Project Management
Prof. Raghunandan Sengupta
Department Of Industrial and Management Engineering
Indian Institute of Technology – Kanpur

Module No #4
Lecture No #19
Work Breakdown Structure in Project Management

Very good morning good afternoon good evening to all my students and friends who are taking this course so I am Raghunandan Sengupta my IME department IIT Kanpur. So we were discussing in the last class which was the eighteenth lecture we just completed the concept of utility so there was a quite a lot we have covered utility analysis concept wise and I did mention twice duration the course of eighteenth lecture that we will cover the problems of say for example in details using very simple numerical values.

For certainty equivalent concept how you find out the expected value of the project are you rank them according to the expected value you rank them according to the variance if expected value is not that important for you or rank them according to the ratio of expected value to the variance of the risk or the reverse ratio or risk to the expected value then we consider the concept of safety first principle the concepts of trying to minimize the probability maximize the values depending on constants of probability alpha.

Alpha is basically general variable value which I am using and then we consider that what is the concept of geometric mean values and how it as some resembles are concept with the other efficient frontier considering log of the prices is to or log utility function is to then we saw that how utility function in quadratic it has some ah set of relevance is to normal distribution or returns and all this we will come back to this problems later on.

So in between either the twenty first or the twenty second lecture I will just take up break and then do that. Even though it would definitely make a sense into to do this problems in such a way that you will understand the concept utility with respect to the concept of project management as

such. So let us start this nineteenth session or nineteenth lecture of half an hour considering the extra other concepts which will be covering for project management.

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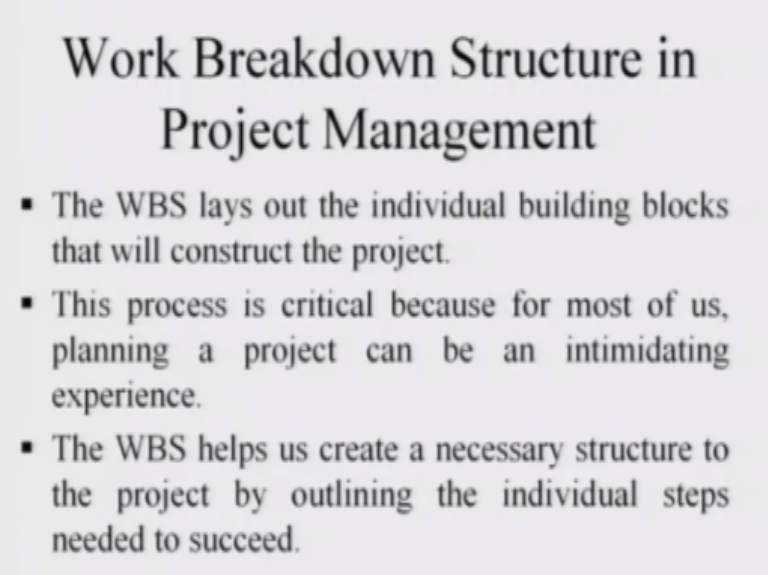

So next topic of discussion is work break structure in project management so work break structure or WBS is basically concept we break up the whole project in activities jobs. Such that they have some concepts of how jobs slow from one to other and how the activities are linked and how one activity or one job which with delays no delays with slacks no slacks what are this I will come to that concept of delay slacks later on how they link.

In order to accomplish the whole project which is on hand so WBS layout individual building blocks that will construct the project. So if it is a software project obviously there would be concepts that how you do the software project management work considering the collection of data is there for the project trying to build up the data management system trying to build up the flow process diagram of the of the of the programming concept for the need you look out to be written down expressly they one need to write the progams are different and try to combine that.

So all this thing would be basically come into the picture the second bullet point is that in WBS which is work breakdown structure this process is critical because for most of us planning a project can be and intermediating task and we can find out the how the overall projects would look like by going through the components or WBS. WBS helps us create a messages structure to

the project by outlining the individual steps and how the individual steps are combined to give you the bigger picture of project.

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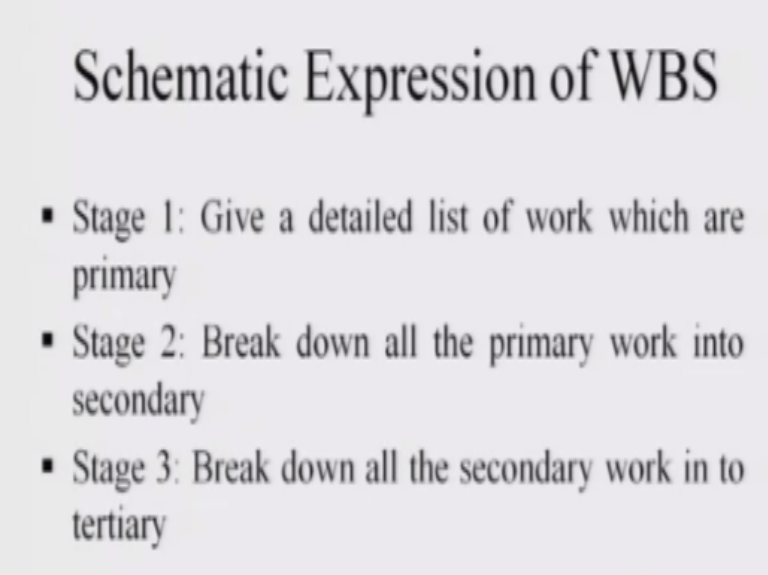

So what are the schematic of the flow process or the steps which we take for WBS are trying to basically draw the project management curve of the graph or the diagram. So the curve, diagram, graph there were all make sense and as we start to do the problem later on. Stage one gives the detail list of work which are primary and importance and we should be accomplished in some sequence.

