Production and Operation Management
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Lecture 58
JIT and Lean Operations

Welcome friends. Now we are moving almost to the final stages of this course on Production and Operations Management. And we have discussed different issues in detail, with respect to forecasting, inventory, material planning, facility layouts, project management, quality management, some of the important areas we covered. Now, we will use this remaining time for discussing some of the latest trends or some of the burning issues in the field of operations management.

And one such topic, which we are going to discuss in today's session is related to Just in Time and Lean Operations. When we were discussing the inventory management, we had a small introduction of JIT, which is normally understood as a system of inventory management where we are providing products just in time. Whenever need is there, immediately we are procuring the products and we are not keeping any inventory. Normally, this kind of myth is there with respect to JIT. But it is not so, we do keep inventory in JIT but we keep a very minimal level of inventory.

The second topic which we are going to cover in this session is about the lean operations. Lean operations are very important because of improved competitiveness. You want to increase competitiveness and that is only possible when you are lean, lean means when you are able to avoid, when you are able to eliminate wastage in your systems. So, these two things are very important and the future direction of operations management that how to have a JIT enabled system, and how to have lean concept in your operation system. So, we are going to discuss these two topics in this particular session.

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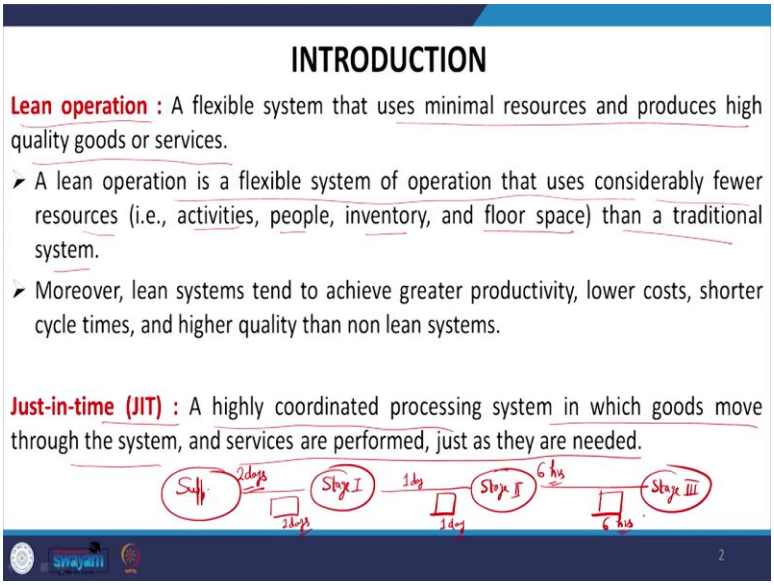

Now, when we are talking of lean systems, so it is a flexible system that uses the minimal resources and produces high quality goods or services. So, one very important thing is that nowadays we want more and more variety, we are going into the customisation direction and to provide more and more variety to fulfil the requirements of the customers uniquely, you need to have flexible manufacturing systems, systems which can produce wide variety of products and for that purpose lean is a very important enabler.

When you have lean systems, then only you can have flexible manufacturing and when you have flexible manufacturing, then only you can produce wide variety. So, it becomes you can say a type of necessity only with lean approach you can provide more varieties to your customers. So, a lean operation is a flexible system of operation that uses considerably lesser amount of resources like activities, people, inventory, floor space than a traditional system of manufacturing.

So, because we are eliminating waste in lean system so we are able to work with less amount of inventory, we are able to work with less amount of men power, we are able to work with less amount of floor space. So, you use less resources and when we are using less resources, so we say that we are removing bulkiness of the system.

So, by removing bulkiness of the system we are able to follow the idea of lean. The whole idea is that, how to eliminate unwanted things, and when you are eliminating unwanted things and you

have only those things which are responsible for direct value addition, then therefore your output will have a better efficiency. Then another important concept is JIT, Just In Time, just in time is a highly co-ordinated processing system in which goods move through the system and services are performed as they are needed.

So, it is a system where you have different stages in your processing. These are suppliers, this is stage 1 processing, this is stage 2, this is stage 3. And during these processing you keep some inventory but you keep this inventory in such a coordinated manner that if this supplier is taking 2 days lead time to supply product. So, only inventory for 2 days is there and you have a regular system of receiving the inventories after 2 days each. Stage 1 is taking 1 days' time for supplying the product, so here you have inventory of only 1 day. The stage 2 is taking 6 hours in supplying the products to stage 3, so you have inventory for only 6 hours at stage 3.

