Management of Inventory Systems
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Lecture - 46
Theory of Constraints and Materials Management

Now, during the 10th week, how far lecture sessions we are going to the discuss and important topic called Theory of Constraints. And we know as we usual there will be 5 lecture sessions. And very soon you will come to know that the theory of constraints is actually a very very practical methodology, which has been adopted by several progressive organizations throughout the world and it has got a very close relationship with the inventory control. And inventory control there are the traditional approaches definitely you will try to use those traditional approaches, but the kinds of problems a manufacturing the situations of manufacturing companies or for that matter any type of organization may face.

Now, those problems, remaining those problems that means, those problems remain and within those you know the problems the state you need to, so the control inventory you need to control production and for that the researchers, the practitioners they have been proposing different approaches.

So, one such approaches the theory of constraints that means, there cannot be any situations where the constraints are absent. And the constraints could be where the different types and because of these constraints that could be bottlenecks and if there are bottlenecks and there are the no control say where there is no control on the bottleneck operations, no controls on the bottlenecks, ultimately it has got severe negative effect on the organizational performance.

So, this is to be considered and during this lecture sessions all these next 5 lecture sessions during, this week, the 10th week I will be discussing the theory of constraints in detail and wherever possible with examples, and you will come to know at the end of the sessions that why the materials management they gets benefit if the theory of constraint based methodology is applied in a manufacturing situation or in a manufacturing organization.

Just to make a note that the theory of constraint is applied at the plant level that means, a company may have the several say the divisions, each division may have the several plants or several the work locations and at each plant you can apply the theory of constraint. So, that is your unit of analysis.

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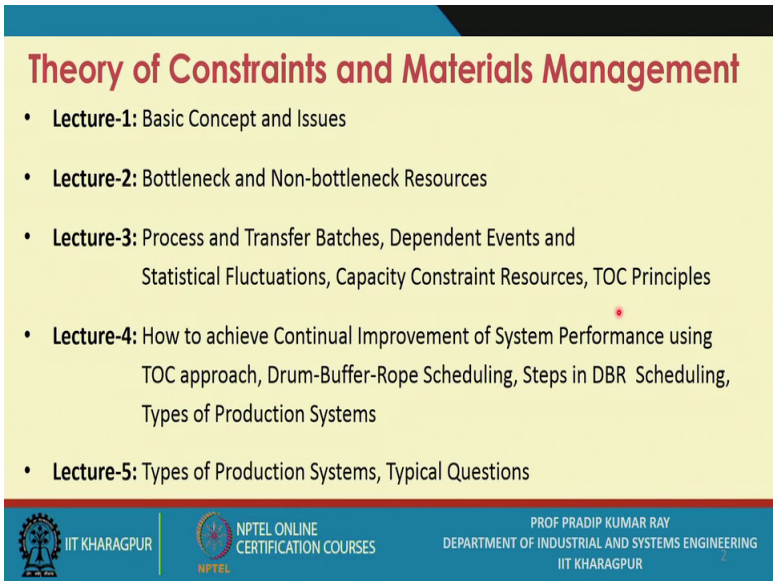

Now, during this the 5 lecture sessions the topics I am going to cover that let me first tell you what are the specific topics I am going to cover.

In this lecture session that means, during the first lecture session I will be discussing the basic concepts on the issues this is very very important. You must have very clear idea about the basic concepts and issues involved, while you study theory of constraints; you study the relationship of say the theory of constraints with the materials management. So, that is our lecture one coverage.

In the next lecture sessions, lecture 2, will discuss the two important issues and these are basically the bottleneck resources and the non bottleneck resources ok. And the theory of constraints deal to a resources, so you must know the how do you define a resource and how do you define a bottle neck resource, how do you define either non bottleneck resource. And what kinds of the conditions imposed on bottleneck resource as well as the non bottleneck resource, and how many different ways you know they may interact and to what extent this may effect the system performance or at the plant level overall plant performance.

During the third lecture session related to say theory of constraints the numbers and number of terms and terminologies you are going to say the define you are going to a say you know in a major. So, what are these terms? There are a number of such terms it has got a specific meanings and usability.

Fist one is a process an transfer batches, so will discuss it dependent events and statistical fluctuations what do you mean by this terms, in which context they become the relevant. Capacity constraint resources, in short they are CCRs. So, this is an important kind of resource. So, how do you define it? What uses an impact on the system performance or you know what extent it defines the theory of constraints based methodology, and what are the specific theory of constraint principles, ok. There is a set of principles. So, once you study all these aspects. Now, you reach a particular stage and at this stage you should be aware of that what are the principles and you must be able to interpret them.

