Operations Management
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Lecture - 31
Project Scheduling

[FL] Friends welcome to session 31 in our course on operations management and we have started now the second part of the discussion regarding the course. We have already finished 50 percent discussion regarding the course that is 6 weeks of discussion is already over and in this 6 weeks we have tried to cover a product design and development, we have tried to cover demand forecasting, we already discussed plant location plant layout and finally, we have seen the production planning and control.

Today we are going to start another important topic that is project management project scheduling. So, we will be covering the network diagrams here, we will be seeing that how the projects have to be managed like the operations are usually managed in the form of a project. These days there is a project team which is constituted to solve or to meet the 2 ends meet that is to complete the project work or complete the target or to meet the demands that is there in the market.

So, basically the work that is assigned is in the form of a project, there a project team members each one has a defined roles and the responsibilities accountability is established, that project team works together to deliver the project and the project can be different types of project. You may be having a batch production a complete batch or a complete type of a product, that will be a product starting from the conceptualization of the product then maybe the prototyping or testing of the product and finally, the manufacturing of the product finally, the product will be sent to the market for market survey and full scale production will starts.

So, there will be a project team which will be responsible right from the conceptualization of the product to the final launch of the product in the market. So, that project team will be over all responsible for the success of the product, at this I think we have already discussed in product design and development. So, whenever a project team is constituted there are fixed targets that within this much time domain the project has to be completed, similarly in operations management also supposed there is an order for

supply of 10 aircraft. So, suppose there is a company which is manufacturing aircrafts and it receives the order of manufacturing 10 aircrafts by any company.

Now, there will be a team that can be constituted to execute this order. So, 10 aircrafts have to be manufactured they have to be already the design is their, the only focus area here is the manufacturing of the aircraft keeping in mind the target deadline or the target due date. So, as per the due date all calculations will be done, what material will be required, how much material will be required, when the material will be required, how many people will be required, how to do the back calculations, when the manufacturing must start?

There has to be answer to each one of this qust these questions in order to achieve the target deadline or in order to achieve the due dates. So, in that case a project team may be constituted for this particular order of 10 aircrafts and this team will then do the calculations will draw the networks, will take help of different scheduling tools for example, c p m and pert and finally, will be able to deliver the products on the target date. So, for that we a use very simple tools which we usually called as c p m and pert the critical path method and the program evaluation and review technique.

So, we will be seeing this to think in the next 2 weeks this week our focus will primarily be or critical path method and the next week of a target will be on pert. So, we will be seen that what is a project, how the networks can be drawn, how what are the things that we have to take into a account while drawing a network, then we will see what type of calculations can be done based on the critical path method as well as the pert technique and finally, we will see that how cost and other maybe resources can be included while our calculations using c p m and pert.

So, we usually focus on 3 parameters here the first parameter as I have try to explain in the beginning that time is a critical parameters. So, the first thing is time, the second time the second think that we can take into account is the people or the number of people involved in the project and the third parameter can be cost.

So, these are the 3 important resources that we will be the optimising using the c p m and pert technique, we will focus on time, we will focus on manpower, will focus on cost and try to solve different problems and try to schedule the projects in such a way that our target due deadlines are met effectively and efficiently. So, let us start our discursion for

week 7 and the first session that we have today is regarding project scheduling and in project scheduling our focus will be to understand the 2 words that is project and schedule, schedule is always in the time domain. So, we will be studying a project what is a project, how to define and then we will see how to represent a project on a piece of paper, what are the various rules that we used to draw the network or to represent the project in the form of a network.

So, let us quickly start our discussion on this important topics and I must address here that this is not an important topic only for a mechanical or p and I engineers this topic is very very important for all engineers, c p m and pert can be used in civil engineering projects also. There also being use in most of the research projects specifically pert is used for search such type of projects, this is not only relevant to mechanical or p and I engineers were those people were involved in the manufacturing of products for development of products and processes, but there are also useful for other engineers as well as well as for the manager who have to manage very big projects way where different activities are involved and there is a interrelationship among the activities.

So, the topic is really important and I feel that when we discuss this topic or learners will enjoy the topic and will definitely add a new skill to their skill set by solving certain problems related to c p m and pert. So, let us start our discussion with this topic.

