Rapid Manufacturing

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Lecture – 42
Rapid Product Development, Technomatix (Part 2 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, I will again to the start page view start page.

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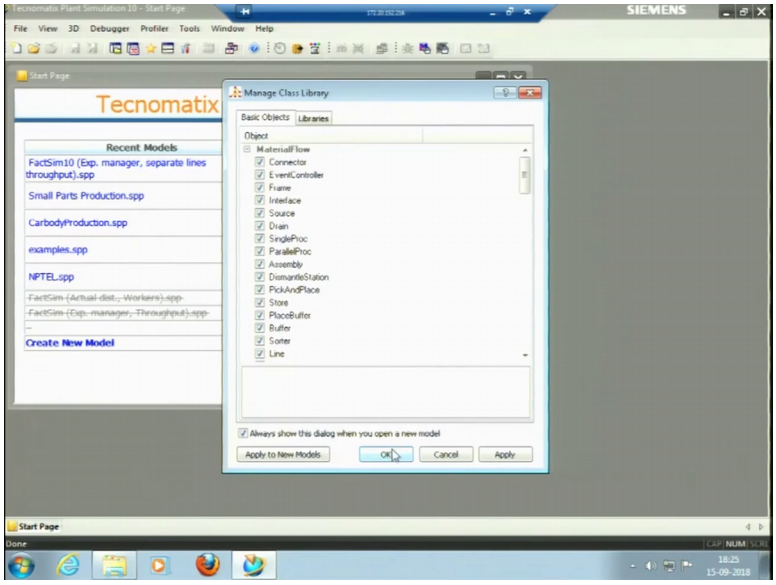

So, we will create a new model and ok.

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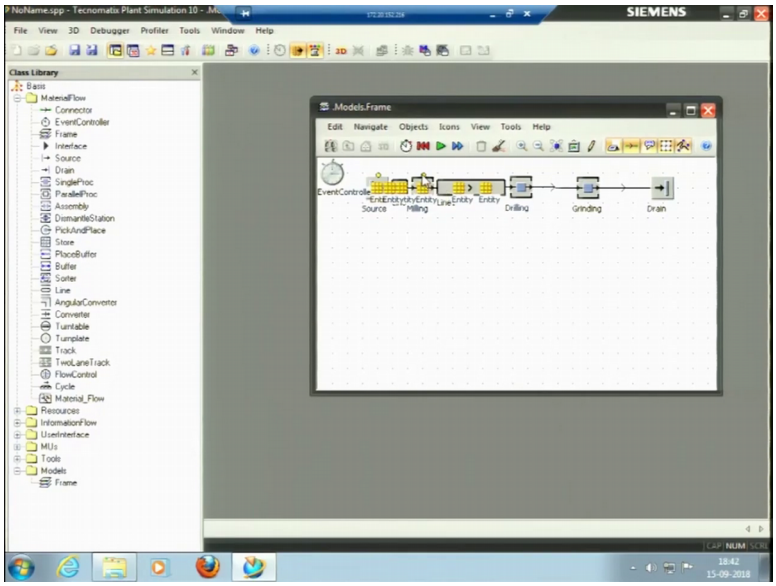

So, this is the model that I am trying to generate here. So, I will just open the class library and open the material flow. So, there are certain objects here connector, even controller, frame, interface all these objects are here. So, these objects have specific meaning this for instance this is model frame this is frame; frame I can say a kind of a room one room in a factory. One room in a factory means a factory in which one kind of specific processes is happening and I can move to another frame another rooms using interface ok.

So, I will try to first tell you what are these objects frame as I said, this frame is this is to create your simulation models in a frame. So, we create a simulation models in a frame this is one frame and it is located in the folder models in the class library. Generally, frame is located here in the models ok. So, this is actually the primary location of the object, but it has been kept here as well sometimes because if we need to add a new frame we can add it from the material flow that is the most used class library here.

So, the frame serves for the grouping of objects to build eradically structured models by inserting any of the built in objects any of the building objects from these or any objects that we can design because we can design our own objects near in this software as well you know there is a code that is written for this the software to design the objects. So, if someone is conversant with the code, he can also design the objects by itself.

So, the frames when we use frames with connectors or plant simulation it opens the dialogue select interface. This interface means from which frame to which frame do is it ok. I will just put the source here; source is to produce the parts in the sequence which we specify in a sequence table. Source is a starting point or the entry gate the entry points from where the parts are coming, if the parts are coming in it has to go out. So, this is a drain source and drain has to be there when we design any layout similar to source we have drain. So, the drain has a single processing station it moves the mobile units; mobile units from the installation after setting up for it and after processing it moves it away. So, where does it take it to we can put an interface here and take it to the other room ok.

So, one important object here is a single process, what is single process? Single processing unit receives and processes a single mobile unit that is known as MU mobile unit. So, single process is one process any one process like I said in the cellular layout different operating processing units were there, those processing units can be called as single processes.

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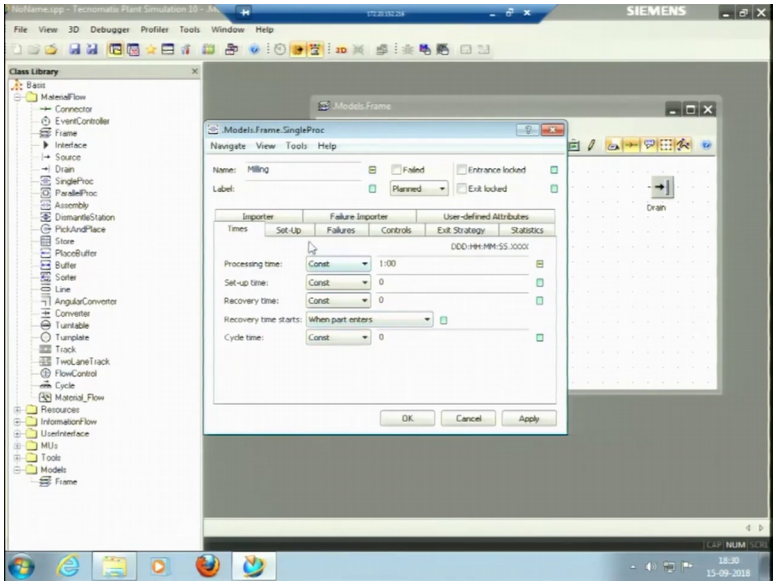

So, if I right click it and open it this is the single process. So, I can change the name of the single process let me say the single process is maybe milling ok, milling machine. So, their processing time is there; processing time is we can select any of the distributions. I will talk about the distributions also like the probability distributions are

the frequency distribution based upon certain past data that a specific flow follows with a specific kind of a process follows ok.

To constant means it will constant just take 1 minute. So, it is 1 minute. So, the constant the format is kept here it is days, hours, months, seconds and microseconds ok. So, this is 1 minute the default time, if I pick a distribution uniform distribution which is also known as the angular distribution. I will talk about this later, it will ask us to put it in this formats stream, start and stop. So, I will just talk about this later let me first pick any processing time.

