Management of Inventory Systems
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Lecture - 49
Theory of Constraints and Materials Management (Contd.)

During the last 3 lecture sessions we have been discussing various aspects of Theory of Constraints or the TOC approach. So, by this time you have come to know, what are the main issues involved in theory of constraints, and if you want to implement TOC approach in your production systems at your plant, means what actually you are supposed to do?

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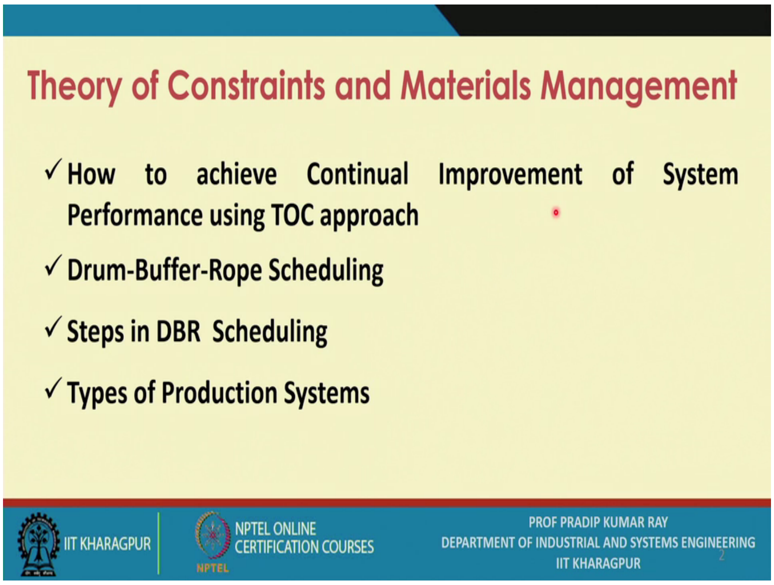

Now, in the last lecture sessions, we have also mentioned that, what are the specific TOC principles you have to follow. So, all together you can identify some 10 the 10 specific principles and by this time you are aware of you are familiar with all these principles. Now, during this lecture sessions the 4 specific issues related to say the development or implementation of TOC approach in a manufacturing system. We are going to discuss.

So, let me first tell you that what are these specifications will be discussing at this point in time? The first one is how to achieve continual improvement of system performance using TOC approach? I have already mentioned that, you know it is a continual say the improvement approach and what you try to achieve? You try to achieve the best possible system performance. That means, you are not satisfied with the sub systems performance.

So, you while you go for improving the system performance, you need to consider definitely the sub system performance. And, then considering the interactions or interdependency between the sub system say the performance, what you need to do? You must have the best possible optimized system performance.

So, what is the procedure you employee? If, you have the TOC, TOC approach so, this what are the steps to be followed so, this aspect will be discussing first. Next, we will be referring to the so, called drum buffer rope scheduling. As, I have already pointed out that that the TOC approach is referred to as a scheduling approach. And, particularly one say particular type of scheduling systems which is referred to as the drum buffer rope scheduling. So, you should be aware of so, we will discuss in detail what is this scheduling approach and then what are the steps involved in the DBR scheduling?

So, you should know what are the steps? How to define them? What is it is implication and by using this DBR scheduling, what extent you get say condition, where the smooth flow of materials within a production system is guaranteed. And, towards the end we will be referring to different types of production systems. And, as per you know when you apply try to apply the TOC logic or TOC approach, you need to define or you need to say you know the classify, the production systems in a particular way.

So, how and based on these classification approach, what are the types of production systems you come across? And, what is required, what is needed is for each type of production system? How do you say the implement? How do you develop say the TOC approach? So, all these the 4 issues, we are going to discuss now.

