Logistics & Supply Chain Management

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Lecture 56 : Robust and Resilient Supply Chain Design

Hello dear friends, welcome back to NPTEL online course on logistics and supply chain management. So today we will start our discussion on another very important topic which is robust and resilient supply chain. So how we can design such kind of supply chain which can be resistant to any external or internal disruption if anything is happening throughout that supply chain. So we'll discuss about what are the supply chain challenges, we'll talk about supply chain risk management strategies, and then we'll talk about resilient supply chain, and we'll talk about the robustness of the supply chain. We'll discuss one case study of JD.com, who have developed a kind of resilient supply chain in that way, removing all the intermediaries so that directly you can contact the end customer.

so this is how we will proceed so first supply chain challenges now the whole world is one market and interconnected right so that means anything happening here will impact rest of the world, right? So, and then economic activities globally, things are changing. Whether you talk about either 2008 recession, which just started from the bankruptcy of Lehman Brothers, then if you talk about COVID-19, how it impacted the supply chains throughout the world, and it started somewhere in China, and then if you talk about Russia-Ukraine war, you talk about any global disturbance, you talk about recent..

. political scenario in bangladesh or any country right maybe very small country but yes the kind of you know the clothing industries are getting maximum inputs from bangladesh right and then the bangladesh or all these kind of location sri lanka can be very strategic locations in terms of getting the cheaper locations so any part of the world any disturbance is happening will impact your entire supply chain so these are kind of your challenges right which are coming time to time and these are cyclic in nature and these should be there forever right in some or other way So, these challenges are posing some risk to your existing supply chain and our supply chains are vulnerable to these kind of disruptions. So, how we can go for such a robust and resilient supply chain so that the impact can be minimized. So, first we will talk about supply chain risk. so risk management one is risk mitigation another one is risk management right so how we should you know move from risk mitigation to risk management when you have better prediction of maybe future and then you can you know in that way implementing

predictive analytics you can predict the risk coming on your way right so then obviously you can manage in better way and in advance but mitigation is something something is happening and then you are coming with your reactive process how you are responding to that situation right so we'll talk about risk management and obviously when we talk about supply chain risk can be operational risk anything goes down during the production at suppliers and vendors and or your manufacturing end then obviously your whole supply chain will be interrupted because there will be no supply of the material financial risk what if some bad debts happen how you will you know your supply chain will be resilient enough that they can absorb if any extra charges will be there if your inventory is tied up somewhere and you are not able to you know generate cash out of that you are not able to move your inventory so whether you have that enough capital to survive during that time right what if your strategies go wrong and the way you are predicting the future and something else happens how you can respond that so the steps here are we need to identify how the things are happening and in what way it can impact you need to assess the impact the amount of the impact and then you have to come up with the mitigating strategies right So effective risk management strategies involve building redundancy. So you should have enough alternatives.

If something breakdown is happening in the machine, let's talk about you are using molding machine producing different plastic parts, right? so something goes wrong with that machine whether you have alternative or you have those spare parts with you quickly you can change over and then you can again maintain that machine or maybe you have some other machine and you have that extra capacity that you can maintain same goes with whether if something goes wrong with the transportation network if you are going through road transportation whether you have the option to go by air because road transportation something natural disaster happened and the complete road is now obstructed so how you will reach to end customer do you have the train connectivity do you have the air connectivity any other way or you can diversify your suppliers if your suppliers are located nearby or maybe overseas any condition you can consider and something goes wrong with those suppliers situated in or maybe overseas right so then you need to diversify into different location if something is going wrong in the northern region maybe natural calamities are happening so then maybe the southern supply chain can can be uh efficient enough to supply the raw material right and then contingent plans you have the situational planning if anything goes wrong how you will handle that next concept comes supply chain vulnerability so how susceptible your supply chain is towards the these disruptions may be internal or external will go through what can be those disruptions right and then in what way it can impact the supply chain obviously these three flows either it will impact the material or information is not completely supplied then the resources the money is not flowing through the supply chain this way they can pose and what can be the sources obviously natural disaster cloud bursting flood

