Rapid Manufacturing

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Lecture - 41

Rapid Product Development, Technomatix (Part 1 of 3)

Good morning welcome back to the course I am Dr. Amandeep Singh and I will take the plant simulation technomatix 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 do we how the material is being carried from one point to another all those things what kind of simulation we can do there.

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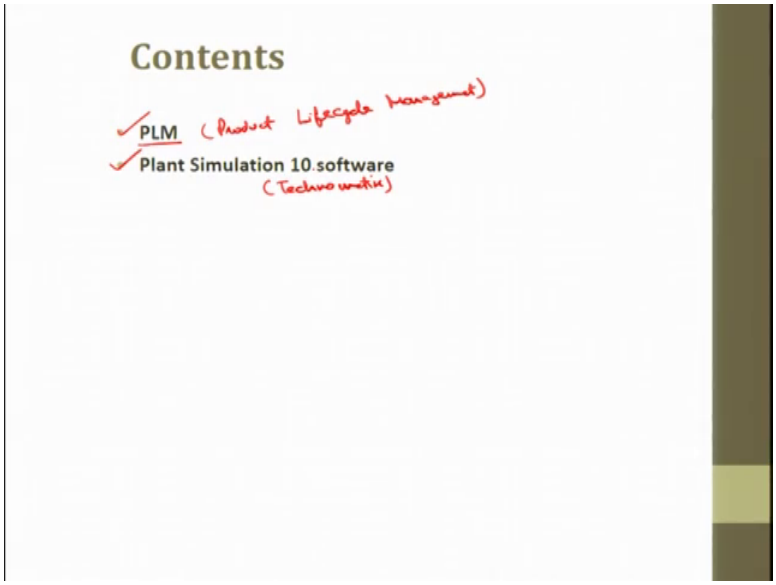

So, before moving ahead I will just like to give some the contents here the contents we fallow like this first I will discuss what is PLM? PLM is Product Life cycle

Management; Product Life cycle Management. Then I will just go to my plant simulation software which is Plant Simulation 10 that is technomatix ok, then we will just discuss this software another software arena a similar to this one so, but plant simulation or the PLM software that we have here is in IIT Kanpur that we have is the Siemens PLM version. So, this is a kind of an very advanced version arena has a an extensive use in research and its application in industry, but this plant simulation if you talk about the software get two major functions; one thing is a specific simulation for software one thing is the functionality; the functionality what is the function that software is able to do. So, how intelligent is our software to design the systems.

Second thing is the aesthetics; 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 splendid in this case. So, we can see the workers taking 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 an add on, but the capability of the software to simulate using distance different distributions using a even we can have energy simulator to minimize the energy used in the plant or also we can be 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.

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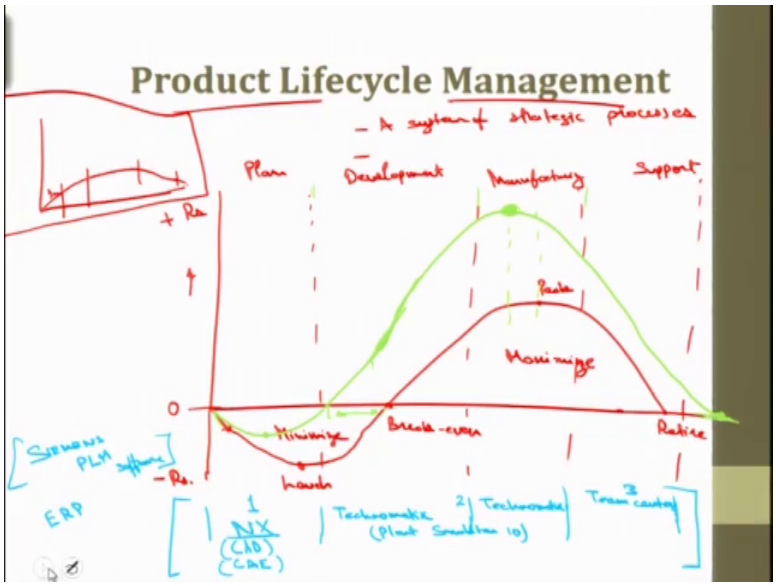

So, let me move forward. So, what is product lifecycle management? Product lifecycle management is the system of strategic processes which are employed to reduce the cost of getting a product to market ok. It is a system of strategic processes, I would say you know these days we need to extend the duration of the profitable years of the product. Because the product if you talk about the product life cycle; product life cycle is something like this not from marketing perspective; I will talk about from the development perspective. Product life cycle is if I say this is my profit ok. So, this is I would say rupees and this is plus rupees and this is minus rupees ok.

So, it is if I divided 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 trying marketing kind of product life cycle is just like this we have growth and we have sorry if we have first we have introduction, then we have growth, then we have maturity, then we have decline and also some decay could happened. So, this is marketing perspective. So, I am talking from the product development perspective from the varied design meaning design a product we are talking of the product design and the simulation in the systems.

So, when we designed the product during design itself the development perspective is taken into account. Actually this kind of curve which I am going to draw this is the curve like this; it was something like this ok. Initially what happens when we have planning

this is the planning stage, second is the manufacturing stage, then we have the manufacturing can be extract, then we have before manufacturing. I will put manufacturing at third point before manufacturing we have development; development of the complete plan or development of the may be prototype of the product. So, after manufacturing the product is sent to the market then we have after sales support ok.

