Logistics & Supply Chain Management

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Lecture 52 : Inventory Management

Hello dear friends, welcome back to NPTEL online course on logistics and supply chain management. So today we are going to start another very interesting chapter which is on inventory management and we will spend couple of session on discussing various concepts of inventory management and what are the methods we can follow when we are talking about you know managing our inventories. So in the first session of this inventory management we will discuss about the various definitions of inventory, how we define inventory within any manufacturing unit or services unit and then we will discuss about some terms we are using for managing the inventory or when we are talking about inventory management. We will talk about what are the different types of raw materials, what we are handling and then we will talk about the steps in the inventory management process. so first of all inventory is all the items goods merchandise and material which any business unit is keeping with themselves so that later on they can sell that inventory and earn the profit right but yes this is not complete definition because there are other materials as well which we are maintaining within our factory but we are never selling those inventories, material or equipments. If you talk about equipment, we are never selling those equipments and to maintain those equipments, we are using different raw material, spare parts.

So, that is also kind of inventory. Inventory is an asset can be tangible or intangible right and like I told you which is used to generate the revenue and we are get delivering some value through product and services in terms we are getting the monetary value right and then asset which is in process what is meant for sale in the end market right. So, if we will talk about the manufacturing industry. it's not only the final product we are keeping inside the, any manufacturing unit or factory, right? So, if we, let's say, in any manufacturing unit, these many different stages are there in the production line, right? More than 500 stages are there.

So, when at, say at 6 o clock we are turning off the factory or may be we are closing the shift. So, all those stages whosoever was working will be leaving some semi finished product. on all those stages right. So, this is also kind of semi finished goods which are lying on the different you know production stages right. So, that is also counted as

inventory.

Raw material is also counted inventory whatever you are taking from different vendors and then you are converting those raw material first into semi finished goods and then those are converted into finished goods. So, these three typically three different types of inventories we are managing in any manufacturing unit so when we talk about services industry obviously the very basic thing the difference between services and manufacturing industry in services we cannot make inventory of typically I'm talking about services right so if very simple example barber shop we are going for haircut or head massage right so before i will reach barber shop person that shopkeeper cannot you know keep the inventory of the haircut and i'm going that shop and then they will give you that haircut right that is not happening but in case of manufacturing industry this is the beauty of manufacturing industry even if right now i'm not having any demand i can produce the product i can keep on producing the product and whenever there will be demand i can consume the product in the market but in services industry may be for first 2 hour there is no customer at the barber shop next 10 minutes 10 people are coming together right so because you cannot maintain inventory in services industry so then you cannot but yes we are also maintaining some inventory in the services industry if you talk about the barber shop only they are maintaining all the equipments right that is also inventory they are using different types of oil they are using different types of combs shampoos and whatever product hair dryer massager all those products they are using they are maintaining inventory for all those supporting products right which are supporting them to deliver the services but the end delivery to the final customer is services which they cannot store that's why in manufacturing industry we talk about mostly inventory management but in case of services industry we talk about queue management right so if you go to bank or post office then you can see long queues are there how we can manage the queues when we are talking about the services industry these are some of the useful terms Bin card, bin card is a kind of card or document which is used to update the inventory of any product within that particular bin. I am not talking about the whole inventory lying within that factory, I am talking about only the bin which is placed may be on the production floor, what is the inventory left out in that bin, that bin card will be reflecting. overall inventory may be you are keeping some inventory in the storage house right so then as per the kit will be issued to the production floor then you will be supplied with that inventory but bin card will represent the inventory of the bin only buffer stock this is the stock which you are keeping you know that equivalent to the consumption during the standard replenishment period so you know that if you are consuming the inventory continuously when converting the raw material into finished one Obviously, you need to keep some buffer stock and before that your next lot should arrive in your storage house. So, that you should not be stock out and then your

production all those people the machines will be stopped working for next if 2 hours inventory is not there.

So, they will be sitting idle. Then committed inventory is a kind of inventory. again the inventory which we are committing to some particular model or some particular order. Let us say Maruti Suzuki is making Swift also and Desire as well. Now, you can see may be same tires size they are using in both different models.

So, when they receive the order for 100 desired cars, obviously they need 500 tires for that and then maybe they receive the order for maybe 200 Swift also right. So, then accordingly they needed 1000 tires for that. Now, if first they receive the order for Swift, so those tires they will book because then that inventory is kept. aside for specific that order only. This is not usually happening.

