Industrial Engineering
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Module - 04
Lecture - 01
Materials Management –I

A very good morning to all of you, today we are going to start a discussion on various topics of industrial engineering, so the first topic that we are going to cover is Materials Management, there are lot of topics that we have to cover in this subject on industrial engineering. So, today we are starting with the most basic topic that is the materials management, how much importance do we give to the materials management in our daily life.

So, let us start the discussion with a very simple example of buying potatoes from the market, all of us go to market to purchase, so many different kinds of things. Now, suppose we want to purchase tomatoes or the potatoes or any other vegetable, we will go to the market, we will see that what is the rate, we will compare the rate among all the vegetable vendors and then we will purchase from the vendor who is supplying the things at the cheapest price.

Moreover, we will see that if there is some discount available, if we buy more number of potatoes or more quantity of potatoes, so suppose we buy 10 kg potatoes we will get some discount in the price, If we buy 1 kg or half of kg the discount will be less. So, we have to take a decision that how many potatoes we should buy, so that out daily demand is met and we are not short of potatoes whenever we plan to prepare a vegetable. So, we know that for a particular week or for a particular fortnight we will be having a demand for 5 kgs of potatoes.

So, should we buy, all the 5 kgs of potatoes at one go or should we buy the 5 kgs of potato in two goes or in three goes, depending upon the price fluctuation that is there in the market. Suppose, we feel that after 10 days or after 15 days the price of the vegetables is going to change or it is going to be very high, because of certain weather condition or because of certain strike by certain people or due to some other problems, which we are not knowing.

What we will do, we will stock up the potatoes, so that we are not short of the vegetable whenever, we have to prepare our food, so such type of decision we are always taking in our life, so we have to take a decision that when we should purchase, how much we should purchase and at what price or at what cost we should purchase. So, all these decisions we are taking in our daily life, so these decisions are to be taken in any industry, which is suppose manufacturing a finished product based on certain raw materials.

So, they buy the raw material, they transform into different finished products and the finished products are then sold to the market, so they have to take care of the materials that come into the industry and then they go out from the industry in the processed form. So, materials management is one of the most important, rather I should say one of the lifelines of any manufacturing industry or any other industry, which is related to the materials aspect.

So, today we are here to discuss some of the tools which are used in materials management, so let us start our discussion, we although the materials management is a vast aspect, we will be focusing our attention on inventory management. But at the start of the lecture, we will see that what is the broad scope of materials management, where materials management is required and then slowly, we will focus our attention towards the inventory management. Now, at the start, we need to understand that what is the basic definition of materials management?

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So, on your screen, you can see a definition, I will read it for you Materials management is the planning and control of the flow of the materials that are part of the inbound logistics system. So, you can see that it is the planning and control of the flow of materials, so we have to plan that how much materials are going to come, and how they are going to flow inside the industry from one setup to another setup that we call as the work in process and then they go out of the industry in the processed form. So, inbound logistics system means that within the industry, so logistics that is inbound that is coming and then going out from the industry.

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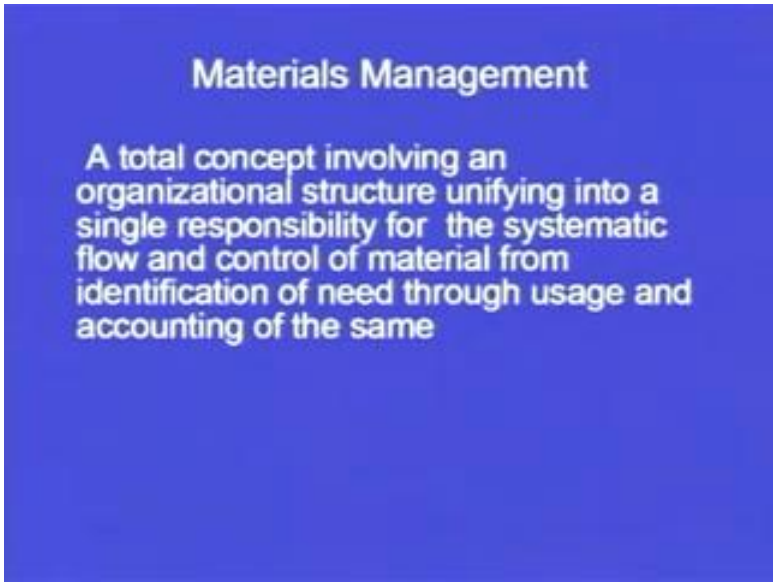

We have another definition on your screen on materials management. A total concept involving an organizational structure unifying into a single responsibility for the systematic flow and control of materials from identifications of need through usage and accounting of the same. So, we have to see that already in the previous definition, the flow we have already seen that flow of material is planned as well as it is control. So, here we are also seeing that the systematic flow and control of material from identification of need through usage and accounting of the same.

