**Product Design and Manufacturing**
Prof. J. Ramkumar
Dr. Amandeep Singh Oberoi
Department of Mechanical Engineering
Department of Industrial and Production Engineering
Indian Institute of Technology, Kanpur
National Institute of Technology, Jalandhar

Lecture – 29b
Software demonstration: Plant Simulation (Part 1of 3)

Good morning welcome back to the course, I am Dr. Amandeep Singh and I will take the Plant Simulation Tecnomatix in this lecture. So, we have discussed about the plant, we have discussed about the simulation, we have discussed about the product design and manufacturing aspects.

So, in this lecture I will just touch what is the kind of the simulation that we do in designing a plant, and how the material is being carried from one point to another, all those things what kind of stimulation we can do there.

 (Refer Slide Time: 00:53)
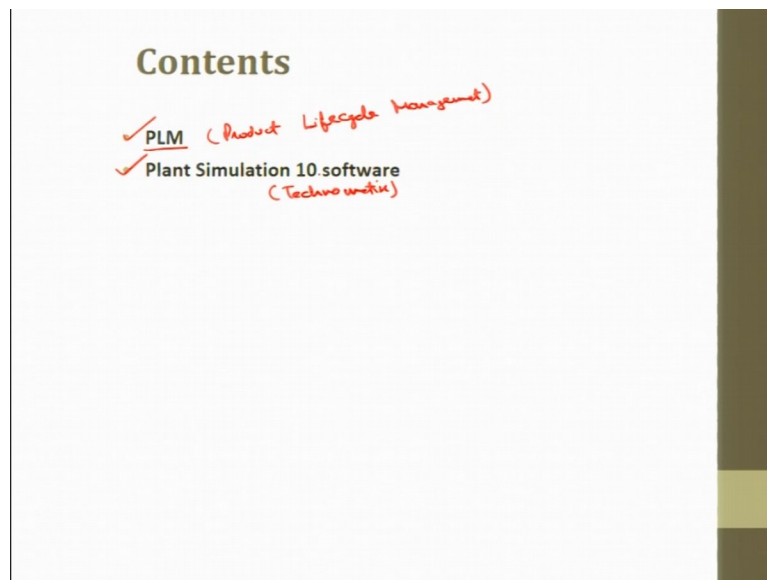
So, before moving ahead I will just like to give the contents here, The contents would follow like this first I will discuss what is PLM? PLM is product life cycle management, then I will just go to my plant simulation software, which is plant simulation 10, that is Tecnomatix .

Then we will just discuss the software, another software Arena is similar to this one, but plant simulation or the PLM software that we have here in IIT Kanpur that we have is

the Siemens PLM version. So, this is the kind of a very advanced version arena has had an extensive use in research and in few application in industry.

but this plant simulation, If we talk about the software, gets two major functions one thing is specifically simulation software, one thing is the functionality, what is the function that software is able to do. So, how intelligent is our software to design the system.

Second thing is the Aesthetics or appearance in this case in the plant simulation software, I will show you that the three dimensional movements can also be seen, the aesthetics are suspended in this case. So, we can see the workers checking the material, we can see the movement of the materials all that animation kind of thing is there. So, that is the kind of an I can say, is an add-on, but the capability of the software to simulate using different distribution using, even we can have energy simulator to minimize the energy used in the plant.

or also we can we actually calculate the throughput or the total output that is of a day or of a month and in during the day or during the month what is the total cost that is incurred to cost of operating. The cost of processing all those things can be done.

(Refer Slide Time: 03:07)
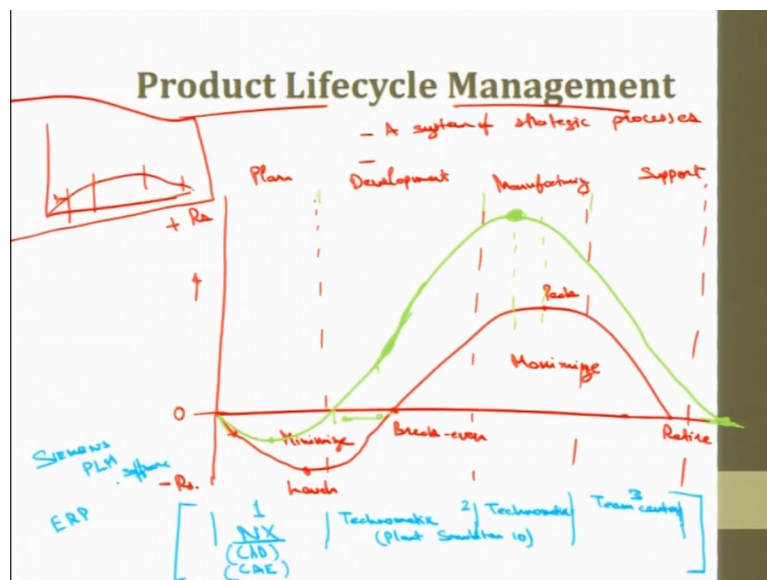
So, let me move forward, so what is product life cycle management? Product life cycle management is the system of strategic processes which have employed to reduce the cost of getting a product to market . It is the system of strategic processes, I would say.

