then you have role playing business origami and then you have cognitive walk-through. So, these are some of the low fidelity prototypes which are made when we were working on Amla deseeding or amla grating machine the first a few prototypes what we made was out of cardboard. We also made the mechanism in cardboard. We used a low stiffness spring, attached it to it and then started demonstrating it to say what motions it will do and what amount of forces it will try to exert and where we'll be the exerting point. How are we going to feed the amla and then how is it going to get grated or deseeded.

So, when we made through a low fidelity prototype, we also changed our mechanism several times. So first we thought of rack and pinion, then we thought of, we went into scotch mechanism. So these are some of the mechanisms which are commonly available and which is bookishly available. So we started moving from mechanism to mechanism to make sure that we get the proper force at regular intervals of time at that location of the amla. So, this is very important. For example, we made prototypes and at the end of the course there'll be a few demonstrations which we will show to you what we developed in the low fidelity prototype for various agricultural applications. So, when we did this low fidelity prototype, we understood, okay, the stiffness of the spring is very important. This shape is not handy for the customers, the material, what we used, these are the places where there has to be given

more functionalization or selective reinforcement in the product has to be given to get a better performance. Then we also looked into the form, how the form should be improved and then we also start off, okay, if there is a hopper to be attached, how should be the hopper. When we are trying to look about a grass cutter, which is to be converted into a sugar cane cutter. So, we were trying to look at a model, and then we were trying to make a small pipe and do the demonstration and see with paper of equal and stiffness what sugar cane gives we realize that where exactly the load will be, how, what will be the difficulty faced by the agriculturist while cutting. So these are all the informations we get when we do your low fidelity prototype. Low fidelity prototype is failing quick and failing economical.

Once the low fidelity prototype is done, customer feedback is received. Then, the maybe from the first step it starts, from the empathy study, we start reiterating everything, and then we come back to the prototyping with the next revised Prototype and once the revised prototype to a some extent is accepted, then we move towards the high fidelity type. High fidelity type is basically having all the basic functions. It will be a full scale model. We will try to use real materials so we will try to give importance to aesthetics. We will also look forward for interaction between one system with the other system. So this one is called us high fidelity prototype. In high fidelity prototype it is almost the final version of the product made here. So high fidelity prototype is a product in its closest to some resemblance to the final design in terms of details and functionality. Low fidelity, low fidelity leading to high fidelity, high fidelity will be also tested with the customer we get a feel for it and then we try to freeze our product. So we have tried to cover low fidelity, high fidelity in this discussion.

So, now let us see what are all the **advantages and disadvantages of making proto-type**. Let us see that one day this proto typing brings the user into the process early of final development. Next is prototyping generates practical experience equal to limited risk. So practical experience. Many things we are learning when we tried

to make this prototype. The errors are detected at a very early stage. Our advantage of prototype, more human centric approach games more important within the organization. When we talk about disadvantages, development process can slow down considerably when we start making prototypes to some extent, I'm not saying to a large extent but to some extent. Additional costs because prototyping only represents your model, not the final prototype.

So, that means to say you are not making the final product, you are making one more version of the final product and you should invest money in it. So, generally what we do is we start first prototype to make out of wood, cardboard, a small sheet metal which is available in the market or maybe it is available, in your garage. So please pick those things, try to assemble those things. So, but for that also you should invest money that's what we are trying to discuss here. Though it is very small, but still there is a cost invest. Users maybe unfamiliar with a technique or idea behind proto-typing and hence error deduction, maybe unlikely. So if a person does not know to make any prototype, then it becomes very difficult. And, if at all he makes prototype leaving certain things and he explains those things by words, then again, this prototyping business is lost it's important. Prototyping can lead to remaining in a permanent optimization loop and not taking decisions possible. So, sometimes we always fall in a in a loop and we always say I would like to do the best out of it. So, you spend a lot of time in making the best prototype. Then you will spend a lot of time in making prototype and you will not go towards the final prototype. So, need for minimal viable product should be there. So, in numbers we are talking such that when we try to choose processes, or machines we can try to optimize that cost.

So prototype is, is all about end user. So here till now what we saw is a prototype which was physically made and it had, when we are talking about mechanical functionality only, we were talking. Now that is also prototypes, which you can make with electronics parts. So prototyping with electronic gadgets are listed here. So you can see here people have made a smartwatch, something like

a smartwatch. So here all the functionality was assembled using a printed circuit board and a display device. So this used them a quick understanding and basic functions they know to make. So we also try to do electronic prototyping, which will be attached to our product to meet auto customers demand. So here is a display of a low fidelity prototype, can be just some combination of lego and sticking notes. So Lego sticking notes. That means to say, I did not have a display here, but I said that in the display I will show you these, these, these, these words. So this is also a low fidelity prototype. It's not only mechanical, it is also integrating electronics to it, automation to it. So above example is a user experience prototype for blood pressure monitoring device, which is been demonstrated. So take the end user through the prototype and let him her experience it completely. You should give you enough time, you should give them enough space so that they experience your product. Though it will be very crude. It might be sometimes harsh, it might be sometimes misleading, but still show them the prototype. Ask them to enjoy the experience of it. Make a note of whatever they say and make a note of that emotions also, make the user speak about it's moment by moment experience. That means that, Oh, it is scary when I looked at this watch, when I started tying the watch, I was not pretty sure whether this watch will work so, every moment you start recording it. So this will help you as a design thinker to capture the minute details of this experience. Try to actively observe an enthusiastically engaged with the user during this experience. Don't try to make fun, try to enjoy whatever he says, whatever his criticize is, please make a note of it and then you start noting it down, okay. Once the experience is over, follow up the user who had the experience with a set of questions. So, first you give him the prototype, ask him to experience the prototype. You keep recording minute by minute and you keep engaging during the experience, some conversation, or giving him some tips or giving him some incentives or cracking some jokes try to evolve because it should not be monotonous and it should not be monologue. He keeps on complaining or he keeps on saying, wow, it is very good,

no, you have to also give them a feel that you are also part of it, you're also trying test along with him. You should not give any of your explanations. Why is this like that? Why is this like that? You should never say. At this point try to record and then what you do is after everything is over you try to ask him some questions so, these questions can be a repeat of whatever he has said or it can be a new question which comes to your mind where in which please make a note of it. Don't try to interpret that data in your own way. Record it and write down what all he has told. This might give you a lead to get towards a better product.

To summarize, in prototyping we first saw why prototyping? Then we saw what is prototyping, then we saw different levels of prototyping, low fidelity, high fidelity, and then we finally saw what are the advantage and disadvantages of proto-typing. Proto typing does not mean only making mechanical. It is also integrating electronics to it and electronics sometimes might need software so, making that is also part of proto-typing when we tried to develop a product towards the end user.

Thank You.

Download

PDF: Prototyping-Part 2

6-3 Ideating continued – Usability Testing: Efficiency

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Transcript

Basic Introduction

Welcome to the next lecture on Usability Testing. So till now we were looking into, how do we make prototypes and what are the different types of prototypes. Now we will get into the testing phase. Testing is very very important. You making a product without validating it with a customer. You might not be able to get or develop a better product. Even in academics if there is a set of teaching going on. End of the teaching there will be a small test to validate your knowledge or your understanding of the course.

So testing is very important. So from the testing, we might get more insight about the product. So now we will try to see the usability testing and primarily it will be focused towards efficiency of the product whatever you have developed.

Efficiency

- What is **usability testing**? Usability testing is a technique used in user-centered interaction design to evaluate a product by testing it on users. So here you will try to get all the experience. Aesthetics, form, color, texture. Then you will talk about functionality. Then you will talk about, when he tries to wear; response, the feeling, the effect, the betterment of the product, all these things.

So usability testing is a technique used in user-centric interaction design to evaluate a product by testing it on users. Till now maybe you yourself would have declared as a user and you would have tested it. Saying that it is vow! It's like you standing in front of mirror and saying I look beautiful. It's now what happens is, you try to show your product to others and try to get their feedback.

- This can be seen as an irreplaceable usability practice, since it gives direct input on how really user uses the system. For example when you try to develop a toy for a kid, and you keep the toy in front of the kid. The first thing what the kid will do is, it will try to put it into its mouth. So when you try to develop a toy, you would have not even thought about it. So that is what it is. Since it gives direct input. How real user uses the system. And when you try to develop a toy, it is also expected when a kid gets overenthusiastic or when it is bored, it throws the toy. So there will be an impact which comes on the toy, the toy still has to withstand.

Okay. So same way when you are trying to develop agricultural implements, the skill level of the people who are using the instruments or the product is not so great. And in the user field, you cannot ask them to do a feather touch. So it has to be as rugged as possible. And there is a huge impact load. The people who are involved there have lot of muscular power. So they would try to use

it in a very vigorous manner. So if you try to make it completely with plastic or with anything else. It might fail in the first go itself. So that is what is how really user uses the system.

- Important testing parameters will be three, in that
  1. Efficiency
  2. Capacity
  3. And throughput

Are the three important testing parameters, which generally people use for testing it.

Efficiency

- The concept of efficiency is used to evaluate, how well a machine performs its designed task in terms of quantity and quality. For example I try to take 1 liter of fuel, fill it in my product and if the product gets drained. Or if the energy for running the product uses 1 liter of petrol in 5 minutes, then the product efficiency is extremely poor, however good might be your product, but it is no way energy efficient. So when we try to talk about that we try to talk in terms of efficiency. Second thing is what amount of mechanical load the farmer has to apply in driving the system. When I talk of agricultural implements, please don't think only farm, it is also used for cattle rearing, and then it is also used for hair trimming which is used in sheep or extracting milk from cow. So all these things are part of agricultural implements. So here what is the efficiency it works.
- Owner and the manager of farm enterprise are deeply concerned with the efficient operation of the equipment and other resources, because inefficient operation leads to greater operating expenses and reduce the profitability. For example you try to develop a plowing machine, a mechanical plowing machine which costs around a lakh or which costs about x

price. And with this x price, if he has to use it in his farm. And he will take the break even after 10 years. Then naturally people will not try to buy such capital intensive equipments, why because in agriculture industry it is always a seasonal based industry. So here it is not going to be used all through the year. So only in particular seasons it will be used in an efficient manner, and rest of the time maybe it will be idle. So we should keep that also in mind. So that is what they are trying to talk about here.

- Efficiency is usually expressed as a percentage. Because efficiency is a ratio of two quantities having the same unit. The unit gets cancelled. So you try to get a percentage of it. Percentage is calculated by comparing two quantities and multiplying it by 100.

Then efficiency maximize and minimize. So here it can be like a speedometer. It can be like a level indicator. It can be, nowadays people try to walk so many steps. It also tries to say efficiency in terms of exhausting energy. You can also talk in terms of finance. So there is an indicator which is used. So efficiency will always be shown in a pictorial manner. So you can see green means good. Red means poor or bad.