So, there is a need that this material is required then we have to see that how it is used in the industry and we have to manage the accounts also, that what was purchased how much we are left with and what will be the further requirement. So, the cycle keeps on rotating that identification of the need is there, so this material is required after this much amount of time. And then we have to take care of the usage aspect and finally, the accountability of those materials that have been purchased in order to transform them into the final product. So, what are the major objectives of materials management, so one by one we will see what are the objectives of materials management.

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Like the first one is support operational requirements, now operational requirement means that any industry which is operating, it is transforming certain amount of raw materials into final products. So, in order to support the operational requirements we

require materials, so the materials will help us to transform from raw material stage to a final product stage. Similarly, it manages the material process efficiently and effectively.

Now, we know that we cannot, suppose we get a discount, I am going back to the example with which we started this lecture, we know that if we buy hundred kgs of potatoes a rate will certainly be lower as compare to buying one kg of potatoes, but can we buy hundred kgs of potato and keep it in our house. That is not quite efficient and an effective way of managing the materials that in our case is the potatoes because we know that after sometime, the potatoes may start to wear out or may start to get spoiled.

So, we have to take care that how much quantity we have to order, so we have to take a very efficient and effective decision that how much quantity we have to take care of while operating. So, in an industry this decision has to be made that the minimum amount of money should be spent for holding the materials inside the store, so materials management helps us to manage the material process efficiently and effectively efficiently means that we will be able to save some money for the industry.

And effectively means that our purchase or our purchasing doctrine will be very, very effective, then the third major objective of materials management is we have to select, develop and maintain sources of supply. So, there may be number of suppliers, number of vendors who will be supplying the material to our company, so we have to select them that whatever quality we require they should be able to give us that quality or able to provide us that quality or able to supply us that quality.

And we have to develop new and new vendors, because we cannot be directly related to one or two vendors only because sometimes, because of the price fluctuations or because of certain market conditions the vendors may not be able to supply us the required amount, so we need to have different options available with us. So, we need to select, develop and maintain the sources of supply. So, materials management will help us to do that, then develop strong relationships with other groups that has already been explain in the previous point.

Then, support organizational goals, so organizational goals we set certain goals for our organization, so materials management will help us to achieve those organizational goals then develop integrated strategies that support organizational goal. So, different strategies will be formulated by the materials management team, in order to achieve this

organizational goal or in other words we can say in order to support these organizational goals.

Like, suppose an organization has it goal, as one of its goals that whenever the customer wants their product should be available to the customer, so if we do not have a very effective and efficient materials management process then tissue goal sometimes may not be achieved. So, an effective materials management will help us or help the organization to achieve all it is goal and it will support the organizational goals.

Then, what is the scope of materials management, so till now we have seen that materials management is an important aspect of any organization for effectively and efficiently running its operations. Now, what are the scope, what are areas where materials management can be applied.

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So, it is required in materials requirement planning and control, so it is materials requirement planning there will be a complete lecture on materials requirement planning, what is materials requirement planning, where it is used, what is the control in materials requirement. Then, we have to see that procurement, procurement is the one of the most important aspects, which is related to materials management, because it gives us an advantage over our competitors.

If, we are able to procure the raw materials at the minimum possible price then inventory control that we will be seeing in the topic of inventory management that what are the various tools that are used in inventory control. Then receiving and inspection falls under the scope of materials management. Transportation from one place to another that as also to be taken care of because materials handling is one of the most important points that as to be taken care of in any manufacturing industry.

Then material handling already I have spoken about it then disposal of materials is also one of the most important aspect, especially in today's scenario. We are seeing that every now and then there are very strong legislations coming for the environmental friendliness, so each and every industry has to take care of the materials that it is releasing or that is given to the environment. So, suppose some effluents are given to the are being given out as part of the industrial process into the environment or are realized into the environments.

Then, it has to be checked, whether those materials are easily disposable or they are going to cause certain harm to the complete environment or to the local environment, so disposal of materials also falls under the category of materials management. Just to give an example, suppose we are working with composite materials, the disposal of these materials is or the norms for disposal of these materials are very, very stringent and one has to plan in advance that what is going to happen to this particular product that we are going to make out of composite materials.

So, disposal of materials is also one of the most important scope of materials management, which has to be taken care by the materials management team of the organization, so it falls under the scope of materials management and last, but not the least the valve analysis. Now, valve analysis is basically means that we have to find out the alternatives, which give us the cost effective solution to a problem. Now, suppose we have, we are manufacturing a particular product with one particular material.

Suppose, we take an example of this mouse, this mouse is made up of a particular plastic and it costs for a, the cost of this mouse may be fixed to suppose rupees x. In valve analysis a part of the materials management team would always be working on designing and redesigning this mouse and finding out alternative materials which can provide the same function, but at a relatively lesser cost.

So, that is also a scope of materials management in which we are able to find out that which other material or which other process can be used in order to give a more cost effective solution to a problem or to the manufacturing of this mouse. So, we have seen in this particular slide that the scope or the areas of materials management are very, very, very, very wide. So, we have seen that there are so many areas which have to be tackled by the materials management team.

