Logistics & Supply Chain Management

Professor Vikas Thakur

Department of Humanities & Social Sciences

Indian Institute of Technology, Kharagpur

Lecture 41 : Supply Chain Performance: Balanced Scorecard Approach (Contd.)

Hello, dear friends; welcome back to the NPTEL online logistics and supply chain management course. So in the last session we discussed about balance scorecard and in this session we'll continue the discussion how we can implement the balance scorecard approach in supply chain, measuring the performance and how we can improve the performance in different all those four perspectives. So already we discussed about the basics of the balance scorecard, what are those different four perspectives related to customer, related to stakeholder, related to how we are learning, how we are growing, our internal processes, how we can implement, how we can improve those processes so that we can tap all those performance indicators and we can improve that. So, we will continue this discussion and we will find out the balanced scorecard for supply chain, we will discuss about the quality delivery cost performance indices and then we will see how we can measure the supply chain performance, different techniques and we will end this discussion with one case study. So already now we know four perspective.

So what are our financial results? Financial result in terms of profit, in terms of market share, in terms of return on investment, how much we are investing in all the areas in your warehousing, keeping extra inventory, whether we are getting those returns, we are renovating innovating the products with our r&d team whether that investment is getting we are getting the you know fruitful results or not so we'll measure in terms of financial performance right and internal business processes so machine productivity customer responses time machine productivity means how we can improve that maybe we'll come with the new technology or not if new technology how efficiently we can use the old technology and we can improve the overall performance. Improve and innovate how we can internally we can improve our resources we can in that way we can empower our resources in that way so that we can utilize those skills to satisfy our customer with the quality with the delivery parameters and also we are cost efficient so clients so client satisfaction all the clients stakeholders involved in that value chain how we can make them satisfied so we'll quickly go for this balance scorecard approach and we'll see what can be the financial measures when we are talking about supply chain specifically so first is how we can decrease the cost right so there are so many different ways if you are you know negotiating on quantity with the supplier then also you can decrease the cost if you are automating your warehouse you can decrease the handling and storage cost if you can implement a point of sale system where you are directly linked with the sales team you can minimize the inventory right so spending and cost of goods sold how you can analyze your spending you can do the spending analysis so how much your transportation is contributing in that how much your logistics is contributing in that how much your manufacturing is contributing your raw material suppliers contributing so that you can find out and then you can compare that ok your logistics is contributing 14 percent but the industry average is 10 percent how we can improve by this 4 percent gap right Resource optimization, again routing, vehicle routing, warehouse optimization, manufacturing facility optimization, payment terms, financially, how we can negotiate with our vendors that will make payment in 30 days or 60 days or 90 days. Longer period you will get, that means your negotiation power is high. leveraged agreements if you have said that 90 days payment you can leverage on that period right you can extend the payment so for that period it may be that cost that financial cash you can use somewhere else supplier consolidation this also when you are you know maybe for one supplier you are ordering different components dealing with the same kind of you know metal if you are doing dealing with same supplier can supply the multiple products also And not so if only one component, so then you can consolidate the order in large quantity, so that on quantity you can negotiate.