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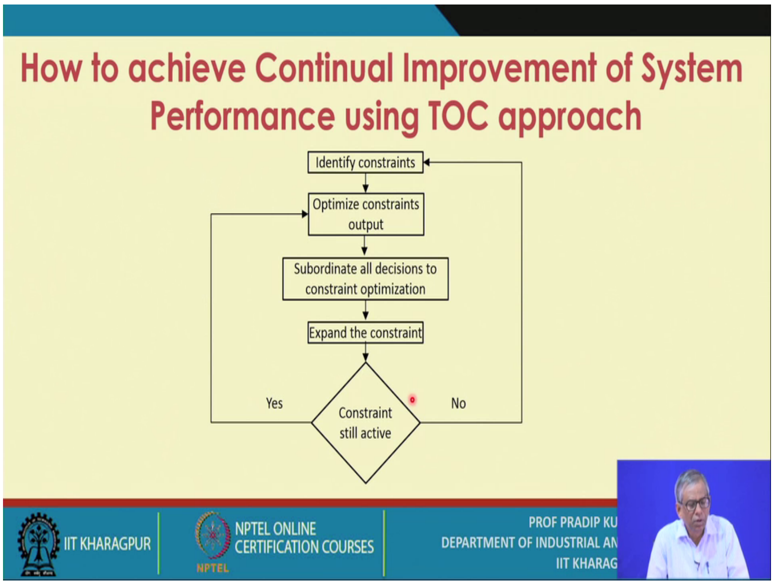

Now, the first issue is how to achieve continual improvement of system performance using TOC approach. So, here is you know it is explained with a flow chart in closed loop. So, there are several steps and you have to the follow the steps and in a systematic manner. And, you have to define say all sorts of say the variables all sorts of parameters, all sorts of outputs, at each of these the states involved.

So, the first one which you find, that is identification of the constraints so, that is your first step. So, the starting point is you know say; obviously, you start with a internal constraints ok. And many a time the internal constraints are referred to as bottlenecks. So, it creates bottlenecks. So, you start with identifying constraints and the constraints are related to the resources and; obviously, based on these constraints you need to identify you know the capacity constraint resources ok.

So, so, this is the first step and what sort of say the approach you follow for identification of the constraints. So, this is an important issue. And, you know that you are you are familiar with several examples of constraints and so, these constraints are to be identified and entire for the for the plant or for the production system, which you which is under consideration where TOC is to be applied; that means, what are the resources and the where the these constraints are really a problem and what are the bottleneck resources?.

Now, what do you try to do the next step is you need to optimize constraints output. That means, supposing you know at a particular resource that resource is considered to be a bottleneck resource. And, it is not only a bottleneck it is also a CCR ok. So, so, the capacity constraint the resource and what you try to do? That means, the first step should be how to improve the performance of say the constraint resource or the bottleneck resource CCR.

So, that is your starting point at any point in time there could be a number of such constraint resources. So, out of all these constraint resource which one is the most severe, which one is the most critical. So, and then what sort of say the measures, you need to take to improve the performance of this constraint resource. So, that is your first step and it is expected, if you follow the steps as we have discussed in the previous lecture sessions, if you follow those steps in a systematic manner, it is expected that you can optimize the constraints output.

So, output in the sense that the output is nothing, but the throughput ok. It is not that you just you produce for activation or for utilization say; that means, whenever you say that I want to have the best possible or say the maximum utilization of a particular resource and in this case say it is basically the CCR. So, what you try to do? That means, you focus on utilizations not only the activation; that means, this output will have a direct relationship with the throughput. So, you have already mentioned what is a throughput. So, all these details you should look into. So, it is expected that if you follow the steps meticulously systematically, you will be achieving this conditions.

Next, what you do; that means, this is say the one particular critical resource, you consider and you and as per the requirements of this critical resource, you try to produce, you try to produce say the related say the say the inputs or the or the outputs of other resources, and make sure that that this subordinate all decisions to constraint optimization. That means, as we have pointed out like say a bottleneck resource is essentially it will it will guide it will guide the other resources, non-bottleneck resources, in terms of actually what is the how much it is our non-bottleneck resources are supposed to produce as per the requirements of the bottleneck resources.

So, these principles you have to follow and this is referred to as subordinating all decisions to constant optimization and then you expand the constraint ok. So, so, as far as the possible you need to expand the constraints, then you just check whether a particular constraint is still active or not. That means, if it is no; that means; obviously, now one problem related to one constraint is over; obviously, in the next period of time you will have another constraint. And you follow the same steps so; that that particular the next constraint is seizes to exists is it ok. And, if suppose the constraint is still active, then you need to further optimize the constraints output.

