Management of Inventory Systems
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Lecture – 37
JIT-based Approaches for Materials Management (Contd.)

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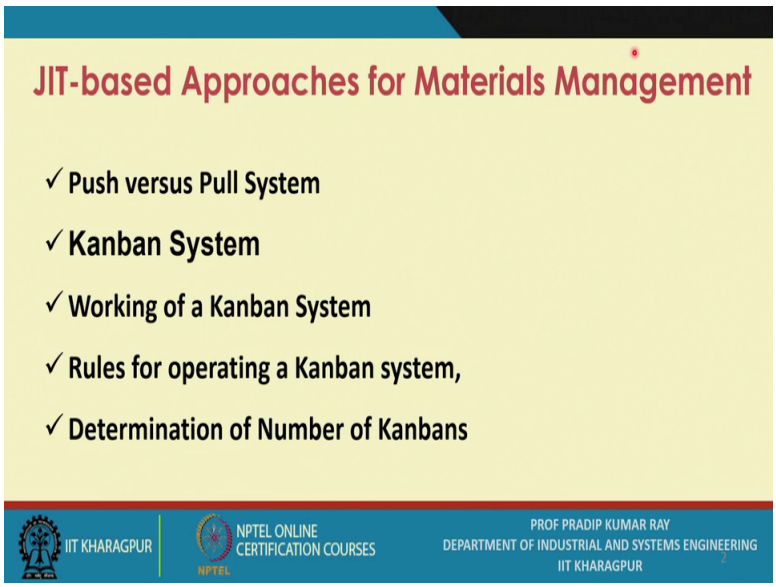

During this lecture section, I will be taking up the few important issues related to the JIT based Approaches for Materials Management. The first one is I will elaborate on the difference between the push and the pull systems that is the first topic we are going to discuss in the in the last lecture sessions. I have just referred to say the push system and what we mentioned that that the MRP system is based on the push system whereas, the JIT system is based on at the pull system.

So, you must have a very clear idea about say the difference between the push and pull system. Then we are going to discuss the Kanban systems and what is the Kanban systems and you also must know are the working of a Kanban systems, how does it work; and while you implement a Kanban systems, what are the rules you have to follow for its for its working and how to determine the number of Kanban. So, these are the few issues, we are going to discuss the next half an hour or so.

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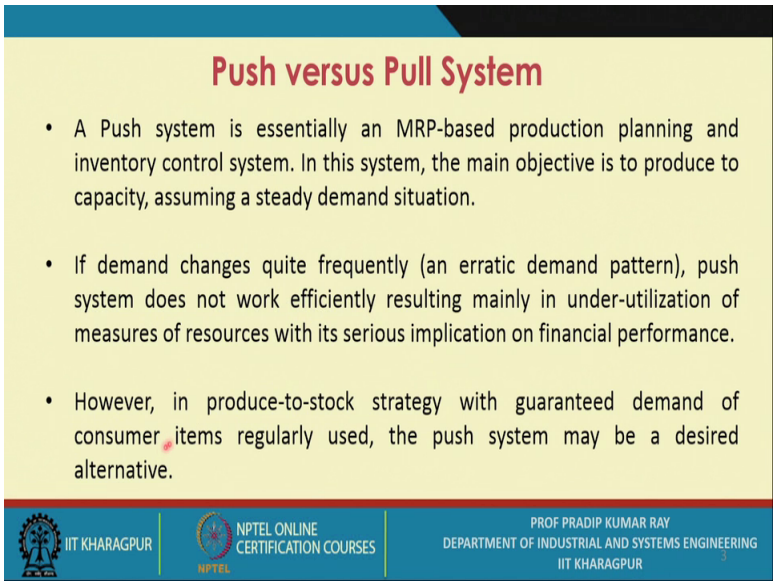

Now I have already used the term called push system as well as the push or the pull system. Now what is a pull system? So, a push system is essentially an MRP based production planning and inventory control systems. We have already discussed MRP in detail so, whenever you create an MRP system, it is based on a push system. In this system, the main objective is to produce to capacity; that means, at any particular work station or the work unit or a particular say machining center or at a particular facility, what is known in advance that is its capacity. While you start producing say the producing the components or the items at a at that particular workstation.

Now, if you produce as far the capacity, then essentially it is the push system. Assuming a steady demand situation; now you will feel like producing up to the capacity only when you are assured of a steady demand or a fixed demand and that is when the steady demand situation only you opt for a push system. If the demand changes, quite frequently, an erratic demand pattern; push system does not work efficiently because what might happen that if the demand pattern is erratic, sometimes, the demand could be very low and so, under the low demand conditions. So, you will be using your resource or use your work center say underutilized, it remains underutilized.

