Modeling & Simulation of Discrete Event Systems

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Lecture – 31
Introduction to Simulation of Manufacturing & Material Handling System

Welcome to the lecture on introduction to simulation of manufacturing and material handling systems. So, manufacturing and material handling systems are basically the potential uses for this simulation work because many a times, the simulation is required to access because in mostly in these areas you require a large amount of capital investment to start anything any process and without knowing the effect in detail if you start any process then it is likely that the process will not be effective.

So, this simulation has been an effective tool in the area of manufacturing as well as in material handling system to first of all predict what will be the outcome of any changes or how the system will behave once any changes are suggested. So, we will discuss; what are those aspects why we study the simulation of manufacturing and material handling system what is the goal what are the performance measures which we are interested in to in the area of manufacturing and material handling system.

So, what we know by simulation that it is normally used to design and optimise the manufacturing systems. So, you know manufacturing system mean any system where mean to take the manufacturing as a whole. So, this simulation is applied to manufacturing system then to any other application area. So, basically all the areas are basically getting benefited by this simulation process.

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Now, what is the purpose of this simulation? So, simulation is used as an aid in the design of new production facilities. So, wherever you have to make the new production facility you have to take the help of simulation like you have to make new warehouse you have to have new store you have to have suppose new restaurant. So, all these places that will help you in designing now why designing is required because we know that because of large sense of competitiveness in the market whenever you are offering any service or any you have production facility at the production facility also if you have a better design, it will lead to better productivity, there will be less congestion there will be more and more effective utilisation of the machines, there will be less bottlenecks similarly you go to warehouse now in the cases of warehouse or suppose you have a network from I mean you have a network of many centres and you have to take the goods from one place to other and then go to other places.

Now, where strategically this warehouses should be located now this is basically the simulation helps us in identifying the places where we should have the warehouses because if without the prior knowledge and if you are giving with some of the benefits keeping in mind if you are putting the warehouses maybe in the long run when your requirement changes or your requirement expected to change looking at the broader perspective in that case you may feel that the decision to put the warehouse at that particular place was not good enough.

So, in that case, what we do is we first of all simulate that if you put this warehouses at this place from here the cost of transportation overall will be minimum or the ease by which you can get it or the customer satisfaction which we get that whatever be the parameter based on that it will help you to think about it because in most of the cases when you have a new production facility once the facility is created you cannot change it, I mean changing that facility takes a large amount of resources and time. So, this simulation is used as an aid in the design of new production facilities warehouses work centres all that.

To evaluate suggested improvements to existing systems now there is suppose some system and you are facing certain problems in that system you want to evaluate it suppose you are having a restaurant and you feel that the restaurant is not able to cope the demand of the customer there is large amount of customer who are in the queue and ultimately they are going to different you know restaurants or. So, so in that case what are the suggested improvements like what should be the number of tables and chairs? So, that the waiting time is reduced what will be basically the investment required for that. So, without doing that if you take more and more number of tables and chairs if you put more and more counters and if they are not utilised properly, then the return on the investment will not be proper.

So, it will tell you that if you try to improve any existing system how to evaluate it whether any change is you know suggested, whether it will lead to the improvement or it is not desired for evaluating the impact of capital investment. So, whatever capital investment we are making, how it is going to be utilised how it is going to be worth of worth. So, in k area of investment also this is used in having a test drive before making capital investments now many times without going into the particular practical changes you can have a test drive. So, without doing anything without physically changing the parameters, we can have a test drive and you can access the effect on this system performance measures.

