Operations Management
Dr. Inderdeep Singh
Department of Mechanical & Industrial Engineering
Indian Institute of Technology, Roorkee

Lecture – 57
Kanban System

[FL] Friends, welcome to session 57 in our course on Operations Management. As we are aware currently, we are discussing the 12th week of our topics in our course on operations management. In the last week, our focus is on the topics that are much relevant in efficient and effective management of operations. In the previous session, we have covered just in time and we have seen that how just in time can be used or what is the importance of this philosophy in the overall management of operations. We have seen that the productivity improves if we are able to eliminate all kinds of wastes that are there in the overall production chain.

So, the focus is primarily on providing the materials, the type of materials required at the specific time in the specific quantity at the specific place. So, if we are able to streamline our production flow or production flow line, I think we will be able to save lot of money for our organization. In just in time, if you remember in the previous session, we have written seven types of waste. So, we can avoid the wastage in terms of manner, we can avoid the wastage in terms of time, we can avoid the wastage in terms of unnecessary motions of machines and equipment as well as human beings or the workers working in the organization. Similarly, for materials also we can optimize our inventory or we can totally eliminate the inventory by asking for materials or ordering for materials just in time.

So, that concept if we overall philosophically we implement the concept of JIT, we can save lot of resources which in turn will make our manufacturing or our operations more productive, more efficient, and more effective and effective efficient and productive.

Similar is the concept of Kanban which is a kind of a signalling technique, where a signal will be generated whenever there is a requirement of a of for a particular machine or an equipment. So, based on the signal system the pull system, the overall we can say efficiency of the system will be improved. So, we will see that if we have a pull type of system, wherever suppose there are three machines in a line. So, in normal system what

we do we input the material in the first machine, it processes the material and sends it to machine 2, then the machine 2 sends it to machine 3, so kind of a push type of system exists.

But in Kanban, we have a pull type of mechanism that when machine 3 will be free. It will send a signal to machine 2 regarding the quantity, the product that is required at station 3 or at machine 3. And the machine 2 will then send that material to machine 3, so that is kind of opposite to our conventional push type system, here the signaling technique is used to have a pull type of a system. So, in today's session maybe a very brief session of 25 minutes, we will try to understand the basic concept of Kanban, and we will try to see that what are the advantages, if we use this signaling system.

So, earlier there may have been cards or trucks, or maybe bins which were used as the signaling mechanisms. But today because of the advancements in the in the field of information technology, we can use integrated systems in which the say triggers can be triggers can be you can say initiated, in the case of emails or fax, or SMS is or maybe on the screens the things may start to flash. So, maybe the intern information technology and internet, and the computer systems have made the life much easier for dissemination of information or maybe sharing on of information, among the various workstations within the factory or the organization.

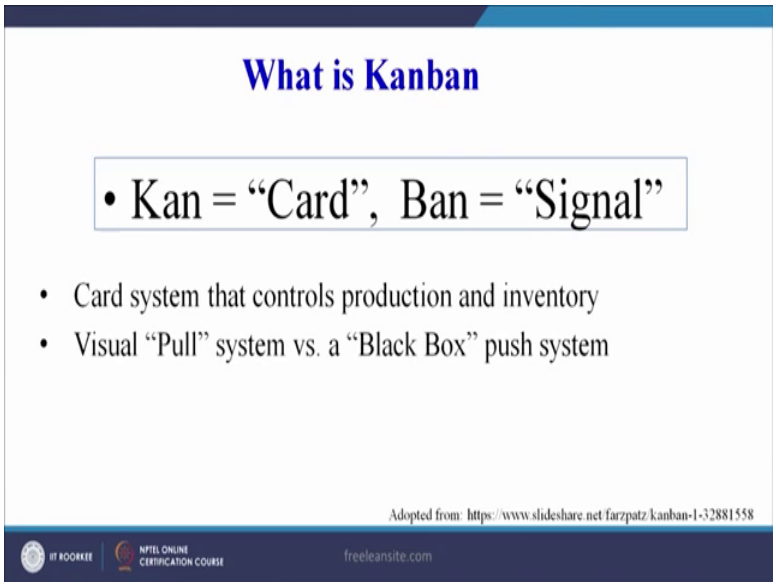
So, today the information sharing or the signalling systems may be entirely different from the systems that were followed maybe 20, 25 years ago because of the developments in the field of information technology. But still the basic concept that the signal must be triggered, whenever there is a requirement at a particular station that basic the method of signalling may change. But the basic philosophy will remain same, that whenever there is a requirement, there must be a signal to the preceding section, that yes now the material may be sent, and I am ready to receive the material, and process the material.

