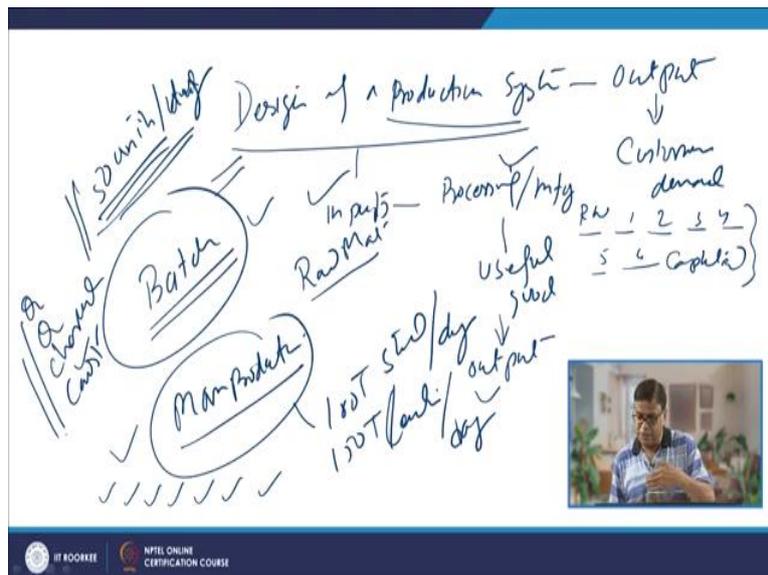


**Principles of Industrial Engineering**  
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**Lecture 29**  
**Production Planning and Control Capacity Planning**

Hello, I welcome you all in this presentation related with the subject Principles of Industrial Engineering. And in this presentation primarily we will be talking about the capacity planning. This is the term which is related with the production, planning and control. You know in capacity planning we try to plan out the infrastructure in such a way that the demand of the customers can be realized or can be achieved so that the required items can be supplied to the customers on time in the required quantity and the required quality.

So, to make the goods and the services as desired by the customers, it is required that there is a production system.

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So, basically designing of a production system is needed. So, that it can give us the required output which can satisfy to the customer demand. And this a design of a production system will be based on the kind of the inputs it requires, like what kind of material, machinery, manpower and then these will be used to convert the raw material or input items through the different processing or manufacturing stages, so that these inputs or the raw material kind of things can be converted into the useful goods. So, inputs processing, so using the machinery or the different is kind of the, the processes, the raw material is processed, so that the required

goods or the required product can be produced with the features having the desired characteristics, so output is obtained.

So, considering the input processing and output suitable production system is designed. So, when this is designed now we have seen variety of production systems means the way by which the things are produced. For example, a required machinery is arranged at one place of the same type to produce the goods in batches and when the machinery is arranged in the sequence of operations to be performed for mass production, but there will be a limit on the volume that can be produced by the machineries arranged at one place, whether it is a batch production or the mass production, for example, the 50 units of particular type are produced in one day, in one per day or like say, 100 tons of the steel is produced per day.

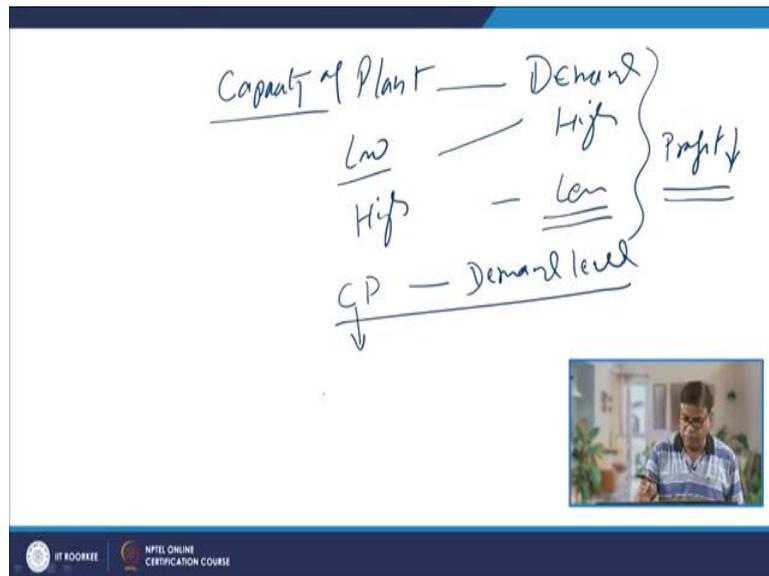
So, depending upon or like say 150 tons of the cement is produced per day. So, the like in case of the mass production, mass production, where the jobs are normally done through the processing in sequence through the different machineries, like in assembly lines or where the different the steps or operations required to be performed are done in sequence to complete the job from the raw material, the stage 1, 2, 3, 4, 5, 6 and then it is completed.