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 just these kind of a loss ok. So, this is I can say this is here I can say the milestone this is the launch of the product ok. I can have breakeven point here because the 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 retires 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 mobiles is about and year or maybe it has an even reduced contracted then and year it is about 6 months, 9 months sometimes. So, this is it final retirement of a product happens.

So, what PLM; if we use PLM or product lifecycle management software or what happens this is reduced; this is reduced and this is maximized. You know this peak is a peak is I would better say peak is attained earlier than the normal design ok; then product launch could happen even before, break even is achieve before. So, this is the kind of a profit or the kind of a contraction of 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 it if we do planning here the product for instance ok.

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If I need to design this mouse I will have; I need to have the specifications or I can just scan this mouse and get the point cloud and then the triangle or mesh and those are; these are the mechanical comes 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 a simulation happen happened.

So, that is a kind of a mechanical simulation. So, we can even call at you heard of if you heard of the term computational fluid dynamics that is a kind of a mechanical simulation; then certain multiple modules are available for many softwares in the market, but because we are talking more about the product design and manufacturing and we have not to talking about the systems design here. So, I will focus more on technomatix that is the manufacturing, the development or specifically the manufacturing part ok.

So, about this curve this is here we have speed to market that speed to market that the 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. So, curve 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 the standard retires the retirement period is now we get retirement at a later stage.

So, this is what product lifecycle management if we actually do the product lifecycle management lifecycle means not only designing the product; managing the overall over the complete life of the product From the very idea generation when we have an idea to

produce a product to the final retirement of the product. Retirement means when the product would just kind of opsolate and new product would take its place.

So, above the software I would say we have in PLM Siemens software this is we have this four stages. This part is done by NX. NX is a kind of a CAD software ok. It is CAD and CAE. CAD is Computer Aided Design, CAE is Computer Aided Engineering. Computer Aided Design is just design like a said I will design this mouse this specific product I can if I need to have this specification.

This specific curves I need to draw and I can design that that is computer aided design then I can do certain analysis, certain testing on this which are the critical parts and what would be the life of this plastic portion. I am not talking more the internal body I am just talking about the cover of the mouse here ok. That is Computer Aided Engineering. So, this is NX; NX software to used. We would more focus on the development and manufacturing that is done using technomatix ok.

Now, this is again technomatix ok. 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; we have different components. If I dismantle it, this cover, this roller, the base, the there are certain nuts and this is the cover at the bottom, the cell is the cell is an 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 mould, injection moulding can happen all those things; extrusion is not required other 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 will also discuss here. So, this is technomatix and the final support that is done by team center ok. So, this software major three versions. Number 1 is NX number 2 is technomatix and number 3 is team center ok. This complete version we can call it as an ERP, an Enterprise Resource Planning ok.

So, this enterprises resource planning team center is more focused on ERP, but yes we will we can say that enterprise complete enterprise resource planning can happen and we can even simulate the simulation happens more in NX in technomatics and in team center what happens whatever we are 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 ok; those are used by the team center version of the software; the data is stored in different formats.

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

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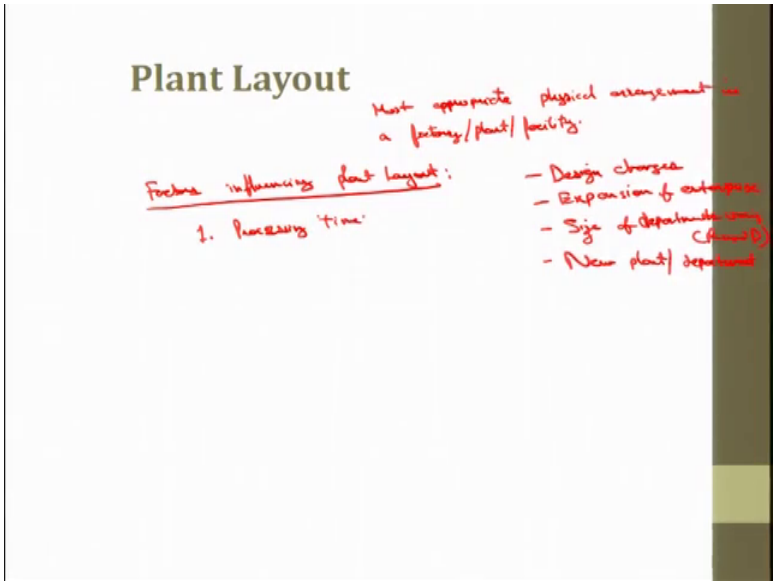

So, next I will like to discuss the plant layout; a brief introduction to this before we actually move to our software plant payout what is plant layout. Plant layout planning is the most effective physical arrangement either in the existing or in the plants of an individual may be it so; it is a kind of a study of an it is an engineering study to analyze whether physical configuration of a manufacturing plant are good or not.

So, it is the most appropriate physical arrangement in a factory or a plant or a facility. You know it is important plant layout if even we do not plan it to minimize the movement, to minimize the time that is incurred; we have some layout for instance in a classroom the layout is like the teacher is teaching, this the chairs are kept here and in manufacturing you have different kinds of data that I will discuss process product.

And plant layout I would just put the benefits or the use of the plant layout or we why do we need plant layout because their design changes, why do we need to plant. So, because the new tool, new processes may be added then expansion is there. If expansion of the enterprises has to happen with this has to happen ok.