you can find out the cheaper location and then competitive bidding then open competitive bidding can be done so whosoever is cost efficient quality efficient you can use that so this is financially how you can improve business processes sourcing methodology already we discussed about that vendor rating will help you to pick the best supply your stakeholder and then sourcing how much purchasing if you are talking about strategic sourcing long term vendors you have developed so how you will do the purchasing decision how frequently you will buy what will be the lot size right what is the lead time whether you are implementing just in time to cut down the inventory cost so then your strategic sourcing is required risk protection what if you are dealing with some kind of uncertain market and then suddenly you need to phase out your product so what you will do with the inventory raw material inventory supplier alliances, contract management, performance management these are some of the internal business processes how you can handle with your stakeholder means all the processes you are doing or dealing with your stakeholders you need to improve that right decision making skills how predictive analytics big data analytics and those tools software you can use to predict your demand to predict supply to predict the fluctuation not only in the internal environment in the external environment in the internal environment also you can use this like total predictive maintenance when a particular machine requires the maintenance before breakdown happens how we can maintain that so that there should not be any breakdown, no rejection should be produced. learning and growth team building we can do learning and growth means within all the resources how we can develop those resources develop the skills so that maybe some sometime it happens during recession one of very beautiful example what Infosys did like when all the industry during that 2008 recession when major IIT stakeholders they started firing their employees but what Infosys did They retained all the employees and delved their capabilities. They took it as the time for pulling up your socks and whenever again there will be market demand, you can run in the more faster way. So, that will help you to satisfy your employees, your turnover rate you can manage. attrition rate you can manage so the example I quoted that you need to maintain if you need to maintain your employees for longer time you need to show them the proper career path development path their development should not saturate then customers how we can satisfy customer with different features variety customer services how we can improve the quality prices whatever price they are asking in that price range whatever quality you can offer so and after sales services your branding whether your customer is feeling comfortable you know when your customer is bearing that brand, using that brand, sometimes you are wearing very expensive watch, then always you are showing that or you are carrying that image that you are wearing Rolex or you are using that kind of stuff, high status product, so that is attached with the customer performance.

So we will go through financial perspective. in supply chain all the KPIs which will help us to configure your financial function. So, cost reduction talking about I have already discussed in the previous session where we are involved with the cost function. your material acquisition, handling, storage, transportation, manufacturing, distribution all these functions are adding cost so how we can reduce the cost return on investment like if we are investing on something let us say we are investing on developing technological infrastructure right so that technological infrastructure is helping you to fetch more customers right if you are saying that amazon today will announce that all the deliveries will be done in the same day that means technological implementation will be there and you need to fasten up your distribution network if you are doing that huge investment will be there even for sometimes if one person is carrying maybe more than 200 orders even sometimes 100 also they need to deliver. right so that investment if you are doing whether you are fetching more customer more traffic is coming to your website then revenue growth is happening if sales are increasing then it is fair enough you can go for the improvement right second is client or customer perspective order fulfillment rate how quickly you are fulfilling the order customer satisfaction score feedback whether customers are giving you the high feedback or not or if you are getting lower feedback you need to prioritize those area where you are getting lower feedback very small example let's imagine you order AC through flipkart now flipkart gave you the best pricing option you are very happy you are getting the cash back also then they are giving you free installation services right this is what flipkart could do maximum they did this now now they have to deliver this product within that time using the local retail partner that is also may be they can ensure that within that delivery is done but who will do the installation the local technician who is coming from that if you are buying from Hitachi that technician will come if you are buying from Whirlpool, Whirlpool technician will come so then your feedback is not only your feedback it is associated if delivery person or that installation technician is coming late not behaving properly with the customer you as that service provider will be rated maybe you did everything right but there you lagged and then you got lower feedback so then you need to it's not that you will just say that that is not my you know area or jurisdiction area where I can control those things but then I will think about that player who can control the installation services also right so lead time how much time you are require you know taking to fulfill the order internal business process perspective talking about the improvement of supply chain you can include KPIs like cycle time how quickly you are completing the order how quickly if you are manufacturing how quickly you are changing over from one model to other model inventory turnover how much inventory you are keeping and how much how quickly you are selling that inventory in the market right ,supply chain flexibility how quickly your supply chain can adapt to the changes if any demand for new product variety or any supply disruption is there any disaster happens any strike is there still your supply chain is resilient enough to you know absorb all those uh disruptions within the supply chain and then you can still maintain the smooth supply innovation and improvement so how you can ensure your kpis targeting continuous innovation Philips and you continuous innovation right innovation and you that is the tagline for Philips right so implied training and development technology utilization innovation rate how quickly you are innovating new products coming up with new products how quickly or what is the you know technology penetration rate, how quickly you are implementing new technology.

