Modeling and Analytics for Supply Chain Management
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Lecture 01
Introduction to Modeling and Analytics for Supply Chain Management

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Hi, good afternoon and welcome to this course on modeling and analytics for supply chain management.

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This is the first module which will basically cover Introduction to supply chain, supply network, integrated supply chain, objectives of a supply chain, data generated at different

stages of supply chain, major supply chain issues and basically we will sum up by finding out what supply chain management means?

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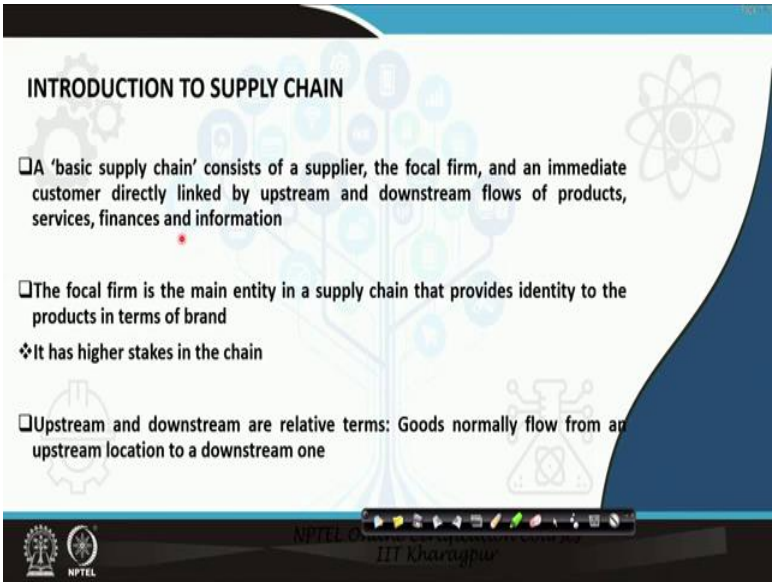

So, we start with the basic introduction or basic concepts of supply chain management. Now, a basic supply chain consists of a supplier, the focal firm and then immediate customer directly linked by upstream and downstream flows of products, services, finances and information.

Now, here you have to basically understand, what do we mean by the focal firm? In every supply chain, the focal firm is the main entity that provides identity to the products in terms of brand. It has higher stakes in the chain and hence, it is the most dominant entity in the entire supply chain. Now, there are two more terms that you should be familiar with upstream and downstream, this upstream and downstream are basically relative terms, goods and services normally flow from an upstream location toward downstream one.

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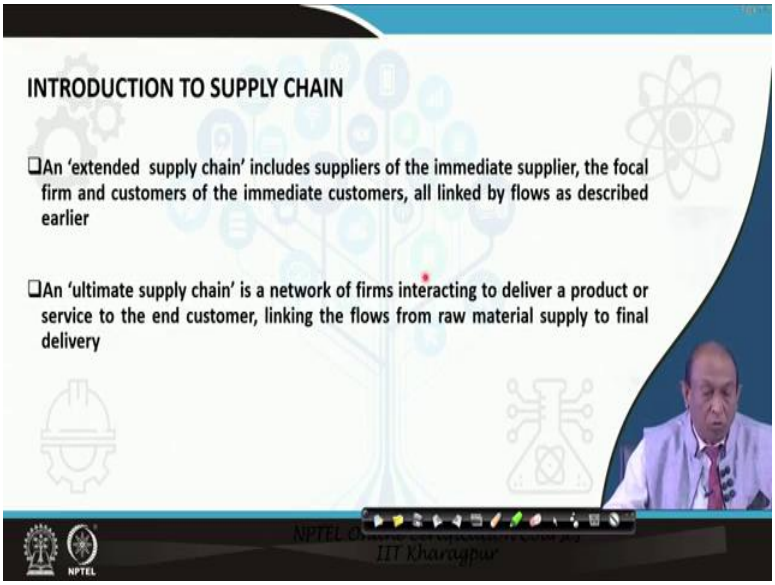

Now coming from the basic supply chain, let us delve into find out what do we mean by an extended supply chain? When we talk about an extended supply chain. This includes suppliers of the immediate supplier and the focal firm in the middle the and also it includes customers of the immediate customers all linked by flows as described earlier. These flows are basically flows of materials and goods, finances and information we will talk about this management of flows later in details.

And when we talk about an ultimate supply chain, an ultimate supply chain is basically a network of firms interacting to deliver a product or service to the end customer linking the flows from raw material supply to the final delivery.