So, here these things are done in sequence, but even in this case, the entire assembly line or this mass production system will have a capacity to produce certain volume on that capacity will be crucial with regard to meeting the demand of customers. So, in case of the batch production, this capacity is limited while in case of mass production capacity is higher.

So, that is about the requirement and the kind of the systems we have. So, the suitable system whether it is using the batch production approach or the mass production is approach. Now, the suitable production system has to be designed, so whatever output it is giving that should be capable to meet the demand of customers and that too in the required quality, required quantity and with the required characteristics and also cost.

So, quality, quantity, features and the cost these should be met so that customers can be supplied the required goods. So, that was about the capacity related thing and how it is obtained.

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Now, we will see that the plant capacity or the capacity of a plant, this should match with the demand and if there is any mismatch, then it will not be good for the system like if the plant capacity is low and the demand is high then there will be deficit means the company or organization will not be able to meet the demand of customers. On the other hand, higher production capacity and the less demand or the low demand will be leading to the unnecessary building up of the inventory, holding up of the cost and the capital, so that is also not good. In both these situations, the profit will be reduced.

So, it is important that whatever is the capacity of the plant that should be almost equal to the level of the demand capacity should match the demand level, so that the plant capacity is maximum utilized and whatever is the demand that is also fulfilled.

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So, when developing the plant capacity or plant capacity is being planned, what is kept in mind so that whatever is produced because the plant will be developed today and then once it is established completely it will be able to produce the things at a certain rate after some time and that that is the part of planning how much capacity should be planned, so that it can meet the demand of customers and this plant capacity is normally for the long term basis like the demand will be met for like say in the next 5 to 10 years.

But this is a very difficult situation, why? Because, if the demand is stable like on an average monthly it needs like 5000 units of particular product, then it will be easier like develop the capacity accordingly so that demand can be met, but in actual practice, actual demand is hardly stable. It always fluctuates sometimes 4000 sometimes 7000 units say.

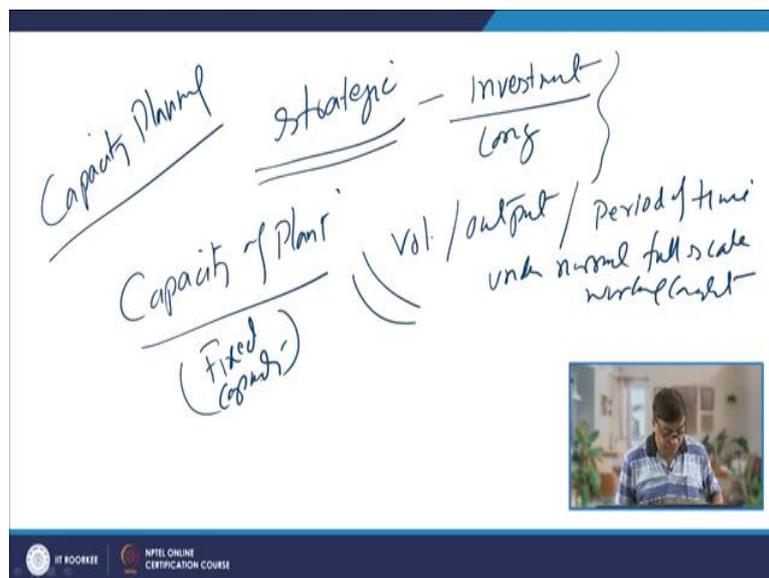
So, in both these situations we need to work as per the situation like if there is a higher demand that has to be fulfilled or if there is a lesser demand then we need to deal differently. So, that unnecessary piling up of the inventory can be avoided. So, the difficult part here in capacity planning especially the long term capacity planning is that the future growth and expansion plan has to be kept whenever capacity is planned, we need to consider what is the potential for growth of product in future and what will be the kind of expansions which will be there in plant.

