Product Design and Manufacturing

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Lecture – 13
Value Engineering, a case study

Welcome back to the course. So, in this week we are trying to study value engineering. So, today I will take value engineering case study; a case study on value engineering.

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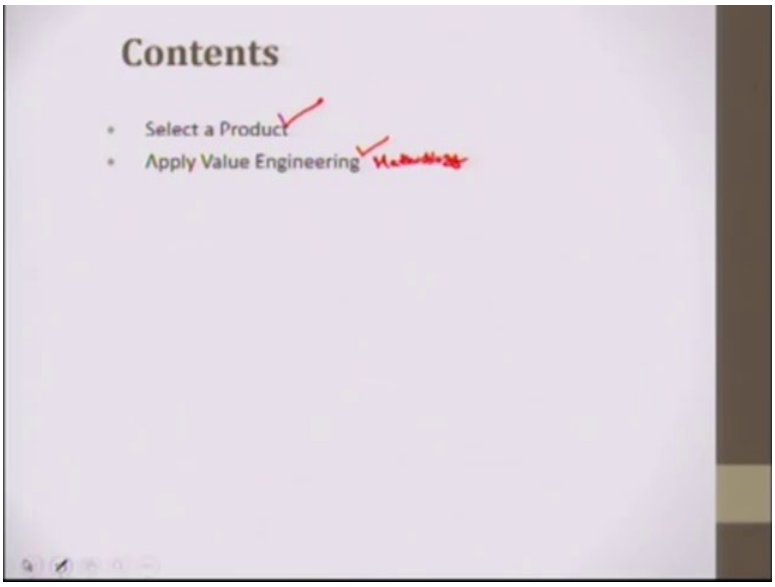

I will select a product, apply value engineering methodology.

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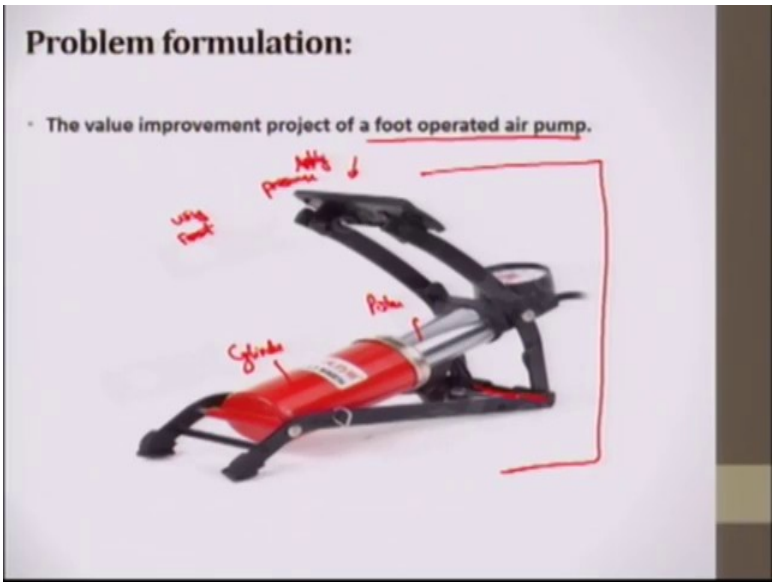

The product that is selected is a foot operated air pump; you might have seen this product we apply pressure here. Apply pressure using your feet or single foot and this is the cylinder and piston the air goes to this pipe and inflates your car tyre or the other object you want to put air in.

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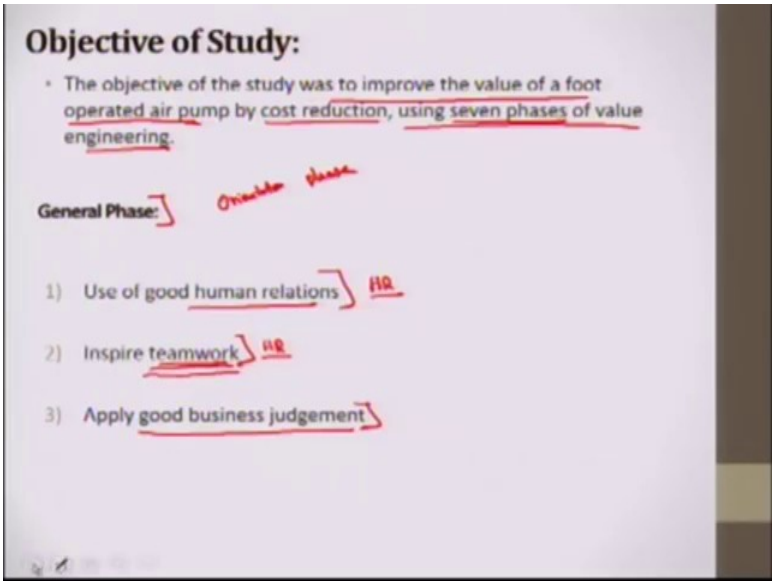

So, the objective of study here is to improve the value of a foot operated air pump by cost reduction using seven phases of value engineering; here seven phases were used that is the general phase was also used. This was the study carried out with one of my M-

Tech students; so, actually the whole study took several months to do, but I will just take some part of that to explain how value engineering is carried out.

So, in general phase there are certain general rules number one is use good human relation value engineering team is over dependent on data collection, analysis, data implementation so; obviously, the HR human relations would come into play. So, inspired team work this is also the kind of human relations thing; one of the fundamental principles of value engineering is to employ teamwork, a team can only work to conduct full value engineering study.

Now, apply good business judgement; this is a general statement that the judgement has being based upon the facts and data and used quite often in this decision making. So, this is the kind of the general phase or orientation phase.

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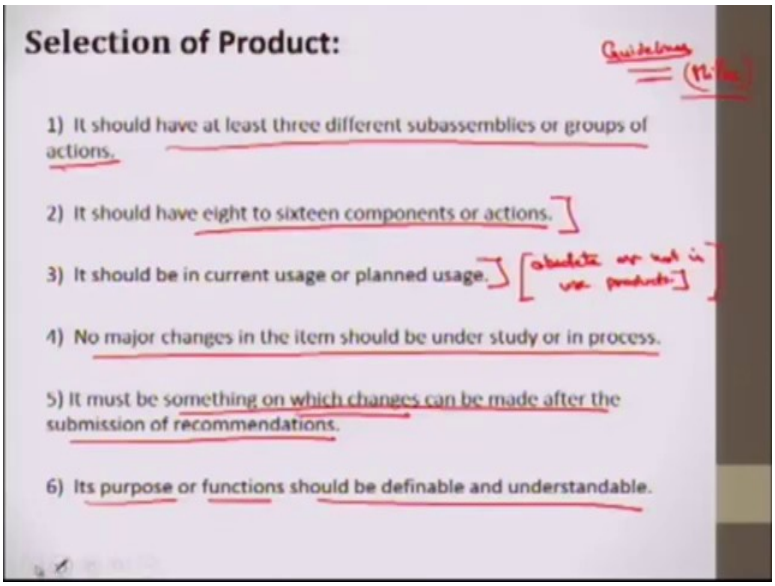

Next, we select the product; these are general guidelines for selection of the product these are also given by Miles; the founder of value engineering he says it should have at least three different subassemblies if it is a mechanical product three different subassemblies is a group of actions that is the components could be made into groups for example, if I say I selected my pen as my product before. So, in that I have 5 or 6 components body front nut back nut refill four components were there.

So, these four components can be grouped into maybe I am working on the body front nut and back nut one group; second group is body, front nut and refill; third group might be only refill in only refill we have ink, the tube and tip these are the groups. So, these are kind of subassemblies here; so, it should have at least eight to sixteen components or action these are the guidelines given by miles, but it is not very much necessary that these must components have to be there.

It should be in current usage or planned usage that is the absolute products are not recommended here absolute or not in used products. No major change in the item should be under study or in process if the item is already under study that is some major change is going to happen that conducting value engineering that would not help.

It can help if we know that change; if we know that what change is going to happen and if value engineering can even help in that way as well; it can enhance that process the change that is being carried out. So, it must be something on which changes can be made after the submission of recommendations that is the decision maker should have the power or authority to make the changes its purpose is or function should be definable and understandable; these are general guidelines for selection of the product.

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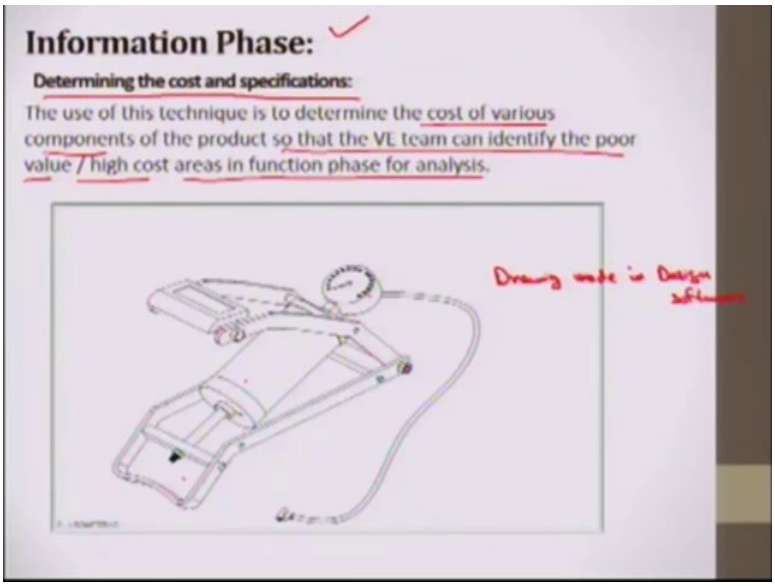

So, the next is information phase information phase the first step we are what we doing is determining the cost and specifications; specification is this drawing is made drawing made in design software. All the components here are made and they are then assembled

the use of this technique is to determine the cost of various components of the product. So, that the value engineering team can identify the poor value and high cost areas in function phase for analysis.