During lecture the fourth lecture sessions, will discuss how to achieve continual improvement of system performance using TOC approach or theory of constants approach equivalent system. Sometimes we need to study that is the drum buffer rope scheduling, ok. So, sometimes the TOC the scheduling is refer to as a drum buffer rope scheduling.

So, you need to define it in clearance specific terms, the steps in drum buffer rope scheduling, what are the steps involved and the types of production systems, so as per the TOC norms so that also we should be aware of. And during the last lecture sessions will again refer the two types of production systems and the typical questions or the queries that you may come across with reference with respect to this particular topic that also I am going to the mention.

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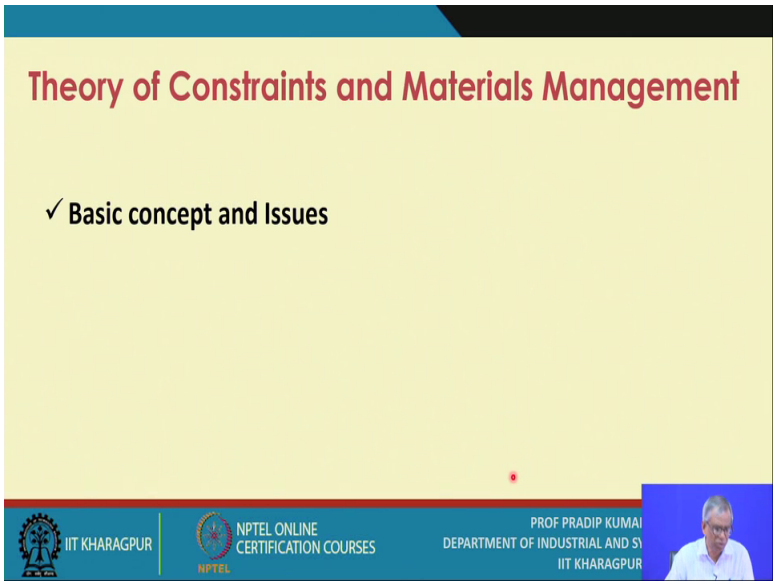

Now, let us first talk about the basic concepts and issues related to the theory of constraint.

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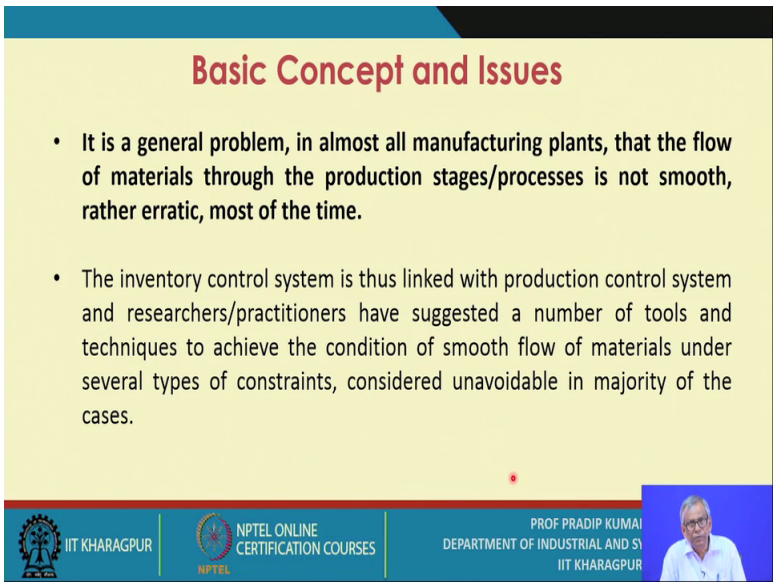

Now, in any manufacturing system what do you find that there could be you know the different kinds of problems, related to production control related to inventory control. Now, the main say the problem that we have always being you know you know say expressing or you are trying to telling others, that is the main problem is how to the maintain the flow of materials through the production stages or the processes this is the

main problem, and for many a time due to many reasons this flow of materials may not be smooth.

So, at any point in time a smooth system they become may become a non smooth systems. So, so you must know that how to get at any point in time the smooth flow of materials say condition in your manufacturing systems, there if which is basically a smooth flow of materials within the production system.

