Design for Quality, Manufacturing and Assembly
Prof. Palaniappan Ramu
Department of Engineering Design
Indian Institute of Technology, Madras

Lecture - 35
DFA Examples & Discussion

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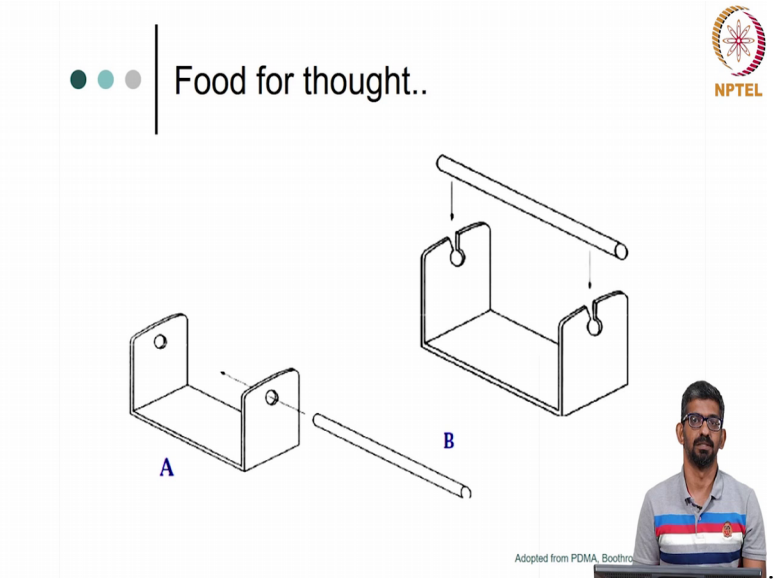

So primarily we are what we discussed is you need to be able to evaluate two different assemblies at the design stage. So, we said how do you evaluate an assembly in a quantitative sense is we will look at that time that is taken for the assembly, but the time will be dependent on different aspects of what is the size, what is a weight, what is a symmetry. So, we took a few stuff off that and we discussed how to quantify those and how that is stabled in both way, currently it is a software. So, you go and choose such that thing it will automatically tell you this is what the time, but this is what goes in the back end of that particular software.

And I guess you might be able to change or the moderate those values a little bit ok. So, finally, it will give you an assembly efficiency that is one particular number or the metric that you are looking at. So, you look at A B C D and then you look at what is the assembly efficiency for each of them and then you choose the one that works for you the best ok.

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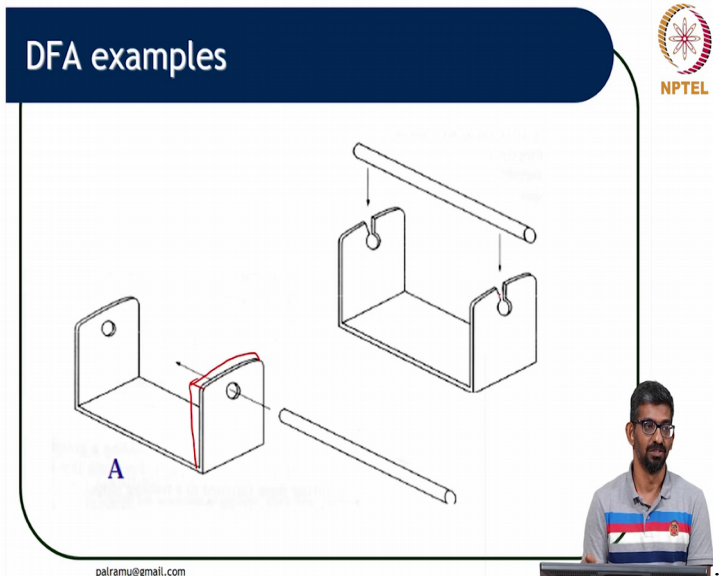

I have a problem with this assembly, what could it be?

Student: Once we put to one of the cylinder into one the second (Refer Time: 01:25).

You understand right, so you put this ok, it will go this is a point of this is a point of pivot, so it will just keep doing this ok. So, this alignment need not be straightforward you cannot put the guide here; obviously, cannot put a guide ok. So, what is the potential solution?

Student: (Refer Time: 01:51).

Something else?

Student: Sir, increase the length of increase the length.

Increase the length?

Student: We can hold it.