- So efficiency can be expressed mathematically in several forms. In the most general terms efficiency = output/input. Output is, what is the yield you are getting divided by what is the investment you have invested into the product to get the output.
- Efficiency is a ratio of what we got out of something relative to what we put inside. For example 1 kilowatt of power is given to a motor and the motor efficiency is only 20%, while putting it into good use. Then it is no way energy efficient
- If the output of 9 units is 9 units and the input is 10 units, the efficiency is 90%.

- If the output is 5 units and the input is 10 units, the efficiency is declared as 50%
- Efficiency can also be expressed by comparing the actual performance to the theoretical performance. So it can be expressed as actual/theory. For example you might say, I can run at 100 kms per hour, but actually you may run only 30 kms per hour. So this talks about human efficiency as 30%.
- It is important to remember that an efficiency calculation provides a mathematical answer.
- The answer is only a tool or an information, that can be used to make decisions.
- For example if you determine that the fuel efficiency of an automobile is 20 miles per gallon. That is not sufficient information to determine if the automobile is performing satisfactorily.
- This number must be compared to the historical performance, manufacturer's guidelines, or the other data to take a decision whether it is efficient. Suppose you try to work. You are able to climb 10 stairs, first day, the next day you go to 11 steps. There is definitely a 10% improvement in your efficiency. But that does not mean that the system has become efficient. If a normal man is supposed to walk 30 steps per day and you have walked only 11 steps, when you compare it as against the standard, you are able to realize what is your efficiency. When it moves from 10 to 11; 10% improvement is a relative improvement. But it is always better to check with a standard data, or a manufacturer's guidelines data

Performance Efficiency

- Performance efficiency refers to a quality of work done by a machine. The performance I write, the performance of plowing, the performance of a sickle. How frequently you have

to sharpen? The material gets corroded. The swath which is used for cutting the grass in the farm. The wire which is attached to a grass cutter, the life of it. So all these things are performance.

- The importance of performance evaluation is not the same for all machines. Inside a machine there can be several sub-systems. Each of the sub-systems have different efficiency. And when you sum it up, some might be positive, some might be negative. When you sum it up, you get a different efficiency. So performance efficiency for a sub-system is different, for a full system is different. But unfortunately we will always talk in terms of a full system.
- For example the quality of a job for primary tillage like plowing is not as critical to the profitability of the farming enterprise, as the quality of the job for a combine.
- In addition it would be very difficult to mathematically evaluate the quality of plowing.
- For harvesting machines, performance efficiency is a measure of an actual performance of the machine compared to that of a desired performance.
  o For example if the machine is a combination, the bushels of grain harvested would be measured and compared to the total bushels of standing grains in the field.
- Combines could also be evaluated, according to the amount of damaged grain.
- Other harvesting machine would be evaluated on the basis of the amount of bruising of fruits or a number of cracked shells. So this is all talking about the performance efficiency.
- A combine can lose grains in three different ways: the gathering units can shatter grain from the head or drop heads. The threshing unit can fail to remove grain from the head as it passes through the machine, and the separation and cleaning unit can fail to separate the grain from the material other than grain.
- The losses are usually expressed as a percentage of the yield of

the farm.
- Evaluating combine losses is a multiple-step problem.
- What we want to know is the amount of grain that the combine failure to put into the grain bin.

Field Efficiency

There is something also called as the field efficiency,

- Field efficiency is usually used to evaluate the performance of tillage or harvesting machines.
- It is a comparison of the actual amount of work done by a machine compared to what it would do with no lost time or capacity.
- The maximum rate that a machine can perform is determined by the width of the machine and the speed at which it travels. So field efficiency and performance efficiency are different.
- When a machine operates with a constant width, and travels at a constant speed. It would perform at 100% field efficiency.
- The machine is capable of 100% field efficient for a shorter period of time. But as soon as the speed changes or the width changes; the efficiency drops below 100%.
- The primary cause of loose efficiency is lost time, and a working width of the machine less than the maximum.

So a long narrow field can enhance the efficiency of the field operation. You can see how the plowing happens or how the harvesting happens in a narrow field. Long narrow field, how is it done.

In this lecture we talked about efficiency. Efficiency we talked about performance efficiency, we talked about field efficiency. I am sure you will be able to appreciate how are the usability tests made and one such technique is efficiency measuring technique.

Thank You.

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PDF: Usability Testing Efficiency

6-4 Ideating continued – Usability Testing: Capacity and Throughput

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Transcript

The next lecture in **usability testing** we have discussed in the previous lecture that usability tests will use three parameters – One is **efficiency, throughput and capacity**. So now what we will discuss in this lecture is throughput and capacity. These two will be the two measuring quantities where in which your product will be tested keeping users perspective.

Capacity

So how do you define the term **Capacity**? The term capacity is used to evaluate the productivity of the machine. In agriculture two types of capacities are commonly used, one is field capacity, the other one is throughput capacity. So **field capacity** is used to evaluate the productivity of machines used to work the soil such as plows, cultivators, and other machines such as drills, sprayers and harvesting. Throughput capacity is a measure of the volume of material that passes through your machine, machines such as grain

augers, balers, forage harvesters and combines. If a tillage machine operates at 100% efficiency, it is operating at a hundred percent capacity. This is called us **theoretical field capacity.**

Theoretical field capacity is determined using the width of the machine and the speed of travel. It can be calculated using units cancellation, but an equalization is also available. (please check the slide) is an empirical value which has come by calculations C suffix T is a theoretical field capacity which is talked about in actual per hour. Then S is the speed of travel. W is the width of the machine. So let us take a simple problem for your understanding. Determine the theoretical capacity of a machine that travels at five miles per hour and has an operating width of 20 feet. So the CT will be calculated (please check the slide) so that is nothing but five into 20 divided by 8.25 which is approximately 12 AC by per hour. So, if the machine travels at a constant speed and uses your constant width it has a theoretical capacity of 12 ac/h. So it has a theoretical capacity of 12 acres per. The difference between theoretical capacity and the effective capacity is **Lost capacity.** The **Lost capacity** is an important concern for the machine operator and or manager because it represents lost revenue or resources.

There are two primary causes for lost capacity, lost time not operating and operating the machine with less than the maximum working with. Common causes for lost time includes – **Mechanical breakdowns, Taking time to adjust the machine, Stopping to fill seed hoppers, spray tanks,** etc., **Slow down to turn at the end of the row or crossing waterways etc., Operators rest stops**. So, these are all, some of the lost time includes. Many a times in industrial engineering we tried to give all these things as fatigue allowance. We have a standard allowance given. We calculate all the standard allowance added and then say the operator will work at this many minutes and these things are added to it as the fatigue allowances. In the same way, if this is added, then the last time will not be there. But if we exactly calculate the last time, these are all the causes of its failure. So for example, mechanical breakdown, then adjusting the machine height and then stopping when we have to refill the

hopper. Then slowing down when you have to turn you cannot run in the same radius and then turn, so you will slow down and then turn. Then operator rest. So the common equation for effective field capacity is (please check the slide) . So, throughput – throughput incorporates time because throughput usually refers to the flow of the material through your machine. The units may be different from those used for capacity. For example, the performance of a hay baler would be evaluated using units of bales per hour or tons per hour, or a solar food dryer for amla candy drying developed at IIT Kanpur has a throughput of 25 kgs, per 16 hours. Why 16 hours? Because as you can't do it for hour. So one batch takes 16 hours. So we have to do that. The throughput of Baylor also can be evaluated in units of bales per hour. To use these unit additional information is required, including the weight of the hay and two unit conversion values.

Throughput

So let's try to take a simple problem and solve what is the throughput capacity of a baler that baled 150 tons in 1 week while operating an average of 6 hours per day. The unit of throughput capacity are not identical. They can be tons per week, tons per day, bales per day. For this example, assuming the manufacturer, advertises that the baler has the capacity of six tons per hour and the owner wants to compare the actual performance to the advertised performance, this means effective throughput capacity needs to be calculated in units of tons per hour, so tons per hour equal to one 50 tons per week into one week divided by five days, that is operative then, why one day they are operating six hours. So, if you look into it, it will be five tens per hour will be the final throughput answer. Knowing the actual throughput for the Baylor, the throughput efficiency can be determined. The throughput efficiency will be, E is equal to actual output by input into hundred. So, the actual output was five and the input which was given was

six, so the efficiency is 83% page. Like this, you are supposed to calculate for every product which you developed. So the usability test, apart from customers' feedback, these three are very important from the business perspective. So, no product will be developed for, for individual use. So it will always be looked in terms of business. So when you talk about business, you have to talk about in terms of capacity, efficiency, and throughput. So, these are the three most important usability testing parameters.

Thank you.

Download

PDF: Usability Testing-Capacity and Throughput

7-1 Prototyping and Testing – Laboratory Demonstration (Part 1) – Tools and Materials in Prototyping

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Transcript

Welcome to the course 'Design Thinking for Agricultural Implements'. We have discussed all the 5 stages in the previous weeks. In this week I will discuss about prototyping in detail. We have discussed prototyping in the last week, which was the second last step in design thinking approach that we followed. In this laboratory we have certain kinds of machines and tools, those are used to tinker on. This is actually a Tinkering lab, which is part of Imagineering Lab in I.I.T,Kanpur. In this laboratory we have certain materials to develop low fidelity and high fidelity prototypes. And in between also we can have medium fidelity prototypes. Certain materials which are displayed on the desk right now.

So on this table I have just displayed a few common and important tools, which are used for developing the prototypes. We will focus more on the low fidelity prototypes, that is the first hand prototype and we will also try to portray hollow sketch, and from the sketch how do we bring the model from the paper to the physical model. We will discuss about certain agricultural implements which are

used in post processing. So for low fidelity prototypes there are certain materials, those can be used. Some kinds of material. And here we have the joining section. These are all the materials which are used for joining, and these are the tools which are used for marking. And these are tools which are used for cutting. And these are the other hand tools, which can be used for cutting, joining and final finishing.

So regarding the materials, the first material I would like to discuss is a very common material; paper. This is an A/4 sheet. This is just a 75 GSM paper. This is very helpful in developing certain prototypes, low fidelity prototypes. So in the sense this can be formed into any shape. If I want to develop a very low strength pipe, I can just fold it and make a pipe of this size. I can just cut it into any shape and make a low fidelity component based upon this. Also if a little high strength is required, this is corrugated sheet. That we will definitely demonstrate in this laboratory session, that how do we develop the implements or the machinery using this corrugated sheet. We actually get the junctional shape as it was explained in the previous lecture. The junctional shape doesn't have the full performance, it does not have the aesthetics. But it can give a feel, how your prototype would look like. So that junctional shape can be taken or developed by using this corrugated sheet.