earthquake anything is happening will disturb your supply chain political like scenario i talked about in bangladesh in sri lanka what is happening right and frequently these are events are happening with pakistan as well so if your vendors are located there if or if your customers are located there in any way either your reverse supply chain is connected to these locations or your forward supply chain is connected to these locations both way you will be in trouble so how you can manage that any economic downturns like during covid 19 pandemic so if you talk about major automobile industry so sales went down like anything right so people were not having enough money because of shutdowns of the operations and then their income was also stopped right so in that way we cannot you know think of spending extra so we want to save something for you know for the future so then how you will deal with these kind of economic downturns there will be recession in the economy any unexpected shift in the demand that may be because some player came with some kind of disaster strategy and all now your customers are shifting towards that brand so what how you will respond to that what you are manufacturing how you will consume that because customers are moving towards some other brand right so then we will talk about supply chain robustness robustness of your supply chain will be defined how long your supply chain can withstand with during those disruptions if anything goes wrong with the internal or external environment still your supply chain is able to provide you the raw material to provide you the finished product and then you are you are efficient enough you are capable enough with your resources that still you are your flexibility your adaptability and agility flexibility how quickly you can be you know flexible in managing your capacities if extra demand is coming or if there is downturn in the demand how you can utilize the existing capacity adaptability how quickly you adapt to those situations those disruptions and agility how quickly your supply chain is responding right so these are some of the you know characteristics of any robust supply chain so if your supply chain is working on your these dimensions so any disaster is coming on the way you can manage in a better way supply chain resilience resilience how you can manage during that disruptions and how quickly you can bounce back right in that disruption so let's say if any earthquake is there or flood is there so obviously your main supply chain stream is disconnected so roads connectivity is gone train connectivity air connectivity there is no point right and then you are not also getting enough information because there is no IT infrastructure electricity is gone all the ways to communicate are also gone so first supply chain obviously these kind of concepts are more you know relevant when we are talking about a disaster management supply chains so maybe we are not talking about the routine products we need to supply to those affected location but yes when we are talking about a disaster relief operations so medical supply may be the first we need to ensure maybe then food packets may be the Another we need to ensure. Then maybe the clothings and other things, rescue will come in picture. So how quickly we can come up with our that strategy, talking about specially disaster relief operations. So then it will be defined if your supply chain is resilient

enough, right? so this involves you how it is possible obviously you have to build the adaptive capacity suddenly you need to produce more or suddenly you need to produce less or you need to produce something else which you are not producing right now right and then fostering collaboration and transparency throughout the network see if any change or fluctuation in the demand at the end customer right so right now what we are doing we are observing those fluctuations at may be some regional level and then we are consolidating the data at district level then we are consolidating data at state level then we are consolidating data at regional level then we are consolidating data at country level then world level we are consolidating data wherever your supply chain is working right this much time that means there is chance to You know for the bullwhip effect, which we discussed earlier, right so your information will be amplified when it is passed through multiple stakeholders so how we avoid that when you have one-stop solution, anything at any point of the supply chain is happening quickly should be shared transparent to all the stakeholders let's say if my A vendor is producing one raw material, and something goes wrong with any of the machines he is working on in his manufacturing unit. So, throughout all the supply chain, all the stakeholders should know what is going to be the implication.

There will be an interrupted supply of that particular component. Can we go for an alternative vendor? Can we go for some alternative material? How quickly we can adjust, right? This will be possible only first you need to share the information that collaboration and transparency should be there it should not be that something has gone wrong and they are repairing it and then we don't have any idea what has gone wrong right so that that is required to build the resilient supply chain one very good example of dell supply chain and we know that dell basic model is to provide you the customized product but then now again they are making to stock also and then they are keeping the stock of maybe some standardized product items and customer are going and they don't want to wait so they can pick those standard product but still they are giving you option that you can pick that So you can provide them with the configuration the steps are you design the plan price and then procure whatever the moment customers place placing order with Dell supply chain they are only then do their raw materials fly from the Asian countries Asian suppliers and finally,, they are selling in the market and then obviously any any any issues or any you know installation services or any customer support services they are providing right so in this network because they are closely connected with the last customer they are recording their information so you know there are chances that threats can be there from the external environment right and then some legislative requirements are also there which keep on changing how you need to handle your electronic equipments electrical equipments then then customer requirements are also changing and the choices are also changing these all external disturbances can be there can be some other disturbances from the raw material suppliers as well right so if

any change in that design so how quickly they are meeting those obligations so this is there So to define that under supply chain risk management process, first they need to define what is the disruption level, right? And then they need to assess how it is going to impact. And then you need to come up with some mitigating strategies. And it's not one day process or one stop solution. Today you addressed that kind of maybe cyber attack you addressed today.