If there is WMS, warehouse management system, whether you are implemented or not. If we are talking about industry 4.0 supported system, whether you are doing that or not. So how quickly you can improve and innovate. So let's talk about this supply chain perspective, this balanced scorecard framework, specifically with the procurement.

talking about procurement financial measures will be how we can save cost that means we need to negotiate with the vendors how you can negotiate with the vendors when you are having more purchasing power when you are buying in bulk right so that means that purchasing power you can use to negotiate with the vendors total cost of ownership you are calculating it's not only the raw material cost so how he is delivering storing in between that cost is also there what is the cost per unit or per transaction you can calculate and what was the procurement budget and whether you are hitting that budget as per the planned budget or you exceeded or you managed within under that budget right so that means you are performing better Depending upon customer, how many complaints are coming, right? Customer, which are directly related to your vendors, right? So let's say one component is not working properly. So that means you bought TV or then you suddenly realize that your sound system is not working properly, right? so that means from where you are ensuring that system so that is the response so you need to do the why why analysis why that happened so then you will find out quickly that this is happening because of the problem in the component of sound system right internal customer satisfaction we can use cross functional teams for selecting and evaluating suppliers we have already discussed in detail how we can select the vendors based on that any customer complaint is coming directly related to the vendor of that particular component so that is the responsibility of that vendor and we need to improve that with collaboration with the vendor. Internal business processes like procurement. procurement is how you are raising the purchase orders when you are sensing that there is you know the inventory has depleted up to that level you need to again replenish the inventory how quickly you can do that kanban production system you can implement right So, when you are raising the purchase order you need to keep in mind the quantity you are purchasing so that you can negotiate the price then you need to keep in mind the inventory also. So, one way you are negotiating the price of acquiring that material other way you are increasing the inventory cost.

So, average value of purchase order you can calculate learning and growth. so how your stakeholders are learning and implementing certifications if you are talking about ISO certification quality certification whether they are ISO certified or not so it is important if you are claiming ISO certified your vendor should be first ISO certified because you are getting raw material from them so then employee satisfaction and turnover these are the points we discussed in the balance score card how we can implement balance score card in supply chain these are some of the steps define your strategic objective first is you need to define the supply chain reason and your objective if you are saying you are cost efficient then you need to stick to that if you are saying you are responsive you need to stick to that if you are saying that you are providing a variety of the products you need to stick that so if you are saying that we are covering the maximum pin locations you need to stick with the distribution strategies right develop specific matrix once you have defined the strategy you need to develop the specific matrix if i am saying i am serving to all the pin codes in in india that means I need to develop some specific matrix related to distribution network, how much lead time for particular pin code in rural area, in urban area, in 7 urban area, in metro city so whenever you will say one day delivery you will keep in mind what are those location where I can ensure one day delivery that is one matrix so that means when you are coming up with new strategies so you need to figure out whether that same strategy one day you can implement in the rural area no because the demand you cannot consolidate in that way very fragmented demand is coming right so that you cannot ensure once you have developed the matrix you need to collect the data so now you know lead time you are recording inventory cost you are recording transportation cost per unit per kilometer you are recording or manufacturing cost per unit you are recording you need to record data ,today whatever you have produced you need to record the what is the cost total cost review and adjust then you need to make the informed decisions that these are some of the area where you need to target so those areas which are contributing maximum to the you know cost you need to may be these are some of the area which are contributing to the cost so leave those area first we need to tap these two areas may be which are contributing around 60 to 70 percent again 80-20 rule you can implement Pareto analysis you can do and then foster collaboration anything you are implementing that will be implemented through your stakeholders so collaboration need to be ensured so quickly benefits of stake using balanced scorecard Holistic approach, we are including all the functional units, all the stakeholders. Strategic alignment, whatever your strategy is, you are aligning all functional units with your strategy. Enhanced decision making because more informed decisions based on facts and figures and continuous improvement because internal growing and learning and sustainability that parameters we are tapping here. So under supply chain, we'll discuss about the quality delivery and cost.