Then the variation in size of department for instance the size of department some specifically the R and D department. Departments vary specifically R and D like company or the factory would like to expand its R and D in the future when new products are coming. So, when the expansion happens the future plans as to be made before hand that if expansion happen this wall can be taken down and this room can be converted, the room can be expanded and the layout can be just and the change a little to have the proper set up for the future as well. So, another point I can put here some new department is to be added or new plant is to be set up ok; new plant or department if this needs to be added.

So, for the in this case this is the plant layout study is required. Factors those influence; I will just put the factors influencing plant layout; factors those influence plant layout what are the factors. The kind of the, or the nature of the processes which are working on are we going to do a mass production, are we going to do just a batch production or a just a job kind of production.

So, is it a fixed position production for instance if a trying to produce a aero planes or ships big products those are the layout is such that the product is kept at its centre and different jobs are done by different work or the different machines at the product or on the product I would say. For mass production one specific setup of machine is done, then the product has to just flow through this line ok. So, this is known as the product layout because one product is being manufactured for a long period; this is product layout then process layout.

What factors do influence before actually discuss the layouts what factors influence. Number 1 I can say is processing time ok.

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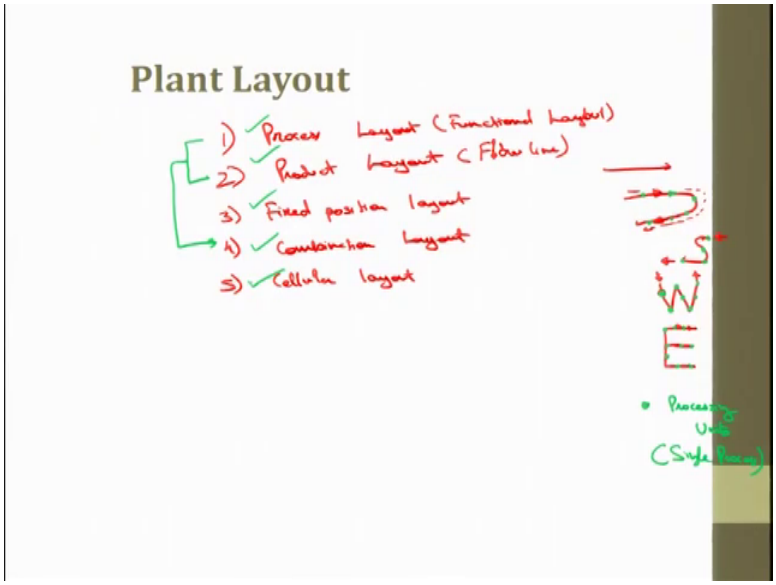

Before taking this I will just like to just list the kind of the layouts that we have the first kind of layout that I will like to talk here is the process layout ok. This is also known as functional layout. What happens in process layout; in process layout one kind of process is putting one section in a factory or in a plant for instance the layout in the hospitals. All the laboratories are kept in one section and all the OPD thing is kept in one section ok, then operating theatre or the surgery room is in one section; we have all the equipment all these specialist in that or the people not the specialist doctor the specialist, helpers who are there though those can work there.

So, the process layout is in manufacturing if I say if you talk about few know about the machines there are turning machines, drilling machines, grinding machines. If all the grinding machines are kept in one section and all the milling machines are kept in one section this is known as process layout, where is this process layout used. If we need to do mass production you know first process is milling then it has to go to drilling, then is it has to go to grinding and inspections final let me say ok. So, it has to pass through milling, then drilling; then grinding let me say after grinding some milling has to happen again, it has to again come back then it will go to the inspection and then go out.

If this if a few more object to be manufactured that is a kind of a job production or kind of a not job if it is kind of a batch production. We can have think of having process layout because only let me say a few pieces are to be manufactured the machines are kept on it in this place, but in mass production in actual manufacturing for instance any product that we have is generally manufactured in masses for instance 10000 pieces are to be manufactured.

So, this kind of movement from one machine to other then them again coming back again going to the other machine; this is not recommended. In that case what we do we use a product layout. In product layout what happens if flow line is made it is also known as line layout. We will put it a flow line.

Flow line that is the line through which our product would flow. For instance milling, drilling, grinding, milling and inspection another milling is put here; milling, drilling, grinding, milling, inspection done; again milling, drilling, grinding, milling, inspection done ok. A flow line is made and a product would follow this flow line ok. So, it can be one line we can have various kind of it is, I will discuss about the cellular layout and that can we can say I will just put the names of the layout first. It is fixed position; fixed position layout then we have combination layout, then we can have cellular layout and certain miscellaneous layouts can also be discussed, but these are major layouts which that I will try to demonstrate in using my software.

So, what is our product layout; when I am talking about product layout then line can be just this in one direction; this is the line or the line can be something like this; if the product flows through like go here and come back here I will show you the examples that I have said that I have made in my technomatix software.

So, it can be S kind of the S is S kind of the direction or the layout is used when the direction that is this is let me say input and this is output when these are in the same direction. If the input and output that or the entry or the exit of materials, you know the one side of the factory only we can use W kind of layout. So, this is input this is output ok. So, we can have a sometimes the buildings are considered like this way sometimes a E kind of layout is also there for instance this is one product line and product is being manufactured here.

