**Operations and Supply Chain Management**
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## Lecture - 1
## Introduction – (Challenges, Methodologies)

We begin this course on Operations and Supply Chain Management, we have two instructors for this course, my colleague Rahul Marathe and I will be handling sessions in this course.This course is about operations and supply chain management; in operations management, we address planning and control issues in manufacturing and services. In supply chain management, we address these issues considering more than one organization or more than one facilities within an organization.

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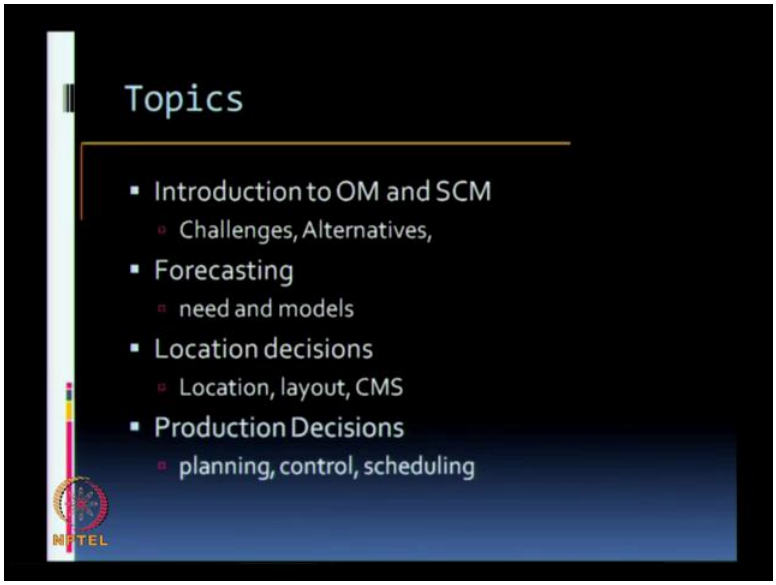


In this course, wewill be addressing several topics,this lecture will be on introduction to operations and supply chain management.We would also be addressing the challenges that a manufacturer has to face as well as alternatives, that have evolved over a period of time to meet and address these challenges.We will also have topics on forecasting, location decisions, production decisions.

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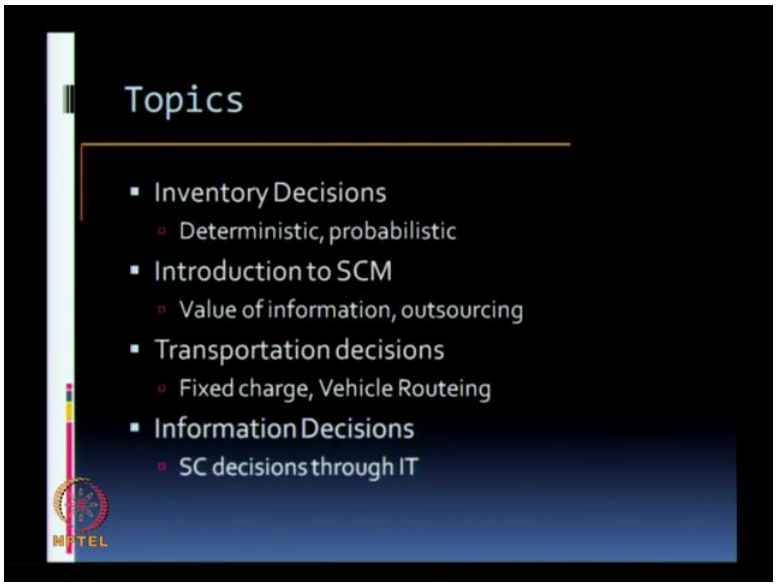


Inventory models, introduction to supply chain management, value of information and outsourcing in supply chain management, transportation decisions and information decisions. In forecasting, we will be addressing a need for forecasting and some quantitative models. Under the location decisions, we will have some quantitative models on location, layout and cellular manufacturing. Under production decisions, we will look at aggregate production, planning and control as well as scheduling.

And in inventory decisions, we will look at deterministic and probabilistic inventory models. We will then go to the supply chain management part of the course, where we will begin with an introduction and also highlight the importance and value of information and outsourcing. We would then address transportation decisions and decisions based on information.

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So, let us begin the discussion on operations management, as I mentioned operations management deals with planning and control issues in manufacturing and services. So, we will address ourselves primarily to requirements of manufacturing. Today's manufacturing faces several challenges and some of these are shown here. These are changing market conditions, where the market conditions seem to be changing faster than ever before.

And more importantly, not only has the market changed from a seller's market to a buyer's market, the rate of change is also very fast. Today's customers are far less patient and far more demanding than customers of the past. Today, there is a need to meet various customer requirements, which we will see in a subsequent slide and in addition to meeting the customer requirements, the manufacturing organizations will also have to face global competition.

The number of global competitors and foreign players in the market are large and whether the manufacturing organization is an Indian organization or a foreign company, they have to face this global competition. It is also necessary for manufacturing organizations to be proactive and make proactive decisions so that, they do not have the disadvantage of having to react to changes, that competitors and others make.

In addition, there has to be increased customer focus, because the business comes from the customers and customers are far more demanding and to some extent, far less loyal

today. If the manufacturing and service is not upto the expectation of the customer, today's customer has enough alternatives to consider and the manufacturing organization would lose it is business.

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Now, what are the customer requirements and how the customer has changed over the years? We begin this slide with the simple comment which says that, the customer was once satisfied with a black car. This means, we are going backwards in time to a situation, where there were very few cars available and there were only black cars available in the market, this was a state of manufacturing in the early 1920's. So, the customer was prepared to accept whatever was given and whatever was available in the market.