And that does not matter. The rod is actually lengthier than this that is not matter.

Student: It is the diameter of (Refer Time: 02:14).

To do what?

Student: Get little bit over (Refer Time: 02:17), thickness of the wall sir. So, that the pivot can (Refer Time: 02:23).

What will happen that is a good answer. The thickness of the wall it is a good answer, but what will it essentially do? If we increase the thickness of this wall to this much let us say what is it going to do? How will it help the alignment of this rod? The answer is can be considered right, but what is going to happen?

Student: It is more constraint.

It is more constraint ok. So, what is going to happen as it is going to sit. So, right now it is going to do this. When you increase this it will sit, it will sit like this and then you can keep sending it and then finally, it will like ok, so that is one. So, it is more like a more point of contact is more now ok, instead of just one you will have like point of contact is more. So, the rod or the cylinder can sit and then it will go the point of contact is more.

So, the surface contact is more. So, one the other solution is what this is a textbook solution, but it is not necessarily true that you can do this in all cases ok, this is a case in which something like an wood or plastic you can do this ok, not in the metal cannot maybe it will not let you do this because metal cannot plastically deform ok, so there is a problem here if it is a metal based system.

It is usually in wood or plastic you can do this ok.

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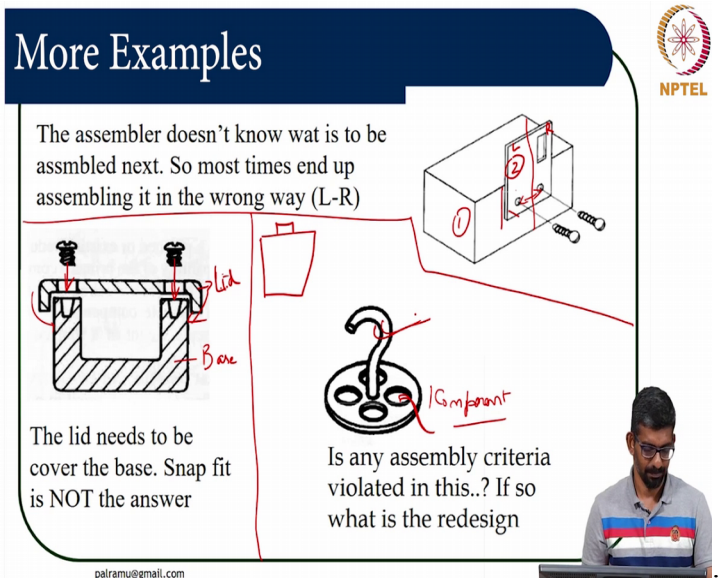

I will change this, but let me ask you the assembler does not know what is to be assembled and next. So, most times end up assembling it in a wrong way left to right. You understand right, you understand what I am saying? t7his is part 1 this is part 2 ok, but the way it is currently this has to be in the left side rather right side, but there is no guarantee I can always flip it and do it. How can you guarantee that? Some concepts that we have discussed itself will help you.

Student: Marker, the marker it should be (Refer Time: 04:58).

That is visual inspection you can have a marker here or you can say this is the left side this is the right side.

Student: There is a marker on the right side.

This is not a marker this is a hole.

Student: The hole can be treated as marker, the hole has to be (Refer Time: 05:16).

You need to convey that information, but these are like pretty much now they like what is the best assembly, they said you should be able to assemble it using a boxing glove, you should wear boxing glove and you should be able to do the assembly ok. So, it is as good as that without saying I should know that, this is how it is.

I should not go through some manual or something, it should not let you do that way it is assemble as it is.

Student: Sir, they do which the screws are the grow rate or the helix. So, when the starting point if it is like aligned so that it can directly combined, the opposite in the other opposite side it might not be directly aligned.

So, basically it could just be this symmetry, currently these two screws are symmetric to the axis that particular axis. You can actually change you can just put this screw a little above. So, that if you do at the other way you cannot do it you understand what I am saying that could be one solution. What else?

There are plenty of solutions for this plenty of solutions visual view that something and he told. We can do you can put guides here we can mark it left right something like that

or you been have an yellow thing here you can have an yellow you should say yellow goes with yellow.

Student: You can slice that one (Refer Time: 06:57).

But that is not help here right because that the SIM card goes and sits in a shape that also has that corner Sliced.

Student: (Refer Time: 07:09). If possible we can.