Then what is the market trend? How the product is doing currently and what is the possibility for the growth of the demand and in future. Then what about the sale forecast? So, these are the kind of inputs which are considered when the capacity of a plant, plant capacity is

planned, but these things are really come with a lot of uncertainty and that is why the capacity planning becomes difficult especially the long term capacity planning becomes difficult and that is why the different strategies are deal different strategies are used to deal with these uncertainties associated with the future growth, market trends and the sale forecast.

The technology is changing very fast newer products are coming up. So, the companies will be will be forced to come up with the newer products with the newer features, better technologies, and the companies must be ready for and dealing with those situations. And that is why the capacity planning for those products where technology is changing very fast becomes very critical and very crucial to see that the whatever plant is developed that remains in working conditions and that is utilized for long so that before it is abandoned or before it becomes obsolete.

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So, what is important here is this capacity planning is basically strategic decision because it comes with the lot of investment, if a capacity has to be developed then it require a lot of investment and it will be there for long. So, we need to see how the things will go in future and when it comes with a lot of uncertainty, then it becomes very crucial to take such kind of the strategic decision.

Now, if we have to define capacity of a plant, so it is about the volume or the output that can be obtained over a unit period of time under normal full scale working condition and this helps to plan whether we need to go slow or we need to increase the capacity using the different approaches whatever is possible for a given maximum fixed capacity of the plant.

So, there are various ways to get more output from the given plant and those are strategies we will be talking. So, these can be like the long term strategies and the short term strategies.

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Plant Capacity Planning

- \* Cost effectiveness of operations
- \* Scheduling of operations / man power requirement
- \* Capital Investment

Measurement of Plant Capacity

20 products

No of units produced / period

150 units/day

150T/day

200T/day

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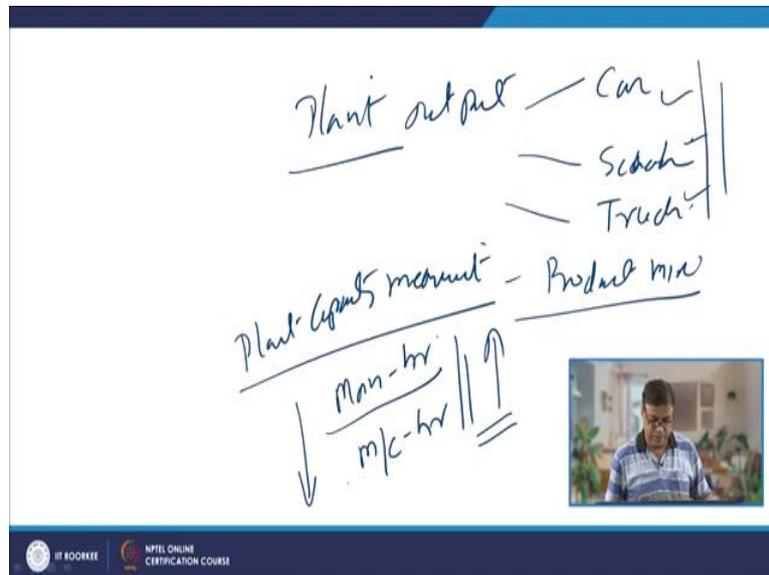
And why the plant capacity is so important for the management as well as managers, because it affects a number of things, plant capacity planning is very crucial for management, why? Because it affects the cost effectiveness of the operations. So, means it affects the cost at which the product will be made available to the customers.

So, the one factor is like cost effectiveness of the operations is affected, it also affects the scheduling of operations, because the different systems will have the different capabilities, different time requirement to complete the job, so accordingly these will also be affecting the scheduling or the man power requirements.

Then it is also crucial, because it involves a lot of capital investment and before making huge capital investment, it is important to consider the various possibilities that will happen in future, so that whatever plant capacity is developed that can be utilized effectively. So, measurement of plant capacity, measurement of the plant capacity in simpler situations it is very easy, we just count the number of units produced either over a per unit period like 150 units of car produced per day or 150 tons of the steel produced per day or like say 200 tons of the sugar cane is crushed in sugar industry per day or it can be on the hour basis or per month basis.

So, there are simpler ways to measure the plant capacity, when the number of units or the the products which are products or the output of the company is in form of a single product, it is easier.