That means, you are proceeding in right direction, but you have not reached a maximum level of performance is it ok. So, this is this is the flow chart and with this approach it is expected, that you will go for continual improvement of the system performance ok. So; that means, you can what you can do you can set different the targets at different points in time and you check whether you are achieving those targets or those goals or not ok. So, so, this is the general approach. So, now, in a given situation what you try to do? That means, this generic approach you have to follow and you have to apply this generic approach in a particular case is it ok.

So, what are those specific constraints? How many constraints you have been dealing with for the last couple of years? So, that sort of information we will have and there must be specificity in your whole approach.

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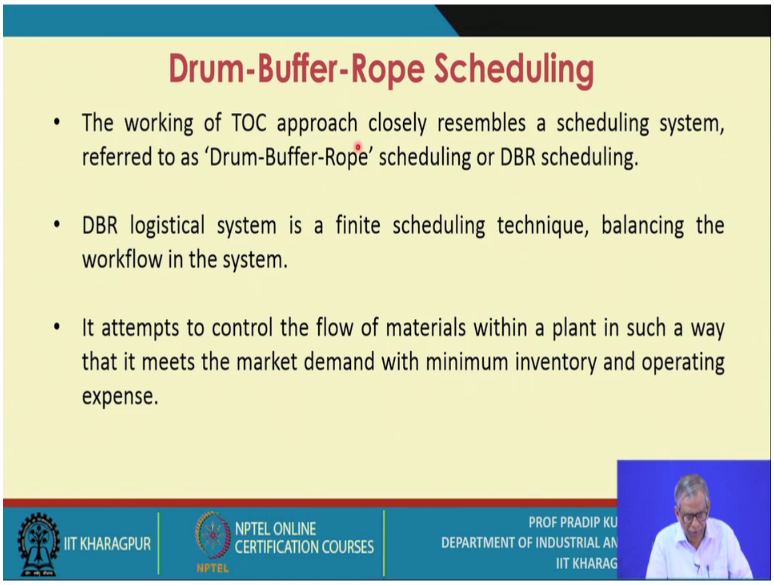

So, this is the first step you do. Now as so, more or less now by this time you have come to know, that what is TOC approach? And, how do you say get the optimized system performances applying the TOC approach?

And, it is a continual improvement philosophy and mainly applicable for repetitive manufacturing. And what is most important is that that you know the flow of materials within the production systems or the manufacturing system. The flow should be very very smooth and you must have sufficient control on this flow. That means, even if suppose this flow of materials is disturbed, you must know that what are the possible reasons? And, and you must be very very responsive or say and as quickly as possible the corrective measures you must be able to take.

. So, essentially it talks about scheduling. And, and this scheduling; that means, the TOC based; TOC based scheduling many a time this is referred to as the Drum-Buffer-Rope Scheduling ok. So, please note down this the name Drum-Buffer-Rope Scheduling or in short it is referred to as DBR scheduling ok. So, the working of TOC approach, you have already know that, what is the that flow chart? So, if you look at this flowchart, which you have already explained, you will come to know the working of TOC approach in specific terms. So, the working of TOC approach closely resembles a scheduling system. This point we have been already say the mentioning referred to as Drum-Buffer-Rope scheduling or DBR scheduling.

Now, what is a DBR scheduling? Now, it is essentially it is referred to as a logistical system ok. Because, it is a logistical systems and you know overall what we will trying to do in the next lecture sessions of sequent lecture sessions, we will be referring to the logistics and supply chain management. So, so, you are just getting into so, the logistical systems. So, this logical system is a finite scheduling technique, balancing the workflow in the system ok. So, this point we have been telling you all the time.

It attempts to control the flow of materials within a plant in such a way that it meets the market demand with minimum inventory and operating expense. So, as per the TOC the logic you know what is inventory and you also know, what is the operating expense?