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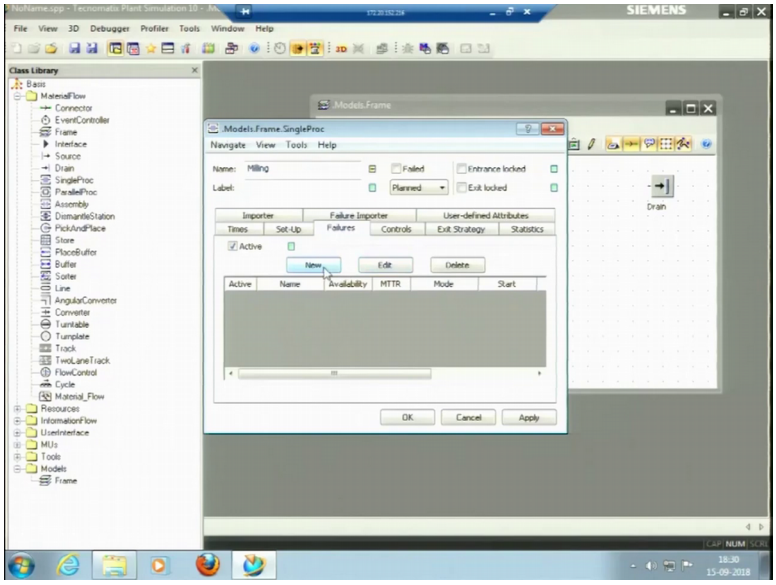

Processing time, setup time, recovery time, in cycle time these times can be put then also we have the availability.

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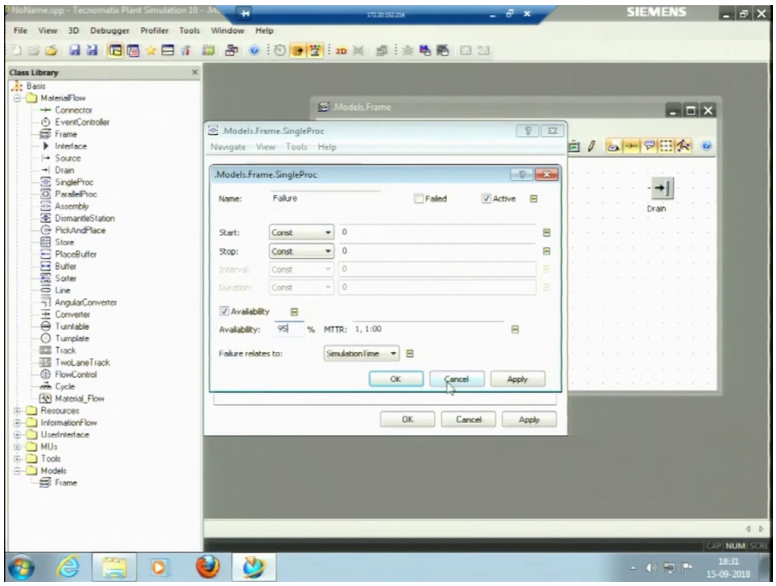

Availability of the process is 95 percentage; that is for the 5 percent of the time it would fail because in actual conditions for the 100 percent of the time the things are not available.

So, for the 5 percent of time it might fail we can change the availability depending upon the process we are working on. For instance, if it is an automated machine; automated machine can be available for the 99 percent of the time and if it is some manual operation. Let me say it is an operation where human is involved for instant it is a counter; at the entry counter where the person is the person has to take some time off or it has to take it some time it takes t while working or it something we talked about the person talked to the other people.

So, we can think that when the actual situation the availability of the person is not 100 percent, but for the 90 percent of time it can be available so, we can vary this as well. We will work on this I have changed this from 95 to 90, I have changed this from 95 to 90 let me kept it default 95 only and I will just cancel let me just try to run a simple model.

Then we have anything, any process or any object we have here, if we need to find the flow that which flow does it follow as it, but is it a straight line u, s whatever the flow it has to follow it has to be connected using a connector. So, this is a connector the very first object here is connector. So, connector is used to connect an object to the other

object. So, I have connected source to a single process and the direction is showing the this direction arrow is showing the flow.

Now, an important point here is event controller. So, whenever we need to model something we need event controller; so, I can add the event controller here or event controller you can also remain control it is just here in the bar in that tab here ok. So, event controller what does this do, when you are modeling needs require it. You can select settings of controlling the simulation run on the tab and this or in this event controller for instance the settings in the settings we can say when would the process end, if we do not use event controller the process would go for infinite time.

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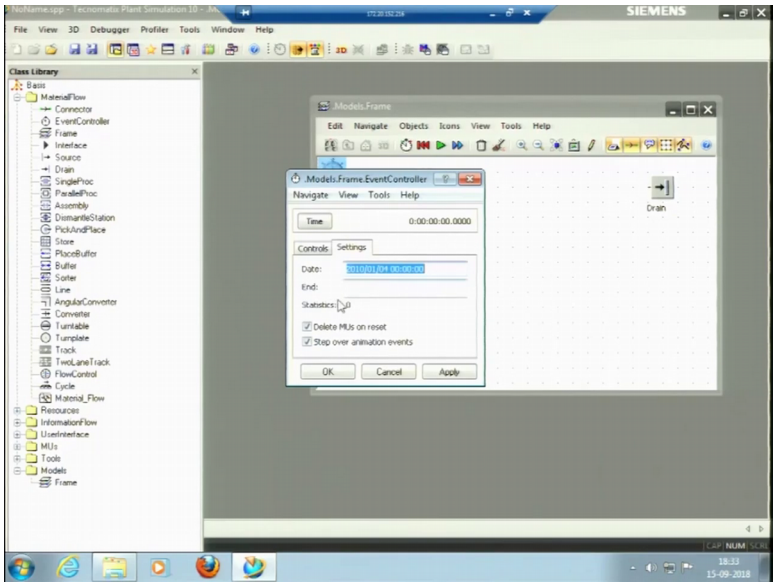

So, let me try to just put another source here or not another single process here, let me consider there are two-three processes, I will use connector to connect them; these are not connected now, this is the last one is not connected.

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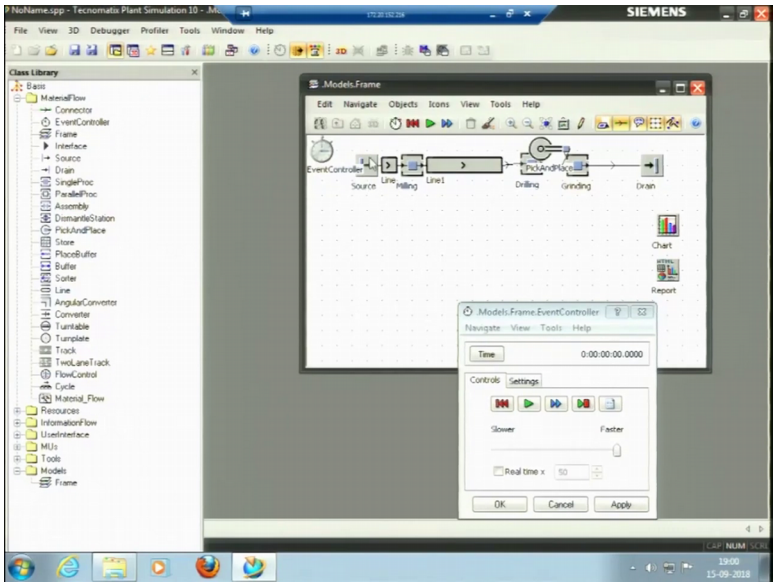

If I now run this using my event controller you know there is a play button for play button for this start or reset the simulation this is fast forward if I run this it is running, running at the fastest speed you know it is what is this time going on this time where the cursor is this time is 200 and 300 days these many hours. So, it is running in the fastest speed ok. If I stop it here it has run for 566 days based upon the constant processing time which was 1 minute for single process one and for single process two it is 1 minute single process three again it is 1 minute.