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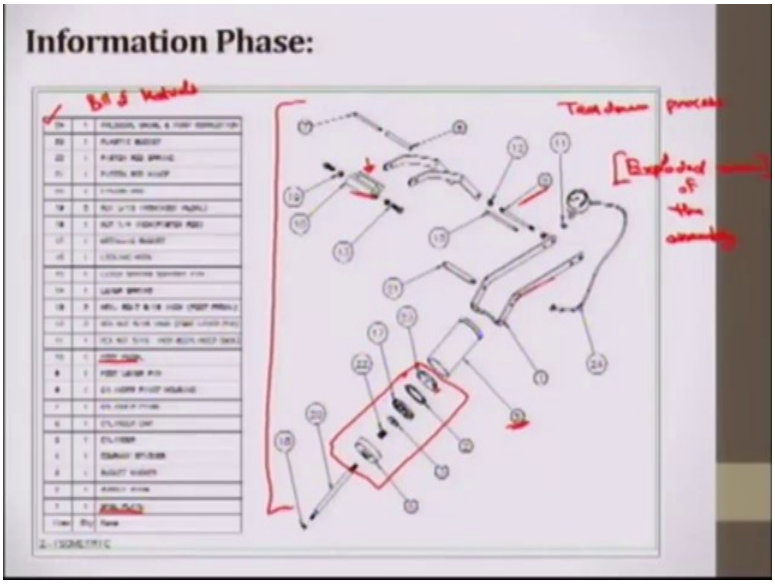

So, this is the table that gives us the material details; so, this is called bill of materials. So, if you see we have various components this is again the tear down; tear down process or in design software's, we call it exploded view exploded view of the assembly.

So, this product has these much number of components 24 components are there for this is the component one here is base plate. This base plate is connected using this component nine that is pin with this lever the lever is further connected with the component 10; that is foot pedal this foot pedal is here foot pedal we apply pressure this foot pedal and also we have component seven and eight has the pins or pivets; then we have the piston here this is the cylinder component 5 is cylinder cap is there and in between in this we have this piston mechanism here this all is piston mechanism these are the components of my product.

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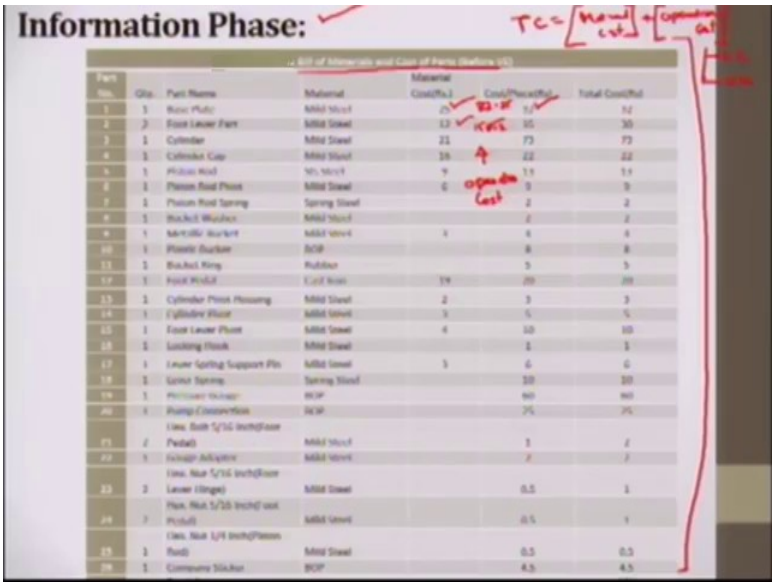

Next what I do? To elaborate the information phase further I put the bill of materials and cost of parts; if I do not put the cost of the parts it is just bill of materials if I put the cost of the parts this further elaborates our materials details here. We have the base plate is costing rupees 25; it is in one quantity here actually the total cost of the base plate is three rupees 32 of which rupees 25 is the material cost and rest rupees 7 is the operation cost that is being carried out to manufacture this base plate.

And in this case foot lever the cost of material is rupees 12 cost per piece comes to rupees 15 that is rupees 3 is the operation cost; that is 32 - 25 or 15 - 12; these are the operation cost. As you know the total cost of the product is material cost + operations cost; I have just put one element here that is operation cost this involves everything labour cost and over heads. So, that two components two quantities here; so 15 into 2 total cost is 30; in this way we enlist all the materials.

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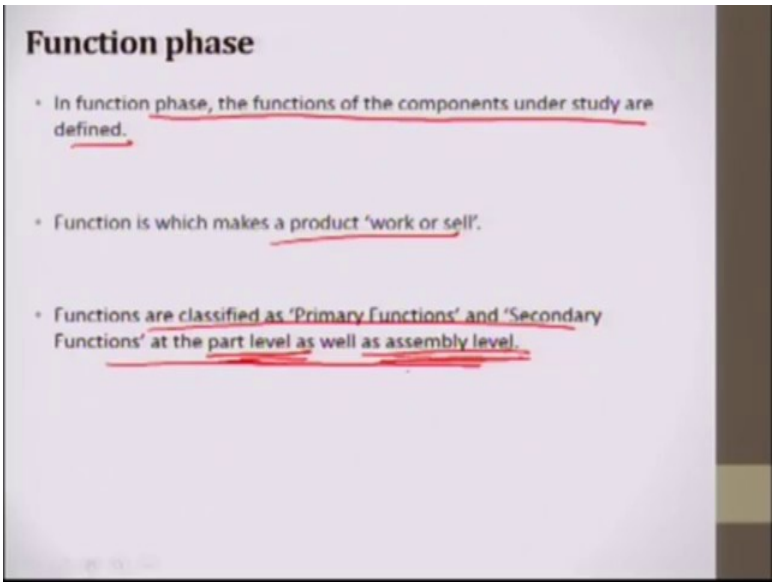

Next comes the function phase in function phase the functions of the components under study are defined just to recall function is which make the product work or sell functions are classified as primary functions and secondary functions at part level as well as assembly level will see how do we do this.

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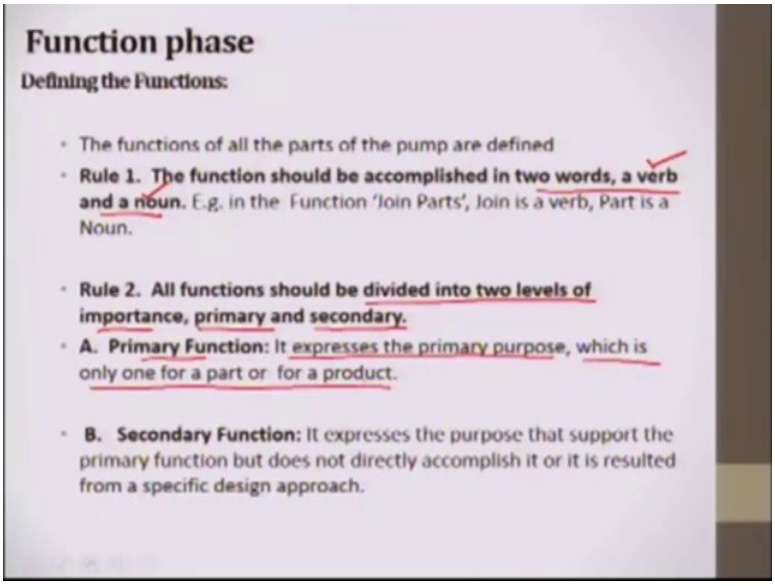

Or defining the function there is certain rules here the functions of all the parts of the pump are defined rule 1 the function should be a accomplished in two words verb and a noun and active verb and measurable noun.

For example, the function join parts join is verb part is noun rule 2 all functions should be divided into two levels of importance it is primary and secondary. Primary function it expresses the primary purpose which is only one for the part of the product the product could be doing multiple function, could be doing may be 5 or 6 or 7; may be 10 functions ok, but there could be only one primary functions for which the product is made all other would be secondary.

Now, secondary function it expresses the purpose of that support the primary function, but does not directly accomplish it or it is resulted from specific design approach.

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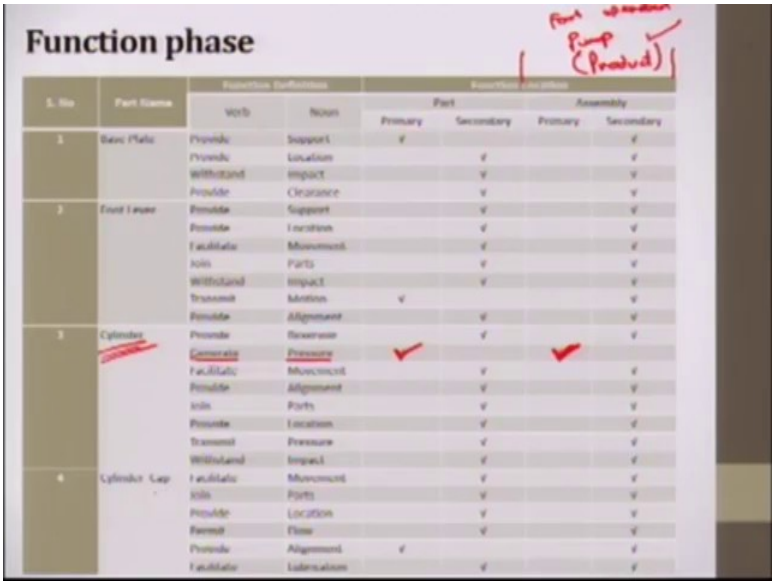

We will see this; so, this is dividing all the components into the function the base plate; the basic function of base plate is to provide support provide support to the cylinder it is the primary function.

Secondary functions are ‘provide location’ for the pin location for the cylinder, with stand impact when the pressure is applied it has weight and impact, provide clearance is between the levers between these levers and the base plate it has to provide some clearance here as well. Then foot lever; the primary function of foot lever is to transmit motion transmit motion to our cylinder to the cylinder piston mechanism here; this is the primary function. So, all other are provide location for the pins and other joining features here, facilitate the movement join parts with stand impact these are all secondary functions.

Now, we can see at assembly level the primary function that is identified is generate pressure; this is the primary function of my assembly that is of my pump; foot operated pump that is my product. And if the primary function of the product exists in our component here; it would be the primary function of the component here this is for sure. So, we cannot have 'generate pressure' here and that becomes the secondary function because generate pressure is the primary function of the product for which the product is being made. So, this would be an; this should be the primary function of our component which has this.

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Now, next is cylinder cap also you can we can see the various functions here. So, I have just selected ten components here the whole other component would divided to you in the notes. So, we have piston rod, piston rod also has this function primary function you consider there are certain components like piston rod pivot, piston rod spring, bucket washer metallic, bucket plastic bucket these all are the components that helps to fix and operate the piston in the proper way; here this movement of our piston is being carried out. So, these do not have the primary function of assembly in them, but in the present design they do exists we will see are they essential or just desirable.

