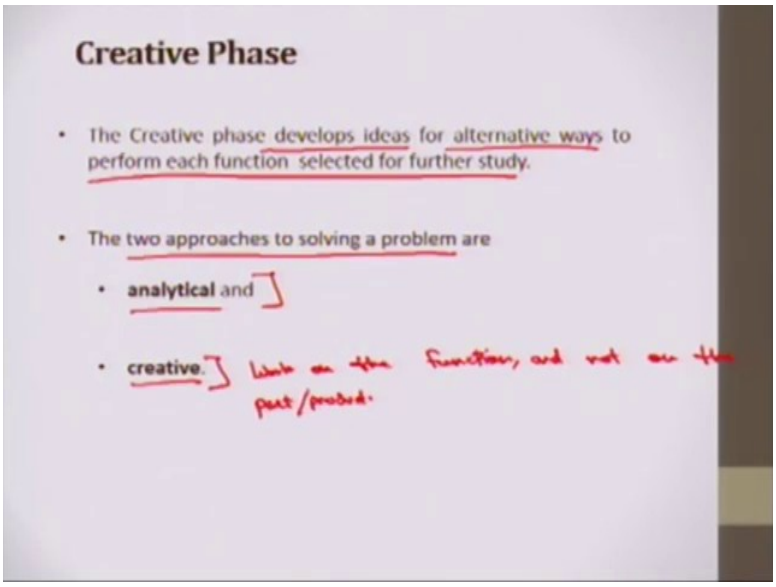
**Product Design and Manufacturing**
**Prof. J. Ramkumar**
**Dr. Amandeep Singh Oberoi**
**Department of Mechanical & Design Program**
**Department of Industrial and Production Engineering**
**Indian Institute of Technology, Kanpur**
**National Institute of Technology, Jalandhar**

**Lecture – 12**
**Value Engineering Methodology (Part 3 of 3)**

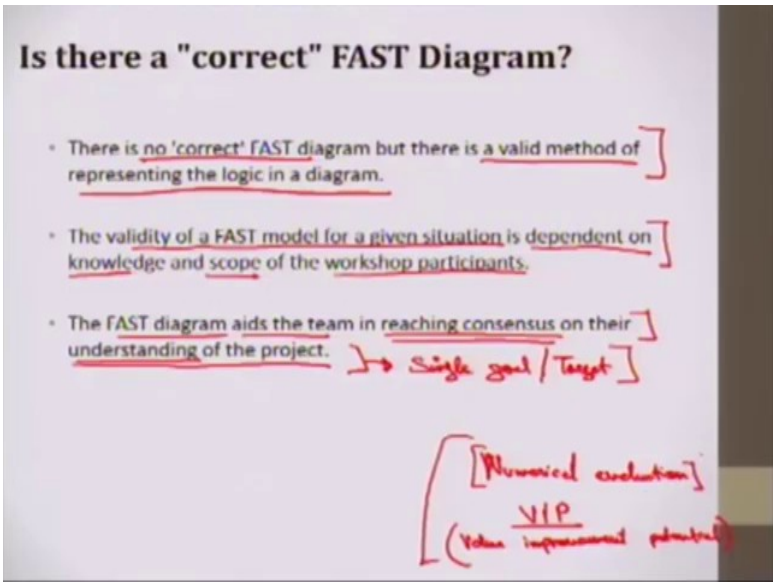
So, this is the part of the lecture Value Engineering Methodology. So, next phase is creative phase.