Otherwise without any information the material is produced, and it is sent to the next station where it gets piled up, there are delays, there are unavoidable delays though all these type of may be delays; which can be avoidable unavoidable. Normally lead to unproductive environment or unprovide unproductive ecosystem in the organization, and

therefore these type of delays can easily be avoided with the concept of Kanban, moreover we can always optimize our inventory if we use the Kanban system.

So, we will see a structured advantages of Kanban system in our today's session, there are number of good books in which you will have the detail related to the Kanban system, but we will try to understand the basic concept that how Kanban can be used for the advantage in managing the operations.

(Refer Slide Time: 06:41)

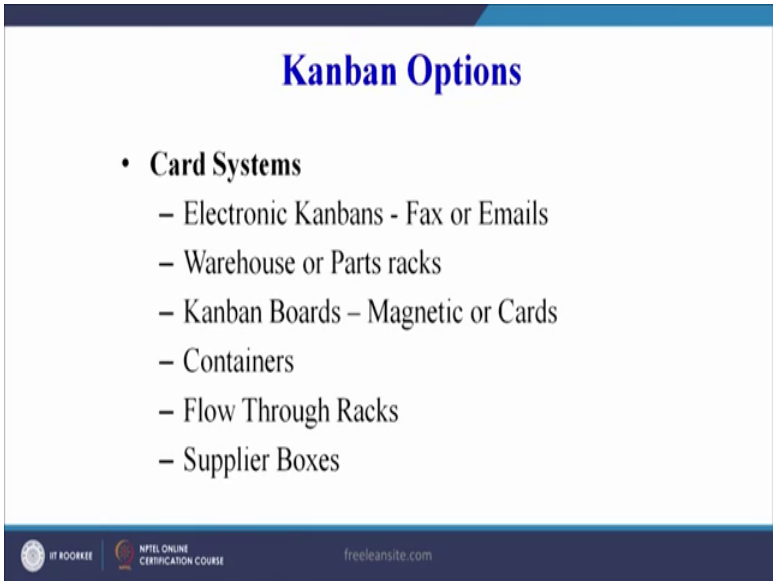


So, let us quickly first see that what is the concept of Kanban from where it originated, so Kan means card and ban means signal, so it is a card based signaling technique which is used in the industries, so card system that controls production and inventory. So, in this case we have a pull type of system visual pull means, because we have cards or containers, or buckets, so they these are the signalling techniques which will help us to pull the kind of materials that a particular the workstation needs. For example, there are two workstation, so the second workstation whenever it is free, it will send a signal, in the form of a bucket or in the form of a card, or in the form of a container or in the form of a flash, or in the form of maybe internet message or SMS.

So, the mode of communication may be different, but the message will be sent to the previous workstation, that yes there is a requirement of 100 components of type 4 or type 5, whatever is the nomenclature for the articles or the component that this is the requirement at my station or at this station. And then the it will become the responsibility

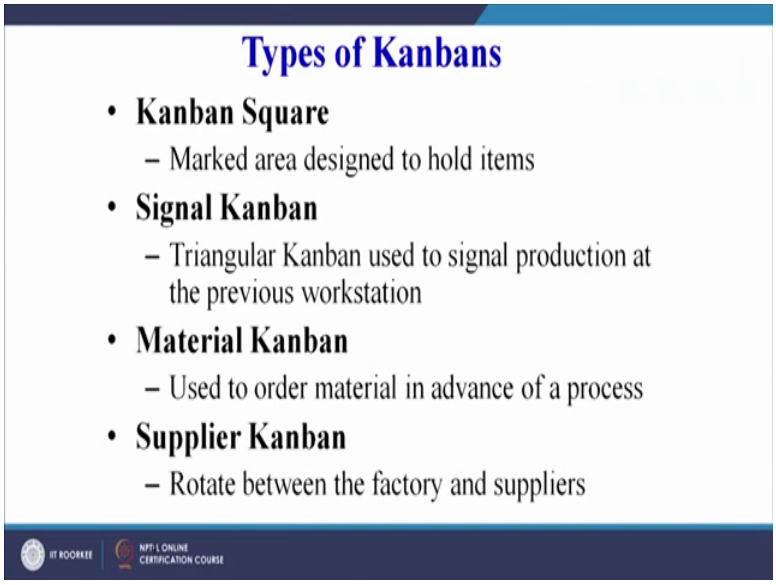
of the previous workstation to supply that material to the next work station, or to the current workstation where from where the signal has been generated. So, it is a pull type of system whereas, in the previous cases in most of the industries we have a push type of system that whatever is produced at workstation number 4 will be sent to the workstation number 5, this is what I understand from the concept of Kanban.