Stage two breaks down all the primary work into secondary and in what are the linkages between the secondary work inside the primary one and if the primary are related to each other what are the linkages between the secondary work inside the primary one if the primary are there related to each other or secondary to each other. Stage three breaks down all the secondary work into tertiary one also is to find out whether after the tertiary.

We have the first level below tertiary second level below tertiary and go on accordingly and obviously linkages between the first level of tertiary. We have the second level of tertiary linkages of later layers are basically combine in such a way that they make sense that how the overall projects are managed and combined.

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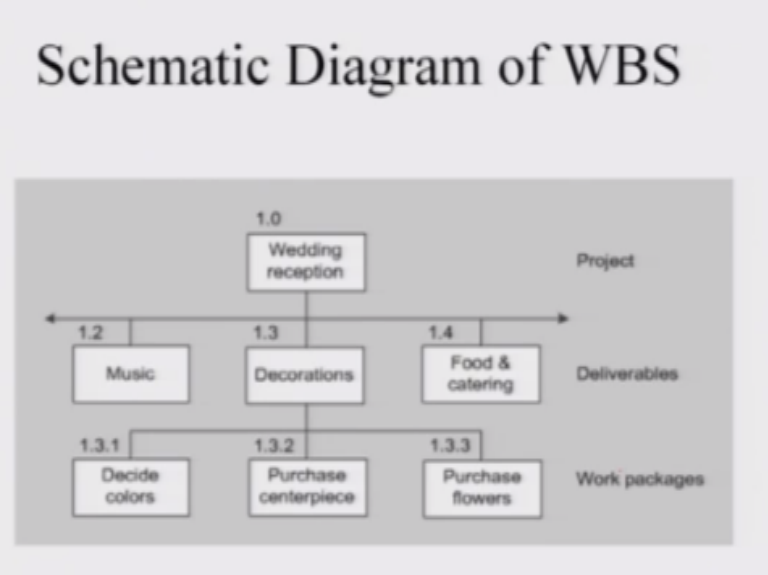

So consider this chemical diagram according to the WBS concept so you have the your planning a very so wedding can also be a project not the basically plan the wedding reception have to be planned and that is project and what are the deliverable. Deliverables may be want to have a music function for that you want to have that decorations the food the catering, the coming of the bride and the bridegroom.

Or say for example relatives who are coming so they can be basically some part of the overall project you want to basically manage. Now in the decoration can be want to basically setup the stage even though it is not given or drawn in the diagram in the music can be want to set on the stage you want to basically called either the shenay or you want to basically have the DJ whatever it is basically you planned it accordingly.

You give them a call basically set up the lighting so that can be sub part of the music deliverables as such decorations are as mentioned so this number which are one, one point two, one point three, one point four are just number in system in order to make you understand. So one point one would be somewhere on the left where I am showing it is not shown. So you will one point five one point six so and hence so forth on to the right.

So under decoration it basically a decide that colors what type of different clothes you should be used to make the purchases the flowers you want to purchase the of example the different type of

linens which you want to basically lay on the table the mats and different types of cutlery sets which are going to use considering it is a part of decoration then you have to purchase a flower purchase the different type of things which are used for the for the birthday or the marriage party.

And then if you go into say for example the food catering it may be what is the menu you want to basically plan to other different type of guest who are coming you have the starter what is the main dish very to be basically planned and all this things. So if you see this blocks which are there it would mean some where the AHP problem which you have done where the hierarchy are there and then went from the bottom to top part trying to basically combine to force in order to find out what is the critically needed in based on that you made your decision.

This concept why is drawing the box is exactly the same as AHP one or ANP one which is analytical network process which we would not do in this course but we want to mention that if you remember I did mention about ANP part in initial stage. So this hierarchy is basically come and combine together with the overall output of the project which is basically to plan the wedding reception.

So these are the first layers with the primary layers in any of the secondary layers then we have tertiary layer so this one point three as been broken down into for our convenience in problem as one point three point one one point three point two one point three point three corresponding to that one point four we can have into sub layers also

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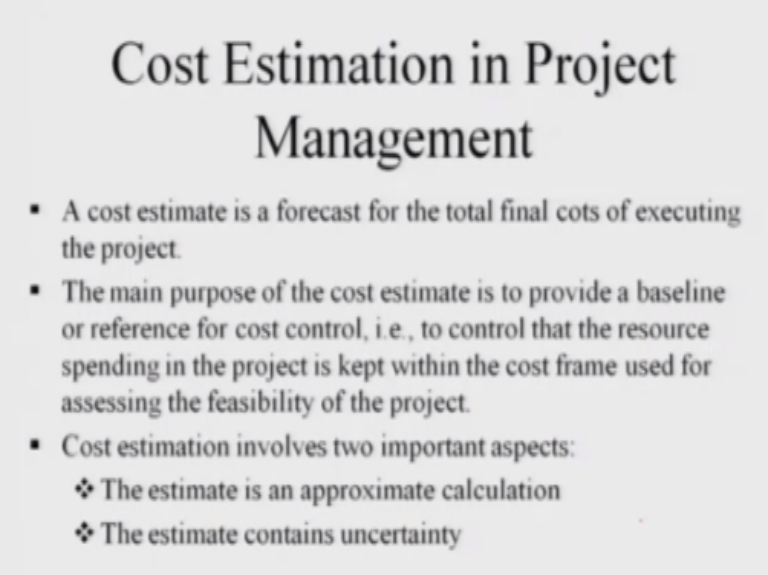

