Product Design using Value Engineering

Prof. Inderdeep Singh
Department of Mechanical and Industrial Engineering
Indian Institute of Technology, Roorkee

Lecture - 15
Value Engineering: Case Study - II

Namaskar Friends! Welcome to session 15 of our course on Product Design using Value Engineering. So, today we are going to complete the 3rd week of our discussion. The course is a 4 week course and in the last week, our focus primarily has been to understand the applications of the Value Engineering approach, as applied to product design. So, we have seen number of case studies, we have seen case studies related to the design of a pencil, the decision making related to the design aspects of a pencil.

We have seen in the previous discussion things related to the design of a divan or household divan. We have also seen a case study related to the medical industry. So, we are trying to now spread the dimensions of value engineering all around us. So, all products that we see around us can be analysed from the spectacle of value engineering. We can try to analyse each and every product that we see around us from the point of view of value engineering which is very simple by now. Today is the fifteenth session all of the learners are well aware that what is the important point in value engineering.

The two important things in value engineering are function and cost. So, for every product we have to see that what is the function, for which the product is being designed, what is the function which the customer is seeking from this product, then we have to classify those functions into primary, secondary and tertiary and use function as well as the string function. And then we bring in the most important part for which the companies are doing business that, is cost.

So, two important words are function and the cost and how to make a good marriage between the two, how to make them a couple that a function is also satisfied and the cost is also taken care off. How this marriage can be beneficial to the customer that is what is our target as a product designer. So, as a product designer, I will try to see that the function is achieved successfully, reliably, efficiently, effectively. The performance of the product in context of the function is not compromised at all, but still I am able to save the money from the customer's pocket.

The customer gets the value which he or she is desiring from my product at a reasonable or a competitive cost, and that is the purpose with which the company is normally operate. The companies want to offer a product to the customer which is functionally excellent, but cost wise it is reasonable or competitive. So, that is the target and it is not a easy things. But if you remember in the previous sessions we have seen that if we apply the concept of value engineering, we are able to come up with the modified product, sometime the product itself is changed right from the scratch.

Normally what we do? In cost cutting, we focus more on manufacturing and materials and aspects and try to compromise on the functional requirements of the product, try to eliminate some essential function, and then thereby cutting the cost. But in value engineering, we do not compromise on anything, but the target is that the cost is still competitive; cost is reasonable, cost is something which the customer must be happily ready to part with for getting the functional requirement from the products.

So, that is the basic aspect for every product designer that he or she must try to achieve that balance between the functions that the product is providing, and the cost that is being paid by the customer or the price that is being paid by the customer to acquire that product.

So, that is the balance, and today also we will see another case study which is a very common product that is being used by people who commute on the train. And we have seen we have try to take the products from as diverse as from the medical industries, from the household, from a pencil. So, we have taken an example of a lamp post when we were discussing the functional analysis. So, we are trying to take examples from all around our social circle. So, that we are able to appreciate what we are trying to learn.

So, the products we are not taking products which are very very selective production specific to a particular branch of engineering. Like I am a mechanical engineer, I can take number of examples from the mechanical engineering field. One still I have included in the presentation that was the universal testing machine. So, we can see that right ranging from any specific branch of engineering to as simple as that of a pencil used by a school going children or executive in a conference.

We have taken diverse products and today also our target is to take a product, I think the introduction has been a bit longer today, but quickly, we will try to understand another

case study in which we will try to see that how the concept same; the approach remains same, the product will be different, analysis will be same or the objective or the goals or the aims will be same that is to a get the desired functional performance at a competitive cost.

So, let us now go to the next slide and try to understand the case study. Now this is a value engineering, a case study of Mumbai local train.

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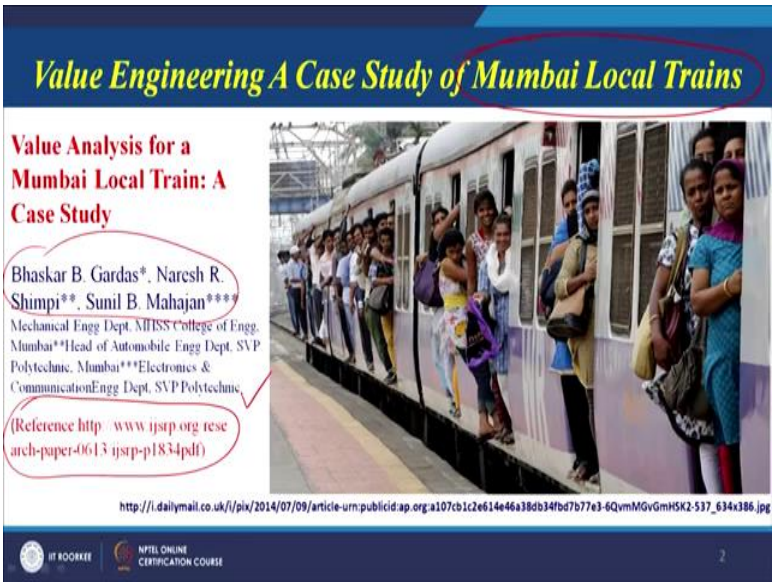

So, let us see what is happening in the Mumbai local trains and what are the issues, we are taking a very specific example. This study has been conducted by the authors Bhaskar B. Gardas, Naresh R. Shimpi and Sunil B. Mahajan. They are from Mechanical Engineering department of MHSS College of Engineering, Mumbai, yes, because the users are the best judge.