(Refer Slide Time: 00:21)



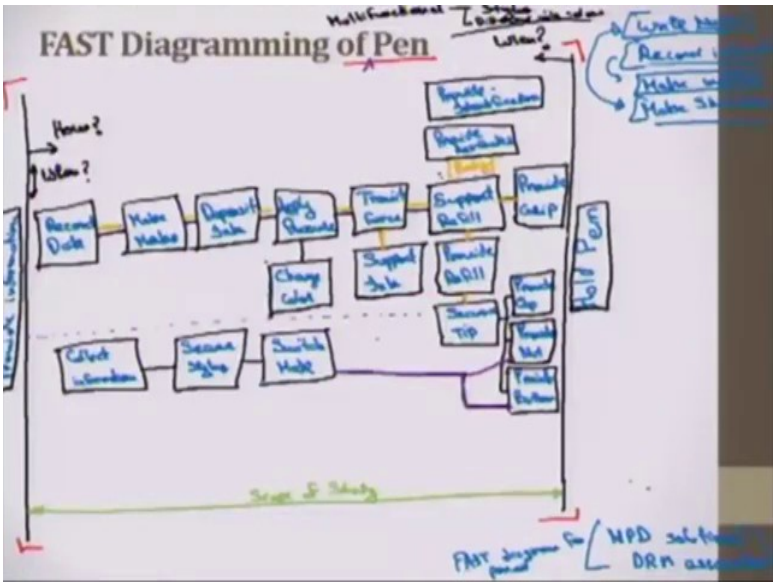

So, in creative phase, various ideas are developed for the alternative ways to perform each function that is selected for the study.

(Refer Slide Time: 00:38)




In the function phase, we actually select the function the function that is low value function that is a technique known as will do that in the next lecture; Numerical valuation. That we get value improvement potential for the specific function or we will do that, will see.

(Refer Slide Time: 01:11)

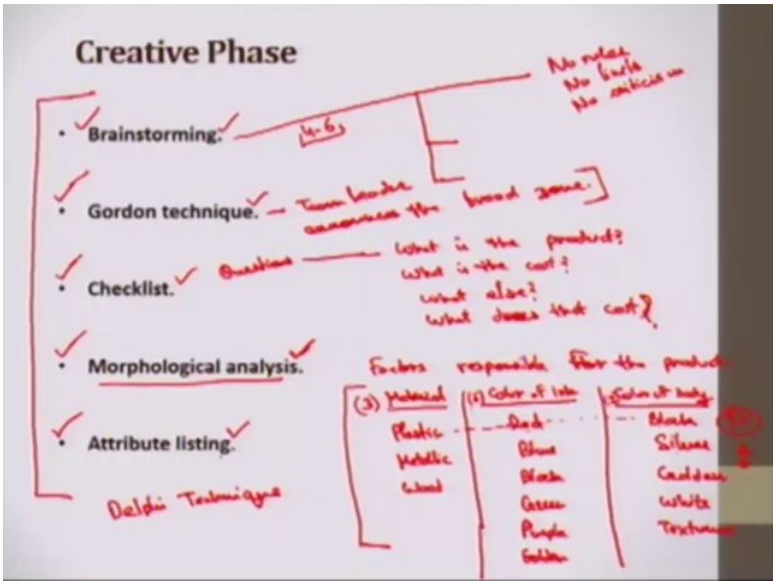



So, this was just diagrammatic representation of my functions, identifying the basic functions. To identify the low value functions is; one that is done using this Numerical valuation technique. When we have identified the low value functions, we develop the

alternative ideas using creativity techniques. So, there are generally two approaches in problem solving; analytical and creative.

Analytical approach is the general cost reduction technique. In analytical approach, the problem is stated a direct step by step approach to the solution is taken. So, in creative technique what happens, we work on the function and not on the part or product here.

(Refer Slide Time: 02:11)




So, there are various methods of Creativity; Brainstorming, Gordon technique, Checklist, Morphological analysis, Attribute listing are a few of them. So, in creativity, we use creative thinking no rules, no limits. No rules, no limits to ideas, no criticism of the ideas this happens in Brainstorming. So, we do not let the regulations or other people control our thinking and thing is that if you do not look for the second answer, if you do not look for that you will not find that. So, it is better to think out of the scope, out of the available scope or the perceived scope you have.

So, what happens in Brainstorming, criticism is ruled out, free wiling is welcome it is actually the group of 4 to 6 people at least who are launched around a table and they perceptually create thoughts intending to technical a particular issue. So, the combination and improvement sort here.

Next is Gordon technique. In Gordon technique, there is one team leader; team leader who announces the broader function, the broad like you say tell me something to make marks.