I'm just coding one example, right? And then if you are processing another lot of 100 desires, maybe 500 tires you need, so then again you will place the order with the vendor or maybe the inventory will be there. In this case, inventory will be there in the storage house. You can channelize that inventory. demand signal any demand is coming from the market or from the end your dispatch house that you need to move that stock into the market or into the warehouse that is a kind of demand signal coming to the production floor inventory I told you mainly in manufacturing we are talking about either raw material inventory semi-finished goods inventory or finished goods inventory these are major three things but yes sometimes what we are doing during the production process we are producing the rejection as well sometimes rejections are coming in terms of warranty guarantee from the market that inventory is also lying with you and you need to maintain those products you need to if you need to change the spare parts you will do that and will make that inventory ready for the end customer right so inventory ledger obviously like accounting we are doing all the transaction inventory coming in going out will be kept in that ledger right all the account will be kept in that Lead time, when you are placing the order and when you are receiving the inventory, that lead time is very important to consider because then you know that I need to keep minimum 2 days stock because anytime minimum 2 days vendors are taking to replenish the inventory to again send the lot and we will be receiving that lot minimum 2 days are required. So, that will help you to calculate the safety stock or buffer stock, right.

The minimum stock like I told you, this usually this is not fixed sometimes we are using buffer stock and safety stocks interchangeably right this depends upon the nature of the industry but some industries are you know considering as two different aspects and

saying that the minimum quantity always available in the stock to avoid shortage right that is the minimum stock you need and then we talk about the minimum stock is the sum of your buffer stock you want and buffer stock is that the inventory you want to keep with you for that period a kind of replenishment period right the time you require to replenish the inventory again and then there will be there must be some stock safety stock if some Disruptions happen during your supply chain delays in the production at your vendor end delays in the logistics anything can go wrong, right so that is the minimum stock you want to keep inventory on hand, so items in stock, whatever you have that is an inventory on hand overstock how many times you are overstocking the inventory so too much inventory is also dangerous and because carrying cost right physical inventory we have all the records digital records we are maintaining or we are maintaining the ledger hard copies we are maintaining but yes time to time we are checking the physical inventory as well whether the records are matching or not Reordering cycle is the period time between two successive regular orders right, how much time it is required. Safety stock already I talked about the extra stock that is kept to mitigate risk of stock out because of the uncertainties delays happening during the supply chain. Stock card, this is bin card is different, stock card is different. Stock card will tell you the overall stock of any single product within the factory. whether it is lying in the bin on the production floor, whether it is lying maybe as semi-finished goods, whether it is lying with the store as raw material.

Stock keeping unit, this is a new unique code or nomenclature that designates a single line item of a larger consignment. So, we have small small stock keeping units as well. Stock out, how many times you are stock out, you want to avoid that because the cost is used, the whole production line will stop working. Vendor managed inventory is another term which we are using so frequently where vendor is taking the responsibility to manage the inventory at the production end. If we are producing something, our vendors will take care of the inventory, only thing we are paying them for that managing the inventory, providing the raw material and they have to ensure that we should not be stock out.

So, these are different types when we are talking about different types of inventories we quickly will go through raw material all the items whatever we are maintaining within our production plant. If we are talking about the manufacturing unit and we know that those subsequently will be transferred to the work in progress or process and then will be converted into the finished goods. when we are talking about maintaining the raw material inventory we have to be very careful how many items we are maintaining and those are having may be limited lifetime so then first come first serve kind of sequencing model is very very important to move that items those items into the end market by

processing them into obviously into the final product right so before the end life happens you should move that so obviously you will consider the shelf life if you are talking about a chemical industry even if that life is may be little longer even then you want to move those raw material first which came first to your factory so that as soon as you will move those products in the market you will first is generate capital out of that second is the customers will start using that those components and electrical appliances home appliances if you talk about specifically if you will keep those you know products for maybe six months or one year and then suddenly with switch on after that long period so then you can say that that damage can happen so we want them not to keep for longer period of time in our inventories work in progress so whatever we are semi finished products we have manufactured not we cannot sell those right but yes that is a part of inventory later on we are going to convert those into your liquidity. So, here we are using two terms work in process and work in progress. When we are saying work in process typically we are using in manufacturing industry how quickly we are converting into the semi-finished goods right.

So, that is work in and work in progress is usually we are using in project management when we talk about your construction industry. So, we try to track let us say this is the timeline. and this activity we are doing let us say a activity is there so by the end of may be fifth month so this much part should be completed right Gantt chart this is how we are doing but we can track how much we have completed we have completed only this much so that means we are lagging with this much part so we need to find out work in progress where we are lagging why we are not progressing the way we wanted it to progress. So, maybe we are lacking with the resources or if you are moving ahead of what you decided then is also dangerous situation because that means you are deploying extra resources to complete that project. That is also not good for the project manager.