No, these are the only two parts, these are the only two parts.

Student: We can make a shape of part 1, part 2 consider (Refer Time: 07:21).

No, even with the existing part, what can you do? Agreed? Let us say that you have something cut out here and you should have the similar one there also. So, that it goes and sits that is possible, then? So, there are multiple solutions so, there you escaped two solutions fine. Now, let us look at this example, the lids need to be the lid needs to cover the base sorry, this is a base this is the lid ok, the lid needs to cover the base snap fit it is not an answer do not say snap fit. There are two screws, I put the lid and then I put the two screws to tighten it, a perfectly fine can this be improved.

Student: So, the lid can be improved (Refer Time: 08:46).

How?

Student: Sir, the inside diameter of the lid, sorry, outside diameter of the lid should be equal to the inside diameter of the base.

Then how will you put it in?

Student: Sir, (Refer Time: 09:00).

The lid has to go in. Then after it closes we should also be able to remove it without cutting.

Student: We can handle.

You know that is just handle will just go and set right. How will it go in? It should be it is a snap fit kind of a stuff if might have liquid into it and when I transfer it the liquid should not come out.

Student: It should be (Refer Time: 09:31).

Sorry?

Student: It should be tightly fit.

No, I am not getting your point. See, this it is like this you are saying that you are going to put a lid like this with the handle.

Student: This is tightly fit.

How would, how will you tightly fit?

Student: (Refer Time: 09:45) containers in the (Refer Time: 09:49).

No, this is you cannot change the material let us say. Let us not change the material, if you want I will say the material is iron some kind of iron or steel.

Student: Sir, (Refer Time: 10:00) things are there.

That is one thing.

Student: (Refer Time: 10:11).

So, the only thing is what is the fastening or the assembly mechanism in these screws? The screws are likely to take 1 minute. Can you quickly do that, something like he says, you put two things and then lock it that still that that is a catch that I am saying it does not go in it stays outside the lid stays outside and then you lock this guy ok. So, that is one solution. So, we will see what the solution is in the next slide the next one is in this particular kind of stuff is any particular assembly criteria violated? This is one component.

Student: O-rientation of the (Refer Time: 11:12).

Orientation, why orientation?

Student: The hook is supposed to come in the middle of the circular as in the phase of.

Imagine that it is like a holding like the tea thing that you have seen people hold it, do not do not imagine that, but I am just saying. It does not matter whichever the hook that, it will still hold it you are just going to pour it like that. If you meant that along the axis it can be anywhere that is not a problem tangling this will go and tangled into the next one ok, or it can angle into the next one. So, that is could be a problem ok.

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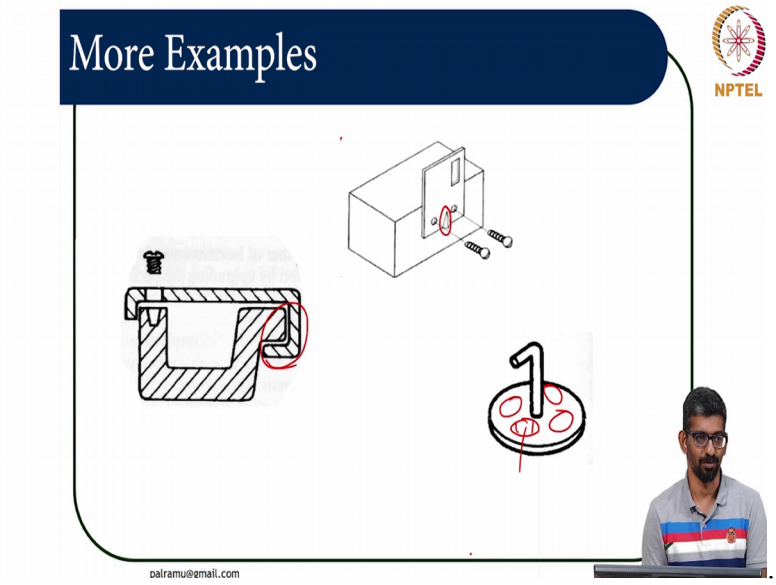

We will see what the solutions are. So, in this one what they have given us a text book solution is to introduce a small projection.