Cost estimation is a which is made for the forecasting for the total final cost is for the executing of the project is basically analyzed. The main process for the cost estimates is provide a base line based on which reference or the cost of the whole project it can controlled or decision can be made. So you want to basically control the resource spending project is kept within the cost frame used for assessing the feasibility of the project where that the project is feasible whether the project is feasible it has positive return and it have negative return.

And the fixed cost is very high whether the variable cost is very high all this concept can be cleared once you make a decision of the overall process has based on that positive or negative outcomes what you are seeing you can make a decision whether we should go ahead and basically invest in the project. Cost estimation involves two important aspects one is basically the estimation is an approximate calculations it does not mean by exact calculation.

Because in case say for example the risk free interest it is changing it can change depending on government securities or say for example the price of petroleum crude oil is changing consider your product is based heavily based on the price of petroleum or consider labor cost is increasing or consider some political situation is changing such that the overall cost is increasing or consider environment cost is brought into the picture. So as this change they keep changing the overall project cost so they are tentative based on which we will proceed for final stage of the project.

The estimate concern constraint on certainty so these uncertainty have to be minimized are kept as possible as possible depending that you are able to estimate the variances of this errors as far as possible. So this are the white noises of the effects which are coming from the external environment and effecting your overall project.

There are in principles two types of estimating method one is the synthetic method in this method we are estimate the cost with the breakdowns and only use the characteristics of the system which means the synthetic method can be used in early phase for the basic ball park estimate which you want to make.

So overall bullet point costs and that the analytical method find there application in developing controlling estimates based on which you can work. Analytical methods we estimate the resource consumption such breaking the total system down to subsist tertiary systems and such sub levels of resources and what are the relationship of the resources and what are the cost structure for each resources and how they effect each other.

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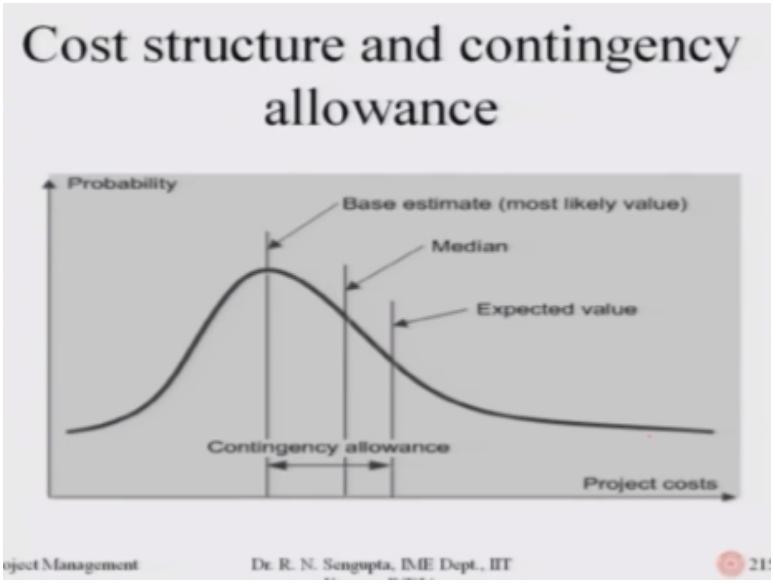

So consider this graph here for the first time and trying to bring the graph if you remember already mention long time back in the initial classes the distributions are there in the project management phase and did mention about PERT and CPM. So in one of the methods I will come

that with to that very soon you use to the gamma distribution also think I had mention about the gamma distribution most pessimistic most optimistic time and the average time median time and this concept.

So that graph is basically gives you that picture in hand were where the probabilities are there in the Y axis is true. While in the X axis we basically gives the cost rather than the time. So cost and time if you remember the concept of project management was basically to minimize the fine of the optimum time the where the resource constant were not there but later on I would also mention that in general we would be interested to minimize the cost as well as minimize the time such that trying to find the best project as such that both the objectives are taken into consideration.

Even though solving though may be different but we will still try to attempt our level best to basically take those objectives into consideration. So the graph shows that we have the base estimate of the cost the median is given because median is if you know the value below and above which the probability divided into fifty fifty percent. So for the normal distribution just I am mentioning from the normal distribution from mean, median mode or the same values but for the other distribution is it not be same.

So in this case you have the mean value, median value and the mean value and the contingency allowances are given and the less estimate basically the estimate based on which you are going to work and if the median and the mean values are on to the right.

So you will basically have some allowances so if you if you exceed the allowances it means that you are overshooting your cost if you are below and active level allowances it means you are following the overall plan of trying to implement that project considering the cost structure have been taken into consideration using the concept of there is white noise.

