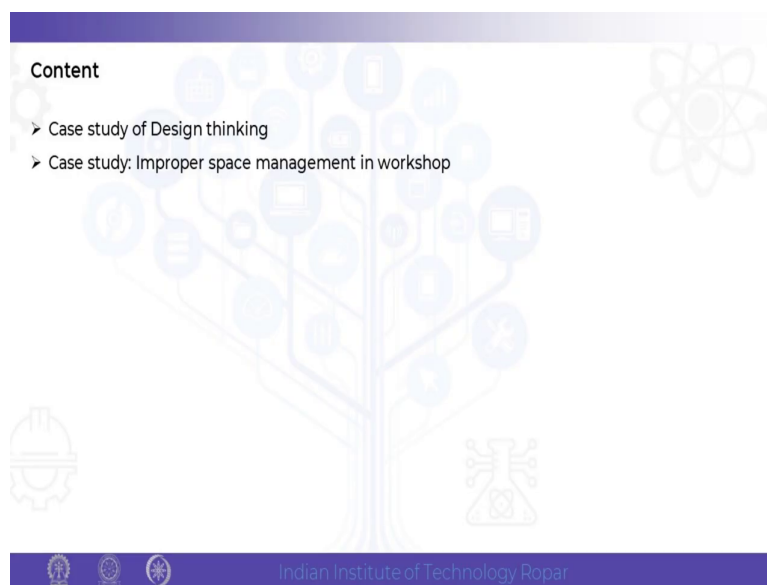


Product Engineering and Design Thinking
Prof. Prabir Sarkar
Department of Mechanical Engineering
Indian Institute of Technology, Ropar

Module - 08
Industrial Design, Design Entrepreneurship, and Design Thinking
Lecture - 39
Design thinking in Industrial Design- Case Study

(Refer Slide Time: 00:04)



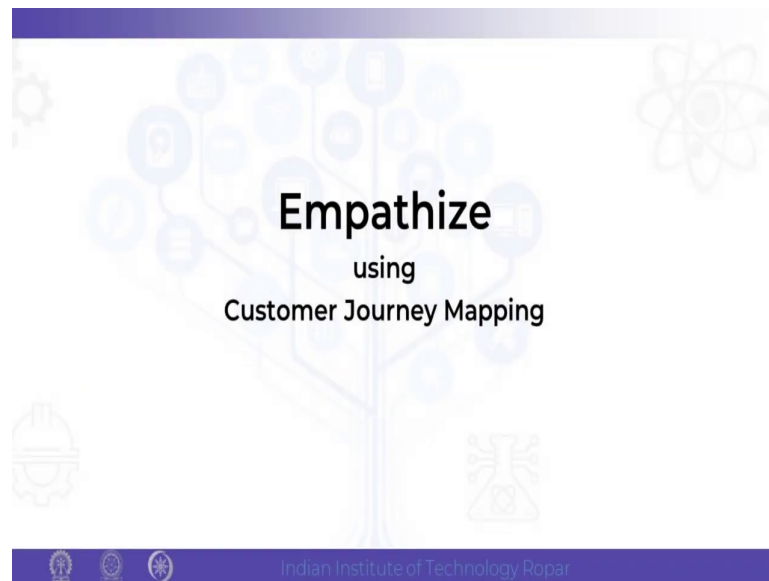
Ok, we will come back and thank you for being here. And today we will be actually design thinking is basically initially it was part of the conceptual design stage and slowly it has been popularized by IDEO and Stanford University. Currently it is having five steps. First one is first one is basically to understand the user and there is empathy, mapping them empathy and then the definition of the problem, how to define the problem.

And defining actually the problem is and then the ideate is the generating solution and their prototype. Prototype is basically making some kind of prototype for solution testing and then the testing, testing is actually to test the test the solution in the user to the user.

So, first one is empathy mapping. So, empathy mapping is we are going to basically the aim is to actually understand the customer in depth. And what is the need of the customer, what is the barriers, what is the attitude and aspiration, what exactly they do and try to understand and feel their pain points understand also what kind of issues are there with the customer.

And here we have a particular set of people for the particular problem in the case study we are going to solve it and that we call it is going to tell you in more detail. However, we are going to use customer journey mapping. Customer journey mapping we basically to understand how the a customer how or customer user is going to use in the in their entire day what exactly they does, what exactly he or she does and how exactly this product is a solution is going to fit there.

(Refer Slide Time: 02:03)



So, since we have already had an interview and a semi-structured interview with the workshop staff member. So, we all got to know what the problems here the members are facing. And the major issue was that the lack of space in the workshop for the new machines to come up and during the machining there is no place for the workshop members to operate and to stand.

So, with the use of the that interview we are going to now map the customer journey of the map the journey of the workshop staff. And also, we are going to first of all we are going to have the profile of the workshop staff.

The gender of the workshop staff is mostly male. The age profile is around 25 to 40 years of age.

Ok.

And you know anything more? In profile.

Working time?

Their working hours are I think usually from 9 am to 6 pm.

Ok.

And lunch they will they also have a lunch break of 1 hour in between, that is from 1 to 2 pm.

So, what we have done is we have the customer we have the customer and it is profile.