You know these days we need to extend the duration of the profitable years of the product because the product, if we talk about the product life cycle, product life cycle is something like this not from marketing perspective, I will talk from the development

perspective product life cycle is if I say, this is my profit. So, this is I would say rupees, and this is plus rupees and this is minus rupees.

So, if I divide it into stages when I am planning and I am manufacturing, then I am building the product, then I am trying to provide after sales support. So, this is not the marketing kind of product life cycle that I am doing, marketing kind of product life cycle is just like this - first we have introduction, then we have growth then we have maturity then we have decline and also some decay could happen. So, this is marketing perspective.

So, I am talking from the product development perspective, from the very design, when we design a product, we are talking of the product design and the simulation in the systems. So, when we design the product during design itself, the development perspective is taken into account.

So, in product life cycle management, in the present day this is known as this kind of curve which I am going to draw this is the curve like this it was something like this.

Initially what happens when we are planning this is the planning stage, second is the manufacturing stage, then we have the manufacturing can be extract then we have before manufacturing ok, I will put manufacturing at third point before manufacturing we have development. Development of the complete plan or development of the maybe prototype of the product.

So, after manufacturing the product is sent to the market then we have after sales support. So, what happens, We need to minimize this and maximize this you know this curve that is this is my 0 value that is below the 0 line this is kind of a loss . So, this is I can say here the milestone this is the launch of the product.

I can have breakeven point here because that investment that is made is covered here so, this is breakeven. So, this is the peak profit that we have reached and the product data is here.

So, what is the life cycle of a product? For instance you purchase a new mobile like Samsung note 9 is there in the market where does note 8 go, where does note 7 go ? I had been using note 2 since last year. So, where does that go, that has completely retired. The new version of the product has come. So, the life cycle of a product, of one specific segment in case of this electronics or maybe mobile is about an year or maybe it as even reduced contracted than an year, it is about 6 month 9 month.So, this is finally, the time of the product happens.

So, if we use PLM or product life cycle management software, what happens this is reduced this is reduced and this is maximized. You know, this peak is I would better say peak is pertained earlier than the normal design.

Then product launch could happen even before breakeven is achieved before. So, this is the kind of a profit or rather kind of a contraction in the time that happens using the software because when we are doing the simulation, you know it is better to fail a simulation than to fail a factory, it is a very common course that is said. So, when we do simulation when we design the product, we can do the kind of testing. So, if I am talking about the product, if we do planning here the product.

If I need to design this mouse, I need to have this specifications or I can just scan this mouse and get the point cloud and then the triangular mesh and those are the these are the mechanical come to get to do some analysis that whether the strength of the material, which kind of material would I use all those things can be done in a software.

So, in that simulation happened. So, that is a kind of a mechanical simulation. So, we can even call you out of the term computational fluid dynamics, that is the kind of a mechanical simulation then, certain multiple modules are available for manufacturing the market, but because we are talking more about the product design and manufacturing and we are not to talking about the system design here.

So, I will focus more on Tecnomatix that is the manufacturing, the development or specifically the manufacturing part.

So, about this curve this is here we have speed to market that speed to market; that that it has reached the market before then productivity is boost you know the slope of this curve is higher this curve the slope is higher over the slope is greater. So, there is a boost in productivity there is an increase in revenue because peak is here right.

then we have at the standard return the retirement period is now we get retirement at a later stage.

So, this is what product life cycle management, if we actually do the product life cycle management life cycle means not only designing the product, managing the overall out of

the complete life of the product from the very idea generation when you have an idea to produce a product to the final retirement of the product, retirement means; when the product would just kind of Obsolete and new product would takes its place.

So, about the software I would say, we have in PLM Siemen software see we have this four states this part is done by NX. NX is a kind of a CAD software . It is CAD and CAE, CAD is computer aided design, CAE is computer aided engineering computer aided design is just design like I said I will design this mouse this specific product. If I need to have the specification this specific curve I need to draw and I can design that is Computer Aided Design.

Then I can do certain analysis, certain testing on this which are the critical parts and what will be the life of this plastic portion, I am not talking about internal body, I am just talking about the cover of the mouse here that is computer aided engineering. So, this is NX software to use, we would more focus on the development and manufacturing that is done using Tecnomatix , but this is again Tecnomatix . This we will use the plant simulation 10 software.