So, both side you need to take care. Finished goods is that inventory which is ready to move in the market. You can consume that finally after packaging is done, quality you have ensured, everything is done. Now what you want, the quickly you will move in the market, the quickly you will get the money out of that. so because already you have invested your raw material suppliers vendors all the stakeholders in that supply chain must be waiting for the margin and that margin you will get by selling that product consuming that product in the end market right so uh yeah you need to take care this there may be cases that the finished product for one industry may be the raw material for another industry if i am talking about manufacturing cars right so for maruti suzuki the end car product is complete product is the finished wood but the jk tire or any mrf tires whosoever bridgestone supplying the tires to maruti suzuki so for them tire is the end product So, this is you need to understand.

So, for raw material suppliers, obviously that is raw material supplier for manufacturer. So, raw material for manufacturer, but yes it is the finished product for those vendors who are supplying that raw material. Then the inventory management types, again the next is MRO inventory which I talked about little bit, maintenance, repairing and operating. This inventory anyhow you are not selling, right? Within your plant you are using some cleaning products right to clean your floor production floor to clean your washrooms so all those supplies are required that is one part spare parts are required the machines you are operating sometime breakdown is happening you need to change the spare part that is also inventory you are keeping within your storage house, but yes you cannot sell you are not supposed to sell that inventory the equipment to maintain the office supplies lab equipment, whatever you are using that is just to perform that function right or provide your services so those equipment your work station is required but yes that work station also we are maintaining. We are maintaining your office where you are using table, chair, fan, AC, printer, desktop everything you are using, but that is also part of inventory, but that inventory we are not selling.

So, this point is important. So, you can see different industries are using different kind of these MRO kind of inventory, tools are required. The another concept is buffer stock. Now, I told you that whenever we are starting manufacturing this is let us say is the inventory level. Now, when we will start producing converting the inventory into semi-finished and then into finished one we will continuously we will deplete.

we are assuming at constant rate this is showing that constant rate is there but yes that is not practically possible may be first hour you are producing the maximum and then the output is also you know decreasing towards you are going to lunch then it will decrease because continuously 4 hours work so then may be you are feeling tired and all that so but yes we are assuming that with continuous rate we are depleting the inventory So there must be some point where you need to realize that we need to again reorder the inventory. That point you will decide based on how much lead time is required, means when you are placing the order and when the next order is coming. this is one thing and then the other thing is how much buffer stock safety stock minimum stock you want to maintain right so they realize that somewhere here they need to reorder replenish the inventory so once they will replace the order at this point at this point So, still we are consuming the inventory. So, at this point, we will again get the lot, and it will be again going to that level which we are maintaining for that particular item. Again this will happen we will deplete again it will be replenished this is how it is going on.

So, this buffer stock all time we are maintaining this stock. This is the buffer or safety stock. So, cycle inventory refers to the goods, supplies or raw material that a business

keeps on hand to meet its minimum production requirement. So, cycle inventory total cycle is there before you start the manufacturing until you dispose of the final product. So, how long it will take for that cycle at least you need to maintain the inventory.

So, this also you can calculate. How much cycle inventory you are keeping for that particular period of time? Maybe 10,000 units you are keeping. So, that is the cycle inventory you are maintaining because you know that to get another 10,000 inventory you require 2 days. So, for 2 days 10,000 inventory is required plus minimum stock level. So, then this is how you are keeping this inventory.

decoupling inventory. This is another concept is used when you have different you know so many different work stations and machines. Now, let us say we have machine A, B, C, D, E. Now, whatever A is processing after that inventory is shifted to a semi product, semi finished product will be shifted to B. B will manufacture, will do its own process and will be shifted to machine C. This is how it is going right if the sequence is same.

Now, let us say something goes wrong at point B. Now, there is nothing to supply to C. So, just to meet that situation we are keeping the decoupling inventory at every stage. So, for A machine also we will maintain some inventory, B, C, D, E all the machines we will maintain some inventory. If the previous workstation is not able to process something, next workstation should not sit idle.