So, I have machines here at some points I have machines here; I would quick another colour for machines. So, these are the machines or the process is which are happening these are the machines. Green colour is my machines if not machines I can just call the some processing units processing units I am talking about a factory that is why I am using more mechanical terms like machines, but it these are we can just called them processing units ok; these are processing units or I can call a single process ok. So, fixed position layout I have discussed process and product is discussed. Fixed position is little introduction is given; combination layout is a combination of the product and process ok.

When the product in factory we have a kind of a process layout, but we know that one of the products is manufactured in a big number. So, we can induce a product layout separately. So, what we have intense this is a section in which we have all the milling machines this section we have all the drilling machines we have all the grinding machines, but we know that after grinding, milling operation was to be happen as I discussed one of the processes.

So, we can were just do we can just pick one milling machine from here and put it here one or one or two, three milling with a few machining milling machines can be put here so that the product does not have to the material flow is minimized ok. So, that would be then milling, drilling, grinding, milling, inspection ok. This is kind of a combination of the process and product layout. Combination can be anything combination can be a product in a process layout or a process in a product layout those things could happened.

Then cellular layout is when we have these kinds of small cells when the small small cells like this U, S, W, E small small cells are there and cellular manufacturing is also there; also we have a computer integrated manufacturing when one specific cell is controlled by one computer for instance I have been working in hero cycles and their we have a kind of a cellular layout for most of the manufacturing. So, what is there for manufacturing there of a ring actually we have these special purpose machines because it is all mass production. So, I will take another example cellular layout is when we have the specific for instance the automobile has to be manufactured a big car has to be manufactured ok.

So, car manufacturing engine components are separates then car body separate, car interiors are separate then fixing of the component that happens in a conveyor that is a

separate thing. So, engine components where those are manufactured that can be like I will to pick just one or two engine parts. Let me take think about the ampere of a system and few valves those can be manufactured in a one cell and controlled by one computer. So, this is computer integrated manufacturing another cell can manufacture, another set can manufacture some other component another set can manufacture another component this is kind of a cellular layout then ok.

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 here in IME department Industrial and Management Engineering department at IIT Kanpur. So, the software install in the systems in the lab only, we have server in the lab only. We cannot have this software this, but I am using the software using remote access on this computer. So, I will just open.

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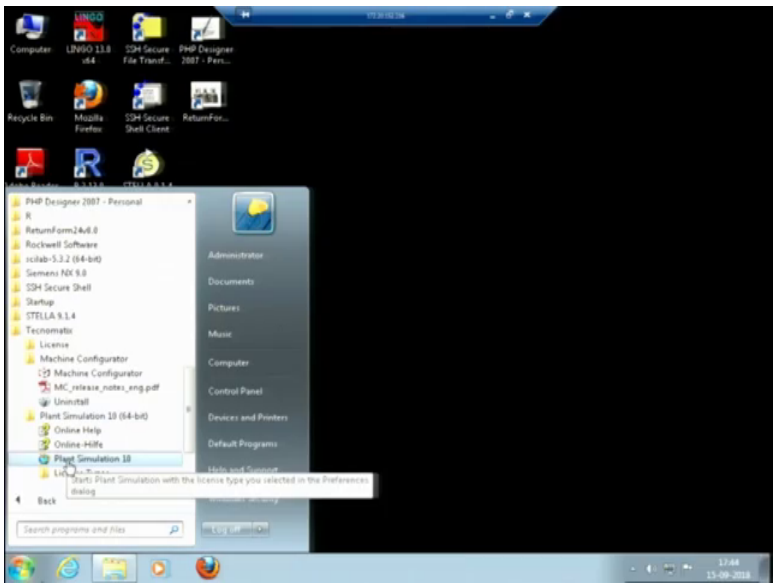

So, remote access connection is already made. So, this is my computer which is there in the lab and I will open my software, I will go to all programs and I have technomatics here and in technomatics I have plant simulation and I will open the software ok.

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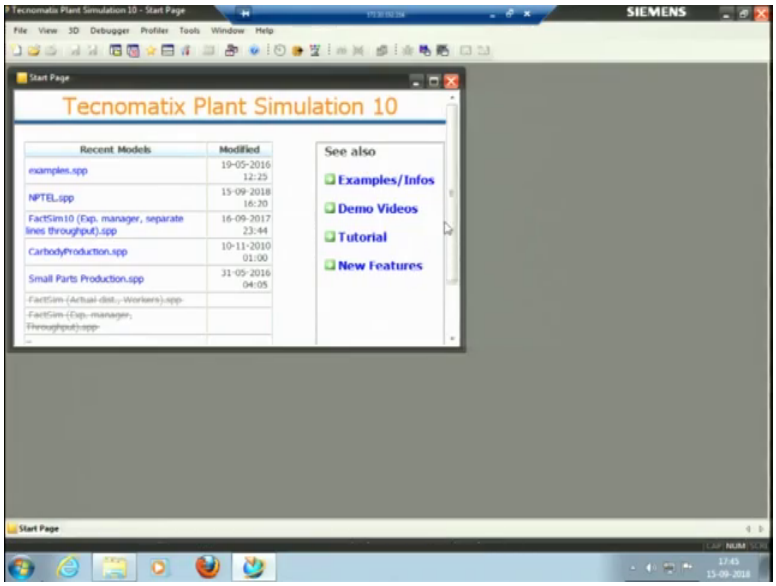

So, this kind of window appears when we just open the software, these are the certain programs which I have just worked on. So, the recent programs are there. So, this is the start page ok. So, I can open or I can create a new model from here.