So, while you know the Toyota or the proposes the GIT based systems I have already mentioned they are basic objective is this one that means, how to get smooth flow of materials within the production system. And in order to achieve this in the process of achieving this conditions they have they have proposed the GIT based manufacturing systems. So, this flow usually is not smooth rather erratic most of the time in almost all manufacturing plants. So, we are at the plant level.

Now, the inventory control system is thus linked with the production control systems like when we refer to MRP system. So, essentially it is a combine inventory and production control system and that is why the inventory control system should not be treated separately it must be linked with the production control system.

And the researchers practitioners have suggested a number of tools and techniques to achieve the condition of smooth flow of materials under several types of constraints considered unavoidable in majority of the cases. Like for example, we have referred to say the UQ modeling and say the classical UQ model if you refer to you will find there are the 10 conditions in post there is referred to as assumptions.

Now, in the real system what you find that these assumptions you cannot these assumptions are not valid. So, you need to (Refer Time: 11:25) assumptions and there could be lot many constraints and constant optimization problem we have already dealt with under constraints. Like there could be constraints on the number of orders, there could be constraints on the so the amount of inventory investment and the corresponding you know the solution technique also you are aware of like the Lagrangian, multiplier, the technique or you have to form the Lagrangian. So, these are all discussed and you are aware of.

So, in a real systems always you work under constraints and you and given a particular say work flow pattern that means so the flow of materials the patterns you need to know that what are the constraints are actually affecting the flow pattern of in a particular system. So, the flow pattern of the materials and what is the expectable flow that you must know and to what extent you can take some remedial measures to what extents you can take some you know the preventive measures, so that so the flow pattern which you get in the materials within a particular plant is acceptable to you.

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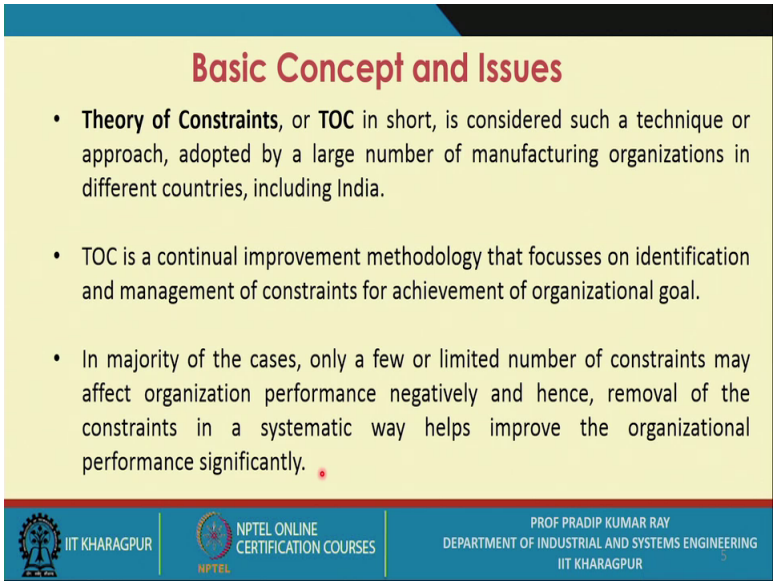

So, this is the main problem and for which you know the many years back, almost the 40 years back a person the named say Gururaj, he proposed this particular the methodology called theory of constraints.

Now, the theory of constraints and in short this is known as TOC. It is an well accepted methodology throughout the world and once the details are known you can definitely the implement the TOC in your in your system. And if you apply the TOC a number of advantages you will have is it, one advantage is definitely the smooth the flow of materials within the production system, but the major advantage will be that you know you will be the producing a quantity and out of this quantity you will get your sales that means, revenues are guaranteed. If you produce something and if you cannot sell it obviously, it may be treated as the waste.

So, the system is such in TOC if you apply TOC that means, as per your requirement as per the sales requirements you will try to reproduce and if you if you produce and you can sell then it is referred to as the throughput it you produce any and you cannot sell obviously, it is treated as a waste. So, that sort of you know the fine tuning you must have in the control system, and you in your production control systems and essentially the main focus of theory of constraints is here that means, producing throughput. So, will we are going to explain all these terms and terminologies with which you explain the TOC methodology.