And we should be in the position still we can utilize the time, that is the main purpose of keeping the decoupling inventory. Transit inventory, transit inventory is most of the times inventories are travelling on road, by a ship, by air, through train. So, that means if they are, this inventory is taking 10 days, and 10 days of this inventory is there. it is not lying at the vendor end it is not lying at the manufacturer end it is not in the warehouse it is not in the distribution center it is not at all available for selling purposes right so that means that FOB inventory freight on board when the freight that inventory is traveling through different modes of transportation who is having the ownership is important right so Usually, the concept is once the inventory is uploaded on any container, then it becomes the responsibility of the wire and the ownership goes with the wire only. But yes, that is one thing to decide with the transit inventory.

But yes, even wire cannot utilize if the travel time is let us say 5 days, although the transit ownership is lying with the buyer, but yes still it is not available for the consumption. So, this is the transit inventory. So, these are different types of inventory.

Now, let us talk about the planning process when we are talking about planning the inventories what are the different steps we have right planning inventory obviously we need to find out the optimum level of inventory what we should maintain and we have some techniques mathematical framework we have which we can use to find out what should be the level right and then This is important to decide how much to order and when to order. And where to order is also important, but that is not under your inventory management.

That is another function of your production operation management. But here, how much to order? When to order? When you want to replenish the inventory. You know that this inventory will take minimum 5 days to replenish to receive. Then you want to maintain the inventory for 7 days. Why? Because may be from vendor 1 you are expecting within 5 days you will get the lot.

So, I am saying that for 7 days you are maintaining the inventory. So, we are assuming that after 5 days we will get the inventory, what is the guarantee that whatever lot we are going to receive will be accepted by our incoming quality control. There will be some checks may be during transportation or may be whatever lot they send. will be defected and we need to send that lot back to vendor because we cannot utilize that, right? It is defected. So then I know I am having two days extra inventory and I have meanwhile I have placed the order with vendor two as well, right? So, that way you can channelize that is why we I always stress on that we should have more than one vendors not too many, but yes three four vendors depending upon may be the criticality of that particular component we are using getting from those vendors.

So, when we are saying this we need to obviously decide this then again another thing is inventory purchase and storage fee this is another trade off we need to make that whether see if you are buying in bulk quantity obviously you can negotiate with your vendor this is what walmart is always doing placing large orders with their vendors specially in clothing industry in bangladesh or pakistan or bhutan or nepal and then they are negotiating on that particular thing that we are keeping large orders with you so that's why they are able to sell five dollars t shirt right this is one point so you want to place big order with the vendor so that you can negotiate on price but the other thing is storage fee if you are keeping large inventory then in storage you are keeping your capital is tied up there right this is one point and then maybe in storage you can damage that right so that also can happen so these two trade between these two parameters you need to think what level of inventory you want to maintain so also you want to reduce the number of refunds and cancel customer orders if orders are placed online right so you are also considering that it is now this inventory is consumed right and we are replenishing the next inventory

but what if orders are coming back and we have seen that average 30 percent orders are coming back that is also inventory we need to again maintain that and resell that inventory right so that is another point so talking about inventory planning process first is your data analysis which is very very important obviously we need to figure out the trends we need to figure out is there any change in the demand pattern or not what customers are buying when they are buying why they are buying so if in any multi-brand store if customer is moving and they are picking one product over other products so now we are generally we are talking about big data analytics right so we have different data points right and those touch points are generating huge amount of data i just want to know why customer preferred one product over other product when all were placed in front of the customer in that particular shelf there must be something going on sometime customer what customer is doing picking one product reading some information putting that back and then taking the competitor product i just want to see why customer is doing that so that means this huge data you are not only this on the billing counter also customer is providing so much information so all the touch points when customers are buying by they are buying in what quantity they are buying what variety they are looking for what price they are looking for all these touch points are there which i want to record so i should install those sensors where i can record this information and once information is recorded big data big data analytics is required we need to analyze that data so in analytics obviously we will first figure out what happened So, we need to find out what happened, why that happened, we need to analyze the data and then we need to find out why that happened and in future what will happen. right that also we need to find out that is the third stage first is what happened why it happened in future what will happen predictive analytics we need to find out the demand using that big data we need to find out what is going to be the demand depending upon your pattern and then fourth one is using that data how i can control anything before it is happening right so these are the different stages when we talk about data analytics big data analytics right and obviously the next point is supplier planning this is important talking about inventory management your suppliers got huge role because their relationship is important right so obviously then how we will work with the suppliers we have discussed about vendor rating concept which we can use And obviously we can rate vendors depending upon what price they are providing, what quality they are delivering and then obviously their delivery schedule. When how many times it is happening that we are placing the order and they are saying that within 5 days plus minus 1 day we will deliver you the lot and how many times actually it is happening. So, whatever we discussed in the vendor rating all those points you can work on and then you can improve this is the responsibility of manufacturer to improve your vendors right. So, if you have close collaboration with your vendors.

