Welcome to the course Project Management Planning, Education, Evolution and Control. I am Professor Sanjeev Choudhary from Indian Institute of Technology Kharagpur. Today we will be covering module 6 that is Developing Project Plan. This is an important chapter in which in the first lecture we will be we will be discussing about the concept of project network and network development rules. So, to come to the topics or the concepts that will be covered in this lecture are developing a project network, then constructing a project network, then activity on node or activity on arrow. So, these three we will be covering in this lecture.

The rest we will be doing it in the in the subsequent lectures. So, to start with today's lecture so, developing a project plan using network model. So, first thing comes to the mind we ask what is a network?  Can anyone of you answer it? What is a network in project management? A network is a graphical representation of a sequence of activities, its flow, illustrating its flow, then its interdependencies, its interrelationship and criticality.  So, in other words we can say a project network is characterized by a set of events, its sequence, its interrelationships and dependencies.

So, this project network is a powerful tool for planning, executing, monitoring and control of the project and it is said if a project network is drawn or developed, then three-fourth of your planning work is done and good network will ease your work for your execution of work, monitoring, progress monitoring and its control. So, it is a powerful tool.  So, now next we will be finding out types of networks and their characteristics. What are the types? There are generally two types of networks, one is called AON that is activity on node   and another is AOA which is an activity on arrow. So, these two types of networks I will just show it to you now, then we will discuss it further.

What is AON and AOA? Say this figure is AON network, say AOA network, this is AOA network.  In this network what you found? The activities are denoted by the arrows and this node represents an event that is a point of time where an activity one or more

activities can start or end. So, this A this A, A is the activity and 2 is the its duration, it is 2 is represented its duration. Then C is the activity and node are 2 2 3, it is the C activity 3 its its duration. So, this is called activities on arrow whereas, activities on node this each node denotes an activity and these are the and the subscripts are the durations, these are the conventions and there are many types of conventions are there and many authors use different conventions, many practitioners use different conventions and like that.

So, for this you can say an AON, this is AON network. Here as I told you arrow represents the flow, the directions, the precedence, precedence relationships and here activity arrow represents the directions of the progress, how it is going on ok. These are the 2 networks generally available for project management, one is AOA and AON. These 2 were developed by 2 different groups we which I will discuss it in the next slide. So, I hope what is AON diagram and AOA network diagram are clear to you and more on these we will be coming on in subsequent slides.

Now you must have heard the words' part and CPM. So, now, we will be talking about how to develop a project plan using part and CPM. These are the critical path analysis, where first we will talk about critical path method that is CPM, then we will be coming to the other one. So, first say how these 2 both part and CPM were developed in the by 2 independent groups in the USA nearly about at the same time for 2 different purposes. So, critical path method was developed by Dupont, Dupont Inc that is a chemical giant a chemical company, it is well known to the world.

Dupont in 1956-57 with the help of Rand Corporation and it is a the dupont wanted to come up with a new chemical plant and also, he it wanted its shutdown maintenance to prepare a shutdown maintenance schedule. Those who are in chemical industry they know that plant shutdown maintenance and all it is a big job. So, for that they along with the Rand Corporations they developed this critical path method and it is believed that Mr. Walker and Mr. other gentlemen from this they were the architect of and Mr.

Kelly, Mr. Kelly and worker were the architect of developing this critical path methods. What are the characteristics of this critical path method? Critical path method is generally used for used for repetitive jobs like construction industry or the or any other industries where where the jobs are repetitive in nature and you have the past experience of similar types of job. So, you know the work packages that is the activities time duration, resource requirement, cost requirement and all you know something. So, this is the take one time estimate that is the deterministic time and it follows AON network activity on node network that we have seen it know and it is for repetitive job as I mentioned to you.

Whereas, this if you come to the then the another one is the project evolution and review

technique that is called PERT. This was developed around the same time by the US Navy with the help of Booz Allen and Hamilton consultants in the US. US Navy in 1957-58 they were developing Polaris missile and that program Polaris missile programs and also and it is a huge complex engineering and other technology the program and this program therefore, to complete it they had 250 major contractors and 9,000 subcontractors. So, you can imagine the coordination required for managing such a big program. So, so they develop this part and what is the characteristics of this part? It is the three-time estimates because these are the new program generally the it is done for the non repetitive jobs, we do not the say R and D work, new product development, new technology development you do not have the past experience of that similar type of job done.