So, this therefore is an important aspect of industrial engineering as well as, this has to be taken care of by any organization that is working in this field of manufacturing are of final products based on certain raw materials. Now, what are the responsibilities from the scope, now we come on the responsibilities, we have seen that what is the scope, so many different areas have to be taken care of by the materials management team of the manufacturing plant are of the organization. Now, there are certain major responsibilities or the certain major goals with which the materials management team works, they have to take care of all those scope, but they have to work with certain constraints.

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So, what is the constraint, they have to focus initially on cost reduction. Already I have told you that why cost reduction is important because with the example of the mouse, we have been to explain that this is made up of material and it has been made by a particular manufacturing process. Now, can we change the manufacturing process or can we

change the materials by which it has been made, so if we are able to make it by some other material, but its function should be effectively achieved.

Its function should be reliably achieved, another important thing is that we can make this mouse out of another material, but the quality as well as the reliability may decrease, so in valve analysis we are not compromising on the quality and reliability of the mouse or of the material of the mouse. We have to develop it, so that the quality is maintained, the reliability is maintained, but the cost is reduced, so cost reduction is one of the most important points that have to take care of by the materials management team.

So, they have to redesign the materials, they have to buy the materials, they have to order the material, they have to take care of all the aspects of materials management keeping in mind that the money that they are spending on managing the materials should be reduced. Now, second is the optimum service level, so optimum service level means that whenever the manufacturing process is going on suppose I take an example of assembly line.

In assembly line, the raw material starts from one end and it moves along the path and finally, the final product comes out at the other end of the industry, so in that complete assembly line, different parts are assembled on to the base structure and we then finally, we get the final product. So, as and when the assembly is been done along the path so many materials are required to be assembled, so suppose at one particular point the material that has to be fitted in that particular raw material or that particular base material that is not available.

Then, the whole assembly line will stop, so the, it is the responsibility of the materials management team to provide the optimum service level it means that whenever there is a requirement of a particular material in the assembly process, It should always be available, if it is not available then the process will stop, which is not a case that is required or that is desirable by the authorities or by the organization because it will lead to huge amount of losses.

And losses means that loss of business for the organization, so materials are directly related to the profit making of an organization then it is also the responsibility of the materials management to assure the quality of the products that they are or the raw materials that there are buying. So, quality assurance there are different measures or

different methods to check the quality that we will discuss, when we discuss the quality related issues in industrial engineering.

Then, low level of capital tied up, already I have given example that if the prices are less for a large quantity it is not desired that we buy a huge amount of quantity and then keep it inside our store. So, that has to be taken care of that we have to design the procurement cycle in such a way, so that large amount of capital is not tied up the materials, so the capital tied up should be less and the last is the coordinated interdepartmental effort.

So, that is also a responsibility of the materials management because the purchase manager will not be able to place an order for a particular requirement inside the industry, If the people who are on the shop floor do not communicate to him that this thing is required. So, if he is able to get, the particular order or particular indication or particular communication from the shop floor that this material will be required after ten days then at least he can start the procurement process.

So, that at the end of tenth day or before that he is able to procure that material for the people, who are working on the shop floor. So, the coordinated interdepartmental effort is also required and it is the responsibility of the materials management team, that there should be a very good coordination among the, but different people who are related to materials management aspect within the organization, because lack of these is going to harm the profit of the organization.

Or is going to result into losses because the process will stop, if on the shop floor the material is not available, then the workers will say that the material is not available we cannot perform our duties. Therefore it is seen that if at a proper moment of time, a communication is passed from the people on the work shop or the people of the particular shop to the purchase department then they can initiate the order. So, that is a very, very important part or the very, very important responsibility of materials management team.

Now, materials management, first part in materials management we are that we are going to discuss is procurement, although we are not going to go into much depth related to procurement, our major focus will be on inventory control. So, but the procurement is also one of the most important scope of materials management and it has to be taken care of by the organization.

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Now, what is the importance, it contributes to the competitive advantage of the firm, so already I have told that if we are able to procure the raw materials at a very competitive pricing or at a very low price as related to our competitors then we will be able to transform that raw material into the final product at a relatively lower cost. And if, we are competing with them at the same price, the margin of profit that we getting will be much more as compare to our competitors, because the raw material cost also adds up to the total selling price of the product.

Or I can say the total cost price of the product, so that reduction in that raw material cost is going to help us in order to be more competitive and we in order to make more profit from the same type of product and significant portion of the logistic cost is also saved. So, we have, we can see that if our procurement is very efficient and effective and we are able to procure the raw materials at right price and at right time then we will be able to save a large amount of money for our organization. And we will be able the make huge amount of profits.