And so, there could be under utilization of measures of these resources with its serious implication on financial of the performance ok. So what will happen that if there is erratic demand pattern, then the resources which we use for production these resources

could be may be underutilized or in certain cases, it also may be over utilized. Now, both the situations; both the conditions are treated as undesirable.

However, in produce to stock strategy with guaranteed demand of consumer items regularly used ok, the push systems may be a desired alternative; that means, with the produced to stock. So, either today or tomorrow, this stock the stock will be sold that is guaranteed because you know it may be in the category the product which we are producing that may be in the category of are the essential goods and there is a constant demand for such goods and the products.

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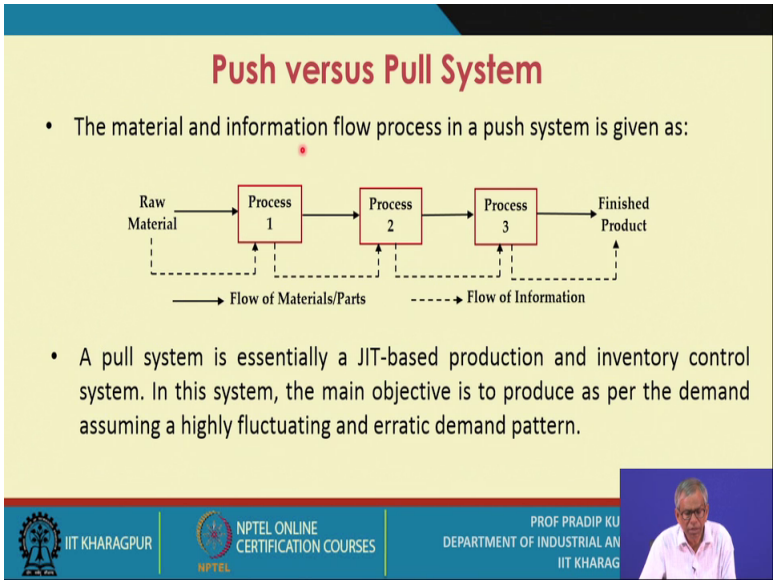

So, the material and information flow process in a push system is given by this one; that means, suppose there are 3 processes we have. So, the process 1 output goes to process 2 has an input and similarly, the process 2 output goes to process 3 and the process 3 is basically maybe the last stage and the assembly stage you get the finished product and this is your material flow and what is the information flow? That means, the raw material you send, you send to the process 1 along with the information, that this much the raw materials has been sent to for production at the process 1.

So, both and these flow of materials or the parts and the flow of information there in the same direction ok. So, you are pushing it; that means, as soon as the process 1, the production is over, the output is pushed to the next stage, is it and similarly, the same logic holds between process 2 and process 3. Now so, MRP system is essentially is based

on at the push system, but if you try to adopt the JIT based production and inventory control systems, so, the first thing you have to do that is you need to convert their existing push system into pull systems.

So, already you know the circumstances maybe forcing you to change the push system to the pull system. So, suppose the previous back, it was the steady the demand pattern, the today because of many external reasons, suppose for the same product, you are getting an erratic demand pattern. So, what we do; that means, the previous back when there was a steady with the demand of the situation, it was a push system , but today under the the erratic demand situations, we have no other alternative are to convert your push system to the pull systems.

So, that is the first pretty conditions you have to you have to adopt; you have to you know for the fulfill; so, so, a pull system is essentially a JIT based production and inventory control systems. Now in these systems, the main objective is to produce as per the demand assuming a highly fluctuating and erratic demand pattern; that means, if you just to refer to the third object of tps. So, it talks about how to you know. So, the respond effectively cost effectively to be erratic on the demand situation; that means, that is referred to as a change.

So, so, if you adopt the pull system in your the production systems or manufacturing systems, it becomes easier for you to adapt to or say respond to erratic demand the situation effectively.

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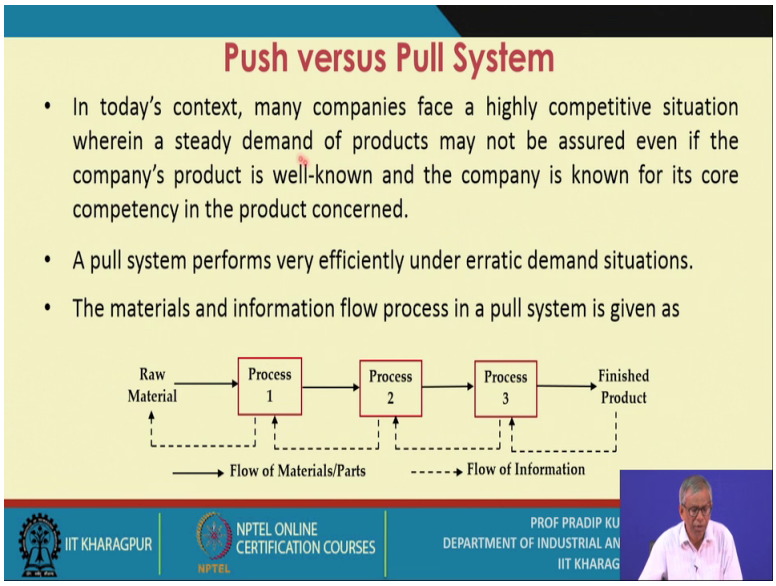