So, the TOC is considered such a technique or approach adopted by a large number of manufacturing organizations in different in different countries, including India, is it ok. That means, you create a condition where the constraints are absent, and if the constraints suppose due to many reasons, today may be there could there is no constraint, but tomorrow there could be a constraint as soon as you face a condition of constraints you must be able to take effective effect effective action so that the constraints are removed. So, that sort of the mechanism you try to create is it ok.

And in the portions the main advantages at the soft flow level with the TOC methodology implemented you get a very you know moral accepted the scheduling technique. In case the scheduling becomes much easier and you know the whatever the schedules you propose whatever the schedules you use they are going to they are going to say you know the greater going to get the throughput out of the sales you can make. So, TOC is a continual improvement methodology that means, it supports the logic of continuous improvement and it is a practical approach and it is essentially you know it is a database modeling.

So, this methodology focuses on identification and management of constraints that is why it is referred to as the theory of constraints and for achievement of organizational goals. So, first thing you must know that given an organization what is this specific goals.

Now, what we have observed or what the practitioners have been observing on the researchers being pointing out, that in majority of the cases only a few or the limited number of constraints may affect organization performance negatively. It is not that at any point in time you may come across a 10 specific types of constraints, it is not that all

these tens constraints are affecting your system performance organizational performance. If you the studied them their effect on the system performance you will find that out of 10 such constraints, only a few may be 2 or 3 or basically affecting negatively or the organizational performance of the plan performance.

And hence removal of the constraints in a systematic way helps improve the organizational performance significantly. That means, first you need to do that which one out of many constraints which one is the most critical one. So, how do you identify the critical one? Is it ok, so that basis should be known and the TOC talks about this and very specifically it mentions, that what is how do you what is the selection the criterion of the most the critical constraint.

So, once issues are identified then you have to think of reason means for removal of this constraint is it ok, as soon as you remove this constraint from the systems there will be a performance gain and at the systems level. And again you know you hold on you try to hold on that performance, so again in course of time another the constraints may become very very critical.

So, again you have to consider the, that particular the constraints again you have to think of how to remove that constraints. So, this process goes on, so that is why it is referred to as the continual improvement methodology. With organizational performance improve TOC ensures smooth flow of materials through the resources of a plant matching with market demand.

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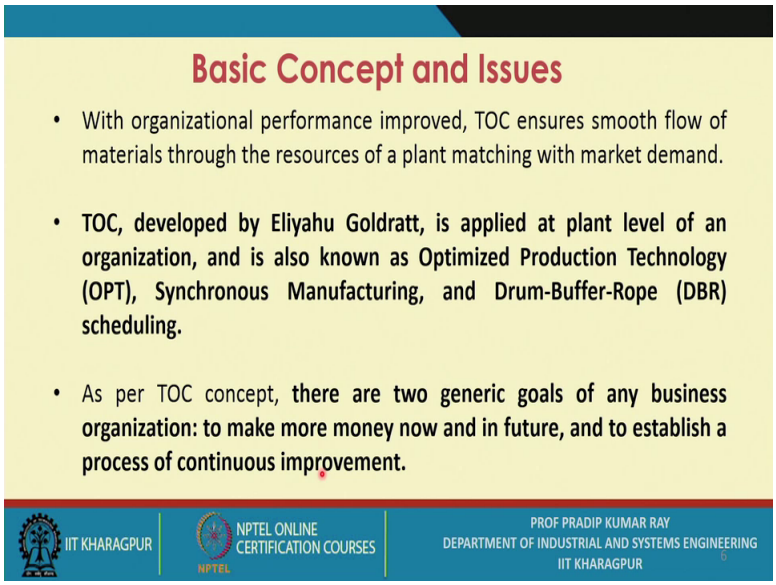

Now, what do you find in a typical plant or in a typical manufacturing systems? You come across several types of resources and these resources are activated, these resources are utilized to meet the demand and there must be proper say synchronization. That means, as we have been pointing out in GIT based manufacturing system that that means, system should be such that it is capable of you know the matching the demand exactly at any point in time.

That means the demand may change and to what extent you are able to meet the change demand is it ok, do you have that flexibility in your manufacturing system. So, with a rigid the scheduling technique or say you know the rigid manufacturing systems say you cannot achieve this conditions.

So, essentially you know when you study the theory of constraints, what do you find that you know the knowingly or unknowingly you are making the system flexible one, and this flexibility will have a positive impact on the system performance. Particularly in getting a condition of say smooth flow of materials through the resources of a plant, so will define what is a resource, and what are the possible types of constraints you may have how do you define bottlenecks. So, all these details we are going to discuss.