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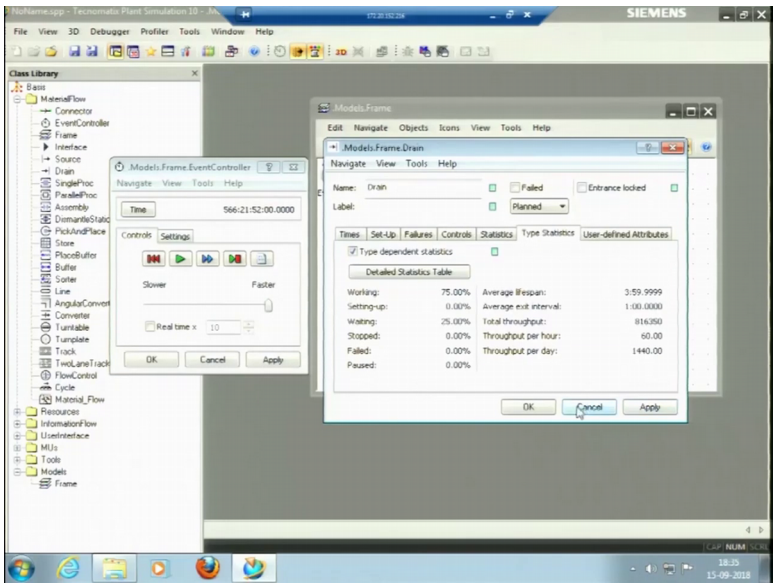

If I right click here and open I can see my throughput here in a type statistics in the type statistics. So, it has produced 1440 pieces throughput per hour is also given, throughput complete for 566 days it has run for 566 days ok. So, it has produced 816350 these many number of pieces ok. So, I can see the throughput.

Now, there is a big flow in this flow line, we have just connected we have one thing is we have placed the drain and process one at some position. So, you can see these dots right here these dots this is the dot 1, 2. 3, it is kept at about 3 meters away from this ok; it is kept at about 3 meters away you know when we put the machines in a workshop there is a span. For instance in a role of directory when people are sitting in an office they span one counter or not if we can say it is a one cabin, another cabin there is a space that is in it designated for that cabin minimum phase this is ergonomics, you know if we talk about plant layout this is work study what is our minimum space that has to be kept.

So, in case of a manufacturing, the space the distance between two machines not considering the width of the machine will be separated other than the width of the machine, the space between two machines is generally kept from 0.8 meter to like even more than that ok so, that the workers can move from in between ok. So, this is a space in between I have just completed at a random point here; a random location here.

Now, it is not taking any time for the material to travel from the single process zero to single process one, I will name this I will open I will call it process milling the examples which are picked apply ok. So, this is my single process I will name it after milling I can pick drilling ok so, this is process milling, drilling and I can pick grinding ok.

So, what is it doing? It is trying to move from milling to drilling in no time, the time taken in between here that here the time taken by this connector is zero; again the time taken by this connector is zero. Right way to do this is to use some material handling systems you know there are certain to material handling systems here, we have turntable, we have line is a kind of a conveyor, then we have pick and place robot ok. I will try to use these and or like to tell you that how do we use these.

So, I will just pick line which is a conveyor and put it here, line I can just shorten the distance, but I have to make sure that this is connected this is connected to process one, but not connected to process two I am deleting, I am just selecting it and pressing my

delete button. So, this connector is deleted to this line is now connected through sorry connector has to connect the line to milling ok I am so, sorry for this ok.

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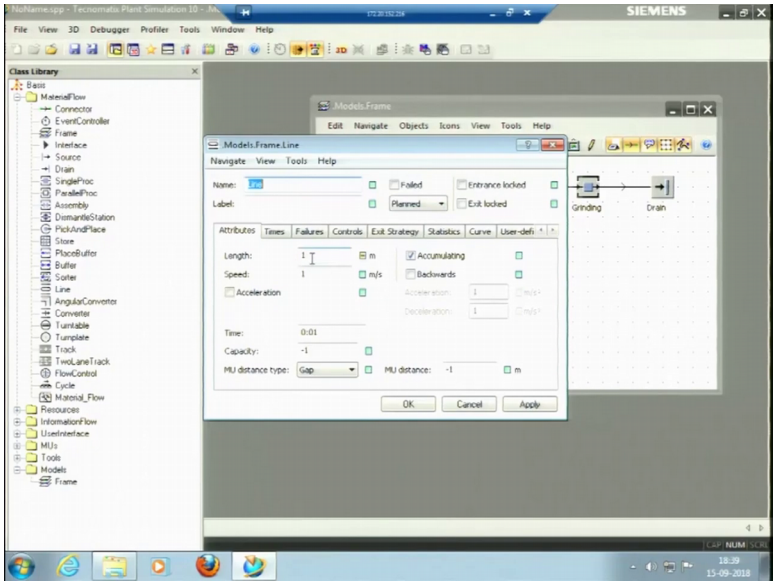

Now, if I right click here and open I can see the length of the line is 1 meter; length of the line is 1 meter that is and the speed is 1 meter again, what is the speed I will just let you know. If I put another line here; line is my conveyor ok I will take this connector off first this connector I am taking off delete, yes; put another line here it is connected this is connected by itself. So, I will extend this line or I can specifically put the length this space let me say that length of the conveyor is 4.5 meters, I put it 4.5 meters ok. So, 4.5 meters that will be the grid is on because the grid is on it will just snap, if you think about the know about this snap command it will just snap that specific point.

Now, the grid is taken off, now it I can move it at any point let us see keep the grid on just to see this. So, it will take my mobile units the units which we you can see you could see here these entity; this entity is a mobile unit that is a 1 unit is being moved from one point to another this mobile unity is moved in a speed that is mentioned on my line on my conveyor the speed was let me say what was the speed?

The speed is 1 meter per second; speed is 1 meter per second. If I try to see this at a lower speed using event controller let me say I like to just see that how a simulation running you can see it is going at 1 meter per second or I can just do it in real time it will take actually 1 meter processing whatever done with real time. I will put a real time into

10 times then apply back and ok. Now, enter real time into 10 times. So, in place of 1 minute it is taking 6 seconds here, because 6 seconds it has moved at a speed of 1 meter per second into 10 time it has moved at 10 meters per second ok.

So, the capacity of the line is only one piece here if you can see, capacities to put negative means not more than one pieces I can put the capacity as maybe this line get carry 2 pieces and distance between MU distances dispense with speed and mobile units. Mobile units can be just kept like this or a distance can be so, I can put the distance is 1 meter again apply then back and again run. Now you can see 2 pieces can come on this line.

