Supply Chain Analytics
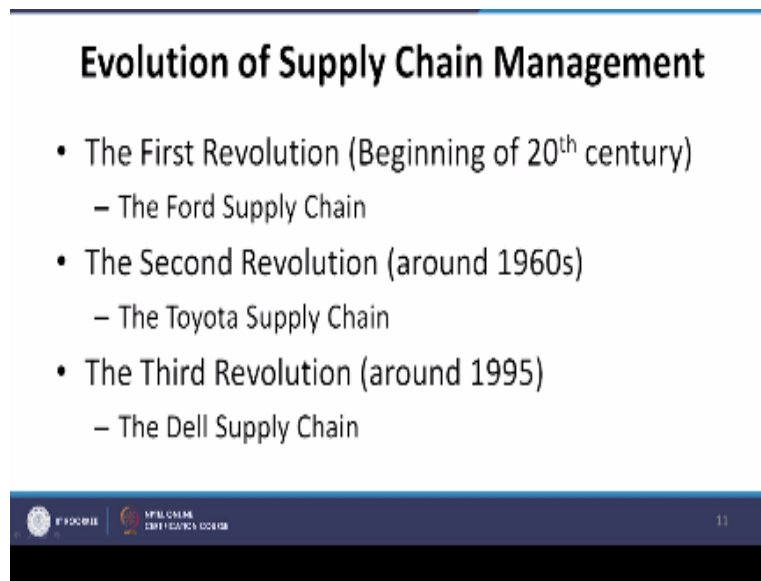**Prof. Dr. Rajat Agrawal**
Department of Management Studies
Indian Institute of Technology-Roorkee

Lecture-02
Evolution of Supply Chain Management

So in our first lecture we discuss the role of supply chain, the importance of supply chain and how the supply chain has become such a very important functions for modern day business.

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Now we will start discussion of this lecture with evolution of supply chain management in last 100 years, if we start the discussion of evolution the first very important case for the first important revolution which is in the beginning of 20th century around 1910 and 1920 that time and this is characterized by the ford supply chain. The Ford motor company is pioneered in integrated the entire supply chain.
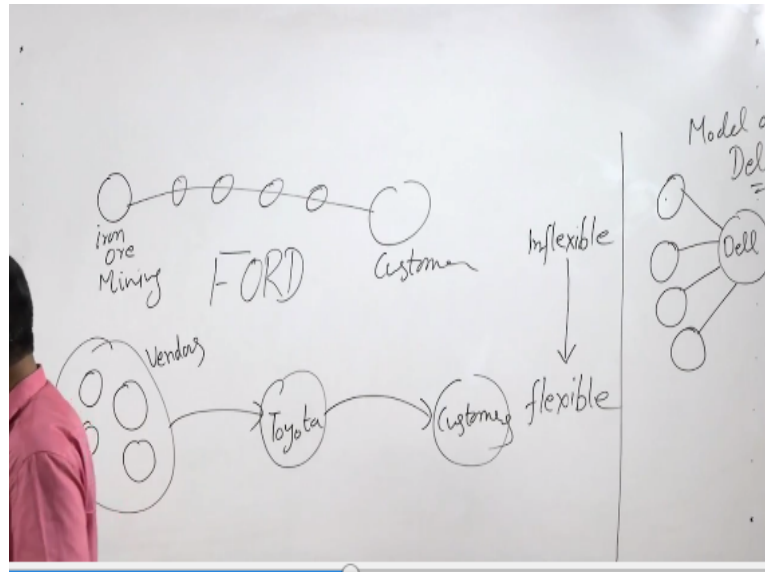
Right from birth to death of the car ford supply chain is known to be one of the most efficient supply chain, on one side Ford used to have its own Iron ore and on the other side they used to distribute the cars, finished car on the market, so on one side they were having the mining business, they were used to process the iron ore to get the screen use that is steel in making the car and then distribute the car.

And they efficient it that system so well that it is documented, that Ford use to deliver a car from mine to the retailer in just 81 hours and therefore for example is one of the most pioneered example in the case of efficient supply chain that in 81 hours ford can deliver and it

was a very well saying at that time that as long as a car is of black colour it can be delivered by ford.

And as long as it is T model, it can be delivered by Ford, T and black these are the symbols of efficient supply chain, then the second important phase of the development of supply chain is from Japan, when Toyota created a different type of model.

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In the model of ford right from the beginning where you have iron ore mining to customers, all the activities which are required in making the car are owned by ford company. But nowadays in this Japanese revolution which came around 1950s and 1960s after Second World War, now what they did, Toyota developed a pool of vendors and these pool of vendors they used to supply different types of products, components, assemblies, sub-assemblies to Toyota.