(Refer Slide Time: 08:28)



So, card systems, so there can be different options with Kanban, we can have electronic Kanbans, in current scenario most commonly used like fax or emails warehouse or part racks so that is another way the racks where the parts are stored can also be used as signals. Then Kanban boards which can be magnetic or cards. So, the boards can also be used as a signalling mechanism, then containers different colours can be given to the containers depending upon the product types can also be used as a signalling mechanism, flow through racks can be used as a signalling mechanism or supplier boxes can be used as a signalling mechanism. So, we have different types of mechanisms which can be used for signalling the requirement or signalling the completion of a particular product or the menu processing of a particular product.

(Refer Slide Time: 09:24)



Now, there are different types of Kanbans like Kanban square which is a marked area designed to hold items. Then there is signal Kanban triangular Kanban used to signal production at the previous workstation. So, we have to send a signal to the previous workstation that the production may start. So, it is used to signal production at the previous work station. Material Kanban used to order material in advance of a process as we have seen in our section on materials management that we have to offset, and our offset will help us to order the material. Now, suppose the product has to be ready by September 30th it may require 5 days of processing.

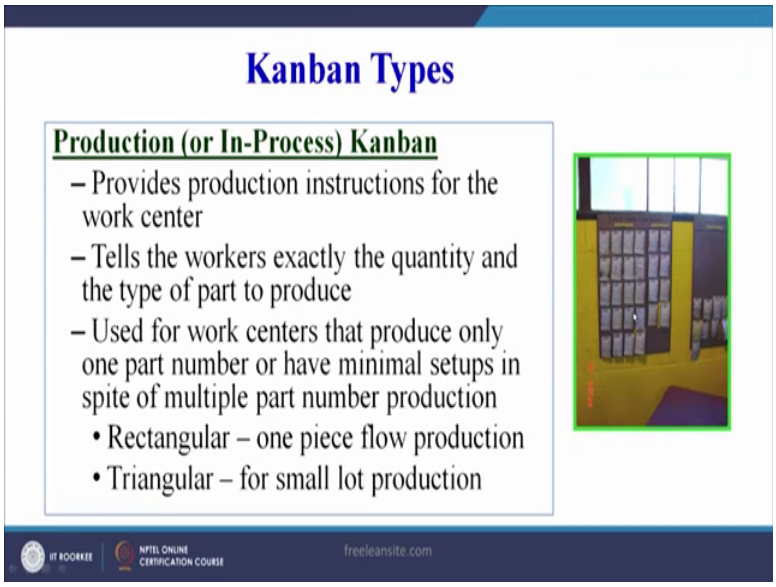
So, what we will order we will order the and the or ordering lead time for the material is another 10 days. So, when we must order? So, we must order at least 15 days in advance, so that 10 days is the lead ordering lead time. So, if we order before 15 days after 10 days the material will arrive at our premises and then 5 days for of processing, so we will be able to supply on the due date. So, similarly the material Kanban is used to order the material in advance of a process of the signal will be generated that yes the material is required.

Supplier Kanban; this is can be a mechanism any type of mechanism that we have seen in the previous; it can be e-electronic Kanban like fax or email. So, it will rotate between the factory and the supplier. So, we will be communicating with our suppliers regarding the requirement of the material. And if you remember all concepts are interrelated in J I T or JIT that we have discussed in the previous session. One of the major drawbacks was that if the supplier is not able to supply the material well in time our overall process may

suffer and there can be a stock out in the industry, and we may not be able to produce as per the requirement.

So, if we have a supplier Kanban system effective means of communication with our suppliers, the problem of stock out can be minimized. And we will be able to have a one-to-one interaction and we will be able to get our material well in time in order to maybe have our continuous production line and minimize the effect of a stock out.

(Refer Slide Time: 11:58)



Now, Kanban types we can see with the figure also here. Production or in process Kanban provides production instructions for the work center. As I have already discussed that if there are three workstations from third workstation, we will send a signal to the second workstation regarding the requirement. So, provides production instructions for the work centers tells the workers exactly the quantity and that and the type of the part to produce.

So, the signal will be sent maybe for example, it is not a line type of layout. So, line type of layout means that only one type of product is being produced. Now, there can be a process type of layout in which we have different types of products being produced on the same machine. Now, this machine may be producing five different types of products.