People can say, ok to make marks you use pen, use pencil this is one thing using product ok. I can say to where to make marks is not defined yet to make marks on a ground, use a stone to make mark, to make marks on a mud use your finger these are all creative techniques, creative ideas that is rule is coming out. So, those not a kind of the factual or product oriented ideas, but these are not at all ruled out. No criticism in is practised in no criticism is allowed in this creative phase so.

In Gordon technique, the broad idea is listed. Broad idea is set and they the team start working on. And in between, he will take a break and make the notes of the ideas which are being given. And if the team is getting out of track, he will again try to bring the team into the track and they will work on the objective which they are to improve. So, next is Check listing. In this strategy, agendas are planned to tackle a particular issue that is the help our flood memory; the memory in our back brain. Checklist is check listing questions are out here.

Like I said, the questions which I put in the starting slides here; what is the product? What is the cost of the product? What does the product do? What else will do this job? What else is very important here? So, whatever else is there, what does that cost, this else the other idea. In this way, the list is made. So, creativity or creative phase in itself is a big topic. We can talk about each technique at a stretch, but I am just trying to give an overview of what techniques are the other techniques as well like Delphi method is there.

Then, we have Morphological analysis. In this what we do? We list the factors responsible for the product, for the product; for example, if I need to manufacture a pen I will list; the material is one factor, then colour is another factor, colour of the ink colour of ink, then colour of body is another factor. Then let me say, I have chosen this material, one is plastic, the outer body one is metallic and one is wooden or simply you put wood here. Colour of the ink is red, blue, black, green, purple, golden and so on. Colour of the body, let me say simply black, silver, golden, white or some texture.

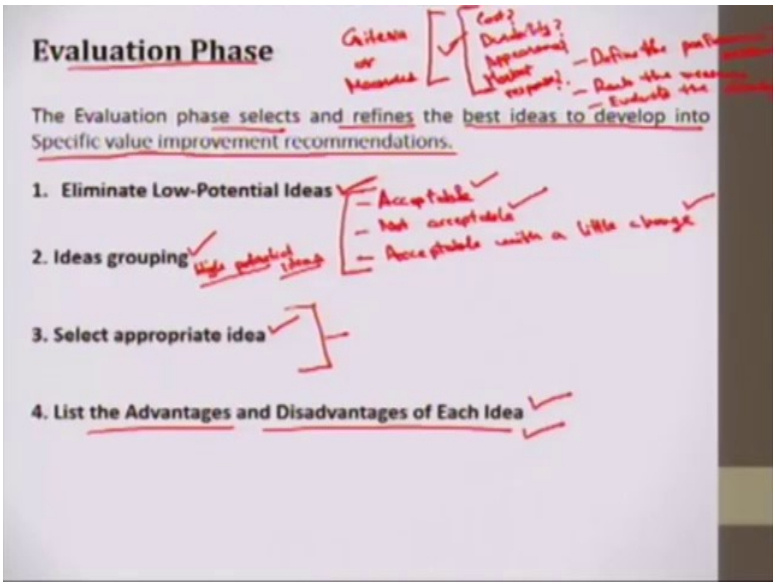
So, what does morphological analysis say? It makes a kind of a factorial design; what is factorial design? If we are having 3 levels of materials; 3 kinds of material, we are having 1, 2, 3, 4, 5, 6. 6 levels of ink and we are having 5 levels of my body. Each of the material is combined with each of the other factors here. Plastic body red colour ink; black colour body,

plastic body red colour ink; silver colour body. In this case, will have 3 into 6 into 5, 90 alternatives.

This is Morphological analysis each of the alternatives here is selected, but in case of manufacturing when we do there are certain other techniques like Response, Surface Methodology and other Taguchi method etc are there, which reduce these number. Those are actually the number of experiments which are to be carried out. So, in this case, we will do the full factorial of all the factors would be worked on here.

Next is Attribute listing. In Attribute listing, the first step is to list all the various characteristics of the product which we are which is under study. The second step is to change or alter these attributes. By methods of this system, it is consumable to unite new mixes of quality or trades that will satisfy some current needs better way.