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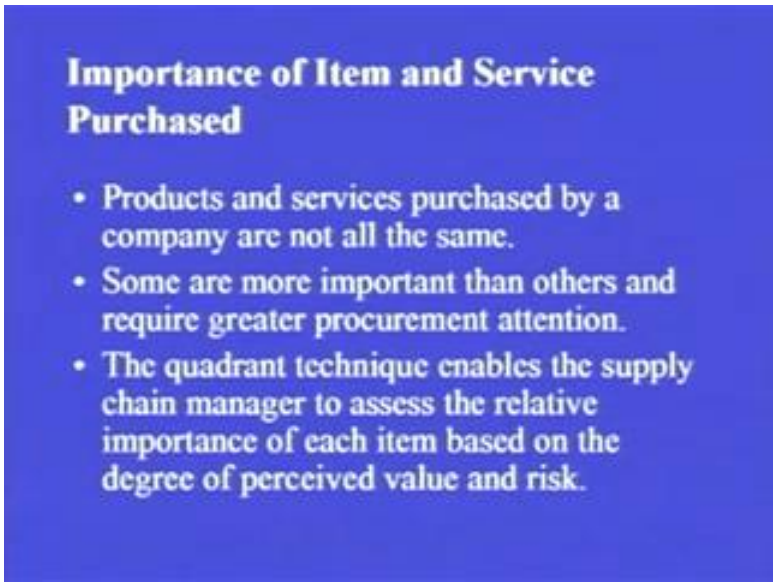

Then, importance of item and service purchased, products and services purchased by a company are not all the same, so all the time it I have taken number of times example of one particular item only, but there will large number of items, large number of raw materials that will be procured by the industry, some are more important than others and require greater procurement attention. Now, there may this is a point is very, very valid and very, very clear that some equipment may require more attention from the procurement team.

And some equipment may require even very less attention from the procurement team, so we can save, if one of the criteria for classifying this can be that if a item is very, very costly we can say it requires more detailed attention from the procurement team. And it is very, very cheap and it is not adding too much to the cost of the product then we can be little lenient with the procurement process. The quadrant technique enables the supply chain manager to assess the relative importance of each item based on the degree of perceived valve and risk.

Now, there is quadrant that we will discuss at a later stage that will help, a supply chain manager or a procurement manager or a materials manager to take a decision that which item requires more attention to towards procurement and which item requires less attention towards procurement So, the other things that have to be taken care of is the

value and the risk, value already I have told if the value is more, it may require more attention.

And if the risk involved is more then also it requires more attention, so on the basis of value and risk it can be segregated into different items that some items may be high value high risk or low value low risk and then the quadrant helps us to take a decision that in which quadrant this particular type of material will fit in So, that we will see with the help of a quadrant.

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Then, how to manage the procurement process, so this is very, very simple, I have already started the lecture with one of the most basic examples of going to the market and purchasing the potatoes. We go and then we have a relative market study and then we purchased from the vendor, who is supplying the quality that we desire at the minimum possible price. So, same basic principle is utilized for procuring the materials in the industry also.

First thing is to determine the type of purchase that what type of purchase we are going to initiate, whether it is a completely new purchase or it is straight re-buy or it is a modified re-buy. So, if it is new then the whole procurement process has to be started from the very beginning, so if is a straight re-buy already suppose we have bought a laptop, we want to buy another laptop, so the same order or repeat order can be given to the vendor from whom we have bought the laptop.

A third is a modified re-buy because why I have taken an example of a laptop because in information technology in computer science and engineering, the things are changing at a very fast phase. So, today I have bought this thing may be after one year, there may another model available for the of the same company , but at a relatively lower price. So, then I would modify my buying process, I would order for a modified laptop, but at the same price.

So, if either we will be buying a completely new product, new material or we will be buying a straight re-buy or will be using a modified re-buy procedure to determine the type of product that we are going to buy. Then identify the type of purchase, then we will see that what type of purchase we are going to make. Determine the necessary levels of investment of time and information that how much time will be required for this process, what information will be required.

If, suppose the item that we are going to procure is a proprietary item, directly it can be bought because there will be only single supplier for that particular thing. Now, we can also see that the more complex the purchase, the more time needs to be spent and more information needs to be gather to get it right, the first time So, if it is a very, very simple product then not much of effort is required on our part.

But, if it is a complex product then although the definition between complex and simple also needs to be understood, but we can say for the time being that if it is a product, which has number of suppliers with number of relative pricing and number of models that are available for that particular product. Then, the purchase process become a little bit tricky because, so many models are available, so many different companies are making it. So, many price ranges are available then we have to spend more time and more information is related to the procurement of or to the purchase of that particular product, so time required will be more as well as the information required will also be more