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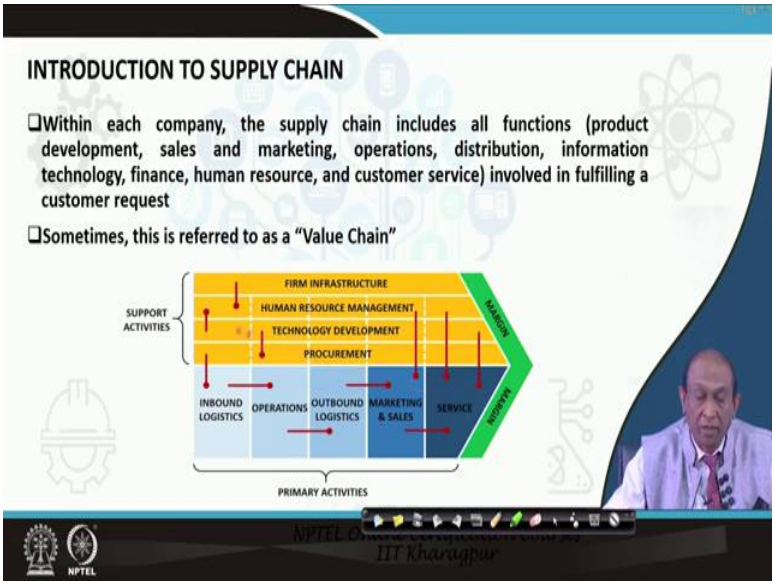

Within each company. The supply chain includes all functions. All functions means product development, sales and marketing, operations, distribution, information technology, finance, human resource and customer service. All these functions are involved in fulfilling a customer's request.

Now, sometimes this is referred to as a value chain. If we look at this particular slide, then you will find that the primary activities of a value chain consists of the inbound logistics, then operations, the outbound logistics, marketing and sales and then services.

This is being supported by the support function of the support activities in terms of procurement, technology development, human resource management, firm infrastructure as well as this information technology comes under technology development.

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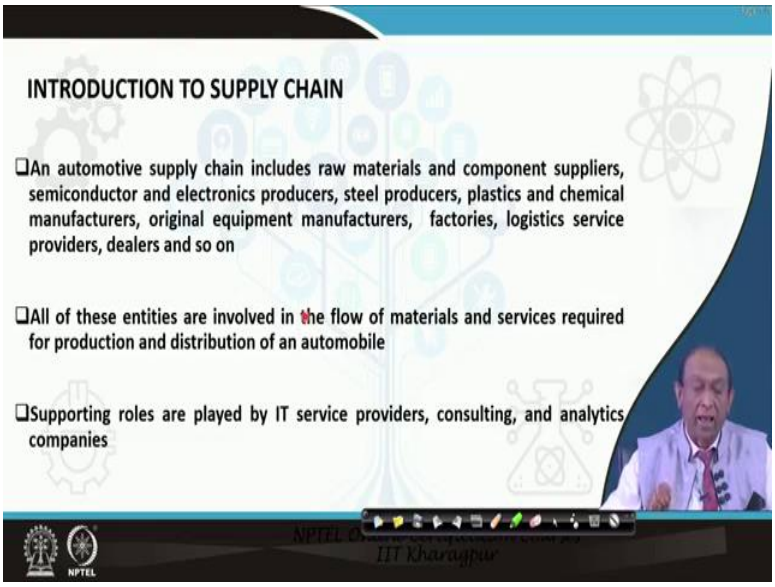

So, what we basically see that for let us look at an example first, an automotive supply chain basically includes raw materials and components suppliers, semiconductor and electronics producers, steel producers, plastics and chemical manufacturers, original equipment manufacturers, factories, logistics service providers, dealers and so on.

So, you see, all these entities are involved in the flow of materials and services required for production and distribution of an automobile and in case of an automotive supply chain, the supporting roles are played by IT service providers consulting and analytics companies.

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So, if we sum up a supply chain basically includes suppliers, manufacturers, transporters, warehouses, wholesalers, distributors, retailers, and customers to deliver value to the customer through upstream and downstream linkages of different processes and activities. So, the scope includes all the business processes, the transformation processes, from raw materials to a product, final product, in that and in distribution of that product to customers.

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Within a company we have already said the supply chain includes all the functions and departments engaged in fulfilling that customer request. So, you see all these entities for example, suppliers, manufacturers, transporters, warehouses to wholesalers this each of them represents a particular stage in a supply chain.