This is balsa wood. This is balsa wood and this is balsa ply. So this is also very soft wood. This is soft wood. This can be transformed into powder to give some packaging. For instance, this is a file. This is known as file; okay! It can be transformed into powder form. So this powder form that can be used while mixing with some as if to work as packing in the material in the final prototype, or in the low fidelity prototype that we are developing to avoid leakage etc. So this is balsa wood; soft wood. You can see it has some flexibility in it as well. This is hardwood. Now comes styrene. The common name that we have in the market for this material, this is actually thermocole. But we call it as thermocole. This is also known as polish styrene. This is actually XPS. XPS is actually expanded polish styrene. And an upper version of this is extruded polish styrene.

This is also polish styrene. But this is quite high strength material in comparison to what we have here in the common thermocole.

This is also known as HDF(High Density Foam). You know the difference between these two is that, if I cut this, there might be some roughness that we get here. But this is definitely a plastic material. If I press it, it transforms into the shape whatever I give him. And with this material at IIT Kanpur we are even developing the aircrafts. Aircrafts or as I said crop duster kind of aircrafts, and aircrafts for some inspection, the drones, many prototypes which require high tensile strength, those are developed using this material. And all these prototypes, the first thing we use is the tapes. I am coming to the joining part right now. There are certain kind of tapes here. When I said tape; tape is a very important component or very important material that we use when we develop the prototypes. These are the general tapes. This tape all of us know, is known as cellulose tape. This is a transparent tape. Whenever we need transparency, this tape can be very beneficial. For instance if I put the tape here, we can see what is written here. The color below this. All these things can be seen. This is known as cellulose tape. Other than this, we have, this is translucent tape. This is a plastic tape. This is generally used for masking. Masking is carried out when we need to paint something. When we need to do selective painting, then masking is taken there. Wherever we put the mask the paint doesn't apply there.

I will just show you demonstration here. Other than this; this is also masking tape, but this is a paper tape. Paper tape means it is tearable by hand. You can tear this tape by hand, and also while applying this tape, we can put some notes here with simple pen or pencil. Using simple pen or pencil we can write something here. This tape might not allow to write. Okay but we can write the name, we can use this tape for marking. Also other than that these are known as sticky pads, those can also be used for marking. These are also used for marking or putting some tag on the material, this can also be used.

So two or three very important types of tapes I would like to

discuss here, which many farmers might not know. One is this. This is known as DST(Double Sided Tape). This has two sides, on which adhesive bonding is there. On this side as well and on this side as well. This is also hand tearable. This is used for fixing some component over it. Like on this part, I put this tape and on this tape I put this component. It is held here. This is two sided tape. So to provide the adhesiveness on both the sides of the surfaces which we are trying to join, this kind of tape is used. Another kind of tape is this one. This is known as printed tape. This comes in printed tape, means it has many colors in it. It comes in blue, green, red. Whatever colors you want. So if you want to give different colors to the different components of your prototypes these kind of tapes are used.

This is a very uncommon tape. This is known as filament tape. It has filament in between. It has filament joined on it. So this filament provides strength. For instance if I said, we developed the aircraft using this. If it runs at very high speed maybe 50 kms per hour, 100 kms per hour. So we provide strength to it. High tensile strength while applying this tape here. When this tape is applied, now on this portion the strength is enhanced. So this is also commonly used. This is not very commonly used in agricultural implements but for providing strength to the material. The base material that we are using if that is not of high strength, this tape can provide strength on thatas well. Other than that we have the insulation tapes. These are electrical insulation tapes. These are also flexible tapes which can be stretched to some point. Okay, these are generally used for electrical insulation, wires or joints that we make. So these are certain kinds of tapes.

Other than tapes also we have patches. This is a double sided patch, rectangular shape. Like I tore this tape and put it here. Other than that I can just put this patch. I can take these two suppresses to stickers off and put it here. Similar to this we have this round patch; double sided round patch. Other than that like this is actually water activated tape. This is actually generally postal stamp. We put some water here, and this activates at that point. Because this is water

activated, some water is applied. It activates and it can be used for fixing something.

Similar to this, that we don't have here, we have tapes which are heat activated. Heat activated means you should apply some heat and it can be activated and those can be used for high strength. We don't have heat activated tapes here, but we have hot tubes here. This is a hot tube, if you want to make some joining or insulate some joining. For instance if I put this here and this here. I want to insulate that. If I want to heat this using some hot gun. This will contract. And this will just attain the shape whatever it is applied on. These are known as hot steam tubes. So these were the tapes. So when I am talking about joining also we have adhesives. When I am talking about adhesives, there are certain kind of adhesives if I classify them into the major forms, we can talk about the craft adhesives, the wood adhesives and the super adhesives.

Craft adhesives means this is craft adhesives. This is just fixing some paper. It can be used for fixing paper here. Okay, this fevicol, this is one of the wood adhesives. And we have super adhesives, that can used for fixing maybe some metal part. These are for high strength. For craft wooden high or for craft wooden super the strength is increasing. These are the joining materials. Other than that, for high fidelity joining we have rivets. These are rivets. Now rivets are put in there and this side is hammered on. This can make the points to make the parts to join. And also we have screws, nuts, bolts and so on. This is all joining. Yes we have locked eye. This is locked eye. If you want to join some part, you can just lock it here. It doesn't go back. It's locked eye. Right, so locked eyes are also joining material.

So other than that we have marking and cutting material. When I say marking, marking can be done with pencil. Obviously pencil is a very common tool for marking. And when I say marking, we have to have some calibrated scale. We need steel rule. This is two feet steel rule. It has to be kept straight and we have to do some marking on the paper. Okay when I say, I am using some marking tool. One of the marking tool is actually pencil. When I am using

with the help of some calibrated tool or some straight line, I am making some drawing. Since I am making two parallel lines here. Okay, the tri-square has to make a perpendicular. This is tri square. This has to make the perpendicular lines. Exactly perpendicular to this. This line is exactly perpendicular to this line. So when I don't use these kinds of tools. If I just draw something while using pencil only. Free hand, that is known as sketching. I am just sketching this. It is all with practice that one's craftsmanship or sketching becomes better.

Similar to that we have this paper marker. That is also a marking tool. And on these metal parts we have these dividers. These are also markers. Different kinds of markers are also there. And for cutting in home, and for low fidelity we need to have the very basic tool, this is cutter. This is cutter. This is used to cut the different types of foams that we have. See if I cut this foam, the finish that I am having is excellent. Right, these are cutters. So other than cutters we have the combination plier. This is a plier. This is a combination plier. It is a combination of different operations that can be done with the help of this plier. This is known as nose plier, mostly used in electrical applications, where the reach is far. So these are tools. This is a screw driver flat tip. This is a screw driver with multi-functional tips here. It has flat tip. It has this spiked tip. It has crosshair tips and different sizes of flat tips. So these can be used here.

So if these tools are there. You can see that this tool has plastic back and metal front. Only this portion is hardened to very high intensity, because this has to bear high forces. Only this portion, this portion needs to be hardened. This is the main body. And this is insulated as well. For instance if we need to work on some electrical components or electrical wires, this insulation helps in that; so that the current doesn't transfer to the human body. Similar to the hand tools, we have other hand tools, like this is a mallet. This is just used for putting some force. But for putting the nails in. For striking the nails in, this is the hammer. This is very common tool. And for cutting metal parts, we have this hand hacksaw. It has a tool attached on it. This tool is known as saw blade. So there are certain

kinds of forms are there for the tool base. These are also kind of rivets, as I said rivets. These are also kind of rivets. We will put some nodes or some links in the description of this lecture to give you more information regarding the rivets and some other joining tools.

Similar to this. This is also a mallet. This is a wooden mallet. This is a polymer mallet. Yes this is emery paper. This is emery paper. This is used for finishing actually. For instance if I have developed this kind of surface. I need to finish this. Emery paper is used for finishing this. And this emery paper is also a tape. It has adhesive on the other side. Using this adhesive property, we have developed an emery tool here. This is a complete tool. Adhesive property of the tape is used here. This is a flat emery tool, that is used for having the quicker action. The portion can be flattened. There are certain tools which are displayed here, but for the low fidelity prototype, I would just suggest to use these tools. A few tapes will be available, these paper tapes, insulation tape, okay this you might not require. Yes some adhesives are required. And pencil, scale; if not a big scale. You can use a small scale, and paper always has to be there obviously. Corrugated sheet, thermocole, and if you need to have some high strength material or high accuracy, high dimensional accuracy. High density form is very much used. So these are the general tools which we use in the tinkering lab most frequently, We have certain more advanced tools in this laboratory, but for the home purpose, for the use in the home. I would definitely recommend a few tools like, this is the paper tape. This is your insulation tape. You have certain adhesives, you can use a scale and a pencil for marking. And paper is required obviously. Right, and if not a small scale you canuse a big scale. This is available; and sharpner and rubber, corrugated sheet; we will use corrugated sheet, thermocole.

These are materials if you wish to have higher dimensional accuracy, this is the material that gives you a higher accuracy. This is high density foam. Also I would like to mention here that when we develop the prototypes. Prototypes can be subtractive and additive. Whatever we are discussing right now here is subtractive

prototyping. But additive prototyping is, when you do not cut the material. Just keep on adding the material layer by layer. For those we have different machines like we have fuse deposition modeling, we have styro lithography apparatus, different kinds of machines are there. Different components we have developed using the additive technology. This is the shape of a boat. This is one of the valves that you develop. This is one of the, you can say slippers we have developed. These are just the prototypes for different other components than agricultural implements. Then this is a waste, this is a waterproof. This is actually developed using thermoplastic urythene. This is developed using the additive technology.

Yes for finishing or after finishing, we need to paint the components as well. For paints we can use simple brush and paint or we can use this as well. This is a spray paint. This is a quick kind of paint that we have. Also I like to show you that if we do some masking here. If I do some masking here, and put some paint here. And remove this mask. You can see the paint is only applied where the mask was not there. So this masking helps to do selective painting. So these are the general tools used for prototyping. In this week we will discuss about the prototyping. I will just now discuss certain types of prototypes, starting from the drafting. The draft that we will make on the paper. We will start from the low fidelity to the middle fidelity to the high fidelity prototype of a specific machine.

Thank You.

7-2 Prototyping and Testing – Laboratory Demonstration (Part 2) – Prototype 'Grain Packaging Machine'

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://opentextbooks.colvee.org/designthinking/?p=78#oembed-1

Transcript

Welcome to lecture 2 in the Laboratory Demonstration week of this course, "Design Thinking for Agricultural Implements" the first prototype that I would like to discuss here is the grain filling machine. This is a grain filling machine. What is the drudgery? What is the laborious thing when the farmers or the laborers have to fill the grain? Bags, they have to fill the bags using spade manually. Then they have to take the bags and weigh them. And then they have to lock the bags. So this machine can just fill the bags in one go. So how does that happen.

There are certain components, I will show you. This is outer frame. This is the inner frame. And we have the base here, this is the base. On this base we have the weighing machine. This is the weighing machine. How does that happen? Suppose the wheat pile is here, the big mountain of wheat is here. The pile of wheat is here. So this machine can be taken forward to the pile. Now once it has hit the pile of the wheat. Then the outer frame can be rotated. Now this portion is filled with wheat. This portion is filled with wheat. Now

the wheat is transferring to the bag. The bag is will touch here. It is we will show you in the low fidelity prototype.

