Logistics & Supply Chain Management

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Lecture 53 : Inventory Management (Contd...)

Hello dear friends, welcome back to NPTEL online course on logistics and supply chain management. So, we will continue our discussion on inventory management and in the last session we discussed about the definition, we discussed about the various terms we are using and then we discussed about the inventory planning process, what are the different elements in that. So in this session, we'll see what are different methods we can use for managing the inventory.

We'll talk about a zero inventory model as well. We'll talk about vendor management inventory as well. ABC analysis, how we can implement the Pareto analysis to manage the inventory. Then we'll just compare a little bit of inventory management with queue management.

Obviously, queue management is altogether different chapter and we used to discuss that in queuing theory in operation research. So yes, we have different methods to manage our inventory and again, that is how much you want to carry what is the market demand what are the uncertainties what are the capacity available warehousing capacity what are your production requirements depending upon that we have different models right and then obviously these methods some positives and negatives will be there so one by one we will discuss all these four methods right so Yeah, so first is just-in-time. So this just-in-time system was obviously when we talk about the quality concepts or major intervention in manufacturing. So Japanese organizations are kind of leader. And Japanese organization, Toyota Motor, and we talk about Toyota production system, right? And their contribution in terms of quality matrix and in terms of the production practices they are implementing is huge marvellous So, this just in time system somewhere in 60s and 70s they tried to implement and the obvious purpose was to increase the efficiency and decrease the waste.

So, that means just in time is when your this inventory is required only then you will purchase the inventory,right when it is required you will supply the material. So, that means you will be efficient because no requirement of keeping the inventory like we

discussed in the last session you are keeping 10 crore inventory always with you you go to any big bazaar shop or vishal mega mart or those one time stop solution how much inventory they are maintaining but yes they have to keep the inventory because there are so many different products from different sellers and manufacturers are coming obviously when customer is going then you cannot so that zero inventory concept cannot be implemented there but yes we in manufacturing system production houses we can define some of the items large value items where we can go for zero inventory we will be more efficient and the second point here is when we are talking about zero inventory we will not produce any waste means keeping product or raw material in inventories we damage the inventory many times this happens right when you are handling you are shifting from one point to other point and then keeping it that inventory is waiting for the process so then you will be producing waste so how this is possible your zero inventory just in time when you have your production planning and control ppc is working so so close with the marketing team sales team with the trend analysis data analytics that they can configure the demand function so accurately that whatever is required they know in advance and when they know in advance obviously then this can be delivered when required if your relationship with customer is supporting that right so that if you are maintaining zero inventory no money is tied up there you can reduce waste and as well no storage requirement will be there and obviously in that insurance cost is also there we are keeping this with us and then we are ensuring the raw material inventories right so that also we are paying for that yes approach is risky not little bit risky high risk is there what if any an unexpected spike in the demand will be there so how you will manage that you cannot manage that right so chances are there you will be stock out in the market so examples who are implementing just in time Toyota has implemented just in time to reduce waste and increase efficiency and I talked about Toyota production system is very big example and benchmark for all the manufacturing system Dell computers also because they were initially now they are changing their model but initially build to order so once customers were placing the order telling them their requirements configuration only then customization was happening and they were providing the customized products. So, right they were not maintaining the inventory. So, that is another model. Harley-Davidson they also implementing JIT to reduce the inventory cost and improve the product quality.

Quality how it will be improved because as the material is coming you are not interrupting in between. interfering in between you are smoothly you are supplying on the production line so you can keep the quality intact right what are the advantages no inventory no cost improved cash flow because now cash is not required to buy the inventory supplier relationship this is positive as well you need to have very close supplier relationship not only relationship physically also they should be very close to your manufacturing unit if directly from their production plant the raw material is

coming to your production line directly that means they should be very near physically. Efficiency and productivity will be there and quality products will be delivered as I mentioned. Challenges are huge maintaining zero inventory I talked about if something goes wrong with vendor then how you will manage if some issues are there during the transportation although i am saying that very short distance but even then packaging loading unloading something may go wrong and then how you will maintain that any natural disaster then how you will handle that suppliers dependency is used to implement because this is only supplier driven approach just in time is only successful the role of supplier is I think 70 or more than 70 percent right. what if demand fluctuation is there, unpredicted demand will be there and then because you are not planned for that so difficult to.