(Refer Slide Time: 09:45)




So, next is Evaluation Phase. Evaluation Phase selects and refines the best ideas to develop into specific value improvement recommendations. So, what we do? We define the performance measures; we define the performance measures, then we rank the measures here, then we evaluate the alternatives. So, for instance if I have chosen this Morphological analysis, I have chosen these alternatives here. So, this all alternatives would be then evaluated plastic material with red colour ink and with black colour body. So, what would be the cost? What would be the performance? What would be the acceptance by the customer? So, we can define the performance mere here as what is the cost? Ok.

Second is Durability. For instance, if I select plastic metallic and wood body, the durability would be different, then what is the appearance, if the select that is one of the measure. So, these are all based on the customer requirements. How would the customer react, then market acceptance or market response better to put here. This can be put if we have once made the prototype and just tested in the market; test market has been carried out.

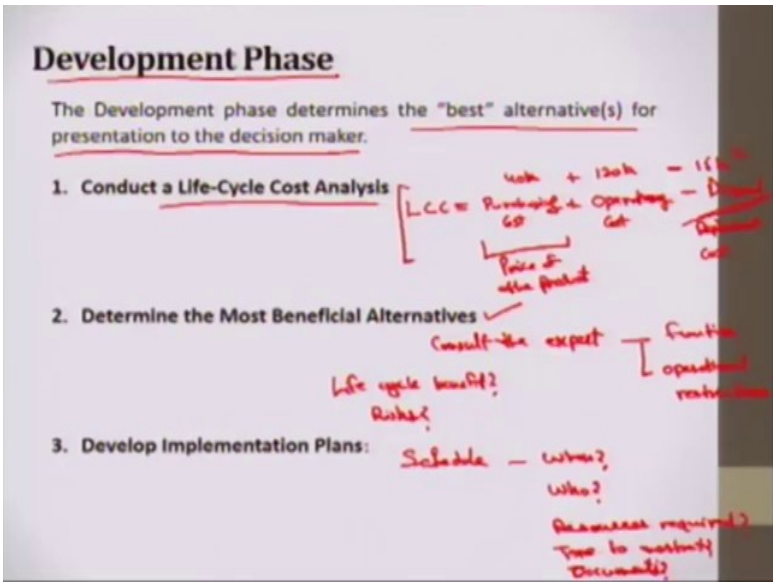
What we do here, we eliminate the low potential ideas, that is we mark the ideas as acceptable ok, not acceptable and acceptable with some change if there is some minor change; little change. So, all the ideas are put into one of the categories; the idea acceptable or is the idea preliminary not acceptable or is the idea acceptable with some change. So, eliminate low potential ideas here. So, these ideas are acceptable appears to be feasible and have a relatively high probability of success.

So, the low potential ideas are which are not acceptable. So, that is the ideas will have little or no potential this time. So, this acceptable with a little change is kind of a maybe this we selected or maybe not. These ideas have potential, but they appear to need additional refinement or work before they can become the final proposals. So, then ideas are grouped together. The similar ideas or the remaining ideas which are selected this the higher potential ideas only; high potential ideas.

They are grouped according to the similarity. So, the categories are examined and there examined to determine if they should be modified or combined with some other ideas, those things happen. Then we select the appropriate idea. Selecting the appropriate idea is, we select the highest potential idea based on this criterion. These are the idea criteria, criteria or measures you select the appropriate idea finally, this is the champion idea will serve the purpose in a better way.

So, we also list the advantages and disadvantages of each idea and keep the record. So, as if this idea does not work does not go well in the implementation phase, we can select some other idea from the reservoir.

(Refer Slide Time: 14:20)




So, the next phase is Development Phase. So, in the Development Phase, we determine the best alternatives, that is made ready for presentation; the alternative for presentation to the decision maker. So, we conduct a Life-Cycle Cost analysis. Life-Cycle Cost is purchasing cost + operations cost or you would say operating cost + disposal or replacement cost. First it like when you purchase your motorbike, the purchasing cost is rupees 40,000 and operating cost is you spend rupees 2,000 per month on the fuel. Replacement cost is when you sell your motor bike after 5 years; when you want to change that bike, you will sell it at may be 15,000 rupees.