Now, at each stage there are there can be multiple players. And that is why the supply chain, if you look at the structure, it becomes complicated and it is rather looks like a web and that is why it is popularly known as a supply network. As I have already said that supply chain management basically deals with the flows of material money and information. So is basically management of flows to match supply with demand in fulfilling a customer's request.

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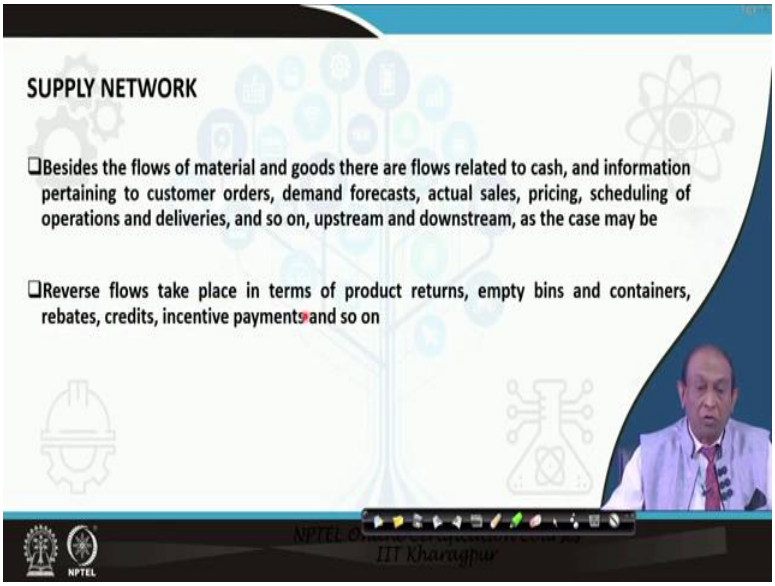

So, besides the flow of material and goods, there are flows related to cash and information pertaining to customer orders, demand forecast, actual sales, pricing, scheduling of operations and deliveries and so on upstream and downstream as the case may be.

Reverse flows take place in terms of product returns, empty bins and containers, rebates, credits, incentive payment and so on. So it is basically management of bidirectional flows, which is very, very important in case of managing supply chains.

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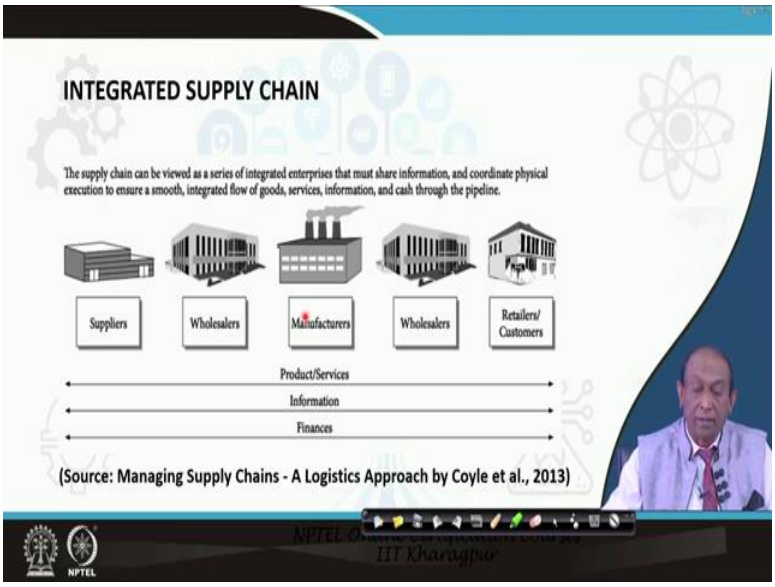

So in an integrated supply chain when you look at an integrated supply chain, the supply chain can be viewed as a series of integrated enterprises that must share information and coordinate physical execution to ensure a smooth, integrated flow of goods, services, information and cash through the pipeline, so it is basically it calls for information sharing, coordination, and collaboration among all the entities in the chain.

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Now let us look at the objectives of a supply chain, so what is the primary objective of a supply chain? Or basically let us start with the primary objective of the focal firm, the primary objective of the focal firm is to basically create a mutually superior value for the customer in terms of the product and service delivered at the right time with the right quality at the right place in response to the customer needs. So, the objective of every supply chain is then to maximize the overall value generated by the chain.

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Now, you might ask me, sir what is this overall value? The value generated by a supply chain is basically the difference between what the final product is worth to the customer and the overall cost that has been incurred across the supply chain to deliver that product to the

customer. Right from the stage of procurement, down to manufacturing because at each stage, some sort of value addition has taken place. And that is why some costs are involved.