(Refer Slide Time: 03:29)

The slide features a central text box with a light blue background and a tree-like graphic behind it. The text is as follows:

Target Population — Workshop Staff

Profile

Age :- 20-40 Years
Gender :- Male
Working Place :- Workshop
Working Hours :- 09:00 Am – 06:00 Pm
Lunch Time :- 1:00 Pm – 2:00 Pm

At the bottom of the slide, there is a dark blue footer bar containing three small circular logos on the left and the text 'Indian Institute of Technology Ropar' on the right.

(Refer Time: 03:35) ok. Now, see since we have got the profile of our target person or the target user. Now through the customer journey mapping we are going to step into the shoes of the workshop staff and look what they do in the 24 hours regime. So, we will going to categorize this customer journey mapping into 3 phases that is before during before it is time in the workshop during the time where they perform actual work in the workshop and after. So, we will start with the before phase.

Ok. After interaction with one of the workshop staff we get to know that they generally, begin their day by at early morning by waking up at around 6 or 6 to 7 am.

So I am so, I am good to.

Wake up in the morning 6 am.

6 am then they get freshen up and they start preparing for their job to coming to campus for their workshop.

So, in pin point that they are getting ready.

Ready getting ready for the workshop and they reach the campus by 8:30 am.

Ok.

And mark their attendance.

Reach the campus.

Reach the campus by 8:30 am.

Should mark the attendance?

Mark their attendance at around up to 9 am. And they begin their job from 9 am onwards and.

So, in this our journey before.

Yeah, the that is before starting their work for the day.

And in during these activities what kind of move (Refer Time: 05:23).

As they are going to start their day they are in happy mood.

Ok. So, I will mark with the happy mood.

Yeah.

So, this is what the before.

Before that is the activity and their mood before the start of the journey or the day.

Thank you. Now, we will come to the second phase that what now they have reached the workshop. So, this will be categorized into the during phase. So, in the workshop what are the activities they tend to perform in it?

Ok. After entering the staff members into the workshop, they make sure that every machine is being ready for the work to be done. Then after the after the machine is ready, they are going to train these students and the researchers for their work. So, they distribute their work according to the time they have the students they have and after that you need to maintain the logbook of the other works as well.

Ok. So, we can pinpoint these into preparing of the machines. The first part the second one is training the.

Training the students.

Graduate and undergraduate students on the machines and the third we can say that.

Helping the research students with their project work.

Ok. Yeah. This one could be the next one, ok. Apart from this what are all the activities they tend to perform is?

As we know there are a lot of machines in the workshop. Sometimes it may happen then some few of the machines are got broke down. So, maintaining that broke break failure or breakdown machine.

So, maintenance of the machine.

Maintenance of the machine.

(Refer Time: 07:13) one of the point.

Yeah.

They also need to maintain the inventory of the other materials of the workshop.

Like a tools.

There are tools and the other machinery to be used during any operations. So, this is one of the (Refer Time: 07:31).

So, inventory of the machines.

Inventory management.

Inventory management (Refer Time: 07:35) write it as inventory management of the could be.

Tools and materials (Refer Time: 07:40).

Like inventory management as well as logbook maintenance.

[FL] logbook maintenance.

(Refer Time: 07:43).

Logbook maintenance we can also go at the bill of materials.

Bill of material, consumers used.

Consumers used.

Ok.

Then at.

Also. [FL]

[FL].

And also like in addition to maintaining the inventory they also need to maintain and maintain length properly and timely scrap. There is a the charges scrap that is formed from the machining operations. So, timely disposal of the scrap is also a duty that they need to perform that on what timely basis they should need they need to do it.

Ok, so, I will look and do then they have to look into the scrap management.

Scrap disposal and management.

Ok.

And at the end of the day while they are wrapping up the day, they need to again look at the machine whether the machine is being (Refer Time: 08:36) not proper whether the machine has been cleaned or not. So, that the next day they have to again prepare for the jobs so, again after the completion of job maintenance of like setting down as well as cleaning of the.

Ok.

Machine shops and machine floors.

(Refer Time: 08:53) during the this though to the end phase of this during category become right now as the again getting ready the machines for the next day.

For the next day.

So, we will also mark the mood of the workshop staff during this activity. And since we have note down so much of a point. So, it seems like that this workshop staff is schedule is quite hectic.

(Refer Time: 09:17).

Hectic for them so.

It might happen they feel lazy or like bit.

It might happen they feel some tired kindness. So, we can write down the mood as a neutral to.

Not so happy.

Not so happy a neutral phase.

Or neutral phase.

Ok, now we look into the after phase of the after the completion of the all the work in the workshop itself. Now, we come into the next phase that is the last phase that after doing all these activities what they are going to do next. I think simply they going to shut down the workshop.

Yeah.

They have to mark the attendance while.

The leaving attendance.

A leaving attendance also, ok.

And they will leave for their home and they will be eager to meet their family after the long working day and.

We can mark that everyone after going to.

Home.

Home before going to work is in a happy mood.

Yeah, obviously.

So, all can do with that is in a happy mood (Refer Time: 10:41). So, like this now. So, we like this we have completed the empathy and look into all the customer journey mapping also (Refer Time: 10:52).