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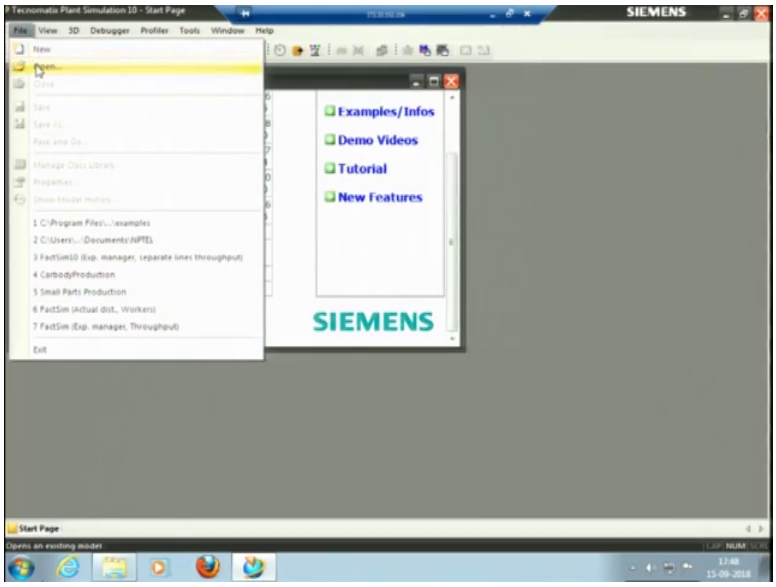

So, I have a menu bar here in menu bar also I can open the new file, I can open the existing file that we have. So, in also we have another, this tab here we have these icons for opening. So, I will just create a new model, when I click to new model the new model is trying to open yes ok.

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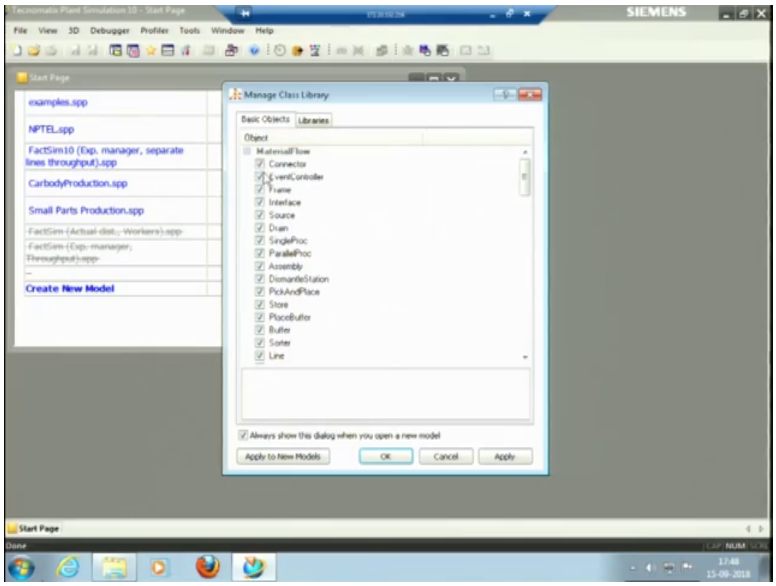

Now, it has basic objects here, the basic objects which are there this would be enough to discuss in this lecture, we have limited scope and time here.

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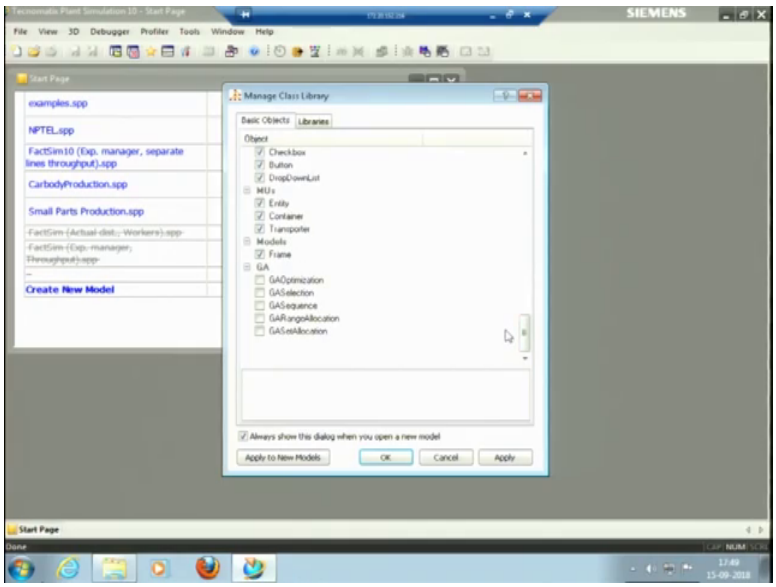

So, basic object whatever it is selected I will just say yes to them; however, there are multiple models that we can select here as we can select certain.