So, this is the capability of this four to another processing is happening, the green color here means you can see the dots here this is yellow dot, this is green dot ok. Green color means processing is happening and yellow color means it is being blocked; block means that the successful process is doing something. Successive conveyor is completely filled and the predecessor that is the our source here or the n th alignment is blocked. Because the successor is waiting successor is completely fulfilled and it cannot just transfer it material from one point to from its one point to the forward process. So, if this capacity is two now restart stupid to bitten, I will just remove this line and add another line because I was to change all the dimensions, I will just try to pick the default values which are there I will connect using a connector.

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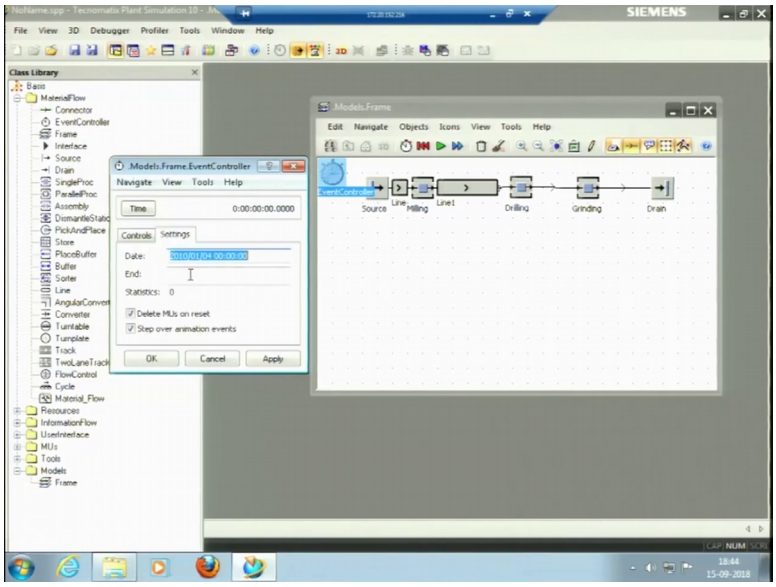

And in the event controller in the settings I can put the end time when would my process end here. So, it is in the format this is days; this is this first 0 is days, second 0 is hours, then this is minutes, this is seconds. So, I can put in an 8 hour day, it should be 0 8 colon 0 colon 0 0. So, if my simulation would now end at an 8 hour day, if I put apply here ok. Now, let us run what is running, the capacity is one it is running in the speed that is mentioned here trial time in to 50, you can see in the real time into 50 a time is running well let me try to run it in the fastest space. So, I can see in the setting that the time is kept 8 hours ok so, if I need to see it in a fastest way so, I will just apply and ok.

So, let me start. So, it has run for 8 hours is at the fastest speed, it has run for 8 hours I cannot see the throughput here open type statistics is 4931 pieces, total throughput is 477 in an 8 hour 477, per hour is 59 pieces and throughput part is 1431 ok. So, for an 8 hour it is telling this much per day it is considering 24 hour day here ok.

So, I can see the all this throughput and I can even see the reports, I can see various charts as well whether like it for how much percentage of time the process is blocked, for how much the percent of time for the completely 8 hour day, for how much time my process is plot or waiting or actually processing, or for how much time the failure has happened in which process? Because, you know failure is 95 percent. So, some at some point of time failure it could also happen so, all this thing can be seen. For that I need to use resources before that I would like to make you to note that we have not even yet put anything between the drilling and grinding there is no material handling system.

So, I like to put pick and place robot pick and place robot I will these are the names I if it is getting a little congested I can take this off using this command. So, delete this connector, now I will connect using the pick and place robot. A pick and place robot would just pick the material from the predecessor that is this drilling and put it to the successor that is the grinding, how does this work; Let us see first of all let me try to reduce the speed just to make you people appreciate it in a better way and see how the simulation is happening. It is trying to now the processing is happening it will now pick and place you can see pick and place ok.

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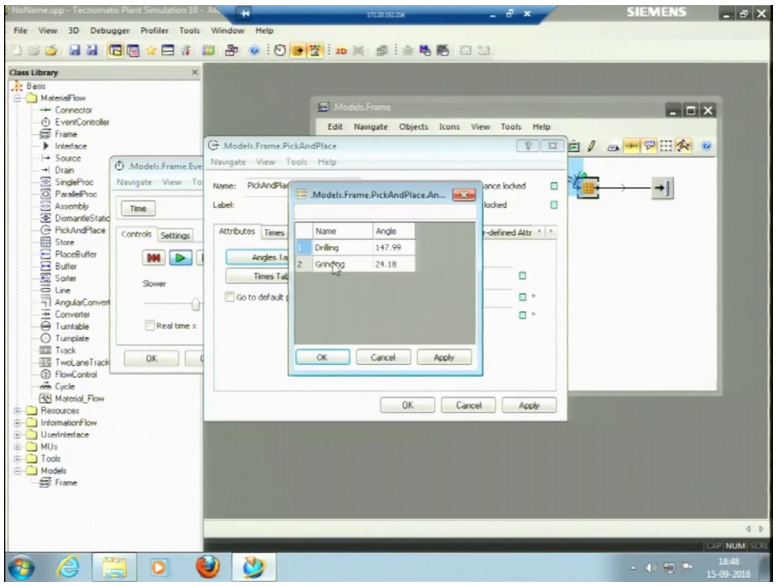

For pick and place robot also we have pick and place what are the controls here, entry, exit. What are the angles? Angles between drilling and grinding all those things we can consider here and with less times and failures. If we had this case is also 99 percent failure if its MTTR is Mean Time to Repair this is reliability engineering. In reliability engineer we have mean time to failure, mean time between failures, mean time to repair.

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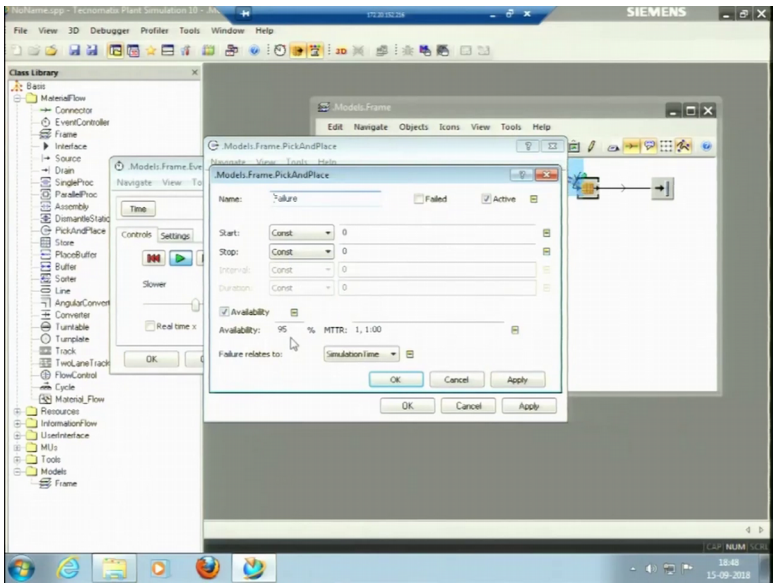

So, if failure happens if actually the processes failed that is the kinetic abilities stop it takes about 1 minute to repair that. So, these attributes we can select. So, I will keep it

default only. So, it is still running, it has run for 18 minutes and 28 seconds. So, this is pick can place robot. So, what I was talking is that let me put this and the grid on here.