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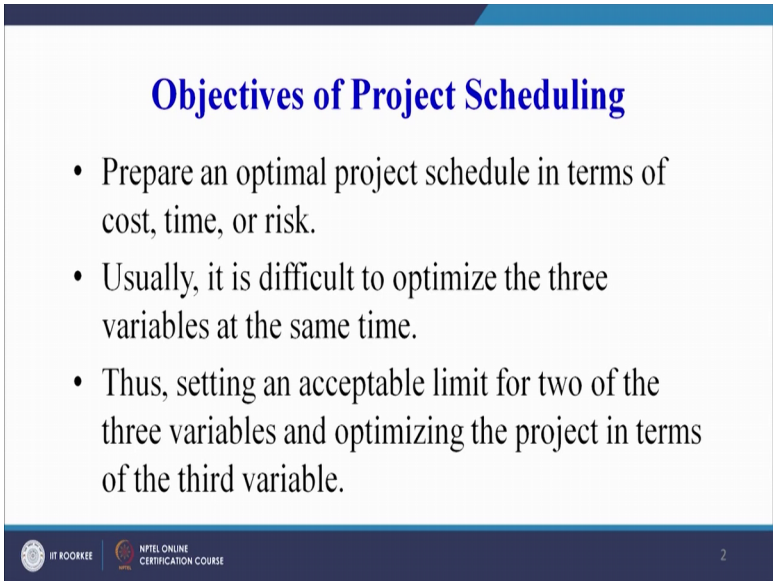

So, what are the objectives of project scheduling? Why do you do project scheduling? So, as per the main objective goes the first one is to prepare an optimal project schedule in terms of cost, time or risk. So, 3 terms are mentioned here cost, time and risk we have meet the deadline therefore, our focus is on time, we must be able to achieve our target with an optimal cost. So, cost is also mentioned there and there is always a risk involved with the execution of the project.

So, we will try to mitigate this risks and the risk factor has to be taken into account when we are doing our project scheduling, these 3 parameters are important when we are focusing on a preparation of project schedule, the second objective is it is difficult to optimise the 3 variables at the same time. So, we have to that how these 3 variables can be optimised it is difficult. So, therefore, what do we do, the setting an acceptable limit for 2 of the 3 variables. So, usually we see whenever a building is constructed, what are the things that we usually fix, we usually fix the cost as well as the time and then we try to minimise the risk somewhere maybe we may be able to optimise or maybe set limits or to think the third thing can be cost, cost can be variable, but the other 2 things are fixed.

So, thus setting an acceptable limit for 2 of the 3 variables and optimising the project in terms of the third variable, many times may the risk we say we are not going to take any risk we will reinforce everything risk we will always you will say, you can say that we are 0 risk decision is taken time is also fixed. So, cost can be a variable. So, may be any 2 of the 3 we will fix and third we will try to optimise.

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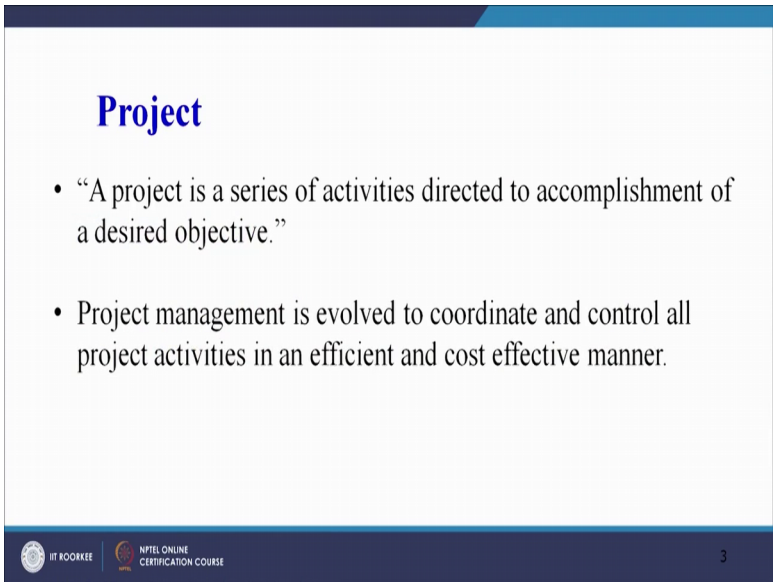

Know how do you how do we try to we can define a project, on your screen you have a project definition of a project a project is a series of activities directed to accomplishment of desired objective. Now, the desired objective can be construction of a building, it can be delivery of 10 aircrafts to a to the customer, it can be maybe setting up of assembly line for manufacturing of a car.