As I have pointed out TOC originally developed by say Goldratt, is applied at plant level of an organization that is a unit of analysis and is also known as optimized production technology, OPT. So, it has it is known with the several names one name is the OPT or

optimized production technology, they are all same. It is also referred to as the synchronous manufacturing as already pointed out later on you will come to know when we talk about the DBR scheduling you will come to know that how the 2 TOC approach you create you know a synchronous of the manufacturing system. And this is also referred to as the drum buffer rope scheduling is it, there is a bottom line is that are you in a position to so the create such a system that means, which is referred to as the DBR scheduling, is it ok. So, first you create such a system and you try to you start using it and you maintain it, ok.

As per the TOC concept there are two generic goals of any business organization to make more money, now and future. This is number one; please make a note there is a two specific objectives of any business entity or business organization. The first objective is to make more money now and in future, is it and to establish a process of continuous improvement. Obviously, while you make money you know by fair means only and following the rules and regulations stimulated by the state or the government.

But the second objective is very very important that is to establish a process of continuous improvement, and what do you find that if you apply the TOC methodology the second objective is full filled. And what is our assumption is it unless and until you have the second objective you cannot hold on to the first objective, is it ok.

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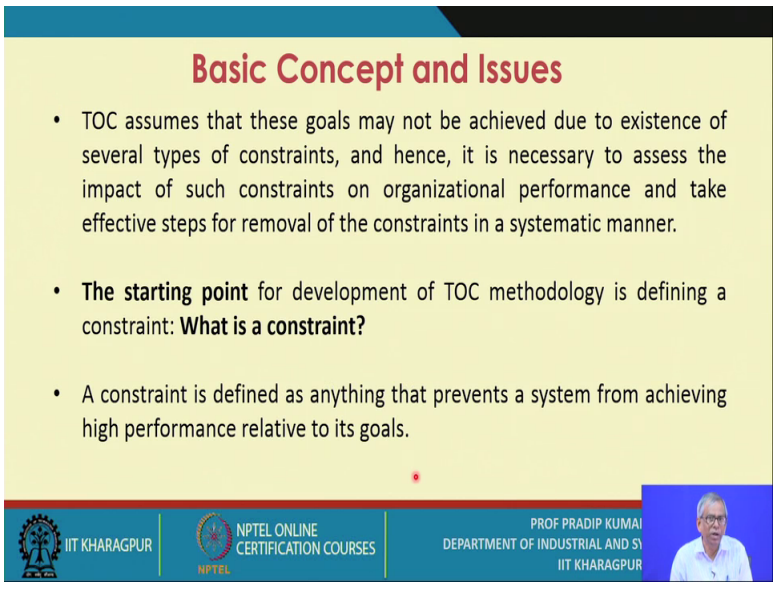

So, these are interrelated and specifically to the progressive organizations they focus on the second objective, is it ok. So, the if your if your able to say achieve the second objective that means, the first objective is assured and first objective is guaranteed.

Now, this TOC when you apply the TOC concept, TOC assumes that these goals may not be achieved due to existence of several types of constraints. So, that is our basic assumption as I have already pointed out, that always at any point in time that could be many types of constraints you should be aware of particularly in fact, at each level whether it is a strategic level or the operations level or at the middle management level or the tactical, so the management, ok. So, you will find that so the always at any level of an organization there are many types of constraints. So, you should be aware of.

And it is necessary to assess the impact of such constraints on organizational performance. So, this is the point, it is a basic point. So, you must be able to do that. And take effective steps for removal of the constraints in a systematic manner. So, the point to be noted is the systematic manner it is not that you know there must be a systems to be created, it is not just an individual approach, is it ok. So, whenever you try to. So, the implement TOC that means, you try to create a system, for the TOC.

The starting point for development of TOC methodology is defining a constraints. Now, what is a constraint? A constraint is defined as anything that prevents a system from achieving high performance relative to its goals, ok. So, this is the definition.