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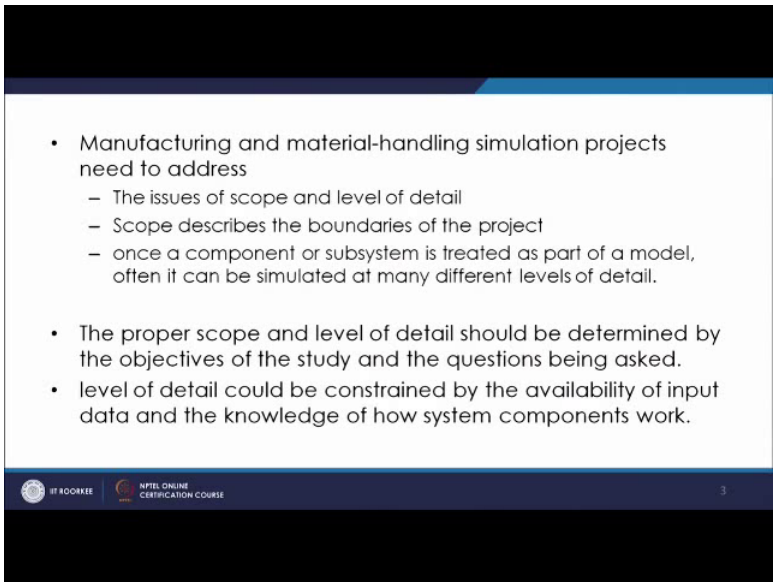

Now, manufacturing and material handling simulation I mean they need to address certain you know issues certain details. So, first of all the thing is that you should discuss the issues of scope and level of detail. So, issues of the scope. So, means you must know in what is the breadth of the; what is in what breadth you can go how much you can expand the study. So, that will tell you that yes you can go to that these and these parameters or. So, what are the parameters which you can find out of it?

And then the level of detail means you can go to the depth what are the level of details. So, one tells about the breadth and one tells about the depth. So, what should be the encompassing area where you can work and you can get the work done and then what should be the level of details; what are the parameters up to what value can get all these things; I mean you should know that what you want to achieve it describes. So, scope is describing the boundaries of the project, it tells you that these are the issues; these are the you know points up to which you have to keep your domain and then once you have done that then you go for the level of details.

What are the parameters you want what level of details you need to up to what depth you want to get the results because if you go for a very large system if your domain is very large you keep the scope very very large; certainly, it requires more and more infrastructural support you need to give more investment and that is basically justifiable when accordingly you have set what level of details you want if the level of details are

very minute if there are quite you know considerable then you can go for it because ultimately you have to justify the investment which you are making you if you go to any complex system very large scope very minute level of details you have to have in that case you have to spend good amount of resources and then accordingly, it should be justified.

Proper scope and level of detail should be determined by the objectives. So, that is what we discussed that we must have the objectives in mind we have to ask the questions our self that what we want what are the performance measures up to what detail we require the knowledge. So, level of detail could be constrained by the availability of input data and knowledge of how system components work now the thing is that once you have the scope once you have set that domain now you want to have the level of detail, but then that may be constrained by the input data how much data you have you need these data you need certain particular data, but for that the input which is required you have not. So, that may be one of the constraint.

Also many a times when we keeps simulation in mind we feel that we can get anything, but the thing is that for getting anything you wish you must know how to get it how your system will work how that simulation will work and how will you model. So, that whatever you want to achieve you can get it. So, the proper objective should be clear you must know the constraints the constraints may be the available of input parameters available of resources as input all these things are constraints and we will have to work within that constraint if you do not work within the constraints, we will not get what we get and even if we try to get some how those results cannot be said to be a credible results we cannot say that these are the results which are trustworthy which are credible. So, that is to be kept in mind whenever we have simulation results.

Now, you have the different models of manufacturing system which has been taken into consideration. So, you have to see that the different characteristics are there different types of systems are there which have different characteristics and these you know these methods are there are many kinds of such models which will which are like this like physical layout then labour equipment.

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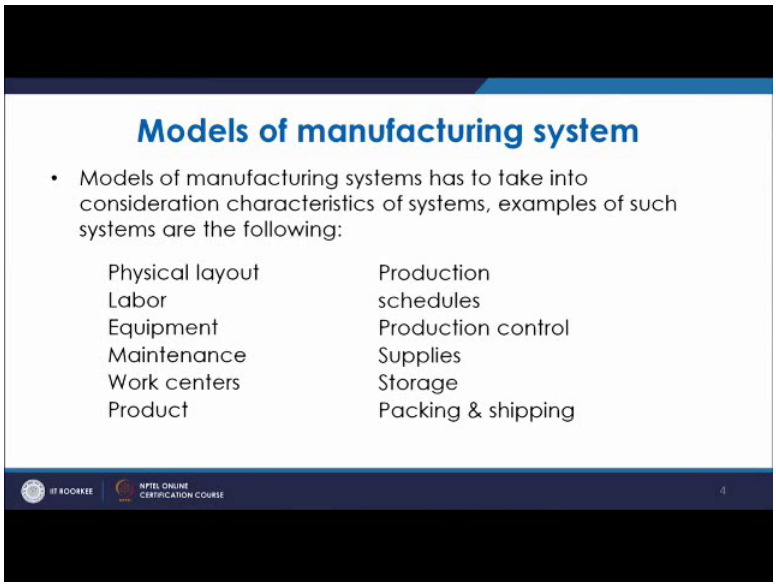