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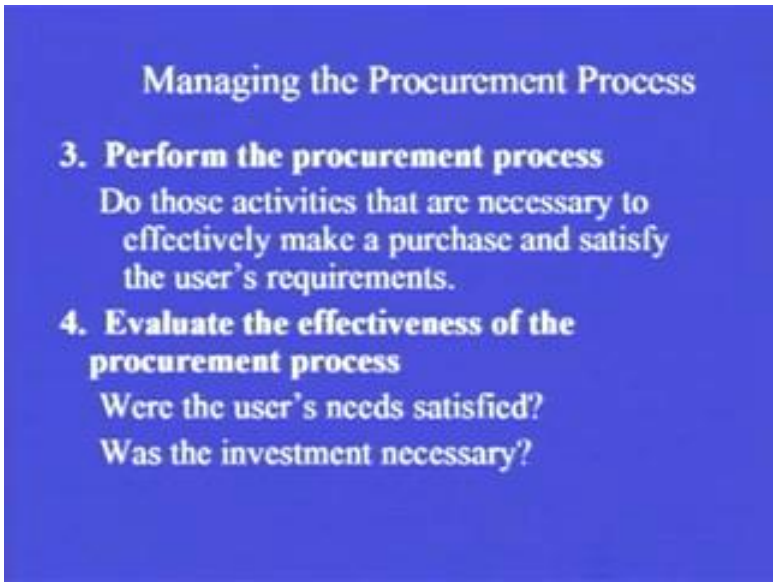

Then, perform the procurement process, so once it has been identified that which particular model, which particular product we are going to purchase, then we can very easily go forward with the performing the procurement process. So, do those activities that are necessary to effectively make a purchase and satisfy the users requirement, so who are users, if we are taking about a manufacturing industry the users are basically the people who are working or who are using those materials on the shop floor or in the work shop.

So, they have identified the need that this is required and then the procurement team is going to procure that material, so once the material has been procured, so they will be now using it, according to their requirement. So, do those activities that are necessary to effectively purchase, a effectively make a purchase and satisfy the user requirement. Then finally, evaluate the effectiveness of the procurement process were the users need satisfied.

So, are the people, who have just given the who have identified the need, who have just given us an idea that this is a thing that as to be procured, are they satisfied or was the investment necessary. So, could the investment have been avoided, if there were other some other materials available, already with us in the inventory then those materials could have been used, so then we do this type post procurement thinking that whether the investment that we have made was necessary or not.

So, we can see that these are four basic steps, which are required in any procurement process and as simple as said this is not as simple, so many things have to be taken care of. So, we have seen that it requires time, it requires information and then the users requirement have to made and then we have to make a feasibility decision that whether the investment that we have made is really required or was it necessary or not.

So, if it was necessary, we have spend the money, we feel that the user requirements I have been met because there was no other alternative available with us, but we have to first check all the alternatives. And then we have to take a final decision that we are going to make an investment on procuring this materials.

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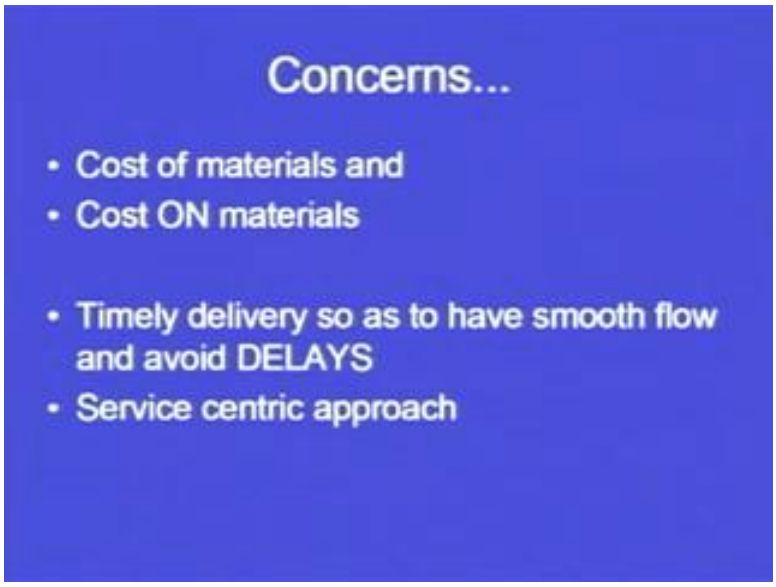

Then, what are the concerns, the concerns are the cost of materials and the cost on materials, so we have to take a decision that what will be the cost of material and what extra money, we are going to spend on the materials. Then we have to take care of the timely deliveries, so as to have smooth flow and avoid delays, so already I have told, I have given an example of an assembly line, so if the materials of the raw materials or the subassemblies are not available, which have to be finally put onto to the base product or to the base assembly.

If those materials or subassemblies are not available with us then it is going to result in the interruption in the smooth flow of the assembly line and it is going to cause unavoidable delays, which are going to result in the loss to the company. So, timely

delivery of materials is a major concern, whenever we are procuring a material and the service centric approach has to be taken care of, already I have told what is service level, so that service level should always be available, if certain materials are required we should have certain quantity of those materials always available within our stores.

So, coming on to that particular thing, now inventory coming forward from the procurement the service centric approach we know that always we should be able to provide the service or able to supply the materials, which are required by the shop floor or the people who are transforming the raw material into the final product. So, what is inventory basically, so we need to understand the basic meaning of this word called inventory.