It's not for the final time you are doing that. Maybe this will frequently happen. so how your system can be strong with your firewalls with your all the you know security safety you are providing to your records so that you can keep those records safe with you so continuously you have to work and you have to monitor your strategies right supply chain risk management so as i talked about it's not only a particular kind of risk within the organization only so we have internal as well as external supply chain risk let us see when we are talking about external supply chain risk obviously which are coming from the external environment you talk about social environment political environment technical environment ethical environment legal environment all these environment which are surrounding your organization any factors any cultural shift is there obviously will impact your organization any major technical technological breakthrough is there obviously you have to implement that that will impact your productivity as well any political instability obviously will impact right so these are some of the external supply chain risk demand risk any either you miscalculated your forecasting error is there or maybe you forecasted as per the how we are forecasting looking behind the previous data right so you forecasted based on that but there is something like covid 19 pandemic and there is shutdown completely shut down so that there will be sudden drop in your demand or maybe the grocery items i am now feeling uncomfortable going again and again in the market and then maybe the panic buying will be there maybe tomorrow supply chain will work or not because government is shutting down all the operation that fear may be in the customer mind so then there will be huge spike in the demand so actual demand is not like it is increasing but yes because panic buying is there then there is huge demand supply risk as the risk is posed by your forward supply chain backward supply chain is also risk because now your those supplies will be disconnected if you are having overseas suppliers or suppliers in China still that or in Bangladesh in clothing industry right So we are getting maximum be products from Bangladesh, but now their economy is the political scenario everything is shut down so we cannot imagine the smooth supply of the material obviously, environmental risks are there like I talked about, social change, economic change, political governmental or environmental issues are coming sustainability parameters you need to address these are going to impact and any business risk that is also there if in between something goes wrong or maybe your business is acquired by some other organization then the cultural shift will be there so these kind of business situation any business failure can happen so or joint ventures can happen so that

that is also uncertain right that is also kind of risk to your organization talking about internal supply chain risk yes up to some extent we can control internal risk right but then there are certain points where we cannot go beyond that so let's talk about we are maintaining fairly well the absenteeism rate within our organization but suddenly something goes wrong and all the people are going or leaving how you will manage right so obviously the quick strategy will be you will outsource manpower or something like that but yes up to some extent you can control right or if there is any disaster within the organization or fire outbreak is there or any anything so how you will control that and quickly come up with the counter measures so manufacturing risk can be there if your production goes down because of some breakdown in the machine because of high absenteeism rate today because of interrupted raw material supply then your manufacturing risk will be there business risk as i talked about disruption to standard personal management reporting or there is joint venture or you are selling your shares so that risk is also there planning and control risk planning and control is based on your forecasting only so if your forecasting goes wrong this will go wrong right mitigation and contingency risk how you are handling the situations in hand and then those you are having some plans but those plans are not going as per the disaster or risk is posed to your supply chain so this is also kind of risk so this is again you can define vulnerability Is risk plus your exposure. And we have external risk. Demand coming from the outside environment.

And then there can be uncertainty. Sometime customer is ready to wait. Sometime customer is not ready to wait. So you are getting very short lead time.

Margins. Markdowns. All those things are there. Environmental challenges are there. Security related. Any cyber attack is there.