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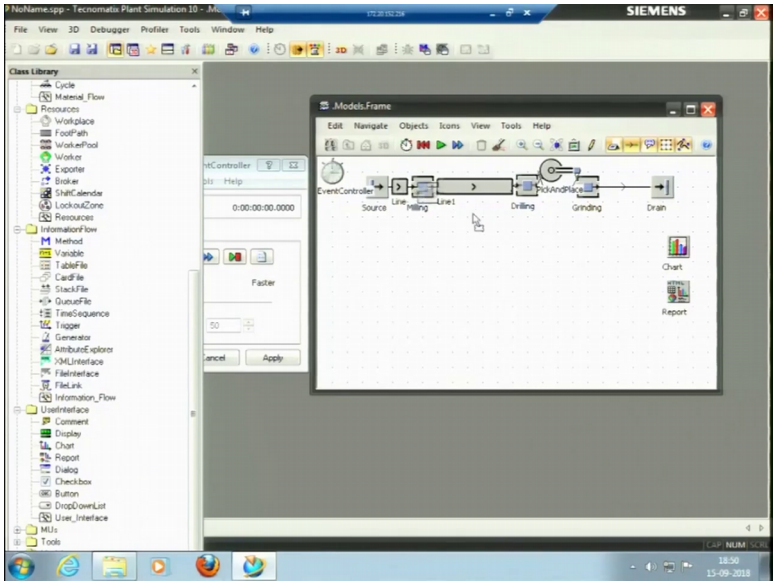

So, we can use some resources sometimes like the workers if they are working on and the broker is there who is trying to distribute the work to the workers work place is there, a footpath, work pool is there like. I showed you in the car body manufacturing then information flow, if the information has the method specifically has to be defined sometimes then generator at rate I will I will explain these objects it. Let me first try to show you a simple flow line. So, this is in user interface I have a chart, as user interface means I will put a report here and I will put a chart here, user interface means sign anything that a user could see after the process has run for one time

So, if this is I have a chart here and I try to just drag my processes here milling, drilling. So, I am just trying to put the processes here.

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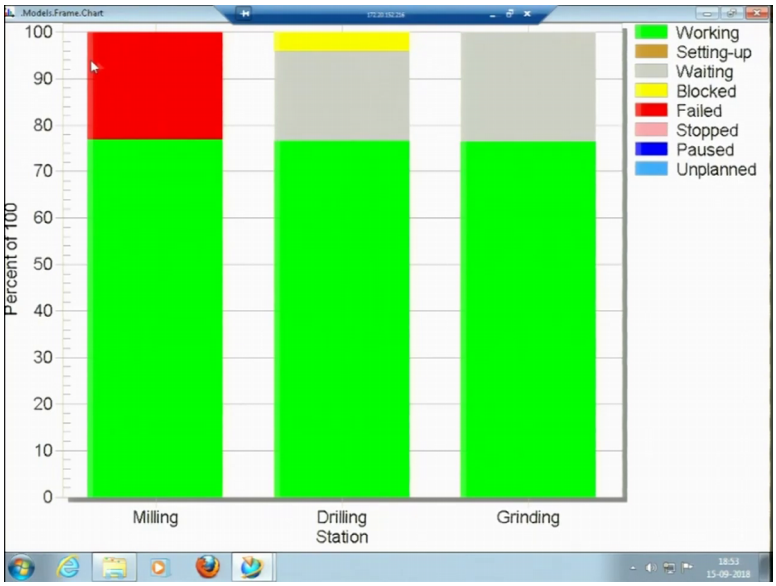

Now, when I run my process it will show you can see this chart you can see this chart it is different colors are there working, setting up, waiting, blocked, failed, stopped, paused, unplanned all these times are there. So, when I run it for the 8 hour day, let me try to run it for an 8 hour day. So, it is run for an 8 hour day you can now see based upon the times which are put here the present times this process milling; milling is working for about more than 95 percent of time and for the rationale time it is just blocked because the next process drilling or the next conveyor or line.

The line which was kind of a conveyor which is transferring the material from one point to another machine. So, that is trying to block this one this is also blocked, but this is not blocked, but this is waiting for the material to come ok.

So, it these are working for I can see the exact times this is the graph it is just showing this calibrated graph here. I can see the exact times as well using these processes I open the process, I have opened the milling process, now I can just see the statistics in this process I can see that for 95 percent of time if you see here 95 percent of time machine is working and it is blocked for not about 5 percent it is 95.5 percent working and 4.5 percent blocked which is represented in this graph as well ok.

So, let me try one thing, I will say cancel it. Let me try one thing let me try to change the failure rate of milling, failures it is working available for the 100 percent of time. So, I will just change this I will change this it is working that is why I did not the failures

happened change it to 80 percent 80 percent of time it is available for that 20 percent of time it might failed. So, let me apply it and apply and let me run it again for the 8 hour day now what is that it takes is you know for the 20 percent of the time this process has failed, you can see the red color here for 20 percent of time it has failed ok.

So, it was not blocked because you know had it the feel it not been there it was working for about 95 percent of time ok, but 20 percent is the failure 20 percent of failure. So, it as work completely for 80 percent of the time and the previous process it is blocked because the actually this drilling process is blocked because, grinding process was not able to receive that, and this is waiting this gray color this gray color is waiting because it is not receiving anything from the predecessor from the milling drilling is not receiving anything from milling ok.

So, this is waiting so, I can see the statistics here. So, I can see it is statistic for drilling you know it is working for you can see the graph as well here, it is working for 76 percent of time, it is waiting for 20 percent of time and it is blocked for about 4 percent of time 76.6, 19.34 then 4.06. So, this is how broadly I am telling you how the resource or the information flow we can use and various kind of material flow how the simulation can happen, this is just one flow line. I have just picked three processes this was a very you can say trivial example, but in actual processing we can use the simulation even we can use simulation experiment.

So, before going further let me show you the different objects. So, I am not saving this model this was just a kind of a demonstration for you people. So, this is connector I have talked about this event controller is done, then frame is done, interface is done source, then drain single process is one process parallel process parallel process.