So, your time estimates are not deterministic. So, you have you take here three time estimates like pessimistic time, optimistic time and most likely time. We will talk about this later on in subsequent lecture and it follows an AOA network. What is this AOA network? That activity on arrow. So, one follows one follows AON network and the other follows AOA network and we all know this this is the AON network and this is the AON network.

This is followed by part and this is followed by CPM critical path analysis. So, now, after the after these two projects say dupos chemical plant and maintenance shutdown and the US Navy's this Polaris missile programs and all these were successful these and these were and it caught the attentions of the other industries you know all industries across the world. So, they tried to develop their own plan following these two methods and whether it is in airport building, construction industry, dam, then power plant or the ship preparing ship building or the product development, R and D work, space mission everyone started using it and when they the new people they started using it they generally took best of the both. So, in course of time what happened the difference between part and CPM has narrowed down. So, nowadays it is synonym part and CPM it is synonym it has narrowed down because and moreover the computer programming that software project management software came.

So, they took the best of the two. So, it further narrowed down the differences, but till today till there are some basic differences. Differences are one uses AON activity on node network another uses activity on arrow network and the time estimates a critical path method uses deterministic one time estimate and the part uses three-time estimates that is optimistic time, pessimistic time and most likely time. So, these are the main differences nowadays, but today most of the because of visual appeal and all you know computer program programs and all software they the appeal is more for the AON activity on node network, but AOA is also used and was very popular say few decades back and when it started this network this thing that time AOA was predominant.

Nowadays AON is predominant because of ease of understanding visibility visual appeal for all these, but AOA is also used for big projects construction project types of projects and all they are it seems that AOA is represents a more better representations ok.

These are the two types of project network critical path analysis. Next, we will be talking about the terminology before going further you must know some of the that terminology for constructing a project network. So, say activity what is an activity can anyone of you can say an activity is an element of the project which consumes time it may or may not may not consume resources. I will give you activity say any work packages is an activity task is an activity it is an element of the project. So, it generally consumes time and suppose when it does not consume resource generally activities consume resource also resource man manpower material and all, but suppose you are waiting for decision waiting for material you are not using any resources other than time that is an activity.

An event is a point in time where one or more activities can start or end that is an event, we will talk about show it to you bit later. Then merge activities what is a merge activity? A merge activity is one that it has more than one it is dependent on more than one activity this is M is a merge activity it is dependent on three activities J K L unless these all three activities are completed M cannot start. So, merged activity has more than one predecessor activities unless they complete this activity cannot start. Then there is parallel activities or concurrent activities these are the the activities which can be which can be done or carried out at the same time if manager wishes and it may be possible, they manager has the discreations to shift some activities to do in some other time if provided that activities are having a slack or time. So, this we will be talking about you bit afterwards say another is the say parallel activities I will show you we have we have seen it that AON diagram knows these are the parallel activities know here you can see say here say D B these are the parallel activity A B are the parallel activity C D are the parallel activity it can be done at the same time ok.

So, let us move move ahead. So, this is the parallel activity. So, there is a burst activity what is a burst activity an activity which has more than one successor. So, this this is A is a burst activity A has B C D as its successor. So, this is called a burst activity then there is something called dummy activities what is dummy activities? Dummy activities are activities which does not consume time or resources it is just kept for showing the interrelationships of the of the your network diagram just take this one this one these are the dummy activities say it is C 3 these are the events AOA these are the events.

So, this is does not have any that connections with C just to represent that the loop is closed it is shown as a dotted line it does not consume any time or resources just to

complete the network for a better visual representation these are the  dummy activities. Actually, dummy activities are formed only in activity on arrow AOA network.  Dummy activities this network is the same as this network for AON network dummy activities do not form. So, these are the differences that is why AON network is more acceptable nowadays those are called dummy activities is just to for having a good graphical representation. So, that these are closed otherwise it shows these activity shows open.