So, actually this is (-) here, I will correct myself here. Purchasing cost is 40k here, let me say in 5 years you spent 2,000 per month is 24,000; per year 24 into 5 is about 120 120k on fuel (-) you sell it at 15k; is your life cycle cost.

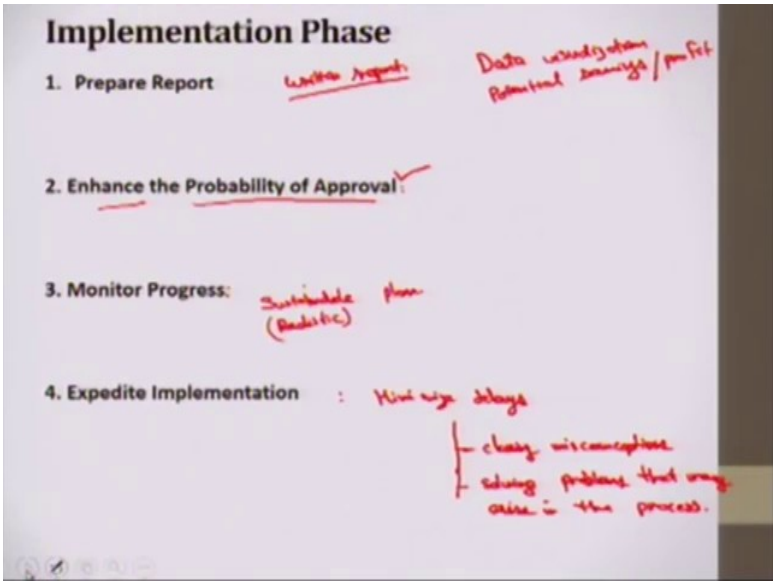
In general, the normal cost is just the purchasing cost; that is the price of the product. But it is recommended to conduct a life cycle analysis to see what is the Life-Cycle Cost? What will be the replacement cost? What will be the disposal cost of this product ok? So, in this operating cost may be new tools repair cost is also there; we need to get the bike. Repaired preventive maintenance, corrective maintenance all those things comes into play here. Then new tools or fixtures additional materials, new assembly instructions in manufacturing all those things come into this Life-Cycle Costing.

Next, we determine the most beneficial alternatives. In evaluating the alternative, the value engineering team should consult personnel who have knowledge about the item function. We consult the expert here ok, expert who has the knowledge about the product function, the operational constraints; experts who is having knowledge on functions, the operational restrictions, dependability and requirements and so, on. This person will tell us what is the life cycle benefit? Or do the benefits out way the cost, what are risks? Then we develop the implementation plans to implement it in the next phase.

The implementation plan for each alternative should include a schedule of the requirement implementation steps that when and where the specific step has to be conducted. Identify when would dis-conducted again out of 6 serving man will use this, when who would do this? Who would do the specific step here? Then they will specify the resource is required, the time to market. Time to market is the time between the starting of the development of the product and the time specific point when the product reaches the customer.

So, this development time is time to market. So, then also a necessary documents and timing requirements, the coordination requirement, documents which are required and so forth. This is developing implementation plans. We will see the case study in the next lecture, in that will see all the steps and will see how do we conduct the value engineering on a specific product and finally, will have the cost savings.