See apart from the is customer journey mapping we have used, but empathy is fine, but we also need to understand what exactly the customer is you know feeling. Empathizing means with respect to this problem like you know space is not there much. So, it must have some effect on their happiness, or working cycle, or the way they are working, or maybe sometime they are clashing with the material table or with other people. So, they it makes it a little uncomfortable or they plan something they not have to do.

So, yeah empathy means when we are going as a customer. So, what kind of problem will be which we will be facing? They may be facing so many other problems, but with respect to space problem if you have any other understanding about the customer, about the person who is that you can share. There is a little bit of observational or something, which you feel that they might have felt (Refer Time: 11:57).

Regarding to lack of space in our workshops suppose staff is working in workshop during his working hour. It may happen that due to improper placement of machineries as well as no available gas for them to work.

It may happen sometimes some injury or sometimes some clash between two or three staffs may happen that may cause some injury to them. And that will make him make them suffer or in that case they will feel that the environment or the working condition is not so good. So, they will feel bad due to lack of space and space management.

Also like while interacting with one with the custom with the customer here that is the workshop staff. What we see is that they also complained about that while expansion of the workshop it is quite a difficult task here because the doors are very small and the placing of the new machines. It takes a tedious start they have to break the wall and remove the uninstal the doors. So, this was one of the problems that a that they are also mentioned here also. What you feel when you got to interact with the staff?

Yeah, one more issue that they have mentioned is that that they do not have a proper sitting area while they are not working or during the rest period. When they are in the like during the

lunch period when while having lunch the area that they have is like they have just made a sitting arrangement between the machines where they sit together and have lunch.

So, that area is not suitable or not proper for them to have lunch and that also affects their like the working standards that they have and the mood. Their mood is also affected by that because like after that they do not feel that energetic and not that they do not feel with that excitement they do not work.

Because they are not motivated enough.

They are not motivated motivation has not happened it is present to them to work.

This definitely led to the lack in inefficiencies.

Lack in productivity of.

Poor efficiency.

Poor efficiency and productivity of the workers.

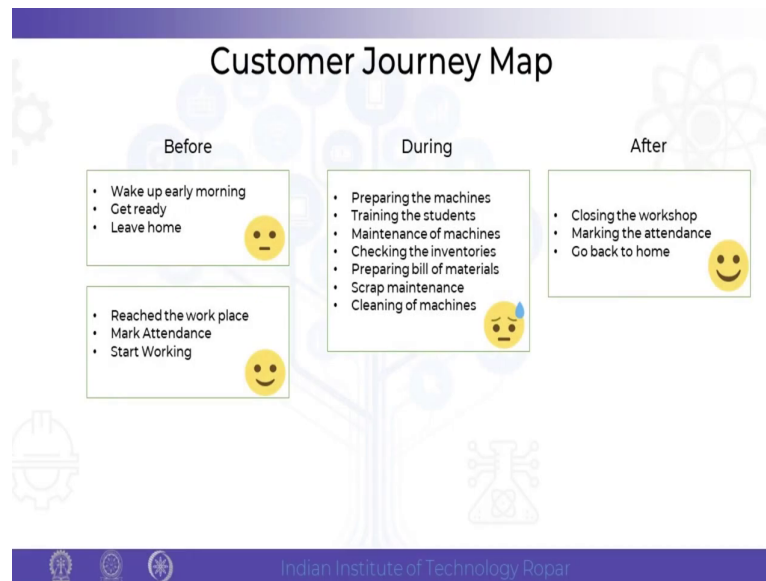
Fine now we can say (Refer Time: 14:10).

So, while interacting with all and noting down the actions of the of the workshop staff we have completed our customer journey mapping.

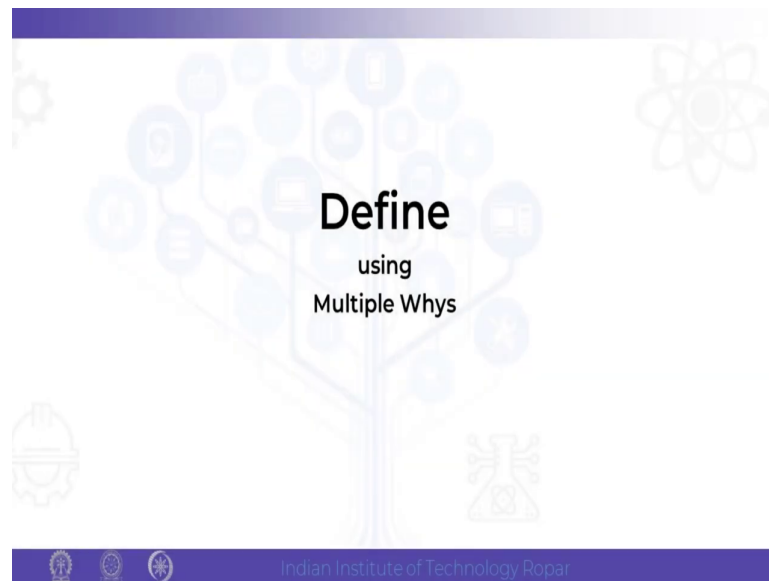
Empathy (Refer Time: 14:24).