In today's context, now this is the point, we noted many companies face a highly competitive situation, wherein a steady demand of products may not be assured even if the companies product is well known. That means, the well known companies, reputed companies internationally in the renowned companies there also facing these problems because it is a we are using a perfect competition say the situation, and the company is known even if the company is known for its core competency in the product concerns they also may face this sort of the problem.

So, this is a very common occurrence these days. Now a pull system performs very efficiently under erratic demand situation this point already are mentioned. The materials and information flow process in a pull system is given is given with this if you look at the figure. So, it represents essentially the materials and information flow process, we have already you know what is the are the materials and information flow process for a push system.

Now the from the pull system what do you find over here; that means, the flow of materials or the parts this is in one direction from left to right; that means, from. So, the upstream to the downstream process; so, these this is basically the upstream process and this is basically your downstream process.

So, this is in this direction, whereas, the information flow is in the opposite direction; that means, at any point in time, you must know that what is your finished goods product

or finished product to the demand. So, during this where these information you get and as for this information or so, you start producing. Suppose you find the next one hour, the 50 units are to be produced. So, this information you collect from say the downstream, say the process and as far the downstream process of the requirement, you start process producing as you are the upstream process ok.

So, and as soon as you know this the required quantities are manufacturer are produced; that means, that the next stage is pulling the required the quantities from the preceding stage so that is why it is refer to as a pull system. So, this logic; we follow at all the all the production stages down to the you know the say the upstream stage; is it ok; that is the first stage is the raw material stage in the typical are the repetitive the manufacturing say.

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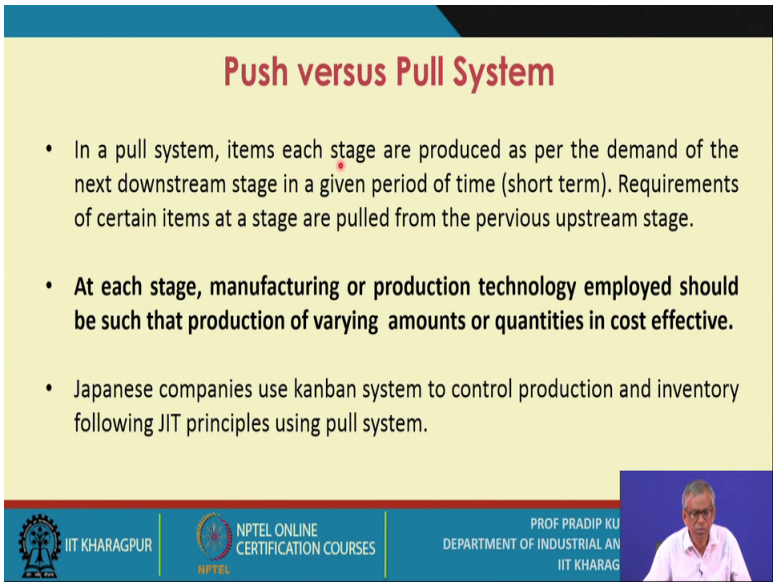

So, the system in pull systems items at each stage are produced as per the demand of the next downstream stage in a given period of time that is the short term; is it ok?

And the requirements of certain items at a stage are pulled from the previous upstream stage at each stage manufacturing or production technology employed should be such that the production of varying amounts or the quantity is cost effective. So, that is to be checked; that means, what is most important is that introduce the conditions and the technologies are available these days that suppose you produce 50 units per hour. So, you

get a cost and this cost is acceptable to you even if you produce one 40-50 units say the per hour or say in 2 hours.

So, again the cost, there could be you know some marginal change in the in the production cost as well as the product cost, but this change is minimum. So, that is why this is an acceptable situation as far as the cost of production is concerned Japanese companies use Kanban systems to control production and inventory following JIT principles using pull systems.