If they are found to be essential components will keep them if they are just desirable that that is the product could operate, product could do it its main function without these components we can eliminate them that as well we can find some other alternative.

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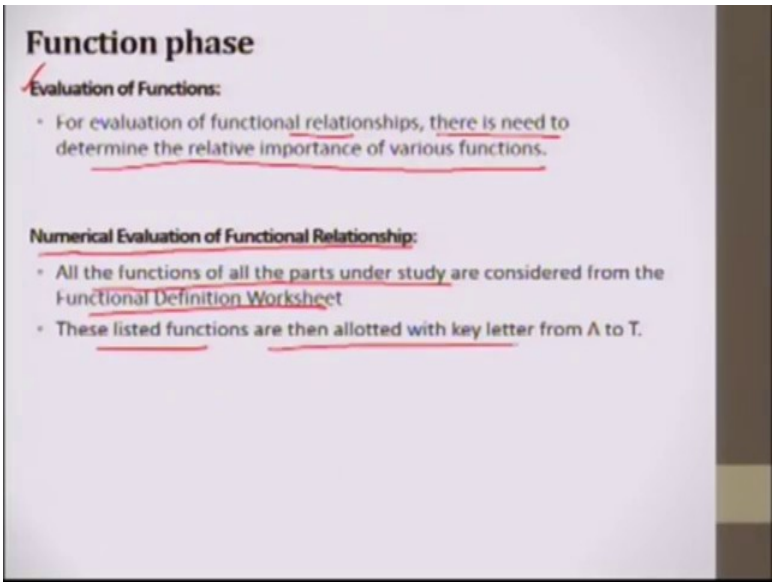

So, next we will evaluate the functions for evaluate of the functions for evaluation of functional relationship there is need to determine the relative importance of various functions. The numerical evaluation of functional relationship is carried out here all the functions of the parts under study are considered from the functional definition worksheet; these listed functions are then allotted with the key from A to T; there are number of functions like join parts generate pressure with stand impact; we enlist these functions and denote them with some letter some notations from A to T; there are these many number of functions here.

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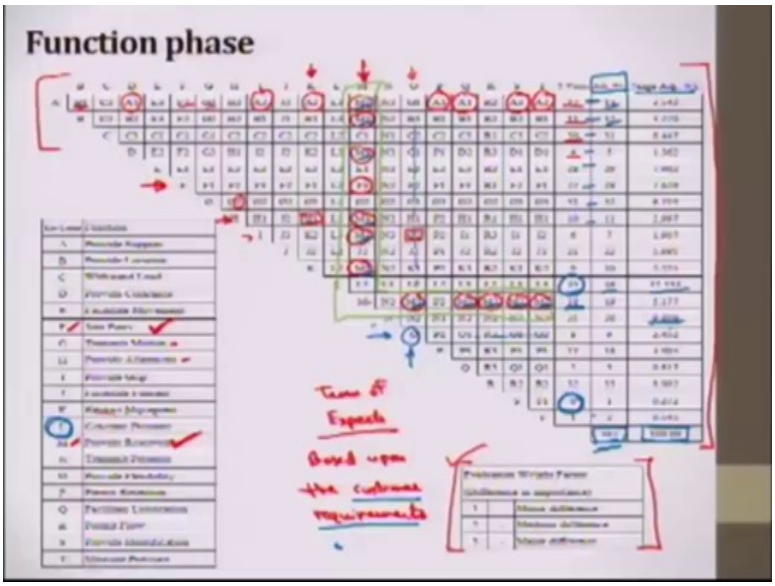

Then what we do we make this numerical evaluation chart here how do we do that? I will just let you know.

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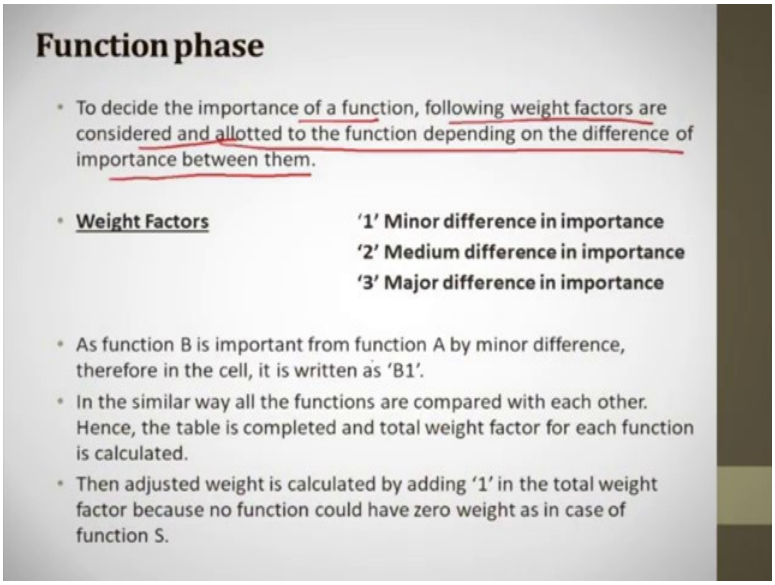

To decide the importance of a function following weight factors are considered and allotted to the function depending on the difference of importance between them. What is happening here we have given these weight factors 1, 2 and 3 for minor medium and major difference in the importance of function. In this case if I have put B 1 here; B 1 means function B is important than function A with a minor difference 1 is for minor, 2 is for medium, 3 is for major.

Let me take an example of medium difference function G is important than function H with a medium difference function G that is transmit motion is important than provide alignment with medium difference of importance let us pick some other here function F is important than function M; function F here is join part that is important than function M function has F from this side, M from this side. It is important function M with a major difference of importance that is my join parts is much important than provide reservoir; provide reservoir that is provide space for the piston. So these ratings are done by the experts; experts or team of experts; experts means they do it based on based upon the customer requirements.

So, a customer would like to have the parts joint that is the function than he would think of to provide a reservoir. So, function F is much important than function M here. So, let

us see two functions which are close here let me see this H 1; this function H is important because function H is important letter H is put in; what is the difference as potted? It is minor difference importance H 1 function H that is provide alignment is important than function K that is restrict movement by minor difference important that is the importance of this functions are very close.

Then the similar way we put the letter whichever is important function for example, this O 2 again I will take one more example here O 2; this O means O is important function than this matrix O and I; O is important than I and the difference of importance is medium. So, what we do? We have this rate as function B is important from function A by minor difference therefore, in the cell it is written B 1 function B is important than A by minor difference.

So, in this way this rating factor is used to evaluate the function numerically. Now what happens? We calculate the weight of the functions; now this is the weight of the function A, wherever we have A that is A 1 + 2 + 2 + 1 + 1 + 3 + 2 that comes up to 12. Similarly, I will take some other example this is function M; M 1 + 2 + 2 + 2 + 2 + on this side M 1 + 1 + 1 + 2 + 2. Now this is all added for M; these numbers and these numbers where ever M exists so, how it is happening is M 2 + 2 is equal to 4 + 1; 5 + 1 6 + 2; 8 + 1; 9 + 1; 10 + 2; 12 + 2; 14 + 2 16 + 2 total 18.

Similarly, for each function for O this where ever we have O in the column for the O and in the row for the O these weights could be added. Now because the generate pressure is our basic function L that would have maximum weight we have the function L the here weight here is 45. And one function you always find the way to be 0 that is least important function that is function S that is provide identification provide identification is nothing here they have put the sticker the logo of the company here.

That customer does not care at all because we are talking about the customer requirements or customer needs or customer view point here. So, what we do we add 1 to all the function 12 + 1; 13, 11 + 1; 12, 27 + 1; 28 so, on we add 1 to get its adjusted weight factor here.

Then total of the adjusted weights is made here 361; this is normalized with respect to 100; so this comes out to be percentage adjusted weight that is 13 / 367 what is the percentage contribution? 3.5 percent; 12 / 367, the percentage is 3.2 the maximum would

be for 45 this L function; that is 46 / 367 that is 12 percent contribution. So, this is the weight of the function that is the customer are trying to look for function L first they want something to generate pressure something to inflate their objects, then the second weight we can see here is 9.8; they want function N function N is transmit; they want to transmit the pressure from the pump to their tyres, this is function N; the second highest level of weight. This is the weight of the function based on the customer requirement.

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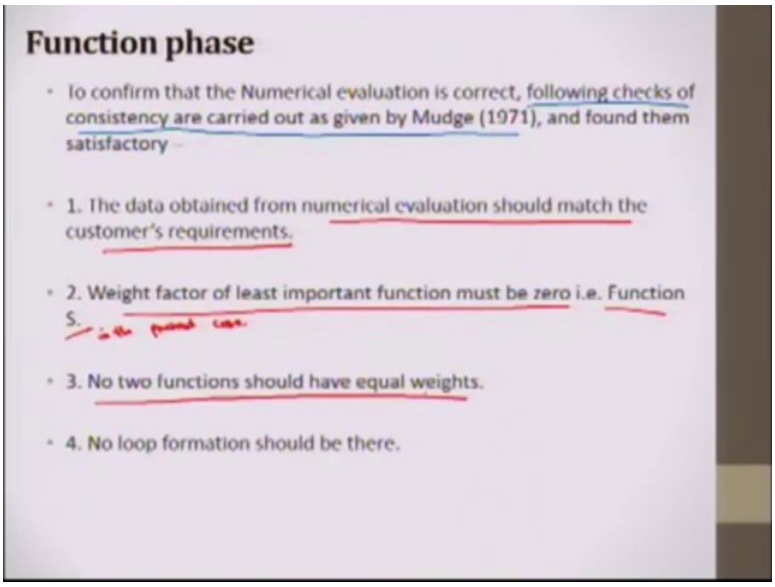

Now, next what we do? We confirm that the numerical evaluation is correct; following checks of consistency are carried out as given by Mudge. He says that the data obtained from numerical evaluation should match the customer requirements; this is based on that only. Weight factor for least important function must be 0 that is the function S in this case; in the present case. No two functions should have equal weights; that means, no these weight factors should be equal.

Then no loop formation should be there loop formation is if we have for in case if we have 2; 2; I am talking about this P 2 here 2 here and if it is 2 here and 2 here this makes a closed loop had a 2 here and 2 here 2, 2, 2, 2. So, there is no closed loop formation; so, these are certain checks for our correct numerical evaluation. Actually, we added 1 here because we will use this as a factor somewhere and if we use 0; 0 by that total would be 0 contribution, it has least contribution this function S has least contribution that is 1 by 367 and we do not want any function to have 0 contribution.