Yes, customer journey mapping and we can move to our next (Refer Time: 14:28).

(Refer Slide Time: 14:29)



(Refer Slide Time: 14:33)



Now, we are going to define the problem. Define the problem is basically we would like to see where we are focusing our attention our problem what exactly the problem is then we are going to try to solve it. So, here in the definition we are going to collect the issues with this problem.

And then understand what is the in the going to the in depth understanding of the problem and then we are going to ask the right questions and ultimately, we are going to have a set up exact problem, which has been defined to define the problem that is going to be solved in the next step of idea.

So, definition of the problem can be done multiple methods. So, we are going to use two method one is this 5w technique 5 why's why it is multiple asking, multiple whys. And second technique which we are going to use is this like conflict of interest is another

technique. There may be multiple other techniques these two we are going to use it. And now Vikalp will be going to explain in the technique and then we are going to start the technique.

Ok, thank you sir. So, now we are going to begin our second step of design thinking that is the defining phase. And so, since with the interviews with the interaction of the workshop staff we got to know the multiple problems of the staff. So, since there are for multiple problems, we all can have multiple solutions also.

But we are going to target at one of the problem of the workshop staff and throw that problem while going to thread that that problem. We are going to use the multiple why's techniques multiple why's techniques in which after knowing the one problem we are going through this multiple why technique. We are going to have continuously ask about the problem the root cause of the problem then again why did this root why this causes again asking.

So, why and why at a sequential stage we are going to ask with each other and we are going to reach to a root cause of that particular problem. So, this is how we are going to do this multiple whys technique. So, this is how we are going to use it. So, let us define our problem.

So, we can all define a problem is that interacting with all them we all got to know that is the lack of proper space in the workshop. So, what we can do is we can simply define this as a problem and through multiple why's we are going to find out the root cause of this problem itself, ok. So, we are going to start very good asking the sequence sequential whys. So, the first is why there is a lack of space in the workshop?

One of the reasons for this lack of space can be due to the overcrowding of the machines in the workshop as the demand for more and more machines increased, we had to the workshop had to accommodate more and more machines in the within the confined space that is given to it. So, that is why there is lack of space the machines are the number of machines that can be accommodated in the given area are more. So, the there is a lack of space that can be the first why.

Ok, so, first why can could be that overcrowding of the machines due to which the workers are not able to find. So, we are going to write up first stage of the why is that over crowding of the machines. So, now we come to the next level. So, now we are going to come to the next level of the multiple why's technique that, why the overcrowding of the machines are going to have is going is happening in the workshop?

One of the possible reason for overcrowding of machine may be improper placement of machine in a workshop like in between like suppose two machines are already being installed and if some few new machine is being come to the workshop and it has to be installed. So, due to lack of space it made the possible that in the vacant space within two machine that new machine can be maybe installed. And that will again occupy the vacant space or empty space in between the machines.

Ok, so, we can answer that simple question that, why the overcrowding was taking place? You mean to say that because improper management of the machines and the equipment's.

Proper placement management.

So, I will write into that improper placement. So, now we get to this second level that improper placement of machine equipment's and machines. So, we are coming to the next level is that why is there the why it is that improper placement of machines in the workshop is happened?

The.

(Refer Time: 19:46).

The cause for this may be because of the initial pre during the initial phase when the workshop was being designed, there was no room for expansion provided that there was no room for future. There the future increment in the number of students the college may have or the few the need for expansion was not considered in the initial planning and that is why I

think the machines are overcrowded and there is no and there is no like the machines are not properly arranged because of this.

Ok, so, we got to the reason is that why this improper placement of machine is that in the initial stages while the workshop was designed there was no proper planning of the future expansion.

For expansion.

And it was not a good planned structure. So, I will write that no future expansion. You are going to ask that why there was no proper future planning while during the initial stages and there was no not a good structure. So, why then we are going to get to the next stage while this happened?

One of the main reason for the improper future expansion plan may be due to improper planned layout in the initial phases of the building of the workshop that causes that causes this no future expansion plan.

Yes also. So, like you mean to say that if there are entrance entering of new machines in the existing workshop, we are already the existing machines are there. So, that functionality of the existing machines and the space of the existing machines the designated space is also getting disturbed.

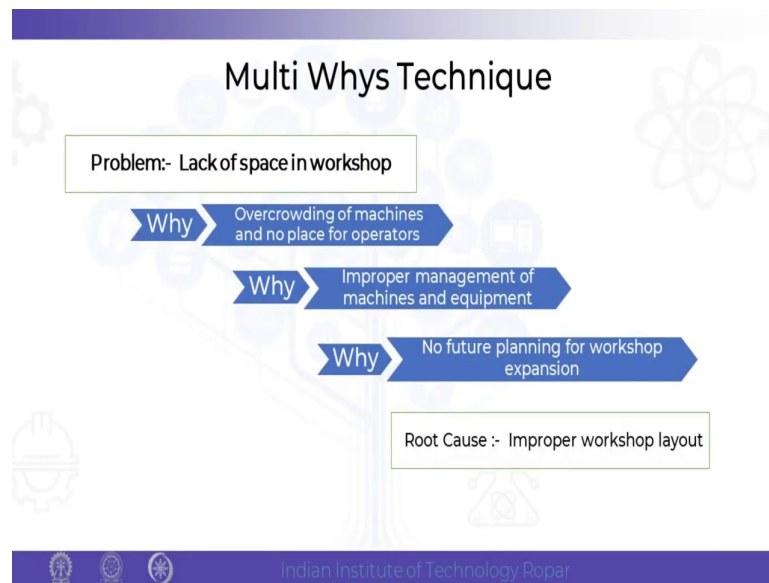
Disturbed or you see (Refer Time: 21:42) being to (Refer Time: 21:43) new installed machines.