Or any other attack to your supply chain. Or maybe IPR leakage. That also can happen. internal so anything goes wrong internally with your production process with your purchasing with any department working within our organization accounting purchase so if anything goes wrong with the accounting that means bad debts are increasing day by day so how you will maintain the liquidity ratio how you will maintain the cash required to meet the day-to-day obligations right so these are kind of internal risk so how we can come up with the supply chain risk management strategies right so obviously as I told you the global impact is there and you cannot work in isolation so first approach is you can leverage on PPRR risk management model that works on prevention preparedness response and recovery four parameters are there so that means first you need to take the precautionary measures how you can prevent yourself from the disruption second is if you are not able to prevent yourself then preparedness so you must come up with some

contingent plans so that that situation in hand you can deal and then response how quickly you are responding Right responding to that particular situation only, which is abnormal, and then you come to a normal situation how quickly you are recovering to the normal situation so manage environmental risk in the supply chain and This pandemic, other than that, what else can you code here to how we can manage the environmental risk? During the COVID-19 pandemic, all your supply chains were hit badly, right? And if your suppliers are based in China. And then already in warehousing, transportation industry, logistics industry, we have seen we are failing.

We are falling short of your manpower. So then, workforce shortage is always there. So in that way, your supplies will be delayed, your manufacturing will be delayed. So in the end, customer will They have to wait for the order. So how you can mitigate that? Multi-sourcing model.

Instead of getting from one supplier or two, maybe you can go for a multi-supplier so that smooth supply can be ensured. And you have seen that during COVID-19, many breweries started producing sanitiser. close industry to that but yes earlier they were not doing that right ford started manufacturing ventilators there was huge demand of ventilators and there was no demand for automobile so obviously let us utilize the existing capacity manpower resources and then In that way, you can contribute something to the society, right? And we can go for some risk assessment software. These software will help you to, you know, go for predictive maintenance, to go for, you know, predicting the future risk coming, disaster coming, and in that way, you can minimize the impact. So, key strategies include diversify your suppliers, many suppliers, and sourcing closer to.

Now, earlier we were talking about offshoring. now we are talking about nearshoring earlier we were saying that let us go overseas to get the raw material because quality will be improved price will be improved and those cheaper location we can get the benefit out of that right now we are saying if these disruptions are so frequently happening you need to set up your vendors nearby so that you can implement just in time so that you can maintain zero inventory or near zero inventory right that is only possible when your vendors are very close to you or any disruption change in the demand pattern change in the product you can easily modify at the vendor end because they are very close to you so these are some of the strategies regular stress test you can do building inventory buffers yes and technology you can utilize so you need to store more they are this is the solution but yes if you want to store less, let us go for a near-shoring set up your vendors ask your vendors to set their manufacturing plant near to your manufacturing plant right so that supply chain distance they need to cover very minimum distance so in that way if

anything is going wrong other part of the world still your supply is maintained this is another very important decision when you are picking your freight carrier partner right who will be your carrier partner so obviously we had talked about in detail heavily we are relying on road transportation somewhere around sixty percent and only one percent we are going through air and this is also carrying very less share maybe five to six percent and then train rest of the share we are shifting through trade but yes if you talk about the sustainability measure if you talk about the cost this is the most efficient if you talk about that delivery time lead time this is the most efficient shipping through air right but yes you still see we are struggling with this and sixty percent we are transporting through road and when we are doing this We need to evaluate the existing carrier system, so how can you evaluate obviously, we have certain parameter transit time, how much time they taking to transport the material may be on average you can find out per mile how much time the ship is taking the air aeroplane is taking the your train is taking the through road you are taking a number of stops and average stop time how many time your carrier is stopping in between right even if it is not required and then it is stopping so that means stopping means taking extra time average loading time how quickly you can load your stuff your load on that ship on that aeroplane on that train that also you can calculate because any delay will cause the overall delay route optimization how easily you can go for route optimization because that will minimize the fuel minimize the time and then maintenance schedule if your carrier planner they are planning the maintenance in advance that means there will be minimum breakdown and when you have planned maintenance that means you have the alternative plans as well so implement a logistics contingency plan if plan A fails how you will proceed for plan B and then this is how it is required in such kind of crisis where we have talked about the covid-19 then conduct internal risk awareness training we need to go for mock drilling type of training programs and we need to train our staff for these kind of disruptions right and what should be the parameters how we can train them we can go for common supply chain risk what can be the risk and how it will pose challenge if this is happening how it will impact our supply chain then what can be the best practices during that time how we can leverage the technology and share the information throughout and how we can implement the softwares for predictive analytics so that we can predict the future we can predict the risk coming on our way consistently monitor the risk obviously this is not one one time measure right that today you figured the risk and then you took the strategy maybe tomorrow bigger risk is coming so continuously you are measuring the risk you are measuring the scale of the risk also and accordingly you are also scaling your operations and risk mitigation strategies use data to model key risk event scenario so this is a kind of predictive analytics we can use so if we talk about we are using molding machines many molding machines are there so if we are planning the maintenance using predictive analytics if we are planning for a obviously we know when we need to plan for b when we need to go for maintenance for c machine right so your ai your data analytics will help