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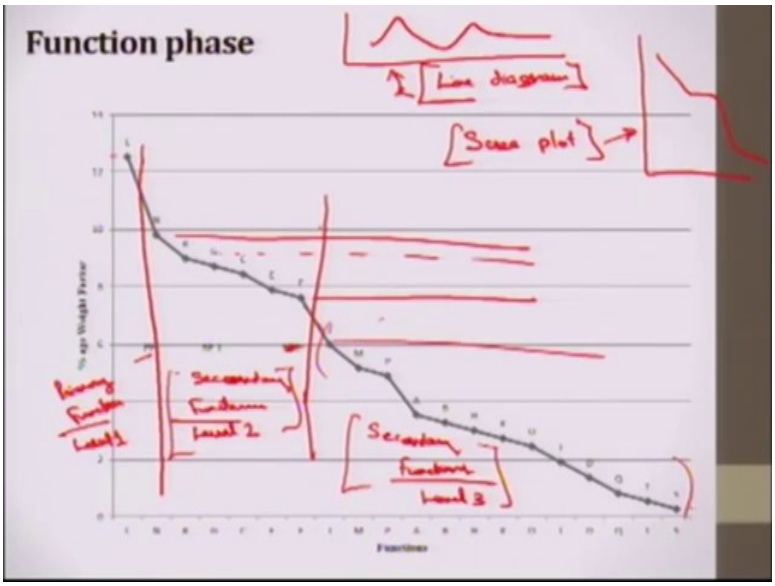

Now, this says the line diagram the plot for the functions line diagram or data visualization is used also this is known as screw plot.

Line diagram could be any line like this in the plot; when the plot is like this it is flowing down like this kind of plot is known as screw plot this is line diagram. So, what is happening here is.

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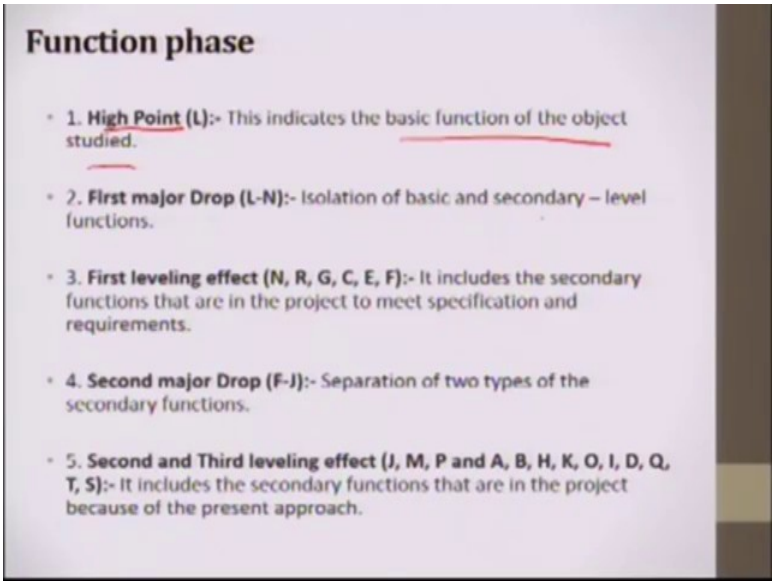

We have high point L that indicates the basic function of the object studied the AC function is generate pressure that is the point L. Next what we have? First major drop

that is L to N that is isolation of basic and secondary functions secondary level functions; that is from L to N that is the first drop, this becomes our primary functions P of here is primary function.

Second drop is here at N; this is secondary function functions level 2; this is actually level 1, then the rest of the functions after function F are secondary functions level 3; level 3. This is a kind of illustration that identifies the top function that is the highest order function L and shows that how the functions since in the one level that is the level 2 and in the other level 3 three are closed to each other. So, this is the difference in weightage here from N to F this difference is here; for j to S this difference is there this is all this levelling or drops are mentioned here.

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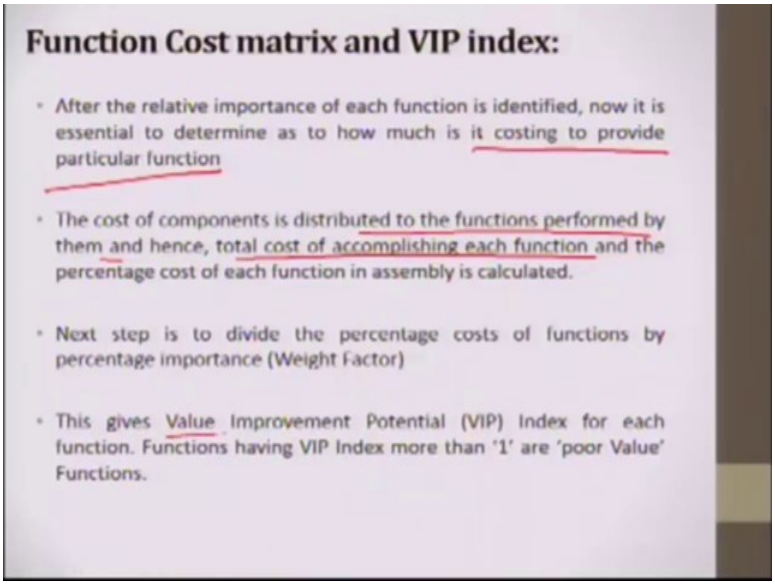

Next is function cost matrix and value improvement potential. After the relative importance of each function is identified, now it is essential to determine as how much is it costing to provide particular function we have given the weights to the functions. Now we need to identify the cost of the function, as I said before value is utility per unit cost if we know weight we know utility. And if we know the cost of that we can take that ratio to find the value the cost of components is distributed to the function performed by them and hence total cost of accomplishing each function and percentage is taken here. So, will come up with value improvement potential here.

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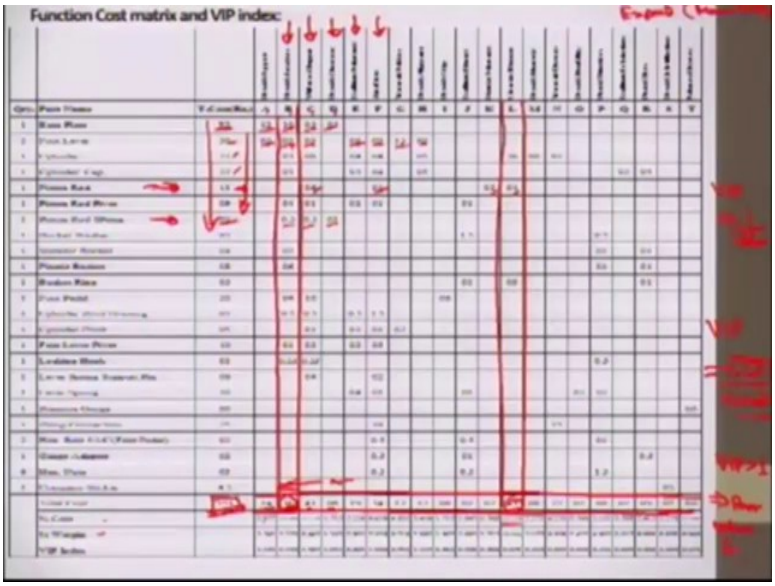

I will show you with this chart; so, this base plate has these functions. So, this plate has functions A, B, C, D, E in it that is provide support provide location it is an impact and so, on and foot lever as these functions function A, B, C, E, F, G and H; what we are doing here is this was the total cost of the base plate we have divided this cost into the functions rupees 32 is divided into these components out of 32 rupees 12 is for function a rupees 10 for function B, 5 for C, 4 for d and so, on rupees 30 is again divided into these components here.

What happens here each of the components is divided into functions at the cost of the components is divided into its functions. This is again done by the experts who are manufacturing experts; they know what is the cost of this specific function. For example, to provide support there has to be some material that can withstand load there is a to withstand impact they have has to be some material cost of the material is there, the cost of the operation is there; considering all these points these components are divided into functions there their cost element is divided into its functions.

So, with this what we get? We get cost of these functions, cost of getting function B is the total cost of column B here. This is the total cost of function B; similarly, if I say cost of function L that is my primary function is this much rupees 43 this is rupees 36.

Again, I take the total of this cost what I do? I take the total of this cost 14 pus 36 + 41 + 6; this would come out to be see 351 and this would also be the total cost of my pump 32

+ 30 + 17 + 22 component wise and function wise; this total cost would be rupees 351 now fourteen by 351 is my cost contribution; 36 / 351 is my cost contribution for function B. For function L it is 43 / 351; the cost contribution is 12 percent. Now what I do? I take my VIP Value Improvement Potential; VIP, your Value Improvement Potential is exact opposite of value what we defined.

In this case I take various the percentage cost over percentage weight. So, VIP is equal to percentage cost over percentage weight; we actually want to reduce the cost here if the cost is high this VIP would be greater than 1, VIP greater than 1 implies poor value function and we will work on that.

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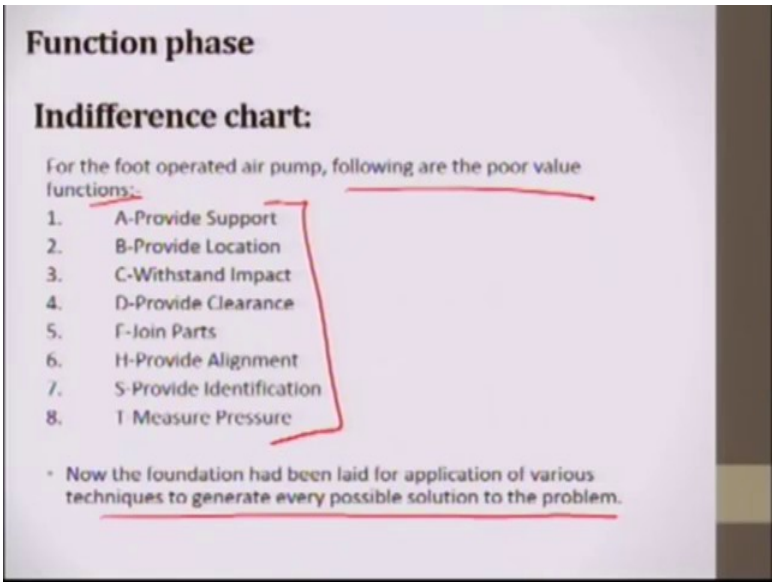

So, let us see in foot operated pump following on the poor value functions A, B, C, D, F, S, H and T. Now foundation had being laid for application of various techniques to generate every possible solution to the problem. These are the functions on which we will work on till this point we identified the poor value functions. So, the value and analysis part is over.