Ok, so, we are so, we can come to this conclusion that why this so happens is because there was improper.

Planned layout.

Planned layout improper planning of the workshop.

(Refer Slide Time: 21:56)



(Refer Slide Time: 22:00)



Ok, now we are in the most one of the most important stage that is the ideate. In the ideate we generate solutions. In the previous stage we have already step we have identified what exactly the problem is and we went to the depth of the problem and then understood what is the problem.

In the ideate phase we generate solutions and possible ways to and remedies and there are a lot many methods are available to use in this method in this technique. In this phase take for example, brainstorming is there then landscape mapping post-it notes and gallery method there are so many other ways to do it. Here we are going to use brainstorming technique and Vikalp will be going to write it down the steps.

Ok, so, friends like this we have completed our two exercises of design thinking first is empathy then the defined phase. Now, in the third ideate phase we are going to generate the solutions of the problem that we have identified.

The problem along with the root cause that we have identified and we are going to generate the solutions. Also keeping in mind, the desired results that we want that is new machines can be installed more machines can be installed and the space cannot be compromised that is space should also be more sufficient.

So, we are going to begin our ideate phase with the multiple solutions we can have many solutions of the problem also and we can also pinpoint these solutions we are going to write it down. And so, that that will help in our a next phase that is prototype. So, using the brainstorming we are going to discuss with each other about the solutions of the problem that we have identified in the previous phase, ok.

The solution of the problem which I think for the space management is that if we standardize if all some standards for the (Refer Time: 24:12) of the machines in a workshop if the authorities all the follow all the instructions that is particular given to them. Then the space can be easily managed and also if we have different machine different size machines in a workshop.

So, if we do categorize some machines for the smaller, mediate and the larger ones and if we place according to the shops some of for example, if we have smaller machines we can categorize according to the placement where, the there is a smaller layout according to the plan. And we place the big machines according to the anti-intuitive (Refer Time: 24:46) machine supporting to the other placements. So, in the in this way the space can be easily managed and overcrowding can be minimized.

So, we can write this that standardization of standard rules has to be followed for the planned layout ok fine, I will write it down.

Like after proper standardization as well categorization there could be a like proper place for storing the waste as well as good product also like there should be separate room for where we can put our scrap as well as used raw materials. And there should be a different room where we can store our fresh as well as raw materials.

Ok.

So, that we can easily use them without any hindrance.

So, you mean to say that we can have a separate space instead of the existing one. That we have is that the scrap is at a particular place.

Yeah then that particular corner and (Refer Time: 25:48).

And it is scattered. It is taking the much more space so, designated place.

Space or.

Space or a room or.

Organized room or space.

Organized room or space can be there for a that.

(Refer Time: 25:55).

So, in our planned in our planned layout what we should have that this.

Proper storage or rooms there.

Proper storage facility and waste storage facility both for raw materials and inventory and.

Fine.

Ok, so, while discussing with the operators we also found out that the sitting operation sitting position or the place for the operators and the workshop operators is not sufficient or not proper. So, we should also focus in the new planned layout we should also focus on providing the operators with a proper seating arrangement and if possible, we should also provide them with an air conditioner air condition closed chamber.

So, that they can have a break whenever they are on break, they can relax their have their lunch properly and plus we should also make sure that the surrounding of the atmosphere the surrounding atmosphere from the workshop does not interfere with that compartment. So, that the air inside that is not as is pure or much pure much pure as compared.

(Refer Time: 27:01).

Fresh air is available in the compartment provided for the operator to sit as opposed to the workshop environment.

This will definitely motivate the work workers to be more efficient also and they will kind of relax there in their lunch time or then in their relax time.

(Refer Time: 27:16) in break hours.

Also, I think in addition to that what we can have is that proper air conditioning should be there and.

Ventilation.

Ventilate and sound probing should be also be there. So, that the big machine is working. So, in that space no kind of a sound is.

Enters to the compartment.

Enters to the compartment so, it could be a calm and soothing and relaxed environment in that air condition apartment ok, fine.

Yes, this will also help improve the productivity of the operators.

One of the solution to tackle this the space management problem is that if we do have very small doors and big machines cannot enter through it also there is a lack of space for the big machines to put up in particular space. So, if we want to want to enter some big machines. So, the because of a small exits and a small doors the doors has to be taken down.

So, in the in this case the big machine big machines have to be entered if you are breaking down the small exits and a small doors. Also, for the exit plan there is no much windows available. So, if we want if for the for the exits of these two ends and the other staff members if we have exit doors properly planned. So, this solution can be minimized according to the space plan.