White noise is taken into consideration the prices of the products or different activities or different jobs of different resources or machines or human beings everything has been done in the proper perspective.

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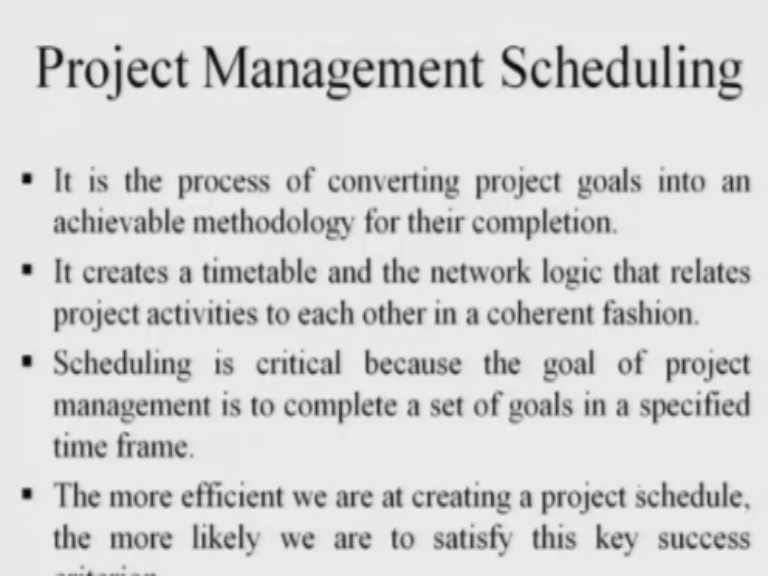

So in project management scheduling what we do is that is the process of converting the project goes into an achievable methodology for their completion such that the main completion is to attain the overall objective of the project. So if you remember just the simple example methodology for their completion such that the main completion is to attain the the overall objective of the project.

So if you remember in just the simple example of WBS what we consider is that their wedding was the project and they were different deliverables based on the sub criteria's or the groups or the deliverables being combined and the main objective was to hold the function for marriage in the best possible way such that to minimize the cost do in the shortest possible time and all this things which are practically feasible for that project.

Now if you consider the ideas which we discussing in the first few classes it was basically the project objective or to basically dovetail in the organizational objective and also the social objective have to be taken into consideration. So if you consider these your project goals and what are the variables you will basically have look at the variables in such a way that you are able to make the criteria of all these sub goals in the best possible way.

So in project management scheduling it creates a time table and then network logic what is the relationship between the activities sub activities tertiary activities and relates the project activities to each other and coherent fashion. Scheduling is the critical path because the goal of the project management is to complete the asset of goals in specified time in the specified set of the activities how the flow.

So say for example if you trying to build up a house your first objective would build the base then considering the base is build then you go into the first floor second floor and considering that has been completed then you build the electrical system the switch system and the corresponding things.

But incase if you basically try to finish without looking though the sequence of the events obviously the work will be finish first and much before time but your overall objective of the project may not be met. The most efficient way we are we are doing is that we are at we are creating a project schedule the most likely we are now we are able satisfy this key success criteria in the best possible manner considering the overall objective or the project which is to be met by us.

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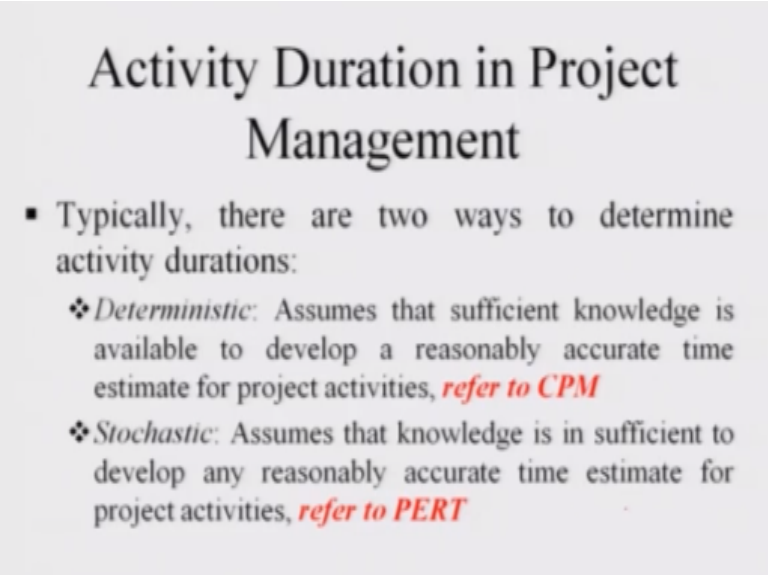

Typically there are two ways to determine activity durations one is the deterministic one see if you remember I did mention about the distribution being and all this consequences so they can

deterministic time frame and then you can be probabilistic timeframe of the stochastic time frame. In the deterministic timeframe we assumed the concept of critical path method would be coming we assume the sufficient knowledge available to develop our reasonable accurate time estimate for project activities hence average would be taken.

And under the stochastic and the non-deterministic time concept we assume that knowledge is in sufficient such that we have to develop reasonable estimate between based on which we will be work and this is under the preview of PERT this project evaluation review technique and we will also see that under PERT we will use the concept of most optimistic most pessimist and why they are used.