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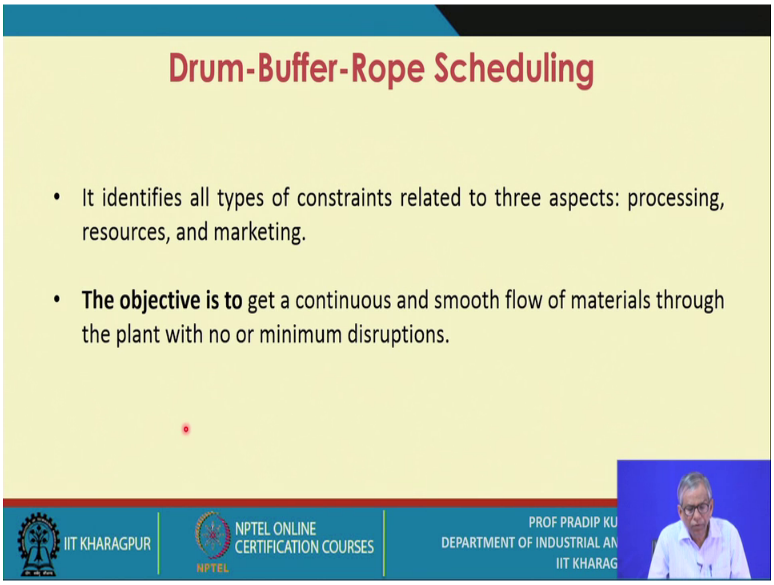

It identifies all types of constraints related to the 3 aspects processing, resources, and marketing so, the marketing actually the talks about the demand generation ok. And, that is why what are the constraints related to marketing you must know, then you have been using several kinds of resources, we have already defined what is a resource? So, related to a particular resource, what sort of the constraints right now you are facing you should be aware of you have already come to know, the few examples of this constraints we have already mentioned.

And, similarly while you go for processing the item or processing a particular say the product or the component at a particular resource. What sort of constraints you may be facing. So, this list of constraints you must have with you so; that means, first the step in developing such a such a scheduling approach is to get the data, related to the types of constraints at the processing stage, at the resource stage, at the marketing stage.

The objective is to get a continuous and smooth flow of materials through the plant with no or minimum disruptions. And, even if there is a disruption just make a note there could be a suddenly there could be certain you know unforeseen developments. And, because of this there could be disturbances or and now if there is some distortions, in the flow now as quickly as possible you must be able to say the identify the causes. And, you must be able to remove those causes. So, that you get back your original system and say the previous flow rate.

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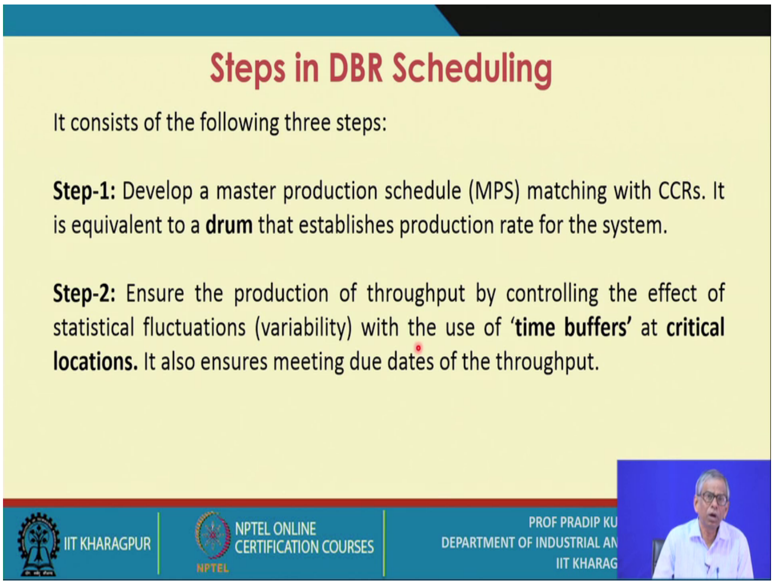

Now, when you talk about DBR scheduling so, it is also a systematic approach ok. So, let me the tell you what are the steps involved? Now, essentially there are 3 inter related steps; Step 1, Step 2, and Step 3. Now, let me tell you what are what actually you are supposed to do in each of this the steps. And, the first step or the step 1, you need to develop a master production schedule or the MPS matching with you know capacity constraint resource or the CCRs ok.