So, in this co-ordinated manner, so that you understand the capabilities of your previous stage and the previous stage understands the requirement of successive stage. So, having this kind of coordination, we are able to develop a smooth flow of material, so that nowhere in your entire system inventories are unnecessarily piled up. So, this type of system is JIT, and elimination of waste is lean manufacturing.

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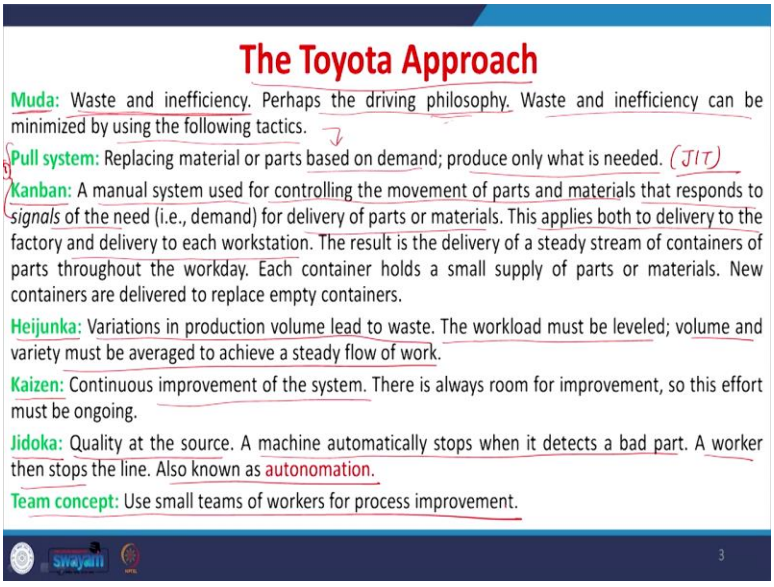

Now, the concept of lean manufacturing where we are talking of elimination of waste is actually, a contribution of Toyota car company. The Toyota approach or the Toyota production system is

basically responsible for development of this idea of lean manufacturing. We have a full NPTEL course on Toyota production system, where we discussed in detail that how this philosophy is implemented and what are the various tenants of the Toyota production system.

Here in this particular session, we are going to discuss the gist of the Toyota production system that what are the important terminologies, what are the basic idea, basic philosophy about the Toyota production system. So, one important point which is to be known, and that is a Japanese word that is muda. So muda, that means waste and inefficiency. So, it says that we need to eliminate muda, we need to eliminate waste, and therefore our inefficiencies will go down and efficiencies will increase. So, this is the most important driving philosophy of this concept of lean manufacturing.

Waste and inefficiencies can be minimised by using the following practices and what are these, one is pull system. Pull system is replacing material or parts based on demand produce only what is needed. This is also the JIT, that you are producing only what is required by your next stage, you are not keeping the stock available. So, in the previous diagram if you see, that all these stages, like stage 1 is directly supplying to stage 2.

So, no stock is maintained at this level, no stock is maintained at this level, no stock is maintained at this level. Whatever we are producing we are supplying it as per the requirement of our next stage and whatever is the demanded at the next stage. And the same concept is actually implemented by the name of Kanban, in Japanese organisations. Kanban is the meaning of visual signals, that we give signals, yes now I require the product, so just by seeing the signal the previous stage will start producing and start supplying. So, the successive stages are pulling products from the previous stages, that is the meaning of kanban system.

So, it is a manual system used for controlling the movement of parts, and materials that responds to signals of the need, that is the demand of your next stage for delivery of part or materials. This applies both to delivery to the factory and delivery to each work station. So, this kanban is applicable within an organisation and it can be applicable to entire supply chain also. That from one organisation to another organisation, if we need to supply products, we can follow the system of kanban.

That when my customer is requiring the product, when a signal comes from the supplier, from the customer, then only I am going to supply. And the same thing is possible within an organisation where various work centres are arranged. In one of the classes of facility layout, we discussed different types of layouts. Now in that system of layout, we discussed one assembly line. Now in that assembly line it is quite possible that once the work at work station 4 is over, then work station 4 requires more products to work, and then only work station 3 will supply additional products to work station 4.

So in this way, the kanban system is a very useful way to control and coordinate the flow of inventory in your organisation. So, kanban system is basically based on this pull philosophy. This is one of the same things and it is also known as JIT. Then, another important term is Heijunka. We discussed in our quality management classes, that variations are natural but later on we realised with the help of concepts like, Taguchi qualities functions, with the help of six sigma, that variations are undesirable, these are natural but these are undesirable.

As you move away from your central values, mean values customer satisfaction also starts decreasing. And Taguchi said, even within your limits of specification if you are moving away from the mean value, cost of quality starts increasing. So, we should minimise the variation. We should try to produce more products which are on the central line, which are on the mean value of the specification.