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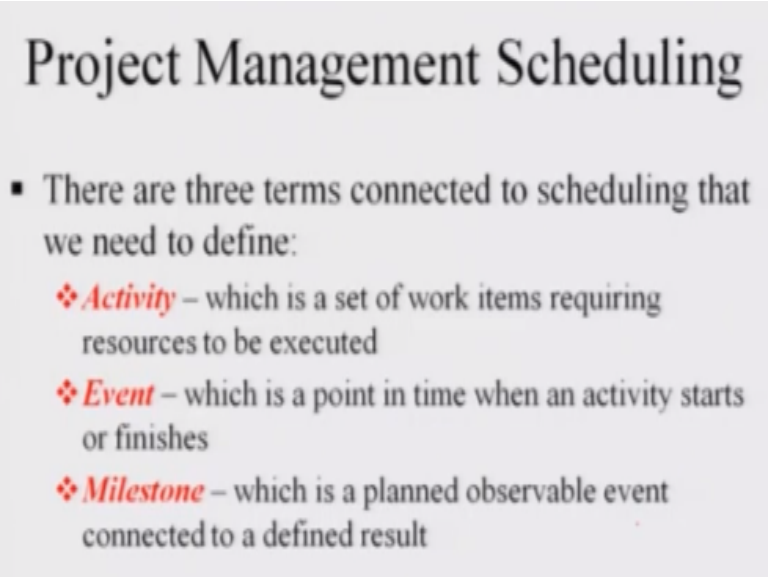

There are three terms connected to scheduling that concept of how the scheduling objects combines activities are combine to get the project one is basically the activity. And activities which are the set of work items requiring resources to be executed. Then which is the point in time and the activities starts or finishes so it one job can start scheduling of jobs are done in such are considering is a gridding.

So gridding one is basically the sources so consider gridding starts on the first day and hence on the fourth day so to the first and fourth would be the concept of event activity would be the gridding and the resources been utilized. And the mine stones are planned which are observable

events connected to getting your overall project done. So consider that you are using the grinding machine you will grind some materials or some jobs and basically use them as clams and fixtures such that the work for the overall project can be done.

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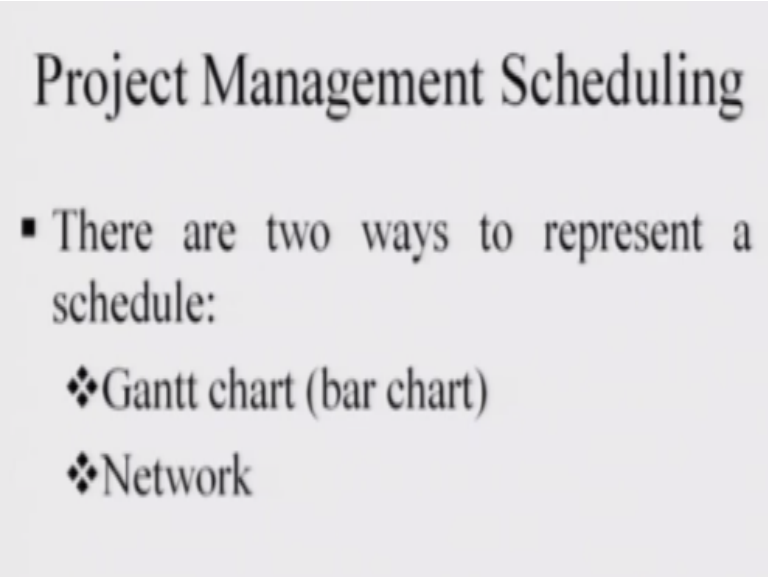

So there are two ways to represent a schedule one is the concept of GANTT chat one is network point. GANTT chart we will discuss in very brief even though we will problems for that and another network will go into the details for PERT CPM and the concept of GERT, QGERT so they are utilized accordingly.

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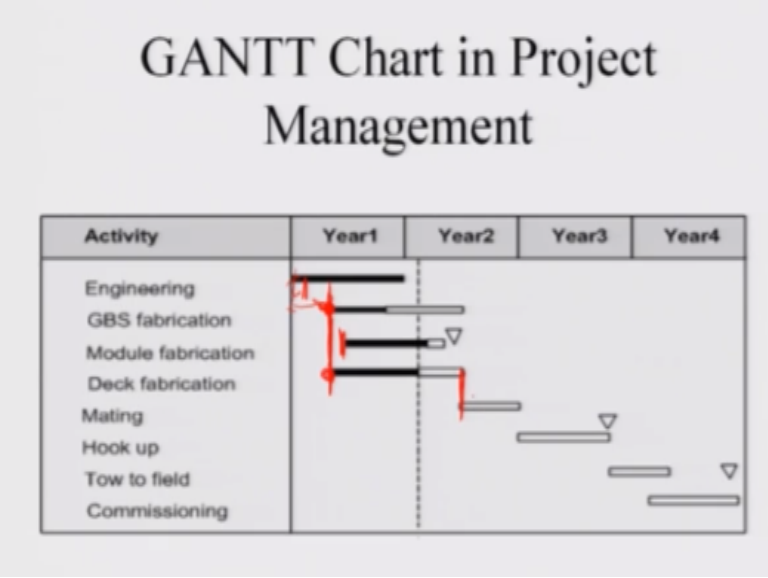

So this is a very simple example of GANTT chart if you see the first column on to the left when I am pointing as the activities and the timeframe as basically shown in the blocks so the timeframe can be either in any weeks or it can be minutes it can be years it can be months whatever it is for this the year concept can be used. So if I am basically trying to do the work of trying to build the very big project it can trying to do the engineering work which will take a lot of time for engineering and design which takes about one year as shown in the black line, black horizontal bar.