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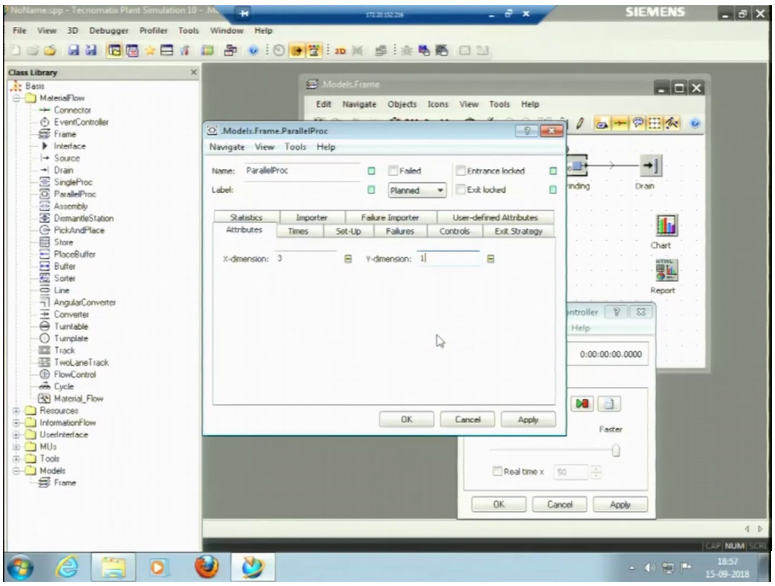

You know if I put parallel process and right click here and open parallel processes when we have exactly same machines for instance we have four drilling machines of same make which is having saying processing time and same setup time and what we need not to put the four machines in parallel specifically four single processes in parallel. We can pick one parallel process because other parameters are same the attributes of this specific process is same.

So, what can I can pick one parallel process and put there. So, this in parallel process it is shown in the form of a matrix here, this is X dimension and Y dimension ok. So, 2 into 2 the 4 machines and the times are exactly same processing time through all the 4 machines is constant it is 1 minute ok, then also I can have it is the metrics actually if I put 3 here, it would not make it 5 if we make it 6 machines 3 into 2; 3 into 2 it will make a matrix into 2 6 machines. What if I need to have the odd number of machines for instance I may need to have 3 machines for to have 3 machines I have I what I will do I will put it 3 into 1 note we bring three machines ok.

Now, where this parallel process is put I will just pick an example and let you know now for instance there is one process that is being blocked for maximum number of value for 40 this block being brought for 14 40 percent of the time. It is being brought for 40 percent of time; that means, the next process is taking more time for its processing, it is really more time for this processing or it is taking an extended time.

So, this machine has to wait. So, what we can do we can put if we can apply other as per taken in considering other aspects management aspects if we can put another machine or we can double the capacity of the successive machine. So, it was waiting for the 40 percent of the time if we have we have put two machines here in that the successive point, now this 40 percent of time reduce to 0 because now the processing is doubled here.

So, in that case we can think of putting parallel processes. Now what does when there is a waiting, when there is a blocking, we can think of adding new machines we can think of then taking a machine few machines off. And if there is a lot of waiting time sometimes we can even think of doing some other processes like I have said in case of the process layout in case of process layout we have a specific set of machines in one section another set of machines in one section.

If we see that if we see the overall machines time and we see in the specific ah this section for the 30 percent of time there is a blockage or for waiting I would say for the 30 percent of there is a waiting and we can must consider that 30 percent of time it is a waiting we can give them some other job some other job could be given. So, if it is kind of a process layout it could be kind of a batch production and job production.

So, in case of batch production another batch could enter. So, that there is no idle time, there is mini no actually not exactly no, but the minimum idle time is there the machines are completely working for the full capacity if possible. So, we can try that in simulation before actually doing in the scheduling, then routing all those things that we have that will learn in the production planning and control that can all be done using the simulation ok. So, this was just an example I have just picked a parallel process I will just delete it. So, assembly is that when we have two lines for instance this is one line I can just pick it directly I have selected everything control c and control v.

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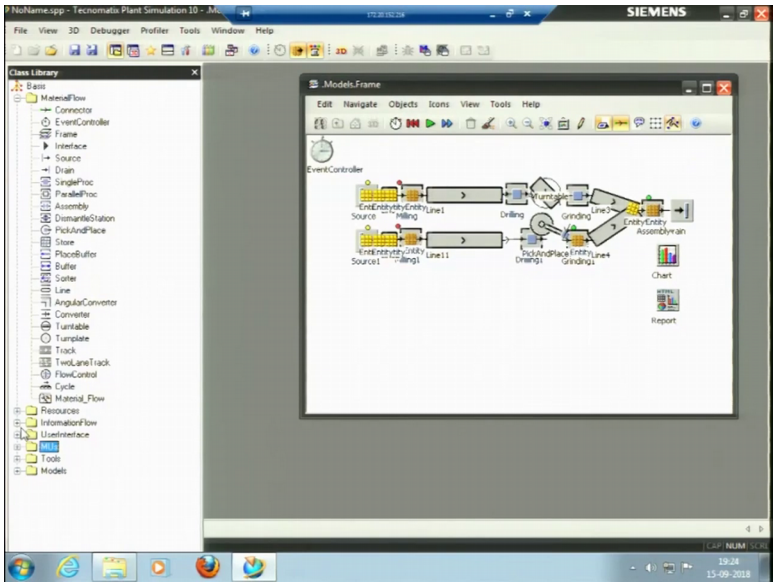

Now, if there are two flow lines like this I am deleting the drain, what I can do for instance I am manufacturing nuts and bolts and I did not need to assemble them. Nuts I mean for manufacturing flow line 1 then bolts I mean for manufacturing flow line 2 then we are assembling them we can use assembly in this place. So, I can pick assembly and put it here let me take this off assembly. So, I had to connect this using something a line has to connect this assembly I will put it very close to drain is it connected now it is still to be connected here connector would connect the line to assembly and another line. So, a connector would connect this to this already exist I said the connection is made let me say try to run.

Now, it has run for the 8 hour day and two units are manufactured now this is flow line 1 ok this is flow line 1, this is flow line 2 and these are being assembled here. Similar to assembly we have dismantle section; dismantle section is when something is manufactured or let me say something comes from drain, assemble part come from the drain. We have to dismantle that for instance a set of screws comes from the source which are just screwed on some component and we have to dismantle them and then to you have to use them and for some other purpose for that purpose we can dismantle.

For this assembly and dismantle have just showed to flow lines here, but we can have multiple flow lines like we can have multiple flow lines different material coming from may be ten flow lines and different and different lines and there those are being

assembled. Like in the car body manufacturing example that we saw they were trying to assemble or they were actually trying to put the mirror on the side mirror on and they were trying to tighten the nuts of the of the wheels. So, those processes were being done. So, this is dismantle section.

Next is pick and place. Pick and place is a kind of a robot that just picks and place from one place. So, it picks a part up at one station and places on to another station. So, next is store. So, stores the MUs; MUs or mobile units these are the mobile units, it stores the mobile units you can define the size of the store by specifying its x and y dimensions like how many pieces for instance is a store in between we can also add the buffer in between for instance this is a big blockage of the materials in one size. We can add a buffer in between if they it has does not have to put the process does not have to wait we can put a buffer, it can the buffer capacity would be there. Buffer capacity that it can hold let me say 100 pieces in a day.

So, whenever the next process is free to pick a piece from here it can pick the piece from the buffer. So, that buffer can be used here. So, just after store up we can have place buffer and buffer.