So, it says that variations in production volume lead to waste. So, minimise the variation. The work load must be levelled, volume and variety must be averaged to achieve a steady flow of work. So it is saying that, we continuously need to do those things where our variations should be minimised. So like, if you remember in our material requirement planning, we discussed two types of production strategies; one was the level strategy and another was the chase strategy.

In chase strategy, we used to fluctuate the volume of production but in the level strategy we used to have almost a constant level of output. So this point says, that we should have the same level of production volume and even though demand may be there, may not be there but if you have the same level of production sometime you may have some kind of inventory, sometime you may have back orders but it will create minimum wastages.

Whenever you are regularly changing your setups, so initial 1 or 2 products may be wasted because of the transient, because of getting the machine into proper functioning zone, sometime you are hiring new employees they may not be trained, so they may do lot of quality related wastages. So, if you have the level production system, in that case variations can be minimised and that will lead to better quality and more efficiency in your production system. So, if you visit any Japanese plant, you will find that the production volumes have very minimum variations.

While, if you go to other parts of the globe and you see their manufacturing setups, so their production volumes have lot of fluctuations. So, if the demand is more, they may go for 2 shifts, 3 shifts, if demand is less they may go for 1 shift and they may fire, they may layoff large number of employees. But in Japanese organizations, you will not find such kind of instances on a regular basis. So, variations in production volume need to be minimized as far as possible. Then Kaizen, that is another important term related to Toyota concepts. Kaizen we have already discussed in our quality management classes.

It is about continuous improvement, that how you are continuously improving your production process. So various process related improvement activities require your regular attention. So, that is the part of kaizen. Then Jidoka, jidoka means you cannot build quality at the last stage when inspection is taking place. So, the final inspector, the final supervisor who is putting that sticker on the product that it has passed the quality control, that person is not responsible for the quality. You have to build quality at the source.

Now what is this source, you have to build quality at the design stage, you have to build quality at the manufacturing stage, and you have to build quality in the mindset of the people who are working in the organization. So, quality at the source is very important concept of Toyota philosophy. And it is that, a machine automatically stops when it detects a bad part. A worker then stops the line, also known as autonomation. So, machine should be developed, the capability should be of such a level, that as soon as a defective piece is produced the line should be immediately stopped.

So that you can see, why it has happened so, and that level of automation is needed in Toyota systems. And finally, it says that it is team efforts. We need to use a small groups of workers for continuous improvement because 1 person or 1 leader cannot do the entire improvement activity.

So, you need to divide your employees into various groups, various smaller groups, so that they can do this kind of improvement activity.

So, the team efforts, the involvement of all your employees are very much required in Toyota approach. This we also, also discussed under TQM, that how TQM is a team approach activity. Same thing is applicable in the lean and JIT operations, that lean and JIT operations are only possible with team activities.

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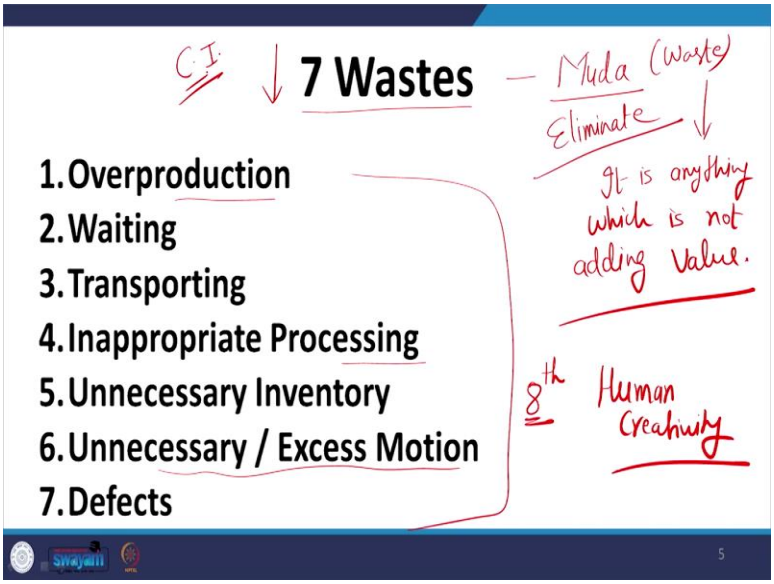

Now, when we are talking of Toyota approach and particularly, we discuss the philosophy that we need to eliminate muda. We need to finish this waste, muda means waste, from our manufacturing set up or maybe from our service organizations also.