Then the fabrication part if you have its basically building up or building a bride again it will take a lot time but it may so happen that the work of the fabrication would only start after the engineering work as started obviously that is true but it need not start at the end when the overall engineering work is finished. Because considering there are three important parts of the overall projects.

Part one let me main mention it part one, part two, part three so part one the moment part one the overall design if finished the work fabrication for part one it can start. So that means the delay which you having here is based on the fact not a delay I should not word delay is basically the leverage you should give considering once the design part is over then only the fabrication part can start. If say for example divided by time T1 I am using arbitrary notions in order to make you understand and then the overall work considered considering this block black horizontal line is there.

It completes here now this horizontal is not black but is white it is possible that you can delayed the start of the fabrication part by this quantum that means we can shift which means this black line can be shifted such that the end of the point matches exactly this end of point depending on if there is some resource constraint the overall working of fabrication part. Consider that machines do not arrive, consider there is a resource constraint some material, consider technicians are not available, consider welding person is not available.

So if those happens have to consider that they can shifted in such a way that those slacks can be utilized in order to cushion such that the overall time of the project is exceeded. Then you have

the module fabrication so module fabrication also consider it starts just after few days this this due days is basically T2 which I am marking now after the GBS formation fabrication starts then you have deck form fabrication. So again this wide blocks horizontal once are the shifting which can be done the number of days number of weeks number of months shifting can do.

Then the deck fabrication starts exactly as the norm when the GBS formation starts so they should not be any delay which means the time difference between the start of this activity tool and activity four should be zero there should not be delay they start at the same time then you have meeting the overall the fabrication part the hook up the toe to the field and the commission involved which is done considering whatever project which is there.

So these are shown in say for example blocks which are white and the dotted one horizontal one which is where you are if you are standing at this point of time. Say for example one year plus few days or few weeks based on that you are that you are trying to basically analyze which work is started and how they are progressive an when they finish. So this the fifth sixth seventh eight work have not yet started once they are not black and white in the sense they can be delayed in the sense.

If their whole work if you see this this this this deck fabrication and getting work their overall time difference between the ending and that starting is zero it may so happen that if due to some circumstances some resource constraints these goes on to more terms to the right is delay is there and the overall project can be shifted. So this GANTT chart gives you a very simple sense that how the works or related to each other and what is the overall time be taken for each activity for the project and how there are slacks which can be in order to minimize any overshooting of the time process for the project as such.

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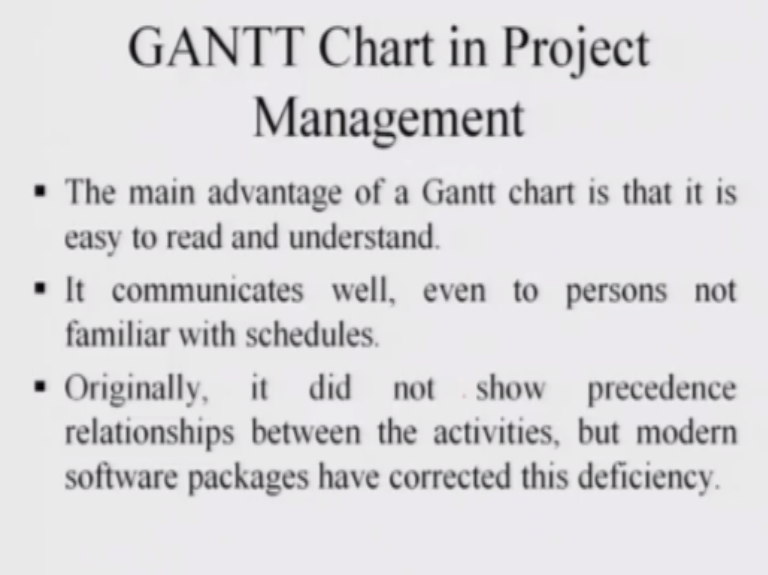

So the main advantage of the GANTT chart is that it is easy to read and understand it communicates well even to persons not familiar to schedules and may not have ny detail technical idea but they would basically that the overall feel that activities are are are commission one after that the considering that what are the sequence or events which takes place and which activities follows the other and what are the number of days gaps or whether they are no gaps between the activity.

Originally it did not know precedence relation between the activities but modern software's can be utilized where it shows the precedence relationship and what are the jobs which we follow what are the delays and what are the relationship in number of days which are between jobs and activities.