So, the objective can be anything, but the project is a series of activities. So, it is a combination of activities or jobs that when finished are able to represent the accomplishment of an object, the objective is pre decided we do a project in order to achieve a objective. So, a project we can say a series of activities is directed to accomplishment of a desired objective, project management is evolved to coordinate and control all project activities in an efficient and cost effective manner.

So, basically the concept of project management is a subset of the operations management. So, in operations management we have broad objective where as the project management is one subset wherever focus is on managing the activities related to the successful accomplishment of the objectives of operations management. In operations management we may set a particular objective within the domain project management will focus on these 3 parameters that we have already seen, the cost time and risk and will try to optimise the use of resources. So, that the targets are achieved the

project management is revolved to coordinate and control all project activities in an efficient and cost effective manner.

Now, let us see what are the salient features of a project, how we will define project?

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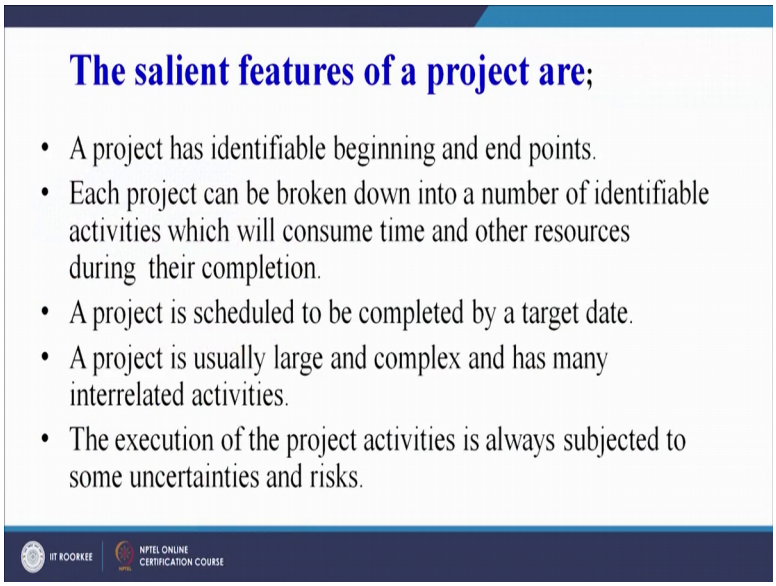

A project has identifiable beginning and end point. So, as I have already told and with the, and tried to explain with help of an example, suppose we have to meet a target of supplying 10 aircrafts to a company. So, we have to take a decision when the manufacturing of these aircraft must begin, what is the start date of this project and the deadline on the day when we have to pack this or dispatch this order for the customer the deadline is also fixed.

So, the project has a identifiable beginning and end points, each project can be broken down into number of identifiable activities which will consume time and other resources during their completion. So, this project has can be divided into a, has to be divided into number of interrelated activities and each activity will definitely involve some time it will involve resources in term of manpower machine equipment.

So, these activities when combination of these activities are interrelated activities when these activities are completed successfully, it represents the completion of the project. A project is scheduled to be completed by a target date which I have already highlighted; a project is usually large and complex and as many interrelated activities. So, it may like I

have already given an example manufacturing of an aircraft will involve maybe 100s or 1000s of interrelated activities.

So, the project is very large in size it has interrelated activities which have to be completed for the success of the project, the execution of the project activities is always subjected to some uncertainties and risk. There are always risks involved like there can be breakdown of a machine, there can be a strike by the workers, there can be some orders of the government that you have to follow, there can be some changes in the schedule because of some unforce in circumstances. So, there are always risks involved in the execution of the project.

Now, one of the method of representing the various activities is a Gantt chart, you can see here.