And please remember that only sources of supply chain revenue is the customer and the sources of supply chain cost are basically due to management of this information flows, products or funds between different stages.

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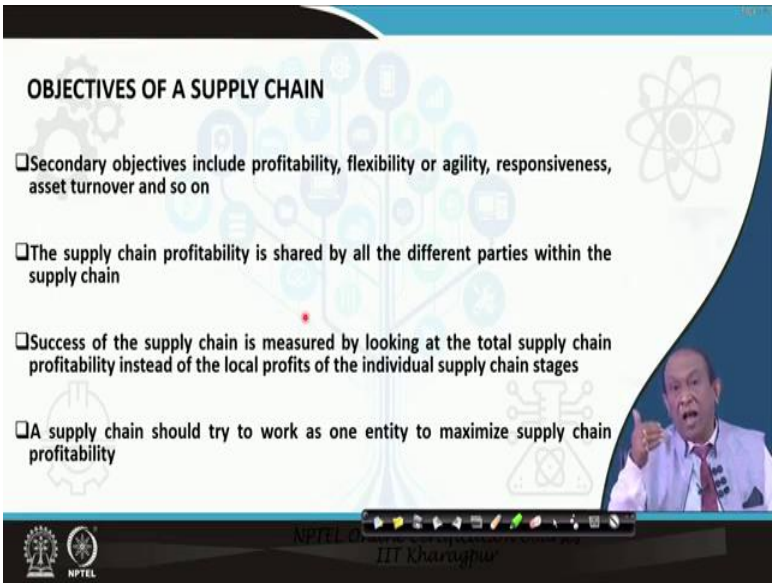

Now, there are certain derived objectives from this primary objectives that we have stated. What are those derived objectives? The secondary objectives include profitability, flexibility, or agility, responsiveness, asset turnover, and so on. Each of these terms are very important in the context of management of supply chain and we will deal with each on every terms in detail at a later point in time.

First let us start with the supply chain profitability, the supply chain profitability is shared by all the different parties within the supply chain. And you see the success of any supply chain is measured by looking at the total supply chain profitability instead of the local profits of the individual supply chain stages.

See, is not important that individual members should try to maximize their individual own profitability, it is the profitability of the whole chain that matters and hence, there should be consistent objectives among all the entities in the supply chain. More about this, we will talk about when we discuss strategic feet. So, you should always remember that a supply chain should try to work as one entity to maximize supply chain profitability.

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Like say, when a customer purchases pampers in a Walmart store, only the customer purchase provides a positive financial flow and all the other financial flows are simply fund exchanges between the different parties in the supply chain between different stages. In order to maximize the supply chain value, we need to manage these different flows in the most efficient manner.

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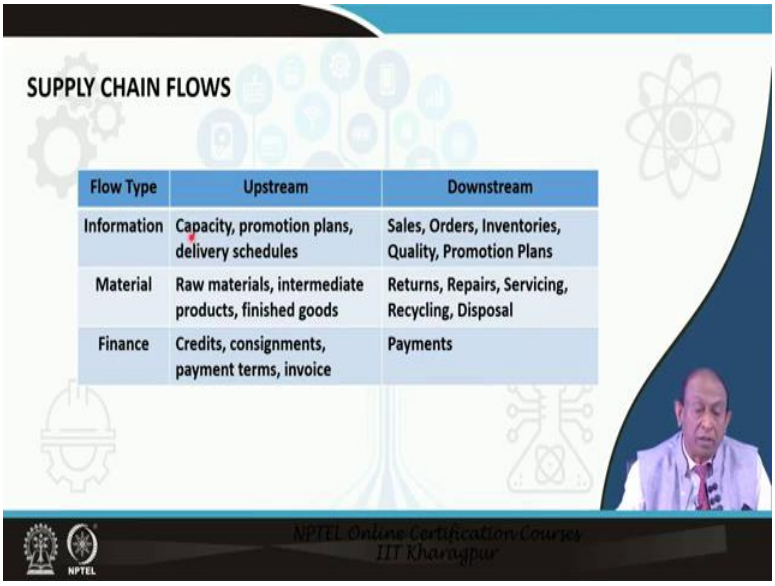

Now let us talk about supply chain flows. Now, we have already mentioned that there are bidirectional flows of information, material and finance in any supply network. Now, when we talk about information flow and look at the upstream side, then we find that the relevant information are related to the capacity of the plants the warehouse, how much production will

be their promotion plans, if there is anything in the mind or in the (())(13:27) taking delivery schedules these are all data or information generated at the upstream side.