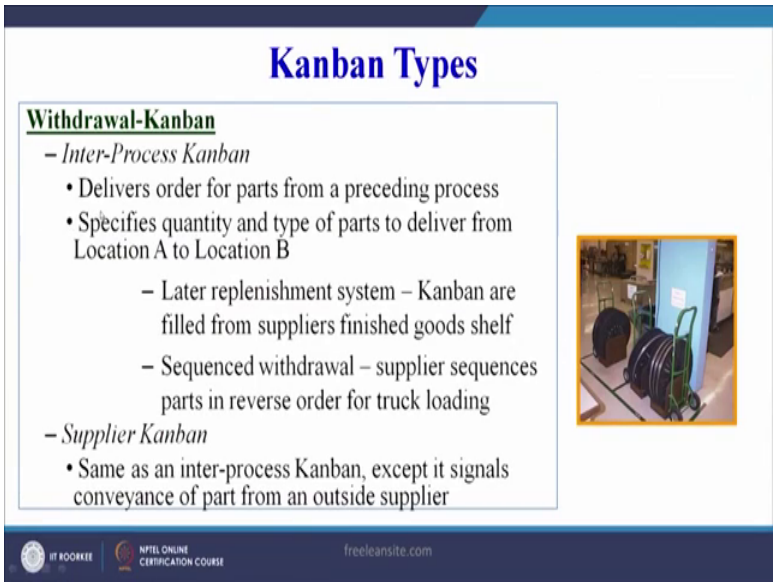
So, may be as per requirement a signal will be sent to the previous workstation that now type 3 or P 3 or product 3 is required or may be subassembly of product three is required.

So, as is given in second point it tells the workers exactly the quantity that is may be 100, 200, 300. And the type of part to be produced, so that signal will be sent to the previous machine and accordingly the machine will produce 200 parts of type of the part or the may be subassembly which needs to be produced.

Used for work centers that produce only one part number or have minimum setups in spite of multiple part number production. So, usually in case we will have more efficient and effective signalling system if the machine is producing one part number only, but the volume may change 100, 200, 500, 10,000. So that number is immaterial, but it will be more effective if only one part is being produced because then once we flash the signal that 500 parts are required the process or the equipment or machine will start processing the quantity as per requirement. So, this is used for work centers that produce only one part number or have minimal setups in spite of multiple part number production.

So, we can have a rectangular one piece flow production or triangular for small lot production. The different types of Kanban or signals can be sent. So, if you have one piece flow production, you will send a rectangular Kanban or a rectangle can represent that and a triangular can represent small lot production.

(Refer Slide Time: 14:44)

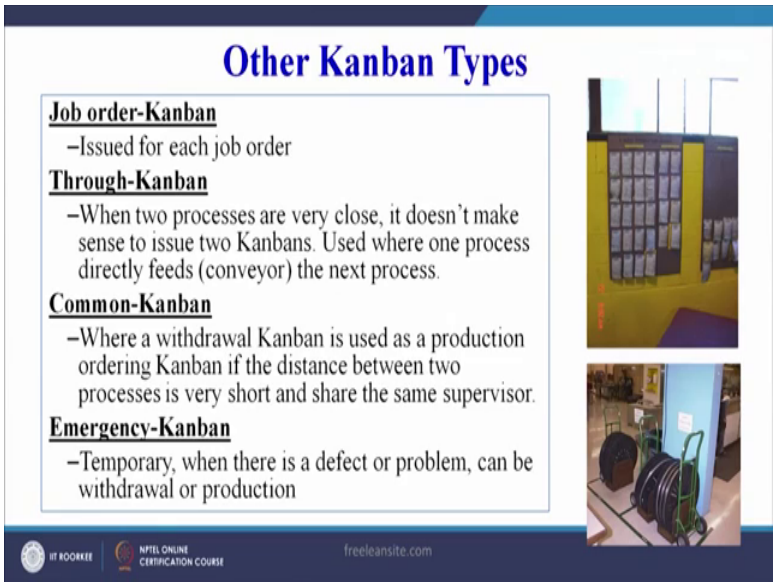


Then there is a withdrawal Kanban inter process Kanban, we can see that delivers orders for parts from a preceding process specifies quantity and type of parts to deliver from location A to location B. So, we can see that we can have inter process type of Kanban

which can ensure us timely delivery of material from location A to location B. So, the quantity and type of parts will be mentioned and accordingly the things will be supplied from one station to another station when a Kanban is initiated or a signalling has been initiated.

Then there can be supplier Kanban same as inter process Kanban accepted signals conveyance of part from an outside suppliers. So, supplier Kanban is a communication between the company and the supplier. Whereas, inter process Kanban is within the organization as it specifies the quantity and type of parts to be delivered from location A to location B.