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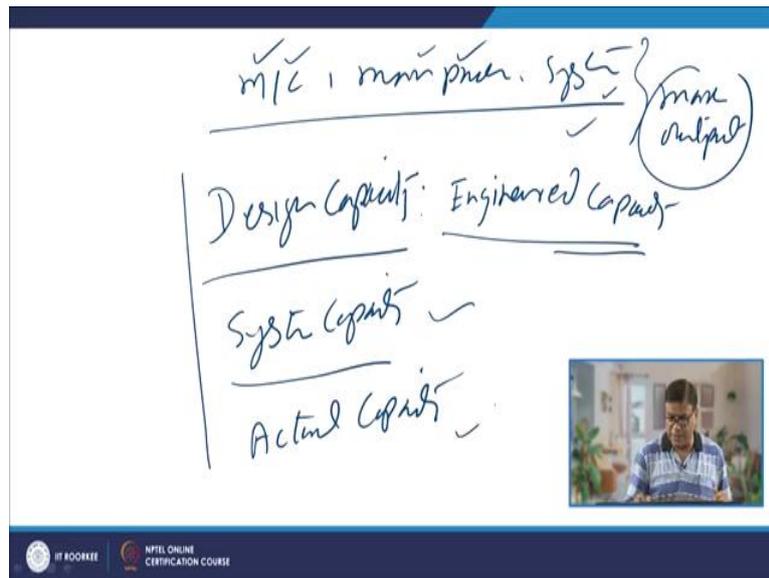


But when a plant is involved in manufacturing plant output in form of different types of the products like it is also making cars then scooters then trucks, so if there is a difference in the types of the products which are being produced, then determining then each unit will be produced in that different numbers per day or per unit period.

So, in that case, the plant capacity measurement becomes difficult especially when we have the product mix. So, in case of the product mix situation, the plant capacity measurement is not that easy. So, what we do basically in that case, plant capacity is measured in terms of the man hour used for giving the output or machine hours used for giving the output.

And if we want to increase the output, then man or machine hours will be increased or man or machine hours will be reduced in order to reduce the plant capacity or the output of the plant. Now, we will see, what are the strategies which are used to develop the plant capacities and what are the important terms related with?

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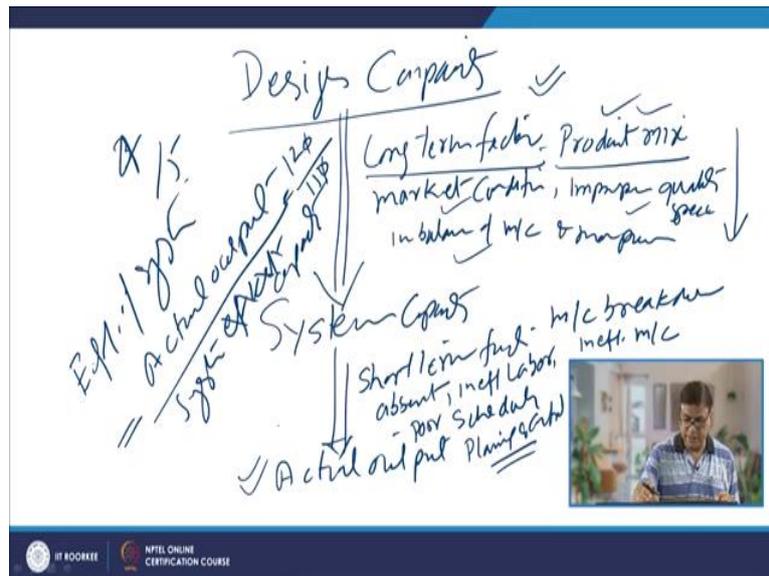


So, like say any plant which is a developed that will be developed using the machines, manpower and a system will be developed considering some kind of the maximum output which is expected from it. So, that will be termed as like the machines will be number of machines will be involved or the number of machines or number of manpower that will be deployed or the entire system that will be established considering some maximum output. So, that is termed as design capacity of the plant.

Design capacity of the plant is the kind of the engineered capacity. So, engineered capacity means the kind of the machines or the manpower or the system which has been established considering some maximum output expected from it but when that system capacity, so apart from the design capacity there is a system capacity. So, system capacity is always lower than or maximum, it is equal to the design capacity. In general system, capacity is lower than the design capacity or maximum it can be equal to the design capacity.

So, what are the reasons behind the system capacity? That we will look into slightly later and then there is one more term that is called actual capacity, actual capacity is further lower than the system capacity. So, what are the factors which are governing the design capacity system capacity and the actual capacity of the plant?

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So, as I said any plant will be designed for certain capacity considering the maximum output desired, but when we see there will be certain machines, manpower and the systems in place to produce the output. So, if the entire machinery is used to manufacture one type of product then there is no change of the settings.