So, now will go to value engineering in which we will work on these functions.

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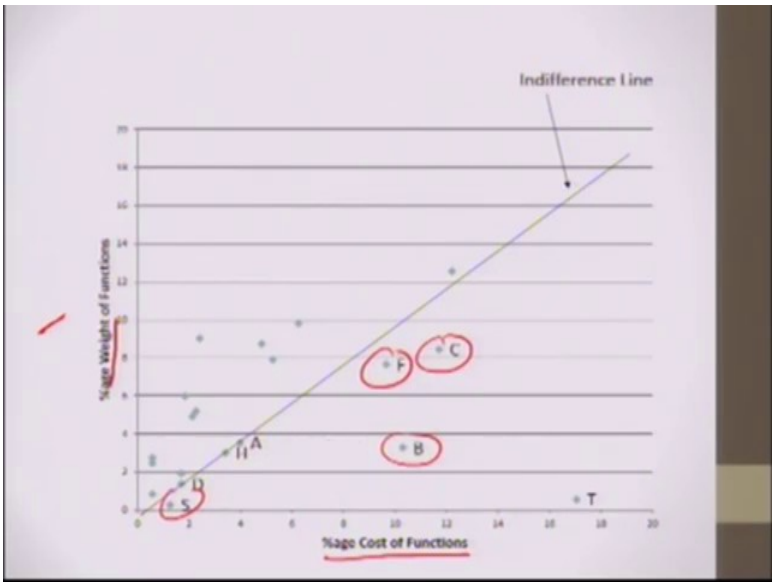

This is an indifference line; indifference line indifference line is the plot between weight of the function and the cost of the function. That is the functions which fall below this line that is their cost is higher than their weight are the poor value functions.

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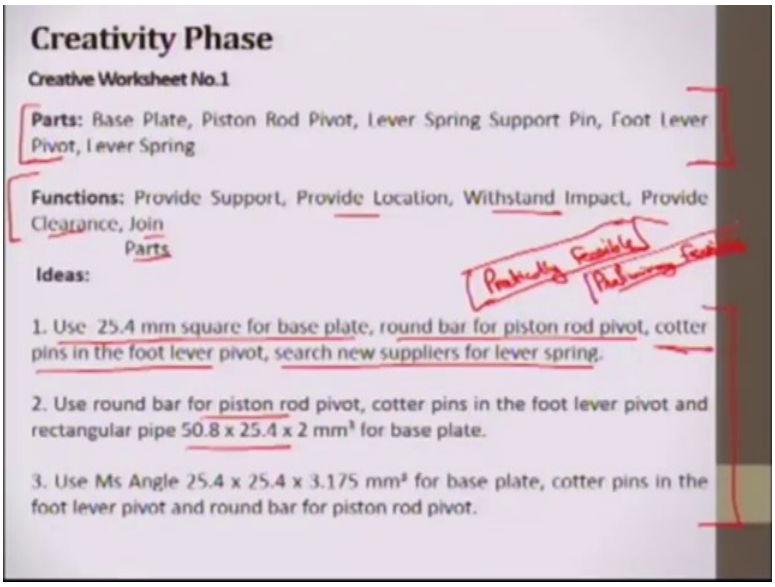

Now, next comes the creativity phase; in creativity phase we create creative worksheet. First, we group the functions which can be worked on; these are the parts I have selected base plate, piston rod pivot, lever spring support pin, foot lever pivot, lever spring these

are the parts and the functions provide support provide location withstand impact provide clearance and joint parts.

So, working on this group of parts and functions we will generate the idea. So, this is one idea use 25.4 millimetre square for base plate, round bar for piston rod pivot, cotter pins for foot lever, search new suppliers for lever spring. So, these are all mechanical engineers thing because now we are into manufacturing then second idea we have. And these are all ideas which are practically feasible; practically feasible or preliminary, it seems to be feasible. Some ideas might not be selected or might not be feasible in that technical or in the cost evaluation phase other.

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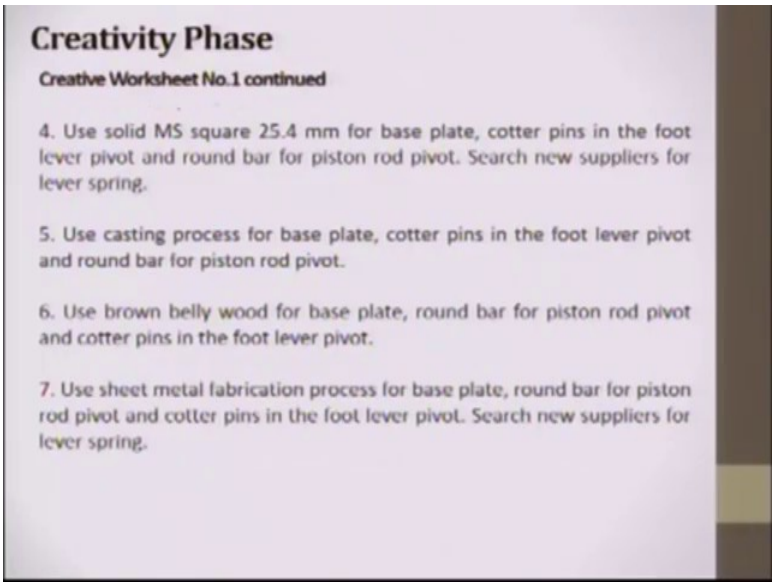

So, this is creative worksheet one continued we have seven ideas actually; they are not only seven ideas when we work on the creativity phase, multiple ideas number of ideas comes down. So, out of those only seven ideas are listed which are practically feasible.

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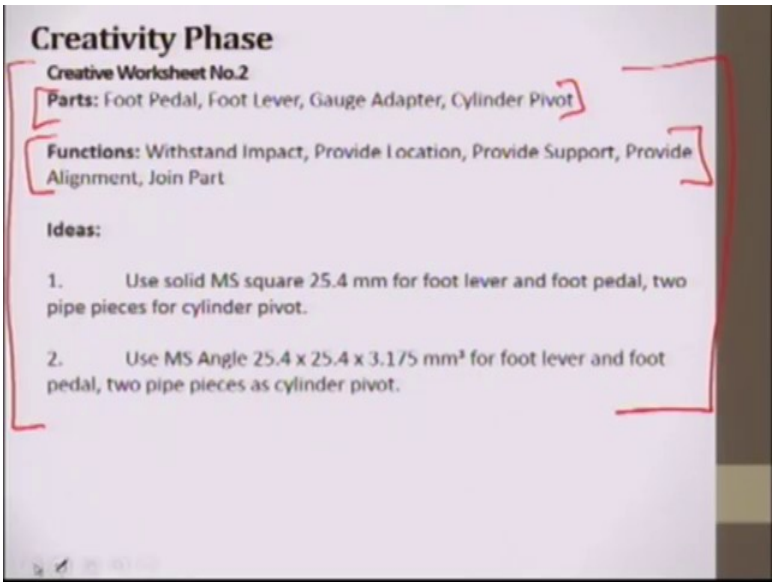

So, similarly creative worksheet two the; this are the parts, these are the functions they are grouped together. In the similar way in this study about 7 to 8 worksheets were made and actually 12 worksheets were made out of which it was found that 4 worksheets, 4 creative ideas or 4 groups of the parts and functions did not work and they worked on the 8 creative worksheets and changes were made.

So, I have listed only 2 worksheets here just to have the overview of how this conducted.

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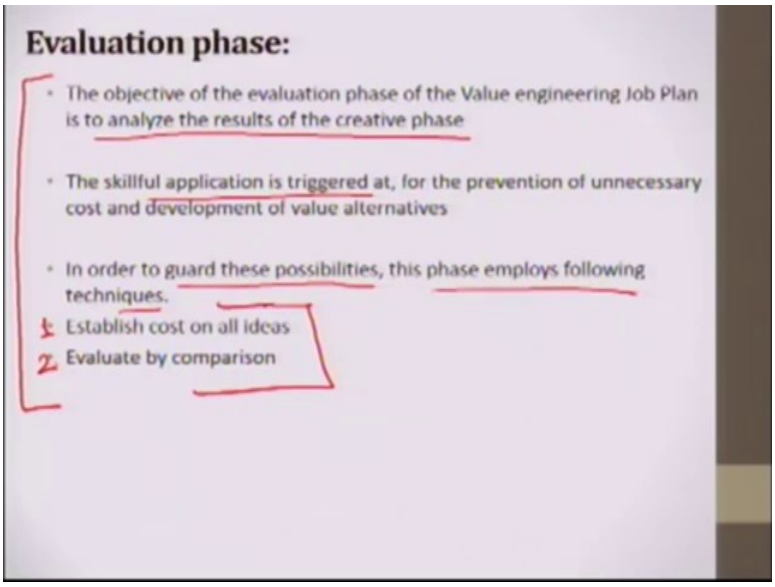

Next, I will go to evaluation phase; the objective of the valuation phase of value engineering job plan is to analyse the result of creative phases; skilful applications is triggered at for the prevention of unnecessary cost and development of value alternative in order to guard these possibilities this phase implies following techniques, establish cost on all ideas number 1, number 2; evaluation by comparison.