Now, we have already defined: what are the CCRs. And, we have also mentioned a point that the entire TOC approach the starts with the identification of CCRs. So, this is your first exercise. So, assuming that the CCRs are identified; now what you try to do? You develop the master production schedule in such a way that that MPS matches with the CCRs. So, this is very very important; that means your base is CCR and based on the CCR the requirements you go for developing the master production schedule.

When, we discussed the MRP we mentioned about the MPS and that is one of the inputs of say of MRP system, you are already aware of and what is my suggestion is that you refer to a typical say the master production schedule format. And, this is universally followed. So, that is the first step you have to do; that means, you have to develop a master production schedule. As you do for MRP system. It is equivalent to a drum that establishes production rate for the system; that means, when you create the MPS. Definitely you will be aware, you will be aware of that what is against a particular item, what is it is production rate? And, it is equivalent to of creating a drum ok. So, the drum is indicative of the production rate for the system it is at which rate you should you know you should rotate the drum.

So, that is the basic idea. So, that is why it is referred to as the drum. Now, once this the drum is created; that means, master production schedule, matching with the requirements of CCR, then you go to step 2. In the step 2 what do you do you ensure the production of throughput ok. As a throughput by controlling the effect of statistical fluctuations or the variability with the use of time buffers at critical locations; that means, when you know what will come to know; that means, you need to represent your production system in a particular manner. So, very soon you will come to know may be in the next lecture sessions, I will discuss the types of production systems. And, while I discuss this the types production systems you will come to know that how a particular production system is represented?

So, once is representation is made you will come to know what are the critical locations, what are the critical locations, where you know you need to control the flow? Now, it has got 2 dimensions; one is the quantity definitely and the second one is the timing, at which point in time during which period of time, you need to decide the production rate is it ok. And over the time period say production rate may vary at a particular location. So, sometimes at a particular location the no units are required. So, you wait you wait for the next time period is it ok. So, sometimes this is referred to as a time buffer ok. So, that is very important term and the time buffer this particular term already we have used while we explain the MRP system.

Now, two important aspects you need to consider in the at this step; the first one is you need to produce only the throughput ok. So, so, throughput production must be assured and the second one is you know you need to control the statistical fluctuations or variability. Now, how do you control it? Obviously, you start using the time buffers ok. So, you wait or immediately you know in a particular time period you, you improve or you need to have more number of units subsequently or to be these units to be sent subsequently to the next stage.

So, by with the use of ‘time buffers’ that critical locations so, you take care of or you control the effect of variability. It also ensures meeting due dates of the throughput. So, throughput is essentially the quantity which you can sell that is very important in fact, but at what point in time you are you are selling it that is also very very important. Are you in a position to meet the due date, because so, the due date I mean meeting the due date is one of the say the important say in the criteria in scheduling is it ok.

So, many a time you know there you apply the priority rules for the jobs of scheduling and in this case particularly one priority rule ok. You must you must able to satisfy or you must use and that priority rule is actually meeting the due dates or expected due dates of the throughput.

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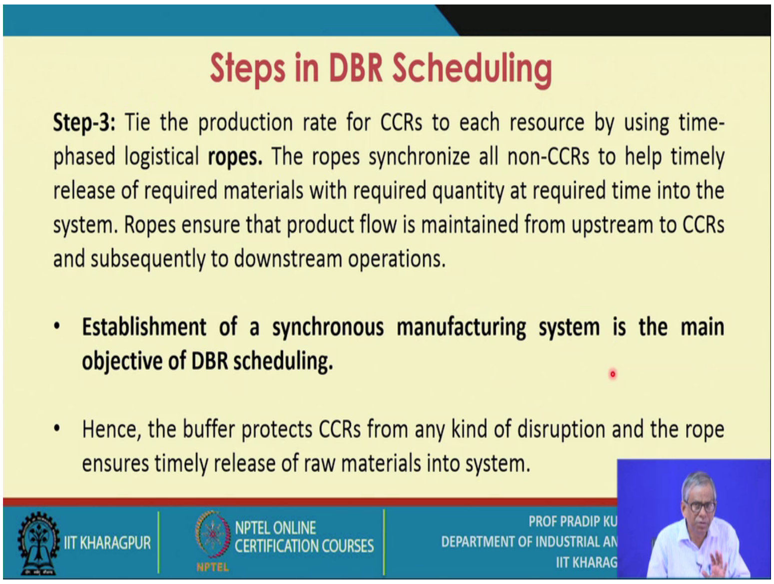

Once this is done; that means, at the first at the first step the drum, at the second step the creating the time say the buffers or the critical locations of the of the production system. And next you move to the step 3; that means, when you reach step 3? The variability is under control, you can use the time buffers to control the flow and you are in a position to produce the throughput only. And, you are also in a position to meet the due dates is it ok.