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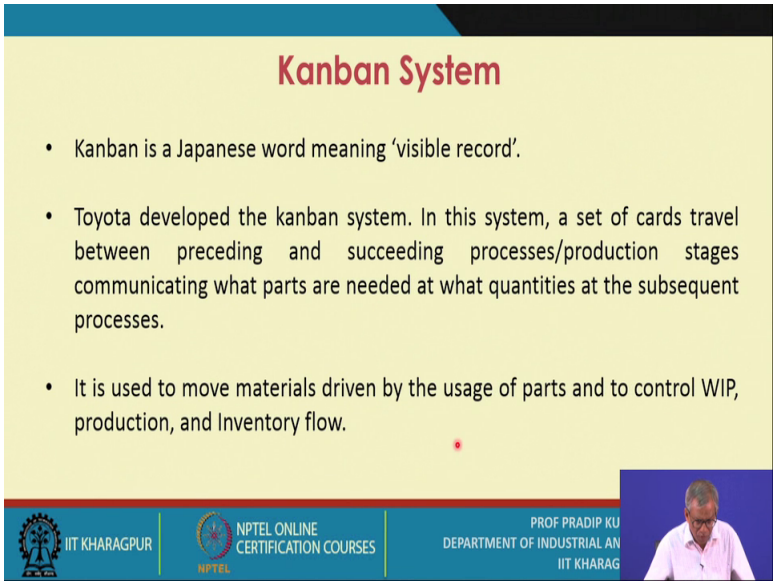

Now we are going to discuss the Kanban system. So, Kanban is the Japanese word meaning visible record. So, please note down this these points. So, this is a Japanese word and the equivalent English meaning in English language is visible record Toyota developed the Kanban system. In this system, a set of cards travel between preceding and succeeding processes or the production stages communicating what parts are needed at what quantities are the subsequent processes; that means, you know there is a concept of internal supplier and internal customer.

So, at a particular stage, you are producing something and you are producing for the next stage so; obviously, the next stage is your the customers and you becomes a supplier to the next stage. So, this is the basic concept and the a Kanban card is used to you know to make you know for sending the items from say the preceding stage to the succeeding stage.

So, it is used to move materials driven by the uses of parts and to control WIP production and inventory flow; that means and how many say the parts you need to send to the next stage and this is this is controlled by the Kanban card, right. So, so, the travel of say the materials either in say the raw material conditions or in a semi finished conditions. So, this travel or the time as well as the how much say the say the quantity; how many units you are the transporting from the preceding stage to the succeeding stage, these are controlled by the Kanban systems.

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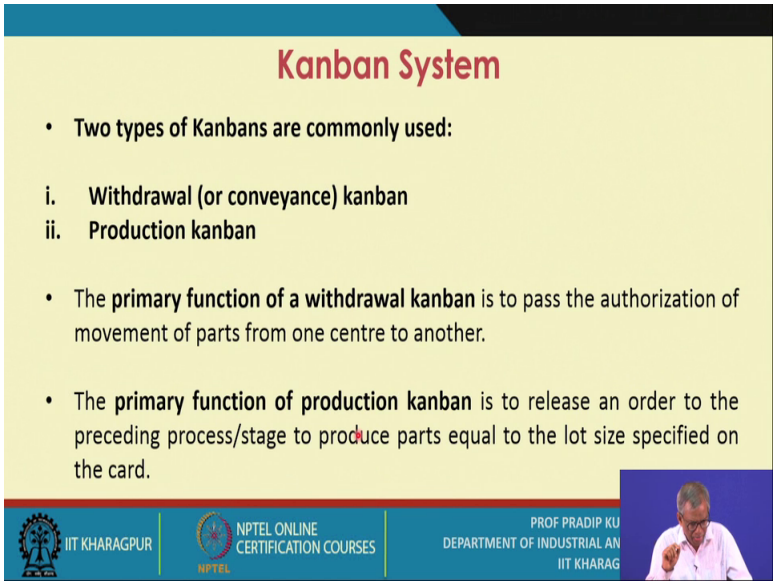

Now the there are 2 types of Kanbans which are commonly used. The first type is known as the withdrawal or the conveyance Kanban, the conveyance means the transporting; that means, on this Kanban card, suppose certainsay the number is given say that units. So, suppose the 50 units are specified for a given part; that means, it means this is an authorization and you need to say by the sent 50 units to say that the next stage or you need to say you know withdraw these amount from the preceding stage and it must be the sent to the next stage or the subsequent stage.

And the next one is the production Kanban; that means, as for the production Kanban say the requirements; that means, the requirements are mentioned that how many units you are going to you are supposed to produce during a specific time period. So, that the number is specified and only this number of a units you produce. So, that is a referred to as the production Kanban.

So, the primary function of a withdrawal Kanban is to pass the authorization of movement of parts from one center to another; that means, from the a preceding stage to the subsequent stage the primary function of production Kanban is to release an order to the preceding process or stage to produce parts equal to the lot size specified on the card. So, the lot size is mentioned for the given item.