The manpower is trained to do the particular job and that in turn will be able to produce the maximum output. Similarly, when the product has been appropriately designed, and there is a demand for that product, there is sufficient demand for that product in the market then the that company can keep on producing the things at the maximum rate.

But, when it does not happen, there are certain long term factors which are beyond control we can say like as per the company policy company is producing variety of products. So, there is existence of the product mix different types of the product are there or market conditions are very uncertain leading to the reduce requirement.

So, market conditions are uncertain and then there is improper quality specification like too tight tolerance or the too high surface finish requirement or the too high soundness quality specifications. So, improper quality specifications will be leading to the reduced rate of the production and then there can be imbalance of the machines and the manpower like either more manpower and fewer machines or fewer machines and the lesser manpower those system capacity is not fully utilized.

So, in absence of these factors, what happens that whatever output has been designed in form of the production system that is not realized and it leads to the reduced capacity or reduced

output of the plant in form of the system capacity. So, this is the actual this is the output which is reduced due to the product mix, due to the market conditions improper quality specifications or imbalance between the workers and the manpower deployed. Then, so this leads to the reduced output and then actual output is further lower, actual output is further lower than the system capacity and that is activity to the short term factors, short term factors like there is machine breakdown.

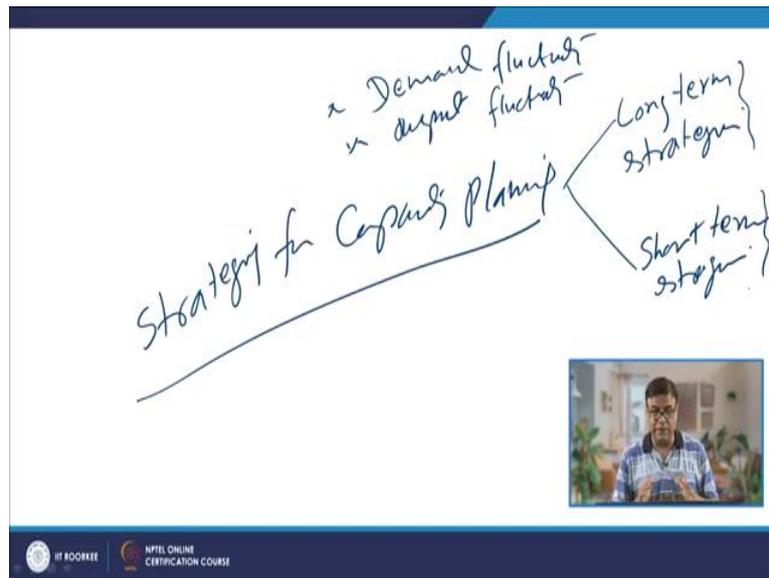
So, actual output will be lower than the what system can produce in under the given set of conditions or the workers are absent from the job or like say in if we workers are there, but workers are not working efficiently, so inefficient labor or machines are not working at the design speed or the conditions under which they should work, so inefficient machines.

So, this is these are the factors or there is poor scheduling like excessive idle machines or idle workers or planning poor planning and control like the job, their machines and manpower is there but they do not have job to be done or the job is there but material is not available, so poor scheduling and planning and control.

So, these are the things which will be reducing the actual output from the system capacity. So, if you want to determine the efficiency of the system, then what we do? The actual output divided by the system efficiency, let us say a plant of steel can produce the output or system if we system capacity system capacity, this is the capacity system capacity is 150 ton and it is able to produce only 120 tons per day, then the system efficiency will be like say 4 by 5. So, like say system is working at 80 percent efficiency, system efficiency is 80 percent. So, that is how we can define the system efficiency or how efficient system is.

So, the design capacity is one that will be based on the kind of the capability of the machines, but actually, the output is lesser because of the various long term factors like product mix market conditions with the improper quality imbalance, imbalance between the machines and workers. So, this may be too high but actual output will be lower because of the various short term and long term factors.

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Now, so, to deal with these situations where the demand is fluctuating, number 1 and the output is also like fluctuating due to the various short and long term factors. So, we need to develop suitable strategies, so that the capacity can be planned effectively its strategies for capacity planning. So that the demand of the customer can be met in time, so the two approach is used for this purpose that is about the long term strategies or short term strategies. About these strategies, I will be talking about then in the next presentation I will summarize this presentation.

In this presentation, basically I have talked about the importance of the capacity planning and what are the factors that are important related with the capacity planning. Thank you for your attention.