Then, the customer started looking at availability which means, when the customer wants to buy something, now it has to be available for the person to buy and this means that, manufacturing systems have to be ready to have enough number of items produced and available for the customer. So, availability would mean that, manufacturing systems have to look at being capable of producing in large quantities. So, manufacturing systems moved towards what is called high volume production, automatically high volume production would mean less of variety.

So, in the early stages of manufacturing, the emphasis was more on volume and less on variety. Now, once the manufacturing systems geared themselves to meet this particular

requirement of the customer, the customer also started looking at price. Once the customer starts looking at price, manufacturing also has to adapt itself to produce items that are affordable. So, a manufacturing system started concentrating on reducing the price and cost of the item.

Now, once the availability and price requirements are met, the quality requirement started coming and the customer was keen that, the quality provided by the manufacturer was good enough. This also meant that, manufacturing had to ensure that, the quality of the products was good, there was less of rejects, there was emphasis more on after sale service and warranties, which are related to the quality of the product. Now, after the quality requirements were met, the customer started looking at variety.

Now, when I go and buy something, do I have a variety of items or things to choose from? So, manufacturing systems are now geared to producing more variety and when the variety increases, it was difficult for manufacturing to simultaneously increase the volume as well as variety and therefore, when the variety increased, the volumes came down. So, the emphasis moved towards what are called mid volume mid variety manufacturing.

And the manufacturing processes changed from high volume production to mid volume, mid variety systems and the layouts also changed from what are called product layout to what is called process layout. In process layout or functional layout, we are able to produce in the middle volume middle variety category. Last but not the least, the customer wants to buy frequently, earlier the customer would change the product only when the product that the customer was using became unusable or was not working.

So, when the equipment or the product was unable, was not fit for use, the customer would go and change the product. But today, we all of us change the products that we use quite regularly. Now, since the customer wants to buy frequently and whenever the customer is buying, the customer wants more features in the product, the emphasis also shifted to what is called new product introduction and new product development.

So, today's manufacturing has to definitely look at, being able to provide volume or availability, should provide items at an affordable price, should provide items with very good quality, should be able to produce a variety of products and should be able to introduce new products.And since the rate of change is much higher, the new products

also have to be introduced frequently, so all these becomewhat is called the requirements of manufacturing.

In addition to the above point,it is also observed that, today's customer is a little impatient in terms of placing an order and waiting for the product. So, it is absolutely necessary that, manufacturing is able to meet the deadlines and produce and make the products available in as short a time as possible. Today, the customer also wants more value for the money given and therefore, factors such as qualities, warranties, after sale services, most of these are packaged along with the price of the product. And this also puts a little more pressure on manufacturing to take care of all these requirements simultaneously.

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Now, let us look at what are the requirements of manufacturing, so whatever we have seen till now, a summary of that is provided in this slide. And the requirements of manufacturing are, to make an increasing variety of products, this is because the customer wants variety, customer wants to choose whenever he or she goes to the market to buy something. Make it on shorter lead times; this is because the customer would buy frequently with smaller runs and flawless quality.

Particularly here, one has to look at the adjective for flawless quality, now quality is now something, on which there is absolutely no compromise. So, the quality has to be exceptionally good and quality has also become some kind of a minimum requirement to

sustain, so manufacturing systems have to produce with flawless quality. Now, the first bullet is with respect to the customer, the second one is with respect to the organization, improve the rate of return on investment by automation or by automating and introducing new technology in process and materials.

So, today there is a need to introduce new technology. Why is that such a need? The need is because price can be reduced. So, by introducing new technology in processes and materials, it is now possible to bring down the time to produce.When we bring down the time to produce, automatically the cost of production comes down and the price can be reduced.And to meet local and foreign competition, because today manufacturing has to face local and foreign competition from other companies.

So, the second bullet that we have seen, essentially looks at requirements of manufacturing from an internal perspective as well as a little bit from the customer, because the price of the product has to be reduced. Third requirement is to mechanize, but keep theschedules flexible, keep the inventories low, keep the capital cost minimum and keep the work force contented. Mechanize says that, manufacturing has to look at automation, to bring as much of automation as possible.

At the same time, they have to keep the schedules flexible, because the demand for the products can be a little uncertain and cannot be forecasted or predicted with 100 percent accuracy. So, there will be rescheduling that happens, because of demand changes and when demand changes, the manufacturing organizations have to be prepared to do the reschedule which means that, the schedules have to be made flexible.

The inventories have to be low so that, the price can be minimized, capital cost have to be minimum so that, the price can be minimized and work force have to be contended - because from a contended and happy work force, comes a good product. So, with all these things in mind, the requirements of manufacturing have been defined by Skinner in 1985, which is roughly about 25 years ago. But, whatever we have seen in this bullet, is still applicable today and most Indian organizations are striving to reach, what this particular slide asks them to do.

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Now, before we get into some more aspects of operations management, let us look at a few events in history that have happened, which have some impact on, how manufacturing and services and also the customer's requirements have changed. If we go back into history, an important landmark is the Second World War, which perhaps was the first time made people understand, that resources are scarce and scarce resources will have to be utilized carefully.

Now, this understanding that scarce resources have to be utilized carefully, led to the development of the field of Operations Research, where the emphasis was not only on doing things, but doing things well. There is an objective of minimizing the cost or time associated with carrying out the activities. Along the same time, we also had breakthroughs in computers and computers were made available and this helped manufacturing organizations in the areas of cost and information control.