Initial investment is very high because you want all the vendors should set up their manufacturing unit within that premises and then you want you know you will change some of the processes because directly you are feeding the material to the production lines so that initial investment is also required. the another concept of managing inventory is MRP material requirement planning and we have different software and we are using also enterprise resource planning we are using SAP solutions also so usually material resource requirement planning we are doing when we have So, many components in numbers and we are using huge quantity. So, to keep the record of every unit moving from here from production line to semi finished product and then to the packaging and packaging then you are moving to the forward supply chain. So, you need to keep the track. So, material requirement planning is very very important in those kind of manufacturing processes where you know heavily you are using the raw material components and many components are there.

So, obviously this will work properly when you will integrate your production schedules very closely with your inventory and that how will happen when PPC is raising the bill of material bomb to store department. So, they know that in advance that for this month this is we are going to deliver in the market. So, for first week we will deliver this much to the market, out of first week first 3 days, day by we will define the schedule, after that the break wise first half, second half how much we are going to produce, this is the role of PPC production planning and control becomes very very important. If you take the example of sky manufacturer they are using MRP, so obviously material requirement planning they will see how much plastic they have fiberglass wood aluminum whether they are maintaining the proper stock or not right so obviously this will work only when your forecast is very very accurate or near to accurate right so heavily depending on sales forecast so examples Toyota again because they are implementing lean manufacturing so they are utilizing this material requirement planning Intel is also using that the again the

semiconductor manufacturing supply chain is also very complex and initial you know plant setup requires huge investment so they are utilizing this everywhere they cannot open these manufacturing units Boeing is another example which is managing thousand of parts and materials they are sourcing globally and utilizing MRP approach to maintain the inventory advantages obviously you have better control over the inventory optimal level you can maintain because you know in advance what is going to be the demand so that stock out or excess stock you will minimize right production planning Yes, the clear production schedules should be dealt by the PPC and in terms of bill of material should be raised against the whatever material is required. So, that should be placed on time basis with the store department, then cost saving.

when we are saying that we are planning so closely with the production schedule you can save the cost supplier collaboration again like in just in time here also suppliers are working very closely with the with the manufacturers only then we can implement the production planning you know proper planning at the suppliers end and then it will be more efficient so only thing is here again the human intervention should be minimized and we should go for automated planning whatever demand we are experiencing from the market should be immediately shared throughout all the stakeholders right only then it will work challenges because this technique is based on data what we are collecting from the market in terms of forecast in terms of inventory levels in terms of below material also we are working with the data right so that data accuracy is big big problem Speed of the data, again, I am again and again highlighting. So, today you are collecting when you are supplying that data. Complexity, so, because MRP is developed only, ERP is developed only kind of platform to handle the complex situation where, you know, multiple components are there, right, and you are using in huge quantity. Flexibility, MRP system may struggle to adapt to sudden change. The reason is because you are fixed with the production why this is working MRP working so perfectly because you have fixed production plan what if something else you need to produce today you need to change some schedule so then the whole planning will be disturbed right integration obviously ERP alone cannot work you need to integrate erp with supply chain management with your warehouse management software with your transportation management software so that you can have all the records of where the product is right now and how it is flowing the other method is economic order quantity and this method usually we are using because this makes the balance between the two points i discussed in the first session of this inventory management that if you obviously as manufacturer you want to place larger order so that you can negotiate on price but then that larger order means holding cost will be there you are maintaining extra inventory in your warehouse so that cost will be there you can reduce the ordering cost but your storage cost will increase.

So, economic order quantity will help us to make the tradeoff between this holding cost and inventory cost. So, total cost we are calculating holding cost plus your setup cost or ordering cost. wherever we are getting this total cost minimum that quantity we want to order and the graphical representation if you see see this is the holding cost if I am holding 5 unit this is the cost holding 10 units 15 units so proportional cost will be there this is one assumption of this model that this cost is linear but practically this is not happening right if we are maintaining larger space obviously per unit cost may go down right but we are considering that uniform cost So, another one is this line is representing your ordering cost. Obviously, if you will place 5 orders, so this is the highest cost. If you are placing 50 orders, so cost will be lesser.