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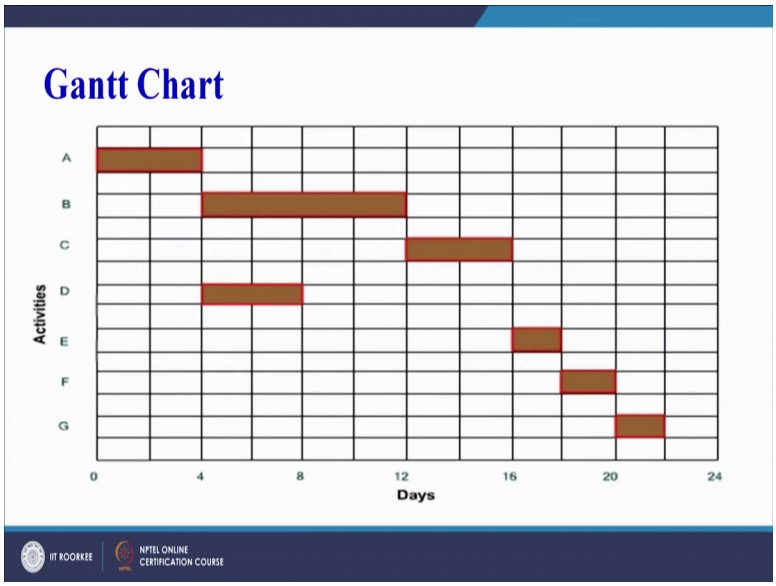

Why the Gantt chart has been put in this presentation because this is also one of the techniques of project scheduling and there is another technique which is the network diagram. So, we will try to understand what can be the differences between a Gantt chart and a network diagram, here also you we can see we have scheduled the various activities as you can see on the vertical scale we have activities a, b, c, d, e, f, g and on the horizontal scale we have days.

So, we can see activity a start on day 0 and is finished by day 4 activity week starts after the completion of activity a and continue till 12 days, similarly the other activities are also depicted. As most of the learners will be students studying for different programs or different degrees or diploma or maybe postgraduate pro programs most of the time whenever you are doing a project you are always told to draw the Gantt chart and show that how your project will be complete what are the various activities involved. For example, for a bachelors project or a B-tech project usually the student start with literature review then development of experimental setup, then they go to experimentation, then data analysis, then the next activity is maybe the writing of the thesis finally, the submission.

So, different activities are involved in the completion of the B-tech project and this is the way the activities can be represented. Suppose it is a 1 year projects you divide the time into 12 months and then maybe the first 2 months can be related to literature survey and problem formulation, then the next step can be development of experimental setup it can take 2 to 3 months time. So, this way we divide the overall b tech project into its individual activities and when these all activities are completed jointly we say the project has been completed.

So, this is one way of a representing the project or representing the schedule of a project, but there are other better method, here we see the only focus is on time. So, there is no focus on who is going to do the activity, how many people are going to be involved in these activities, what is the cost element involved for each activity. So, here the focus is primarily on activities or the times related to the activities also there is little focus on the interrelationship among the activities. So, that interrelationship also sometimes is very very important because there will be some activities which can be done con currently, but there will be some activities which are interdependent.

So, the start of one activity will be dependent upon the end of another activity. So, the activity can only start when the previous activity has been completed. So, that kind of interdependence among activities is not very very clear with the help of Gantt chart. So, therefore, we go for network diagrams which offer us all this flexibility of including the manpower involved including the cost factor, involved including a little bit of risk involved also. The network diagrams help us to focus on all the 3 elements of a project

schedule that is the cost, the time as well as the risk involved. So, let us know focus on the network diagram.

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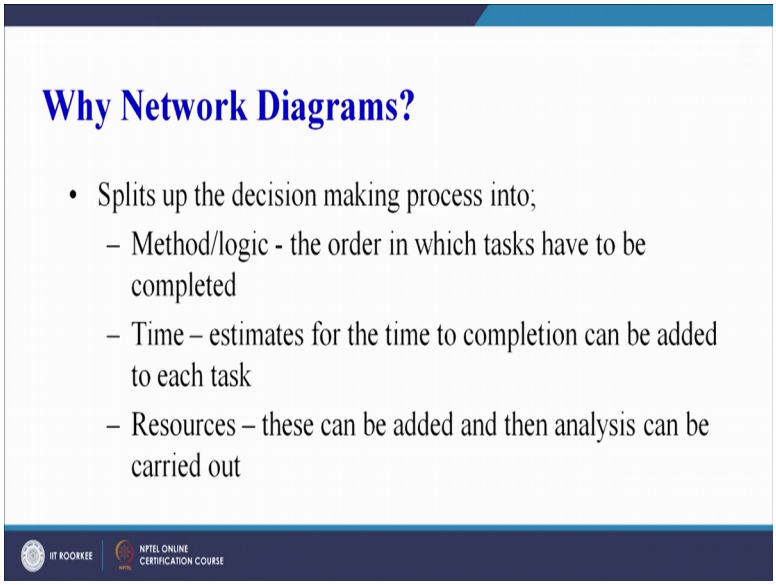