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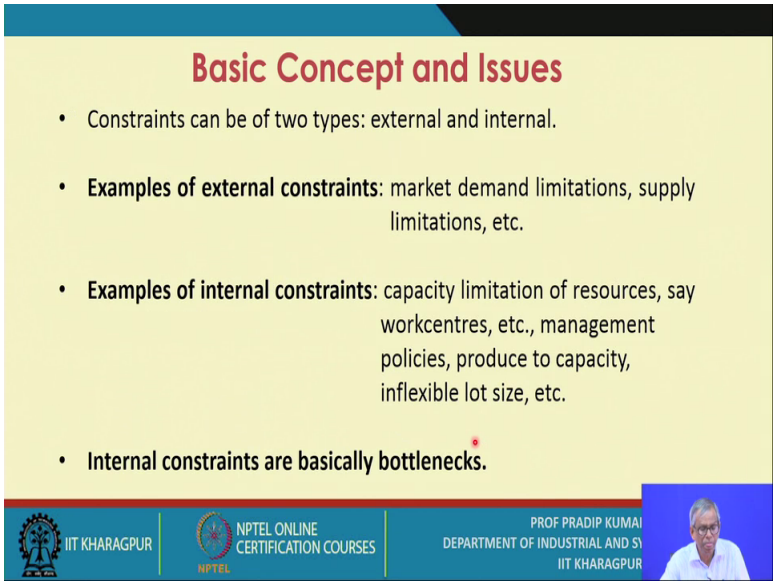

So, the constraints can be of two types external and internal. So, I will just tell you few examples of external constraints. First one is the market demand limitations when because of this your performance is effected and the second one is like could be the supply limitations. There could be many such examples. So, you try to identify 5 or 6 such examples, ok. I have just given two examples.

Examples of internal constraints again there could be many such many examples you try to find out as many as possible. One example is capacity limitation of resources say, work centres etcetera that is one, second one is the management policies produced to capacity inflexible lot size etcetera, is it ok. So, you want the next sheet to be added, but then the management policy is that you just have to produce within say the one shift, ok. Internal constraints are basically referred to as the bottlenecks.

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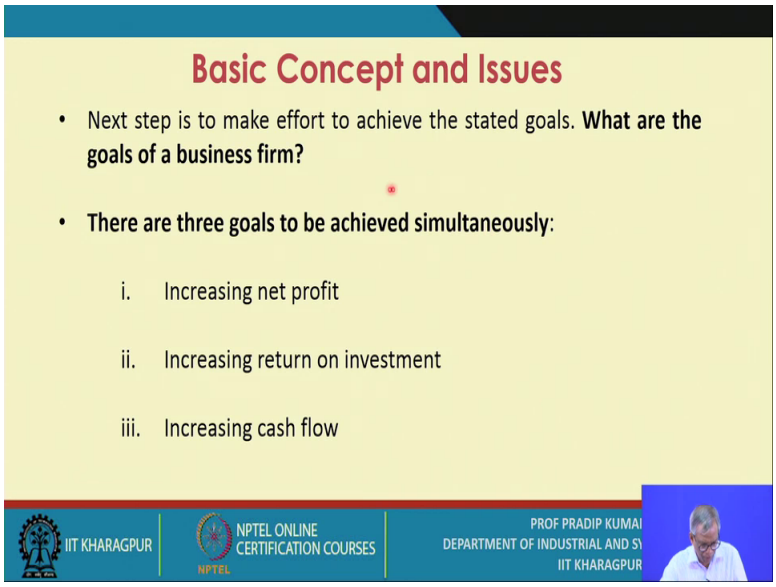

Now, the next step is to make effort to achieve the stated goals what are the goals of a business firm. There are 3 goals to be achieved simultaneously, one is in you please note it, one is the increasing net profit that is goal number one, the next goal is increasing return on investment r y, and the third one is increasing cash flow. And these 3 goals we have to achieve simultaneously.

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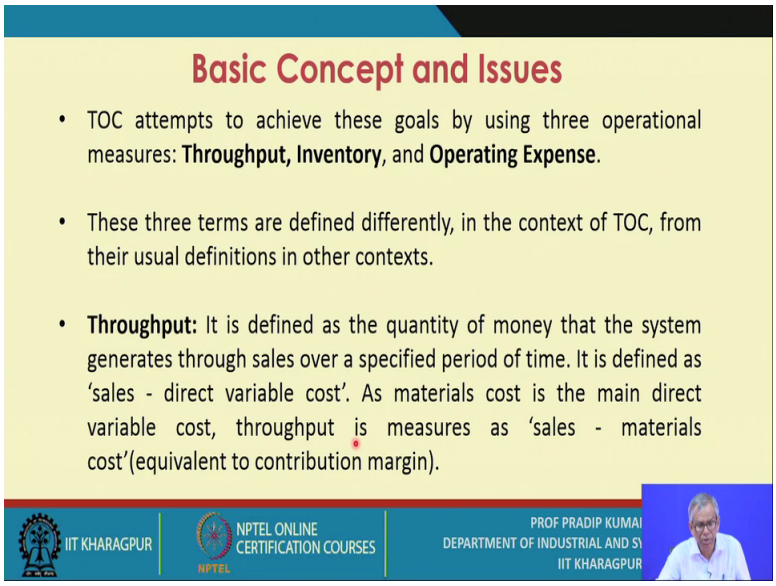