And then Toyota used to distribute these finish cars to the customers, so instead of doing all things on its own Toyota started developing the capabilities of the vendors and actually this is a model which nowadays most of the companies follow, now it is very rare though the example of ford is always known as always popular for its very high level of efficiency.

But there are certain limitations also with this ford model that it was almost in flexible because you are controlling everything in your supply chain, so it is very difficult to change the product and therefore only black colour, only T model became the synonyms of ford

supply chain. On the other hand you have a pool of vendors with their own expertise and now the Toyota become more responsive to understand the customer's requirement.

So this ford model which was totally in flexible and with this Toyota model which came around 50 years after this initial development of supply chain concept, so we started moving from this inflexible model to a bit of flexibility in the supply chain. So some flexibility stared coming in the supply chain from ford to Toyota and now in Toyota you many owners of the supply chain, so many vendors are there.

And all of them share some part of ownership in the entire supply chain and then very recently you can say almost at the end of 20th century or around beginning of twenty first century at that time the third revolution which is more IT driven revolution in the supply chain. This IT driven revolution is the Dell supply chain and that you also very interesting type of development in the supply chain.

And this development helps us in understanding the supply chain in present context that what is happening in the present scenario in the supply chain. Now Dell powered on the advantage of Information Technology, so Dell used to get information from the customer and Dell used to pass this information to its various vendors, these vendors may be located at different locations, these vendors provide different components to Dell.

So a customer normally we all know the capability of Dell, Dell was known to provide the customised products to its customers and we were having the opportunity to design our machine, design our laptop, design our computer on the Dells website and Dell used to collect information from the customer and depending upon whatever specification, whatever configuration a customer has ordered this information was passed to different vendors.

Now all these vendors they supply their components to Dell and then Dell used to assemble them in a single packet, so that that packet will go to the customer. So now this is living the power of inform technology for the better customer satisfaction, so that customer gets the unique product which he or she is requiring. But over a period of time Dell realised that all the customers.

All the normal customers like me, like you, we are giving almost similar kind of configuration for our requirements and then till 2006 Dell was giving only if product through online ordering, but when Dell realized that now customers are not so particular customers are so unique with respect to their requirements, so from 2006 onwards Dell changed its model of supply chain.

And after that Dells products are also available through retailers, through other conventional surprises, because earlier time we for the sake of uniqueness of our orders were ready to wait for 10 days, 15 days from the Dells website, but when we are not having so unique requirements, so why will I wait and this question came in the minds of officers of Dell company and therefore they took a very interesting decision of changing the supply chain of Dell and 2006 onwards Dell change it supply chain.

But nevertheless Dell became a very interesting case in the modern supply chain where we can see that how you can integrate various vendors and your customers just with the power of your information technology. So these are three important changes which has happened in last 100 years and the model of Dell this model of Dell which is based on information technology power, this is actually the starting point of supply chain analytics.

Where we are using real time data, where we started using information for the success of our supply chain. In these two cases the role of information was there, but it was not up to the extent at which then started exploiting the use of information for the success of its organisation. So the evolution of supply chain tells us that what are the important changes which has taken place in last 100 years and now the current model of Dell supply chain is based on that information technology the real time data analysis and that will become the basis of our supply chain analytics course.

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The Objective of a Supply Chain

- Sources of supply chain revenue: the customer.
- Sources of supply chain cost: flows of information, products, or funds between stages of the supply chain.
- *Supply chain management is the management of flows between and among supply chain stages to maximize total supply chain profitability.*
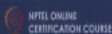
So now once we have understood this development of supply chain in last 100 years, so let us quickly review the objective of the supply chain and the objective of supply chain is the management of flows between and among supply chain to maximize total supply chain profitability. So I again and again always request you that this total world is very very important for the success of supply chain, we never talk of individual stage, we always talk of totality.

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Supply Chain Challenges

- Lack of synchronization between planning and execution.
- Lack of real-time data visibility, with no common view across all businesses and channels.
- Irregular reviews of safety stock levels, causing frequent stock-outs or excess inventory.
- Lack of flexibility in the network and distribution footprint, so that decision-makers find it difficult to prioritize between cost to serve and customer service levels, resulting in less profitability.
- Price volatility and difficulty in de-risking.
- Production line imbalance and suboptimal batch sizes, creating asset underutilization.

And therefore all the decisions are of totality nature before we go into the supply chain analytics let us see what are the specific challenges of current supply chain which we all see and these challenges engines will give us some kind of appreciation that what is the requirement of supply chain analytics, why are we making the simple things so complicated and therefore this particular slide will help us to understand some of the challenges.

This list may not be very exhausted because depending upon the type of supply chain you encounter depending upon a particular market, depending upon a particular type of product category, the challenges may be many more, but some generic challenges considering the current business environment I highlighted here and these are first is lack of synchronisation between planning and execution.

