Principles of Industrial Engineering
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Lecture-33
Production Planning and Control: Priority Sequencing

Hello, I welcome you all in this presentation related with the subject Principles of Industrial Engineering and we are talking about the topic of the Production Planning and Control. And in this topic, we have talked about the various aspects relative to the PPC, but in this one we will be talking about the priority sequencing. That is about determining the order in which the different jobs which are waiting to be done will be taken up for processing. So, you know the jobs will be done on certain machines or certain departments or the facilities. So, the jobs are to be assigned. So, this assignment of the jobs is basically termed as loading.

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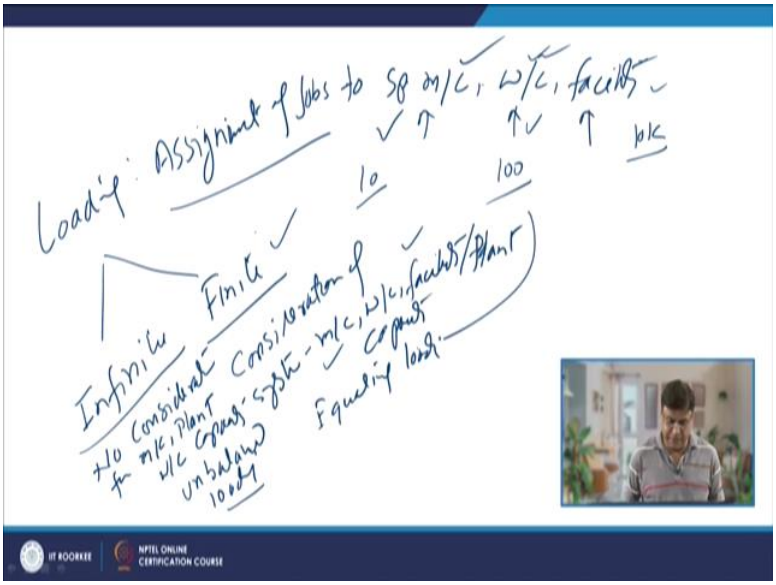

Loading is about the determination or identification of the assignment of jobs to specific machine or to a work center or to a facility. Depending upon the kind of the production system it is, jobs can be assigned to the individual machines or to a whole work center or to the entire facility or the plant. Like 10,000 cars will be made in particular facilities or 100 units of particular type of the jobs are to be made at a particular work center.

Or one machine will be handling 10 units or producing the 10 units of particular type to complete the order for the customer to be supplied on that time. So, there are 2 approaches which are used for loading or assigning the jobs to the machines work centers or to the facilities. These 2 approaches are like infinite loading or finite loading. In case of the finite

loading, the capacity of the machine work center or facility is kept in mind while assigning the particular job or the jobs to be done at that machine work center or facility.

So, here there is consideration of system, that is about machine, work center or the facility or the plant, plant capacity, consideration of the of these items where the job is to be done. But in this case there is no provision for accommodating the abnormal situation if it is coming up. While in case of the in finite loading, the system capacity like the machine capacity, work center capacity or the plant capacity is not kept in mind while assigning the jobs to be done at that facility or in that particular machine or the work center.

So, no consideration for the machine or the plant or the work center capacity. So, if you see, there can be significant unbalanced loading and in case of the finite loading where capacity of the system is kept in mind, the efforts are made for equalizing the load among the different facilities machines or the plants where the job is to be done.