This is the final prototype we have developed. So this is the bag that is being filled. And while filling also it is being weighed. So we didn't attach that, but we have the wire for that, we have the weigh display here; the display for the weight, that would be filled. Once it is filled, the bag would be detached from this and this would be loosened. Now the bag can be taken off from this position. And this machine can further we can keep on filling the bag in the similar manner. The best part in this machine is that we have made it foldable for transportation. While just removing one or two screws. While removing this; this machine can be folded and then taken to the place where it can be stored.

So the design for outer frame is like this. The view that is being drawn is an isometric view. So you have two links parallel, and in between we have a rod, that is used as the linking rod for rotating. This is outer frame. Similarly you have the inner frame. So this is a very broad drawing that we are making here. But while making the low fidelity prototype. Or the prototype using the bamboo sticks or using corrugated board. We will show you details of the component. This is the inner frame. Similarly we have the base. Four numbers of chips that can be used to develop the base. We haven't put the dimensions here right now, because this is the, very first iteration. But while developing or while making the component, we need to know the dimensions as well. While cutting the corrugated sheet.

This is the base and we have four number of pillars. Those can be put on this base and inner frame and outer frame are attached, using this pillar on the base. Now how did we develop this, we will show you a small model that is made of bamboo. So small sticks are used to develop this low fidelity model. So when we cut these sticks, we just need to make sure the size of the pillars. Has to be same, the size of the links has to be same. See it can be rotated in the same way. So when we fill this, if it is very high quantity, it will fill like that and it will flow. You can see, a small bag can be filled using this. For

the same this is the first iteration, for the physical field of the model and the second iteration, we had the corrugated sheet.

You can see a little more precise model, than what we had in the six model. And also we have developed the wooden model. That is full fledged working model. If I call the machine that we showed, the big machine as a product. This is the final prototype. This is the high fidelity prototype that is made of wood. Also this is a bag. You can see a wheat pile. So when we fill it, it is taken forward. And if it is a big pile it will fill by itself. Now we are filling it with hand, and when we rotate it, it will fill the bag. So this bag can be taken out. Now also, there is a small model of the weighing machine down there, white color. This is weighing balance. So this is a high fidelity prototype. So this is also a folding machine. This is a folding machine. This is full-fledged working machine This is a high fidelity prototype, which is properly working, so it is also foldable see. It has all, everything like wheels, outer links, outer frame, inner frame, base, pillars, everything. How did we develop the corrugated board model. That we will demonstrate you in a few minutes. So how did we develop the model out of the corrugated board. We have cut these sticks already. We will just assemble them in front of you. So these are the sticks used for inner and outer frame. We have cut them almost into equal sizes. While matching them we cut them into equal sizes. This is the cross link for the base. Similarly we need one link in the center.

We are not mentioning any dimensions here, because we do not want you to go into the mechanical or dimensional accuracy part at this time point of time. We just need you to know that how do you get the feel of the model. Just to get the feel of the model we are cutting into equal sizes. Almost equal sizes. We are attaching them using this cellulose tape. Here it is also interesting to know that cellulose tape since it is not hand tearable. There is a tape holder here. And on the tape holder we have small teether that can be used to cut the tape. Sometimes taping has to be done twice or thrice, to give the strength, so that the model doesn't break in between. But this is all craftsmanship. Once you start developing the models.

Your finishing, your accuracy, your closest to the original model, that improves with practice.

Scissor is a very important cutting tool, that was here on the table but I did not mention in the first lecture. Scissor is also important tool. It needs to be always there, when you think of the cutting. So this is an inner frame. We need to have 4 pillars of equal height. Now these pillars are being attached to the inner frame. See how quickly this is happening. When you know specifically what you need to do. We have already developed the model using the bamboo sticks. Now we know where the components what to be fixed. So it is happening very quickly. The horizontal links in the outer frame are to be little larger than we have in the inner frame because the outer frame has to come outside the inner frame.

And this fit, if you talk about the fit it has to be clearance fit. Clearance fit means it has to go very loose, very, alliance has to be very high from the inner frame. Other than the cellulose tape, you can also use alpins. Alpins for the quick joining in the corrugated sheets. So now the frame and the base is almost ready. So we have two alpins, that we will use as the pivoting points here. This alpin is put here in the left hand side. So this works as a pivot, along which my prototype can rotate. So this is a low strength, low fidelity prototype, that gives you the feel of the design that we have made.

So this is a low fidelity prototype that we made out of corrugated board. So in this lecture we discussed about the grain weighing machine and the grain packaging machine that we developed in this laboratory, in the tinkering laboratory. We will talk about certain other machines, certain other prototypes that we have developed in this laboratory in the next lecture.

Thank You.

7-3 Prototyping and Testing – Laboratory Demonstration (Part 3) – Prototype 'Plant Seeding Machine'

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://opentextbooks.colvee.org/designthinking/?p=80#oembed-1

Transcript

Welcome to the lecture 3 of this week. We are discussing the prototyping methods and certain prototypes that we have developed here for the agriculture these are agricultural machinery. A very wonderful prototype that we had developed here is the plant seeding machine. What does it do? It transplant or it transform the seed into the sand very quickly. How does it work? We'll show you the demonstration. So, let us assume that we have some mushy soil here in the bucket we put the seed from the top and insert the machine in the soil we put seeds from the top when we pull the lever the cone opens and the seed goes in the sand and then we pull the machine up. Now, the seed is sown. So, what does this lever pulling does? When we pull the lever you see there is the cone that is in three parts that opens and closes while using this lever. So, this is also a wonderful design. So, there certain components of this design.

First, thing is the main pipe that is a cylindrical pipe, then on the top of the pipe you can see a funnel from which we planted the seed

and on the in the bottom we have the cone that is divided into three parts, and three parts of the cone we have strips, these chips are joined using wire to a ring in the center, and this ring is further joint to lever using wires, and we have a supporting rod or holder here or handle that is used to hold the machine. Now, this is also develop using in certain steps. Now, the first step further was obviously the speculation, the ideas were there, then we develop the low fidelity prototype, the low fidelity prototype for this is here. So, this is made out of a corrugated shield and you can see all the components are there in a spring action, the spring action that was there in the main component that was using wire that is being provided by rubber here. Rubber band, rubber band is providing spring action here and the core is again cut in three parts, and this is all joined using again the cellulose tape, and because you can see that the corrugated sheet is folded or is rolled to develop this cylinder, and levers, handle everything is developed using this corrugated sheet. So this is also one of the products that we have developed here. Similarly, the certain other products developed, and this is one of the very important products that we have developed and for the quick action we can just, one can just hold the seeds in the bag and this is operated by a single operator. Single orbital can hold the seeds, keep transplanting the seeds into the soil continuously. So, this is also one of the components that we thought we should discuss in this course. So, this was a quick demonstration on the plant seeder machine.

Next we'll discuss about the pineapple peeling machine and peanut seed separator, certain other machines that will be developed. We have discussed those quickly in the next lecture. So, this is just to give you the feel that how do we develop the prototypes, and how do we get the higher fidelity prototypes which can be taken to the product phase further. These prototypes are actually working. All these prototypes that we are showing you here are being used, are actually tested while giving to the farmers, the first-hand user, the farmers which are close to our institute they have used that, the food cutters, the fruit sellers, they have

used these prototypes. So we will discussed two or three more prototypes in the next lecture.

Thank you

7-4 Prototyping and Testing – Laboratory Demonstration (Part 4) – Post Harvest Prototypes

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://opentextbooks.colvee.org/designthinking/?p=82#oembed-1

Transcript

Welcome to the fourth lecture in this week. We are discussing about the prototyping here and we are trying to demonstrate a few prototypes that we have developed in this laboratory. The next prototype that I would like to discuss is the pineapple peeler. So this helps to peel the pineapple. How does this work? We will show you the demonstration. We can keep rotating the pineapple, and with the help of the blade and we can peel that. Otherwise peeling the pineapple manually, we need to have a peeler and there is also a lot of force that is required. So this can peel the pineapple. In 2 or 3 cylindrical runs, it can peel the complete pineapple.

So what the components does it have. It has a cutter there. It has a cutter. So on the rod of the handle. So on the rod of the handle the cutter is attached, and this rod is further fixed to a 360° rotating strip here. So it can rotate in two directions, you can see. In this direction it can rotate and it can also rotate in this direction 360° strip. So this a 90°strip. Also all these things are fixed on a frame. This frame is attached on a bucket using U clamps. You

can see these three U clamps. So this bucket would carry all the scrap, all the peeled material. And how is pineapple rotated. It is rotated manually using these rollers. These rollers we can control it manually.

We can control wherever the pineapple harness is lower or higher. We can control that. We can peel more or less. And these are attached, these rollers are attached. The fruit is attached to the rollers using a holder, that is having pins on it. So it is spring loaded, this is the spring. See you can take the peeled pineapple, though it is not peeled completely, but to take it off, just to show you. So there are certain 4 to 5 pins on this fruit holder. So this is also one of the implements. We can develop multiple or many these kind of machines, using design thinking approach. The similar design thinking approach that we are teaching in this course is employed to develop these kinds of components.

So similar to this we have another machine. This is automated solid stone grinding machine. So this use a rotary motion, manual rotary motion to grind the vegetables or fruits, those are available in the small portions. So it has certain components here, you can see a big frame here. The big frame has two vertical pillars. And with two vertical pillars, three horizontal frames. Three horizontal portions are welded actually. So this is a welding done here. Because this is the final prototype. This is a high fidelity prototype. Or we can also call it a final saleable product, at this point of time. So it has two bearing holders on the top and the middle frame. And within the bearing holders we have bearings. When we rotate it, the bearing helps to keep the shaft in a central alignment.

This is shaft in between here. You can see this green shaft. This is a green shaft. This shaft is attached to a cam. That is attached to another shaft. That is there attached with the stone hammer. Stone hammer is now put in a stone cup. So when we rotate it. When we put fruit in it. It turns it into the paste. It turns the fruits or vegetables, the small dices of the vegetables, the small prunings of the vegetables into paste. So now it is being rotated manually. So you can see, in between there are two pulleys. There is one big

pulley. One big pulley. This big pulley has a belt on it. Also this can be operated using a motor. You can see, just below the pulley there is a motor. This motor can be given some electrical supply, and this can also be operated using some electric supply.

So this is one of the machine that is manual chutney making machine, or we call it the solid stone grinding machine. So similar to this we have another machine. This is very simple yet effective machine, that is developed for tying the fruits. I need fruits or vegetables that have feather or leaves in them, like we have green onions here, we have spinach, we have radish with leaves. So this can be tied very quickly. So what is this. We have V here in this component. In this V we put the thread used for tying. We put the amount of the vegetable that is to be tied. And we quickly make it a knot. And cut it. This is a quick way to tie the fruit or the vegetables that we have. Yes this machine can have certain varieties of certain quantities of the wood. You see it has an adjustable frame here. So the space on the base frame can be varied while adjusting the frame. So we can just make it move inward or outward. So similarly we will just show you the demonstration while tying the spinach here. Then put some spinach. And we will tie a knot here. This can now be cut. Yes we have also brought green onion. Spinach is now tied.