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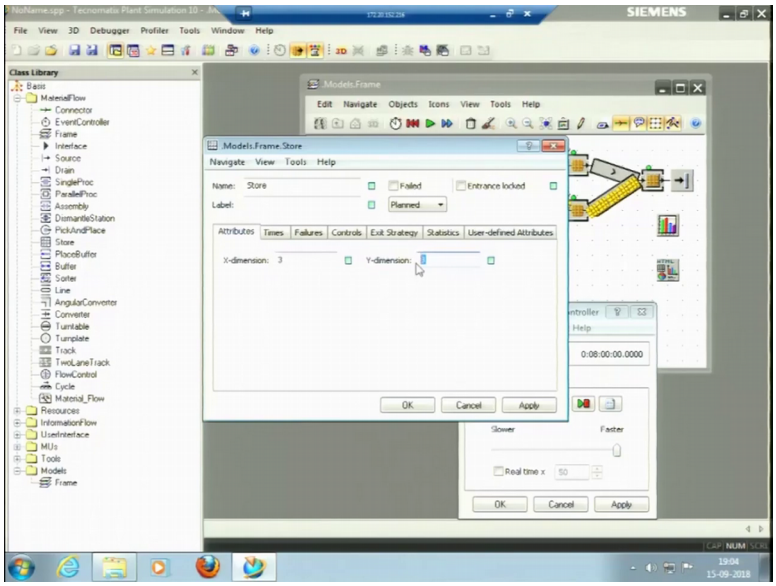

Store is a kind of a longtime storage. So, you can see this is the capacity 3 into 3 9 pieces can be stored here ok. I can just change the capacity do the number which I like not which I like which is actually required in the process. So, this is to I am deleting this one.

So, place buffer what is place buffer this next command place buffer; place buffer lines up several processing units of the same kind of one after the other. The processing units are connected and mobile units have to be processed at each station thus they cannot pass each other. A mobile unit may only leave the place before after it has reached the processing station with the highest number. So, a model a buffer with the great capacity that requires high performance we can use buffer like I said ok.

So, place buffer is a one thing the big; buffer is a buffer is place between two plant components that certain purpose is it temporarily holds parts when the following components failed when the successor is not able to receive the component. The second function it does important function it does is it passes the part on when the preceding components stop working. So, it was the dimensions of a buffer with large enough capacity for covering all failures is to complete decoupling of the plant and the other attributes as well.

So, next is sorter; sorter as the name suggests the sorter arranges the mobile units by sorting the criteria we defined we can define the criteria for instance if I having a nut and bolt assembly. Their nuts manufacturer and bolts manufacturer and on 1 bolt I am trying to assemble 2 nuts on it ok. So, the sorter what is a sorter can do it can pick 1 nut or from the bolt line it can pick 1 bolt or you can sort it through the different lines. So, a sorter we have to define a criteria it can do that. So, line; line is a kind of a conveyor. So, to draw the straight line with active drawing color we select this then this is used I have just used it extensively in this example then is angular converter.

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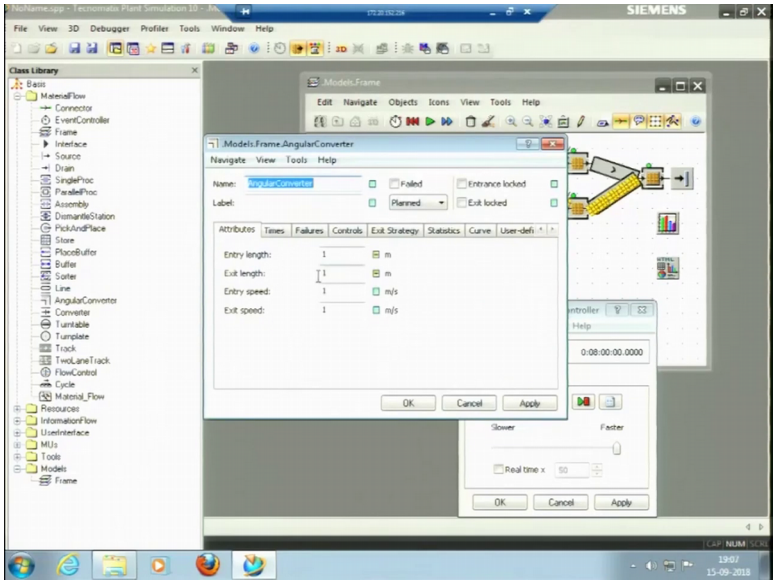

So, what is angular converter? Angular converter changes the conveying direction of the mobile objects from lengthwise to crosswise it is at 90 degree ok. I can just put it here angular converter. So, you can say entry length, exit length, entry speed, exit speed. So, it is a 90 degree when there is a for instance we need to have the kind of a u type of layout, u type of layout would be like this u; u only have this reaction this direction this direction this direction. At the, this ton when we have to need to have ton we can use this angular converter it will convert from one line to the cross sides, you know this direction is 90 degree here.

So, angular converter moves the parts to its successor within the flow of measurements like it moves a part onto the first leg of the angular converter when the booking point length has reached the entrance then angular converter the part drives along the entry length and entry speed all those things we can control entry point, entry speed, exit point these things can be controlled like I just showed the tributes of this specific object.

Now, next is converter. Now, what is converter? Converter is intended for modeling material handling equipment when the part moves on to the converter. It either passes straight through the conveying direction or it is lifted on to a literally moving transport level ok. By lifting mechanism and then conveyed literally to the left or literally to the right. So, angular converter was just one thing it just convert the direction from one direction like 90 degree; its can just convert 90 degree. So, a converter can we can pick whether to go straight or whether to change the direction. So, it can work in that here.

So, turntable serves for modeling a rotating platform it is a rotating platform which turns apart around and moves on to the several connecting material flow objects turntable. If similar to turntable we have can have turn plate ok, I will just try to put the turntable here I will delete this pick and place robot and try to put a turntable here now, how does this turntable work. You will see stuff or let me fix this it is connected sorry. Turntable I need to put the connector ready to put the connector here, I am just showing you some examples in between why is not looking taking place let me switch off the grid now it will work ok.

Now, let me try to run it is running at the fastest space let me try to slow it down and then try to see how the turntable works ok, it is now moving at some speed that is defined now processing would happen, Now, turntable would take it from one place and turn it to the other place. Now what happens sometimes we have to swap the work pieces this work piece on this side this work piece on this side. So, turntable what it does it just pick the pieces from this point and the swap it like this ok.

Similar to turntable we can have turn plate, we can just put one piece on the each direction in turntable it is a single direction turntable that is being shown in the screen turn plate. We can have one plate and we can have multiple work pieces ,what put on there it is like kind of a rotating the dining table that we have we put the dishes or over there and we can rotate it we can pick whatever the twist we like from in between. So, next is turn plate it is done next is track.

So, track can be used to model a part of a transport line with or without automatic routing on which the transporter moves the parts. For example, to replace both the automatic I did vehicle system and the model we can use this track. So, the distance which the transporter has to travel on the track is defined by tracks length, the tracks length can be defined redundant transporters mobile unit length can be defined in that speed can be defined.

So, the maximum capacity of the track is defined by its length and the lengths on the individual transporters moving on it can also be defined that is the track that is 3 meters long accepts 3 transporters of 1 meter each. So, this can be certain other capacities. So, we can have certain kinds of track we can even have 2 lane track; 2 lane track is 1 lane track only we only one direction, 2 lane track is it can go in one direction and come back

from the other side it is kind of a two way road let we have two way track can be put in then flow control.