So, I think we all have concluded according to the certain staffs that should be having the planned layout. Also, we can look into the ventilation of the proper ventilation of the all the machines since the machine is working. So, ventilation is should be such that the fresh amount fresh air.

(Refer Time: 28:54).

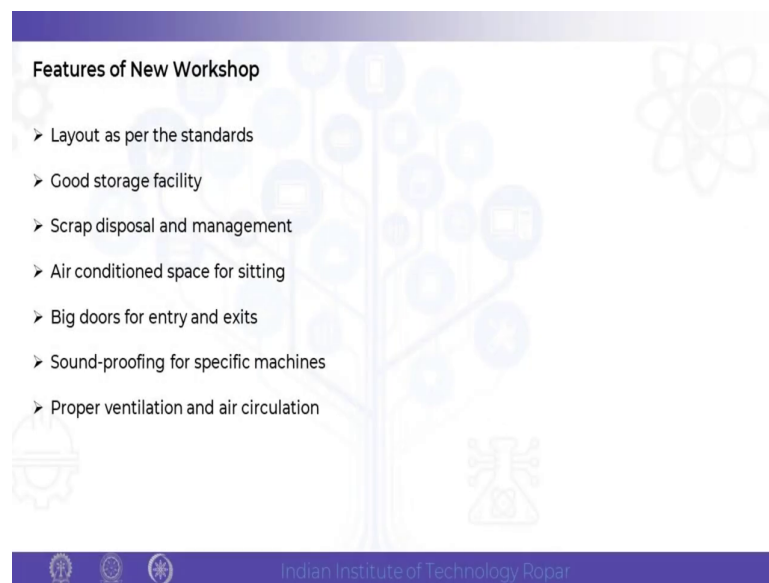
Should be there in the whole workshop.

(Refer Time: 28:57) environment should be there. So, that machine (Refer Time: 28:59) can be improved.

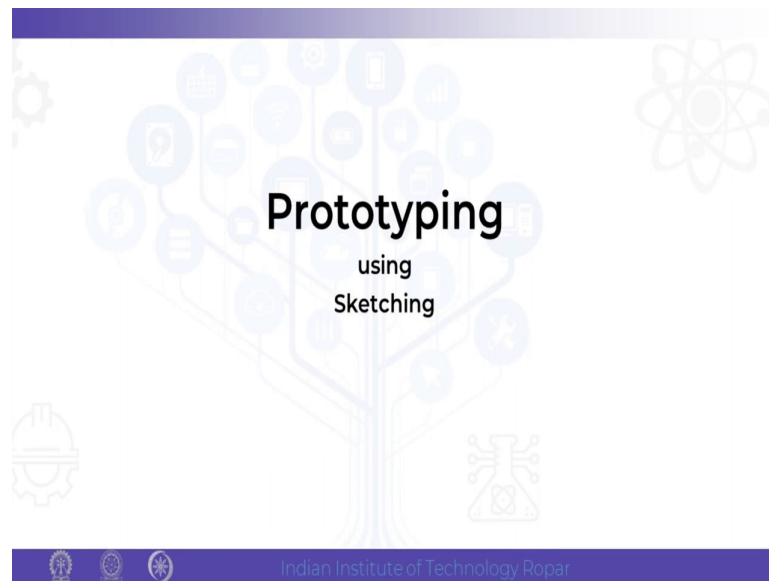
So, we workers can work well and the outfit of they only (Refer Time: 29:02) machine range operations is one (Refer Time: 29:05).

Ok so, I think we have got the many solutions and many features that are planned layout should have in this ideation phase, ok. So, I can conclude is that for the next phase now that since in the next phase what we are going to do is we are going to have a develop a good planned layout for our workshop. And for that in this previous step that is the ideation phase we are we have concluded certain points that could be the features that we are going to use in the in our next step ok, thank you.

(Refer Slide Time: 29:42)



(Refer Slide Time: 29:46)



So, now we are going to go to the next step that is prototyping step in prototyping stage we are supposed to make physical prototypes; however, just because that we have a lack of time and resources. So, we are going to have a either virtual prototype or a paper prototype.

So, in prototype we are going to take a solution the best solution among that whatever we have come up and evaluate all the solutions find the best one and select it and then make the prototype using the any of the techniques, which we are going to have, ok.