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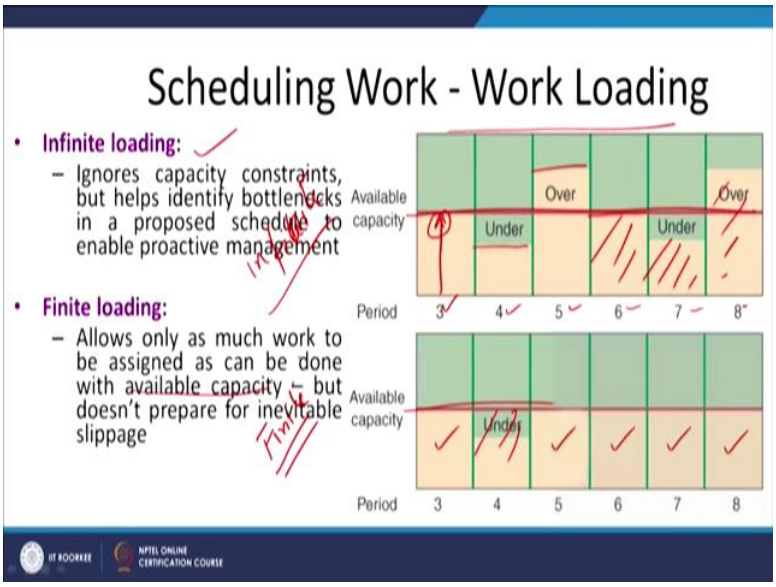

So, this is what we will see here, like the loading of the jobs, the capacity available say is this much, so the different systems are assigned like say 3, these are the like facilities or the machines or the plants we can say as per the case 3, 4, 5, 6, 7, 8 and they are given or assigned with the different jobs.

So, say machine 3, the job is corresponding to itself, the facility 3 is loaded as per the as per its capacity, while the facility 4 is under loaded, facility 5 is overloaded, the facility 6 is as per its capacity, under loading is there for the seventh and overloading is for the eighth. On the other hand, so this is the case of the infinite loading. And the second case where the

system capacity is identified for the different facilities and the load assigned according to its capacity.

So, in very few cases, there may be a situation of the under loading or slightly overloading. So, this will be leading to the more equalized load distribution, this is the case when the finite loading approach is used. So, here the infinite loading ignores the capacity constraints, while finite loading allows only as much work to be assigned as can be done as per the available capacity. So, that was about the loading.

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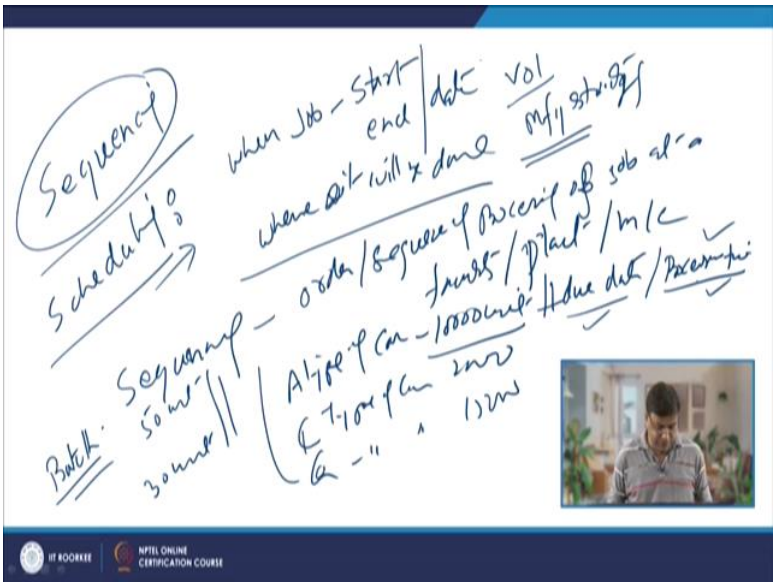

So, now coming to the sequencing which is a part of the scheduling. As we know that in scheduling we identify that when the job will be done, means the start and end dates are identified and where it will be done. So, this is a part of the scheduling, but in the schedules which jobs will be taken up first, which will job will be taken up second that is identified under the sequencing.

So, in case of the sequencing, sequencing is basically determining the order or the sequence of processing of jobs at a facility, plant or machine. So, it can be for any scale of production, like there is an order for A type of the cars of 10,000 units to be manufactured. So, obviously the cars will be manufactured using the mass production approach where the assembly lines are used and there is another order for the C type of the cars of 2000 units, then G type of the cars have 15,000 units.

