Advance Green Manufacturing Systems
Prof. Deepu Philip
Dr. Amandeep Singh Oberoi
Department of Industrial & Management Engineering
Department of Mechanical Engineering
Indian Institute of Technology, Kanpur

Lecture – 44
Green Factory Simulation-Part 2 of 3

Good morning welcome back to the course I am Dr. Amandeep Singh and I will take the plant simulation techno matrix in this lecture. So, I will again to the start page view start page. So, we will create a new model and ok.

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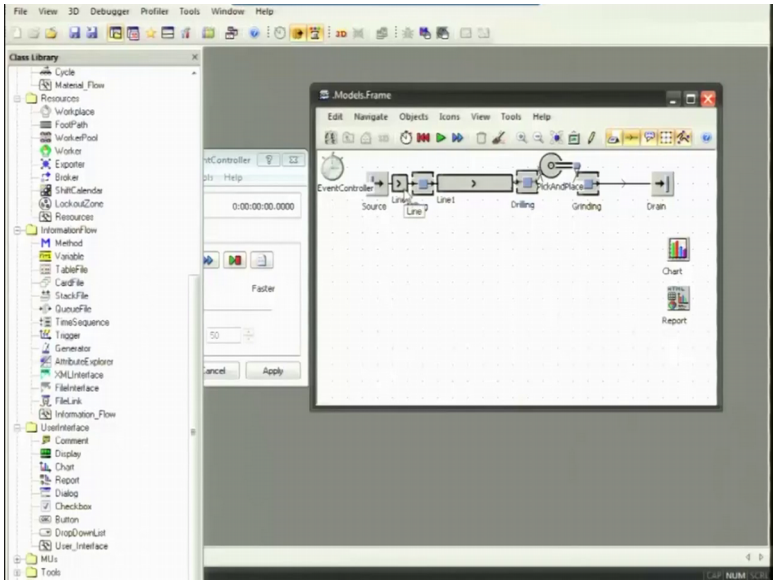

So, this is the model that I am trying to generate here. So, I will just open the class library and open the material flow. So, there are certain objects here connector, even controller, frame interface all these objects are here. So, these objects have specific meaning, this for instance this is model 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 room 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 you need to add a new frame we can added from the material flow that is the most used class library here.

So, the frame serves for the grouping of objects to build heraldically structured models by inserting any of the built in objects and you the built in objects of this from these or any objects that we can design. Because we can design our own objects in this software as well you know there is a code that is written for this software to design the objects. So, if someone is conversant with the code it can also design the objects by itself. So, the frame when we use a frames with connectors or plant simulation it opens the dialogue slept interface phase 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 frequent table source is a starting point or the entry gate ok. The entry point 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, but similar to source we have drain. So, the drain has a single processing station it moves the 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 policy processing units were there those processing units can be called as single processes. 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 may be milling machine. So, their processing time is their processing time is we can select any of the distributions. I will talk about the distributions also like the probability distributions are difficulty distribution based upon certain past data that a specific flow follows, with a specific kind of a process follows the constant means it will constant just take one 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 one minute the default time, if I pick a distribution uniform distribution which is also known as the triangular distribution. I will talk about this later it will ask us to put it in this format stream, start and stop. So, I will just talk about this later let me first pick any processing time ok. Processing time, set up, time recovery time, then cycle time, these times can be put. Then also we have the availability of the processes 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 can be available for the 99 percentage 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 their person has to take some time off or it has to take it some time it takes tea while working, or it eats something we talked about the person talk to the other people. So, we can think that then the actual situation the availability of the person is not 100 percent. But for the 90 percentage of time it can be available.

So, we can vary this as well we will work on this; we will work on this I have changed this from 95 to 90 ok. I have changed this from 95 to 90 let me get to default 95 only and I 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 it is 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 this direction arrow is showing the flow ok. 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 event control it is just here in the bar in that tab here.

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 and if we do not use event controller the process would go for infinite time.

So, let me try to just put another source here or not another single process here. Let me consider there are two, three processes ok. I will use connector to connect them these are now connected. Now, this is the last one is not connected. If I now run this using my event controller you know there is a play button for this start or reset the simulation this is fast forward. If I run this it is 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 an hour, 300 days these many hours. So, it is running 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 1, and for single process 2 it is 1 minute single possessed again it is 1 minute. 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 done for 566 days. So, it has produced 816350 these many number of pieces ok. So, I can see that throughput now there is a big flaw in this flow line we have just connected we have one thing is we have placed the drain and process one ok.

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 integral of better treat when people are sitting in an office this span one counter or not if it is a one cabin and another cabin there is this space designated for that cabin minimal space this is ergonomics.