(Refer Slide Time: 15:51)

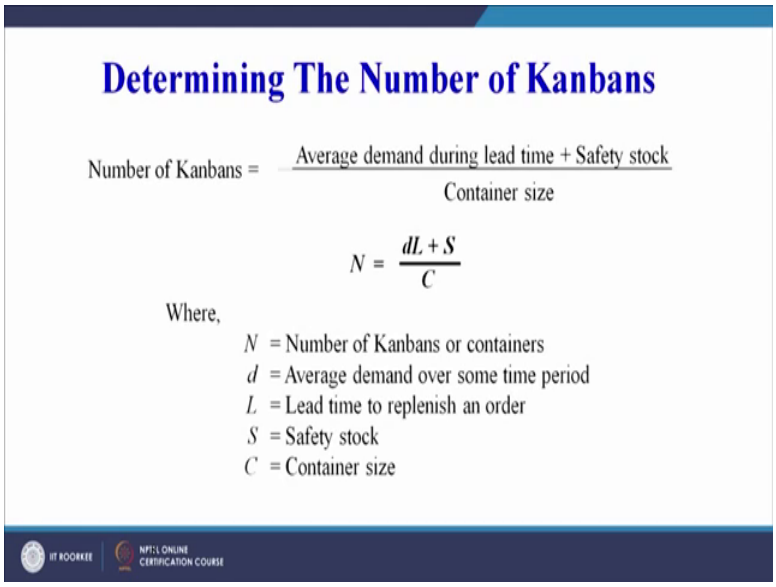


Now there can be other types of Kanban which can be job order Kanban issued for each job order. Through Kanban when two processes are very close it does not make sense to issue two Kanbans used where one process directly feeds the next process. So, maybe if on a conveyor belt type of Kanban conveyor belt type of material handling system or the process line, we can use a through kanban. So, if there are two processes happening need not issue two Kanbans.

Common Kanban when a withdrawal Kanban is used as a production ordering Kanban if the distance between two process is very short and share the same supervisor. So, we can issue a common Kanban also where are withdrawal Kanban is used as a production ordering Kanban if the distance between the two processes is very short and share the

same supervisor. Emergency Kanban, it is a temporary type of Kanban when there is a defector problem can be withdrawal or a production type of Kanban. So, we can see the different types of signalling techniques are there depending upon the function we have named different types of Kanban job order Kanban, through Kanban, common Kanban, emergency Kanban. So, these are different types of maybe signalling techniques which are used for a specific purpose.

(Refer Slide Time: 17:16)



Now determining the number of Kanbans number of Kanbans is equal to the average demand during lead time plus the safety stock divided by the container size. So, N is equal to d L plus S divided by C. So, we can see that average demand during lead time. So, we can see that d is the average demand over some period as we have seen in our maybe previous week when we were discussing materials management; we have seen there the lead time and the demand rate. So, here we can see the small d represents the average demand over some period of time. So, it is a demand rate only because it is over a period of time. So, we can say may be 100 components per week, 500 components per month. So, this is d is the average demand over some time period.

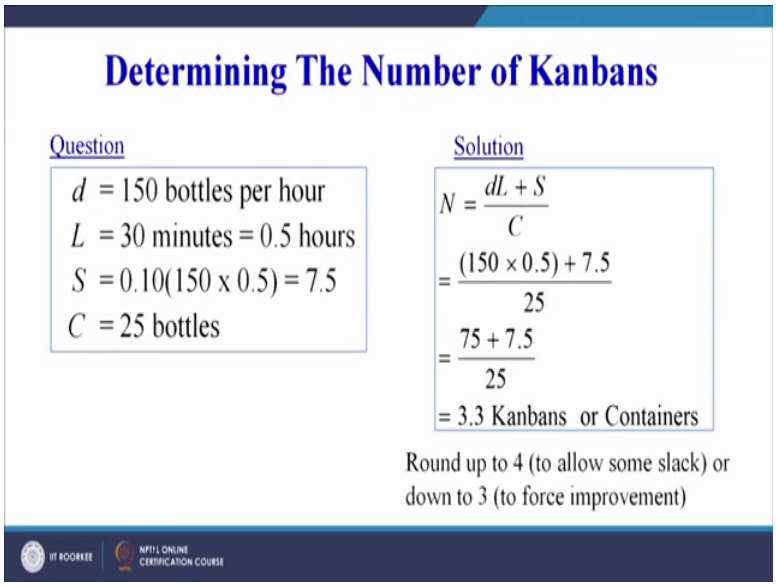
Then lead time to replenish an order that is L plus S that is a safety stock. So, this is we this will be a number safety stock will be a number demand rate multiplied by the lead time. So, demand rate in the denominator we have time and it is being multiplied whereby the lead time. So, time into time which means the number only. So, we will

have number here. And C is the container size, so that is that will be having some dimensions. So, we will see that how many is the number of Kanban. So, container size can also be a number which can be 500 or 700 or 2000.