On the downstream side if we look at then the data are related to sales, order information coming from the customers and the retailers down to manufacturers, the inventory data, quality data, promotion plans, everything is on the downstream side.

Again, with respect to material what are the in information what is amount of raw materials in stores in the upstream side, what are the intermediate products, what are the finished goods and these they flow this raw materials, they flow from the supplier to the manufacturer where value addition is being done on these raw materials to produce intermediate products as WIP then value addition is done to produce finished goods.

On the downstream side, when you talk about material flow sometimes there is a reverse flow of materials particularly in the context of reverse logistics, they are very important for example, returns data, repair data, servicing data, recycling of material, disposal. Even materials that physically return in a reverse logistics situations with respect to finance.

Credits, consignments, payment terms, invoice all these are generated at the upstream side. Whereas, with respect to downstream side, we are basically concerned with payments, payments being made by the customers on to the retailers and these flow upstream and finally arrived at the manufacturer send.

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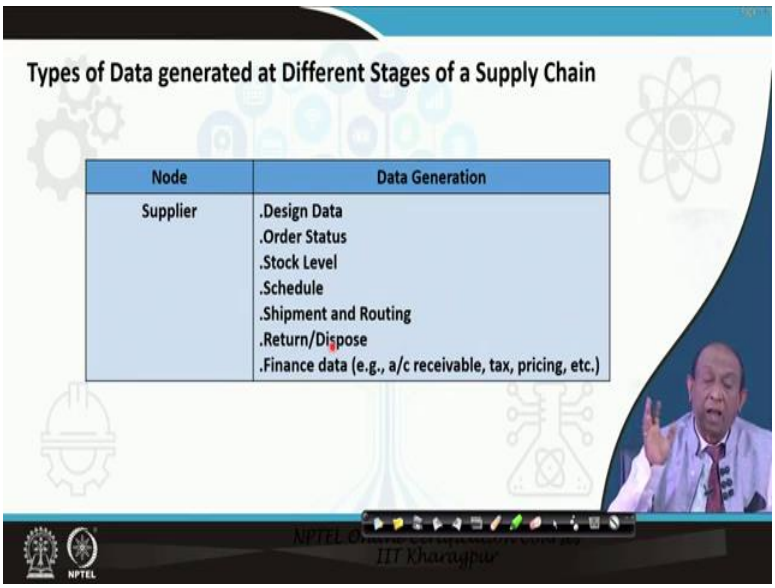

We need to know that different types of data that are generated at different stages of a supply chain, because supply chain analytics deals with the application of mathematical models and analytics techniques to enable decision makers to take a rational decision.

So, basically these are data driven decisions. So in data driven decisions, we need to know what are the different types of data that are collected at each stage of the supply chain, if we look at the supplier side, the data that has generated the design data, the order status, the stock level, the schedule, the shipment and routing, the returns, the finance data, for example accounts receivable, tax, pricing, etc.

So, we need to know what are the different data types that are generated at each of the nodes for developing mathematical models or doing some analytics for enabling the decision makers.

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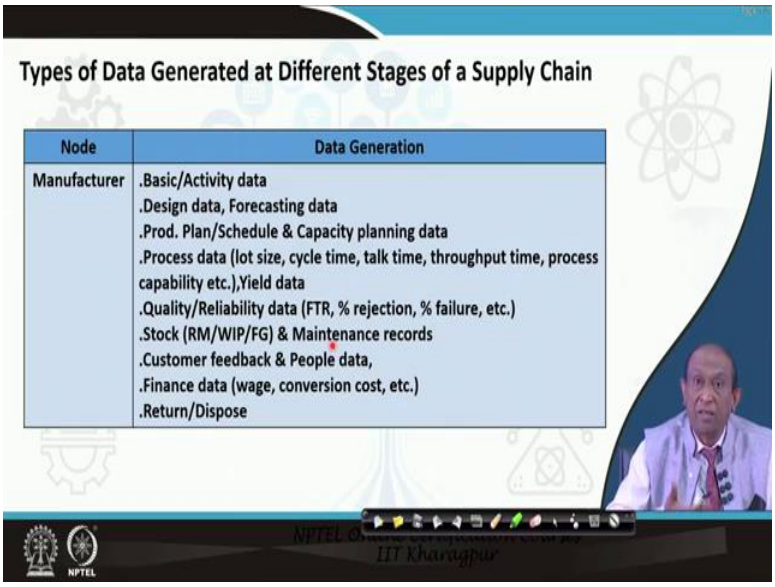

Now, let us look at manufacturer, manufacturer at that particular stage. These are all decision stages. Now in the manufacturer node what we find the data that are generated are basically designed data forecasting data production plan, schedule, capacity planning data, process data, quality, reliability data, stock levels, maintenance records, customer feedback, and people data finance data, all these returns. These are the basic data type that we need to deal with.