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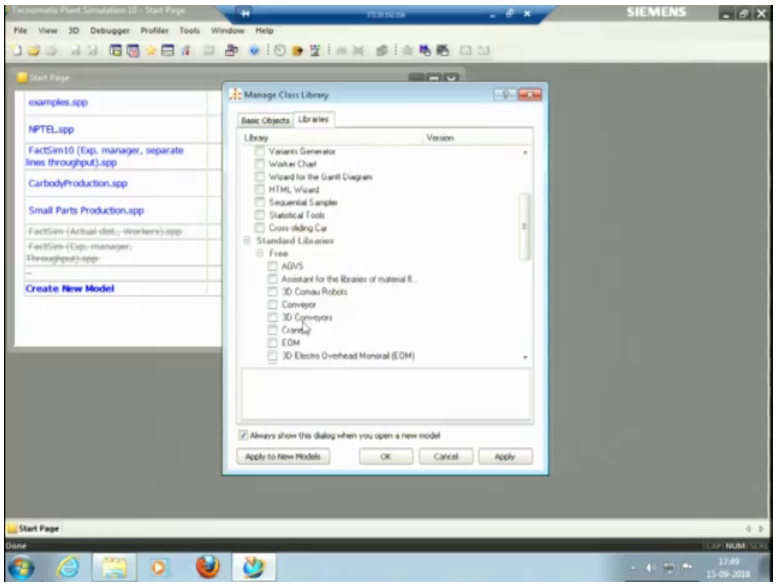

So, there is big library and I can select the 3D or this is know this is AGV automatic guided vehicles, then 3 dimensional conveyors, 3 dimension robots conveyors all those things, but I will stick to the basic selection whatever it is default selection apply. So, the model is opened.

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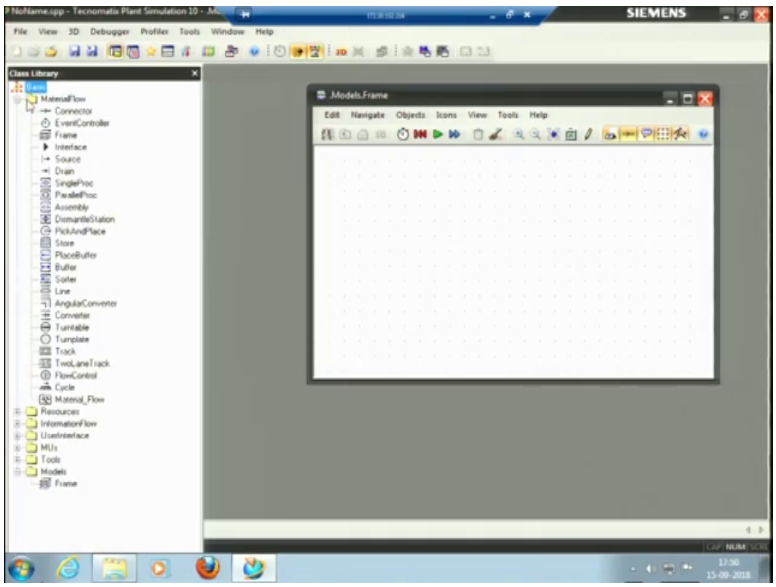

So, this is the model frame, this is workspace where I will work and there is a grid. The distance between any two points here the horizontal or vertical distance is 1 meter. I can

just switch off and on the grid from this icon this button here ok. It hides or shows the grid.

So, these this is I will show later. So, this is my class library. I am just clicking it to bring my icons here ok. So, these are the components before actually starting the model, I would like to show you what is the way would say the potential of the software. So, I have one example here.

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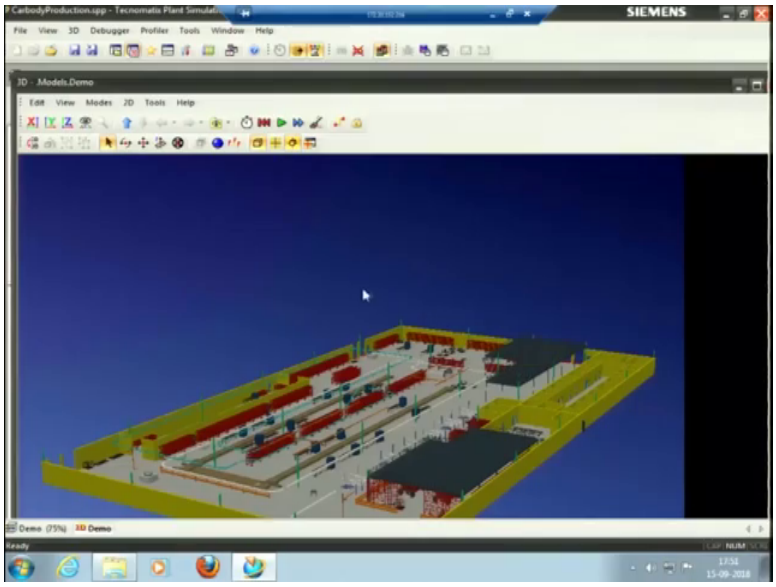

This is the car body manufacturing in 3 dimensional; car body manufacturing ok. So, this is an example in which whole factory is build in the software and also the general motor's had built one of is new plants using the software and they have reported that 50 percent of the savings were there in development part. Because they developed, they try to simulate this say movement of the objects and the times and all those things and what actually they were trying to do in manufacturing they were able to see that in the software like the animation ok.