So, we can see that we have here safety stock demand rate and lead time which is giving us one number divided by the container size in terms of a number. So, we will get what is the number of Kanbans that are required specifically when we are using it as a signalling mechanism that what will be the number of Kanbans required to be sent to complete to optimize our process line.

So, well, let us try to understand this with the help of an example. One more one thing I must address here that if we if we see what we have discussed in the beginning today, there can be different types of Kanban signalling mechanisms and one of them can be the containers or the here the Kanbans can be the containers. So, the that is the calculation of the number of containers that are required for satisfying this type of demand rate. So, we have safety stock demand rate lead time and the container size. Once we know this data, we can calculate the number of containers which will signal the manufacturing or production at a previous station.

(Refer Slide Time: 20:03)



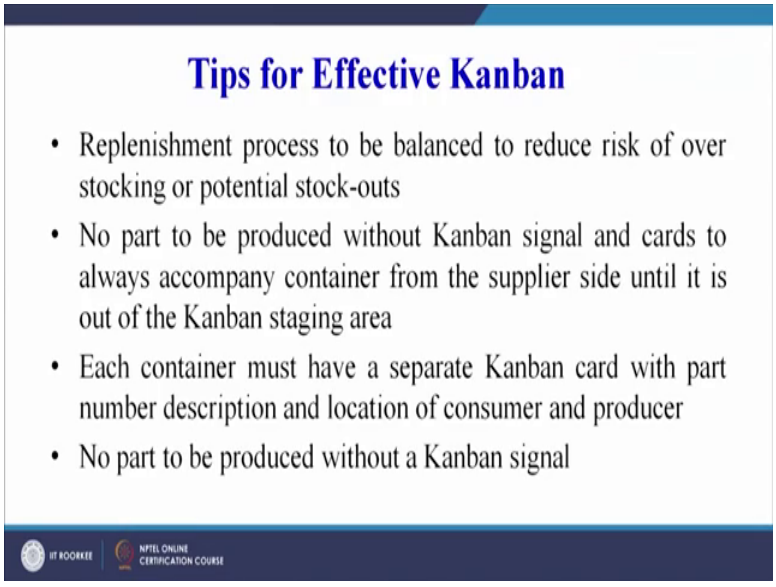
So, we can see the question here determining the number of Kanbans, you can see the question d is the demand rate which is which was I have already told numbers with respect to time. So, 150 bottles per hour is the demand rate. L is 30 minutes that is 0.5

hours half hour. S is what a safety stock that is 0.10 percent I think of 150 into 0.5. So, this is d into L that is 10 percent of the demand rate into the lead time. And our container size is 25 bottles. So, as I have already told that container size will also be a number depending upon the size of the container which is 25 bottles.

So, here we can see it was given in the problem that the number of containers we have to calculate depending upon the demand rate, the lead time, the safety stock as well as the size of the container in terms of number. So, here we can calculate d L, d moderate is 150 bottles per hour multiplied by the you can see lead time which is half an hour plus our safety stock is 7.5 which is 10 percent of d L, so again we have the calculations here that is divided by the container size that is 25 bottles. So, d into L plus F divided by C that is the container size. So, we calculate this it comes out to be 3.3 Kanbans or containers. So, we can round up to four to allow some slack or down to three to force an improvement.

So, here we can see that we using a standard formula or standard mathematical technique we can calculate the number of containers which we need to send as a signal in order to raise a demand which in this case our signalling system is the number of containers. One more thing I think which I have not been able to make very clear here is the S that is a safety stock is a percentage of the d into L which is the 10 percent of d into l that the demand rate and the lead time.