So, each order will be coming up with the certain due date, when it is done due and how much time it will take to process or to manufacture, so that is the processing time. These are

the 2 important consideration, when the job is to be completed and how much time it will take to complete that job that is the processing time. So, based on the constants for the completion of the order or the kind of the due date by which it is to be done, we need to prioritize or establish this sequel, a suitable sequence of the processing for the different jobs.

So, whether it is the mass production or the job shops like say in case of the batch production, the batch of particular type whether it is let us say in case of the process layout, the batch of the 50 units is to be produced or batch of 20 or 30 units is to be produced of the different products. So, what will be the sequence or the order in which the particular job will be taken up for the completion, that will be based on the kind of processing time, due date and lot many other factors.

So, irrespective of the volume to be produced using the kind of the manufacturing strategy, irrespective of the manufacturing strategy being used, sequencing can be useful in all the cases, considering the processing time and the due date.

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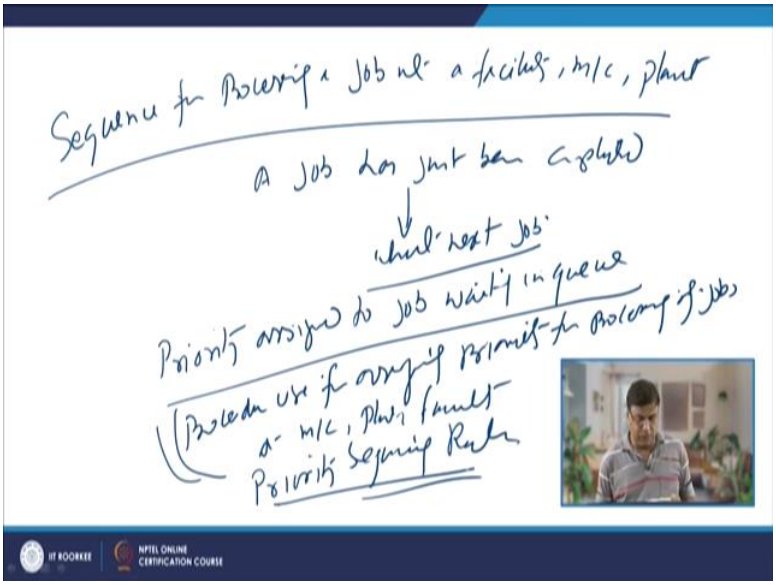

Apart from that, what are the different factors which are considered in establishing the suitable sequence for processing of jobs at a facility or on a particular machine or in a plant as a whole. So, if we see, let us say there is a facility or machine or plant in which a job has just been completed, then now which jobs will be taken up, means what next job will be taken up, that will be based on certain kind of the priority or the sequence.

So, determination of the next job will be based on the kind of the priority assigned to the jobs waiting in queue. And so the procedure which is used, procedure used for assigning priority

for processing of jobs, this process procedure for assigning the priority for processing of a job at a particular machine or plant or the facility, this procedure is called priority sequencing rule.

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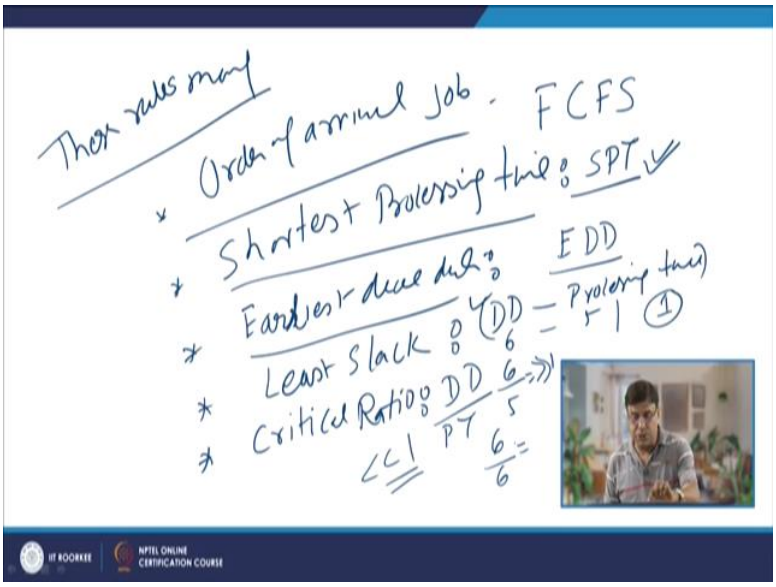