So, now what happens is if the projection is there you not keep it like this it will protrude out correct. So, it will be like that that is one thing, in this one just like what he said it is a buckle, but it is not a buckle lock I am only reducing one of the guys ok. So, I can just take this guy open it fill whatever it is put it in just one screw.

So, you are getting rid of one screw time that is all and this is it should have these, but what happens is you can have thin sheet cover those holes upon shipping you just sphere these guys and send them out that is all ok. So, that they do not tangle with each other that is one simple and then you keep it simple like this you know instead of keeping it like this that is one thing or you can also do this.

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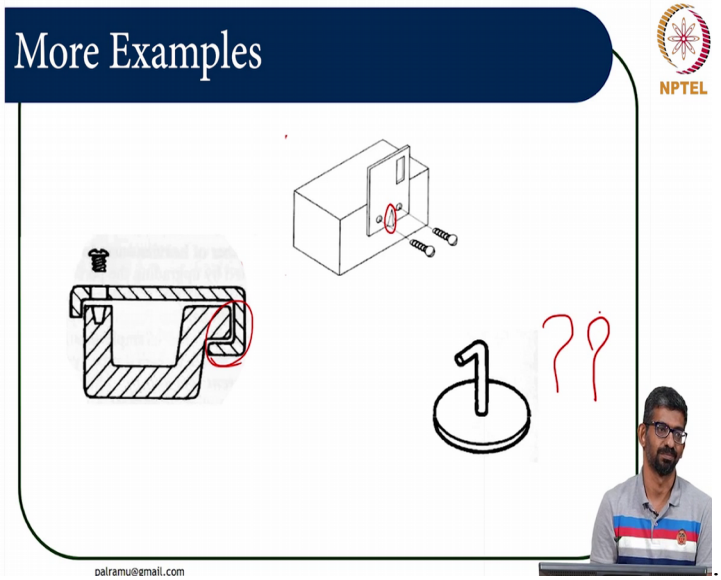

Instead of holding it like this you can keep it like this.

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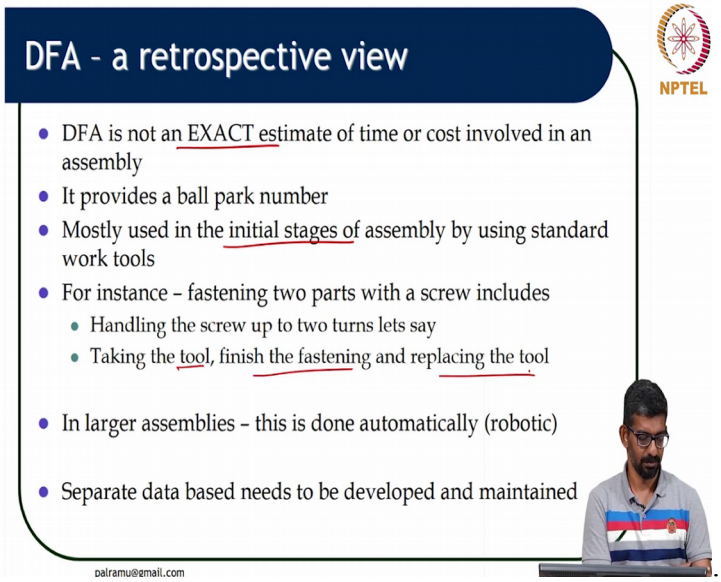

So, that this gap is so small that it will not get tangled. So, now, we will take a retrospective ok. So, right now we all had a perspective right. So, with on the retrospective it is not an EXACT estimate D F A is not an exact estimate of the time or cost involved, it gives you a idea of what is the time and what is efficiency, but it is very systematic there is no it provides a ballpark number. It is usually used in the initial stages the moment you are done with the prototype you have the actual value alright.

So, it is usually used only in the initial stages of assembly using standard work tools ok. For instance, fastening two points with the screw includes handling the screw taking the tool finish the fastening and replacing the toll, but all that is not captured in this in one sense it just says the tool time for instance taking the tool finish the fastening replacing the tool that part is not captured ok.

In larger assembly this is done automatically. So, this is what we have discussed. So, far is only manual assembly in large assemblies they use robotic stuff, but the idea is the same concepts change a little bit that is all ok. And separate data may its needs to be maintained and developed and maintained that is what they have done. So, robotic assembly there is a separate one that is available and each company also have their own D F M a set of rules and tools and all that for an initial estimation they do all these things, but they have their own legacy to defend on ok.