You know if we talk about plant layout this is work study what is a minimum space that has to be kept? So, in case of manufacturing the space the distance between two machines not considering the width of the machine will be separate let 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 kept it 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 0 to single process 1 ok. 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 be 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 0 again the time taken by this connecter is 0. The 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, line is a kind of a conveyor. Then we have pick and place robot I will try to use these and all like to tell you that how do we use these.

So, I will just pick line which is a conveyor and put it here ok. 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.

So, this line is now connected through sorry connector has to connect the line to milling ok, I am so sorry for this ok. 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 ok, it is connected ok, this is connected by itself. So, I will extend this line or I can specifically put the length this way let me say that length of the conveyor is 4.5 meters I put it 4.5 meters ok. So, 4.5 meters actually the grid is on because the grid is on it will just snap if you think about 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 ok.

Let us see keep the grid on to just to see this. So, it will take my mobile units the units which we you can see you could see here this entity is a mobile unit that is a one unit is being moved from one point to another ok. This mobile unit 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 ok, 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 is 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 one will processing whatever run with real time I will put a real time into 10 times ok.

Then apply back and now enter real time into 10 times. So, in place of 1 minute it is taking 6 seconds here 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 capacity is put negative means not more than one pieces, I can put the capacity as maybe this line can carry two pieces and distance between MU distances dispense with print and mobile units; mobile units can be just kept like this or the distance can be.

So, I can put the distance is 1 meter again apply then back and again run. Now you can see two pieces can come on this line. So, this is the capability of this stock whenever the 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 successive process is doing something successive conveyor is completely filled and the predecessor that is our source here or the entity line one is blocked. Because the successor is waiting successor is completely fulfilled and it cannot just transfer it material from one point to from it is own point to the forward process.

So, if this capacity is 2 now, restart click to button I will just remove this line ok. And add another line because I was to change all the dimensions I will just try to pick the default values which are there ok. I will connect using a connector 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 08 colon 00 colon 00. 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 capacity is one it is running in the speed that is mentioned here, real time into 50, you can see in the real time 50 a time is running well let me try to run it in the fastest pace. So, I can see in the setting that the time is kept 8 hours. 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 it at the fastest speed it has run for 8 hours. I cannot see the throughput here open type statistics is 1431 pieces, total throughput is 477 in an 8 hour 477, per hour is 59 pieces and throughput per day is 1431 ok.

So, for an 8 hour if you are selling 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 blocked or waiting or actual 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 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; a 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 ok.

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 ok. 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. So, it is trying to now the processing is happening if you now pick and place you can see pick and place ok. For pick and place robot also we have pick and place ok. What are the controls here? Entry, exit ok.

What are the angles between drilling and grinding all those things we can consider and various times and failures if we had this case is also 95 percent failure. It is 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. So, if failure happens if actually the processes fail that it is stopped it takes about 1 minute to repair that ok. 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 and place robot. So, what I was talking is that let me put this and the grid on here. 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, what 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 no the methods specifically has to be defined sometimes, then generator at rate I will explain these objects. 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 the chart here user interface means sign anything that a user put 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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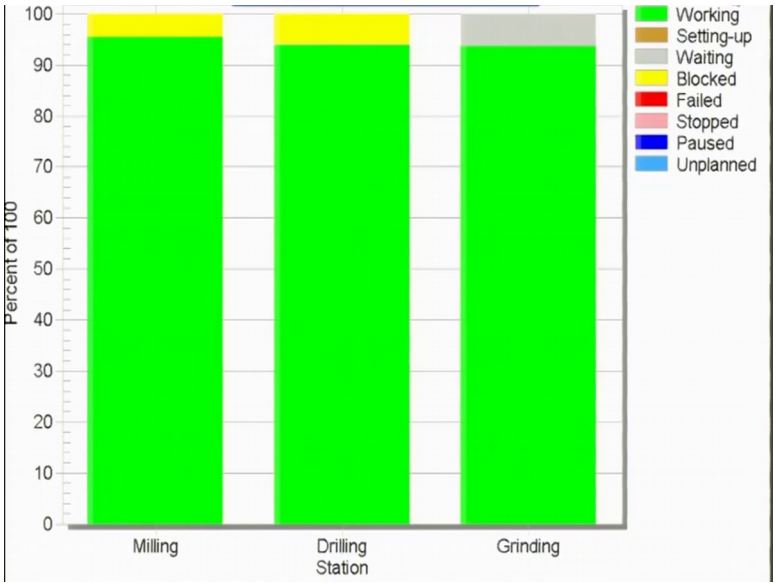

Now, when I run my process it will show you can see this chart; you can see this chart it is the different colors of the working setting up, waiting, blocked failed, stopped, paused unplanned all these times are there. So, when I run it for the 8 hour day ok. Let me try to run it for an 8 hour day. So, it has 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.