There are various types of the rules which are available for determining the sequence in which the different jobs, which are waiting in queue to be completed at a particular facility. Now, these rules are many, like say in the order of arrival of job, this is typically known as first come the first served. The most or the highest priority is given to the job which arrived in the production facility first.

Then there is shortest processing time, there may be so many jobs which are waiting in queue to be done at a facility, but the job which needs the minimum time for completion that is taken up first accordingly to the second rule, SPT it is commonly known as, shortest processing time. So, highest priority is given to the job which needs the minimum time to process, so that it can be completed, irrespective of when it arrived how when it is due and a lot many other factors.

Like say there is another one, earliest due date, earliest due date like when a particular job is to be completed the job for which the due date is the earliest, that will be given the highest priority. So, the top most priority is given, so this sequencing, the sequencing based on the earliest due date, EDD, in this case highest priority is given to the job which is, whose due date is earliest.

Then there is least slack. According to this like what is the due date from today and the processing time, difference of these 2, like say due date from today or the date on which the consideration for the sequencing is being done, due date from today minus the processing time, how much time it will take to complete. So, if the due date is say 6 days and it needs 5 days to process so, the difference of these 2 will be 1 day.

So, this will have the minimum slack, so this difference is called slack and the job for which the slack is minimum that is given the highest priority in processing. Then, similar to this, there is a critical ratio. Critical ratio also uses both these parameters, those are like it is the ratio of the due date from the, means the time for due date from the today. Like say from today, the job is to be completed, like due date.

From today, the number of days available to be completed, so that the job is done by that particular due date is say 6 again in this case and time for processing is, processing time is 5 days. So, the ratio of these 2 will be like say 6 by 1. So, this ratio, this ratio is greater than 1. When this ratio is 1 say like 6 by 6, which means the job will be completed by the due date, if it is started and if the due date and the processing time ratio is less than 1 means the job will be delayed by certain time. So, the suitable criteria is applied as per the objectives of the plant and that is why we need to see what is important.

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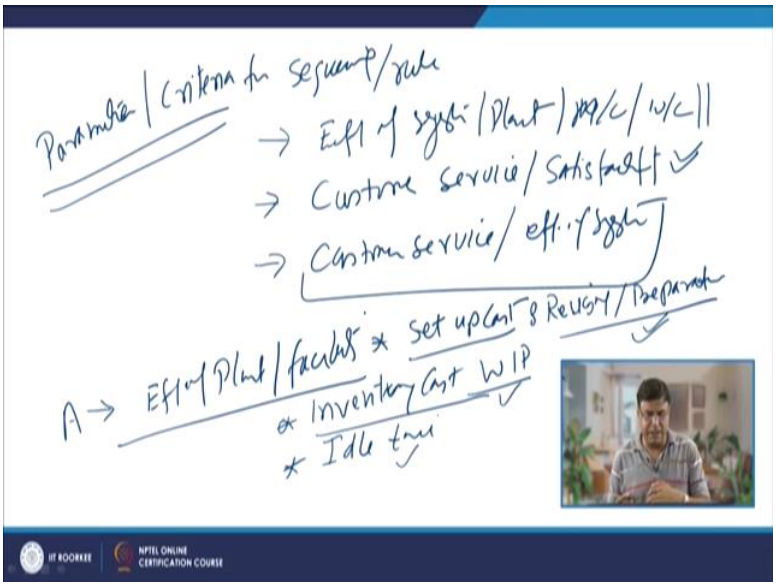

Since there are various other rules also, there is a longest processing time is the another rule. In that case the job which needs maximum time is taken first and then likewise the jobs which need somewhat lesser time will be taken up later. Now, so since there are many rules

for determining the sequence in which the different jobs can be taken up. So, what should be the parameter or criteria for sequencing, means on what basis we will decide like this rule for sequencing should be used.