These are the main performance index, right? Which you need to tap. So always we need to make the trade off what are the constraints right and what are the variables how we can deal with those it's not that any day you can make any promise every industry every player is working on some limitation some constraint some are limited by quality some are limited by capacity some are limited by variety some are limited by their R&D skills and they have their own USPs as well their strength area as well right So, you need to define where you are standing. So, quality performance indices we will see and delivery and cost performance. So, quality performance percentage of rejection that means number of defects received and total number of items received. So, how much percentage 10 percent rejection? that means this much rejection daily you are dealing with either you are talking about let's talk about the raw material you are getting so whatever you are using 10 percent is rejected without using that means those many defects are coming once you have produced that you ship that in the market from market 5 percent products are coming back because during shipment damaged Defects per million opportunities, usually we are using this measure to implement 6 sigma where we are saying 3.

4 defects are allowed per million opportunity. So, how we are calculating that? Number of defects found, total number of items tested. So, that is defects per million opportunity. Supplier rejection percentage. Number of rejection, total number of suppliers.

That you need to find out. What is the supplier rejection rate? If your supplier rejection rate is 3%, that means 3% of your suppliers, whatever they are supplying, usually you are rejecting those items not up to the mark as per quality. But this is, again you can compare with the best performance industry. Percentage known compliance. number of non-compliance total number of observation right so if you say let's say you are dealing with the raw material quality so many zero hour rejection is coming that means whenever you start using the product you just inspected that and you just observe that there is something wrong with the product that means then you how you can improve that you started some compliance measure that they need your vendors need to send the QC reports whenever they are sending the lot that means they need to inspect the quality only then they can ship the lot now this is one measure you have picked but they how many vendors are complying to this QC report may be all the vendors they started implementing but you will receive 10 lots out of that only 8 lots you are getting the reports rest 2 lots you did not receive the QC report of their outgoing quality control so that means that non-compliance percentage non-compliance rectified so how many you are rectifying means you raise this complaint that this time out of ten two lots we did not receive your outgoing quality report so how quickly they are rectifying that that also you can measure next is delivery performance in it supplier on time delivery and in full delivery if i am placing grocery items order i placed order for fifty items so forty items you delivered in time and then rest of the 10 items were not available that means that are not in full so this is you can calculate how many items are in full how many are placed you can find out the percentage delivery in full on time percentage delivery in full percentage delivery in time minus percentage rejected so you delivered on time full quantity but then because of some defects out of 50 items 5 were returned back supplier lead time variability whatever you are saying three times is the delivery time plus minus one day that means that is lead time you are looking for overall lead time actual delivery time required lead time this is overall lead time right percentage of shipment arriving in good condition how many shipments are arriving in good condition how many defective shipments are there that you can find out the average average delivery time so sum of total number of period from dispatch to receive total number of shipment so these are the delivery related performance index you can calculate for the individual whatever you are recording cost performance index now you can record the cost performance also cost performance index whatever earned value whatever actual value actual value you said may be hundred and then the earned value is hundred that means one perfectly whatever your budget was exactly your project is going as per that right if it is greater than 1 your budget is your project is under budget that means cost efficiency is there ,100 you can spend but you completed within 90 bucks only that means you are efficient but if you are spending extra this factor will be more than one so you can just quickly go through earned value is planned value into percentage complete and planned value is the authorized budget assigned that is planned value and percentage complete what percentage you have completed and the actual cost is the total cost incurred for the actual work performed right so this is how you can find out the earned value divided by the actual value cost performance index so cost avoidance actual purchase price what was the actual purchase price and lowest quoted purchase price so you invited the tender what was the lowest price and then maybe you finalized you did not finalize the lowest one depending upon the quality delivery schedule you may pick the next lowest so then that will be the cost reduction what was the actual price you did not may be the actual pricing may be 100 rupees this lowest quoted price was 80 but you picked the vendor with 90 so this will be 100 minus 90 because 80 if you will pick may be he was delivering little late so then you picked the other person right Procurement ROI, cost reduction plus cost avoidance divided by cost of procurement operations.