So, let me try one thing ok, I will say cancel 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 all the failures happen change it to 80 percent ok. So, 80 percent of prime it is available for that 20 percent of time it might fail. 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 of 5 it has failed ok.

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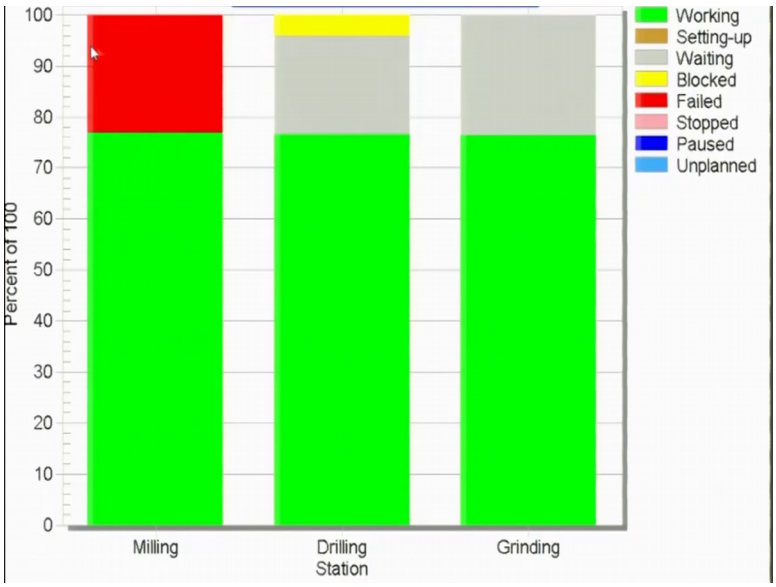

So, it was not blocked because you know had it the fill it not been there it was working for about 95 percent of time ok, but 20 percent is the failure, 20 percent of failure. So, it is worked completely for 80 percent of the time and the previous process it is blocked. Because the actually this drilling 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 statistics 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 ok, 76.6, 19.34 then 4.06.

So, this is how broadly I am telling you how the resource how 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 ok. 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 I like to show you the different objects.

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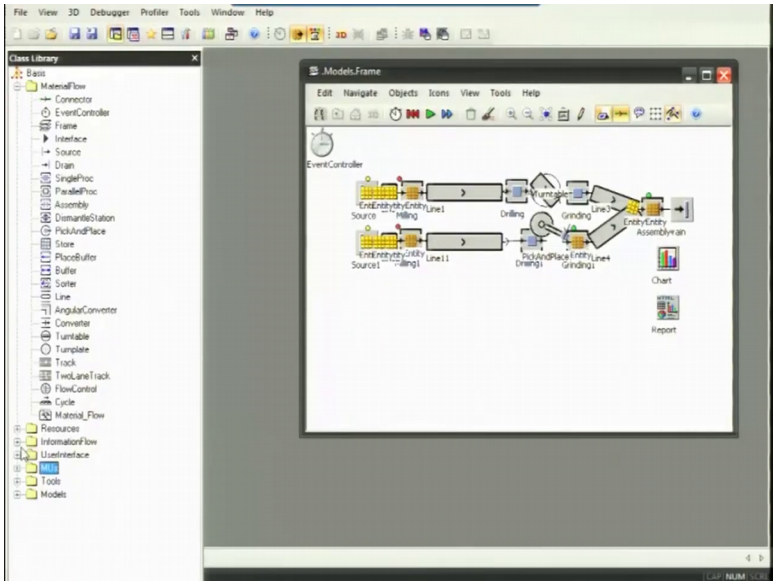

So, I am not saving this model to this was just a kind of a demonstration for you people. So, this is connector I have talked about this event controller is done, then frame is done, interface is done, source, then drain, single process is one process; parallel process you know if I put parallel process and right click here and open.

Parallel process is when we have exactly same machines for instance we have for 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 there 4 machines and the times are exactly same processing time through all the 4 machine is constant it is 1 minute ok. Then also I can have it is the matrix 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 what I will do? I will put it 3 into 1. Now it will bring 3 machines.

Now, where this parallel process is put I will just pick an example now let you know. Now for instance there is one process that is being blocked for maximum number of manifold for this block being block for 1440 percent of the time. It is being draw for 40 percent of time; that means, the next process is taking more time for it is processing ok. It is very more time for is 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 particular 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 put two machines here in that the successive point. Now this 40 percent of time will reduce to 0, because not 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 overall machines time and we see in the specific this section for the 30 percent of time there is a blockage or sorry waiting I would say for the 30 percent nowadays in waiting and we canvass 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 would 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 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. So, this was just an example I have just it 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 ok. 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 then need to assemble them, nut some manufacturing flow line 1 then bolts some instructions for line 2.