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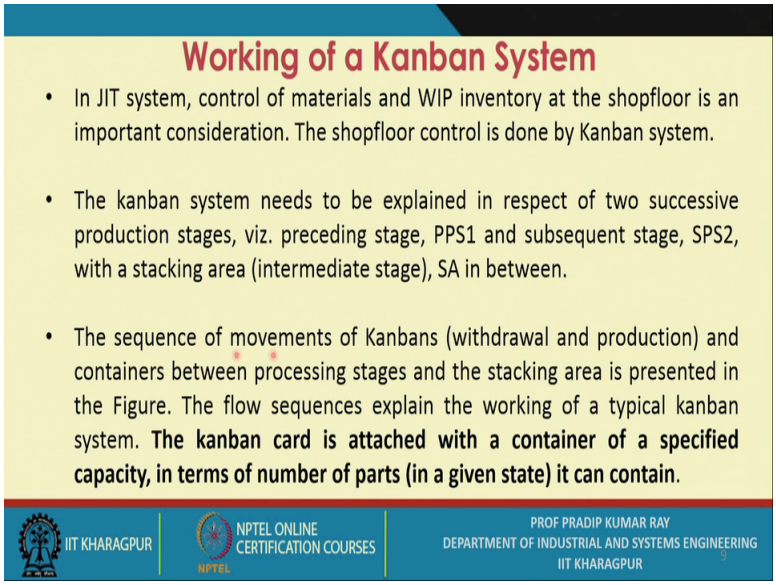

So, the Kanban system is essentially a 2 card system which was originally proposed later on and certain under certain cases are the 2 under certain conditions you know where the 2 card systems can be changed to say one card system also, but only under specific conditions. So, right now, we are discussing the 2 card of the Kanban systems the in JIT system control of materials and WIP inventory at the shopfloor is an important consideration, the shopfloor control is done by the Kanban system, the Kanban systems needs to be explained in respect of 2 successive say success say successive production stages.

So, we will try to explain; what is a Kanban system. So, that the preceding stage that is the you know, the preceding production stage 1 and subsequent stage subsequent production stage 2 with a stacking area; that means, the intermediate stage notation is SA in between, is it ok? The sequence of movements of Kanban's withdrawal and production both types and the containers between processing preceding processing stages and the stacking area is presented in the figure.

So, I will show you the figure the flow sequences explain the working of a typical Kanban systems, the Kanban card is attached with a container of a specified capacity say 50 units hundred units when you will take up numerical examples you made very very clear in terms of the number of parts in a given state it can contain.

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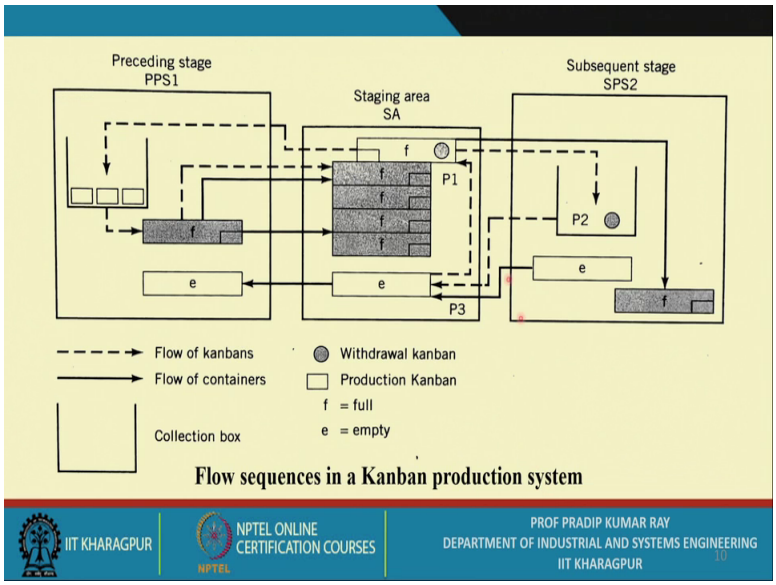

So, what you have? You have the preceding stage you have the subsequent stage.

So, so these are the, you know the full say the containers. So, how many full containers we have. So, 1, 2, 3, 4, 5; now this is this container, suppose, there is a you know the P 1; what is P 1? P 1 is the now this symbol, we use to indicate that it is a withdrawal Kanban. So, this; so, this container is you know or say withdrawal Kanban is attached to this particular container.

Now, the process starts from here. So, so this container with the withdrawal Kanban attached to; it moves to the subsequent stage and then what you find that you deters the you know this withdrawal Kanban from the container and put it into the you know the collection box collection box and then what you try to do; that means, this is a full container. So, the full container you use; that means all the items as given in the container you start using it for the production purpose.

And then full container becomes empty container and empty container what you do; that means, here this is a one particular say you know from the collection box of the Kanban.