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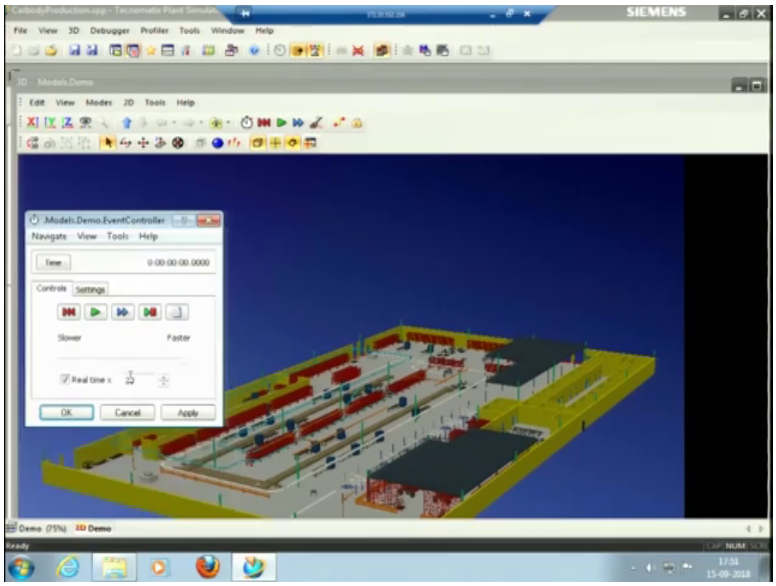

So, this is my event controller. So, I like to show you how the manufacturing happens.

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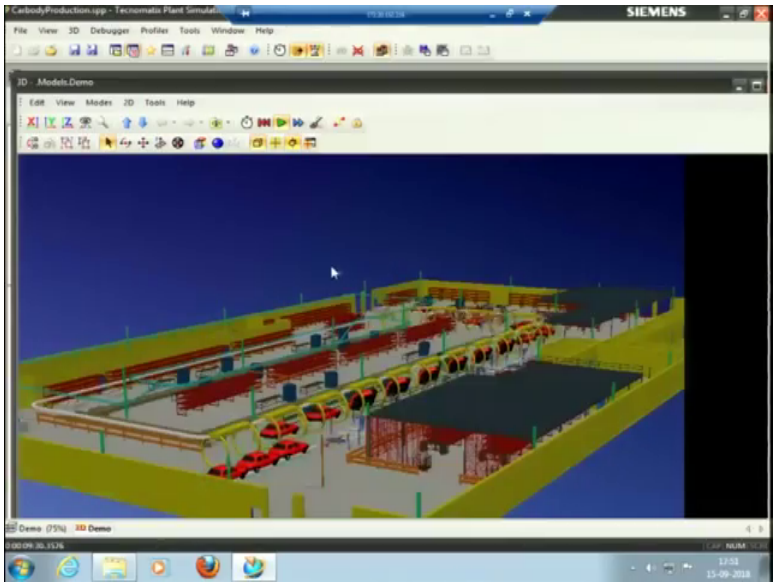

You know this is; you can see this is actually moving very fast. I control the speed you know workers are moving in very fastest into the fastest speed. So, I can control the speed using event controller, let me stop it and let me say look at the speed is real time into may be 5 times, or maybe real time into 10 times apply then play. You know the car is coming here it is then taken by the overhung conveyor ok.

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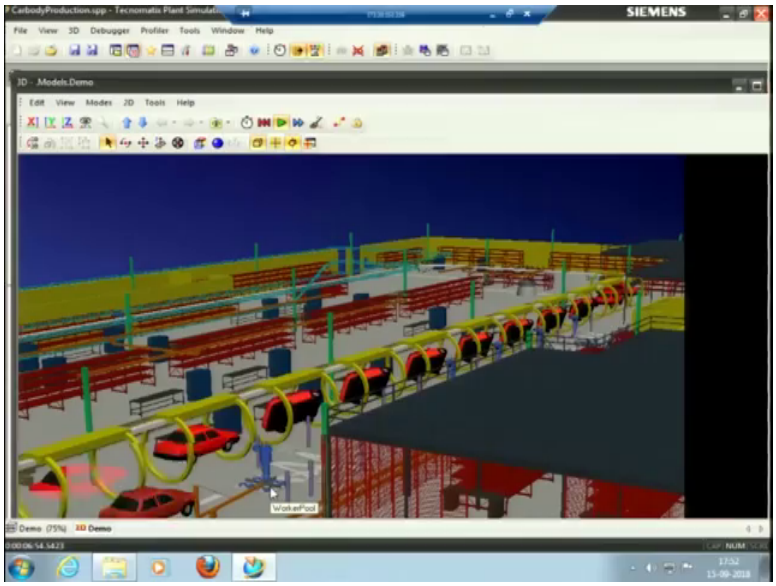

So, the workers are standing here; you can see workers are doing they are trying to fix may be tyres or the econo tyres the wheels here or the side mirror. So, the car is computing manufacture one of the accessories are just put on the cars and those are then sent. So, these are different workers those are working in different stations this is you work place. I will just show the objects when I will come to the actual practice on the software this is the work place work pool we have the workers could stand when there is not working and this is the workplace for the worker and work a just picking.

It is from some point its purple pillars that you can see these are this purple pillar and this purple pillar. So, these are the work stations for the worker the actually this space 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 taking a turned and this is my exit point. So, this is the factory, I can show you some other examples.