So, we have the different you know models of the manufacturing system like if you go to this physical layout we are interested more to know about you know what should be the proper layout how should the machine be placed what should be the placement of different you know units. So, that it will give you more and more productivity. So, that can be you know modelled through simulation similarly you have the labour. So, if you take the labour into account you have to deal with the labour in most of the manufacturing sectors now in that case what happens that you have to schedule the shift you have to assign the job duties? So, all these things require this simulation help because that will tell you that how to have the shift when somebody should come and somebody should do depending upon the nature of job you can have the simulation and get this job done.

Then comes the equipment now for the equipments you have many things which are taken into account like you have the equipment rates and capacities then the main thing comes in the case of equipment is breakdown. So, you need to have many a times you need to have the maintenance of the breakdown. So, you may have preventive maintenance and. So, you may have to see the times when it fails. So, that can be you know you can guess you can simulate and tell that this is the time when it is likely to have the failure. So, that from simulation you can benefit and you can predict and you can go for preventive maintenance or. So, similarly how much time it will take to repair.

So, this is one of the aspects which is required in case of equipments. So, the time to repair can be modelled using simulation as we have understood that many a times this time to repair are following certain typical distribution curve. So, based on that we can simulate and based on that we can have the persons in the shop floor on the shop floor who can be ready for the repair of the machines then if the time of repair is known if the time of failure is known then in that case what are the resources required that can also be you know one of the prime objective. So, this model of equipment will talk about all that that what is the resource requirement for this repairs to take place.

Then comes the maintenance. So, you have in the maintenance again you have the preventive maintenance schedule is there resources requirement is there. So, these are the basically simulation; I mean used in these areas like in preventive maintenance or in the case of you know time and resource requirement and further what is the time to repair what is the tools and fixtures required all this is can be added by the simulation.

Ah further you have work and centre and hear you have basically processing is there assembly is there. So, these are the elements in the work centre you have the product. So, this product is basically you have product flow or routing what kind of routine will; it will be going through what are the resources required. So, that is needed in the case of product model.

You go to production in that you have to see that how much you require to produce when to order; what should be the inventory level what should be the you know items and quantities which is must have in your stock. So, that there is no shortage. So, this comes under that production schedules then. So, this is the production schedule basically, then you have the production control and in that production control we basically do the assignment of job to the workers like we are also doing the task selection to the work centres. So, this is coming under the production control.

Further we have the supplies then storage in the supplies we talk about ordering receipt and then we have the storage we have the storage for many things like supplies spare parts. So, how to have the storage mechanism how to locate in a proper way these are the aspects which we discuss then we have packing and shipping for that we have the order consolidation then you have many a times you have loading unloading. So, how the loading and unloading can be added by the simulation work? So, these are the different

kinds of models where the manufacturing in the manufacturing system where the simulation is very much advantageous.

Now, what we see that this where the models of manufacturing system then we have at the same time we have the material handling system.