This is very effective tool for making quick bunches of the fruit here. Fruit or vegetables. Similarly we can do for green onion. In green onion, we can make two knots if the fruit is lengthier. We can have two threads tied here. We can even tie it close to the head of the crushed onion here. So what was the drudgery. Look keeping the thread and then keeping the fruit on the base. So we didn't have the right quantity of the fruit. In this when we fix the distance between these two frames, the quantity of the fruit can be highly fixed. It can be close to whatever quantity we want to tie, we want to make the bunches of. So this is also one of the machines.

So similar to this we have another machine. This is the mechanically operated peer separator. Peer separator from plant. So any plant maybe peanut separator, maybe rice separator. It is generally designed for peanut. So we have peanut plant here, in

which peanut is there. And this can be separated using this machine. How does it work, we will show you. So it is actually foot operated. Just for demonstration we are operating with hand. It is foot operated because the person generally sits, and then he operates this machine. It is rotated using a cam mechanism. So how is peanut separated, we will demonstrate that. So peanut is put here and it is separated from the plant. The peanut is here and it is separated from the plant. You can see the separated peanuts. So the whole fruit is separated within this machine.

What are the components of this machine? This machine has a base that is A frame. This is A frame on which all these components are attached. So we have a peddle. On the peddle we have cam shaft attached. That cam shaft is attached to the cam. Now it is further attached to the main shaft. That is rotating shaft, which is put in a hub. And it is held in the hub using two bearings. Two bearings are there to hold this and we have two plates. One is an outer and inner plate. In between the plates we have small cutters. Small cutting strips. These cutting strips helps to take or separate the peanuts from the plant. So when we operate the peddle. It is a similar mechanism that is there in the sewing machine. So when we operate the peddle the cam rotates. And the speed of this can also be controlled while operating or rotating the pedal slowly or in a fast fashion. That is depending upon the amount of fruit we need to separate.

So this is also one of the mechanisms we have developed at IIT Kanpur. In this week we have discussed certain prototypes. We have discussed in detail from drafting to a final prototype for the grain filling machine that weighs bags of the grain and also it fills the bags of the grain. Then we discussed about certain prototypes like we discussed about the seed separator. We discussed about the stone chutney making machine, then fruit tying machine. Specific amount of fruit can be tied, bunches of fruits can be made. Certain prototypes have been discussed. So I think this might have given you some feel that how these prototypes are being developed and how do we work on them. Yes testing part is taken by the actual

users. We have tested these machines with the vegetable vendors, with the farmers and they have given us a very good feedback as well.

So next week we will meet and discuss about certain case studies for discussing the whole design thinking process that we have discussed in the previous weeks.

Thank You.

7-5 Prototyping and Testing – Frugal Innovation in Agricultural Implements

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://opentextbooks.colvee.org/designthinking/?p=84#oembed-1

Transcript

Welcome to the next lecture in this week. This lecture is on '**Frugal Innovation**'. We have discussed cost innovation, what is gender innovation and some introduction to reverse innovation. What the word frugal innovation might be new for you, what is frugal innovation? Frugal means reducing the complexity of the product, reducing the cost to some extent and make the product affordable to many people, and make the product usable for the specific need. There's certain frugal innovations those have been carried out in our country. The common name that we have in India is Jugad, Jugad Innovation that is not an english word but it is very commonly used when we say frugal innovation. Now, **What is frugal innovation**?

In general the study of innovation has been subject to various paradigmatic shifts in recent decades, what are these shifts? These shifts are from open to closed, from producer to user, from profit driven to social. Frugal innovation is a transition between these paradigms. Now profit driven to social from open to closed innovation, we have frugal innovation that can cater all these needs, how does this happen we'll just discuss. In past what has been

happening a lot of ideas come that goes through a funnel and in a market only a few ideas are commercialized, but these ideas which were ignored or which didn't make to the final this also has a great potential in them, but these ideas are taken out. In this what happens in open innovation model the ideas which were not taken before are now taken to the market and they can again with some improvisation go to the final end-user. So, this is a scenario that is happening from closed to open innovation. Now, what is frugal innovation? I'll take some examples here, you can read about these innovations, this is Mitticool refrigerator, India, this is drip irrigation methods that is in Taiwan, this water purifier that again India. This is a refrigerator that is made just of clay. It is directly out of it this refrigerator is made it has certain benefits, it runs without electricity, it is a modern design, it keeps your food, your vegetables, fruits, milk, water etc., naturally cool. It is easy to use and the best part of this is the health benefits. The hydro fluorocarbons which are there in the general the gas in the refrigerator those are not here, but this was just a innovation that was done by a pot maker, a generally pot maker he just came up with this idea and develop this refrigerator. Now, this is a full-fledged product that is being sold in India.

Another example, may be this drip irrigation **Drip Irrigation** method. That is one of the methods taken by the people or the poor farmers in Taiwan. You can read about them in the links given below. This is a water purifier in which water purifies when it passes through certain steps. So there's certain granular sieving of the water and in the end we get the completely purified water so, what is this ? So, water is cleaned within a span of a few minutes through granular sieving which is later followed by active carbon ultra filtration, then this machine is equipped with anti-joke mechanism. This person who developed this machine is basically a mechanical engineer and it can filter around 90,000 liters of water in six months. This water can be used for many purposes like daily use, other than drinking and cooking. So, this is a water purifier that can be used where, we have very dirty water. So there

are few examples of innovation that didn't had a great scientific background, that didn't have all the calculations or for scientifics all the research behind them, but these have really worked. So, this kind of innovation is known as frugal innovation.

Now, for the definitions Frugal innovation first definition is:

Product Oriented – frugal innovation is characterized by low price, compact design, use of limited raw materials, or reuse of existing components, ease of use, use of cutting edge technology to achieve lower costs. When I say lower cost we should be mindful that frugal is not cheap it is just reducing the cost but keeping the performance level equivalent. I will discuss this in the coming slides. Next is **Market Oriented** – frugal innovation refers to those innovative products and services which are developed under conditions of resource constraints. **Criteria Oriented** – innovations are frugal if they simultaneously meet the criteria of substantial cost reduction, concentration on core functionalities and optimized performance levels, the same thing which I just said.

Bottom of Pyramid

What is bottom of pyramid? When I have a pyramid, it is a pyramid can be organizational pyramid which I discussed in the first week, this pyramid is the number of people. When I say bottom of pyramid, bottom of pyramid has maximum number of people in it, and if I say this as the purchasing power pyramid. Maximal number of people, fairly rural, underserved, informal, economy inefficient. A little competitive competition is there at the bottom it has around 1 billion dollars of the purchasing power per day. Lower middle class, rural poor, all those people lie in this level of the pyramid. In the top level people cannot afford expensive products, in the middle level people can also afford some kinds of products, but at the bottom level people need some different kind of innovation other than the regular innovation so that the product is affordable as well, and as

well the performance that they get should be equivalent. So, bottom of pyramid approach is used in fugal innovation. It is said that more than 60% of population, untapped, easy to approach, and very low competition is here.

Barriers in Bottom of Pyramid markets

But there's certain barriers in bottom of pyramid markets like higher distribution costs. Due to poor infrastructure in the remote areas the distribution costs is higher. Certain other barriers are there, such as scattered villages that is service costs is high for durables, difficult to penetrate plus 5% remost villages, small-scale growers are decentralized they don't have a central place to discuss and to employ the modern technology, uncertain cashflow bottom of pyramid cannot pay up front or poor, lack of knowledge and local trust, mismatched prioritiesclean water versus cell phone the priority should be to put in an order. Clean water is much more prioritized thing than a cellular phone. Local knowledge and Trust that is microfinance is required, low margin and high volume difficult to achieve in these cases. So there's certain rules for frugal innovation which I'm not covering in this lecture. There's six key principles of frugal innovation that I have put in the link, that I have given in the references of this PowerPoint presentation. So, though you should definitely read the process of frugal innovation and some of the examples of frugal innovation are also covered in the laboratory demonstration in this course.

How to decrease the distribution cost in agriculture products

Now, how to decrease the distribution cost certain tips can be

there for those. The distribution cost in agriculture products can be decreased by getting the local input that is the raw materials can be local, organized suppliers in groups, coca-cola in Uganda and Kenya for its juice organizes these small farmers and give them training which are close to them. Walmart in India to make cold storage. Use technology for delivery if possible. Use existing network of distribution post office etc. Then you will see the key factors of frugal innovations you'll find that teamwork or making small councils like or collaborating with the close neighbors that is very important. So that helps you to have a synergy. Synergy in a way you can have the common order for your raw materials, you can have a common innovative product that you develop together and you can just use it chance by chance. So, a certain benefits of those.

Fugal innovation compared with cost innovation

So, fugal innovation when compared to cost innovation, incontrast to cost innovation frugal innovations are not re-engineered solutions but originally developed products or services for very specific applications, like mittocool like the specific application those are covered in the laboratory demonstration, and these are also in resource constrained environment. Frugal innovations are based on new product architectures and are often quite disruptive. There can be certain examples for this for example. For example, If a stationary product is made portable a frugal innovation may reach an entirely new customer group, but they are an innovation towards functionality not cost. For example, this portable solar panels, solar panel were first designed for the large areas. Now, we have portable solar panels, people are using for polar panels on their back, and they are using small electricity supplied to supply pesticides, to supply this to spray pumps from using some electric energy in that, so their small innovations those happen, so frugal innovation can help in that direction.

Cost Innovation:

So, what is cost innovation. In cost innovation, this is cost efficiency that means the lower cost is in this direction, and this is customized in innovation. So, when we lift the trade-offs of the curve the cost innovation happens that is it is having efficient cost and customization of the product is also high, but in frugal innovation what happens, suppose we have performance here, and we have cost here, mind it this is cost the cost is increasing here increasing cost. So, the product here would be cheap we have cheap product here, that is low cost and low performance, but the standard products which are being used are here. Standard products which are high cost and high performance. What is frugal innovation intended to do ? It has to be practiced to get the high performance products but it has to be low-cost. So, this is frugal, so this is increasing cost.