So, you collect one it and then this is empty container you attach to it and then why do you try to do; that means, there will be a swapping over here; that means, this particular this the Kanban is attached over here and in the next full container Kanban; what is actually it has attached with a production Kanban. So, this is detached this is called basically the swapping and it goes to the preceding stage and it is dropped in the collection box over there; that means, this is the production Kanban.

Now, now; obviously, you know what happens this empty container goes over here and then as for this production Kanban, you start producing you start producing and as soon as the container becomes full then you attach the production Kanban on it and then this full container moves to the stacking area. So, this is the one cycle is over. So, this is the working of Kanban systems.

So, as it appears, it is very very simple as a repetitive type and that is why it is well adopted at the shopfloor; is it ok? So, so, although you know so, when you look at this particular say particular say Kanban system; Kanban production systems. So, you start from here you move over there, then you come back over here then at the stacking area, then you get back to the preceding stage mean while you get the production Kanban and as for the instructions given on the production Kanban you start producing. So, again the empty container becomes the full containers as soon as it becomes full. So, you attach the production Kanban over here and you send it to the stacking area.

So, this these are the flow sequences in a typical say the 2 card are the Kanban system.

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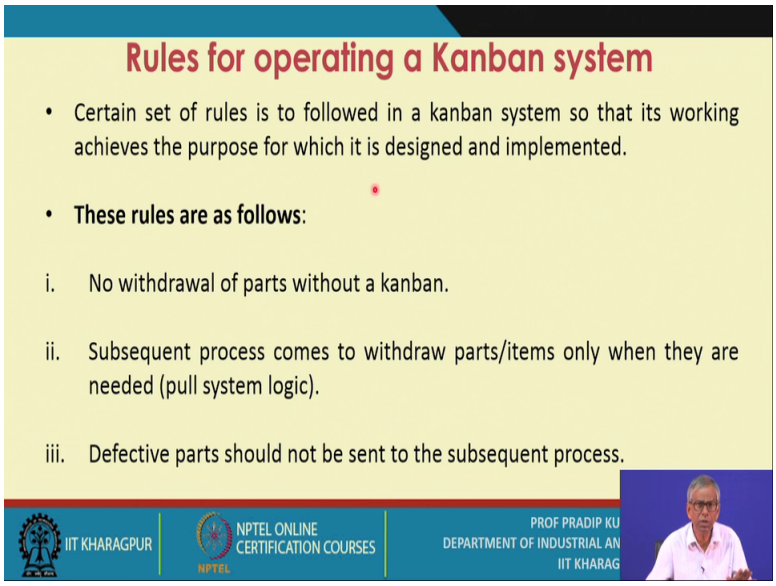

Now, there are certain rules to be followed while you operate Kanban systems. So, let me just tell you; what are these rules. The first rule says rule says that no withdrawal of parts without a Kanban ok. So, Kanban is basically treated as the authorizations.

So, unless there is you get the Kanban as attach to a particular say you know, the container you are not supposed to took any action subsequent process comes to withdraw parts or the items only when they are needed; that means, the pull systems logic ok, we have already explained that what is the pull systems and defectives parts should not be sent to the subsequent process.

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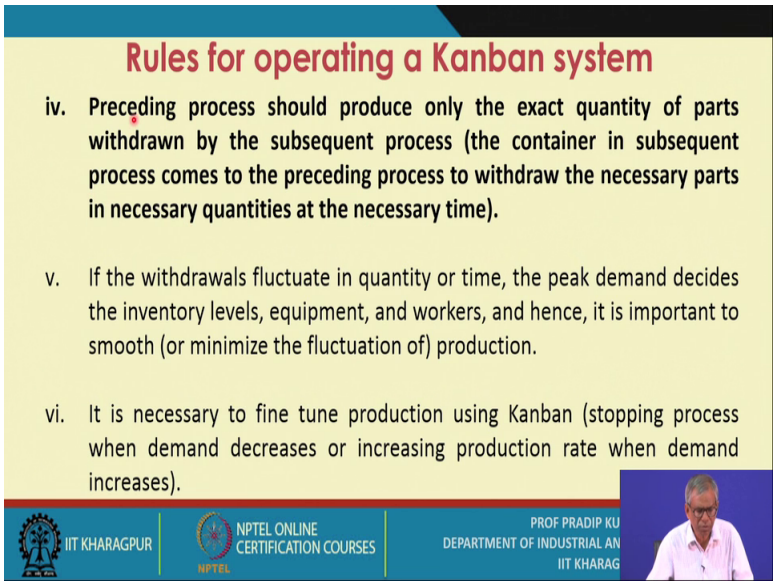

The fourth one is the preceding process should produce only the exact quantity of parts withdrawn by the subsequent process.