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Now, inventory basically is the stock of items kept to meet the future demand So, now we are trying to understand what is inventory my inventory, already as I have stated that this is a stock of items kept to meet the future demand. Right, now let us take an example that we are managing a store, in that store certain amount of material is coming and it is supplying to the manufacturing shop floor or to the assembly line, now assembly line I am taking an example of an automobile industry.

There the chassis starts from the beginning and so many things, so many other equipment subassemblies are assembled on top of it. And finally, we get a complete automobile. It can be a scooter, it can be a I can say, I can take an example of a car, so the raw material

is coming, it is being stored and then it is being supplied to the assembly line. The rate at which the material is coming and at the rate at which it is being supplied to the assembly line, if this rate is equal to this rate then there is no need of holding the material here.

I think, I have been able to make a point that if this material, the amount of material is coming here it is reaching in this store and from here this material is going to the assembly line where it is being used. So, from here and this rate, this rate and this rate if this rate is same then there is no need to store the material because whatever we are getting we are directly using it. There is no need of the store, but this type of case is not always possible and it is not a case in all the industries.

Always, the rate at which we are receiving the material and the rate at which we are using the material will always be different, moreover we have to always place an order and there will be a lead time in-between, the placing an order and receiving an order. Therefore, we need to keep a adequate store from which we can always take a material, this material can be taken at a constant rate that daily ten components are taken or it can be taken at a non-continuous.

Or it may be, it can be taken at a intermittent rate that sometimes ten pieces are required, sometimes five pieces are required, sometimes twenty pieces are required, so always we have to keep a stock of items. So, I think the explanation is very, very clear that the rate at which we are receiving the material from the market is not the rate at which we are consuming it, so always we need to store certain materials, so that is given in the inventory, that what is inventory.

Inventory is the stock of items, which has been kept to meet the future demand, suppose we know that for the next two and a half months or for the next three months, I would be requiring this many number of pages. So, I am not always going to go to the market to purchase the pages, I will purchase certain amount of material that I will keep in my store and that I will keep on using whenever the need will be there, so that is basically the inventory.

So, purpose of inventory management is that we need to decide that how many units to order and when to order, we have decide on a quantity, it can be hundred, five hundred, ten thousand, one lakh and we have to take a decision and when we should order this. Now, suppose we are using a particular item in industry, suppose some components are

being used, suppose I take an example of nuts and bolts, so we know that every week were are using hundred nuts and bolts and when we are using it continuously, the stock of nuts and bolts will be keep of decreasing.

Now, I have to take a decision that at what level I have to reorder for example, it again come to example of potatoes with which we started our a lecture on material management. We are daily using the potatoes may be every two day we are using the potatoes in one or the other vegetable, now we will see that only half a kg or may be two hundred grams of potatoes are left with us.

We have to go to the market and purchase more potatoes, so we have to take a decision that how much we have to procure or how much we have to order and when we have to order it, so we have take a decision now the decision can be in two ways either we decide on a quantity. That after, whenever two hundred grams or two hundred and fifty grams or three hundred and three hundred grams of potatoes will be left.

We will be going to the market and procuring more potatoes or we can say that every sunday there is a market for the vegetables, where we can buy the material at a very cheap price Or there is a [FL], where we can go every sunday and buy. So, then we are fixing the time period that every Sunday we have to procure, so two types of system are there one is putting a constraint on the quantity and another is putting a constraint on time that every week we have to buy.

So, we have to take a decision, in an industry that which of these two policies we have to follow that whenever the quantity falls to a particular level then we should order or every month or every two months we have to order irrespective of the quantity, which is already available with us. So, any of these two policies can be followed, but the important point to understand is that the stock or storing of items is very, very important for any industry. So, we will see that what is the requirement, what is need actually of inventory management. Now, what are the components that fall under the inventory.

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What are the different types of materials that we will call as inventory, so inventory basically is raw materials that we are procuring from the industry or from our different vendors, it can purchased parts and supplies, it can be work in process because many times students do not think that work in process is also an inventory item. So, work in process that is partially completed products are also falling under the broad umbrella of inventory.

Then, the items being transported from one place to another place that will also be called as inventory and the different tools and equipment used on the shop floor or used in the industry will also be called as inventory. If it is service sector industry then the inventory items may be different, but these items as mechanical engineers we feel that in an any manufacturing company, we feel that these are items that fall under the broad umbrella of inventory.

Now, inventory and supply chain management, now supply chain management is one of the hot things these days, many people are putting in efforts to optimize their supply chains with effect of cost, with effect of logistics and so many management people are working in this area of supply chain management, so inventory is also an important aspect of supply chain management.

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So, there is a Bullwhip effect, what is this Bullwhip effect demand information is distorted as it moves away from the end use customer, now the end use customer knows what he wants, his demand is taken care by the salesman of a particular company who is in direct contact with that customer. Now, the salesman will frame his forecast that this is what the person requires and then this he will pass on this information to the next head of the department or the next person to whom he is responsible.