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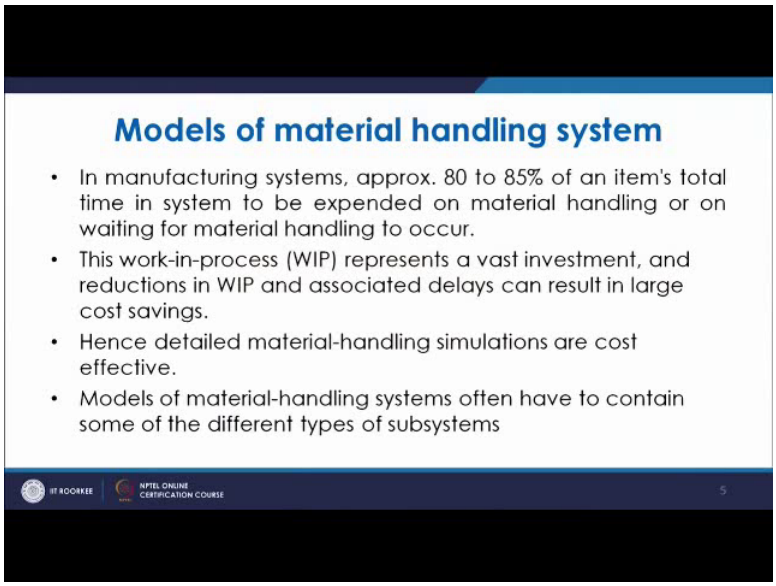

So, material handling system basically, it has been seen that in the manufacturing system about eighty to eighty five percent of total time is going in the area of materials handling because most of the time you have to take the material from one place to other and then in that case you have to see that how effectively you do the handling process. So, if we are optimising in that aspect it is going to give the; you know benefit in terms of good productivity good profit or. So, you know material handling or waiting for the materials handling to occur. So, you have many work in process inventories are there and they are vast investment and if you reduce them it is going to have a great benefit great cost saving.

So, it is very important that you should have a good material handling simulation now the; you know we have modulus of material handling system which contain different types of subsystems. So, what are the different sub systems? So, different subsystems like you have different kinds of material handling systems like we may have conveyors.

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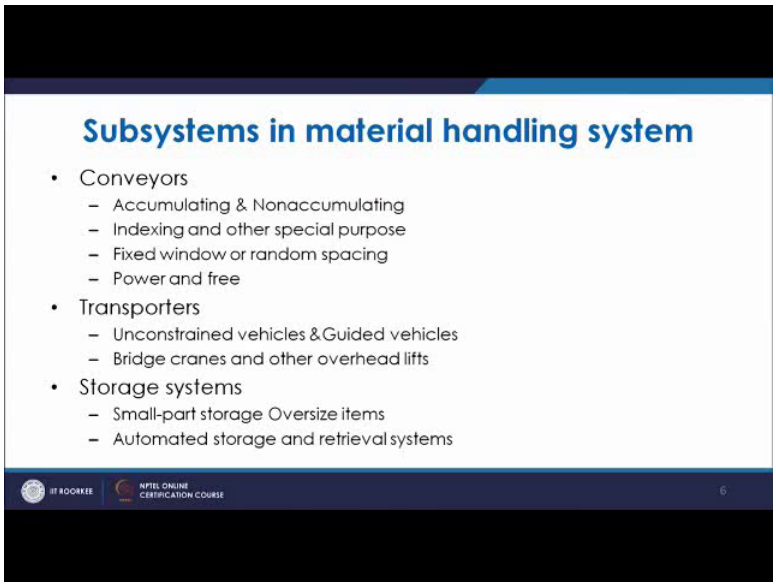

In the conveyors, we have different kinds of conveyors accumulating and non accumulating likes many a times we need the system where the item which is coming from the behind and if it comes. So, if one stops another come and get piles over that and there is no harm in that then that case this is the accumulating type of conveyor and in the non accumulating, we take care that they are not at all coming and closing together because that way there may be damaged to the parts which are basically coming from the back and they are getting collided with the you know part which is ahead.

So, similarly you have indexing like you are having the fixing of the places this way you have indexing type of conveyors you have fixed window or random spacing means in some cases you have the fixed spacing between the 2 items which are above and I mean at the ahead and which is at the back and then sometimes we have the random spacing you have power type of conveyor we have free type of conveyor. So, you have this type of system conveyors and they can be studied by this simulation process.

Similarly, you also use many kinds of transporters in material handling now transporters means you have unconstrained vehicles as well as guided vehicles many a times many of the transporters do not require any specific you know route to go like you have trucks which are coming which are taking the item from one place and giving to other place movement of the rickshaws or trolleys or. So, these are the unconstraint vehicles trucks moving from one place to other.