Now this says, 7 types of waste and these are, one is waste of overproduction. If you are producing more than the requirement, that is a type of waste. That is not adding, waste is anything, it is anything which is not adding value. So, that is your waste.

So, if you are doing overproduction that is a type of waste you are doing in the system. Waiting, your parts products are waiting for their tug to be processed further. So, that is also a type of waste, that means you have not planned your production planning properly. Transportation, so unnecessary transportation from one place to another place, too much of material handling that is also a type of waste, it is not going to use.

Therefore, proper layout planning is very much important to minimize the unnecessary transportation of goods inside the plant. Inappropriate processing, or you can say over processing. Now many a times, if you do not know the customer requirements properly and many a times, it happens that we want to build so many features into our products and we do excessive processing of the product, so that is also a type of waste. Customer does not require those many features, customer does not require that many activities but you have done extra processing.

Many a times in India, you must have seen that when we are constructing our houses, so the linters which are being prepared, so in that we do lot of over processing and we do lot of with the concrete, we mix lot of rods of steels, so that we get more safety. But in fact, there is a limit to safety you cannot get beyond that, but we unnecessarily mix too much of concrete and rods, so that we get extra safety but it is not so. So, in India particularly, we are too much obsessed with extra processing, we need to avoid that. Then, unnecessary inventing.

Many a time we think of lot of fluctuations, lot of variations which are not in our control and to handle those variations we keep inventory. So, we need to see that how much safety stock is actually required. Otherwise unnecessary keeping of inventory is also a type of waste. So, inventory is not going to help you in any value addition. Then, unnecessary and excess motion.

When we are producing products, so sometime small minor motions are also very important because these motions consume energy, these motions may result into your extra fatigue. And as a result of that, these are not adding value, rather it may create more inefficiencies. So see, those small minor motions which are waste. And very good example you can see, from the field of the sports, when a player who is playing golf, so even the minute movement of the golf stick can make the difference in the stroke which he is playing.

When a swimmer, when a athlete is going to start the run, in that case how he or she is taking off that small motion difference can make the whole result a different story. So, the excess motion or the unnecessary motions are to be avoided. And I think, the sports is the best field to have the examples in this particular category. Then the defects, the defects which you are producing, the poor quality where you are generating scrap, when you are generating the rework, and all those things, that is also a type of waste. And that is very easy to understand, I need not explain it much.

But I also want to add one more type of waste, nowadays and that is the eighth waste in this list. And that waste is the waste of human creativity. Many a times, we are not able to take the advantage of human creativity, the employees working with us.

In our previous slide, we discussed that Toyota system or implementation of lean and JIT is a team activity and we need to make smaller teams for continuous improvement. Now, if you do not give enough environment, if you are not creating an ecosystem where individuals can give their best output, how can you take your organization ahead. So many a times, your employees are capable, they have good ideas but you have not provided the platforms to take the advantage of those ideas. So in that case, you are wasting the human creativity.

So, that type of waste also happens in many organization where the proper platforms, proper opportunities are not given to the employees to show their talent, to show their skills for the advantage of the organization. So, these are the different types of waste and we need to eliminate all these types of waste. So, that takes a lot of time that how to identify these wastes, and what are the tools and techniques which can help us in eliminating those waste. But certainly, it is very, very important to identify waste and continuously try to eliminate these wastes.

If you continuously eliminate these wastes, that is automatically kaizen, that is automatically continuous improvement. So simply, you identify waste and then focus how to eliminate those waste, your improvement will take place.

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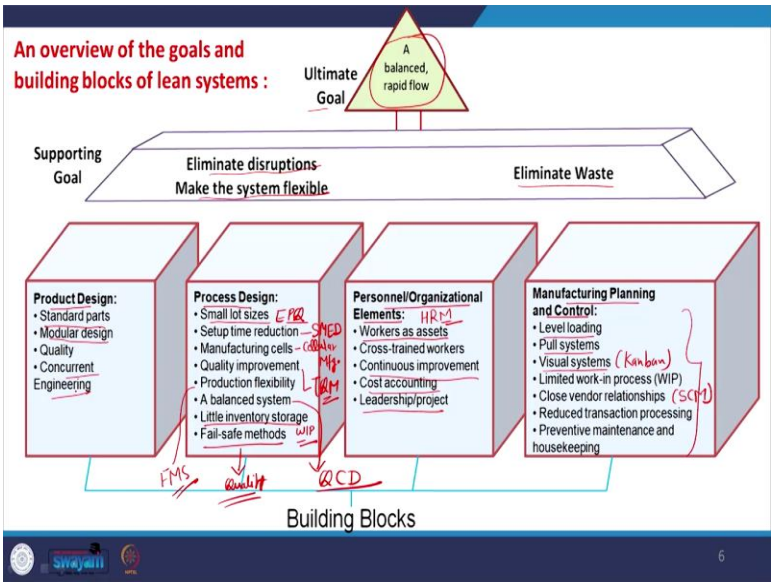