Ok sir, as sir has rightly said that now in the previous stage in the ideation phase, we tend to have the various suggestions that, we can use as a features in our next step that is the prototyping prototype stage. In prototype stage what we are going to do is we are going to

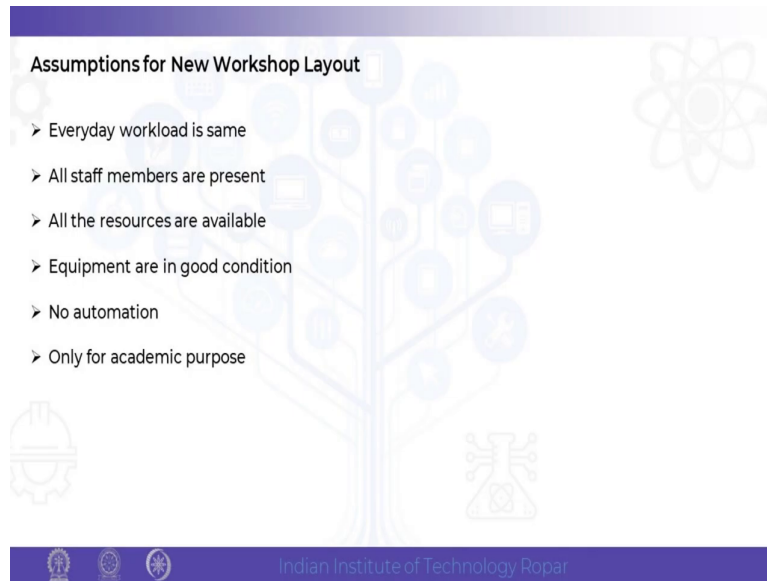
since the root cause of our problem is that we have an improper plant layout for the workshop.

So, in the prototyping phase we are going to make a good proper layout of the workshop in which we can add on the features that we discussed in the previous stage that is the ideation phase.

So, here what we are going to do we are simply we are going to on a paper we are going to draw the design of the workshop that we think will be there we each are going to draw it. And we are going to discuss with each other and have a optimum workshop layout that we can have.

We will discuss with each other and we will look we are continuously going to upgrade it depending upon what each other's things of a particular layout and then we are going to design a proper prototype or a proper plant layout design. Basically, we are going to simply sketch on the paper ok, thank you.

(Refer Slide Time: 31:53)

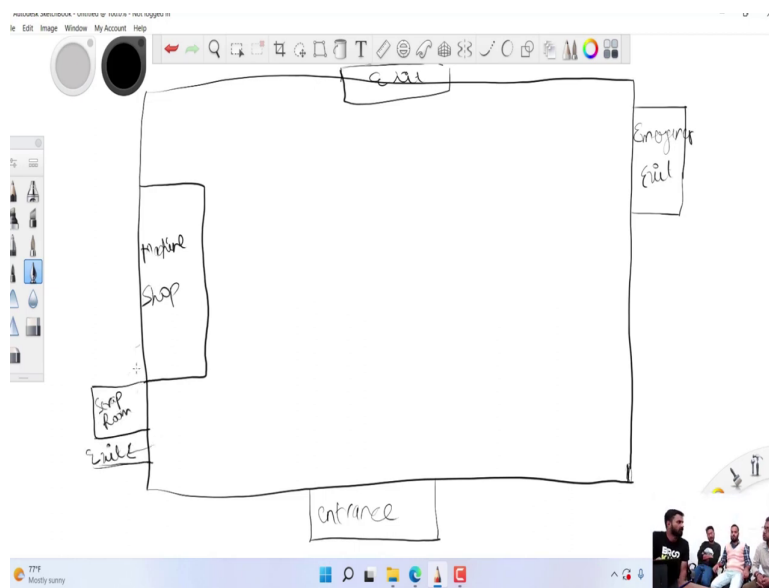


Assumptions for New Workshop Layout

- Everyday workload is same
- All staff members are present
- All the resources are available
- Equipment are in good condition
- No automation
- Only for academic purpose

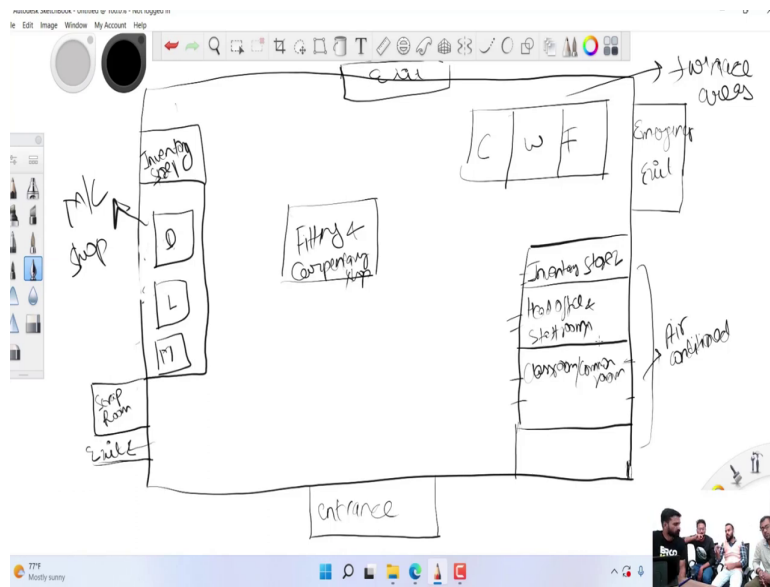
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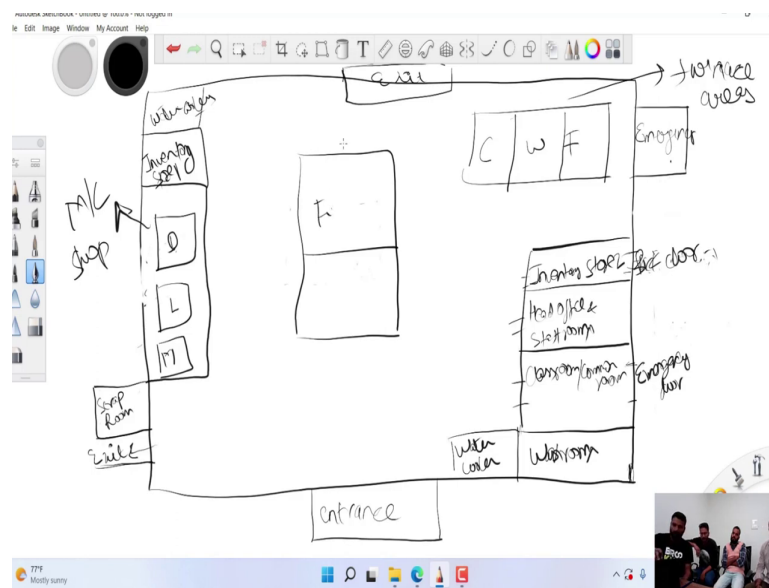