So, the authors are from Mumbai, so, they can identify that this is a issue and this issue can be challenged and then they have published an article. The reference of the article is given here; this is the reference of the article. So, the value analysis for a Mumbai local train, a case study. So, today we are going to see this case study. So, we can see that what is the issue?

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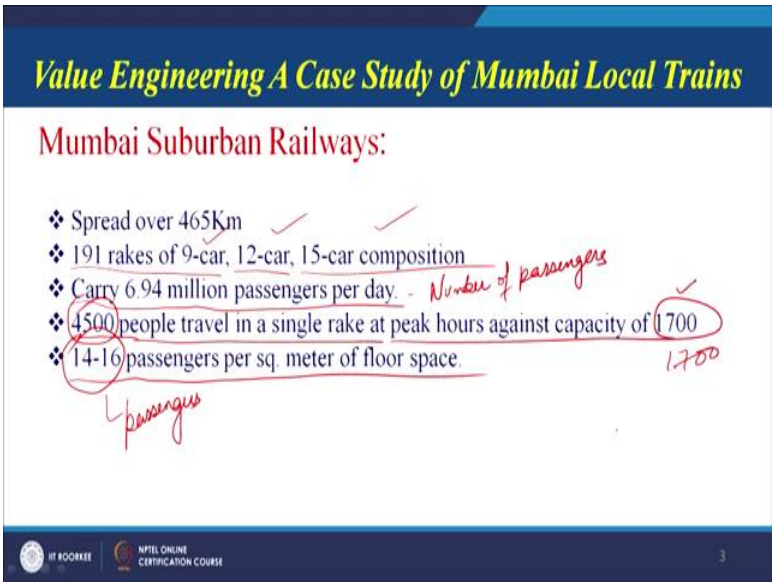

The issue basically is that Mumbai Suburban Railways is a very large network spread over 465-kilometres, 191-rakes of 9-cars, 12 car, 15-car composition. So, different types of rakes are there. They carry a whopping 6.94 passengers per day; so, you can see the number of passengers travelling per day, and which is extremely large. So, and these passengers normally travel using these local train, that are kind of lifeline for the city of Mumbai; 4500; 4500 people travel in a single rake at peak hours against the capacity of 1700; 14 to 16 passengers per square metre of floor space.

So, you can see the density of the passengers as reported by the author. So, the density of passengers is very high in a localized area, and the number of passengers travelling per rake, you can see capacity is 1700, but due to the peak hours and maybe people make use of train because it is a very time efficient method of travel in Mumbai. So, a large number of people travel instead of the rated capacity.

So, we can see here what is the issue? The issue is larger number of passengers make use of the train network in Mumbai for commuting from one place to another.

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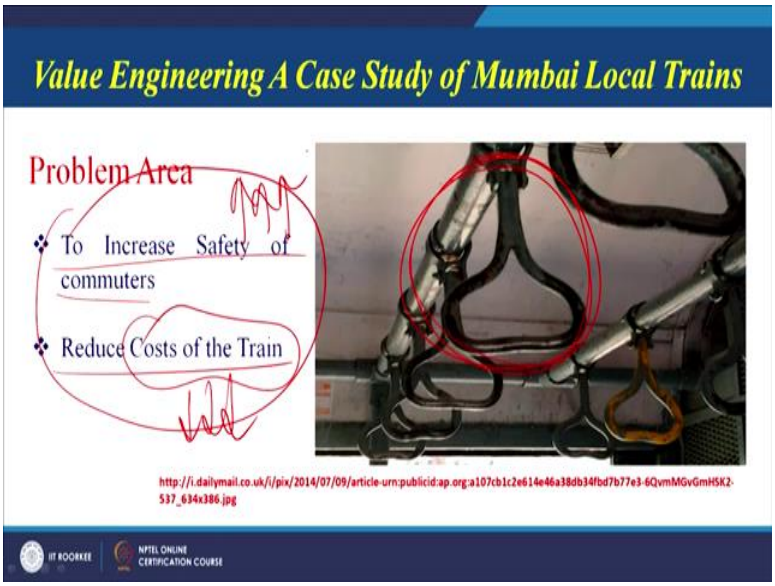

Now, what is the major issue; our target in this case study as the authors have suggested are these handles. You can see the problem area is to increase the safety of the commuter, sometimes the train is travelling, and you are not able to hold onto anything and sometime you are inside the train, you are not able to see outside whether you are reaching the station. a brake is applied.