Procurement cost as per percentage of sale, so how much you are total selling, what is your procurement department is adding into that. So if your procurement is adding maybe 30% cost, so then you can see your procurement if you are including procurement of your raw material suppliers so right acquisition cost total cost of ownership so you can compare the other industries somewhere maintaining 28% so you are 2% you know not cost efficient your competitors are 2% cost efficient than you so you need to you know negotiate better than with your players your partners how we can measure the supply chain performance some techniques quickly we will go for inventory investment already we discussed about what are the different inventory we are maintaining calculation how we can manage the percentage of gross or net revenue right this can be measured as the percentage of gross or net revenue means what is the gross and how much inventory is adding into that always 10 percent inventory is adding into your gross right so that we can calculate how we can optimize it by aligning our operation planning with the sales department sales and operation planning and then we have some methods value stream mapping where we can delete all the known value adding activities and we can do the value stream mapping quick change over single minute exchange of die right how quickly we can change over from one model to other model kanban system where we can use red green yellow kanban production system where we are using those bins how quickly as we are depleting the inventory how quickly we are replenishing the inventory in the bins that visual representation can be done inventory efficiency inventory turnover we are usually calculating what is the cost how quickly we are moving that inventory in the market. So, you can calculate annualized cost of goods sold and average inventory investment divided by measures how often inventory is replaced over the year. Already we discussed about inventory terms. Days of supply, inventory investment into daily cost of goods sold divided by number of days needed to sell current inventory based on forecasted cost of goods sold.

How you can optimize? Exclude all those excessive and obsolete inventory. If today it is not required, may be required for after 60 days, 90 days, 100 days, then do not maintain inventory for that. Again, these are some of the tools, value stream mapping, 7 ways already we defined, we defined this siphon based where transport extra transportation is waste extra inventory is waste extra motion movement handling of product from here to there is waste then your waiting time is waste over production of something is waste over processing is waste and defects you are producing is waste obviously so kanban system can be implemented to enhance the just in time On time delivery performance, how we can measure? How many times your orders are on time? and maybe you can measure how many times your orders are late so you can implement that lean six sigma right so a value stream mapping is another point where you can find out where your deliveries are delayed or conveyance system where you can implement just in time whenever the demand is coming from the customer you can quickly replenish the inventories and the start the manufacturing process right forecasting accuracy usually we are calculating let us say this is the actual demand, this is the forecaster demand. So, if you are measuring the average deviation will be if you are measuring this whatever is the deviation is the error in the forecasting. So, let us say if this is the demand, 1 time you predicted 5 extra, other time you predicted 5 less.

If I will add this, this will be 0. So, your deviation will show 0. That is why we are calculating average absolute deviation. Here we are considering the magnitude only. 1 time 5 extra, 1 time 5 less, this will be we will take only the magnitude.

That means total 10 is the deviation. Root means square error. actual demand forecasted demand you will square right and may be you will sum up all the items divided by n and that root mean square error this is how you can find this in forecasting we will discuss in detail so whatever actual demand is there whatever forecasted demand any difference in that is the deviation simple concept how we can improve that if we are having sales and operation planning whatever you are selling sales department is directly linked with the manufacturing department right So, we can do time series analysis, we can go for regression analysis where we can predict our demand in better way. Lead time. how we can calculate the lead time lead time is whatever activity you are doing when you are starting when you are ending so if you are doing any non value adding activity in that you need to remove that which is not required and still you are doing so that you can do that quick change over how quickly you can change over from one model to other model on the same production line or may be in molding machine you are putting one mold or how quickly you are changing the other mold right 5S approach will help you to implement this.

We talked about series. Japanese term where we talked about we need to sort the things.

We need to set in order. We need to shine the workplace. We need to standardize the process so that the efficiency can be managed and we need to sustain whatever we are implementing.