 In fact, that is open these are the burst activity and that dummy activities. So, here if I find it this D is a what D is a merged activity and B is what B is a burst activity because D and C two activities are following succeeding it and A and B is merging that D cannot start unless A B are completed. So, and two approaches there are AON approach activity on node activity on arrow we have already discussed this. So, next you there is a called something called critical path and critical activities. What is critical path? A critical path is one which a critical path is a set of activities in a network which takes the which is the longest path that takes the longest duration during which all the activities in the project will be completed.

 Critical path has no slack what is that it has 0 slack in other words I will talk about slack and float next point it has 0 float. So, if any activity on critical paths is delayed your project completions will also get delayed and any activity falling on critical path is called critical activities.   And if these critical activities delayed means project is delayed because critical activities all have minimum or the least 0 slack and what is slack? A slack is the amount of time amount of time an activity can be can be delayed without delaying the project that is called slack.  Critical activities do not have slack because if it is delayed project will delay non critical activities have slack means if it can be delayed to some extent without delaying the project, but if the non critical activity is delayed beyond the its slack the project completion will get delayed. We will talk about this slack or float and critical path we more in the subsequent slides.

  We will be talking about basic rules to develop project networks. Project networks have some rules first rule is network flows from left to right you have seen that know you have seen that that it is the that all those projects AON and AOA diagram you have seen this network is flowing from left to right always it will flow from left to right ok. So, now, the network that finish to start unless the precede a predecessor activity is finished the next activity cannot start next activity can only start when the when the earlier activity is finished you have seen that in that diagram. So, this is to be followed and arrows, arrows represent the directions the way it is flowing that the directions of the progress of the project and it also shows the that is in AOA and arrows in AON shows the interdependencies of the activities how these activities are dependent on the predecessors' activities that is shown by the arrows. Then identification number each

activity must have an identification number that is we have talked about WBS work breakdown structure code what is those work packages have some codes.

These identifications number generally have either numeric number or alphabet or it may be alphanumeric number and identification number you know is generally goes on ascending order like the successor activities will have larger identification number than its predecessors activities and we will talk more about these identifications number in the next lecture first slide. Then looping, looping is not allowed for the project network looping means like A to B you after completion of A you do B after completion of B you do C now C cannot come again to A because that means your resource and all has been when A is completed then only B could start. So, when B is completed, C starting, but C if it comes to A means it is forming a loop and it is your computations of critical path and all forward pass backward pass becomes meaningless. So, looping is not allowed then conditional statement is not allowed like if successful you go for prototype if not you recycle it is not allowed in the project management network. It no conditional statement because it violates the basic rules then the dangler what is a dangler it is a best practice it is to if say in your project more than one activity can start simultaneously.

Similarly, that when its project is ending more than one activity can end simultaneously, but it shows a you know open ended thing to avoid that you use a you tie all tie all these activities at the start say to one node stating start or stating end. So, it gives a good visual representation and the complete it also completes your networking say here what you are finding you are A and B both are starting at the same time. So, both should be open ended. So, what you do you put a node with start it is nothing it is a node with start and A B are tied. Similarly, for the end may happen many activities suppose these where the end supposes then many all these activities would have been at the same time.

So, you put a node here and put end that is called a dangler. Now, to so, we have done this all. So, next is the we will be coming to the what we learnt in this lecture. The conclusions we can tell this chapter explains how to develop a project plan using network model. There are two types of networks we have discussed that is activity on node which is used by critical path method and activity on arrow that is used by program evolution and review technique that is part.

The differences between AON and AON network we have discussed and their applicability have been also mentioned. Next, we also elucidated the difference between CPM and part and CPM uses one time estimate as the tasks are repetitive and activity is fairly activity time is fairly accurate. Whereas, part uses probabilistic or three-time estimate which will be further discussed later in this module. This module also this explains various terminology used for developing network plan and basic rules to develop

project networks. These are some of the reference books you can you can refer to and enhance your knowledge further and clarify yourself more.

Thank you very much for attending this lecture.