So; that means what do you can say? That once, you are you are successful in implementing step 1 and step 2; that means, the entire production system is more or less under your control. Then you move to step 3, tie the production rate for the CCRs to each resource by using time phased logistical ropes; that means, with the rope what you try to do? You try to you know the control the rotation of say the drum. So, this so, this is referred to as a the rope and the ropes synchronize all non-CCRs to help timely release of required materials with required quantity at required time into the system.

Now, you are definitely looking at the CCR, but then CCRs are the dependent, working of the CCRs are dependent on working of the non CCRs ok. And, similarly you know the bottleneck resource performance is closely related to what extent you get at what point in time, on which quantity? You know you are you are fed from other non-bottleneck resources is it ok. So; obviously, there will be time buffers and there will be you know the controlling of the quantity, as an inputs as well as from the output from say your say CCRs or the bottleneck the CCRs.

So, this is essentially this is essentially it is referred to as a fine tuning and it is like the controlling through ropes. So, as we have already pointed out that with application of TOC approach, you need to essentially, you need to create a synchronous manufacturing system. So, these ropes are synchronizing all non-CCRs to help timely release of required materials ok, with required quantity at required time into the system. At the required time means so, due dates that pre specified ropes ensure that the product flow is maintained from upstream to CCRs and subsequently to downstream operations. That means, behind the CCRs, you have the upstream processes and beyond the CCRs you may have the downstream processes.

So, what is the role of a rope? That means, rope ensures that product flow is maintained proper product flow is maintained and so, that the system performance is guaranteed. Now so, what we conclude that with DBR scheduling establishment of a synchronous manufacturing system, is the main objective of DBR scheduling. Hence the buffer protects CCRs from any kind of disruptions and the rope ensures timely release of raw materials into the systems.

So, I repeat the buffer protects CCRs from any kind of disruptions ok. It is it is like it is like safety stock, it gives you protection ok. Sometimes, you need more quantity sometimes you need less quantity. So, accordingly you create the buffer and quantity definitely one aspect and the second most important aspect is timing. Otherwise the condition of for say the smooth flow of materials this condition you cannot maintain. And, what is important is the rope ensures timely release of raw materials into the system, is it ok? So, this is also very very important both quantity and timing.

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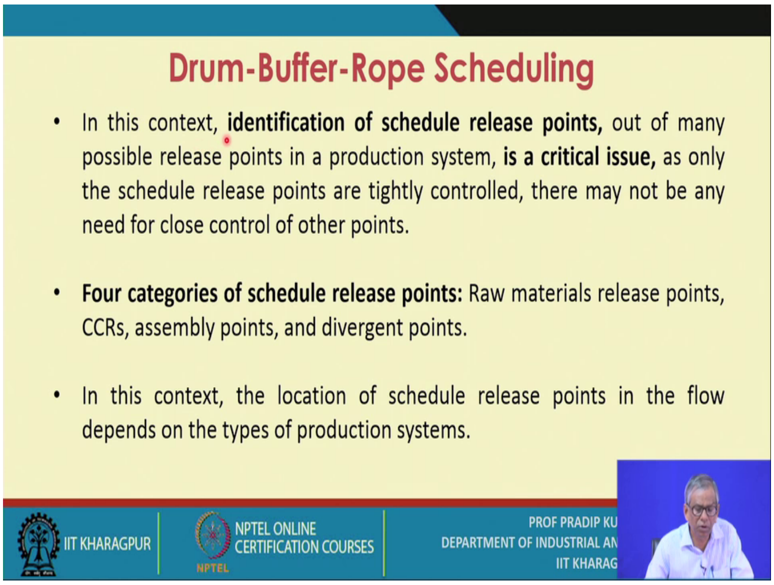

Now, in this context identification of schedule release points out of many possible release points in production system is a critical issue. So, you just make a note of this particular say that term called schedule release points. So, when you represent a particular production system with diagram. And, the where the inter relationship between different stage, different stages are highlighted.