Frugal vs Cost vs Reverse Innovation

Also, I would like to cover some more details on the cost innovation, versus frugal, versus reverse innovation. So, frugal is understood as I believe cost you understand, reverse innovation , reverse engineering that is also known as reengineering is redesigning the existing products in such a way that we can just eliminate the unnecessary parts and take in the only necessary functions to develop new products. So, that is generally like the products those are in the developed countries, those are reengineered to produce the lesser cost products in the developing countries. So, those things are happening. So, when I say the differences between these three, they can be differentiated with certain criteria number was in novelty of the solution, in novelty of the solution, in frugal innovation that the technical novelty is the medium to high, the market is from medium to high. So, this is ChotuKool or the

Mitticool refrigerator again. In cost innovation, the novelty is low, the market is low, but the only cost is reduced. In the reverse innovation the technicality can be low to medium and market can be low to high. For example, this is a re engineered chair that is developed in with a low cost for the use of the people in the poor countries. So this is freedom chair initially developed as frugal innovation for poor people that is disabled people.

Typical Traits

In terms of the traits the typical traits of the frugal innovation are that **Frugal innovation** has cost effective, raw materials, local sourcing, local production, standard components, and commodities reduction in size, new application that is Portability and Tailored for environments with poor infrastructure. **Cost innovation**, cost effective, raw materials are there, local sourcing and local production is there, standard components and commodities, smaller package size. In **Reverse innovation** it is same as cost and frugal innovation both because reverse innovations also need a little higher level of the Internet.

Innovation Strategy

So in terms of the innovation strategy the frugal elimination has application innovation based upon the cheap, specialized new solution. When I say cheap it is economical and all the factors like social innovation, business innovation, technology innovation work together to bring the frugal product. In cost innovation just the cost cutting and cheaper products are there. In Reverse innovation the cost frugal innovation with global launch is taken into consideration cheap and frugal in the solutions for the global market is there. So target customers for frugal innovation it is already discussed the

first time or severely resource constrained customer, the potentially refresh efficiency seeking high income customer. Cost innovation again the customer, target customer here is first time resource-constrained customer. Potentiality is efficiency seeking high income customer. In reverse innovation the resource constrained or efficiency seeking customer is again there.

Summary

To summarize this lecture a true comparison between the different innovation strategies can be derived from consumers affected by their innovation. Frugal innovation as value to the product functionality while a cost innovation may not add functional value but reduce the price of the product to such extent that it create disruption in the market. Reverse innovation takes benefit of frugal innovation, developed for less resourceful market and hence an obvious candidate for sustainable innovation. So this is frugal innovation that I thought should be discussed when we are talking about design thinking in agriculture implements. Frugal innovation is generally practiced by many farmers in home also when you do some tinkering of the components, some tinkering of the shape and form and all of some connection of the components and you get something that is used for some specific purpose you are doing frugal innovation.
With this I like to say.

Thank you

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PDF: Frugal Innovation in Agril Implements

8-1 Case study on Design Thinking – Case Study: Amla Deseeding

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Transcript

Welcome to the last week of our course. We have been discussing about design thinking as a tool used for developing agricultural products or implements. So, we have gone through every stage very detailed and there were few lab demonstrations of the low fidelity and high fidelity prototype shown to you. So now in this week we will try to talk about three case studies which we ourselves underwent and we developed using design thinking approach to make products such that the user were happy and we could sell it in a big way. So the first case study is going to be Amla de-seeding.

So Amla is a small berry. This berry has a flesh outer core and then it has a seed inside. People when they eat the fruit they always find it difficult to remove the seed and throw it. So now there is a market need for this fruit to be deseeded. The seed is hard and it is at the center of the fruit. So current state of the art is we try to do it only manual. So moment I say manual so per piece cost evaluation is done costing is done and so to get your decent amount of daily wages salary they have to de-seed women or men or children have to de-seed minimum 400 to 500 in numbers. So here buying an

industrial grade machine is not a viable solution because these fruits are seasonal and these fruits sometime they have to be sorted out according to shape and size. So keeping all these things in mind we have come up with a machine which can try to help these people for de-seeding.

Why an Amla De-seeding machine?

So why an Amla De-seeding machine? A machine like Amla deseeding closely reflects the economic activities of bottom of the pyramid people. So, this is discussed when we have used frugal innovation. Frugal innovation is always used in developing for bottom of the pyramid, for a mass people, with a low cost where in which you can sell more in numbers. So that is what is bottom of the pyramid people. Does not require high capital to fabricate. See this product has to be slightly better than your high fidelity type prototype and it cannot be capital intensive why because these ladies who are involved, these farmers who are involved, these children who are involved in deseeding don't have such a bandwidth of money to buy capital intensive machines. You can definitely develop devices which can be attached with a motor and which can precisely do. The throughput capacity can be very high. The production and the throughput will not match the throughput will be very high the production rate will be very low and it is a seasonal business so anything which is capital intensive cannot suffice to bring the need. Increase the productivity of an informal sector of associated with agricultural implements. Decrease the effort and work hazard conditions for people who may or may not be associated with any organization directly. Homemakers try to be an entrepreneur. Today looking into the world economy people have being promoted or people are asked to promote themselves to become small entrepreneurs who can satisfy the needs of bigger customers or who can satisfy the needs of a bigger industry.

Empathy Study

So we did empathy study of four or five students, three batches each went and spent almost a week trying to understand the fruit, trying to understand the different shapes, size of the fruit, market, where do they get, how is it getting packaged, how is the longevity of the fruits maintained, and how are they got inside the factory or inside their house, how are they doing the process. So they were looking into the process so here is a photo which talks about their the residence they have, how they pick up the fruits, how they package the fruits and keep after deseeding, and while deseeding the seed falls inside the bucket and here these are all deseeded ones, and these are all ones which is yet to be deseeded. You can see while doing deseeding the coloration is different. So actually speaking people don't eat the deseeded one directly. The preservatives are added, the medicinal values or the sugar coating is added to it, it can be made as a candy or it can be made as a sweet, then it is packaged and it is sold. So for doing all those things deseeding is a proprietary operation. So an empathy study was done by fifteen students, three batches, one week, they did video recording, they did audio recording, they asked questions and they spent the nights with them to understand what is the plight these ladies or these farmers undergo in their home. So what is their socio-economical background. Moment they have a feel for their socio economical background. The understanding and that developing will be focused towards socio economical, rather than keeping technology alone. So here they were looking into the process the process was less productive and every fruit when they took in their hand they took a needle this needle has to be pierced and while talking or while they become fatigued many a times this needle pierce's their fingers so, they get injured and this injury over a period of time leads them to paralysis which is a very dangerous one. So, now and every individual in the farmer's house is a breadwinner so, if one person falls sick the average income of their family falls down and on top

of it they have to spend medicinal expenditure for the sick person so injuries are quite common and it is very time consuming. And it is also pretty interesting the mother starts deseeding and while the efficiency goes down for her immediately the husband the king player of the family comes and pitches in and he starts deseeding along with his wife and moment they both cannot satisfy to their individual targets of the day then the children are also asked to deseed and help them in the business. So in this way what is happening the entire family is involved in the business. So this entire culture is understood by doing a proper empathy study and in the empathy study we also saw if at all they get hurt what are the medicines they use, how do they apply, do they use pharmaceutical one which is chemically rich. So, if they apply it then they cannot further process. And the other thing is if there is a bloodshed happening because of the injury again they cannot process it because these are all not according to the edible standards, and on top of it this market is, and this fruit or the this candy finds an international customer so, it has to be certified by the health authorities so they also come and see the entire process. So, by this what happens many a times their capacity might be hundred but they do only 60 or 50 percent efficiency they work.

Ideation

So now looking into all those things after doing the empathy study we came back and we started doing ideation. Ideation is defining the problem statement. Defining the problem statement what we did was we picked up the key words so, the key words are improving productivity, reducing drudgery, drudgery can be in turn talked in terms of fatigue, and this fatigue in turn can be also talked in terms of injuries. And then we also understood looking into their socio-economical thing whatever machine you develop it has to be rugged and it should be free from maintenance. So that means to say it

should not have any high level sophistications and we also realized when we started working with them electrification of their home was also a problem. So, we have to develop your device which can be manually operating. So, the key words were manually operating, low maintenance, high throughput machine has to be developed at an economical price. This was the problem statement we came after doing the proper empathy study. In fact we also try to define what is the per day wages they are supposed to get so that they can have a happy livelihood. So depending upon that so per piece cost we know so, then we try to figure out what number of deseeding has to happen and we also found out when they do that what is the rejection rate they have in this amla while deseeding. Suppose, while deseeding if the complete food gets shattered then that is rejected, for which also the farmer buys he pays money for the defect what he has generated. So we have to keep that also in mind and then we came out with this problem statement.

Steps

So based upon the problem statement then what we did was we started looking into the different stages. So the stages of Amla deseeding is first stage is removing the seed from the Amla, then breaking the Amla into individual pieces, that means to say they are shattered. Like take an orange so, the outer skin is peeled then you can take individual piece of orange which is ready for edible thing. So in the same way of fruit which is deseeded then it is broke or split into four or six pieces and these six pieces are used for further processing. Removal of the seed from the Amla to be done is mainly having again three steps because they have now, we are trying to automate it. So when you trying to automate what did the manual step do? They went and picked up so, you think your hand as an end effector your end effector went and picked up an amla. Then, it was brought to a fixture so where, and then it was placed in a fixture and

it was supported by your hand. Then the next operation was you took a sharp piercing tool which pierced inside the fruit. So, then it was then when it pierced the seed was deseeded. So, a moment it is deseeded now two things have to be collected – one the seed has to be collected, then the next thing is the fruit, deseeded fruit has to be collected. So that is the third step. So three steps were involved – so one is feeding another one is deseeding and the third one is collection. So we did a thorough video about it, then only we could come to this. Now, what we did was each event, while feeding, what are all the individual sub events we analyzed. For example, picking it from a bin, then placing it in a fixture, gripping it in a fixture, taking a tool this tool has to be used with a certain stroke length and then you try to pierce, and as and when the resistance get built up while piercing they have to apply more muscular force so, all these things we evaluated. We took fruits, we ourselves peeled, we when we peeled it we also try to calculate what is the strength, so we brought the fruits to a universal testing machine and then in the universal testing machine we placed it, and then we did some 10 samples, figured out what load is required to do it. So, why is this important because later when we try to plan for a spring-assisted so we should know what is the stiffness of the spring. So for this, these were all the steps we did for developing the device. Then with this statement problem definition in mind we started doing several ideations. All these ideations what we have first did was we did virtual ideations. So we tried to make several different types of models, infact the 15 students I gave an assignment to all 15 students for each of them to develop 5 different mechanisms and ways of deseeding without discussing with each other and for individual I said you should not repeat the same mechanism or the model within your five times. So, totally we got 15 students, 5 different models and within the 5 there is no repeat. So approximately we got 75 different types of virtual models are prototypes. With this 75 when we applied all sorts of logic we tried to figure out 15 different types of solutions for the same problem in the virtual prototype. Then we tried to pick up 50% of one idea, attach it with 20% of that