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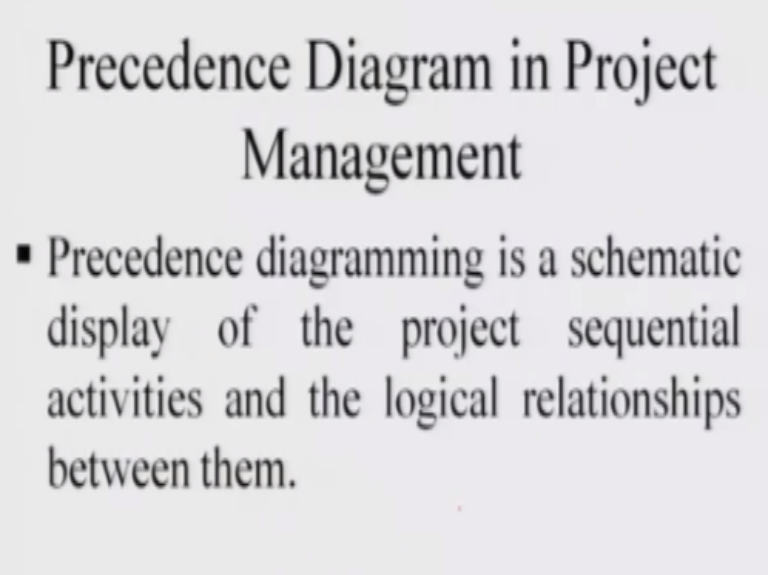

Precedence diagram on the other hand is the schematic display of the project sequencing activities and the logical relationship between them and such that the precedence diagram takes into consideration the overall concept of the project in much better sense that GANTT chart.

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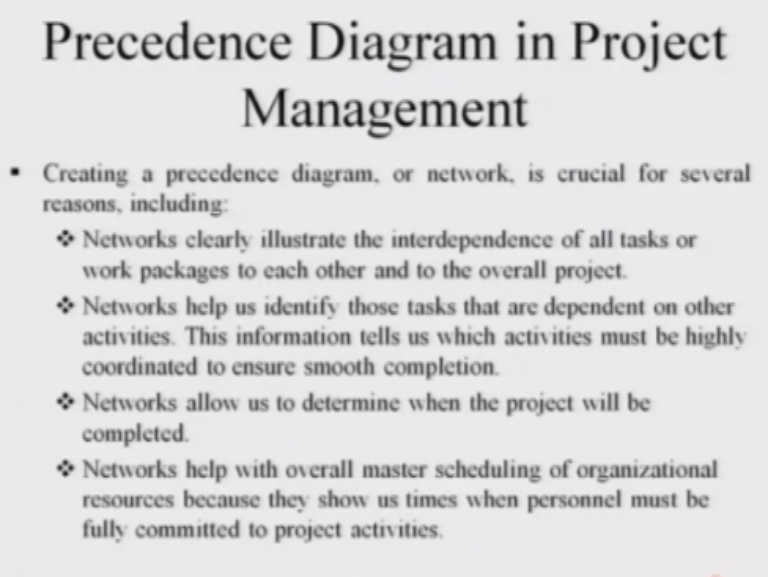

So creating a precedence diagram or network is crucial for several reasons so what are the reasons I will go one by one networks clearly illustrate the interdependence of all task or work packages to each other and the overall project to completion as such.

Networks identifies those task by dependent on one another or the other activities this information's tells us this activities might be high coordinated to ensure smooth coordination and

end of the word networks allow us to determine the project will be completed and networks also helps us to overall master scheduling of organization resources. Because they show us times and persons personal must be fully committed finish the project one as required.

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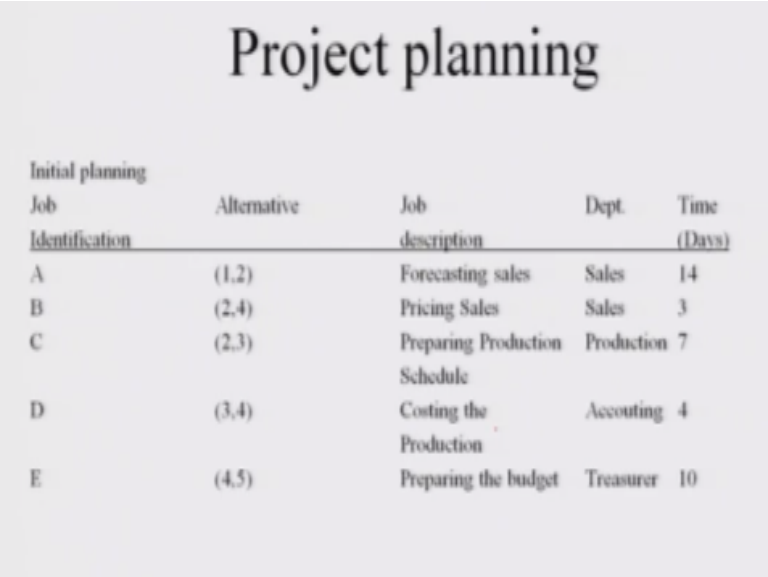

So consider this sequence of activity it is based on which I will try to give you example and feel how the network structure. So consider the first, second, third, fourth, fifth column are there the first column has the heading of initial planning job and the identification marked as A, B, C, D, E. The alternative way of trying to denote this jobs can be not A, B, C, D but can be the start and end number like one two for A, or D can be three four how the numbering have been done once we see the diagram we will understand.