And this way the information process will keep on climbing up the hierarchy and finally, a decision will be taken, but usually it has been observed thus that this type of information is distorted as it moves higher up in the hierarchy. Moreover with passage of time, the end use customer demand his taste, his choices may keep on changing, so the company is not always able to identify that what is going to produce and in what quantity it should produce.

So, that all the customers, who would require there product or who have given a nod that they are going to buy the product of that particular company are actually going to buy the product. So, the demand information, whenever it is distorted the company is not able to take a particular doctrine that there are going to produce this much item over a period of one month or two months or four months. So, when that kind of accurate data is not available with the company, they cannot directly rely on their vendors that whenever the need will be there, the vendors will be able to supply the raw material.

In order to overcome this type of a situations, certain amount of raw material is purchased and it is stored in the inventory, so that whenever the demand changes, you have the adequate amount of material available with you. So, that you can match the requirements of the customers, whose requirements are always changing, so the higher safety stock inventories are stored to compensate this type of the fluctuation in the demand.

So, whenever the demand is fluctuating, you need to have certain inventory, certain store available, certain stock of materials available in your store, so that you are able to meet the demands of the customer. This is much more relevant in present scenario because we are seeing that for each and every product there are so many companies, who are competing to increase their market share, take an example of a motor cycle, so many companies are manufacturing motor cycles.

They are competing with each other to capture the market, they are going, they are going one step further they are advertising, they are given customer the choice in the color, in horsepower, so many things are happening in the competitive environment. So, all the companies want that whenever there is a demand by the customer their product should be available to the customer, so that he does not go to the competitor company.

Therefore, always the company wants that whenever the demand is there, they should be able to process that demand and in order to process that demand, they have to keep a stock of materials always available with them. Then, sometimes there is seasonal or cyclic demand, on your screen you can see the second point is seasonal or cyclic demand, so whenever seasonal or cyclic demand is there also we have to keep a stock of raw materials always available with us.

Suppose, umbrellas are required in the rainy season, all of us know sometimes there may be rain in other season also, but the sale of umbrellas will be much more in the rainy season, so a company that is manufacturing the umbrellas, they have to keep a stock of the different inventory items, which are required in order to manufacture the umbrella. So, if those are available may be there are available at a lower price at some off season, and if the company that is manufacturing the umbrellas wants to procure those material just before the start of the rainy season, they may have to pay more price.

So, the optimum decision is that they should buy the raw materials required to make an umbrella or to manufacture an umbrella at that particular moment of time when the raw materials are available at the cheapest possible prices. So, the in order to take of or in order to take advantage of those price discounts that are available in the off season, the company that is manufacturing certain items which are seasonal in nature they can procure those material and then may keep an inventory of those materials.

So, that they are able to take advantage of the price discount, then inventory provides independence from vendors, this is the first situation that I have told that the material is coming and then it is being stored and then it is being used. So, if the rate at which we are receiving the material and the rate at which we are using the material this is same then there is no need of keeping an inventory. But the case is that we are always dependent on the vendor, who is supplying the material and we are using that material.

Suppose, there is some price fluctuation and we are not able to negotiate the prices with the vendor and he stops the supply of raw material, our smooth flow of the manufacturing process will stop and that as a company we do not want then what is done in order to make our process smooth, we will always keep a stock of items. So, in this way we will become independent of the vendors because we always have certain stock available with us to live for certain amount of time or in order to keep our process going.

In the mean time, we can find out for some other sources of supply and we can switch over to some other vendor, but if we do not have a stock then the problem will be much more. Then inventory provides independence between stages and avoid work stoppages, so that is also a very important point if inventory is there, let us take an example, that the product or the work in process that has been manufactured on one machines goes to the other machine.

Now, suppose this machine is not functioning properly or has broken down and if, we have certain in certain processed material already available which has been processed on this machine, this can be used for some time in order to give input to the subsequent machine, but if there is no inventory available with us, then the whole process will stop. So, it will, the inventory provides independence between stages and avoids work stoppages.

So, these are some of the salient advantages or the salient needs of holding an particular inventory. Now, why inventories are required, although I have explain each and every point, but in order to make the audience much more clear regarding the use and the requirement of the inventories, I am just going to explain all these points once again and in a very, very clear manner.

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So, why inventories are required, to safe guard against the uncertainties in price fluctuations, supply conditions, demand conditions, lead times, transport contingencies etc. So, already we know that inventory is required because of all these uncertainties Now, the uncertainties may be in price fluctuations, sometimes we are getting the raw material at a very competitive price at other time the price of the material is relatively higher or maybe we can say much higher.

So, what as a company, I would like to take a decision is that we are going to procure raw material, whenever the prices are much low, so whenever the prices are less we will buy and then we will stock the material. For example, we can say stockings of wheat in our household, so wheat price also keep on fluctuating throughout the year, whenever there is more supply of wheat the prices may be less, whenever there is less supply of wheat the prices may be more.