Then we are assembling them we can use assembly in this case. 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 corrected no it is still to be connected here connector would connect the line to assembly and another line ok.

So, a connector would connect this to this already exist I said the connection is made. Let me say try to run it now it has run for the 8 hour day and 2 units are being manufactured. This is flow line 1 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 come from drain assemble part come from the drain we have to dismantle that. For instance a set of screws come from the source which are just screwed on some components. 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.

But 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 for maybe 10 flow lines and different and different lines and there those are being assembled; like in the car body mill fracturing example that we saw they were trying to

assemble or they were actually trying to put 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 are mobile units these are the mobile units. It stores the mobile units you can define the size of the store by specifying it is 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 ok.

If it has does not have the process does not have to wait we can put a buffer it can the before 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 we can have place buffer and buffer, 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 to the number which I like, not which I like which is actually required in the process. So, this is store I am deleting this one.

So, place buffer, what is place buffer this command place buffer place buffer lines up several processing units of the same kind of one after the other. So the pressing processing units are connected and the 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 before is a one thing the big buffer is a buffer is placed between two plant components that certain purpose is. It is temporarily hold parts when the following components failed ok. 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 your dimensions of a buffer with large enough capacity for covering all failures needs to complete decoupling of the plant and the other attributes as well.

So, next is sorter as the name suggests a sorter arranges the mobile units by sorting the criteria we define, we can define the criteria ok. For instance if I having a nut and bolt assembly, they are nuts be manufacture and bolts be manufacturer and on one bolt I am trying to assemble two nuts on it ok. So, the sorter what is a sorter can do it can pick one nut or from the bolt line it can pick one 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 is a kind of a conveyor. So, to draw the straight line with active drying color we select this then this is used, I have just used it extensively in this example, then is angular converter. So, what is angular converter? Angular converter changes the prevailing direction of the mobile objects from lengthwise to crosswise; it is a 90 degree ok, I can just put it here angular converter.

So, you can say enter 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, if you only have this direction this direction this direction. At this turn when we need to have turn 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 it is successor within the flow of measurements like it moves apart 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 ok entry point, entry speed, exit point these things can be controlled like I just showed attributes of this specific object.

Now next is converter, Now what is converter? Converters 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 by lifting mechanism and then convey 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, this 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 air. So, turntable solves 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 it 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 first of all let me fix this oh 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 picking paste. Let me switch off the grid, now it will work. Now let me try to run it is running at the fastest pace, let me try to slow it down and then try to see how the turntable works ok.

It is now moving at some speed, the speed that is defined now processing would happen, but 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 just wrap it like this. Similar to turntable we can have turn plate we can just put one piece on the each direction in turntable it is a single directional, I 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 over there and it we can rotate it ok.

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 automated routing on which the transporter moves the parts for example, to utilize 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 rate then the transporters mobile unit length can be defined in that speed can be defined.

So, the maximum capacity of track is defined by it is length and the lengths on the individual transporters moving on it can also be defined that is the track that is three meters long accepts three 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 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 and 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.

So, flow control is like it does not store any mobile unit, flow control is for instance I have a having a is central o here ok, and o a 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 us control the flow whatever line 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. 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. So, resource x is 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 work place ok. If some worker simulation has to be induced for some work is there that is we have just taken the processing time 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 skill, 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 work place we need to put footpath you can see the put 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 workers, then we need to have exporter as well. So, we can work with the workers as well I will just show you the certain examples here. So, I am just deleting these one delete, delete and delete.

So, some important points say method I have said then card files stack 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 1, track 2 we can name them anything like we like then we have table file table file is a 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 file is 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 computer report. When we run the computer simulation I can publish the report of the simulation as well. If I apply and try to run it is run it for 8 hours day.

So, in report we can publish the complete report, in the complete report we can have just the list of these machines different machines ok. If I just show my comments here the machine is milling, milling 1 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 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 it 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 here showing here. The entity can be the car that we have just saw in the car body simulation model. So, then container 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 is these bottleneck analyzer some bottle neck analyzer like we have just visualized the bottleneck in the charts that in the example that we have just seen here. But what a luck analyzer is also 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 trying to explain you certain simulation ok.

So, these are the some of the tools which are used in this software there 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 are just to design the layout ok. Then important tools 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 said experiment manager. What does experiment manager do? It can simulate a specific process the various you can say box plots, or we can have the simulation and the depth of simulation those things all could 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.