Now, the TOC attempts to achieve these goals by using 3 operational measures. So, please note it down first one is the throughput, second one is the inventory and the third one is the operating expense.

Now, let me just the define what is the throughput before I conclude this session. First one is the throughput what is throughput it is defined as the quantity of money that the system generates through sales over a specified period of time. It is defined as the sales minus direct variable cost, and you find in many cases that the material cost is basically the substantial portion of the direct variable cost. So, hence it is defined as the sales minus materials cost equivalent to contribution to margin. So, this way we define throughput.

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Throughput if the system produces products, but is unable to search them, now this point is to be noted there is no throughput. What is inventory? It is not defined as it is usually defined else where we have already defined ideal resource, ok, of with economic value. But here it is defined as the quantity of money that the system has invested in objects like plant property equipment is very clear. The labour and overhead cost is excluded, but the cost of purchase materials and parts is included. That means, the amount of investment what you do.

And what is the third term? That is operating expense. It is defined as the quantity of money spent by the system to turn inventory into throughput over a specific period of time it includes all costs other than direct variable cost. Mainly the conversion costs.

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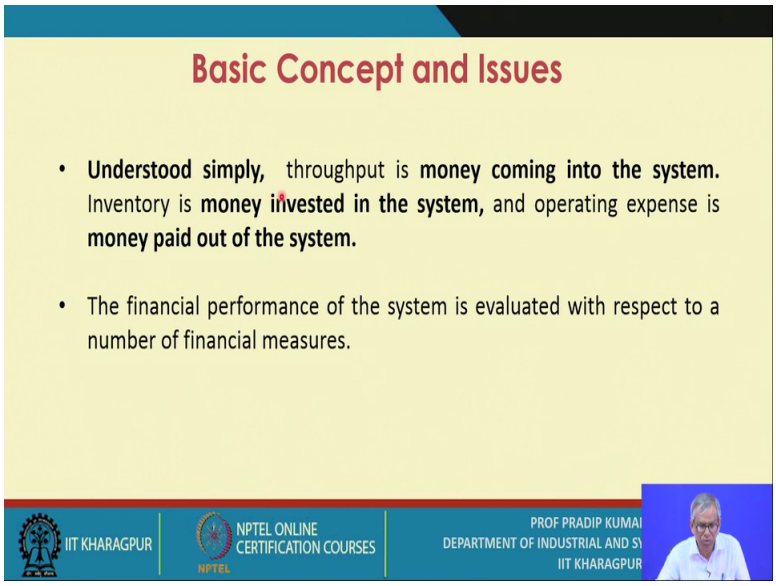

So, understood simply throughput is money coming into the system inventory is money invested in the system just you remember this few points, and operating expense is money paid out of the system.

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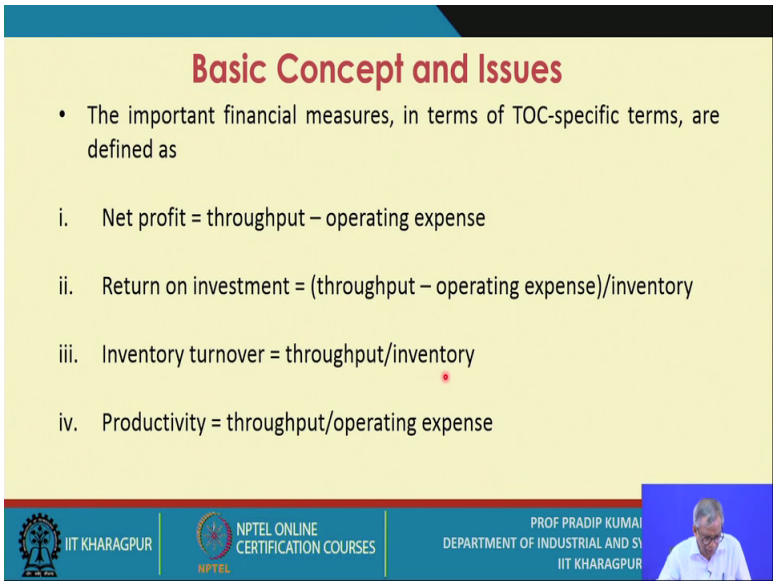