When we have designed the product and we know what are the processes which is this product has to follow, for instance, this is the product with different components if I dismantle it this cover, this roller, the base, the, t h e r e a r e certain nuts and this is the cover the bottom, the sallies and external component.

So, I have different components which are to be manufactured. So, for this I need to have plastic manufacturing machines like, maybe, moulding machines or extrusion injection, injection moulding can happen all those things, extrusion is not required like we need to have the machines.Now, how to setup those machines in a plant or in a factory, that is known as plant layout, that I love to discuss here. So, this is Tecnomatix before moving forward. This is Tecnomatix and the final support that is done by team center . So, this Software, major three versions. One is NX, Second is Tecnomatix and Third is team centre.This complete version we can call it as an ERP an Enterprise Resource Planning.

So, this enterprise resource planning, team centre is more focused on ERP, but yes we can say that complete enterprise resource planning can happen and we can even simulate the simulation happens more in NX and Tecnomatix and in team centre what happens, Whatever we have manufactured the cost which have incurred for manufacturing and if we need to change something because you know this is planning. And the planning and the actual production there is a difference, when that difference happens during actual manufacturing when we actually doing the manufacturing, the data is all stored in our different formats, those are used by the team centre version of the software the data is

stored in different formats.

So, that can be used, those formats which are available in team centre and team centre, we can just modify the data according to the actual which, is happening do not the schedule the actual manufacturing. So, then the simulation can be run again sometimes like to see whether what we have planned or we achieving that or not. So, what is the variations you know you know some variation would always be there and those things it has an extensive application. Arena is a kind of a software which was just confine to the plant simulation only, but this PLM Siemens PLM I am talking about Siemens PLM software . So, this can walk in all these domains.

Now, I will move to the software which is the Siemens PLM software which is in the SSOL lab. SSOL is Smart Systems and Operations Lab, which is there in IME department, Industrial and Management Engineering department at IIT Kanpur. So, the software is installed in the systems in the lab only we have Server in the lab only. We cannot have the software this, but I am using that software using remote access on this computer.
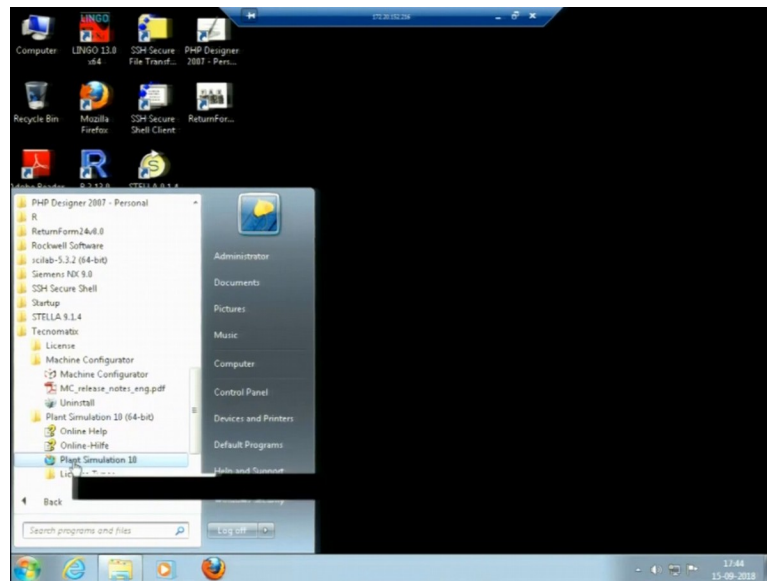
So, I will just open.