(Refer Slide Time: 19:24)

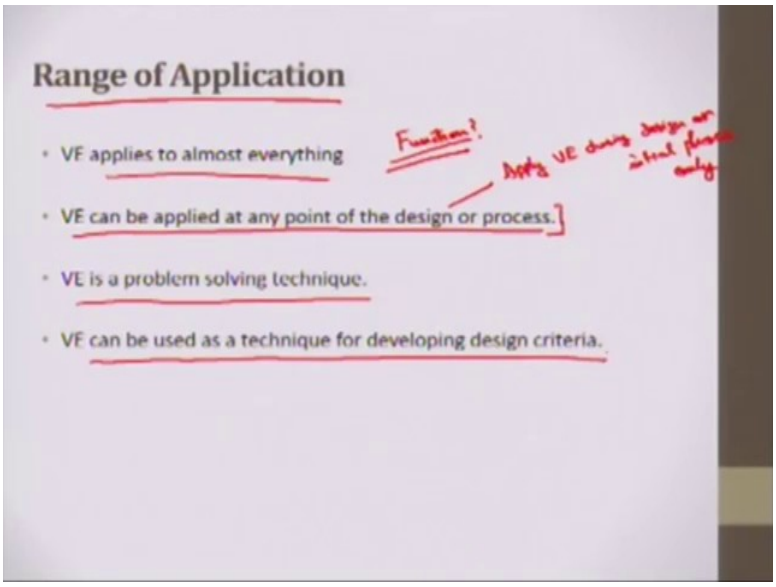


Now, next I have here is the Implementation Phase. The first step here is Prepare Report. This report has to be a written report. The oral presentation is also helpful, but written report is required for the decision maker to see the fact; the data visualisation is used here, will see the potential savings or may be profit. Then, we enhance the probability approval by involving the change to status score; because of this or other pressing priorities, a manager may be slow in making decision.

So, we enhance the probability approval in some way. So, once the approval is made, we monitor the progress that when would the implementation final implementation or final manufacture of the product would start. So, implementation progress must be monitored just as systematically as value engineering study. The value engineering team should ensure the implementation is actually achieved. So, this has to be a sustainable plan. Sustainable does not mean the environmental friendly; sustainable means it should be implementable, it should be a realistic.

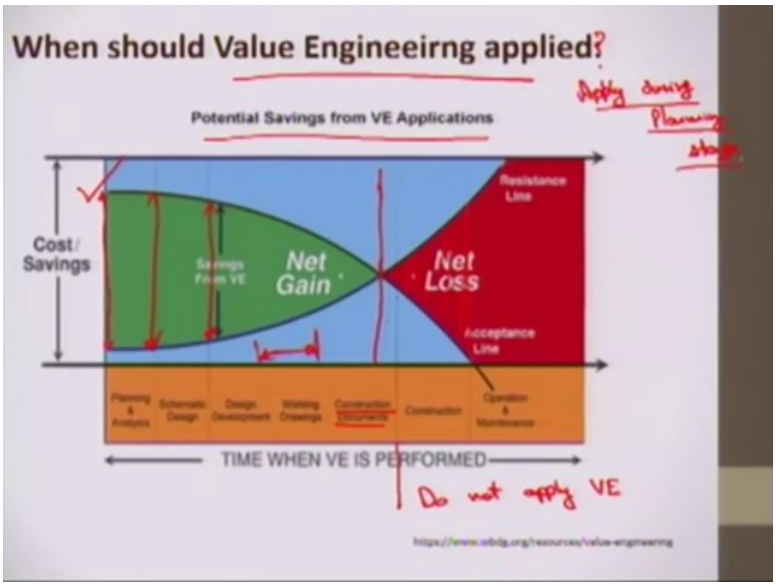
Next is Expedite implementation; to minimize delays in the implementation process, the value engineering team should provide assistance, clear up misconceptions and resolve problems that may develop in the implementation process. See, minimize delays here by clearing misconceptions or solving problems that may arise in the process. This is again a kind of monitoring here. So, this was our value engineering job plan here, we will see how is this actually carried out in the case study in the next lecture.

(Refer Slide Time: 22:14)



Next we have the range of application of Value Engineering. Value Engineering can be applied to almost everything; because every project or process has a function anything that has a function you work on that function. So, value engineering can be applied at any point of the design or process. We elaborate this thing further; because it is best to apply VE during design or initial phases only. So, Value Engineering is a problem solving technique. This technique can be used for developing design criteria.

(Refer Slide Time: 23:13)




So, let me see when to apply a Value Engineering? When should be the Value Engineering applied?