So, this inventory planning process will be more efficient. Safety stock calculation. again

depends upon industry to industry but yes this is the minimum stock what you want to keep with you how you will calculate maximum daily sales i'm considering the idle situation today i'll sell the maximum and then i'll consider the worst situation average daily sales into your average lead time maximum time you are taking to uh to deliver the product right if maximum time in last 10 years 15 days i will always consider 15 days it will take worst situation and the maximum daily sales so that means that is the maximum we can you know we can be demanded in the market and then i'll consider the average sale and obviously the average lead time whatever is the difference we will calculate the safety stock storage space analysis is again another point you are purchasing the inventories but how much storage space is there within the warehouse the capacity how you can manage the capacity right so maybe we have some short term measures once the capacity is build up now only within that capacity how you will manage the different inventories different raw material components you will see if we will change the layout, right, maybe we will get better space, right, space utilization will be there or maybe larger warehouse is required, so maybe we can think of extending the capacity of the same warehouse or we will think of now we cannot extend the capacity, we have extended to maximum, so we need to go for either the second or the third warehouse, right, so then again you need to plan another location where you can go for the Next warehouse right then inventory and forecast monitoring so this is the evergreen process why are we saying that what today you forecasted the same forecast would not be accurate for tomorrow that is why when we talk about this we talk about the speed of the data right accuracy and speed so accuracy is important but yes speed how quickly you are sharing that information is very very important because right now whatever is happening in the market next moment you never know this is how it is happening in the share markets when you are buying and selling the stocks So, that prediction is always going and you are planning on that. So, we need to monitor and measure the inventory always whether we are going sometimes out of stocks or always we are maintaining over inventory that is also we need to keep the eye on that and we need to keep the eye on the innovations as well. If our competitors are using transportation management software they are using warehouse management software they are using vendor management software inventory management software different innovations are happening and still you are carrying your legacy and documents and cards you are maintaining that will not going to work the reason is because if you talk about any automobile industry they are having more than thousand components you just imagine how you will keep the record of thousand components if you are entering you know manually right and then one component is out of stock one you are maintaining extra inventory how you will keep the track that is very difficult right optimization of inventory level depending upon your warehouse capacity planning and then you will plan the inventory this much we can stock in your warehouse but if you have the larger capacity does not mean always it should be full and the demand is only this much this should not happen that this extra inventory always you are keeping

right so you need to manage the warehouse space as well but you managing warehouse space you cannot order extra right Because if you will order extra you are tying up extra capital in your inventory.

So all the time if you are carrying 10 crore inventory this is something you will never utilize because 10 crore is always you are keeping idle with you. If you are moving this part you are replenishing with the next one. how we can move it to may be 2 crore so different things techniques are there yes still we cannot say that we can go for zero kind of concept of inventory that we will discuss in the further slides but yes we we can go for zero inventory for few parts right we will see where we can go for that and in the end we have we will be having satisfied customers because we are manufacturing when it is required by the customer so if any customization is required that also we can do so we need not to push the inventory in the market in the end because we have produced no we don't have any option so anyhow we will sell that inventory in the market right so we are keeping the inventory because supply chain disruptions can happen in terms of weather, disaster, transportation issues, labor issues And strikes anything can happen at the vendor end or during that transportation or after receiving also, I told you the example where you will say this lot is rejected quality parameters, right so then you need to have some safety stock inventory to meet those unexpected changes in demand also you if there is a sudden spike in the demand so then also you need to meet right limited cycle counts With an annual cycle count, we reduce effectiveness because it usually means shutting operations for at least a day. So, we can take a more manageable and informative approach with frequent counts on select inventory.

So, that also cycle also counts. So, how long you are maintaining the inventory and what level you are going to maintain. this is another concept multi-channel warehousing this omni-channel approach we discussed about where orders are coming from different customers through different channels so you need to maintain the inventory and keep the track in your warehouse and then warehouses are also many right so in one warehouse how much inventory you are maintaining other warehouse if one is out of stock how you can you know channelize that inventory from other warehouse. So, both way traffic is coming from not only from one route, different routes are there. So, you need to go for multichannel approach in the warehousing.

So, these all are references you can refer. Some stats have been taken from these sites. So, that is all for this session. We will continue this discussion in the next session. Thank you.