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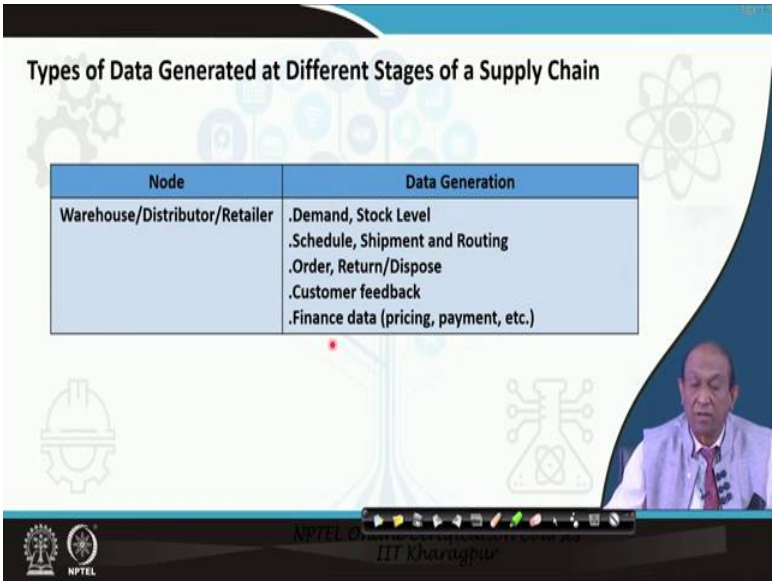

Let us look at the nodes. For example, in the downstream side warehouses, distributors and retailers, data that are generated are demand, the stock level, the schedule, the shipment and routing, the orders, return, disposal, customer feedback, the finance data etc, etc.

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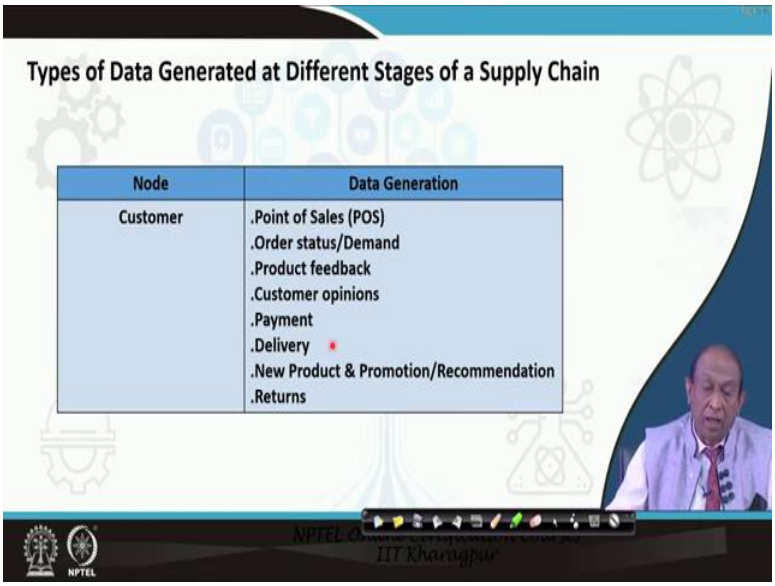

So, again if you look at the customer side, what are the different types of data that we are gathering? The point of sale data which must be disseminated across all stages in the chain to optimally manage the stock level in the supply chain. And this is being facilitated through electronic data interchange ADI and internet facilities.

The point of sales data is absolutely important for real time data visibility and this would be available at all stages in the chain. Then, the difference even the customer is bothered about knowing the status of his order. So, the order status, the demand data, the product feedback, the customer opinions, the payment, the delivery, the new product and promotion and recommendation, the returns all these are important data entities that needs to be known for doing any kind of analysis.