Now this particular diagram gives us a very interesting picture of the lean system that what is the lean all about. So, it is given in the form of 4 important building blocks which are making my lean system. And then you see, that what are the ultimate goal of lean system, that is a balanced rapid flow. That is the ultimate objective of lean approach, whatever we are discussing, so that you can change your products, you can change your systems at a faster rate. And for that purpose, the supporting goals are eliminate disruptions and make the system flexible. These are the supporting goals 1, and the second supporting goal is to eliminate the waste.

So, these are my supporting goals to achieve the objectives of lean manufacturing. And what are the various building blocks, these are product design, process design, then human related elements, and then manufacturing, planning, and control. Now you see that, all these 4 building blocks are complete subject on their own. Manufacturing, planning, and control is complete subject. In which level loading, pull systems, visual controls like Kanban, then how to control your WIP, the vendor relationships which are the part of supply chain management, then reduced transportation processing, and preventive maintenance and housekeeping.

All these things are the important component of your manufacturing, planning, and control. Out of this some of the things we have already discussed, some of the things are being discussed in supply chain management, some are discussed under some other courses. Then this is related to human resource management. Important thing, the philosophical thing, that you need to consider your workers as your important assets, workers are your important assets, that is one important thing you have to realize.

They are not your liability. Many a times, we do not have, we do not go with proper camaraderie with our workers. So, you need to have that kind of bonding where workers and you, workers and managers need to have this approach that we both are working for the same objective. Cross training of the workers, so that they have the feeling of job enrichment and this will give them high moral. Continuous improvement, continuous training of the workers are required.

Cost accounting and leadership ability, so that you can motivate them for higher levels of growth. Similarly process design, you need to produce in smaller lot size, so your EPQ related issues are there. Setup time reduction, we discussed in one of our sessions about SMED, Single Minute Exchange of Die. So how to achieve the faster change of production system, so that you can have, manufacturing cells we have already discussed in our facility layout about cellular

manufacturing. Quality improvement programs particularly, TQM and business excellence program we need to adopt.

Then production flexibility using the cellular layout and flexible manufacturing systems, we can achieve the production flexibility. A balance system, you should be able to provide a kind of trade off between various conflicting objectives. Like continuously, we talk of QCD in operation management. We need good quality product but we want to have those good quality products at the lower cost and we want to have faster delivery of them.

So, how to have a system which is of reasonable quality, reasonable cost, and reasonable delivery. So, if this type of system is designed that is a balanced system. Then already we discussed that, we need to minimize our work in process. So little inventory storage during the processing stages. And fail-safe method, this is again related to quality.

The Shingo developed this concept of fail-safe method, that right from the beginning you should work, you should work, so that there is no mistake right from the first time. So, these kind of concepts are required in improving our processes. Then with respect to product design, standard parts. Now again there is a problem, on one side we are going for more and more standardization, so that we can achieve the economies of scale. But at the same, time we are also looking customization in the final product.

So, you need to see that standardization in components and customization in the finished product you need to achieve both these things simultaneously. Therefore, we go for the modular designs where we are keeping the components ready with us but the final assembly, final product will be made as per the customer specification. So, more and more modularity will enable us to achieve this kind of end product customization. The quality obviously, we all understand that quality is a very important order winning criteria.

So, how to achieve excellent level of quality and concurrent engineering, where the discussions of design team and the manufacturing team go parallely and not only design and manufacturing but after sales support, and the marketing. So, all the functional people who are involved in making a product, and after that delivering a product, and after that maintaining a product, all those teams are sitting together in designing the product. Earlier, all these concepts used to take

place in water tight compartment, and therefore probable development time used to be in few years.

Now, with the use of concurrent engineering kind of concepts we are able to reduce this concept of years to few weeks, because all teams are sitting together and they are able to share their expertise, so that the product is developed in few weeks. So, these type of concepts are helping us, these are the building blocks for developing a good lean system. So, with this we understood that what is lean system, and how lean system is very important for the modern day operations. And particularly, we want to have a balanced rapid flow of the production system, where we can eliminate the waste and we can have more flexibility, we can eliminate disruptions.

And therefore, all these different labels, product, process, human resource, and manufacturing, planning and control, at all these levels you have to work simultaneously then only you can achieve the objectives of lean system. So with this, we come to end of this session. Thank you very much.