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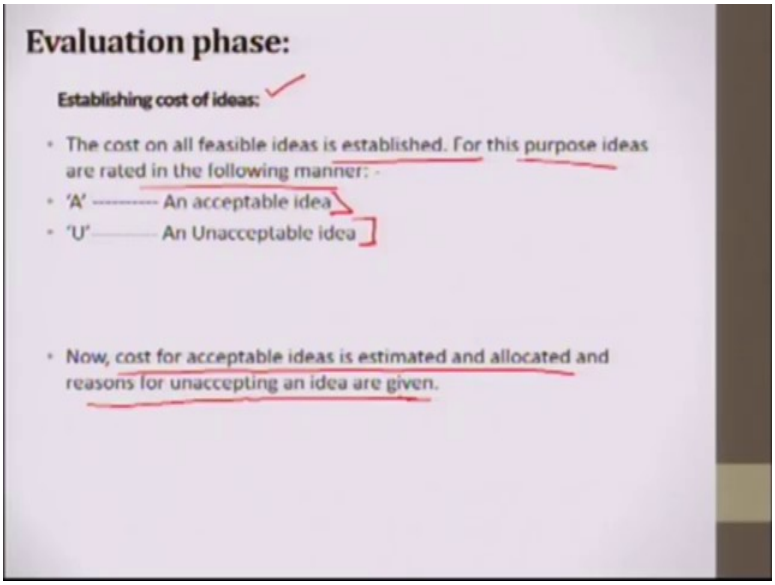

How is this carried out let us see establishing cost; cost of the ideas that is cost on all feasible ideas is established for this purpose ideas are rated into the following manner. Acceptable idea and an unacceptable idea; now the cost for acceptable ideas is estimated and allocated and reasons for unaccepting an idea if we do is mentioned.

So, in evaluation phase a thorough review of various alternative to select the best idea of cost reduction is done. it is kept in mind or made sure that the product is not cheapen or degraded making sure that there is no reduction in durability or ease of operation or other aspects.

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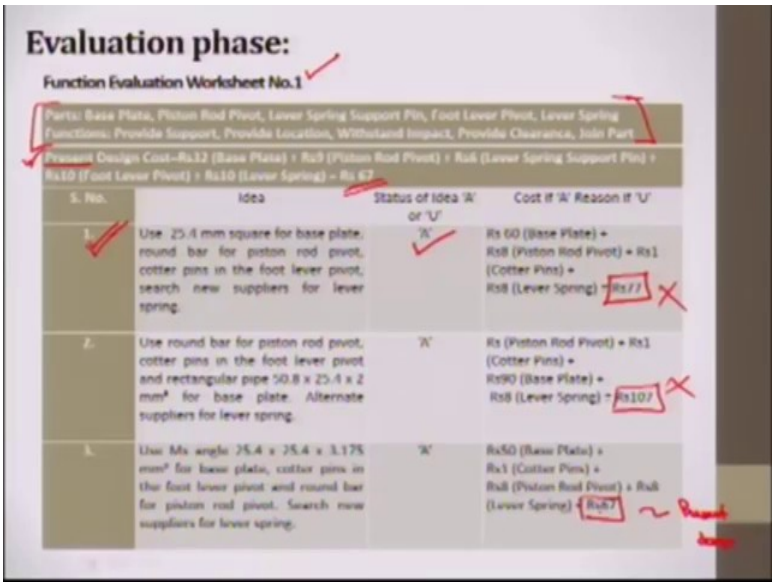

Below the requirement of so, this is function evaluation worksheet 1; in this is the idea same idea which we had in the creative phase. And this is the cost of the present design, this is the idea this is status of idea is acceptable. Then we put the cost of this idea. Total cost of this idea for these components this group of components is rupees 77; the previous cost was rupees 67 because this was in creativity phase, we did not think about the cost much. So, this is greater cost idea.

Similarly, second idea is rupees 1 or 7; third idea is rupees 67 if cost is the criteria these idea would be rejected. This is equally important to the present design that is rupees 67.

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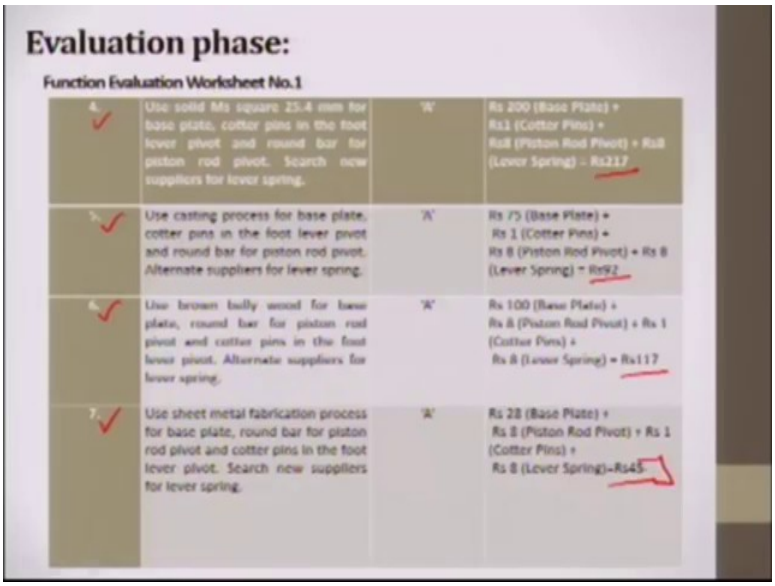

Similarly, we can see the idea 4, 5, 6, 7 had this cost rupees 217, 92, 117, 45 this is the only idea here that has the cost less than that existing cost of the group here.

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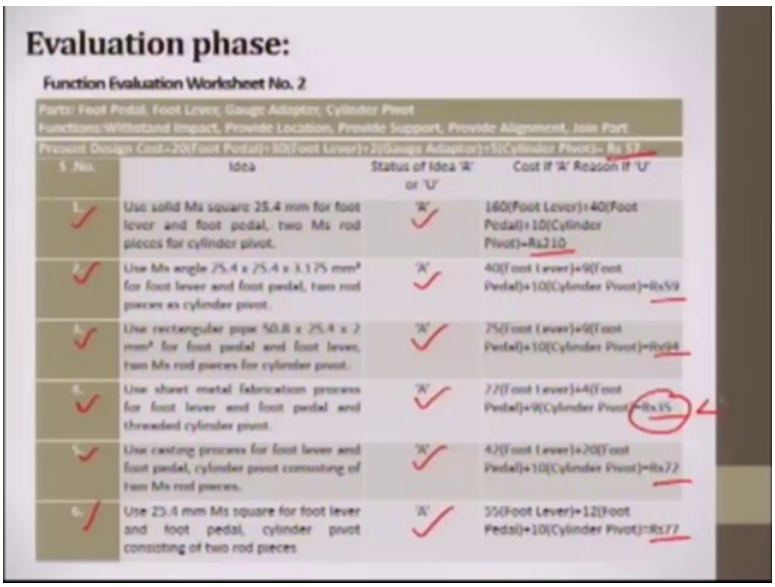

Similarly, the this is the function evaluation worksheet 2 in which these ideas 1, 2, 3, 4, 5 and 6 are put into the status all ideas acceptable that is they are feasible practically these can be done and cost of acceptable ideas are put, it can be seen that most of the ideas most of the ideas cost is high and, this rupees 35 is less than rupees 57.

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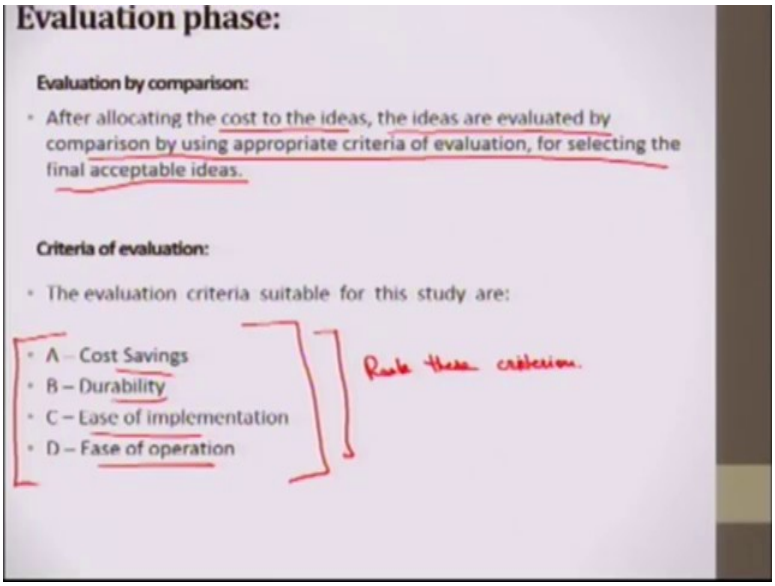

So, evaluation by a comparison after allocating the cost to the ideas; the ideas are evaluated by comparison by using appropriate criteria of evaluation for selecting the final acceptable ideas. These all ideas are compared based on certain measures, as we discussed the criteria here selected is cost saving, durability, ease of implementation and ease of operation; first what we do we rank these criteria.

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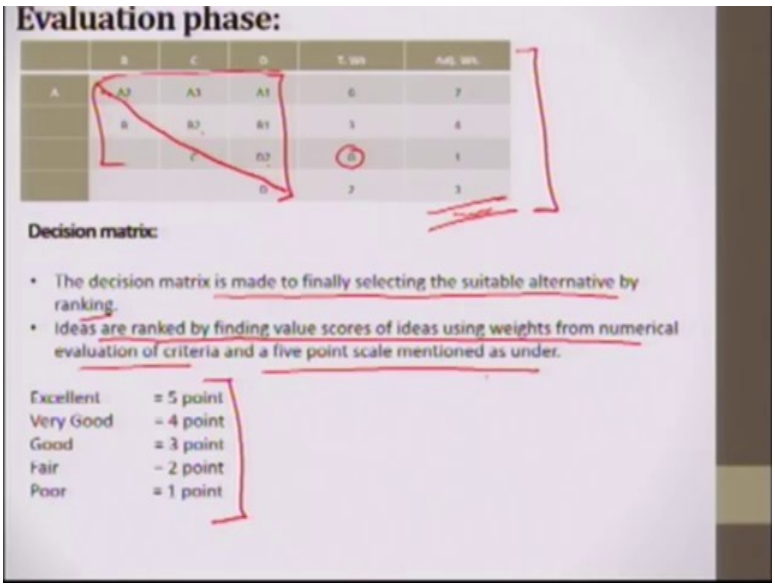

How do we do that? The same method numerical evaluation is there we see that A is important than B that is cost is important than durability with a medium difference. Then

cost is important than C that is ease of implementation then with major difference. Similarly, we find the difference in weights and we take the total 2 + 3 + 1 is 6 for A, for B it is 2 + 1 3 for C it is 0; C is not at all in this triangle; for D it come down to 2. So, we add 1 and we add this adjusted weight.

So, for decision matrix we choose this criteria decision matrix is made finally, to select the suitable alternative by ranking, ideas are ranked by finding value scores of ideas using weights from numerical evaluation of criteria; these weights are used and a 5 point scale mentioned as under how do we put that in our decision matrix?