Now, the first thing you need to do for application of DBR scheduling you need to identify the schedule release points. As only the schedule release points are tightly controlled ok. There may not be any need for close control of other points. Definitely there may be n number of such you know the release points, but out of this the release points, which one are which ones are considered you know the schedule release points or the critical you know the release points you need to identify them only.

Four categories of scheduling release points at this point in time you must know that how do you categorize this release points. First one is the raw material release points this is very very critical in fact, ok. Then the CCRs all the CCRs you need to identify and all these CCRs are critical release points, then the assembly point’s ok. Because assembly points are very critically in the sense that you must ensure the supply of say you know required quantity of materials, as well as for the timely release of such materials to the assembly points is it and similarly the divergent points ok.

So, these are the 4 the categories of schedule release points raw materials release points CCRs assembly points and divergent points. In this context the location of schedule release points in the flow depends on the types of production systems.

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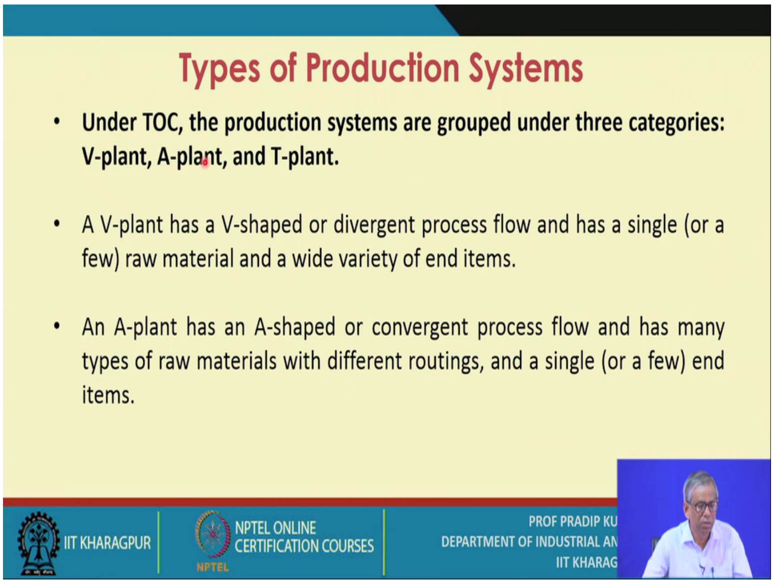

So, under TOC the production systems are grouped under 3 categories. So, one is the V-plant, the second one is the A-plant and the third one is the T-plant. So, as we have been pointing out that, that entire production system for which you are going to implement TOC. So, this the production system as to be represented in a particular manner. So, the 3 ways you can represent a particular say production systems and these and accordingly 3 types of production systems or the plant, we have the first one is referred to as a V- plant, the second one is referred to as a A-plant, and the third one is referred to as a T-plant.

Now, before I conclude this session so, let me define what is a V-plant? What is let me explain what is a V-plant? What is an A-plant? And, what is a T-plant? A V-plant has a V-shaped or divergent process flow ok. It is a divergent process flow. And has a single or a few raw materials; that means, this is the starting point over here. Either one material you start using at the first stage raw materials stage collection stage, either one say the raw material or a few 2 or 3 types of materials, you are going to use. And a wide variety of end items; that means, as you proceed further you come across several stages; that means, it is divergent flow and so, that is why it is referred to as a divergent process flow or a type.

Alternative to V-plant, we have a you may have A-plant. In the A-plant what you do, it is it is an a shaped or convergent process flow; that means, you have been using several types of raw materials. And, all these raw materials are further processed. And, ultimately you know you reach to the final stage where out of all these raw materials; you are going to produce a single end item or a few end items. So, it is essentially a convergent process flow ok. As an alternative to say that divergent process flow which is referred to as a V-plant. So, now, your you may have the a plant, is it ok?