The communication systems also started getting better and then, it is now possible to have a personal touch and constant communication between suppliers and the customers. More recently, we have this concept of electronic commerce, where customers or even people need not go physically to the place of sale to buy, while they can buy from their own houses and things have to be delivered at the door step.We also have the concept of home offices, where a lot of work does not actually happen in the offices.

One of the reasons for going through this is to convey the importance of time and speed, as well as the impact of computers, communications and information technology. We have already seen that, the customer wants new products and customer wants them very quickly. So, the time taken to manufacture has to come down which also means, that the speed of manufacture has to go up.

A careful look at the points that have been described here also tells us that, the customer right now wants things very fast and has become more and more impatient to waiting for something to happen. So, there is a tremendous need in manufacturing, to do things at less cost and to do things very fast.

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Now, let us see how manufacturing have also adapted themselves, but before that, we also have a couple of slides, which talk about some issues in history and how manufacturing picked up points from these. Now, this slide talks about people who have contributed extensively, now the first starting point of almost all of manufacturing was the conversion from up and down motion to rotary motion, which actually helped in the steam engine, which was a starting point of a lot of manufacturing.

Then, early effort atmanufacturing was more towards volume and scale and with emphasis on the steel industry and there was also emphasis on cost control to increase the profits.

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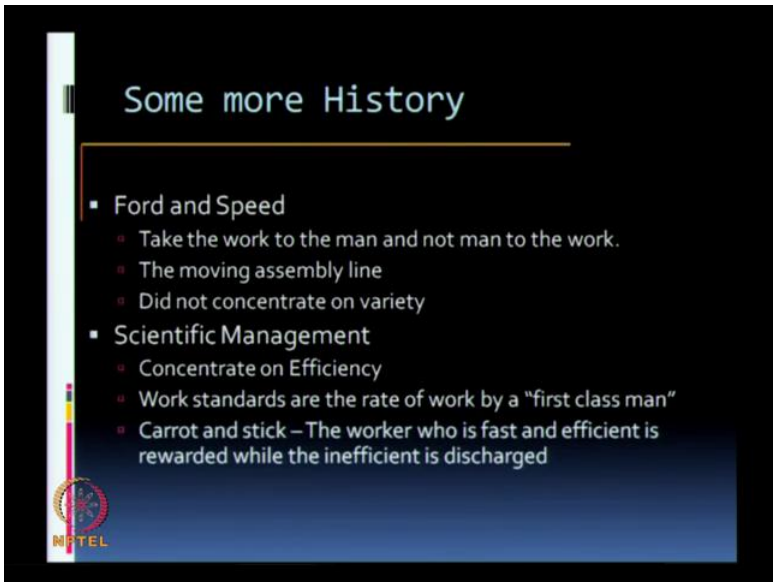


Now, as mentioned earlier, after manufacturing looked at volume and scale, manufacturing also looked at taking the work to the man and not the man to the work and this idea of moving assembly line started. And about the same time, manufacturing systems also understood to concentrate on efficiency and when the principles of scientific management were actually brought out and used largely by the manufacturing industry.

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Then came the idea of scientific management, where the scheduling and other aspects also came in.Here, there is a mention of the Gantt chart and then, we also have the time and motion study, where manufacturing started looking at the human aspects. Now, these slides also tell us, how over a period of time, various aspects of manufacturing starting from being able to produce.

And then, looking at scale,looking at speed, looking at efficiency, looking at bonus and human resources and looking at motions, all these things came into manufacturing and they have all shaped up the evolution of manufacturing systems.

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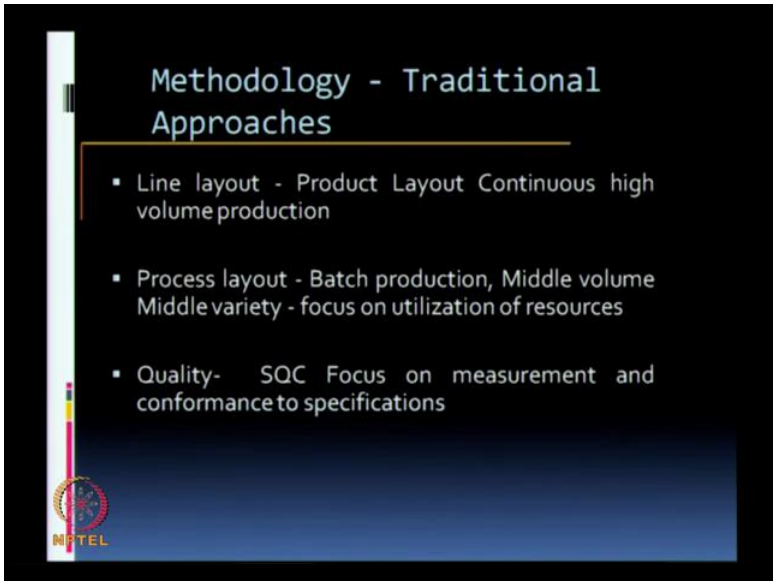


Now, let us look at, what we call as the methodologies that have happened over a period of time to meet the customer requirements.Now, we classify them into methodologies based on traditional approaches.

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And then, methodologies based on process improvement then, methodologies based on human resources and processes, and methodologies based on information systems and decisions. Now,we will look at each one of them a little bit,so we start with traditional approaches and as we mentioned earlier, traditional approaches to manufacturing were based on volume and variety.