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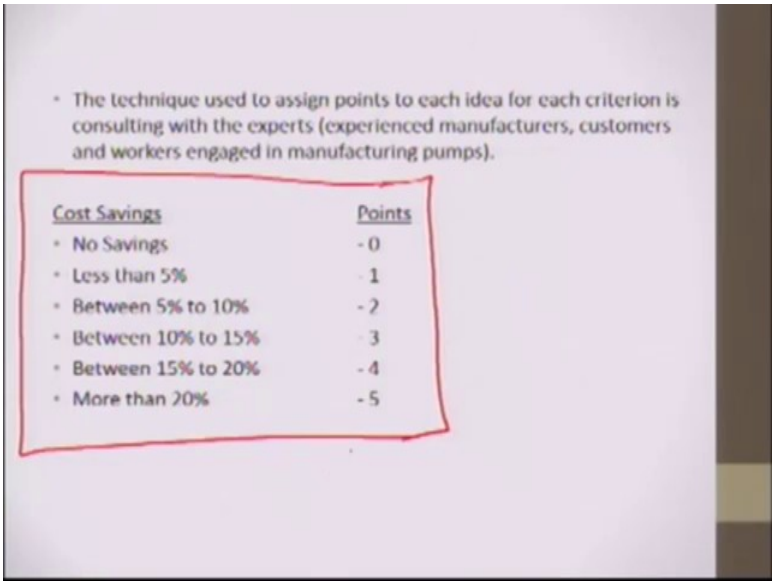

We also use scale for cost savings that is not saving 0 more than 20 percent saving 5 we calculate the percentage of savings if it is there.

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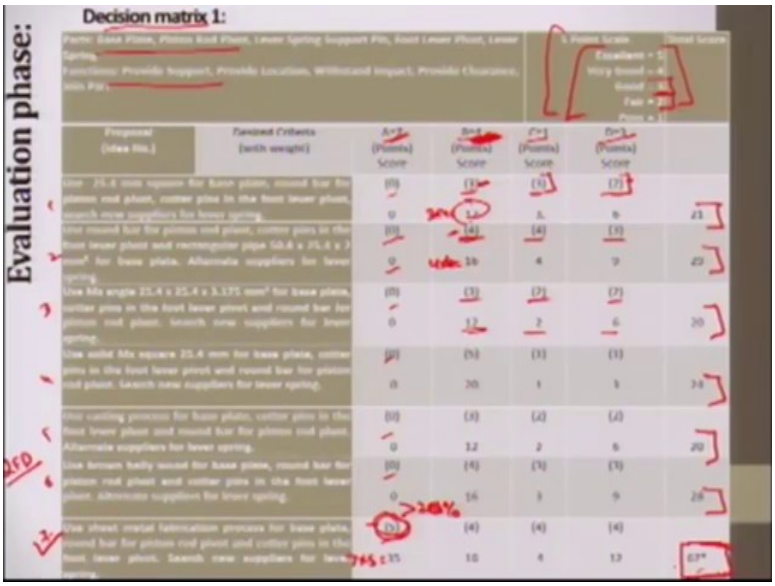

So, what happens here is in decision matrix one we have put the parts and functions in the same way, we put the 5 point scale here. Now we see that the function that is cost; function B durability function B is implementation and function D is operation these are the weights of this function and we see that there is no cost saving only one alternative was there in which cost saving was there. And the cost saving was more than 20 percent more than 20 percent; that means, this rating 5 is given.

So, this rating 5 * weight 7; 7 * 5 is equal to 35 similarly the points for durability are given, these are again the group of experts who give the opinion for that they say that if this idea is there durability would be rated 3, the durability would be good the implementation is also good, but the ease of operation would be fair. So, these are the numbers which are taken from this scale; all the numbers all the numbers in brackets are taken from of this scale these are the ratings which are given by experts and these are the numbers at the lower side this the number is 3 * 4; 3 * 4 is equal to 12. This is 4 * 4; this 4 * 4 4 * 4 equal to 16; this works similar to what we did in QFD; Quality Function Deployment.

So, in this way we have the total score for the ideas here this is the score finally, the weights are considered, the criteria are taken into consideration here. So, this is 12 + 3 + 6; 21, 12 + 2 + 6; 20; we see that the maximum score is of idea 1, 2, 3, 4, 5, 6; idea 7. So, this is the idea that is selected that can be implemented.

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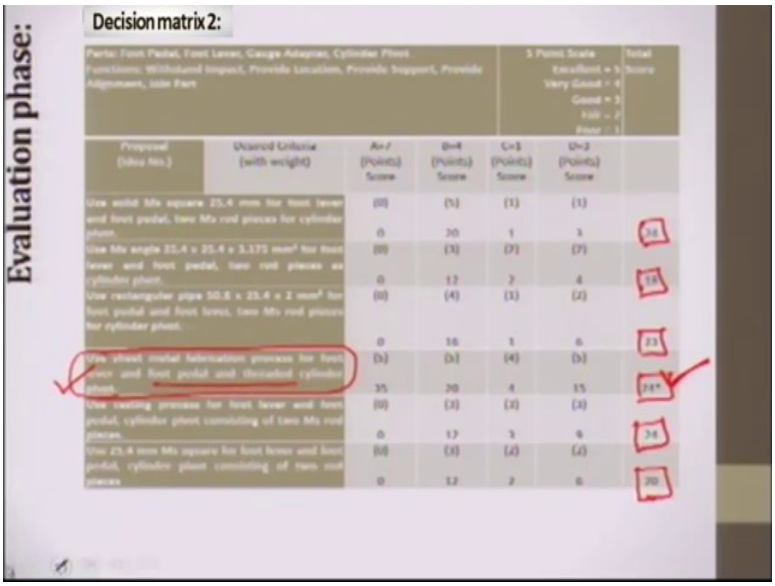

Similarly, we find the scores of various ideas for various groups for based on various worksheets from creative worksheets; we develop the functional development worksheet, then we have decision matrix.

So, in this case this is the maximum score this idea is selected.

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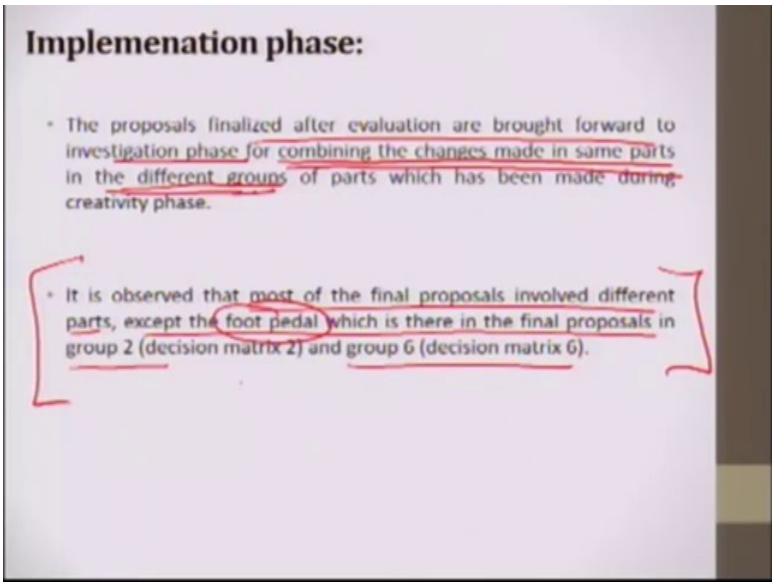

Now, comes the implementation phase; what we have done we have selected this idea use sheet metal fabrication process for foot lever and foot pedal and threaded are under pivot. We have selected this idea use sheet metal fabrication process for base plate and

so on. Now we need to see is there any idea which has contradiction with each other is; can we combine one or two ideas?

Because there are multiple worksheets; so, the combination of the ideas or if the ideas are contradicting those are taken care of. So, the proposal finalized after evaluation are brought forward to investigation phase; for combining the changes made in the same parts in different groups; please note combining the changes made in the same parts in the different groups.

For example, in base plate if the change is made in creative worksheet 1 and again in I would better say decision matrix one and in decision matrix 5; we will see is the change same or do we need to redo the things. It is observed the most of the final proposals involved different parts except for the foot pedal which is there in the final proposals decision matrix 2 and decision matrix 6; it was found that this foot pedal was there in both the matrix.

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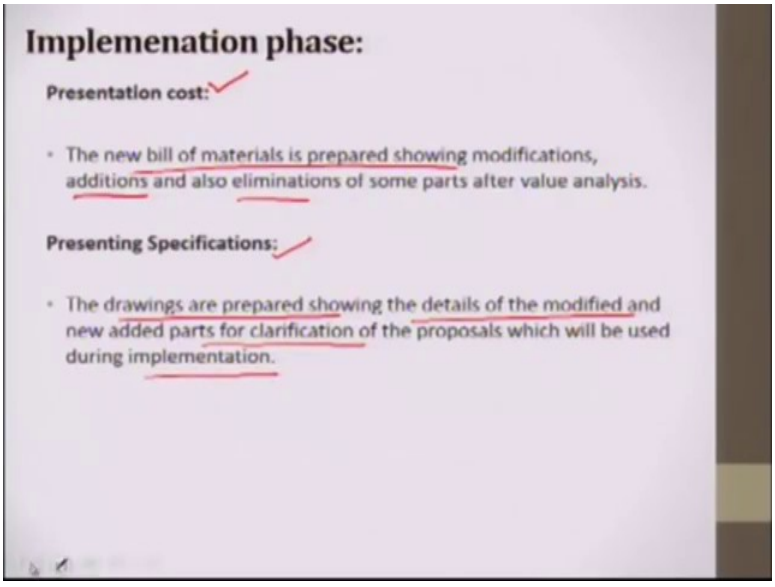

Next is presentation of cost; the new bill of material is made showing the changes modifications, additions, eliminations, presentation, specifications; new drawings are made the exploded view or the tear down way is again presented. So, this is our new cost of the parts with bill of materials.