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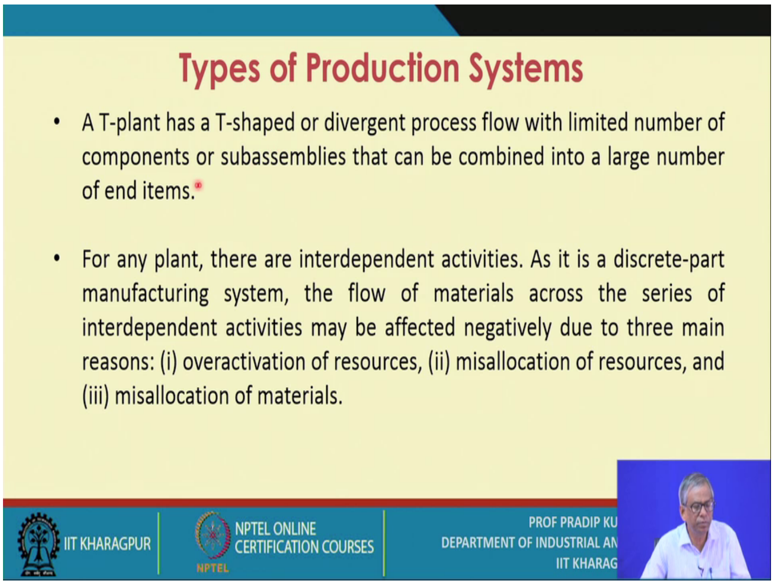

Now, next what you have you may have a T-plant, where T-shaped divergent process flow with limited number of components or subassemblies, that can be combined into a large number of end items. That means, what you have; that means, you have few kinds of raw materials and with this few say the raw materials, when you when you process it a number of stages. Now, you have a set of components or subassemblies. And, by combining all these all these components or subassemblies, you can have a large number of or substantial the number of say the end items.

So, that why it is referred to as a T-plant or the T-shaped divergent process flow or any plant there are interdependent activities as it is a discrete part manufacturing systems, the flow of materials across the series of interdependent activities may be affected negatively due to 3 main reasons over activation of resources, that is one similarly the misallocation of resources. So, that make create a lot of disturbance in the systems as far as process flow is concerned. And, similarly the misallocation of materials this also may effect adversely the process flow.

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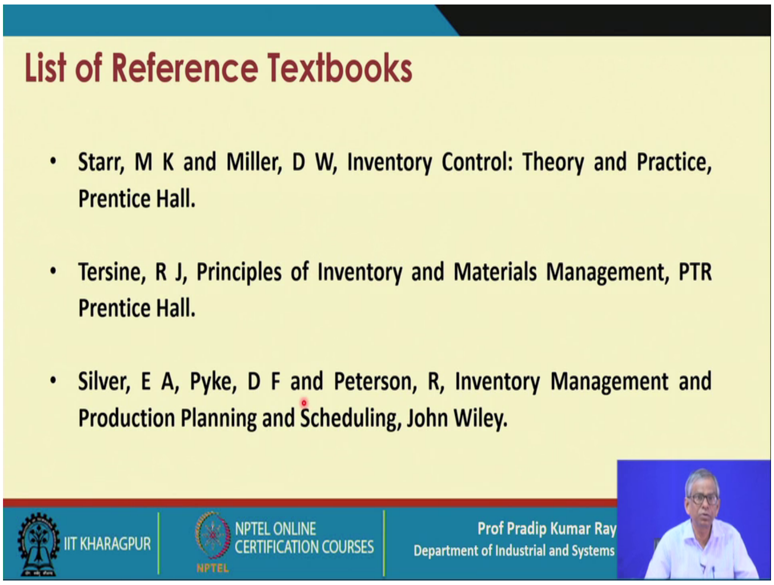

So, with this say with this explanation now we have come to know that how to what is the DBR scheduling? And what are the what are the basic conditions you have to fulfill? And for implementing DBR scheduling at your production plant and what sort of the control features, you have in the DBR scheduling. And with this control features how do you get a conditions where the smooth law of materials is guaranteed. And for that you need to say represent your production system in a particular in a particular say in the format and there 3 formats are 3 specific structures we have mentioned, that is V-plant, A-plant and T-plant.

Thank you.