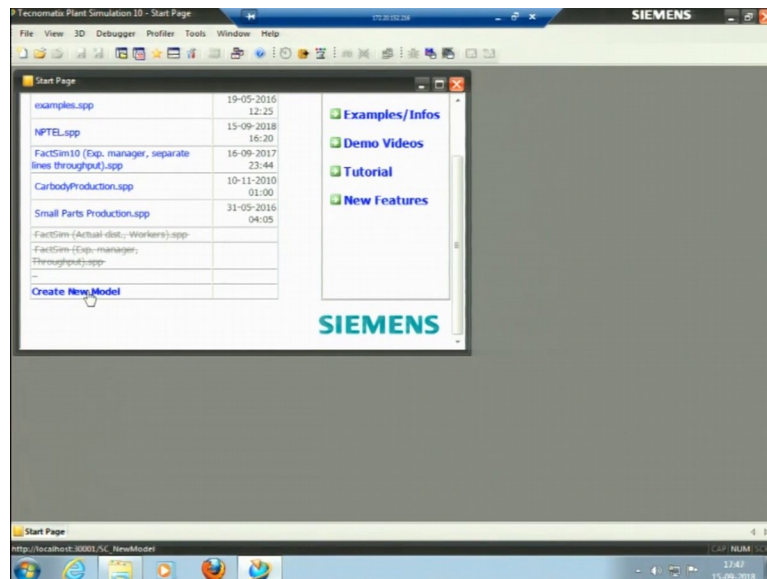(Refer Slide Time: 14:41)
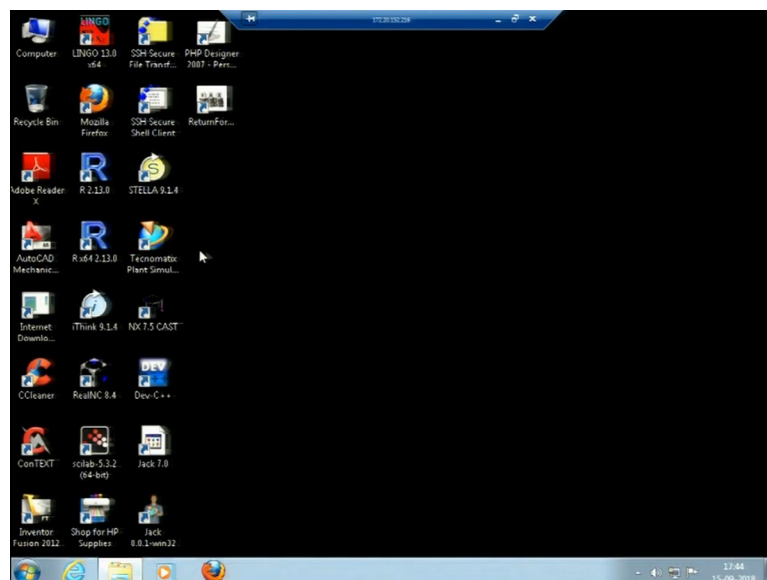
So, remote access connection is already made. So, this is my computer which is there in the lab.

(Refer Slide Time: 14:50)

And, I will open my software. I will go to all programs and I have Tecnomatix here and in Tecnomatix I have plant simulation.
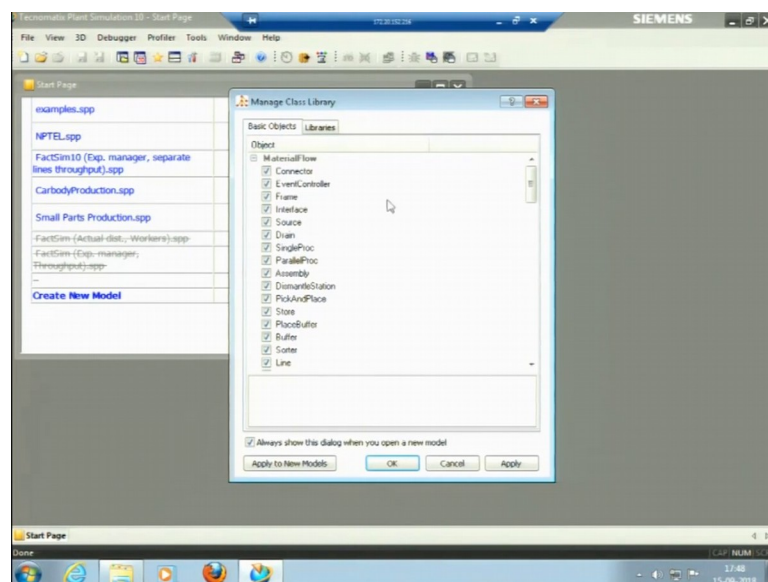
(Refer Slide Time: 15:02)