If you are placing 5000 orders, so that means you are negotiating on price because you are placing order for large number of quantity. Now, it is not that that you can negotiate, but obvious reason is because the cost per unit production cost per unit will be lesser because you are producing in bulk. Now, this is your holding cost, this is your ordering cost, this point is the equilibrium point where this your holding and ordering cost is intersecting and this the total cost will be minimum, this is the point where the total cost will be minimum. So, this minimum cost you need to place this much quantity that is the economic order quantity. If you will place this quantity order with your vendor always for that particular item, you are carrying the minimum cost for that inventory.

right. This is how we can calculate this is the formula to find out you multiply the setup cost or order cost with the demand and then the holding cost you will divide. So, obviously the only how you can derive this equation is your holding cost equal to your ordering cost and then you can derive this equation right. So, this is how we can find out the economic order quantity. so some examples you talk about the large largest retail industry walmart giant they are implementing this grocery stores tesco is another example who are beautifully implementing economic order quantity and if you talk about manufacturing industry automotive industry electronic industry samsung toyota all these players are utilizing this economic order quantity model. In healthcare also when you are placing order for medicines, for medical equipments, so medical devices then again you can use this because again when you are placing order for pharmaceutical products right.

So, again those got limited life right. So, when you are keeping them on shelf for longer period of time. So, the chances of getting that inventory obsolete are there right. So, that also you need to take care. So, economic order quantity we will consider that as well.

Food and beverages industry again that industry is limited by the lifetime. So, you can

see restaurant chains, McDonald's, Starbucks, and Nestle. Say they all these grocery stores are utilizing this economic order quantity to place the order advantages cost minimization this model works on that right when the ordering and holding costs is both are minimum then we will place the order efficient inventory management because the minimum cost so that is why it is efficient simplified ordering process every time you know for this particular component this is going to be the economic order quantity So, repetitive routine orders you can place and in that way your vendors are also well aware that this much quantity lot we are supplying repetitively. Improved cash flow because you are not maintaining unnecessary inventory and holding cost also you are minimizing. So, obviously, so minimum cash is required to maintain the inventory.

Challenges are there, we are considering that constant demand, but that is not you know practically possible. we are considering the fixed cost that I told you this could not be fixed, right it will change, but we are saying that if for placing one order 10 rupees for placing 10 orders 100 rupees that is not possible right no shortage assumption and we are assuming this that eoq model obviously there is no stock out there is no shortage no back order right so these are some of the challenges Another this technique is DSI days sales of inventory. So, this is we are calculating the number of days we are having and or we are taking to convert the inventory into sales fine simple right. So, how many times days you are taking, how much time you are taking to convert the inventory into sales. So, you can calculate this by average age of the inventory, days inventory outstanding, days in inventory, days sales in inventory.

and days inventory simple these terms we are using interchangeably the meaning here is only so how quickly you are converting the inventory into your liquidity right into your cash so when we are calculating we want low lower DSI is preferred that means if score is less how we are calculating the score average inventory you are maintaining cost of goods sold per year right so if quickly you are selling the inventory that means that is good that means this value is lower so quickly you are depleting your inventory in the market so that is the point so pharmaceutical industry pfizer is using dsi day sales inventory. Automotive industry Ford motor is using this model to manage their inventories of vehicles, parts, components, spare parts. Food and beverage industry Nestle is also utilizing this DSI model to manage their inventory of raw material, finished goods and semi finished goods right. So, again the advantages of this is optimum inventory level, right balance between holding your inventory and then to meet the demand, whatever demand you are also considering that. And forecasting and planning, So, you can forecast the sale trends adjust the production schedules and improve the overall demand forecasting.