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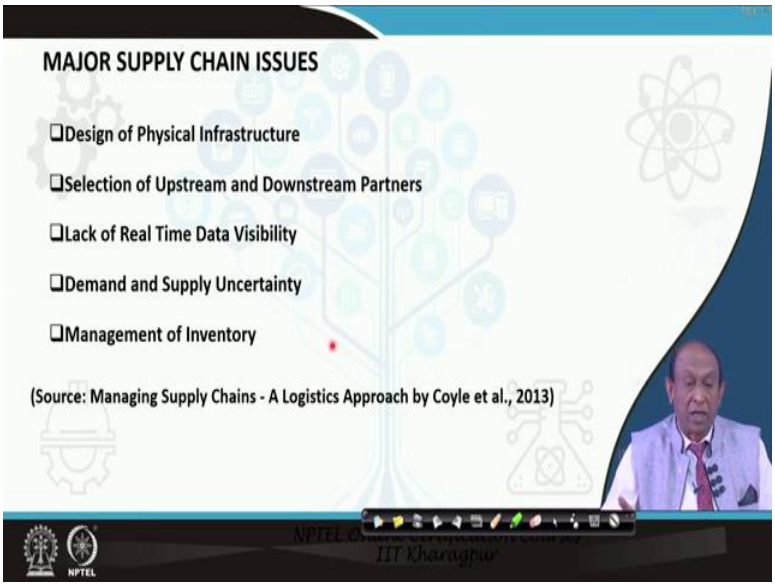

So now, having known what are the different data that are generated at each stage of the supply chain? Let us now look into the major supply chain issue. Now major supply chain issues, when you look at it the first issue is the design of the supply chain architecture that is the physical infrastructure.

The structure of the supply chain is a very important issue, because these issues this particular issue is important because it has a long range effect and these kind of decisions once taken cannot be easily reversed. So, basically these are known as strategic issues.

For example, location of the facilities the where the warehouses should be located, the capacity of the know warehouses, all these the even the network facilities at each and every stage the support for transportation, all these are very important then selection of upstream and downstream partners, downstream partners and upstream partners selection is very important.

And as a result, we are we will be looking into different kinds of models that helps us in sourcing, sourcing means supplier selection, supplier selection, supplier evaluation these are very important entities important work that needs to be done.

For example, you know when you look at, you know who we should be the partners in the chain with whom should we do business? That is also very important. So, selection of the different entities by the focal firm is also very important. Then, lack of real time data visibility. This is also a very important point as I said that the point of sales data until and unless it is being seen by all the entities in the chain up to the upstream side you know the forecasting will not be correct.

And then at such there is demand and supply uncertainty in a chain which makes management of supply chain very complex. Now, if in addition to that there is a lack of real time data visibility then what will it result, it will result in a excess stock at times and sometimes it will result in stock out situations and hence, management of inventory is also a very important supply chain issue.

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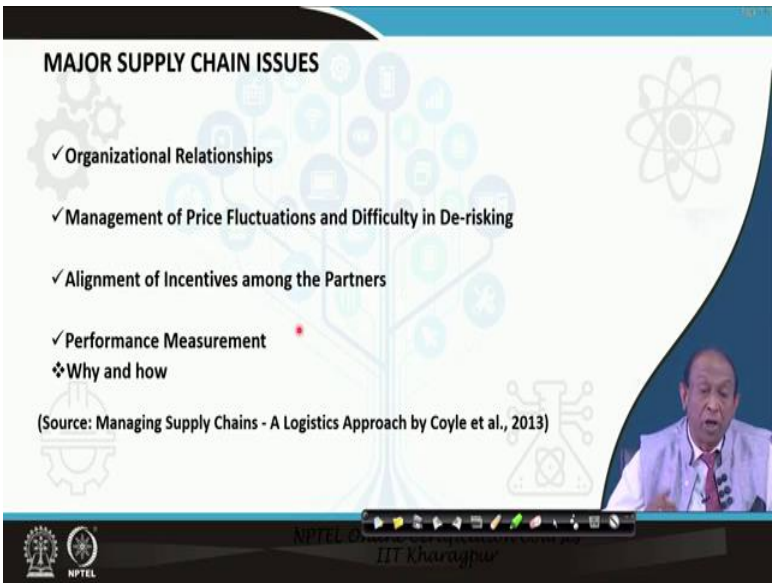

Ownership will depend upon also the integrity, the honesty and the competence level of the supplier with whom we are going to build this relationship. Another important issue in supply chain is the management of price fluctuations and difficulty in de risking the different types of risks that are there in the supply chain.