And, I will open the software, ok. So, this kind of window appears when we just open the software. These are certain programs which I have just worked on. So, the recent programs are there. So, this is the start page; so I can open or I can create a new model from here.
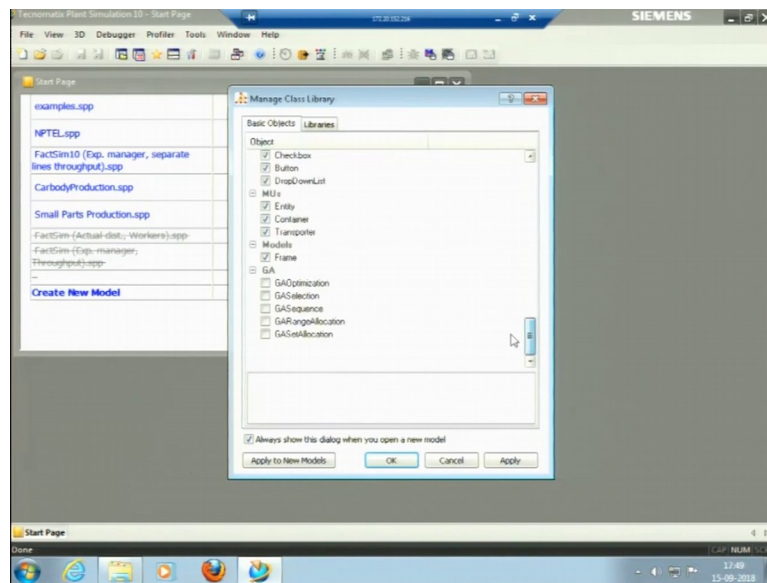
(Refer Slide Time: 15:28)
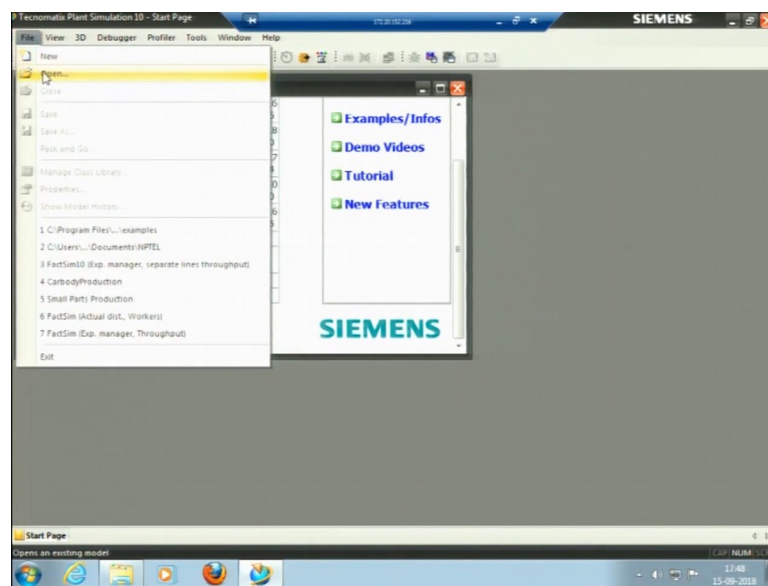
So, I have a menu bar here. In menu bar also I can open the new file I can open the existing file that we have. So, in also we have another this tab here we have these icons for opening. So, I will just create a new model when I click to new model the new model is trying to open.

(Refer Slide Time: 15:45)

Yes, ok. Now, it has basic objects here the basic objects which are there. This would be enough to discuss in this lecture; we have a limited scope and time here.

(Refer Slide Time: 15:56)

So, basic objects whatever it is selected, I will just say yes to them however there are multiple models that we can select here, we can select certainly.

(Refer Slide Time: 16:06)
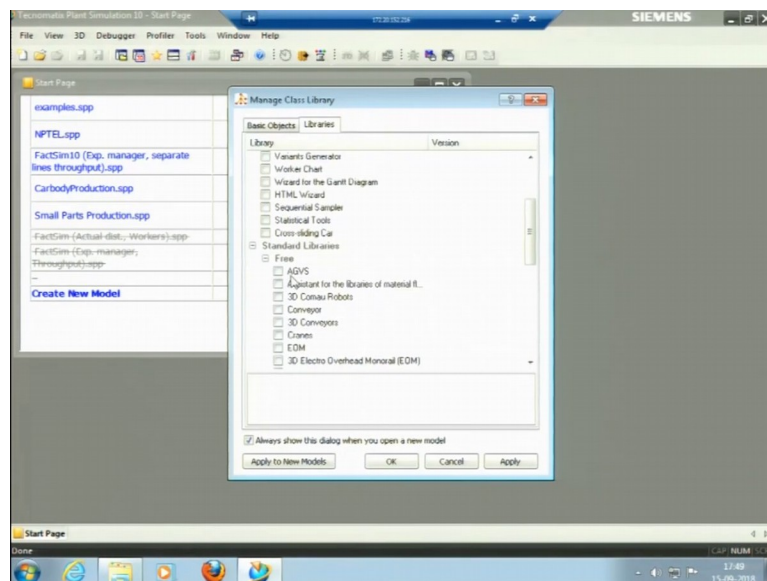
So, there is big library and I can select the 3D or this you know this is A.G.V, Automatic Guided Vehicles and 3 dimensional conveyer, 3 dimensional robots, conveyers all those things, but I will stick to the basic selection whatever it is the wall selection, apply so, the model is opened.
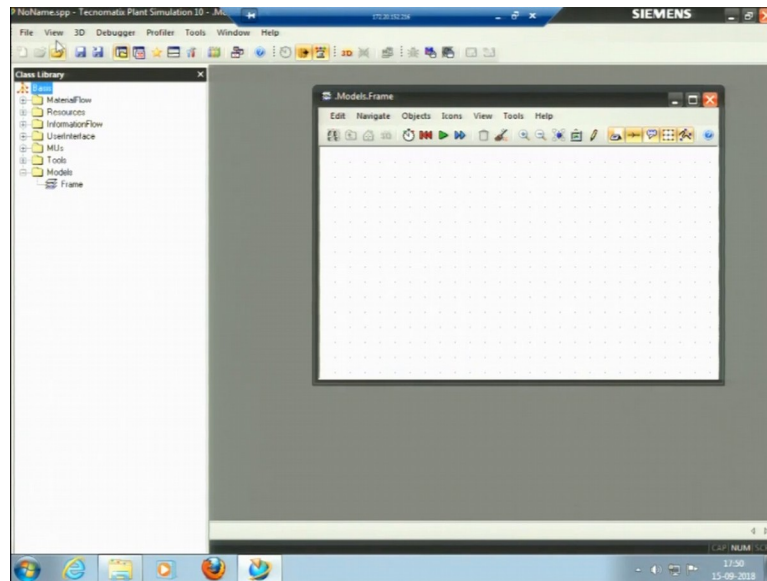
So, this is the model frame. So, this is my work place where I will work .