We do not have what we plan and what we execute, so there is always a difference between that. So we if whatever we are planning and we are not able to execute that, so the objectives of supply chain which we have set for our self will not be achieved, so therefore this is the first important issue related to success of supply chain that we lack the synchronisation between planning and execution.

The second important challenge is lack of real time data visibility and the supply chain analytics type of interventions will help us in improving this challenge of real time data visibility with no common view across all businesses and channels, in fact different persons in the supply chain, if we leave this then model if you have various intermediaries in your supply chain they all we have different sources of data collection.

And maybe there will not be consistency in the data collected by different intermediaries, so there is no common view and when you have lack of consistency in the data or information available with different channel partners obviously lot of problems are going to happen, then irregular reviews of safety stock levels causing frequent stock outs and excess inventory. As a customer when I visit a retailer I always like to have whatever product I want it should be available readily in this stalk with that retailer.

But because of poor safety stock levels it is quite possible that out of 10 times I visit a retailer only 5 times that product is available, so very highest stock out of that product and if it is very high stock out like I explained my customer satisfaction will go down and it is also possible if product which is not in demand so much and you are keeping the inventory of that product.

And if it is happening that way the product is not in demand and you are keeping the inventory, so it is unnecessarily going to increase the cost of your supply chain and that will pull down the profitability of your supply chain. So it is very important that you should have

a very proper review of your safety stocks and in supply chain we talk of a term which is very very interesting and lot of our discussion in the coming classes will be based on the term.

And this is known as bullwhip effect where because of improper reviews you keep on collecting excess inventory at each stage of supply chain and therefore that inventory in your entire supply chain increases and creates it total failure of your supply chain management. Bullwhip effect is a big big fat to the profitability of the supplies so whenever we talk of supply chain immediately we need to find a good solution and efficient solution for the problems like bullwhip effect.

So this is a very serious challenge and certainly the advantage of data analytics can help us in minimising the issues of frequent stock out or excess inventory. Then other important issue another important challenge which is there in the supply chain and that is the need of the our lack of flexibility in the network, our supply chains are not very flexible and this case we have already discussed just now with the example of this ford supply chain which was totally in flexible.

Only known for two things T car and black cars, but nowadays we all know that you cannot fulfill the demand of a customer just by providing only one colour and one model, you need to provide large number of colours and you need to provide large variants also, so you need more flexibility and this flexibility is required with respect to variety, this flexibility is required with respect to quantities and therefore we need flexible supply chains.

But right now we have very limited sensibility in our supply chain, and therefore it is the data analytics activities which may help us in improving our flexibility aspect of the supply chain and this will certainly be a very very important area and we will like to deliberate more on related to flexibility aspects of supply chain in our future classes, future lectures, then another important challenge of supply chain is price, volatility, and difficulty in the risking.

A lot of papers you can find in the area of supply chain risk management and you have lot of threads for the proper supply chain management and we also discuss just now that there is a issue between planning and execution, so lot of academic discussions are going on with respect to the de-risking of supply chain that how you minimise the risk in your supply chain,

but because of globalisation, because of a lot of exchange issues, because of price vats between the competitors.

And all these things are posing regular challenges to the supply chain and probably we need more futuristic decision making where data analytics will come very handy for us that how to make that futuristic decision and that will probably help us in e-risking our supply chain, so this is also a very important area where lot of things are to be done. Then another challenge which supply chains for facing currently that is related to production line imbalance and suboptimal best sizing which creates asset underutilization.

Because of for the sake of flexibility you can say, for the sake of doing better customer service, for the sake of better customer satisfaction for all these things we are doing lot of things which are resulting in underutilization of assets, so actually we need to have a very important trade off between economies of scale, asset utilisation, line balancing and customer satisfaction flexibility service level.

Because these two things or some kind of trade off, if you go for one you have to sacrifice other, if you want to achieve higher asset utilisation and at the same time you are looking for flexibility, then you need to do some kind of trade off, it is very difficult to achieve both these things simultaneously, but the current requirement says that you need to achieve flexibility also, you need to have her asset utilisation also.

This will help you in reducing the cost and this will help you in better customer satisfaction so we need quantifiable trade off between these two wearing aspect, so these are the challenges which are in front of us and we will like to solve these challenges with the help of supply chain analytics. So let us see what is this all about supply chain analytics, so supply chain analytics as we discussed in the first lecture is all about integrity the data analytics into the supply chain management.