Now, this rule is to be followed meticulously and religiously the container in subsequent process comes to the preceding process to withdraw the necessary parts in necessary quantities at the necessary time; that means, we have defined what is the JIT base system. So, these are the points we have already mentioned while we define the JIT systems if the withdrawals fluctuate in quantity or time the peak demand decides the inventory levels equipment and the workers.

And hence it is important to smooth or minimize the fluctuations of production this is also one of the goals of the JIT production system to what extent you can you are able to smooth the production; is it ok? It is necessary to fine tune the production using Kanban; that means, you need to stop the process when demand decreases. So, that rule you have to follow or you need to the increase the production rate when the demand increases. So, this is basically called the fine tuning of the system.

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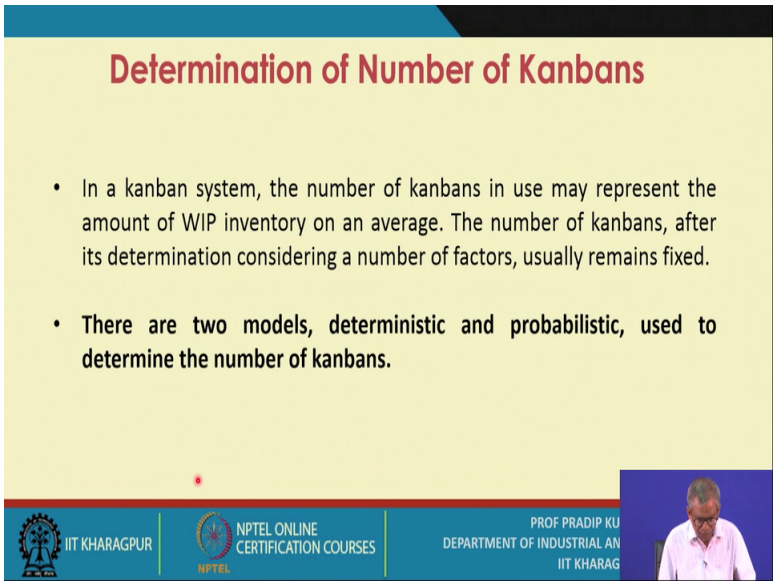

Now, the next important issue is that how many say a Kanbans, you will be where required to use and in a given system with the specifics the demand rate and all and with a specific you know, we need to consider also the safety factor there is a risk involve. In fact, like because of this stoppage because of the breakdown of the work systems and all.

So, the determination of the number of Kanbans is an important issue. So, in Kanban systems the number of Kanbans in use may represents the amount of WIP inventory in an average. So, if you look at the working or if you study the working of a typical Kanban systems, ultimately, we will find that you can define or you can measure you can get an idea about or the inventory level at a particular point in time in a production system are referring to or the number of Kanbans being used.

So, the number of Kanbans after its determination considering a number of factors usually remains fixed, once you determine say usually you do not change it frequently. So, at periodic interval of these 3, you need to review the system and, but otherwise the number remains constant there are 2 models deterministic and probabilistic. So, both the models we are going to discuss to determine the number of Kanbans.

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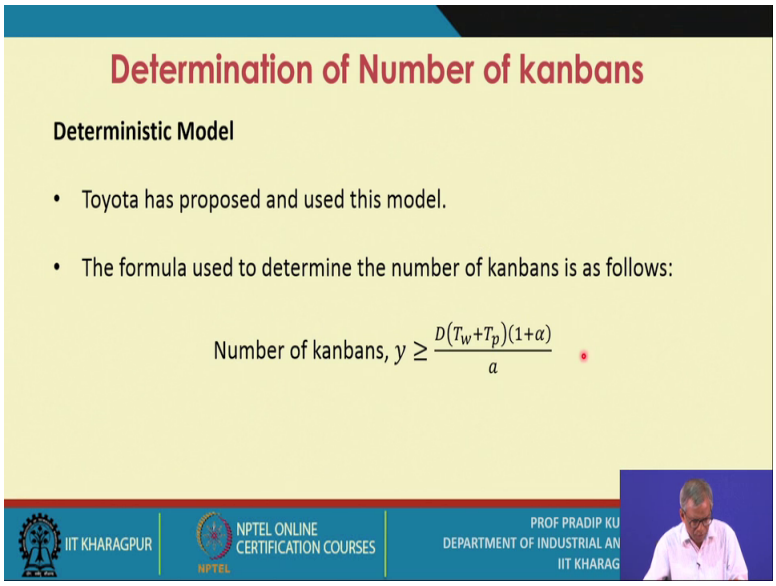

So, let me first tell you; what is this deterministic model, the Toyota has proposed and use this model. So, the formula used to determine the number of Kanbans is as follows like the number of Kanbans that is y should be greater than equals to capital D into Tw plus Tp into 1 plus alpha divided by a ok.