This is the work space I would say this is the work space where I will work and this is the grid you can say, the distance between any two points here the horizontal or vertical distance is 1 meter. I can just switch off and on the grid from this icon, this pattern here , it hides or shows the grid.

So, this is my class library I am just clicking it to bring my icons here . So, these are the components, before actually starting the model I would like to show you what is the, I would say the potential of the software.
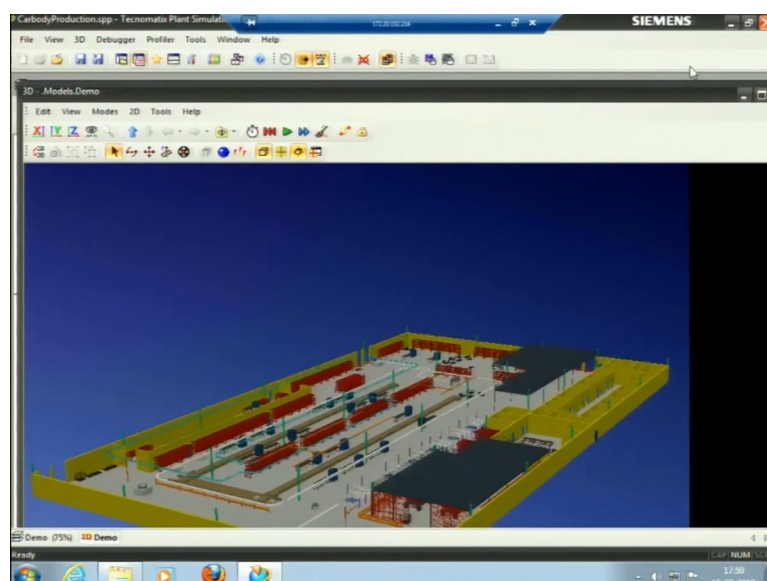
So, I have one example here. This is the car body manufacturing in 3-dimensional; car body manufacturing, ok. So, this is an example in which whole factory is build in this software

and also the general motors had built one of is its new plants, using the software and they have reported that, 50 percent of the savings were there in the development part, because they developed, they tried to simulate the movement of the objects and the time and all those things and what actually they were trying to do in manufacturing, they are able to see that in the software, like the animation ok

(Refer Slide Time: 17:58)
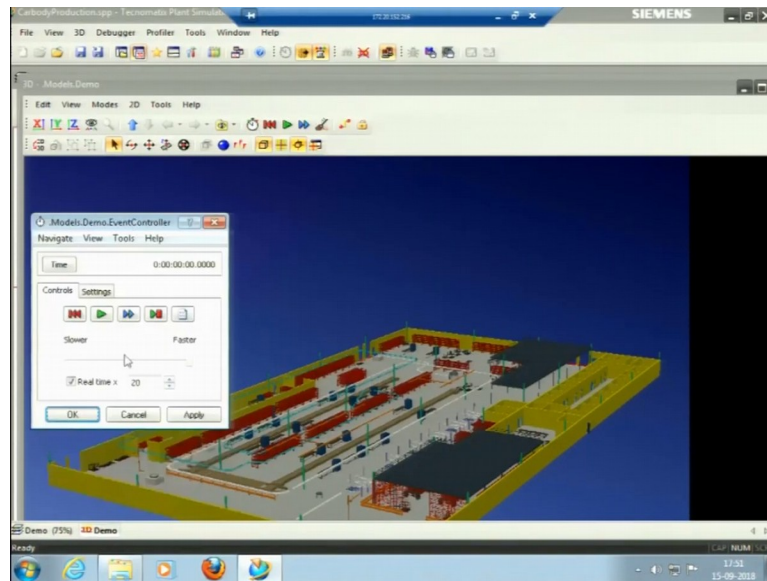
So, this is my Event Controller. So, I like to show you how the manufacturing happens.