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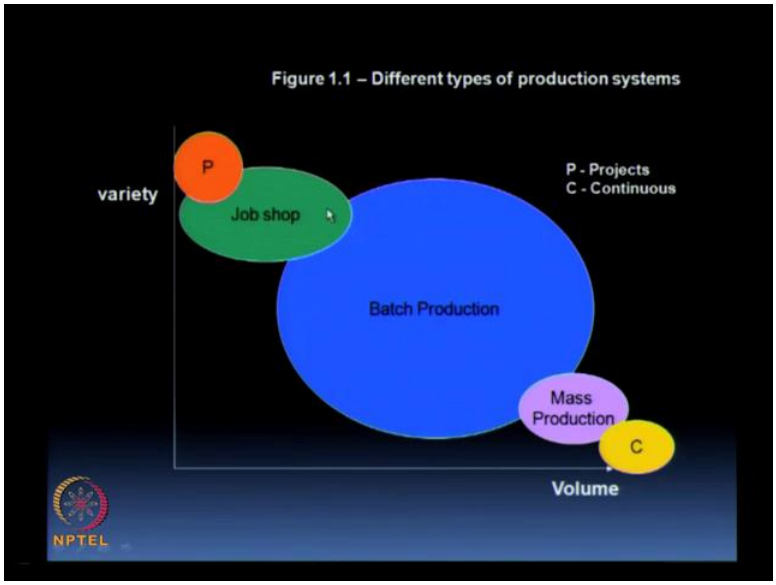


Now, this slide capturesthe relationships the x axis shows the volume and the y axis shows the variety. So, production systems or manufacturing systems were categorized

based on volume and variety as shown in this picture. Very high volume and very low variety systems were called continuous production systems shown as C, which stands for continuous production systems. High volume and little more variety were the mass production systems.

The middle volume middle variety, which is shown as a large portion here, is a batch production system.And as we move on the variety and keep increasing the variety, the volume comes down and we have what is called the job shop. And further up with very high variety and very low volume, we have what is called the projects or a project based approach. Now, in terms of layout, the very high volume systems, this part of the picture or the figure have what is called line layout and also called the product layout, which was meant for continuous high volume production.

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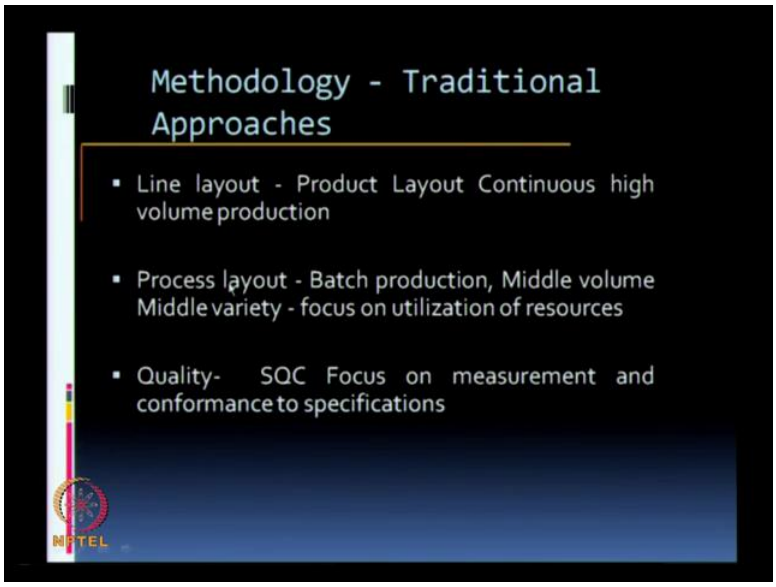


The batch production systems which are shown in the middle have what is called process layout or functional layout, where departments were laid out based on process specialization. Now, these types of layouts and production systems were used for middle volume middle variety and the focus on these were more on utilization of resources. Quality was of importance, but quality was more towards what is called statistical quality control with focus more on measurement and conformance to specifications.

Now, for very many years, people used these type of traditional approaches to production systems, say till about 1960, 1970 people were using these type of approaches. Now,

among the traditional approaches, since a large amount of manufacturing was on the middle volume middle variety manufacturing systems, we had more of the process layout or functional layout that was used for manufacturing. As mentioned, in a functional layout focus was more on utilization of resources and there was little less focus on the product than on the process.

So, quality was also restricted more to the process and less on the product, and over a period of time, people observed that, the ownership and responsibility was not on the product, but was more on the process, because the focus was on utilization of resources. It was also observed that, material move very long distances within the factor, there was not much of responsibility, quality was also suffering, changeover times were very large and there was a lot of inventory in the system.

As manufacturing systems continued to use the process and functional layout for batch manufacturing, people found out that, there were lots of disadvantages of such a type of manufacturing. The next question that came is, while line layout and process layout have their own advantages and disadvantages, is it possible for usto borrow or to take some advantages of the line layout and bring it into the process layout.

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Now, this helped in what is called the group technology or cellular manufacturing. Now, group technology or cellular manufacturing came somewhere in the 1960s, may be little earlier than that, but people started using the techniques of cellular manufacturing and

group technology somewhere in the 1960s. Now, let ussee, what this cellular manufacturing and group technology is.