So, obviously the sequencing or the use of suitable rule will be based on, use of suitable rule will be based on the things that matter for the plant, matter for the company. So, there are few parameters which indicate the efficiency of the system or of the plant or of the machine or work center. There are a few parameters which are used as the indicator of the customer service or customer satisfaction.

So, basically the customer service or customer satisfaction will have parameters like how much late job is late, what is the average lateness, what is the deviation or standard deviation of the lateness with respect to the time from the due date. And there are few parameters which indicate the combined effect, combined parameters indicate the combined performance with regard to the customer service as well as the efficiency of the system.

So, there are a few parameters which indicate effectiveness of both, few which indicate primarily the customer service and the few parameters which indicate the efficiency of the system or of the plant. So, the parameters which are used or which indicate the A type of parameters, indicating the efficiency of plant or of the facility.

These parameters are in form of like say, setup cost, how much cost will be occurring if a particular sequence of processing of the job is done. So, we know that for processing the different jobs at a particular facility, it is required that the setup is changed, or preparations are made in different ways, so that the next job can be taken up. So, basically the cost of revising the setup or doing the required preparation, so that the next job can be taken up.

Higher the setup cost, obviously the lower will be the efficiency. So, the suitable sequencing is done in such a way that the setup cost is reduced. Then the other factor is inventory cost. Indirectly, this is termed as work in process inventory. If so, many jobs are waiting in the system, so much of the material has been held up at the different stations for completion for a longer time, this will be determining the…

This will be affecting the inventory cost or work in process inventory cost, unnecessary holding up of the material and the capital in the system. And then idle time, the for how long time the workers are the machines are idle. So, these are the 3 factors. So, the way by which we are assigning the jobs to the different machines in a particular order that can affect the

work in process, inventory, idle time of the machines and workers and the cost of changing the setup for newer jobs. So, these are the fact, all these can be affected significantly by the way by which the jobs are being, sequencing of the different jobs is being done for processing at a particular facility.

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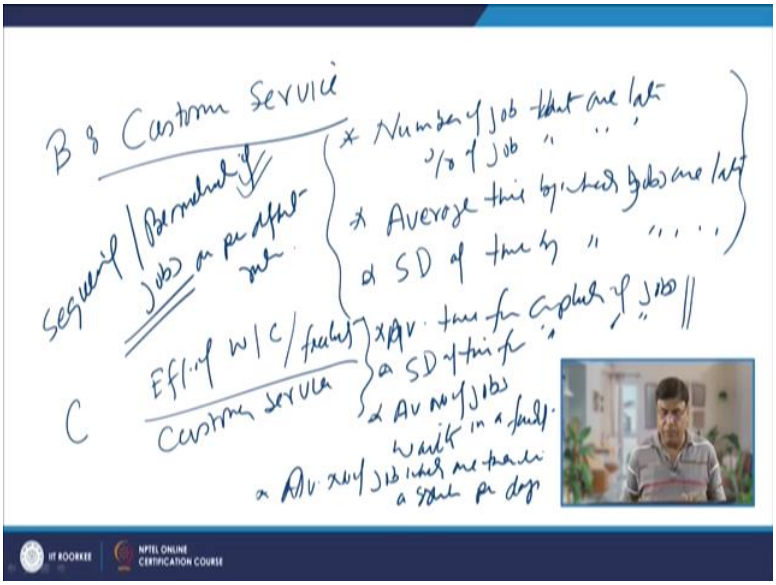

Another category of the factors are basically related with the customer service. So, among the customer service, like customer service can also be affected with the way by which the sequencing of the different jobs is being done as per the particular rule for assigning the priority and it may be in form of like say number of jobs that are late, this is one. Or indirectly we can also determine the percentage of jobs which are late, then average time by which jobs are late.