idea, and we start merging or start unioning this 15 ideas into 5 best virtual prototype ideas. Now all the 5 virtual best prototypes where mood so that means to say here what I am trying to talk about virtual, virtual is these are all brainstorming sessions, creativity was applied and different ideas are getting developed and now from that different ideas we picked up 5 best ideas and for this 5 best ideas we started making prototypes. So this is the virtual idea which is there and then from there we went making fidelity prototypes. The first one which is shown here is called as low fidelity prototype. In the low fidelity prototype we used the raw materials which were available in our lab so without spending much of money we try to use glues, we tried to use nails, we tried to use boards, we tried to make a prototype and understand our five best ideas in making prototypes, you have low fidelity prototype was made. So, in the low fidelity prototype we try to bring in the concept of feeding one at a time, piercing one at a time, and then collecting bins so that shattered food can be collected, the seeds can be collected. So we just try to look into the model. Then what we did was we tried to now improvise our idea. Why, because the five ideas which we were having and then when we made prototypes out of which we realized two of them demanded for a motor. So looking at the socio-economical conditions we realized when you ask demand a motor then the electrification is required, for which again they have to spend money for it. So then what we did was we try to avoid two ideas where motor was involved, try to bring out with three ideas where in which these three ideas were completely redefined and then we try to make the prototype, virtual prototype and show it to them. From that the customer gave a feedback, they said this is acceptable from there we went to again to low fidelity prototype, made some crank the shaper mechanism what we use in normal machine shop. We try to make and then we also try to make Scotch yoke mechanism to convert circular into linear, we got a feel of it. So for which we try to use a low fidelity prototype. Look at it here we have made a fixture and from the feeder the Amla is resting here, and now only one at a time it gets pierced and we try to first pierce

it, pull out the seed out, and then when we give further load there will be a gate which opens and the fruit is directly falling into a tray. So this was a low fidelity prototype which we developed once again after one more iteration. Till now the machine was operated by hand. So we were trying to see how can we, while doing by hand also a lot of drudgery so we were just stuck with that problem, we were thinking about it, again doing lot of brainstorming sessions. Then after doing all brainstorming sessions of several iterations working for 30 days. Finally, we came out with this virtual prototype after doing several low fertility iterations we came up with this prototype. So, here what we did was, there was a hopper attached to this so as and when the Amla fruits are dropped they get sorted out depending upon the shape and size and they roll down we used the gravity, because gravity there is no drive required so free gravity it came down and then we have a feeding mechanism so, in the feeding mechanism it was taken one at a time and then it tried to push it to the place where you see pointer was there and then below it the pointer is a tool and below that the fruit used to come and fall there. And, then since we now realized that it was more difficult to use it by hand so we converted to use it by leg. So, then we took this idea from a typical stamping shop so, that idea was integrated into it. So, we developed a manual high productivity damage-free amla deseeding machine which uses foot as a drive power rather than hand. So, initially we started with a hand, then we said several iterations we improved it and then we came up with the final design. This we made a high fidelity prototype, and this high fidelity prototype was given to the user for their demonstration for three months time. The end of three months, end of one season, they ran it left and right, harsh, in an abusive manner, we recorded all – all failures. So once we recorded all failures, we saw what are all the frequent failures and then we identified those things we started reworking on it and finally we came up with a developed final version prototype which we are able to package it and sell it to the customers. So here is a video which we will play at the end of the case study for your understanding. So these are all different

types of prototypes which we made and this is how we were trying to fabricate individual subsystems. This is a tool, this tool is nothing but a punch. So, a punch we had a progressive punch, so we had the first the advanced tool which will be used for piercing through the fruit and deseeding it that was one, and then we were trying to hold the fruit when it was doing. So this was there, so we had a fixture made, so the feeder was exactly feeding to the fixture and then we were deseeding it it got deseed and we got shattered bael, or shattered Amla which is what the customer wants deseeded and shattered.

Capacity

So the main capacity feature for Amla deseeding machine developed at our campus where four amla's are deseeded at a time. So rather than one we now try to improve. Relaxation time and the feeding time was two seconds. The time for settling an Amla was three seconds, but we were doing it little slow, we did not wanted to have a very high mass production rate such that the entire bin is covered within one hour. So handling time was two seconds, then time for punching was 1.5 to 2 seconds, then we finally did four amlas are punched in 8 seconds, so hence 30 amlas per minute we could do. So the productivity was improved 6 to 7 times and people were very happy by using this product. So this product completely got evolved using design thinking approach.

Technical Specifications

So we did also calculations, we tried to find the force and the power. So force required for deseeding 120 Newton's. The force required for a foot press was 400 Newton's. So we have taken it for a normal

human this is available in the literature. So the last per train drive is 10 to 12 percent again from the literature then a spring constant we calculated and this was attached. So these are now the engineering specifications which we got after doing all the ideation and then getting a feedback we got it done and then the final prototype was fabricated.

Product Characteristics

So what are the product characteristics benefits – four amlas are deseeded at a time, no need of pedal all the time, so just press whenever you need, less maintenance cost. This was a similar concept we took from a tailoring machine. In very small rural villages they used to have inhouse tailoring machines. So in tailoring machine also they use foot, so we got the idea from that. Needs less maintenance along with the deseeding hard part is also remove the seed. Enables to assemble and dismantle for transportation is very fast so we also brought in the modularity concept into it. What is that limitation sometimes it do not divide the amla into four pieces or six pieces exactly in the same size and shape you need and use of hand required at the end of each cycle sometimes if it is getting stuck you have to use your hand to remove so which if we start the improvising our fixture this problem can be eliminated.

Prototype Costing

So this is the costing we developed for the prototype cost and which was around about approximately twelve thousand rupees. So this cost, plus when we do packaging and other things, we could develop a low cost machine including all the profit and package and transport for twenty thousand. People were very happy to invest

twenty thousand because this could be recovered by them within a couple of years and the banks were also interested to give loan of twenty thousand through their small-scale banking segment with no interest so people were ready to buy these machines and try to improve that livelihood. At the end of the day the entire team went to different villages and they recorded videos to see their smiling face the kids could go to school, the women could be more productive, their health were secured and the delivery of the fruits whatever was coming out of these machines were worthy for approving by the health certificate agency and then further processing was done very fast so, the quality of the product was improved.

Prototyping: summary

We have learnt why we took such problem to solve that looks so insignificant but can create a bigger impact because this is hitting towards BOP. Number of machines could be sold much, the profit margin is very low. We have taken a problem, empathized the people with the people who suffer with the problem and generate ideas for product and prototype. We generated some solution first on CAD then using cheap material that is low fidelity and then we made final fidelity. Assess our design for some engineering parameters was also done and we could make a successful product.

Thank You

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PDF: Case study-Amla De-seeding

8-2 Case study on Design Thinking – Seed Sowing Machine

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Transcript

Welcome to the next case study. I am sure you would have enjoyed the previous case study, it was a hard work. We really worked on the complete product for almost a year and 15 students along with me there were six technical staffs who are involved, and who are all specialists in machines. Almost eight iterations were made and finally we came out with a product. Many a times the proof of-concept comes very good, but when it goes towards a real live testing. Reallife testing is you run the machine for 24 hours, you run the machine for 8 hours, look at the spring performance, look at the weld whatever you do, look at the rigidity of the machine so, all these things come when you do a service condition testing. So when we did it we realized many small, small, small ,problems came into existence and of course the major success of this entire project was not me and my team, it was the customer who kept on giving feedback without getting frustrated which helped and improvising the product.

Case Study: Seed Sowing Machine

So, now let us see another product which is basically a seed sewing machine. A seed sewing is a common operation which happens in all farming or on in all paddy farming place. So here in almost all the underdeveloped countries we use manual seed sowing. So when you do manual seed sowing, we had so many problems so we have listed down those problems, did empathy study and then we have understood how to solve the problem. So your low cost ploughing or a seed sowing solution is an obvious need in poor and developing countries if we can add productivity value to the farmers life without a huge capital investment it will directly benefit the local economy of the country. See when you try to develop agricultural products please do the empathy study very very seriously. How long will this machine be used in a year? What is the cost which they can offer for this machine? What is the benefit for them in terms of throughput, capacity, efficiency is going to come to the user. So that is what we have to see and then decide the need as well as the costing for the product. This type of solution can be developed using low-cost materials and methods already available in the market.

Empathy Study

The first case study: this case study is all oriented towards frugal innovation. So seed sowing the empathy study in manual seeding it is not possible to achieve uniformity in distribution of the seed. A farmer may sow at a desired seed rate but in a row and the outer row distribution of seeds are likely to be uneven resulting in bunching and gaps in field which tries to reduce the productivity in terms of space utilization in field poor control over the depth of the seed placement. It is also the depth of the seed when it is sown. People don't sow it vertically, people sow it at an angle and

when people sown they try to just spread the seed so it is not equally spaced, it is always a bunch gets out of your hand. The effect of accuracy in seed planting of plant is a great problem because when you do a improper seed planting the productivity of the firm is completely reduced so here that is your need to develop your lowcost seed sowing machine which will enhance the productivity of the farmer. So the definition is very important and if I could also add the costing to it worth of rupees or dollars whatever it is xxx so then you put the clear definition of the problem and you look forward for solution.

Ideation

Ideation seed sowing with hands to manufacture seed sowing machine. This can be operated by a single operator to set fertilizer with sowed seed to level the ground in small extent to enable the machine for sowing of several of seeds like maize, wheat, etc. It should not be one sowing. So one seasonal use should not be there. To maintain the same distance between two seeds at the time of sowing, and when you maintain, when you use different seeds, the spacing also should vary. So you should try to develop a device or a machine which can accompany all those things. So with this definition of the problem we were trying to ideate, then we were trying to define work reliability under different working conditions, decrease the cost of the machines, decrease the labour cost, the machine can operate with small farming land and making use of machine which can be able to perform the operation.

Product Characteristics

So this is the systematic diagram keeping all these things various functionality was developed and this was a machine which was

schematically done. So into the schematic, then various CAD models were developed, so this is a typical isometric CAD model where in which the seeds are dumped in the hopper and the seeds can be varied, the distances can be varied, the ploughing can be done by a single machine. A single operator it moves the machine in the form of course with larger energy it will not be with very smooth energy with larger energy because this sand can be clogged that can be lump, it can be marshy so, there should be a person with high physical strength who pushes this inside the farm. So it does ploughing, it does seeding and then it covers the land so all these operations. First, is to plant that means to say to put a seed, push it inside and then cover it so that the seed is properly covered so that it can germinate. So, all these operations are done in a single machine. So this is my symmetric view several iterations were made and finally, we have come down. Again I repeat here it is assumed the agriculture farmer who uses it male or a female they should have a high upper body strength, they should be physically fit, to move this equipment. The machine is not heavy, it is made light, we have used two pipes, we are used two frames, it is very light, but when it does a ploughing operation the resistive force which is given by the soil to the machine is high. So this is what is the product which you are developed. In order to avoid more of manual intensive a D.C. motor was also thought of.