The potential savings from Value Engineering is maximum if it is applied in the initial phase only. In the planning and analysis phase only if it is applied, the savings are maximum. In the planning, we review the program, we perform a functional analysis of the facility or of the resource which are available and the maximum cost, and this illustration is for the construction site here. So, if Value Engineering is applied when the construction is going to be started at this point; even the construction has not started, then what would happen? In some time Value Engineering brings a total transformation of the plans.

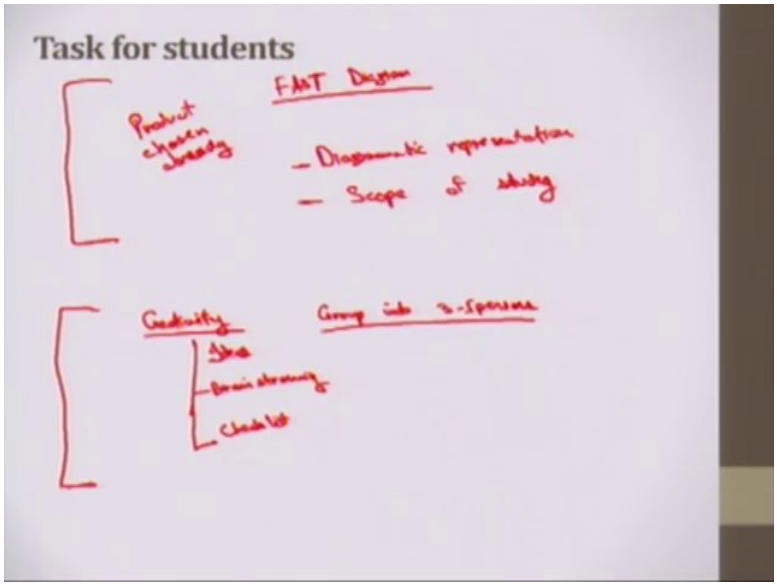
The plans or re-planning or re-designing, re-documentation all those things has to be carried out. And at this point when the construction starts, all the resources are gathered and therefore, we will have loss here. And if some of the constructions has carried out here, then

there will total loss, we need to demolish the building and rebuild again; obviously, value engineering would never be applied at, do not apply VE, but here we can fudge between two.

Planning and analysis systematic design; design development. Some savings of Value Engineering would be there, cost savings would be there. So, at design phase again I am repeating, the benefits are tremendous. Any changes to the program at this stage have very little, if any impact on schedule on the total project here. The project would be developed fewer change is redesigns and greater understanding by all parties.

At planning and analysis an independent Value Engineering team can do the job, but at the later stage is here, they are other stakeholders, other contributors who are already working on the project. So, Value Engineering as to has team has to has team has to have coordination with these people here. So, Value Engineering should be applied, when should be the value engineering applied? The answer is apply during planning stage.

(Refer Slide Time: 25:54)




So, I have a task for you people. So, today I give you a task regarding FAST Diagram. So, the product which you have selected in the previous lecture, you identified the functions. You have seen what are the primary; what is the primary function of the product, what are the primary functions of your components, then you also seen the secondary functions. You have seen the functions which are work functions and sell functions. I would like you to put those functions in a Fast Diagram repeats and those functions in a diagrammatic way of the product which you have chosen, then see what is the scope of your study, this is regarding Fast

Diagram. Second task here is regarding the creativity. So, as I told before if possible, you please group into 3 persons; 3 to 5 persons, then you if even if you have different products, one person has chosen product A, second person product B C D E. Let you should all work together on product A, first on come up with the ideas for product A.

How to accomplish function X? How to accomplish function Y? How to accomplish function Z of product A, please work on this. Creative create ideas, use some technique like Brainstorming, then you can even checklist various questions just enlist the ideas. And in the next task when I will do the case study in the next lecture, then we will carry these ideas, will evaluate these ideas, will put the cost to each idea. And then we will evaluate each idea based on the certain years, certain criteria that we will select. So, let us meet in the next lecture where will see the case study on Value Engineering.

Thank you.