you to identify today we need to repair this machine so this is planned maintenance so obviously you can have the continuous planning right consolidate your data for easy access so you should find the unifying source of collecting the data and it should be you know shared throughout your supply chain right and before sharing you should be able to consolidate if i want to record the customer buying patterns i need to get the data from the retail show I need to get the data from the organized retail as well as from the unorganized retail store. So many different apps if we are selling online then also I need to get the information. So this is how we need to consolidate data from different sources. resilient supply chain and if we will talk about the temple of supply chain resilience the foundation is obviously based on your supply chain strategy aligned with your competitive strategy we have talked about this in detail if you are saying your supply chain strategy you are very fast very responsive you need not to care much about cost first priority is how quickly you can deliver the emergency product to your customers right the floor is obviously product design is very important if your product design is so typical very difficult to find out the raw material the component the structure the shape of the component is also very difficult to maintain for longer period of time so that means your product design is not that easy which will again and again will affect your supply chain performance because today or tomorrow there will be quality issues there will be delivery issues there will be issues getting the raw material then if we'll talk about four pillars of that temple obviously agility Collaboration with your partners, supply chain risk management, how in advance you can predict the risk and your supply chain design.

How you are designing the multi-modal structure so that all the mode of transportation, how you are managing within your warehouse, how you are maintaining internal supply chain in the manufacturing plant. So, you will come up obviously with the top roof is resilient supply chain structure. right so and this this is not today you achieved this resilient supply chains for tomorrow also the same model will work obviously you need to tap some more parameters you need to go more advanced more strategies will be there and thus you can see how you can do you find multiple suppliers and then build resilient inventory management so inventory management obviously we discussed in inventory in two sessions we were having on inventory management So, there we talked about we should maintain minimum inventory because inventory can go obsolete we can destroy the inventory in the storage. So, the other system we can do is just in time or near shoring where we are setting up our vendors near to our manufacturing unit. third is harness the power of advanced technology we can implement strong relationship with the buyers or all the stakeholders not only buyers map the risk in advance predictive analytics then strengthen your transportation and logistics network go for route optimization for all the modes of transportation not only you are depending on road transportation and then sustainability measures are important how this resilient supply chain strategy can sustain for longer period of time right that will only sustain when you are keep on adding the

extra parameters talking about supply chain vulnerability we have already defined your how much your supply chain is susceptible to your external or internal disruptions right so many studies are there and many threats have been identified barriers enablers of implementing this particular issue so quickly we can go through the drivers of potential vulnerability first is planning and supplier network right this is totally based on forecasting anything goes wrong little higher error in the forecasting you're planning at the vendor end storage and manufacturing and distribution network everything will be disturbed right transportation and logistics again how resilient is your physical flow of the product so that will define whether you have alternatives to if road transportation is obstructed due to anything so how you can transport your material your emergency supplies your medical supplies to drone financial resiliency how flexible your company is if something goes wrong if you need to invest little extra how you can maintain that product complexity already i talked about your product structure design should be as simple as possible and not only product design your manufacturing design your production line should also be very very simple so that should be minimum to error prone right so then organizational maturity how mature your organization is to handle all those disruptions and again some of the supply chain vulnerability drivers we can see supply side risk obviously quality is interrupted then the overall supply is interrupted so quality may be incoming incoming raw material quality is important right diverse delivery risk anything goes wrong during delivery that supply is delayed supplier dependency obviously you are getting all the raw material supplies from your suppliers so dependency is there operational risk anything goes wrong machine failure or strike or any disaster will disrupt your total operation right demand side risk any fluctuation in the demand any spike in the demand right surge in the demand how you will handle that environmental risk any threat that is coming from the environment in terms of all those parameters we discussed then it is also posing threat to your supply chain how we can come up with the robust supply chain and that is based on how long your supply chain can withstand with those you know adverse situations happening around and the key aspect already we discussed about redundancy how you can go for different alternatives options you have whether you talk about supplies production warehouse transportation flexibility how quickly you can be adaptable to your new situation the disaster and how quickly you can come up with that right so resilience how long you your supply chain can sustain with that visibility if anything is happening at any part of the supply chain it should be visible throughout all the stakeholders so that all can plan their their planning can be done as per that disruption Collaboration, obviously this supply chain is game of collaboration only because we are never talking about single player.