So, first of all we need to have the original multiple exits. So, what we have one emergency exit here one emergency exit we can have this one yes, this is another problem, yes. This is our second check on emergency exit then what do we need to do first do we have to look for the sitting arrangement or we can simply go for scrap for the scrap storage. Because there is a scrap (Refer Time: 32:50) and that two should be at the one of the emergency exit so, can we have here.

(Refer Slide Time: 33:06)



(Refer Slide Time: 33:46)



You mean to say here we can do one fitting and individual carpentry and this is the stay at the centre and longitudinal direction like.

Long range of the dimension ok.

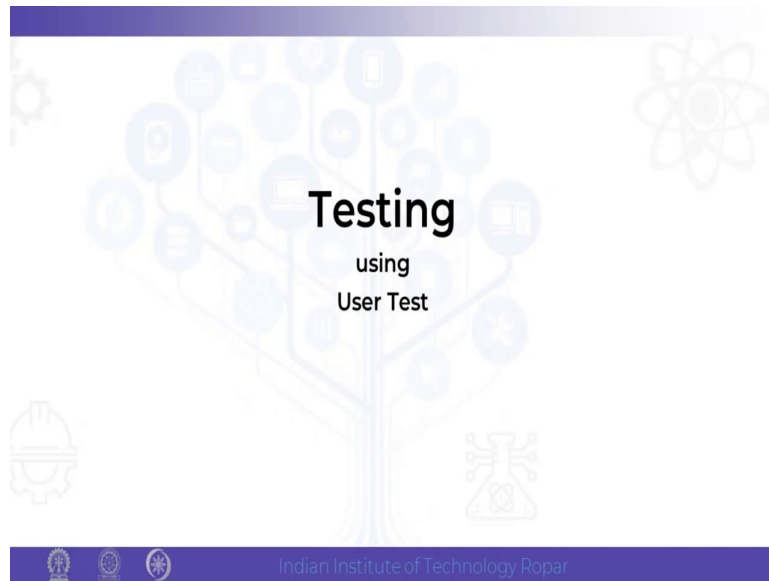
So, you (Refer Time: 34:36) say this if this is the shop, we can subdivide it into fitting no not this way I think in this other way, ok.

In a longitudinal.

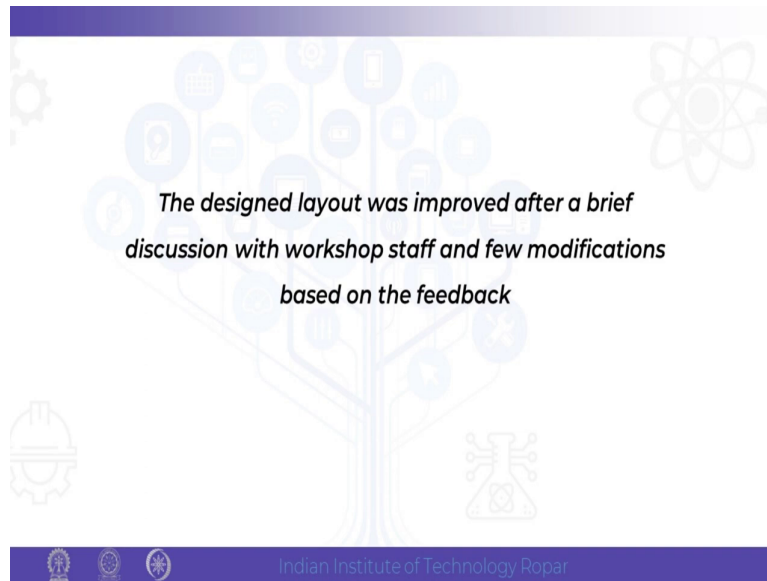
Ok, ok fine.

So, we have just completed the prototype and then we are going to go for testing. In testing the prototype whatever has been drawn and that will be shown with the user. And the feedback will be taken and then the testing will be done.

(Refer Slide Time: 34:54)



(Refer Slide Time: 34:59)



The designed layout was improved after a brief discussion with workshop staff and few modifications based on the feedback

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(Refer Slide Time: 35:03)

Final Layout