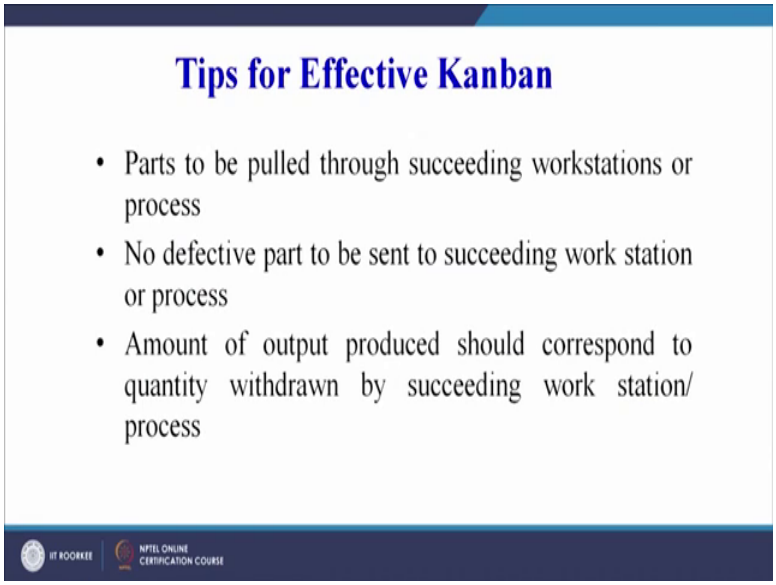
(Refer Slide Time: 22:39)



Now, tips for effective Kanban we can quickly have a look at these. So, first thing is replenishment process to be balanced to reduce risk of over stocking or potential stock-outs. So, we have to in order to have effective Kanban system. We must keep in mind that the replenishment process has to be balanced in context of that we must not be over stocking or we have there may not be a situation of a stock-out with that we do not have materials for further processing or the production may stop. So, stock-outs also have to be avoided over stocking also has to be avoided.

No part to be produced without Kanban signal and cards to be all cards to always accompany container from the supplier side until it is out of the Kanban staging area. So, it means that nothing will be produced until and unless there is a signal to start the production. Or until unless there is a trigger to start the production. So, if you do not have a signal there is no need of production. As soon as a Kanban is issued the production must start. Each container must have a separate Kanban card with part number description and location of consumer and consumer and producer. So, maybe a Kanban system should have the complete information the number of parts desired where they are desired, so all that information must be there with the Kanban signalling system. No part to be produced without a Kanban signal which I have already explained.

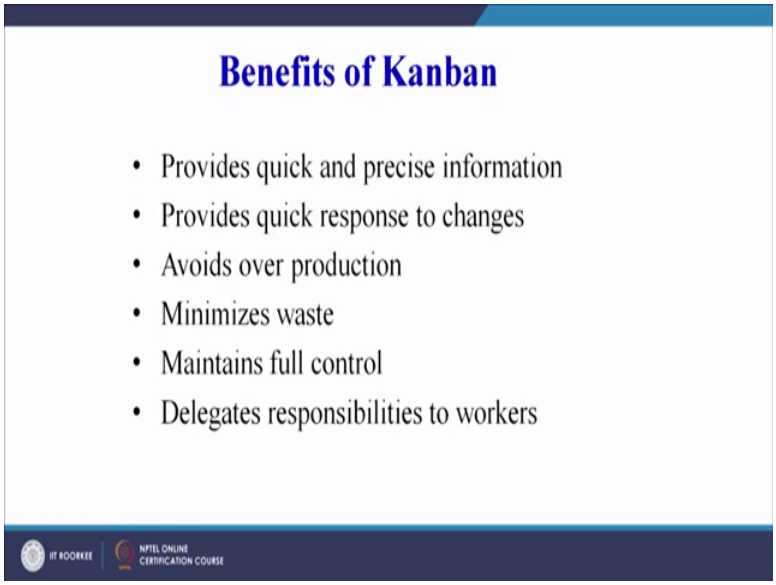
(Refer Slide Time: 24:11)



Parts to be pulled through succeeding workstations or process. So, there will not be any push type of mechanism here the parts have to be pulled through the succeeding