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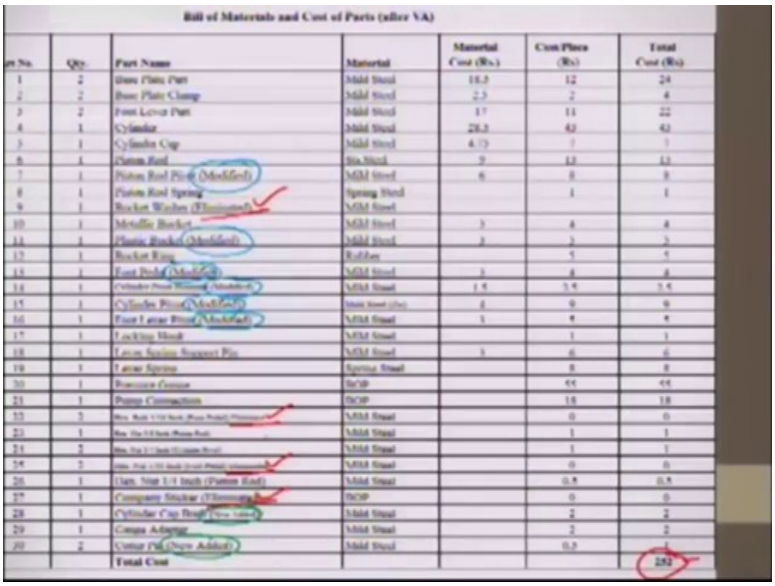

Sr No.	Qty.	Part Name	Material	Material Cost (Rs.)	Cost/Piece (Rs.)	Total Cost (Rs.)
1	2	Base Plate Pin	Mild Steel	10.5	12	24
2	2	Base Plate Clamp	Mild Steel	2.5	2	4
3	2	Foot Lever Pin	Mild Steel	17	11	22
4	1	Cylinder	Mild Steel	28.5	42	42
5	1	Cylinder Cap	Mild Steel	4.75	7	7
6	1	Piston Rod	Ss Steel	9	12	12
7	1	Piston Rod Plate (Modified)	MM Steel	6	8	8
8	1	Piston Rod Spring	Spring Steel		1	1
9	1	Bucket Washer (Eliminated)	MM Steel			
10	1	Metallic Bucket	MM Steel	3	4	4
11	1	Plastic Bucket (Modified)	Mild Steel	3	3	3
12	1	Bucket Ring	Rubber		5	5
13	1	Foot Pedal (Modified)	MM Steel	3	4	4
14	1	Cylinder Foot Mounting (Modified)	MM Steel	1.5	3.5	3.5
15	1	Cylinder Pivot (Modified)	Mild Steel (Ss)	4	9	9
16	1	Foot Lever Pivot (Modified)	MM Steel	3	4	4
17	1	Locking Hook	MM Steel		1	1
18	1	Lever Spring Support Pin	MM Steel	3	6	6
19	1	Lever Spring	Spring Steel		8	8
20	1	Pressure Cocoa	SCSP		44	44
21	1	Pump Connection	SCSP		18	18
22	3	Base Bolt 1/2 Inch (Base Bolt)	MM Steel		0	0
23	1	Base Nut 1/2 Inch (Base Bolt)	Mild Steel		1	1
24	2	Base Nut 1/2 Inch (Cylinder Bolt)	Mild Steel		1	1
25	2	Cylinder Bolt 1/2 Inch (Foot Pedal) (Eliminated)	MM Steel		0	0
26	1	Cyl. Nut 1/4 Inch (Piston Rod)	Mild Steel		0.5	0.5
27	1	Company Sticker (Eliminated)	SCSP		0	0
28	1	Cylinder Cap Bolt (New Added)	Mild Steel		2	2
29	1	Coupa Adaptor	Mild Steel		2	2
30	2	Cotter Pin (New Added)	Mild Steel		0.5	1
		Total Cost				252

So, this total cost here is rupees 252; earlier the cost was more than rupees 300. So, in this case the certain modifications are made; these parts are eliminated parts and some parts are newly added new added parts are there and some parts are just modified.

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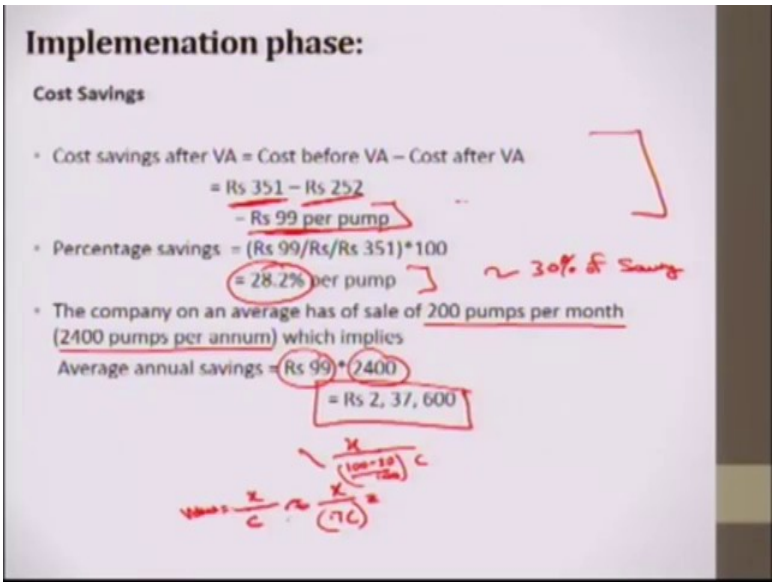

So, we present this to the decision maker and tell them that the cost savings is this much; the cost before value engineering is rupees 351 after value engineering is the this is the same rupees 99 per pump. And the company on which we worked manufactured 200

pumps per month that is it was total 2400 pumps per annum; total saving was this much it is rupees 99 * 2400.

So, this is the potential of value engineering 28.2 percent about 30 percent of savings. So, we had this value is equal to x / cost new value is x / 0.7 of the cost; 30 percent of the cost reduced; this 0.7 is actually this comes from x / 100 - 30 /100 into new cost.

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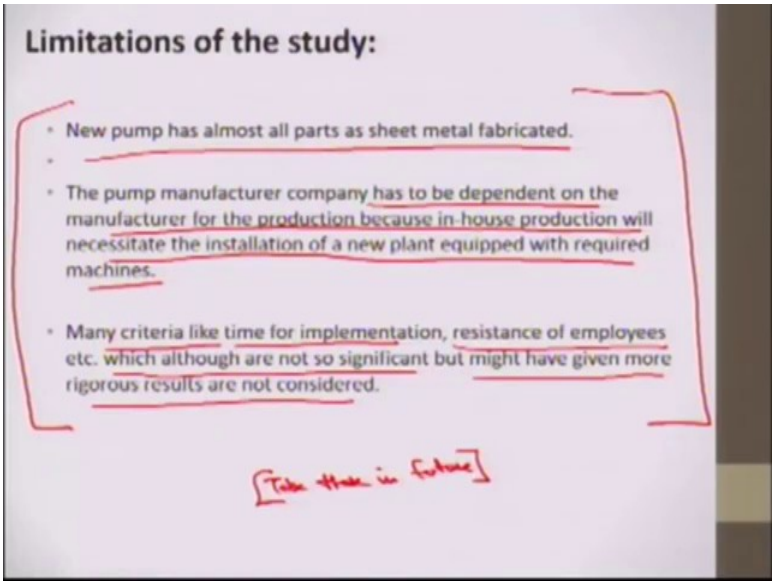

So, this is how do how we implement value engineering; also when we implement value engineering we would always find some limitations in our study.

Some drawbacks or something which we were not able to do or some things which we have observed, but we will do that in future so, those are always to be listed in this case new pump has almost all parts of sheet metal fabricated. So, the pump manufacturer company has to be dependent on the manufacturer for the production. Because in house production will necessitate the installation of new plant equipment with the machines this was for the specific case study.

Many criteria like time for implementation resistance of implementation employees to change which although are not so, significant, but might also have given more rigorous result are not considered. We will list the limitations and take them in future and the ideas which are not accepted in value engineering in the evaluation phase the creative ideas, those are also note just thrown away they are kept in record. In future also if we

conduct value engineering on the same kind of product or even if on the same product those help; so, this was all about value engineering.

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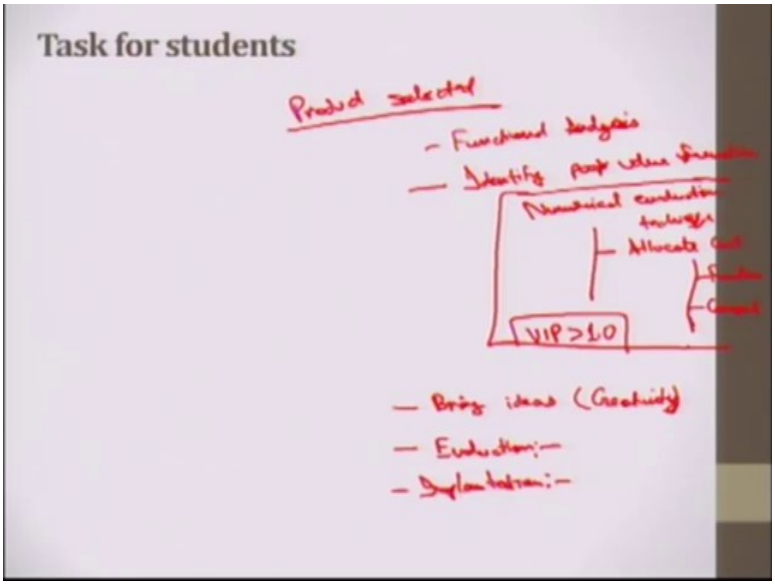

So, I have a task for you people; the product you selected you did function analysis, now you need to identify poor value functions here; using this numerical evaluation. So, that you need to allocate cost, cost for function. cost for each component and that is for the component cost would be divided. You need to compare the functions according to their importance this whole exercise is to be carried out; identify the poor value functions then bring ideas that is creativity I think this you already did.

But now you will work on the poor value function that is use VIP; Value Improvement Potential is more than 1 you work on these functions. Then try to conduct the evaluation and implementation phase as well. So, you will have to apply lot of judgement here; a team is desirable thing here if possible this was all about value engineering.

Next, I will discuss, rapid proto typing in this course in which we will see what are the what is rapid prototyping; how rapid prototyping is related to additive manufacturing, rapid prototyping techniques; we will see the application. Then we will see what is plant layout; we will see various kinds of layout and I will take to smart systems and operations lab in IIT, Kanpur where we will see the plant simulation software, we will see how the plant layout factory design is being carried out and let us meet next in rapid prototype module.

Thank you.