Financial health will improve because you know exactly what time is required to convert those inventory into sales. So, that much inventory you are keeping that only that much inventory you are keeping that. So, in that way you will be more efficient and your performance will be better. challenges again all models are suffering from this assumption of industry variability is there how you will you know tap that variability seasonality effect is there all the time you know some peak seasons are there and then there will be slowdown in the market how your model is configuring within that right so that is also important and then accounting practices what we are utilizing we are calculating the cost of goods sold how you are utilizing. So, different industry different practices are there.

So, uniformly applying one model is not possible you can see Nestle is implementing DSI model as well and they are utilizing economic order quantity as well. So, in one industry you can have multiple models for one component may be you are utilizing one or other you are utilizing other one. so there is another concept of zero inventory concept and when we talk about lean manufacturing so toyota again implemented this concept of zero inventory and this is based on the principle of just in time obviously just in time when required you will move on the production floor and no inventory you are maintaining this is possible when zero failures which is practically impossible right zero failures not at your end only at the logistics end at the storage end at the raw material vendors end right so nothing all we are assuming that perfectly going fine and we will get the smooth supply of the raw material all time right and zero lead time when no inventory just in time so that means we cannot talk about the lead time even if we will talk about 10 minutes no there is no concept of lead time when we are talking about zero inventory obviously that will address the cost will be reduced we are not carrying no carrying cost no holding cost no damage cost no waste cost no insurance cost and we will be efficient streamline processes we are intact with your production planning and control your schedules production schedules are clearly defined and you are efficient because everything is standardized and when things are standardized in the production floor you are efficient working capital minimum capital is required or in fact zero inventory no capital is required so that capital you can invest somewhere else right risk mitigation less inventory suddenly let's say there is no demand from the market right so then then then you you are maintaining extra inventory in that case anyhow you have to consume the inventory like what happened in the bike industry when vs 3 4 engines were banned so they sold the bikes almost half price the reason was otherwise what they will do with those products right after that because supreme court banned all those engines so that means you produced extra so that inventory you were keeping so zero inventory that means you can avoid those situation and customer focus customer whatever customer requires you are providing the customized product customer are also feeling satisfied and

they are loyal customers then so how it will work demand driven production whatever demand is there so there is no such concept of forecasting so speculative process is not there we will implement the pull system not the push system pull system is when the customer will arrive we will place the order we will start processing the things right no inventory is maintained in between so it's not speculative it's not reactive process right we are not forecasting anything so small batch size will be there obviously production will be done in small batch because we are not sure about the demand and we don't want to keep the inventory so continuous improvement is required to eliminate waste improve processes optimize production and delivery times and for inventory management supplier got huge rule right so zero inventory is only possible when your suppliers are ready to move or you know move the material as and when required challenges limitations are huge market volatility that you cannot consider if any disruption in the market change in the demand pattern so that that is how you will see that supplier dependence is very high because we are only getting the material when it is required. Anything goes wrong at that point and we are not maintaining inventory that means you have nothing to process. timeliness highly efficient and reliable logistics is required even if 10 kilometer distance you are traveling very near your vendors are very near so even then you have to be very efficient coordination is required for purchasing production sales department all data should be shared throughout.

Then, contingency planning, obviously, when we are not maintaining an inventory, so how you will plan those situations. So, very difficult for those situations, that is why we are keeping some stock. advanced system if you talk about the softwares obviously we need to go for the advanced system so that we can automatically we can plan the things data accuracy accurate and real time data is required that is the base for implementing this zero model And if you see, we have some custom made orders. If you go for ordering shirt or trouser, if you visit Raymond store, although they are maintaining the piece of cloth, but yes, once they will take the measures, then they will start tailoring your product. So, middlemen like Amazon, it is not purely they are maintaining zero inventory, but yes, inventory led model is also there and zero inventory model is also there.