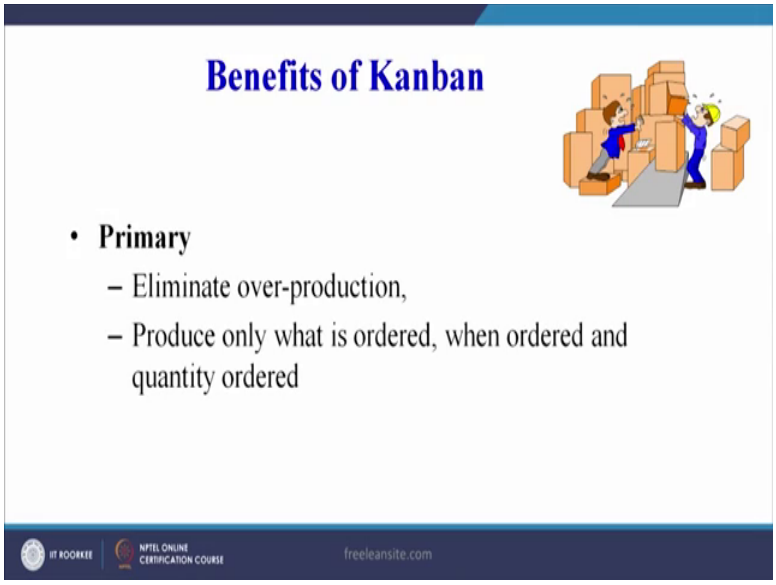
workstations. So, no defective part to be sent to the succeeding workstation or process. Amount of output produced should correspond to quantity withdrawn by succeeding workstation. So, whatever suppose there are two workstation, so whatever workstation two is desiring that must only be the output of workstation one. So, amount of output produce should correspond to the quantity withdrawn by succeeding workstation. Suppose workstation two raise is a Kanban of 100 parts, so workstation one must produce 100 parts only.

(Refer Slide Time: 25:00)



Now, what can be the benefits of Kanban very quickly we can see provides quick and precise information, provides quick response to changes, avoids overproduction, minimizes the waste, maintains full control of the process, delegates responsibilities to the workers. Now, workers have to issue the Kanbans as per the requirement and it balances the line as well.

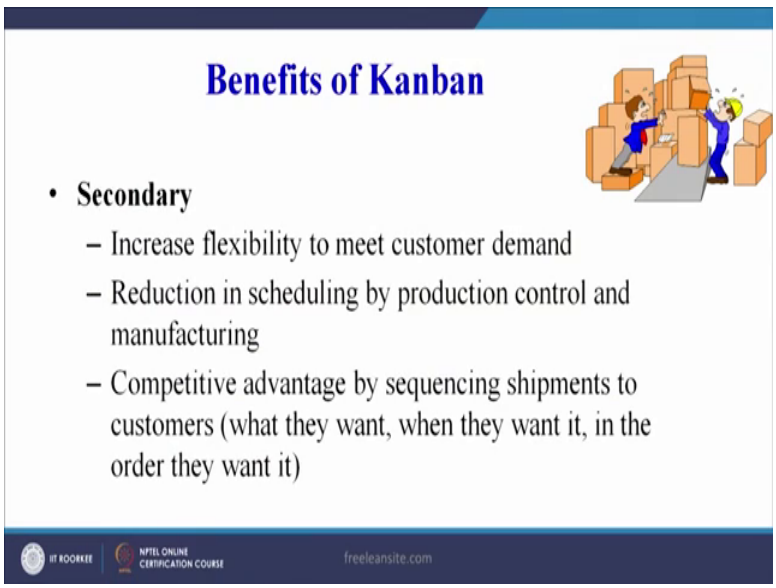
(Refer Slide Time: 25:26)



Now, the benefits of Kanban again the primary benefits are that it eliminates overproduction, why, because it is a pull type of mechanism whenever there is a requirement only, then the pull system will initiate the process of production at the preceding section or preceding workstation, or preceding machine produces only what is ordered, when ordered and the quantity ordered.

So, it is a pull type for as is that demand similar signalling mechanism will be issued, and the production will be according to what is actually desired. So, produces only what has been ordered in whatever quantity it has been ordered and when it has been ordered. So, whenever there is a demand only then the production will take place.

(Refer Slide Time: 26:13)



The secondary benefits of Kanban are it increases the flexibility to meet the customer demand, because now the machines are not only producing whatever has been mandated during that day, it the machines will become more flexible depending upon the signalling mechanism, wherever, in whatever demand is being generated they will produce the things accordingly. So, reduction in scheduling by production control and manufacturing, competitive advantage by sequencing shipments to customers what they want, when they want, and in order they want it. So, now, you can very easily plan your dispatch sequence also, because now you know that how you are going to signal the requirement as per that only the production planning and control will become a bit easier in this context.

So, that we are able to produce what the customer wants, in what order we have committed with our customers, what is a time line for each and every customer. So, accordingly we can use this signalling technique to trigger the manufacturing or production, so that we are able to satisfy our customers or to honour our commitments and contracts with our customers. So, we can see that in broader context of operations management, if we apply the Kanban system or the pull type of may signalling system, it will help in the better management of our operations and in nutshell will improve the productivity of our organization. So, with this, we close the today's session. In our next two sessions, our focus will be on the materials requirement planning system.

Thank you.