So, all these or labours moving from one place to other with certain things these are the unconstraint vehicles where you do not have any constraint on that you know entity which is moving where as many a times you have some very very constrained path a guided path and on that the vehicles which move they are known as a guided vehicles. So, you have automated guided vehicles a g vs. So, similarly you have breeze cranes other overhead lifts. So, these are the different kinds of transporters which are used.

Then you have storage system in the storage system we have again small part storage oversize items are there automated storage and retrieval system is there. So, these are the different subsystems in material handling system.

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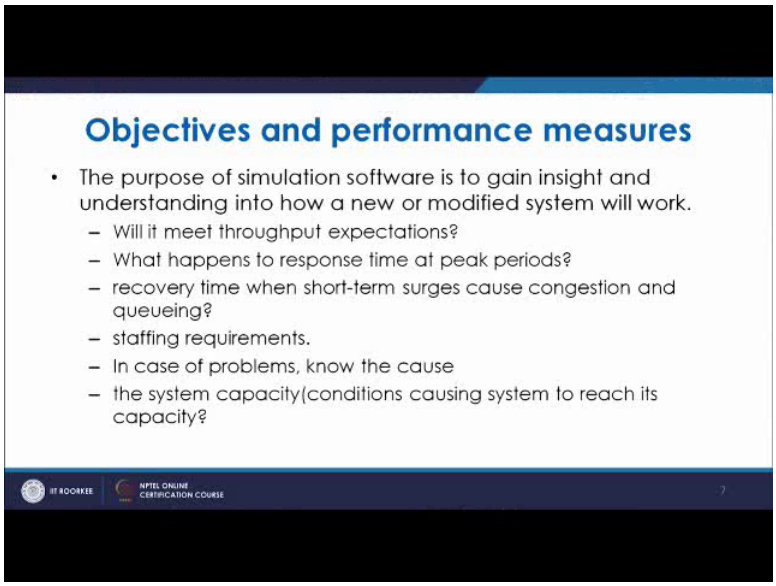

Now, what are the objectives and performance measures of this simulation? So, the purpose of simulation software is to gain insight and understanding into how that new modified system has to work. So, whenever we have a simulation we have we talked about simulation means normally we use the computers we use standard softwares to know about the process and then once we know that then we can see that how can we modify that particular system. So, there are many questions which arise that whatever we are doing whether they are going to meet our expectation whatever you want to achieve whether that is going to benefit us. So, this is coming to us and that is what i mean should be answered whenever we talk about the simulation we are also worried that what

will be the response I mean at peak periods. So, how it will behave when you have the peak periods?

Then there are many instances when you have the; you know short term surges and congestion. So, suppose in queue you are going you will see that all on a sudden the queue had length has become quite high and there has been curves. So, what should be the recovery time? So, that. So, at that time the organisation may think of having some extra servers. So, in that case they can think that if we even if that stays comes may be that if we allow for 10 minutes and if we put three more servers in 10 minutes it will again come to normal. So, that can be studied by simulation. So, before doing that you can have the simulation and then if you come to this conclusion that yes it is going to be benefited then you can go for that particular step staffing requirements how many staffs you want to have what is the number of a staff you should keep. So, that your purpose is solved the staff is utilised is utilising is maximum as well as is not over stressed.

Then many a times you know a large number of problems. So, you should know that what is the cause of this problem. So, it will tell you if you do the simulation then it will tell you that this is the cause of this problem since there was a lack in this communication. So, this problem arose, then system capacity what is the condition which is causing the system to reach its capacity; what are the parameters how much it should be varied. So, that whatever is the system’s capacity, it is completely utilised or it is completely you know coming at that stage.