and inventory led model is also there. So, inventory led model means where they are maintaining the inventory in their distribution center. So, that if any vendor customer is placing the order you can move the inventory immediately, but zero inventory where the sellers are directly keeping the inventory and they are directly moving the product in that way we can say this is the example of zero inventory. so another example concept is vendor managed inventory where vendor is managing the inventory at the manufacturer end we are manufacturer we are outsourcing so many different components raw material from different vendors it is the responsibility of the vendor to manage that now what are

the points for suppliers and customer when we are saying that supplier is only managing that means Optimized performance along the supply chain now, the supplier is very very clear with the information because it depends upon him only to provide the smooth supply of the raw material as a manufacturer I should always be in with the raw material there should not be any stock out right so it's the sole responsibility of the supplier and obviously when supplier is taking the responsibility of the inventory so that means improved service level so that long term relationship will work for the supplier and they know that as long as the Maruti Suzuki is surviving we as jk tyre mrf tyre or any other is surviving because we are selling them tyres for, as a you know raw material component and for the customer or i was quoting the customer as manufacturer here so for the manufacturer there is no point of stock out because now someone else's responsibility no misunderstanding in communication even that communication of placing the order is not required manufacturer is not placing the order right so it only supplier will figure out how much is required when is required and then that enhanced service level is provided so you can see that work is eliminated from the manufacturer side your whole team is working purchase department is working to get the supplies so that you can minimize We have another model ABC analysis which we can utilize to manage our inventories and this model divides the overall inventory all the raw material components if you are using thousand components will divide into three categories A, B, C and Pareto principle is used here you can see A is which is minimum in numbers, but the value is maximum. B is somewhere in between moderate quantity you are using moderate value of acquiring those raw materials.

C is huge in numbers, but yes they are contributing very less to overall value. So, to be see this categorization and percentage may change industry to industry, but yes 80-20 rule of Pareto principle is applied here where we say that 20% are things are happening because of the 80% of the or 20% of problems sorry 80% of the problem is because of the 20% of the reasons so if we will address those 20% reasons only rest 80% life we can sort out so this again this percentage is not fixed sometime it may go that 20% those A category products are contributing 70 percent towards the overall value. That means if you are spending 100 rupees to get your raw material, 70 rupees these only 20 percent items are taking. B category in between where 30 percent is the volume or numbers, but only contributing 25 percent. This can be 30, 20 or 25 may be 20 that depends upon the nature of the industry.

Category C is large in numbers, but only 5 percent they are contributing. This 5 percent can also be 10 percent in few industries. So, that depends upon the industry to industry how you are categorizing, but the overall picture is A is minimum number of components quantity required, but contributing to the maximum to overall value. the cash or capital

you are investing to get that material. So, towards the end we will just quickly we will see in production manufacturing we are talking about inventory management, in services we are talking about queue management.

The only concept is we cannot in inventories our services for later use, but in product industry we can make the inventory of the products and we can sell later on. So, nature of the offerings obviously, here we are providing the physical products. no tangible product only services experience you are getting inventory management here it is required you can do but here you cannot do here we are doing the queue management right revenue model is you are selling the products then you are getting the revenue here you are providing the services and the very basic function is your customer is always part of your production process in services industry but in production industry customer is not part of your production once you will produce somewhere in off location and then you will send that in the end market but in if you you just imagine the barber shop you are going the healthcare hospital you are going there you are getting your checkup done and then you are getting the services of the doctor pharmaceutical is product industry right that is not health the healthcare is only i am talking about where consultancy services you are getting from the doctor manufacturing and production like i told you involves manufacturing and production process no manufacturing and production process the delivery of the services is manufacturing only we can call it manufacturing right and while we are delivering the process services we are manufacturing at the same time consumption of the services are happening because customer are part of your this manufacturing process so no physical storage in services delivery process because it is happening at the time of production right so in case of production we are producing and then we are delivering so there is no in between supply chain or middle man which can do that tangibility these are intangible obviously after sales services are required here here after sales services are not required only i can record your experiences your feedback your inputs negative positive and then maybe next time I can improve only the experience you are getting out of my services right so this is how you can just compare but yes, queue management when we talk about there is queue theory right queuing theory where we discuss about how we can manage the long queues channels right we can open temporary service channels just to you know manage long queues or if there is short queue there is no one in the queue how we can allocate that service channel to something else right so these are all references you can just go through right so that's all for inventory management thank you very much