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And this supply chain analytics aims to improve operational efficiency and effectiveness by enabling data driven decisions, at all 3 levels that are strategic level, operational level and technical level, so all three levels of decision making in the organisation, strategic, technical and operational level. We want to take data into consideration and on the basis of this data which is available with us we will like to take efficient and effective decisions.
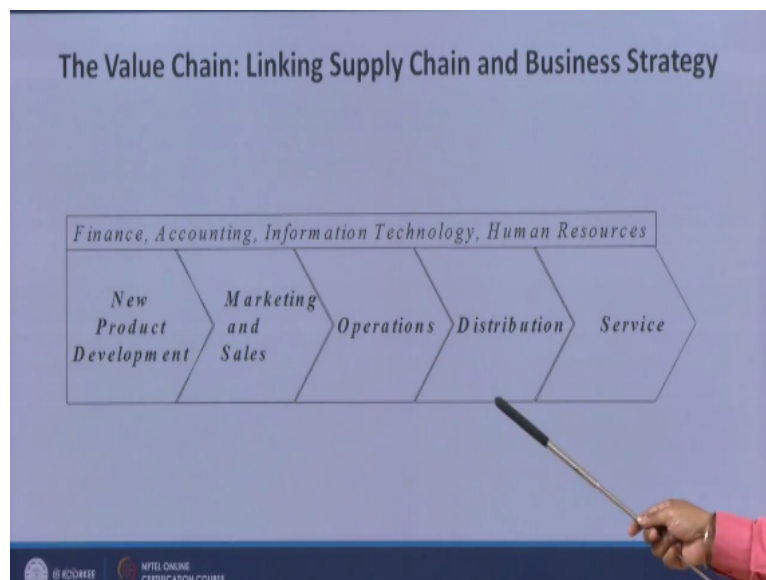
So now the science is coming more into play for the development of supply chain decisions, many times our decisions may not be rational, many a times decisions are based on lot of qualitative factors, but this supply chain analytics is one area which try to capture even the qualitative data also or qualitative data also it is not only the numerical data which is important here.

Qualitative data can also be very useful in taking the decision, but the data at all the levels strategic operational and tactical level so decisions if are taken with the help of proper background data available to us, then it is expected that those decisions will help us in a better efficient and effective supply chain. So this is how we can understand the meaning of supply chain analytics.

And we will see the use of certain algorithms, we will see the uses of some of the modelling techniques for making the decisions at all these three different levels of supply chain. Now it also imposes the complete value chain, the complete value chain which we will see in the next slide started from the sourcing add up to the logistics including the manufacturing, including the distribution and all the aspects.

So the supply chain analytics is not only limited to a particular area of the supply chain, it takes care of your entire value chain right from the sourcing of raw material or sourcing of components or sub-assembly to the logistics and distribution of products through the customers side.

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So just to give you an idea of supply chain value, so this is the value which I am talking that right from the development of new product to the services. All these functions right of new product which is based on the information provided by the customer, so the role of data comes into picture here that what type of information, what type of data is being provided by the customer and whether the new product fulfills those aspects of the requirement.

Then marketing and sales which are very very important to capture the data from the customer, because if marketing and sales people are unable to capture the right data of the customer it is very difficult to develop new product as per their requirements, that operation people are responsible to add value to add the incremental value into the component, so that product is produced as per the specification.

So they are also based on the background data available with them with distribution and services where the customer is we need at what time customer request that product, it is also very very important that the place and the time, so data related to place and timings that will help us to make efficient and effective decision with respect to distribution, at what stage of product consumption the services will be required.

So data related to product uses, how the customer is using the product and it is very interesting and we all know our self that many a times we use products in variety of innovative ways and as a service guy I need to know that what are the different ways in which a product can be used, interesting when I do a class on innovations management we normally ask that what are the different innovative uses of toothbrush.

Now toothbrush we all know we use it for cleaning the teeth, but when we ask this question in a lab of innovation management you can find variety of innovative uses of toothbrush may be as wide as cleaning the floor as well as for making the paintings, so just to give you an example that is service guy must have all the data that in how many conditions in what type of situations my product can be used and accordingly that data will help me to take efficient and effective decision with respect to my service requirement.

So all these decisions which are there at the different stages of value chain if all these decisions are taken with the help of data, these decisions will be very efficient and effective and with the help of supply chain analytics we will try to take decisions at all these stages which will be purpose of supply chain analytics in line with the supply chain management which is in line with the business strategy of the organisation.

And that is in line with the overall objective of the organisation, so in this lecture we discussed the evolution of supply chain management and the key challenges which our supply chains of the modern day are facing and then we also discuss that how data analytics can help us in solving the challenges and what is the purpose of data analytics and what is the meaning of supply chain analytics and objectives of supply chain analytics.

So now in next class we will discuss the various strategic aspect of the supply chain management and which will give us food for thought for our further classes that how these strategic issues can be handled with the help of available data. Thank you very much.