Another important issue is the alignment of incentives among the partners in the chain, because these incentives, if they are not properly aligned, then some of the partners may

ultimately move away from the chain and become members of other supply chain because in today's world, the competition is not between two firms or between two manufacturers.

But it is one supply chain against another supply chain and until and unless the distribution or the alignment of incentives among the partners in the chain is rational and appropriate, you know the participation of the partners will not be there because whether a partner joins a supply chain or moves out of the supply It is its voluntary decision nobody can force them to be, you know in the chain for a long period of time and it might, if he is not satisfied with the incentive, it might join some other competing chain.

So, that is why it is very very important to align the incentives across all members in the chain in the most realistic manner and appropriate manner. Then performance measurement here, we will basically look at the different kinds of drivers and metrics that drive a supply chain. So, why performance management, how performance management and how we can what are the different key performance indicators at each stage and how they help to find out the performance of a supply chain in a balanced manner is very very important.

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Then technology management is another very important issue. There are so many new technologies are being developed, whether we will embed those technologies in our supply chain or not, is also another big challenge. And here analytics can also play a major role in helping managers that whether we will incorporate one particular type of technology or not, what are the difficulties associated with that? And the challenge is basically to evaluate and successfully implement that technology.

Associated with incorporation of a technology, we find that there are so many assets that will that there will be there in a supply chain, whether those assets are properly utilized or not. So, asset utilization is another very important challenge in a supply chain.

And then of course, transportation management should is very important because basically, the right product should be delivered at the right time in the right quantity with the right quality at right cost to the right destination. This is a very important point and also associated with that the, another potential challenges the challenge that has you know come up is the supply chain security.

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So, now let us having known what is a supply chain? What are the different supply chain challenges? What are the different types of flows in a supply chain? The bidirectional flows and all. Let us now try to sum up that what is supply chain management. Summing up supply chain management is basically the planning and management of all activities involved in sourcing and procurement, conversion and related all logistical management activities.

Importantly, it includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers and customers. So, this is all about supply chain management.

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Basically, in supply chain when we look into the details of supply chain management, we will basically find answers to questions like what logistics structures should be used, how our information flows and systems coordinated globally, how can incentive systems for all parties in the supply chain be set up so that the overall performance of the supply chain can be optimized.

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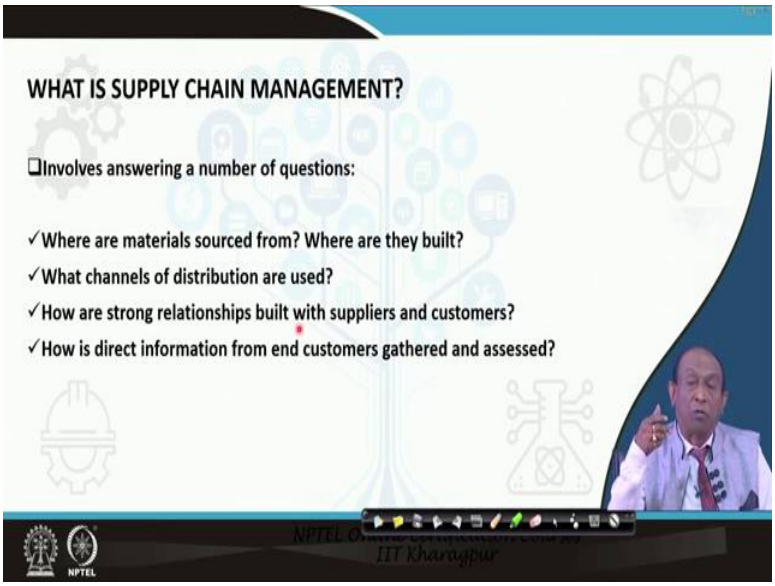

Then supply chain management also involves answering a number of questions like, where are the materials sourced from? Where are they built? Who is the supplier? What kind of relationship should we build with them? What channels of distribution are used in the supply

chain? How are these relationships built with suppliers and customers? How strong they are, how is direct information from this end customers gathered and assessed.

And then you know basically, another important point is there in supply chain management because depending on the pattern of demand of the products, what we need to know that weather minimizing the cost associated with delivering the products to the ultimate customer is important or the supply chain should be more responsive towards the needs of the customer.

So, there we basically have a dilemma that whether this supply chain should be efficient that means it should be very much cost conscious or whether it should be responsive supply chain. So, there is a tradeoff between this efficiency and responsiveness and the uncertainty of demand and supply to match supply with demand is also a very big challenge with you know, with every supply chain, so that will be the topic for our next module. Thank you all for today.