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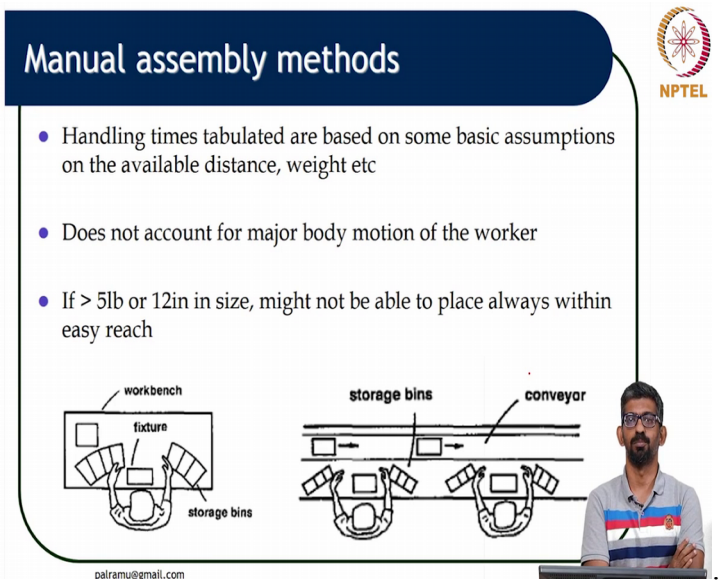

So, this is again we are not going to get into the details of this, for instance we are only talked about a single part assembly, single person assembling in all that, but in real life when you see the assembly line like lot of people one after the other they do quickly right. So, for instance the handling times tabulated or based on some assumptions saying that the part is available right there. So, you can just take it right, but imagine that there is an inventory ok, one day they are going to assemble about 100 of those controlled regulator that we discussed a control assembly regulator assembly right.

So, then what happens that particular the first part that we discussed the regulator will be kept there the screws will be kept there, how many regulators hundred regulators will be kept. So, what happens is the person have to get up walk there go get it and come from here to here I might be able to place it with one hand, but from there to here i might not be able to bring it in one hand that took 10 times 100 times, I may not be able to bring it in one hand. So, then you need to plan all those things that is what this particular chart talks about.

It does not account for a major body motion of the worker just assumes that it is all on the table and then you can do it. If it is a greater than 5 pounds are 12 inch in size might not be able to place always within easy reach, in and just keep it right here screw nuts yes you can do it, but parts that are slightly heavier and all that you keep it away and then you bring it and again you cannot keep all of them right around you, there are multiple people that are sitting and there will be you know these assembly lines are going in front of you. So, you just need to assemble and do it.

So, for instance there are storage bins by the side of you and then the a conveyor belt takes a parts that you have assembled it comes on the previous person you assemble that next one and then course right.

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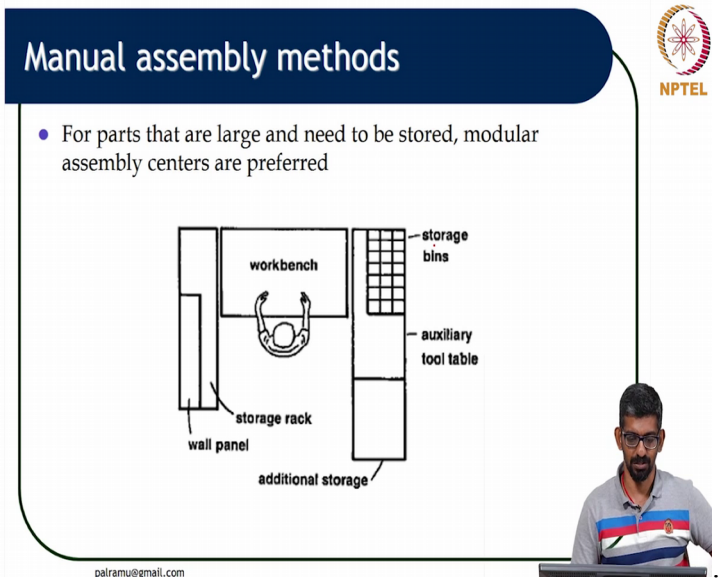

And then this is called the work study ok, there are there is a big research area that says how are you going to optimizely store all these things ok.