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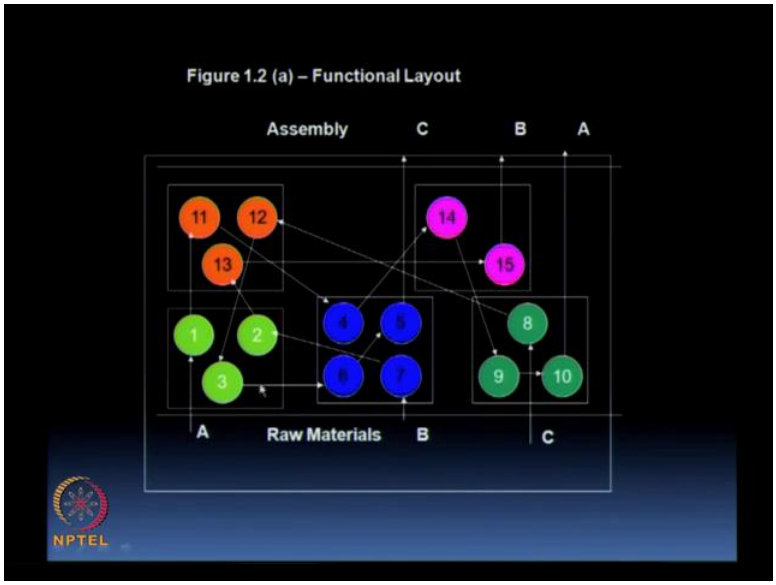


Now, let us look at this picture which talks about, what is called a functional or departmental specialization. Now, we have raw materials that come in, we assume A, B and C as three families of parts, which can go to different products. Now, this layout is based on, you can see this orange color is a set of machines, the light green is another set of machines, light blue is another set of machines. These two are one type of machines and these three are another type of machines, this schematic diagram shows five different types of machines.

Within each type, the machines are similar and can perform the same functions, so the layout is based on functional specialization. So, if we take a typical part or product or a path family, which we call as A or B or C. For example, A would go to machine number 1 here and then, it would go to machine number 11 and then, it would go to machine number 4 and from then, it would go to 14 then, it would go to 9 then, it would go to 10 and then, it would come out.

Similarly, you have these routes for B and C, what is also important is that, in order to increase the utilization of the machines and in order to maximize the time, the machines were producing the batch sizes were large. Since the production batch sizes were large, to go from 1 to 10, the transportation was done in large batch sizes. So, production

batches were large in size, transportation batches were also very large in size and there was a lot of delay in transporting from 1 to 11,11 to 4 andso on.

Because, batches were large and there were delays in transporting, it also led to situations, where some of these machines had to wait for jobs to come. So, while this type of a layout is very good with respect to utilization of resources, this type of layout had it is owndisadvantages with respect to changeover times being very high,batch sizes being very large, lot of material movement, quality suffering, delays in transportation and idle times on machines, because machines had to wait for the products.

So, this is a schematic diagram of the functional layout and then, let us see what happens when we reorganize this into what is called a cellular layout.

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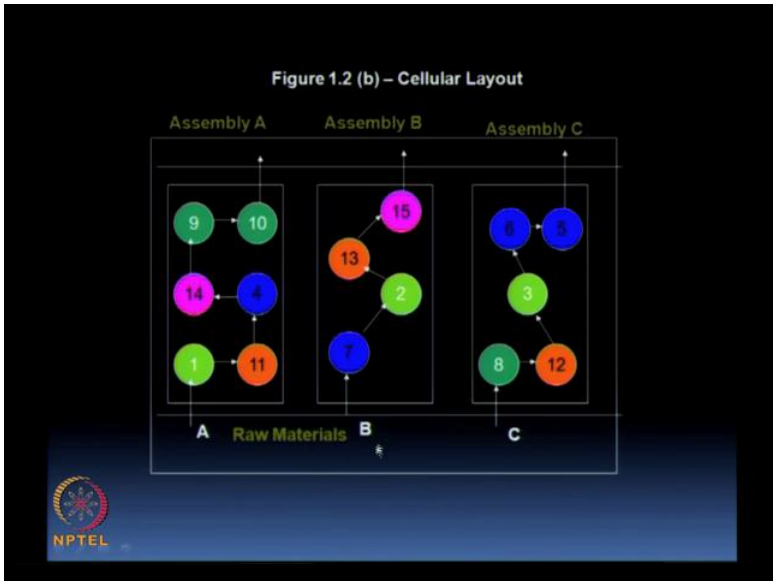


Now, this cellular layout also called group technology layout, what we have done right now is, we have tried to look at all the machines that were used to produce this A. From this picture,1 11, 4 14, 9 10, now you see 1 11 4 14 9 and 10, but please note that, A is not a single product, A is a family of parts or components that can make or that can go into one or more products. Sometimes A can also represent a product, but right now we will assume that A represents a part family, instead of parts or components that are required to make the full product.

Now, this is called a cell. This is a cell which has now 6 machines, this cell has 4 machines and this cell has 5 machines. Now, if you look at this cell, this cell has machines which are functionally dissimilar. For example, this machine is different from this, this machine is different from this and so on. So, a set of functionally dissimilar machines, but similar with respect to the manufacturing process of this A or this B or this C.

So, we try to bring functionally dissimilar machines and try to have what are called manufacturing cells. Now, the moment these manufacturing cells are created, now assume that, we have the facilities or the machines to produce all the parts that belong to part family A. And if we are able to bring these machines physically together and use a certain small amount of space then, it is possible to treat this like a factory within a factory.

Now, this cell will have it is own capacity planning, this cell will have it is own production planning and scheduling and control and so on. So, what was a large factory as shown here, now with the cellular manufacturing systems and if we ensure that, there is no movement from one cell to another, which is what we have shown here. If there is no movement from one cell to another, each cell can be thought of as an independent production unit and can be thought of as a factory within a factory.

So, we are able to simplify the manufacturing processes and control, and we all know that, it is always easier to handle a much smaller system than a very large system. So, cellular manufacturing helps in overcoming all the difficulties that were there in the functional layout. People who started using cellular manufacturing, also have reported a saving of about 20 percent inventory, about 10 percent space and so on.

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Now, group technology or cellular manufacturing as we have seen, deals with organizing machines and grouping parts to families. Now, how do we get these part families, now these part families have to be formed and then, the machine cells, which make these part families, will have to be created. So, it is about, first making part families and machine cells, after which we look at the layout of machines within this cell. We look at capacity of this cell and then, we look at scheduling and balancing the machines within these cells.