So, why the network diagrams are important? The network diagrams splits of the decision making process in 2 method or logic the order in which the tasks have to be completed. So, usually we call it as the precedence relationship. So, there will be a precedence relationship among the various activities and that will be taken into account with the help of the network diagrams.

The next thing is the time the estimates for the time to completion can be added to each task, resources these can be added and then analysis can be carried out to the resources can be in term of manpower involved, than this manpower and machine and equipment can further be clubbed together in the cost element and then cost analysis can also be done with the help of network diagram.

So, we will see during the discussion that how fast can be incorporated into the network diagram, we will also see that how manpower can also be included in the network diagrams in addition to the time for which they are primarily drawn. So, important point understand is that there is a project which has to be completed, a project is made up of different activities or jobs. These activities may have some inter relationship among them we have to represent this network on a piece of paper and then we have to do the analysis and do the calculations to find out that whether will be able to meet the deadline or not

for example, there can be a tournament that is coming up in 2020, right now we are in 2017. So, we have 3 more years to go.

So, we can do we can make use of this network diagrams to find out or to schedule our activities. So, that all the stadia, all the stadiums that are required for the execution or for conducting the tournament are ready by the deadline. So, we can see that the acquisition of land must be completed by such and such date which is one activity, after that the foundations have to be lade or the drawings have to be or the architecture to finalize the maybe designs of the stadium. S

o, that has to be completed by the state, there can be these two things can go parallel if you know that this is the area that we are planning to acquire. So, based on that the architects can start their work, there can be some parallel time between these 2 activities and then further we have to see having the foundations can be lade and then how the what will be the different time targets or due dates for the structure to be built and finally, what is the deadline when the structure will be ready to be handed over to the organisers.

So, maybe 3 years time schedule can be worked out. So, that we are not delayed in handing over the stadium to the organizers. So, that that is the maybe one of the applications of the use of these networks. Similarly when we are doing our operations on the shop floor we can again make use of these networks and schedule our activities schedule the different operations in such a way that we are able to meet the deadline of the delivery that has been contracted with the vendor or with the customer. So, we can see that in order to do all these calculations in order to take these decisions we have to represent the project on sheet in the form of a network diagram. So, network basically as we have seen why network diagrams are important, now we are coming to the actual maybe understanding that, what is actually a network.

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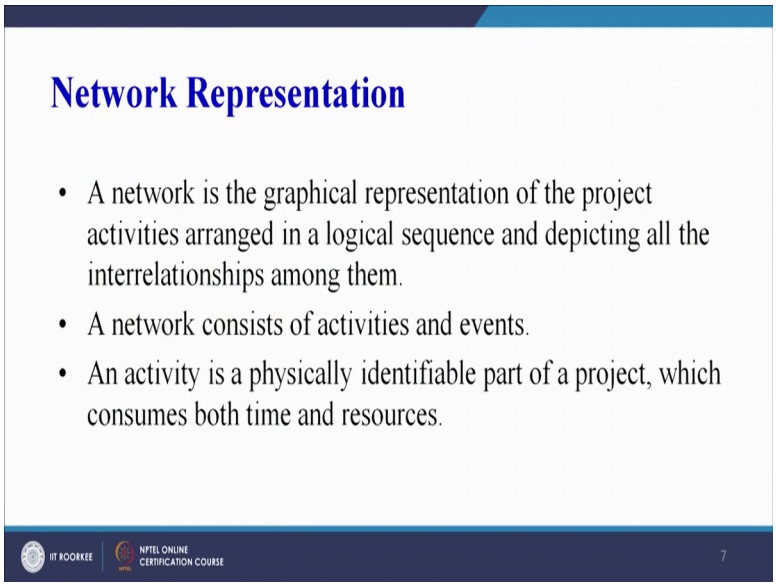

So, we will see and network is the graphical representation of the project, which we will see in the subsequent slides with the help of a diagram a network is the graphical representation of the project activities arranged in a logical sequence and depicting all the interrelationships among them. So, a network is basically what can we call as a drawing or it can be called as a pictorial representation of graphical representation of the various activities that are involved in the project. One more important thing has been highlighted in this point and that is the interrelationships are also clearly establish in the network diagram or with the help of a network diagram, a network consists of activities and event.