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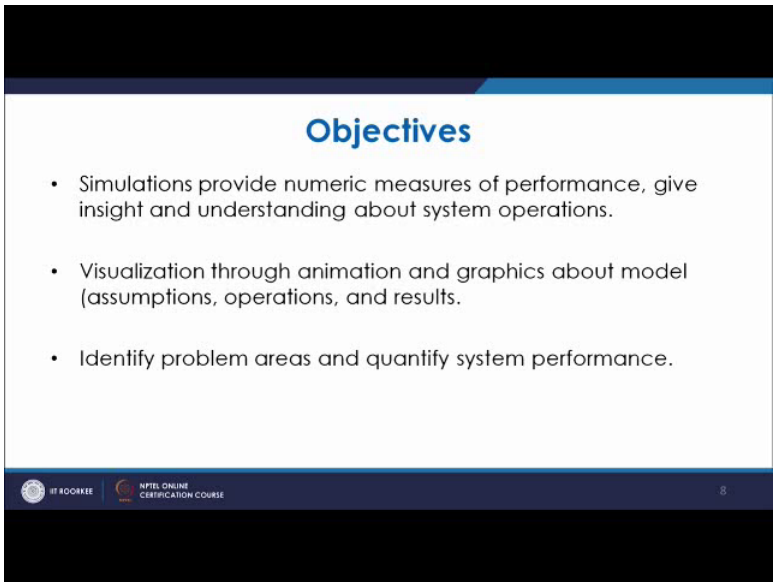

So, these are the objectives normally of a system. So, further; so, objectives come like you have they provide you the numeric measures of performance give insight and understanding about the system operation then the visualisation through animation is a great tool once you see any process happening and you visualise through animation it gives a large amount of insight and feeling about the kind of problems the operations what are the assumptions you have assumed what are how the operation goes on and finally, the results. So, that gives you a large benefit when you see the visualisation through animation.

So, simulation basically whenever we talk about simulation computer simulation and today, since we have very updated softwares and so if you do the simulation you can see good amount of visualisation you can see that how in queueing some person is coming and he is going how queue is getting piled up or how in the manufacturing system how machines are getting used to it once per machine from where it gets free another work comes to it. So, like that. So, that gives a large amount of you know insight about the process and it will help you in identifying the problem areas and then it will also help you in optimising its performance to quantify the system performance and optimise it. So, this is the objective.

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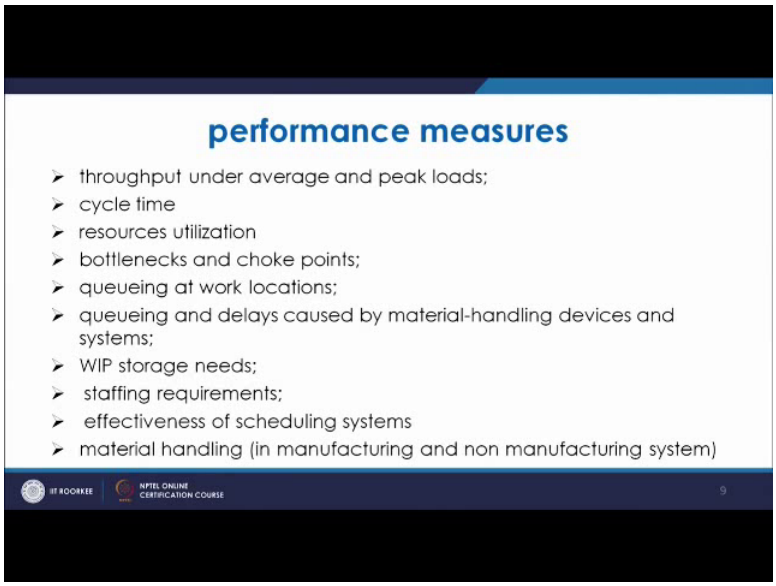

What are the performance measures? So, the performance measures will be something like you have throughput under average and peak loads then you have cycle time that when what should be the cycle time every time what is; how the resources is to be utilised what are the bottlenecks and choke points which are there then what will be the queue developed how it is to analyse them, then its performance measures, then queueing and delays in material handling devices you have working progress storage needs staffing requirements that we have already discussed.

So, we are seeing that we have these are the normal performance measures in the material handling or manufacturing and the even non manufacturing system you have non manufacturing system means you have many places where the material handling takes place there is no manufacturing, but there again the material handling takes place warehouses or doughs or so; so these are the non manufacturing systems. So, there also you get I mean to know large amount of performance measures like queues or delays or. So, so this way these are the different performance measures.

Thank you very much.