So, these are the issues in cellular manufacturing, but largely cellular manufacturing is about ownership and responsibility. Now, if we create this cell and then, we have about half a dozen people or less working in this cell then, these people will have the ownership and responsibility to carry out all the tasks within this cell. So, cellular manufacturing brought increased ownership and responsibility to the manufacturing.

About the same time, we also had the Japanese management systems or just in time manufacturing systems, which started with the Toyota production system, which concentrated a lot on waste elimination and inventory reduction. Now, in order to bring down the cost of the item, it was necessary to identify all the non value added activities. All the non value added activities are called wastes, wastes by definition is anything that does not add value to the product or waste is anything that is more than the minimum amount of resources used to carry out an activity.

So, one of the contributions of the just in time manufacturing was, in the area of waste elimination. Seven types of wastes were classified. They are called the seven Muda and all the wastes were brought into one of these seven categories and there was a conscious effort to bring down or to reduce the wastes. So, waste reduction automatically resulted in less cost, so along with the just in time manufacturing systems, today we also have lean manufacturing systems, where the emphasis is on ownership and responsibility and also on cost minimization.

Now, about the same time, we also had flexible manufacturing systems come in, where there was a lot of emphasis on automation. And flexible manufacturing systems focused more on technological solutions and reduced the production time. And flexible manufacturing systems because of their speed and additional capability, were able to handle very high volumes, very high aggregate volumes, at the same time they were able to handle variety.

So, these three come under what is called the process improvement methodologies. There are many more but,we are looking at these three today, because these three are the most important ones with respect to process improvement.

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Now, there are other methodologies that came, that are based on human resources and processes, there is a tremendous emphasis on total quality management. Now, quality as mentioned earlier is some kind of a non negotiable commodity, people expect flawless

quality and the concept of quality moved from quality control to quality management. Quality gained a certain structurein the organization and organizations started concentrating on what is called total quality management.

Total quality management is a management initiative to empower all people working to do their best. So, there is focus on people, focus on employee empowerment, it also resulted in things like quality circles,where people who were operating and who were doing the job, were given opportunity to discuss and solve problems in manufacturing, as they happened. And since people who were working were able to solve problems, it resulted in increased employee empowerment and better systems from a quality perspective.

There was also this emphasis on business process reengineering, where the business processes were reengineered. Business process reengineering or BPR as it is called addresses a radical and a dramatic change in the process and many BPR issues were related to extensive use of computers and technology. Now, somewhere since the 1990s, there has been an increasing emphasis on quality certifications.

Largely ISO9000 certifications, where manufacturing organizations get themselves certified for designing and carrying out a quality management system with respect to their manufacturing processes. In addition to quality certifications, organizations also looked at certifications related to environment management, related to health and safety, and related to social accountability.

Now, all these initiatives help or helped the manufacturing organizations to achieve good quality and to have a content work force, which we saw as one of the requirements of manufacturing today.

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There are also methodologies that are based on information systems and decisions, so we cover some of them here. Materials requirement planning called MRP, which talks about inventory reduction, consistency in bill of materials, lot sizing and pull systems. We are also going to mention the little bit about enterprise resources planning and a little bit of supply chain management that logically follows from here. We will have more details of supply chain management, as we move along in the course.

Now, materials requirement planning essentially talks about, first it talks about the bill of materials. If we take a product,each product is then split into various assemblies and sub assemblies and then, into manufacturing parts and brought out items. Now, all these will first have to be identified, before the manufacturing begins and computer systems were used in identifying and locating them in the structure of the product.

There are also lot sizing models that came, where the demand for the various components were met by buying from suppliers and by identifying the correct lot size to buy from various suppliers. Now, materials requirement planning then became MRP II, which is called manufacturing resources planning, where capacity planning was also included.

Then, came enterprise resources planning, which are called ERP systems, there are basically two points of view, one of which looks at ERP systems as a logical extension of MRP systems, where additional aspects such as quality, maintenance, human resources,

purchase, procurement, all these were added to MRP systems.There is another school of thought, which talks about EPR systems, as a separate area in its own right and as being independent of MRP systems.

So, irrespective of the approach, we take one thing that is clear is, ERP systems were large systems, ERP systems provided lot more information and sometimes decisions. ERP systems were expensive and ERP systems required a lot of time and effort to mature and to provide good support to manufacturing at steady state.Then, came supply chain management, where organizations primarily wanted to integrate production and distribution and also wanted to add the supplier into the decision making process.

So, in some sense, if we look at it as a chain with the manufacturing organization in the middle, those to the left of it are suppliers and those who are in the right of it are customers. So, supply chain management talks about a network of organizations or a network of facilities, which begins with the procurement of raw material and then, transforming this raw material into products and then, distributing these products till it reaches the end customer.

So, supply chain management talks about the supplier, the manufacturing, the distribution with respect to warehouse, dealers or distributors, and retailers. So, supply chain management also is a large complex system and the success of supply chain management systems are round the ability to use information technology and communication to the advantage of the organization.

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The last classification that we are going to see today, though there are many more classifications, are what we call as business perspective. We already made a brief mention of business process reengineering. Business process reengineering as I said is a dramatic radical way of changing the processes, wholly from a business perspective. We also would look at a little bit of constraint management or theory of constraints, where the bottle neck in any process or any business is identified and all resources are subordinated to the bottle neck.