Unplanned orders. so unplanned order usually that you did not forecasted and that are coming you need to handle those orders but these orders are actually you know carrying more cost because you did not plan for that so if that how you can improve those if you can minimize the unplanned order how you can minimize if you are having accurate demand prediction right so that standard operating procedure you can implement you can effectively implement this sales and you know operation planning and customer collaboration where you can record what is going to be the demand from the customer end schedule change again if there is any change that change can be because of shortage in raw material equipment is not working let us produce something else main power is not there let us use manpower and use that facility and produce something else right impacting efficiency this because when we are changing obviously the efficiency will be lesser in that way so how we can ensure less schedule change should be there we should ensure total productive maintenance where the equipment should not be down right and then we can implement 5s housekeeping approach we can use mistake proofing poka yoke system or we can use jidoka system already we discussed when we discussed about the quality tools how we can implement these kind of you know lean tools when those will be error free over due backlog so when your backlog is there why backlog will be there because these are down your manpower is not there your raw material supply is not there your equipments are not working properly so then your back order will be there so that you need to maintain using these technologies again same you can implement material availability how many time material is available in your storage room you are producing something and then suddenly you are out of stock you are not having raw material supplier because the person who supplied the raw vendor who supplied the raw material is rejected by your iqc team now your what you will do with that manpower with equipment with facility because that will be sitting idle right so how you can ensure that again same tools you can implement at the vendor location as well so that they should have planned maintenance they should ensure the minimum breakdown of the their machinery and error should be avoided excess and obsolete inventory should not be there that will only happen when you are keeping excess inventory when you are away from the customer you are not able to predict your demand accurately and usually this happens this here we cannot control because new product you are offering you are never sure about the supply you are never sure about the demand sometime maybe it will be taken positively sometime negatively so then how you will you need to ensure the availability also so that you will maintain the inventory customer, customer service target what is your customer service if you are saying that your delivery is delayed that is one performance measure you need to do the root cause it's not that your delivery partner did the mistake delivery partner you gave him four hours to deliver that he did within four hours may be the delivery courier partner who is supposed to pick the order from the seller within 4 hours he did not do that in 4 hours that's why the overall that ripple effect was there and the delivery was delayed so you need to do the root cause analysis why that happened perfect order when you are filling all the demand on time all are whatever you are delivering are accurate your order is recorded accurately so then it is perfect order called perfect order so that mistake proofing should be there and standardize the work so that efficiency can be maintained what is the gross profit margin revenue minus cost of goods sold right so you can implement lean six sigma project balance score card to improve the overall the efficiency as well as the your productivity also productivity will be improved your cost will be reduced your total profitable increase return on asset if all the assets how much return is there how efficiently you are using if one production line you are not using 24 hours and it is made to you know to use 24 hours so then somewhere your assets are under utilized right gross margin return on investment already we discussed about if you are implementing some technology for the betterment then what is the return on that technology that also you need to record this is one quick case we will go through so shipbob is leading technology enabled third party logistics provider and they are optimizing their supply chain operations and they have implemented the balanced scorecard approach right and we will see how they have picked different KPIs Perfect order rate, whatever we are delivering should be in complete quantity, quality. There should not be any return high perfect order we need to maintain. This is one criteria they picked. Supply chain cost, what is the total cost? Supply chain cost, whether you are talking about the warehousing cost, transportation cost, last mile delivery cost, you need to reduce that. So they developed the matrix where you can improve.

They went for updating their warehouses where they implemented warehouse management system. They optimized labor and storage and transportation cost as well. order fulfill rate how we can maximize this so that we should not say no to our customer that will only happen when you are implementing predictive analytics your software to you know address the demand accurately you should not be stock out you should not be maintaining excess inventory what lead time and then supplier relationship so lead time only you can minimize when your supplier are sitting very next to you so that means whenever it is required you can implement that cash to cash cycle if lead time is minimized let's say if you are taking five days to deliver the product obviously you will get the payment after five days if you are delivering the product within one day you will generate cash in one day right so that means quickly you are generating the cash out of selling your store so this we can conclude that this your balance score card is the comprehensive framework we are not only the financial measures you can track but all the known financial measures but not only with one department you can include all the departments whether your value adding activities or non value adding departments but all are working towards one single strategy right and that strategy is hitting your vision so you need to tap all those KPIs develop those KPIs measure those put the right target achievable target and then you can take the initiatives whatever initiatives are required so these are the references you can go through so that's it thank you very much