The financial performance of the system is evaluated with respect to a number of financial measures. So, here how do you define net profit? Throughput minus operating expense, return on investment is throughput minus operating expense. I will give you numerical examples later on divided by inventory. Next one is the inventory turnover

how do you define throughput by inventory and productivity is throughput by the operating expense.

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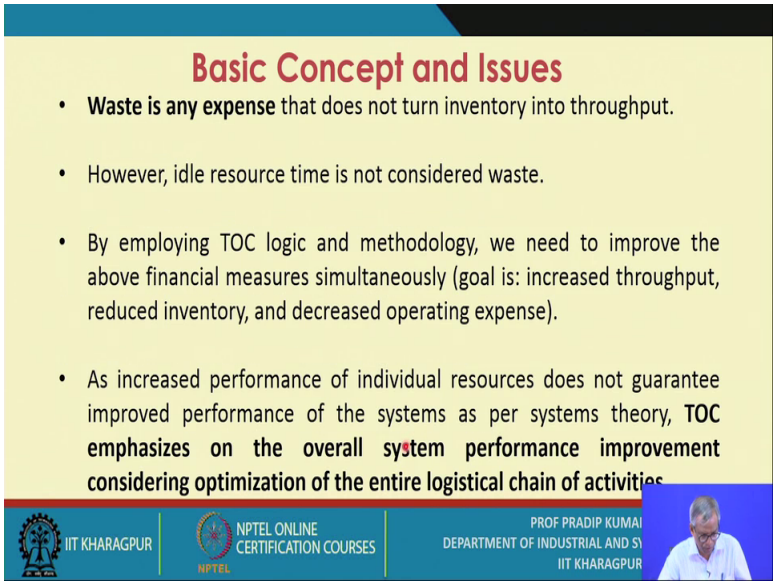

So, these are basic concepts. Now, what do we try to do that means, waste is any expense that does not turn inventory into throughput, ok. So, this point we are going to elaborate and later on and what will find that the TOC emphasizes on the overall system performance improvement considering optimization of the entire logistical systems of goal. That means, what are the 3 goals the increased throughput, reduced inventory, and decreased operating expenses.

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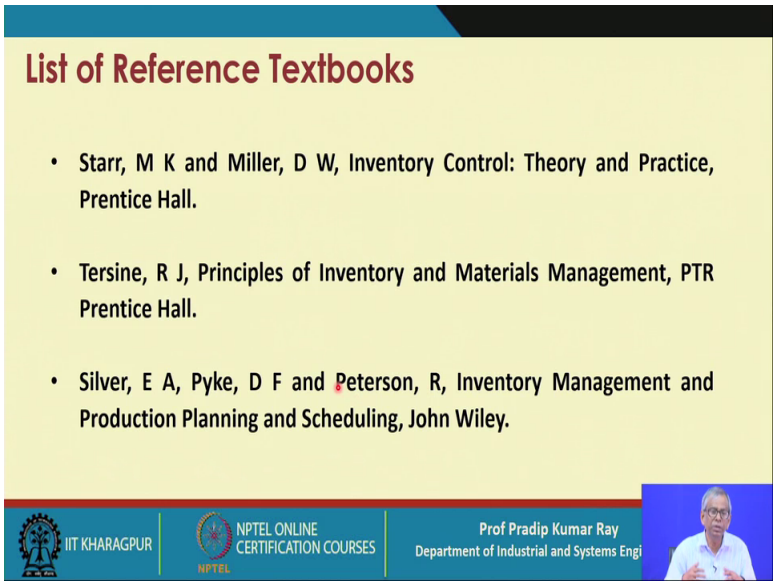

So, with this the basic understanding of say the TOC and the terms and terminologies we are going to say the use while you the propose while you develop a TOC methodology in a particular plant or in a particular systems. Now, we will elaborate all other issues subsequently in the subsequent lecture sessions.

Thank you.