D.C. Motors

So a D.C. motor is used in this model to drive the front wheel which further drives the distributor. So we have placed a motor and this motor if you want to run the motor you can use it solar or battery. So if you keep a battery again the battery becomes heavy, solar also solar panel or if you put a engine it also takes your load. So all these things can be thought of you can run the machine without motor and with motor.

Product Part Description

The hopper is it stores the seed which has to be sowed in the soil, then seed distributor it consists of a fluted roller which are driven by rear wheel with the help of a belt and pulley. So you can see a belt and a pulley is used so this will try to open and close the hopper so seeds can move inside one after the other if you want to put it in a row you have a series of flowers which are there. So cultivator the work of a cultivator is to tilt the soil so that the cultivator is here. So it is to tilt the soil. Just to tilt the soil so the required depth for the distributor is given so that the seed is placed inside the belt and the pulley drive transmits for the effort of the motor to the front end which is used for driving the device. So here are multiple views the low fidelity prototype and the final prototype were not much of difference. The high fidelity prototype was made almost to the final thing so this machine is low cost, maintenance free, which can do tilting of soil sowing of seed and covering the seed.

Design Specifications

Specifications for detailed specifications were done.

Prototyping: summary

So to summarize we have learnt to design a product using already available technologies integrated through innovation. So this is also part of frugal innovation. We have tried to directly empathize with economical constraints of poor farmers that cannot afford fancy solutions we first had a CAD and then developed the prototype we did a user testability and then finally out the product was released.

Thank you

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PDF: Case Study-Seed sowing machine

8-3 Case study on Design Thinking – Motorcycle Driven Ploughing Machine

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Transcript

The last case study which we are going to discuss now is going to be a motorcycle driven ploughing machine. This case study was not developed by us and we have completely taken it from that open literature which was available.

Why a Motor Cycle Driven Plough?

Ploughing is a operation where there is a lot of muscle intensive work. So here for this muscle intensive work if a man cannot do, we always use an animal to do today the animal also are not many, so people are trying to do it using the locomotive which they are enjoying. So there is a famous motorcycle driven ploughing. This is a special case study where we try to shift from creating solutions for extremely poor farmers with medium income. The solution created in the case study might look frugal, but it has been followed detailed product design journey. The product developed in this study is an outcome of innovative design combined with the rigorous engineering design and analysis. Again, I repeat to the viewers, this is taken from the open literature.

Empathy Study

So this is a empathy study which is done. So here is an empathy study, which is done and which people have recorded it. So in cotton seed and groundnut plantation, which is very common in a state in Gujarat, in Gujarat, small and marginalized farmers are deep, are dependent upon cash crops like cotton and grounded. Depending upon the monsoon ploughing can be either single or deep depending upon the moisture of the soil. Increasing frequency of drought, decreased the supply of fodder, restrictive usage of Bullock cart, high maintenance cost of draft animals add to the production of the cost. So tractors were found uneconomical for later stages of ploughing. So people, what they used to do is they themselves tie up to the arm, whatever is there. Two women try to pull the load and person used to stand there and this was the mechanism used to for ploughing where they wanted to do for cotton and groundnut plantation. Gujarat is a state in some parts of Gujarat water scarcity is a common feature. So there they use this as your practice in the past.

Ideation

So after several ideation, that was, a development which happened in those villages. So inspired by the local mode of transport, a three wheeled taxi "Chhakdo" innovator had developed an innovative multipurpose farming machine, which can do all the operations, which can be carried out by a pair of Bullock. So it can be used as a loader, it can be used as a ploughing machine and it tries to be used in all stages of farming. So this is a product which has developed a "Chhakdo", a frugal innovation, which has become inspired for ploughing innovation. Using the self fabricated chassis, drive and power of an Enfield Bullet. Many of the rural India people would love to use Enfield vehicle, which is otherwise called as India's Harrison Davis vehicle. So it is almost a similar version of it. So here people have attached that to a three wheeler so that they converted a two wheeler into a three wheeler for their utilization.

A rear wheel of the motorcycle has been removed and an innovative assembly unit has been attached. It can also be designed and attached to a locally available "Chhakdo" rickshaw or assembled

vehicle with a minimum of 6.5 hp engine. So the 6.5 HP engine is a common thing which is available in that bikes. These are all motorized bikes. This meets various needs for ploughing, weeding, sewing, spraying. The improved productivity and reduced operating costs for farmers who currently uses bullock driven plough and cannot afford for tractors can use this as a ideal solution.

Definition

So the definition, the device was developed by an Indian artesian cum farmer and has already proven its utility ideal for wide range of agricultural operation like field preparation, sowing, inter cultivating, spraying, etc. It is simple, easy, repairable and reduces low and requires low maintenance. It is simple, easily repairable and requires low maintenance in contrast to tractors. No continuous variable cost in contrast to bullock's. Compared price of bullock. Attached an Enfield and some other motorcycle.

Prototype

So this is the first prototype, which the innovator did in 1994 the extension of a rod, which was removed a single rod was there that he extended and he made two wheels there. So the same prototype was further improvised and made as a plough and this was attached to a tractor. So this was manually control for adjusting of the plough depth. This was done. So this was the improvised version of this. And the next one is mechanically attached to the level for lifting the plough. So a lever for lifting the plough was attached. So it was used for disengaging and engaging, converting two wheeler into three wheeler and three wheeler back to two wheeler. So these are the prototypes which people have, developed and it has got evolved. And today you see this is the final prototype which is being patented which is used. So a tractor is not used, a bike is used, a bike and a plougher is a, a plough is attached to it and it is used for ploughing operations in the farm. So a patent is available in India as well as in us. So this is the bike which you are talking about. So a crude prototype, an improvised version, crude prototype, speed reduction by chain driven and no reverse speed arrangement was there. A new gearbox with reverse gear option is incorporated and minimize the

power loss during the direct shaft attached to the gear. No reverse gear facility was available in the crude prototype that means, to say high fidelity prototype, but in the improvise to product it was available so they could attach a gearbox to it.

Design Specifications: Comparative Benchmarking

And these are the specifications which got made. So as a pair of Bullock, this was the spec and then motorcycle plough this was the spec and Asia Tractor Asia is a company where they make tractor and this is a specification. By using a pair of Bullock and motorcycle. So they could see a huge improvement. Buying a motorcycle plough was always a frugal solution for the agricultural people.

Applications

So the field cultivation, inter cultivating, spraying, transporting, sowing of seed by driller and sowing by labor. So all these things are done by the single machine, which got improvised and then a current patent is available.

Prototyping: summary

So to summarize this case study, we have learned that how an already available frugal solution can be used for developing agricultural implements. In this case study, we have brought an innovation in parts of the solution, and we have, the main challenge was the gearbox because vary in speed. This case study can teach us that a complex product development cycle may take lot of time to mature. The product life cycle can be longer, and depending upon both the maturing of the technology and the customer satisfaction. So this is a case study which is taken from the literature in which a device is developed an implement is developed, which can do multiple operations in a farm and can get fit into the socio economical budget of the farmers.

Thank you very much.

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PDF: Case Study-Motorcycle driven ploughing machine

8-4 Case study on Design Thinking – Course summary

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Transcript

Welcome to the summary lecture about this course. The course which we were discussing is on design thinking for agricultural implements.

Weekly coverage:

Week 1

So in the first week we were going through the following topics: We were trying to understand what is design. Then what is design thinking. We were trying to talk about the five small vertical pillars which are there, so then we were talking about design thinking needs and outcomes. Then we were trying to introduce you to design for manufacturing.

Week 2

The second week we were trying to talk about functions of agricultural implements, operational characteristics, aesthetic

characteristics, cost characteristics, ease for maintenance and developing successful products.

Week 3

In the third week we were trying to study about empathy, definition, ideation, prototyping and testing. These are the five vertical pillars which are there on design thinking.

Week 4

Then we were trying to look at week four we were trying to understand the customer. A product without a customer is of no use today. When we are talking about innovation, design thinking we should have a customer. Customers voice is very, very sensitive and very subtle. You are supposed to understand what he wants, what he does not want, what he can quantify, what he will not even quantify. But finally, by looking at your product, you have to bring the wow effect for the customer. So for that you have to understand the customer. Then voice customer, we saw, how do you record? How do you put on a piece of paper? What are his requirements? Then we translate the customer need into an engineering spec. Then we tried to do design and specification requirements for a product. So as I told you in the class itself, many at times the customer will say, I might need it. He might say, okay. Sometimes you might say, uh, I feel it should be heavier, but these are all not quantitative parameters. These are all qualitative parameters. But with this you can't survive. So you have to convert all these parameters into quantity and then only you can start working on it. So that is what was a major emphasis, for our Week four.

Week 5

When we moved to week five, we were trying to think of how do we practice creativity? How do we motivate creativity within us? How do we do brainstorming? So these are all what? These are all you go back and link to your design thinking. Brainstorming session is very, very important. Today, when I was having a discussion with my son. I also felt that he should be given a proper chance and he was trying to express his views when we were trying to buy a microwave oven, so brainstorming session he had my son had

certain points. So it is good that everybody in the team participates and everybody gives their opinion, everything is recorded and then you come out with solutions or possible solutions. Then we would like to talk about checklisting. Then we would talked about web webbing technique and at last SWOT analysis, strength, weakness, opportunity and threat for a product which we are going to develop or for a process which we are thinking.

Week 6

Week number six we saw low fidelity prototype, high fidelity prototype. Low fidelity prototype will work to the customer requirement but it will not be very precise. It might have repeatability, it might not. It might have reliability, it might not. So here you are going to check the form, the functionality and the integration of different subsystems. So that is low fidelity prototype from low fidelity prototype, we moved towards high fidelity prototype, which was almost like your final product which you are going to use. Then, we were discussing about usability testing in terms of efficiency, in terms of capacity, in terms of throughput and finally we were trying to discuss a few things about frugal innovation. Few examples also we saw.

Week 7

Week number seven we were trying to demonstrate the prototype on materials and tools. Then we were trying to discuss about green filling machine. Then plant seed sowing machine. Then simple agricultural implements. These are the different case studies which we walked through and all these case studies we developed it in our lab. We went through the design thinking approach with a set of students, we tried to develop this. So all these case studies I am sure would have enlighten you in a big way.

Week 8

Week number eight we saw Amla deseeding machine. We saw seed sewing machine, then motorized driven plouging machine. And finally we saw a summary of all these things in our course.

Outcomes of the course

What are the possible outcomes of this course? First one is what is design thinking, when to practice it? How design thinking helps to bring more innovative ideas, creativity, brainstorming, session, all those things. What are the functional and design parameters of your product? The understanding customer and translating their needs. Prototyping materials, tools and methods. Finally, usability testing to a developed equipments. These are the outcomes of this course. How to do all these we learned through this course. I am sure you would have enjoyed this course. This course would have at least put a small seed in your thought process. How to develop your product for a customer. The product here, we are primarily focused towards agricultural implement. You can also have your product as service. Agricultural service can be there. So with this, I would like to conclude my course and wish you all the best.

Thank you.

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