Job descriptions are given forecasting is the sales is for A pricing of the sales that means you are doing the marketing project for the overall work which you have planning. C can be preparing production schedule D can be production and is basically preparing the budget and the department under whom they fall is basically sales, sales production accounting treasury and the number of days deployed for this activities without the interrelationship is given as fourteen till the value of ten.

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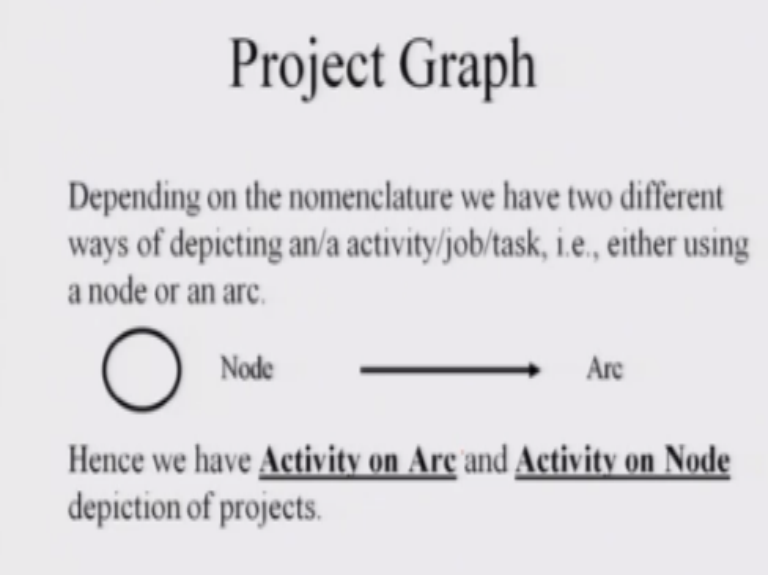

So before we start drawing the diagram I will just give you the concept of activity on arc and activity on node concept. So depending on nomenclature we have used we have two different ways of depicting them one is either using the node which is the circular one so the activities are basically are arc given as the node and activities on the arc. So if you go back to the am not going back to the last slide but if you refer back to the last slide A was being denoted by one two.

So if you going back to the concept of trying to denote the activity considering that it was more based on a node then A would be used as circle as a node. Now if A was being denoted that on arc one then the letter A would not be used rather than A. The sequence of A as one and two would be one so one would come here when I am pointing my finger and two would basically come here. So either you use A for this circle for a node or the arc you use one two in order to denote hence we have activity on arc and activity on node concept for depending on project.

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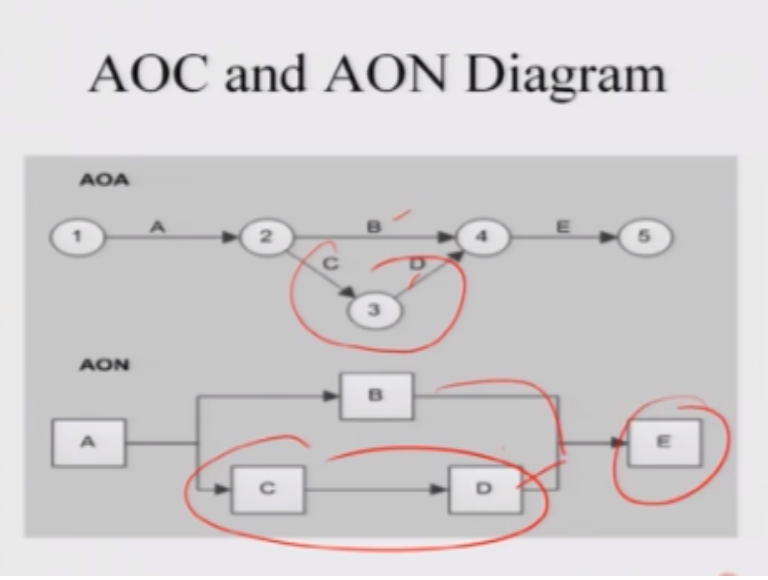

So if I consider this the example I will think on the one or two minutes so activity on arc and activity on node the so you have basically for the AOA unit network. o this one to two given by A one to two that means I discussed and then if you see this sequence of the jobs which were marked as one two two three and so and hence so forth so the overall of the project is basically once one and two is finished then B and C starts which is basically two four and two three respectively.

When C is finished then only we can start but the sequence of events is such that C and D finish in such a way that B also ends. Then only after B and D ends you can start E it means E can only start after B, C, D ends because B and D as to end which technically means before B, A as to end and before D C as to end. So if you basically translate that on node concept see here I have basically draw on the node and square. I have just no such hard and fast tool so they are basically given A.

So this one two basically A and the relationship if you see here A leads to B and A leads to C which is true if you see here A is to B, A leads to C and then after C of D which is if you see this diagram from the C and D is basically this and after B and D is done which is this then only you can start E. So the overall concept of activity of arc and activity on node which gives you the same picture but trying to depict in a different way such that in different examples it may be

convenient whether A is used or AON is used in order to depict all the activities which makes the overall project.

So with this I will end the nineteenth lecture and we will be in a position to continue with the network concepts solve one problem and then come back to the concept of the safety principle and these things such that once we complete this safety first principle and all the small problem and then also solve few network problem it will make sense that how we take that into consideration for different project of different conceptual framework have a nice day thank you very much.