Now, this concept of synchronous manufacturing or constraint management came from the goal, which was a book first written by Mr Eliyahu Goldratt. And there are other books and other material that have come from Mr Goldratt, which talks about how organizations and businesses try to make their performance better by looking at bottlenecks and trying to debottleneck their difficult resources.

The last thing that we would see in this presentation about business perspectives and methodologies is, what is called agility or agile manufacturing, where several aspects such as empowering the customer, cooperate and compete, etc are being discussed. For example, people also look beyond organizations that compete to say, whether two competing organizations can actually complement each other,whether two competing organizations can get into a third business, where they can cooperate.

Many things such as empowering the customer, eliminating waste and producing to customer needs, mass customization and cooperation among organizations are some aspects that have come into agility. So, what we have seen till now are methodologies, which are based on four different perspectives. We started with methodologies on (Refer Slide Time: 42:44) process improvement, which is of course absolutely essential for manufacturing, because all these methodologies aim at minimizing the time of production and minimizing the cost of production directly.

Now, methodologies based on human resources also try and reduce the cost, but slightly indirectly in terms of managing the human resources very well and in terms of keeping their processes and systems in place. Similarly, methodologies based on information systems and decisions, help in quick and correct decision making, which can reduce the time and cost of making decisions and help the manufacturing organization to produce at less cost quickly.

Methodologies based on business perspective also achieve the same result, but the way they look at it is different. They look at the business entirely as a whole and try to make changes in the business processes so that the cost of manufacture comes down. Till now whatever we have looked at manufacturing is equally applicable to the service, though a lot of emphasis has gone into manufacturing.

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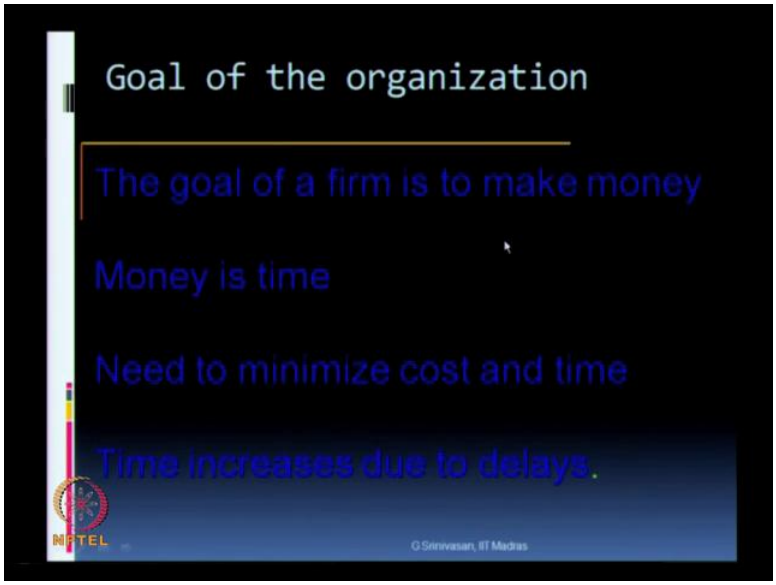

Now, let us look at a couple of other things, before we quickly move into the various aspects of operations management. Now, what is the goal of the organization? Goldratt answered this question by saying that; the goal of the firm is to make money. And in order for the organization to make money, they also have to produce and sell a product or provide a service in as short a manner as possible, so money is essentially time.

So, if the organization wants to make money then, the organization has to minimize the cost of production and minimize the time it takes to produce.The time it takes to produce in any organization increases due to delays.

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So, we will now see, what are the possible delays and how these delays can be reduced, there can be several delays, we classify delays here as delays based on raw materials, delays based on work in process inventory and delays based on finished goods. Now, the reason we do that is, if we look at any manufacturing system, there are a set of materials that come in, which are raw materials.These raw materials are transformed into finished products, so there is a manufacturing, which involves work in process inventory and these finished products are sold and distributed, so there is a finished product delay.

So, very quickly going through these, delays in raw materials, delays happen when orders are not placed for materials in time. We may know that, the reorder level which is the point, at which the order has to be made, has been reached, but orders are not placed. Now, there is a lead time which is taken by the supplier to produce, so there is a delay in

the lead time. There are delays in transportation, there could be delays for the raw material to come and reach the manufacturing organization.

There are delays that are caused due to inspection, because the items that come in are inspected and there are delays with respect to issues. So, all these delays have to be minimized and there is a lot of emphasis on inventory management or materials management, about which we will see in this course. Now, inventory management would talk about, how we ensure to minimize these lead times and how do we know that, how the reorder level has to be fixed.

So, all these questions will be answered in inventory management, but largely all these questions will be answered in what is called purchasing management. Purchasing management is an essential part of operations management.

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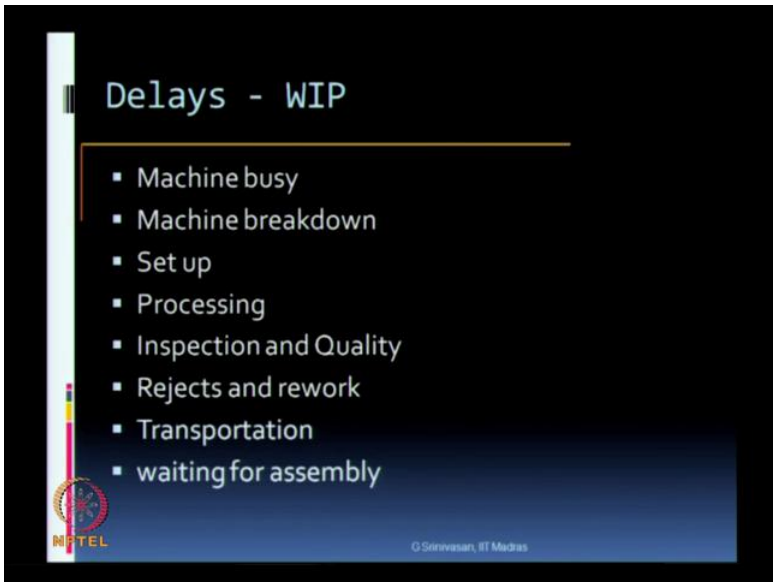


Now, there are delays caused during the manufacture when the machine is busy, the job is available, but the machine is busy, so there can be delays.There can be delay when the machine is available, but the job is not available, there could be delays. There can be delays with machines breaking down or not being available,there can be delays due to large set up and change over times, delay due to large processing times due to in process inspection, rejects transportation and movement and waiting for assembly.