What is flow control? Flow control allows the model common strategies for splitting up and for bringing together the flow of materials. It is important to note that the flow control does not possess the mobile units it only distributes them among the objects. Now flow control is like it does not store any mobile unit, flow control is when instance I have a having a is central o here, in o kind of layout and there certain lines here ok. So, flow, but flow control can do it can just control that one piece here, another piece here, second piece here, third piece here it can be as control the flow, but ever lying this is my o there are lines external to this. It the flow control if I put in there, it can control which of the line is requiring my material now ok. So, it can control the flow in that way.

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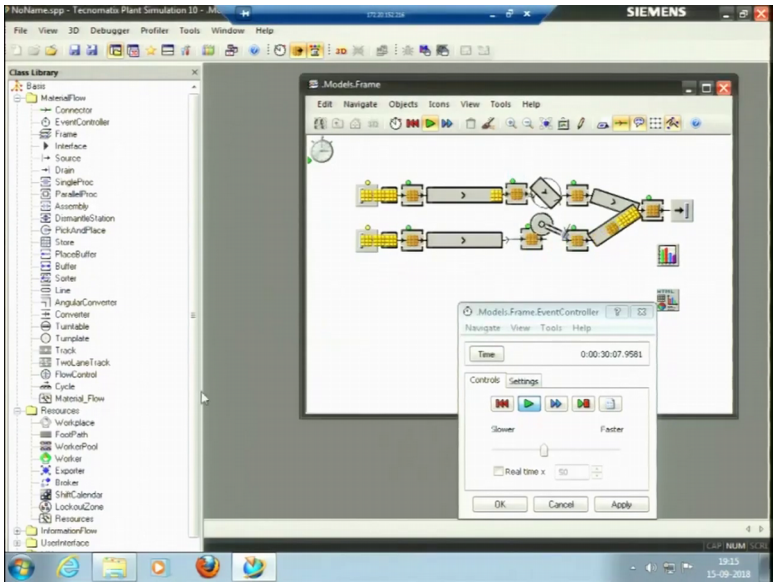

So, after that we have cycle. So, I just cannot show you the actual demonstration for all the objects here because you know in a 2 hour time, we cannot just discuss all these things. So, I am just giving you important objects here I will come to the sources here. The source is actually what place if we need to work with the workers we need to put the work place; work place here for instance in place of this line, in place of this line I can use workers to transfer the material from process milling to process drilling.

So, where the worker has to work would be workplace ok. If some worker simulation has to be induced for some work is there that is we have just taken the processing time ok,

the machine is automated it is taking one minute processing time we are just considering it here.

If the worker has to work here and if workers feel the worker capacity, the ideal worker time and normal worker time those things are to be considered, then this workplace is to be put there between the workplace we need to put footpath you can see the footpath here. I am picking footpath from here and putting here workers have to travel through this footpath to model with worker, we need to have a broker as well who would distribute the work to occurs then we have need to have exporter as well ok. So, we can work with the workers as well I will just show you a certain examples here. So, I am just deleting these one delete and delete.

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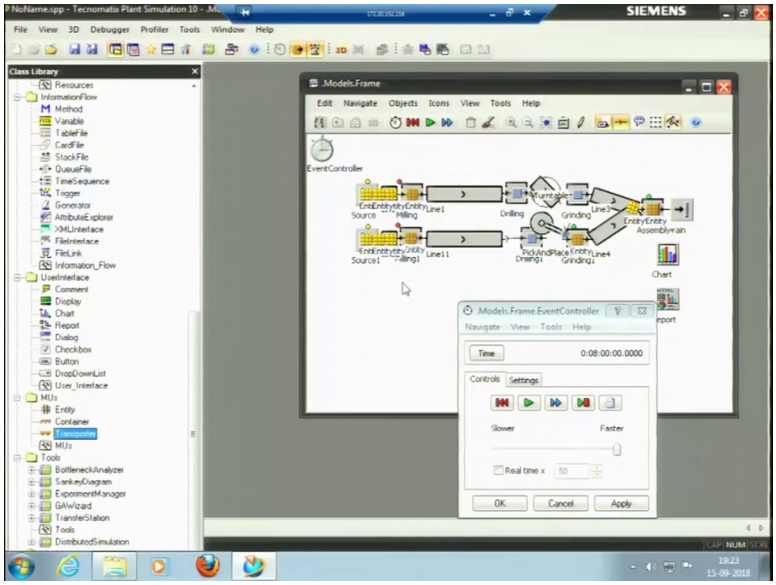

So, some important points a method I have said then card files tax file this is the information flow. How the information will flow we can define the attributes here and see how the information could flow. Some of the information flow objects could be method like then we have variable; variable is when we can work on the source code, I can if I am saying that we can make our own objects if we can understand the code there. So, there we can add a variable.

So, this variable we can declare a local variable anywhere within the source code. So, then we can start to declare our own variable with a keyword let me say the one of the variable is known as may be integer or track one, track two, we can name them anything

like we like then we have table file. Table file list with two or more columns it is a kind of a table like the normal table we have so, we can access the individual cells by employing their index, that is by their position for instance the cell number 3 1, cell number 3 2 that they can be accessed. Then we have card file card for the list with one column, providing random access to the contents of the individual cells using the position that is the row number or imagine the card file as a file card box, we can think of that. So, there are certain things like this.

So, next we have is user interface; in user interface we can have comment we can put some comments we can chart I have just shown you report is the complete report when we run the complete simulation I can publish the report of the simulation as well. If I apply and try to run it; design it for 8 hours day. So, in report we can publish the complete report and the complete report we can have just the list of the these machines different machines. If I just show my comments here, the machines milling one all the charts that have the scene those can be put in there for the time for which the machines were working those can be seen in the report all these things can be produced.

So, next this mobile units are there; mobile units the units which you are being used are entity if I this name this is yellow pieces these are entity ok. So, similar to entity we have a container. Container has a capacity for instance from the conveyor we are not taking one mobile unit the conveyor is taking a container which is containing a few mobile units or few entities actually. So, this entity here the entity is just a block, just a box this is a kind of a box is showing here the entity can be the car that we have just saw in the car body simulation model.

So, then container it is a transporter is there. So, in place of container the transporter some time the conveyor is fixed, but the transporter is a kind of a small trolley small trolley which has some capacity. So, in this we can just put the pieces and take them along. So, then we have tools here tools here, tool is bottleneck analyzer. Some bottleneck analyzer like we have just visualized the bottleneck in the charts in the example that we have seen here.

But bottleneck analyzer is also there that will show this is the primary bottleneck, this is another bottleneck. So, first work on this those things all those all things can be done then experiment manager. So, I will pick one of these bottleneck I will pick experiment

manager so I am try to explain you certain simulation. So, these are the some of the tools which are used in this software some of the objects.

So, now I will try to pick some examples and try to explain you how do we use certain tools. Now these tools are just to design the process, the material flow tools just to design the layout. Then important tools the resources I have just tell you resources are just the workers or exporter broker which are used.

The information flow, how do we use the information ok; then the tools which have experiment manager what does experiment manager do it can simulate a specific process. The various you can say box plots or we can have this simulation and the depth of simulation those things are going to be done ok. So, I like to stop here and thank you for being in the course. So, we will meet next time.

Thank you.