So, for parts that are large and need to be stored modular assembly centres are preferred in this is just an idea this is a work bench here, we have storage rack wall panel additional storage auxiliary and with this if you have a vertical cross section of this you will now they will say that you know easy to I mean heavy to lift should be at your hip height. Something that is not very lift that you can bend and take it that is fine ok, something that is very easy for you can just lift it from there. So, you just keep it about so, that is the separate research area call work study on that is just give you an idea ok.

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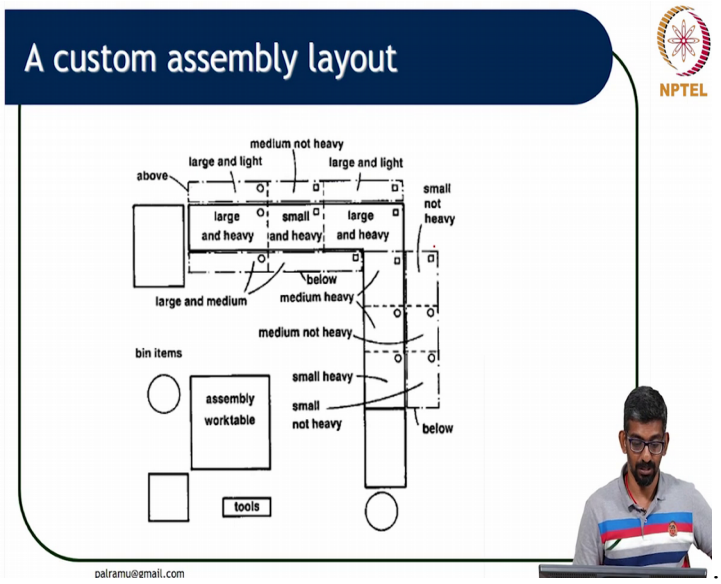

This is exactly what I talked about ok. So, this is the assembly work table and large and heavy parts large and medium small and large and heavy they have different things and they might have cuts to help you bring that the tools are immediately placed here the bin items are here. So, this is just a layout idea ok.

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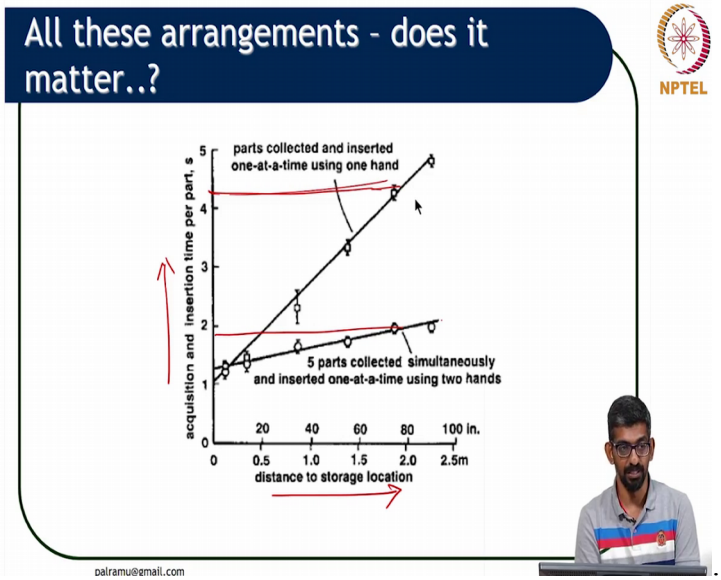

All these arrangements do they really make a difference, that is what this chart talks about distance to storage location acquisition and insertion time per part, you can see here parts collected and inserted 100 time using one hand you can see how this axis is going, 5 paths collected simultaneously and inserted 100 time using two hands and see what the differences.

So, imagine it is placed 2.5 metres it is the time is about or two 2 metres the time is roughly 2 seconds, it is roughly 4 seconds it is twice. So, you collect it does not matter if I go take one assemble go take the second one assemble go take the fifth one and assemble or should I bring all 5 of them keep there and assemble one by one.

Obviously bringing them together, but then again depends whether you can carry all five of them or will there be a curve that will let you do that, so, all that needs to be analysed. So, that assembly stuff kind of gives you an idea, but there are additional issues that you need to take care of and these are this will allow you more precise organisation of these things will let you, conserve time which means save money and increase your assembly efficiency with this we will wrap up the D F A part.