Now, all these will have to be addressed within the manufacturing and various topics in operations management addresses these. Machine breakdowns are addressed using reliability and quality management, set up times reduction is a very important part of operations. Processing times come down due to technology, inspection and quality separate area by itself, which also handles reject and rework.

Transportation comes through material movement and waiting for assembly is reduced by good assembly linebalancing. So, all these reasons for delays are now addressed using methodologies that are there in operations management.

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Now, delay in finished goods come because of assembly being busy, because the line is not balanced, assembly lines are not balanced.There is excess finished goods inventory, there is a lot of delay in transportation and selling, all these also will have to be addressed. So, the delays actually result in increased time to produce and increased cost of production and there is every effort made in the principles in operations management to bring down these delays.

Operations management looks at issues like purchasing management, proper production planning, proper scheduling, good quality, maintenance and proper distribution to ensure that, these delays are minimized which means, the time taken to produce comes down which also means that, the cost ofmanufacture comes down.

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Now, we look at some topics in operations management that we will be looking at in this course.We will begin with forecasting, forecasting is the estimation of demand that we will be using. Now, after forecasting, we will do production planning and disaggregation, scheduling and production control, quality, inventory management, MRP, lot sizing and maintenance.

Now, among these topics, we are going to see forecasting, production planning, scheduling and inventory, the ones that are shown in green color as part of this course, as part of operations management, that is covered in this course and then, we will follow it up with topics in supply chain management. Now, as we say that, we look at these topics, forecasting, production planning, scheduling and inventory, we will start looking at each one of them in detail.

Now, before we get into forecasting, let us also take a quick look at, what are the steps and what are the ways of linkages among these activities, we will do that now.

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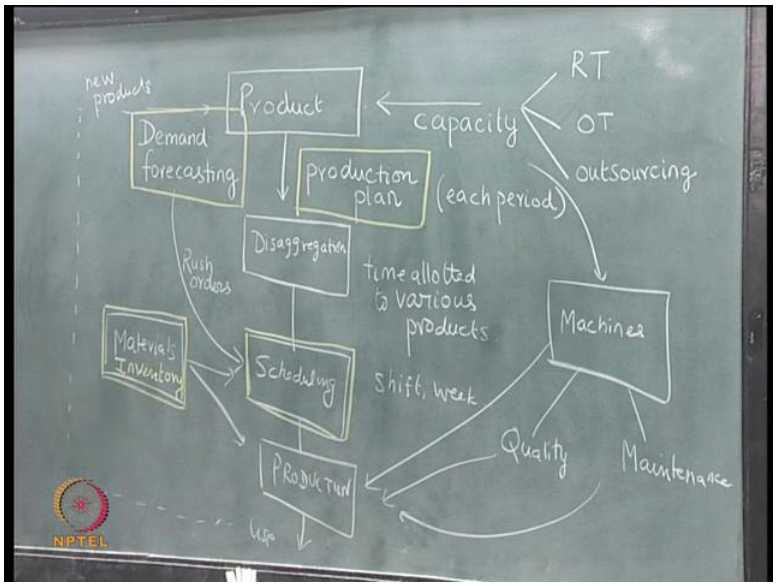


So, manufacturing deals with making a product and the first thing that we need to know is the demand for the product. So, the demand for the product is estimated through good forecasting models. Now, once we know this demand, we also need to know the capacity. Now, the organization should have the capacity to meet the demand of these products and these capacities are usually in the form of regular time capacity, over time capacity and outsourcing.

So, the organization decides, what type of these capacities that they are going to have. So, this combination of demand and capacity results in what is called the production plan, where the organization decides, what are the products to be produced and how much of this capacity is going to be utilized in each period. Then, we will look at disaggregating it and making disaggregation, where the time that is available is now given to various products, time allotted to various products.

And then, from here we look at scheduling, where we look at time period such as shift, week, etcetera. Now, in addition, capacity is provided by machines and these machines have linkages with quality and with maintenance. And in order, this is where the production actually comes and then, this gets inputs from machines as well as quality and from maintenance. Then, the scheduling sometimes also gets inputs from the forecasting due to rush orders, planned orders.

So, scheduling has to take care of this and scheduling also gets inputs from materials and inventory, which links with both scheduling and production. Now, once all these things are established, the product is actually made and put to use and then, based on the time, the organization also creates new products, for which additional capacity may be required. So, this kind of gives us a schematic representation of, how the production processes take place and what are all the things that are related in operations management.

So, in this course as mentioned earlier, we would do some aspects of demand forecasting. We would do a lot of production planning, we would look at certain aspects of scheduling and we would also look at a lot of aspects of materials and inventory. We would look at inventory, so as mentioned we would look at these four parts and then, we would move into the supply chain management area, where we will be looking at distribution separately as well as information separately. So, in the next lecture,we would start our discussion on demand forecasting.