On an average the jobs are late by 20 days or on an average they are late by just 2 days. So, the jobs are late, then the standard deviation of the time by which the jobs are late. So, all these indicate that how promptly and what will be the percentage or the time for which a customer will be getting its job done on time. So, these 3 factors indicate the customer service related aspects and the way by which customer service will be affected due to the prioritization being given to the different jobs which are waiting at a particular facility using the different rules.

And the third category of those factors which indicate the combined effectiveness with regard to the efficiency of the work center or the facility as well as the customer service aspect both, the few factors are indicative of both which are affected by the prioritization of the jobs using

the different rules. So, that is about the average time for completion of jobs, it is low or high and that can change significantly with the change of the sequencing rule.

Then standard deviation of time for completion of the jobs in the system and the average number of jobs waiting in a facility to be done. So, the average number of the jobs which are waiting in a facility to be done, average time for completion of the jobs, these are the parameters which indicate, there is one more that like the average number of jobs which are there in a system per day for processing.

So, it will indicate both the kind of the inventory that will exist, the kind of condition which will be there in the plant. So, these are the various factors which are affecting the work plant efficiency, customer service or the combined combination of both. And the way by which these factors are affected due to the sequencing or prioritization of the jobs, which are waiting to be done as per the different rules.

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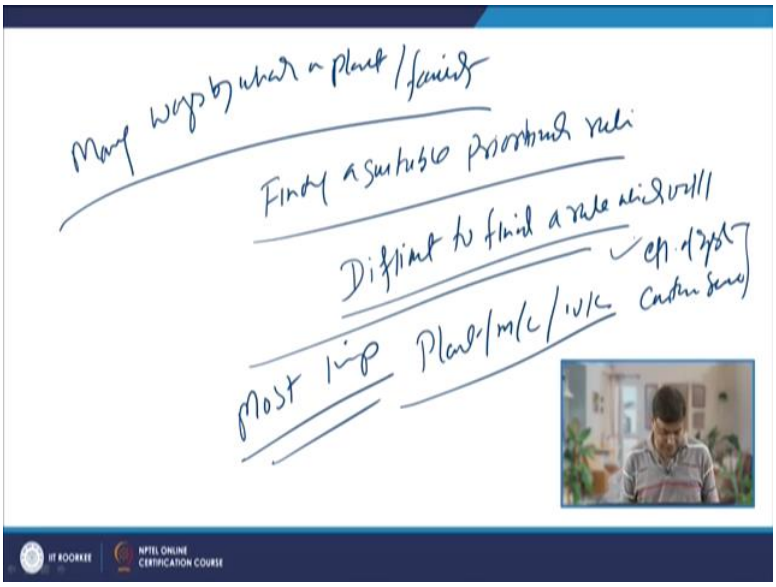

So, you know, everybody will be thinking of let us use a particular rule which will satisfy all these parameters. We have seen there are many ways by which a plant or a facility can be affected with regard to the efficiency, with regard to the customer service, so if we use a particular sequencing rule. So, finding a suitable prioritization rule, like whether it is first come first serve or the least slack or the critical ratio or the longest processing time, which rule is to be used for the prioritization so that we get the maximum, so we get benefit on all counts.

So, this is really extremely difficult to find a rule which will give all types of the benefits as has been listed earlier with regard to the plant efficiency or the customer satisfaction. But if it is not, it is difficult but not impossible, which means we can keep on determining the various sequences, so that we can find it find at least the optimum rule which will offer the benefits with regard to, reasonable benefits with regard to the all factors.

Or we determine what is most important for the plant or for the machine or for the work center. What is most important thing, if that is established and identified, it is the efficiency of the system or it is the customer service that is most important. Or a balance is to be strike, accordingly the suitable rule. If this is established with the clarity, then the choice of the suitable sequencing rule becomes very easy.

So, now I will summarize this presentation, in this presentation I have talked about the 2 approaches of loading the different facilities and the machines and I have also talked about the way by which the prioritization of the job is done, so that the suitable sequence for processing of the different jobs which are waiting in queue can be established. Thank you for your attention.