So, whenever the supply is less and demand is more than the prices will be higher, so we will see that if we have adequate storage space available with us, we are going to procure

that particular item at a relatively lower price and stock it to be used whenever the prices will be higher. So, we want to take the advantage of price fluctuations and whenever we take the advantage of the price fluctuation, if we are buying the material at a lower price we will have to keep it in stock.

So, in order to use the material, whenever the prices will be higher, similarly, the supply conditions already this example we have seen that if the supply is not regular then we have to always keep a stock of that particular item then the demand conditions, sometimes the demand conditions may change, sometimes you require more, sometime you require less. So, the demand fluctuation may also result in stocking up of the inventory.

Then the lead times, lead time basically is the time between placing an order and receiving an order, so there is always a time between placing an order and receiving an order. So, in certain models that we are going to cover in the second lecture, maybe on inventory management, we will see that what basically is lead time, when do we place a order, when we receive a order, so if the lead time is zero as soon as we place an order we are going to instantaneously receive the amount of order that we have placed, but if there is a lead time may be five days.

Today, we place an order after five days we are going to receive the material, so the lead time also changes, similarly the transport contingencies. Now, suppose we are receiving the material by road, if there is a flood or there is any other catastrophe the roads have been damaged then the supply lines are cut, we are not able to get the raw material available and the whole process stops. Let us take an example of a thermal power plant, all of us know in thermal power plant, the power is generated by a burning the coal that is one of the important raw materials which is used.

So, now if the coal is not available, the plant has to stop which is not desired by the organization because in order to restart the plant huge amount of investment is required, so if transport contingencies are there then also in order to overcome these type of contingencies we need to keep of stock of materials. So, right now I am spending some more time on this particular topic, because we need to understand that why inventory is required because the later parts of the lecture are related only when we identify that yes inventory is required because somebody may challenge that no inventory is required.

There have been certain techniques in industrial engineering, where people want that minimum inventory, minimum lead time should be there as you want the material you should get it, but in our scenario, there are certain constraints under which we have to function and for that particular reason we have to always keep an inventory. Now, other points why inventory is required is to reduce the machine idle times by providing enough in process inventories at appropriate locations, this thing already I have explained in the previous slide.

That no machine should be idle, if in process inventory is there, the process will always be smooth and the product even if one machine has broken-down the delivery of the product will be regular if we have adequate in process inventory. Now, third point is to take advantage of quantity discounts, economy of scale in transportation, this is also a very valid point, so in order to take the quantity discount, we will take one example of quantity of discount also and try to optimize that what should be our procurement procedure.

What should be the quantity we should order or we should procure, If we want to take a advantage of the quantity discount, similarly the economy of scale in transportation is also very, very important. Now, suppose we are paying for one truck load of material from one place to another place, so we are paying for that and we are only getting half the truck, half of the truck is empty. Then what we can do is in order to economize that process we can order a little bit more, so that whatever is coming, it can come in a single go. And the money is saved for the organization, so these are very simple things, but these are incorporated into the industrial decision making, in order to economize the complete process of procurement and managing the material.

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Then to decouple operations that is, to make one operations supply independent of the anothers supply, this helps in minimizing the impact of breakdowns, shortages etc, on the performance of downstream operations. Moreover, operations can be scheduled independent of each other if operations are decoupled, so we can see that if we are able to decouple the operations from one another, then we will be able to more effectively and efficiently manage our manufacturing process.

So, managing the materials or always holding a inventory of the materials is going to help us in order to smooth out our process of manufacturing, even if there are breakdowns, there are shortages of material, if the operations are decoupled from one another the process will always keep on and it will result in more efficient utilization of time and resources. And we will able to save the money that would have been lost because of the breakdown. So, holding an inventory also turns out to be a profitable position for any organization.

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Then, to reduce the material handling cost of semi-finished products by moving them in large quantities between operations, so this is also going to economized the whole operation. Then to reduce clerical cost associated with order preparation, order procurement, so that will also be minimized. So, if we are frequently keeping on ordering then the clerical cost and the other cost associated with procurement will add on to the total cost of the product.

So, if we are ordering in bulk, we will be able to save this much amount of money for the organization, so till now we have seen that the materials management is one of the most important aspect of any organization and it requires adequate attention on part of the organization. We have seen that whenever we have to procure material, we have to take certain decision, what is the procurement process, what is the importance of the procurement process, what advantages can be derived if we take of the procurement process or if we effectively and efficiently manage the procurement process.

And, then we have seen that certain amount of stock or certain amount of inventory has always to be kept in order to economize the complete process and in order to avoid the stoppages. So, in the next lecture on materials management, we will see that what are the various tools that are used in inventory management. So, that we are able to decide that what quantity we should order, at what intervals we should order and what are the

different formulae and formulations to help us or to guide us in order to take these decisions.

Thank you.