(Refer Slide Time: 18:09)
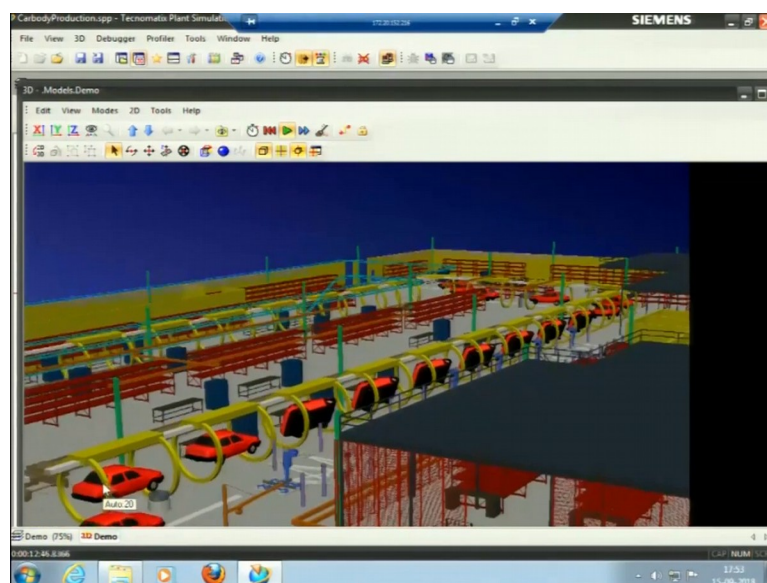
You know, this is, you can see this is actually moving very fast, like control this speed you know workers are moving in very fast this is the fastest speed. So, I can control this speed using event controller, let me stop it and let me say the speed is real time, into maybe 5 times or may be real time into 10 times apply, ok, then play. Now the car is coming here, it is then taken by the overhung conveyor ok. So, the workers are standing here.

You can see workers are doing, they are trying to fix may be tires or you know tires the wheels here or the side mirror. So, the car is completing manufacture, only the accessories are just put on the cars and those are then sent. So, these different workers those are working in different stations, this is the workplace, I will just show the objects when I will come to the actual practice on the software.

This is the work place work tool, where the workers could stand when they are not working and this is the workplace for the worker ok and worker just picking it from some point, these purple pillars that you see watching this purple pillars that you can see, these are this purple pillar and this purple pillar. So, these are the workstations where worker actually this space at the bottom, this is the work place where the workers working and some other processing is also happening. So, cars are just, this is my entry point this is my entry point this is my entry point and here it is getting return and this is my exit point. So, this is the factory ok.

I can show you some other examples.

(Refer Slide Time: 20:15)
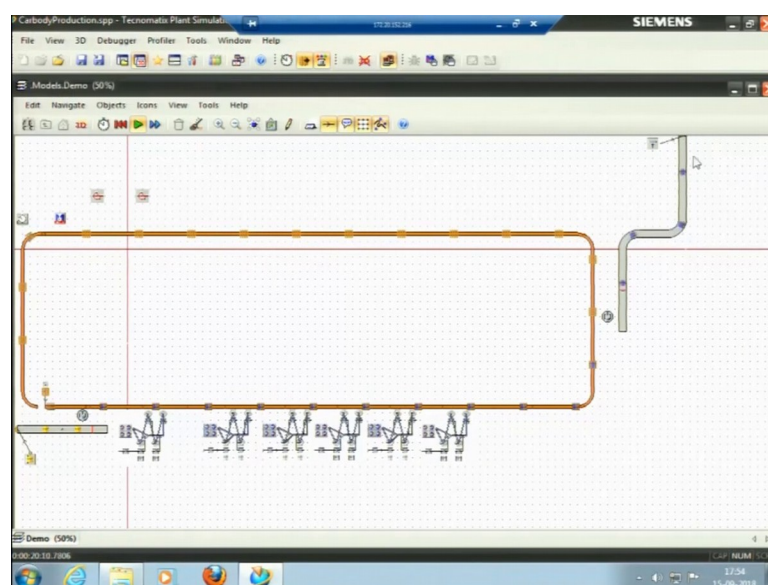
So, this is the two dimensional version of that two dimensional versions the workers are working here you can see ok. So, the car is going out and for some other part for may be inspection it is going. So, I will just close this model and I will come to my start page again