So, we will see that what are the activities and what are the events and activity is a physically identifiable part of a project which consumes both time and resources. So, we will see that an activity or activity is a representation of one job for example, we are we want to construct a house. So, the laying of the foundation can be one activity. So, this activity is identifiable because we are constructing house we have to make a foundation that is our first task.

So, far foundation it is identifiable part of the project and it con it will consume certain time and there will be some people, some material, some equipment that will be required to complete this activity. So, that can be called as one activity, when there can be other activities like erection of the walls can be another activities, laying off the roof can be

another activity, setting up of the electrical connections can be another activity. So, you have combination of activities that are involved in construction of a house.

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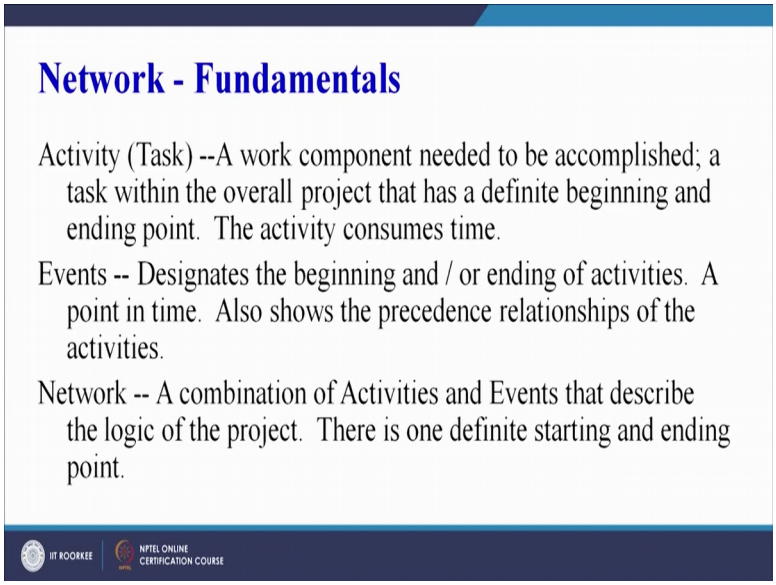

So, network fundamentals let us see there few things that we have mentioned here, the first one is activity or a task I have already explained, it is a work component needed to be accomplished a task within the overall project that a definite beginning and ending point the activity consumes time. So, activity or a task is basically identifiable small part of a project which has a beginning which has a ending events designates the beginning or ending of the activities, a point in time. So, maybe we can say as we are travelling from Roorkee to Delhi in between, we have milestones after one kilometre after 2 kilometre may after hundr every kilometre we have a milestone. So, event can be those milestones representing the end of a particular distance in case of travelling.

But here it will mark the ending of a particular activity or a group of activities, designates the beginning or ending of activities at an event some of the activities will be finishing and some other activities will be starting. To also shows the presidents relationship of the activities why because the activities that are finishing here are the predecessor of these activities must be completed before the start of the new activity. So, that events will represent the beginning or ending of the activities and the network is a combination of activities and events that describe the logic of the project, there is 1 definite starting and ending point.

So, we in today's session we have seen that what is an activity? What is an event? What is a network? As is clear on this slide and prior to this today we have seen that what actually is the importance of project scheduling and then we have tried to compare the 2 important representation of a project when is the Gantt chart and another one is the networks and we have tried to just understand the basic terms related to a network diagram and in the next session we will see that what are the rules that are used for drawing a networks.

We will see the Fulkerson's rule and the maybe the use of the dummy activities for showing the presidents relationship among the various activities. So, the introductory part of the project scheduling is over today, in the next class we will focus more on the actual drawing of the networks.

Thank you.