Here we are talking about all the stakeholders starting from the suppliers of supplier, the first supplier to till the end customer, right? risk management already we talked about we talked about the role of technology how it can be important when we are talking about

data analytics we can go for predictive you know maintenance of the machines we can predict the if any risk is coming we can predict the weather conditions we can predict the traffic coming on the road in our way we can predict if any accident has happened how we need to take the another route all these things are real time data real time information and real time informed decisions can be made so this is how we can go for a robust kind of supply chain you need to plan the demand then that demand you can plan with your suppliers you need to maintain inventory from them then logistics and transportation is there and finally information system will play important role to integrate all these stakeholders This is very beautiful case study of JD.com. You can go through the full case. I'll just highlight the main key points. This is self-operated mode.

Initially, they started. They used to purchase all the products and then they are selling online, right? So, directly they are connecting with the So in that way they are responsible for all the processes like inventory management, distribution, delivery, after sales everything. Anything is going wrong at the customer end they are directly responsible for all those things. Any delay is happening that also they need to take care. But now they have changed this model and some affiliated JD affiliated stores are also there and those are handled by independent merchants. But still you can see 60% share is JD.

com is directly interacting with the customer providing the product to the end customer. now if we will talk about the traditional supply chain we have all the players i think i have yes it is there we are from brand manufacturer it is going to general agents distributor retailers carry forward agent wholesaler distributors huge chain is there but this is the simplified structure where only JD.com is there in between customer and manufacturer they are getting the supplies directly from the manufacturer from the factories from the vendors sub assemblies they are directly sourcing right and then they are maintaining the inventory and through this the inventory is channelized now the plus point of this is when you are having this kind of structure obviously there will be minimum disruption in impact how because you only have to manage everything so you know the information this is the going to be the disaster and how we can implement because within one organization you need to maintain so high level of collaboration obviously because minimum stakeholders are there almost all stakeholders are removed when we are talking about the forward supply chain so high level of collaboration with your backward supply chain will do enough for you effective information sharing see information is delayed or maybe sometime manipulated or over amplified when we have multi stages to share that information but in JD.com only JD.com is there so that is not there high level of agility is also there quickly they can respond to the conditions they have the intelligent platform they have all the software to predict the disaster to share that information and human intervention is also minimum because they are going for

automated planning if anything is disruption is there in the demand automatically it will be configured in your demand function will be shared with your vendors will be shared with your suppliers and JD will automatically will plan for those type of inventories so this is how this total JD.

com business model is working right you can go through this total case and you can see in that way we can be more efficient because we are maintaining disruptions in beautiful way so this is how we can conclude for any supply chain handling risk resilience robustness and vulnerability to external environmental fluctuations disruptions is very important and instead of going for risk mitigation we should go for risk management we should in advance we should predict when and how much going to be the impact right and then we can come up with our resilient kind of supply chain how we need to react during that disruption and after disruption how quickly we will come back to our normal operation there is one very beautiful case study of nissan if you can go through that happened disaster happened in earthquake was there in japan and within i think 18 or 20 days they came back to normal production lines this is this is something huge if we will talk about huge success when we are talking about supply chain resilience robustness right so this is all about for this session these are some of the references you can go for further reading thank you very much