view from view come to start page. So, this is how we can see or I can just pick let me open this model, ok.
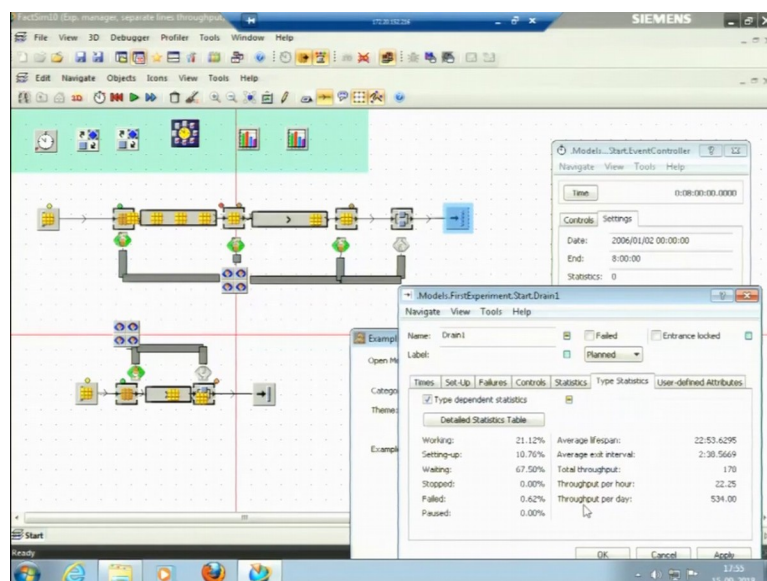
(Refer Slide Time: 20:55)
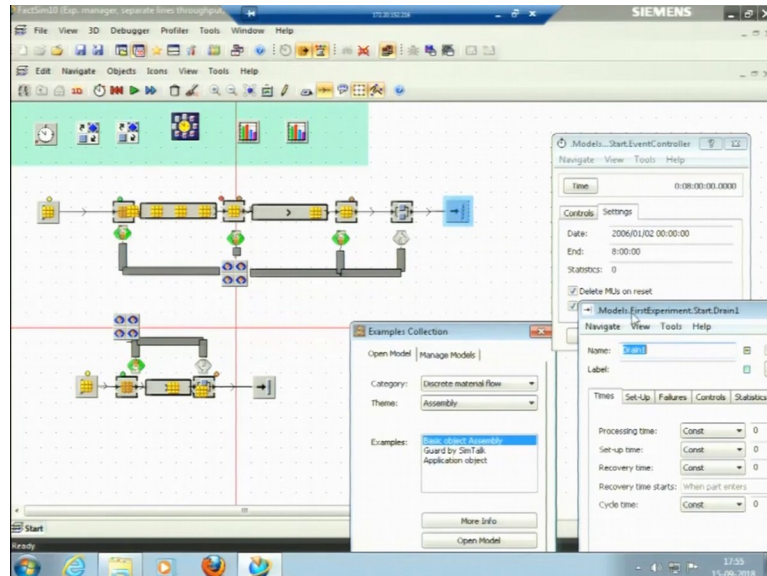
This is one of the models, which we have used, the Experiment Controller, ok. So, you can see if I run the model, it has run for 8 hours in the fastest position, it has run because I had put the n time for 8 hours model has to run and I can see that throughput here.

Open; it is a drain

(Refer Slide Time: 21:23)

The final drain here, I can see the throughput here; What is the throughput? What is the total number of components those are manufactured in a day? This is throughput per day, if you see here this is throughput per day 534 pcs and throughput per hour just 22.25 pcs.

Based from the input that we have given to the specific processes, what are the input in the processes? That I will discuss, it is the setup time, processing time then the availability, is it available for the complete time or is it available for 95 percent or 90 percent time then we have a distribution, we have a specific process for instance, it is a manual process and we do not do not have much data, we have only 2-3 data points which are previously available. So, we can pick may be triangular distribution, if it is an automated process I can pick normal distribution with a very less variation because the process is automated based upon the inputs that we give the software we try to simulate and give us a throughput ok.

So, any software, when we say the software is here, there is a very common codes at study it is GIGO, Garbage In Garbage Out. Software's can just help us to bring our overall ideas into one place and we can simulate the computation that we sometimes try to do one page those can be done here. And this is the softwares are able to show, the animations

in a very elegant way. But, if the input is not proper, input has to come from the systems manager, from the person who is trying to work on it. So, if the input is not proper, output would obviously, be affected, the more errors would come ok.

So, this is I just showed you how to see the throughput. So, let me close this one as well and try to make a model for you, you people and I will let you know how the model is made. So, I would like to stop here and thank you for being in the course. So, we will meet next time.

Thankyou