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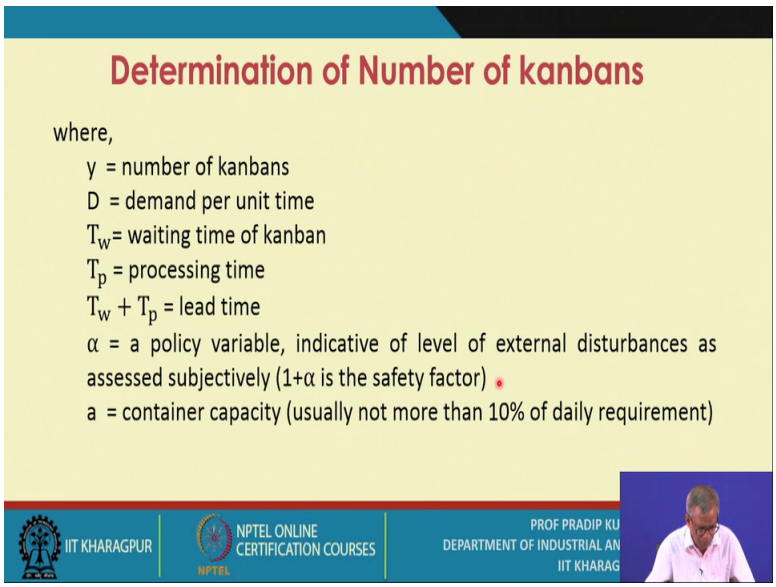

So, this is the formula you use in the deterministic model. Now, let me explain; what are these parameters. The first y is the number of Kanbans capital D. D is the demand per unit time ok, essentially, it may consider to be the average demand, Tw is the waiting

time of the Kanban and Tp is the processing time, I have already mentioned about the throughput time. So, in the throughput time; so, the 2 were the time elements, you are considered over here that is the waiting time and the processing time and if you add these 2, it becomes the lead time.

So, the alpha is a policy variable indicating of level of external disturbances as assessed subjectively; that means, one plus alpha is the safety factor suppose the value of alpha is point four; that means, the safety factor will be?

Student: 1.

1.4; that means, what you expect that 40 percent of the time or 40 percent time the system is affected by some external factors on which you may not have any control. So, uncontrollable noise factors and what is small a small a represents the container capacity usually not more than ten percent of daily requirements. So, the typical values are say 50-100 like that.

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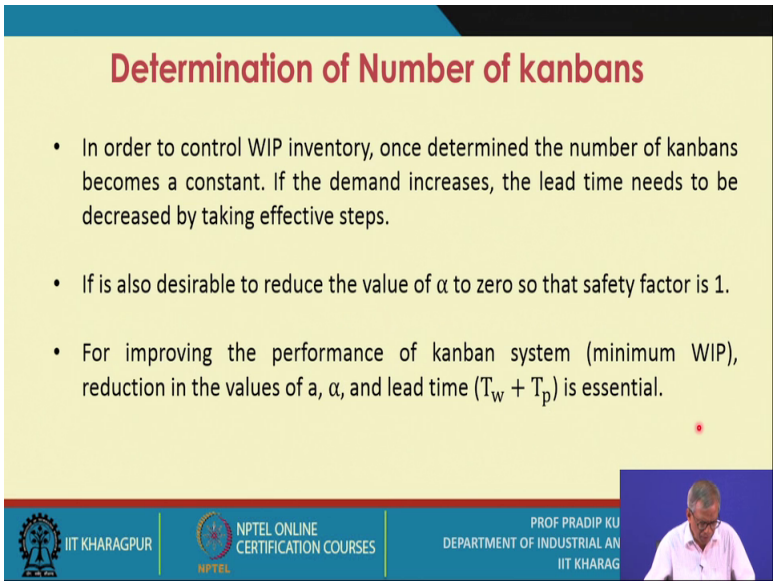

So, this is the formula we use. Now in order to control WIP inventory, once determine the number of Kanbans becomes a constant if the demand increases the lead time needs to be decreased by taking effective steps, if it is also desirable to reduce the value of alpha to 0. So, that the safety factor is one; that means, to what extent you can protect your systems from. So, the external say the disturbances, if you can protect it fully, then;

obviously, the value of alpha is 0 and for improving the performance of the Kanban systems.

So, what is the, that measure; that means, to what extent you are able to minimize the WIP inventory reduction in the values of a alpha and lead time is essential. So, with this I conclude this session. So, you have come to know how to were the determine the number of Kanbans, but we have already just considered the deterministic model and later on in the next lecture session we are going to say I take up a few numerical examples along with the probabilistic model.

Thank you.