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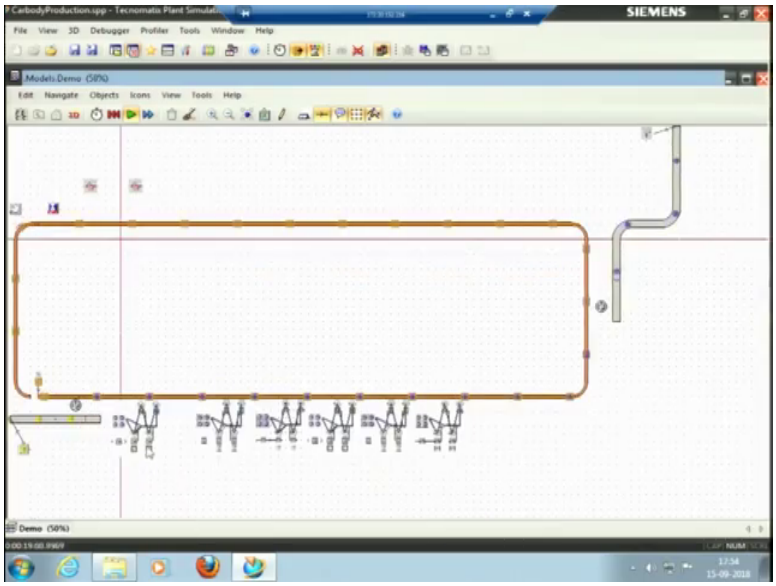

So, this is that 2 dimensional version of that looking the workers are working here you can see ok. So, the car is going out and for some other part for may be inspection it is going. So, I will just close this model and I will come to my start page again view from view come to start page.

So, this is how we can see or I can just pick let me open this model ok.

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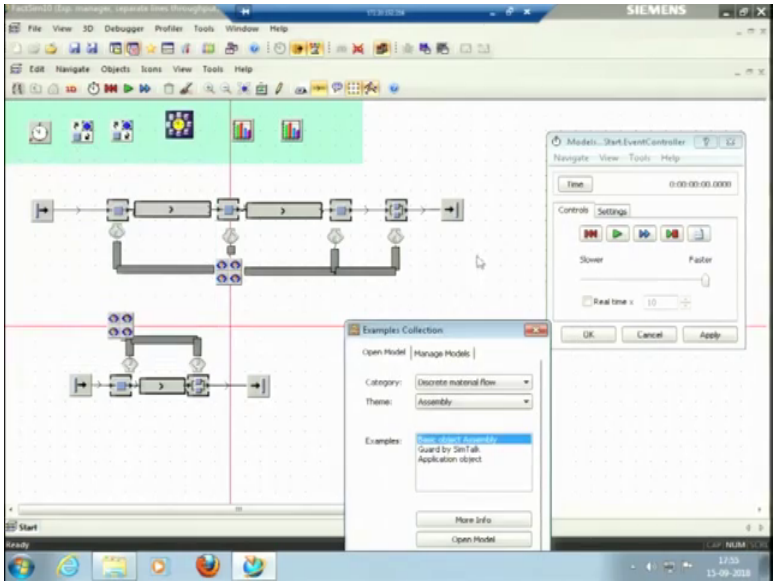

This is one of the models which we have used the experiment controller ok. So, you can see if I run the model it has run for 8 hours in the fastest position it has run for. Because I had put the end time for 8 hours model has to run and I can see the throughput here open.

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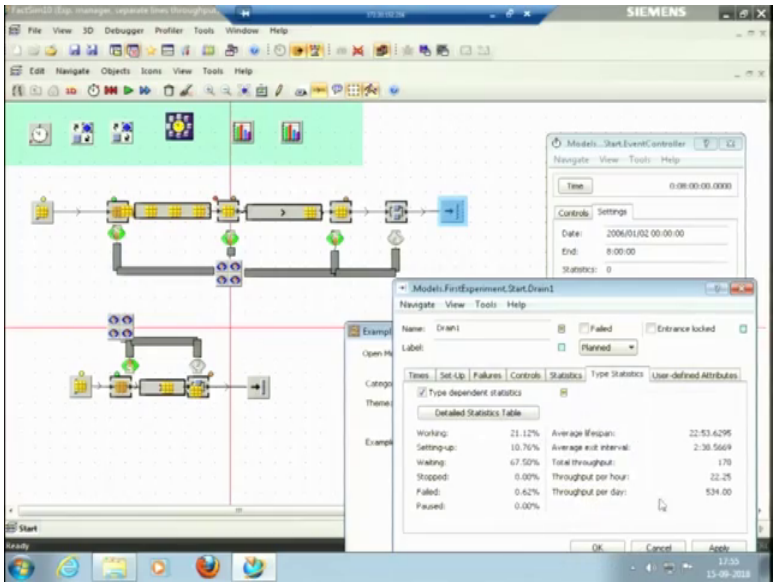

It is the drain complete of the final drain of there. I can see the throughput here what is the throughput, what is the total number of components that is those are manufactured in this is throughput per day; if you see here this is throughput per day 534 pieces and throughput per hour is 22.25 pieces. Based upon the input that we have given to the specific processes; what are the input to 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 of times.

Then we have a distribution we have the specific process for instance it is a manual process and we do not do not have much data we have only two-three data points which have previously wherever. 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 processes automotive. 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 that is a very common code that is study it is GIGO; Garbage In Garbage Out. Softwares can just help us to bring our

overall ideas into one place and we can simulate the competition that we sometimes try to do one page those can be done here and there is a softwares are able to.

So, the animations in a very allegiant way, but if the input is not proper input has to 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 arise would come ok. So, this is I will just showed you how to see the throughput.

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

Thank you.