Sometime it may not be safe for the passenger, there may be a little bit of jerk while moving in the train that is also a challenge, and then reduce the cost of the train. So, this is some material. This is made up of a metallic material, this is a handle. Now how this handle can be redesigned? Maybe just all the learners can think over it how what changes must be done in order to improve these two issues. Cost of the train can be minimized and safety of the commuters is maximized.

So, we have to improve the safety of the customers or the commuters, and reduce the cost of the train. So, why we must see we must use our creative juice is to find out whether this handle is really required. If, it is required, what is going to be the material for this handle. Currently, how many parts are being used for making this handle is this the only way we can provide a grip to our commuters.

So, we have to now brainstorm, and find out that what are the possible alternatives to this situation and other product designer, now, I have to think that how this problem can be attacked.

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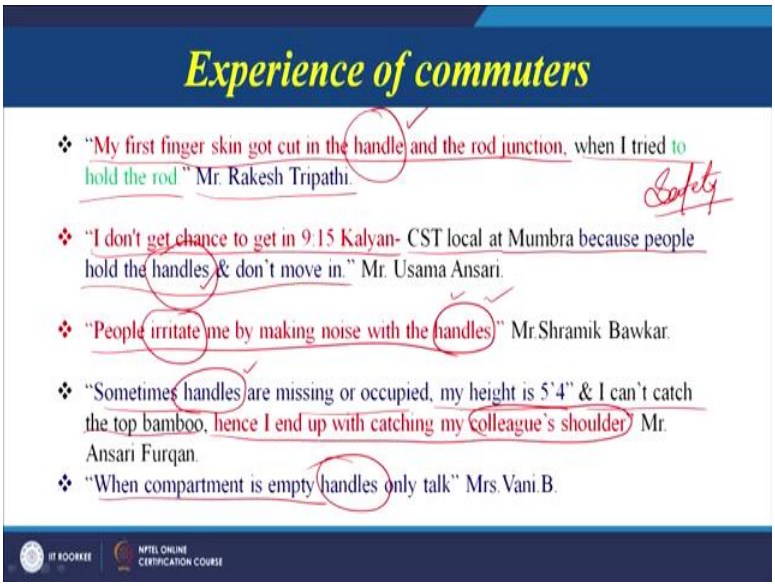

So, once, we attack this problem, we can see, these are the experience of the commuter. So, as we have seen that the safety of the commuters is a major issue. So, we can see these are some of the experiences of some of the commuters Mr. Rakesh Tripathi writes that my first finger skin got cut in the handle, and the rod junction when I tried to hold the rod. So, maybe sometimes there maybe lot of rush. So, because of the pushing and pulling the finger got skin got slightly bruised.

Then the second experiences, I do not get a chance to get in the 9:15 a.m. or p.m. Kalyan CST local at Mumbra because people hold the handles and do not move. So, again the handles are coming into picture; people hold the handles so, they want to be secured at that particular point. So, they do not want to move; so, people are not able to get in. So, the handle is causing some kind of bruise also. In some rare cases, the handles are fixing of the location of the passengers or the commuter.

So, if other people are not able to get in, people irritate me by making noise with the handles. So, that is another point irritation is caused to some people because of that handles. Sometimes handles are missing or occupied my height is 5 feet 4 inches and I cannot catch the top bamboo. Hence, I end up with catching my colleagues shoulder. So, that is another point that the height of the handle is an average height or below average person is not able to get hold to the handle. So, the handles have issues.

Another one is when compartment is empty handles only talk. So, the handles make lot of sound also when, there are not many passengers in the train or the rail. Now you can see handle is common here, handle is common here, here also handles, again handle, again handle and there can be a long list of issues related to the handles. Now how these handles can be redesigned? As a product designer, now what is the function? The function is to help the passengers travel safely, help the commuters to travel safely, provide them grip so, that they do not fall when the brake is applied by the train.

It should be safe to handle, it must be a safe holding device, it must be something which is not going to cause any grievous injury is to the commuters. So, that is one specific requirement that is you can say importance. So, first thing is to provide safety, and the second thing is that it should not hinder with the overall objective of the train, that is it should the space in the compartment should be optimally utilised. People should not stick to one place so that the others are not able to get in.

So, we can list down all the objectives, we can list down all the functions for which these handle have been provided, and then start to brainstorm that what can be the alternative to these handles. So, that is a challenge now; so, the problems are listed.

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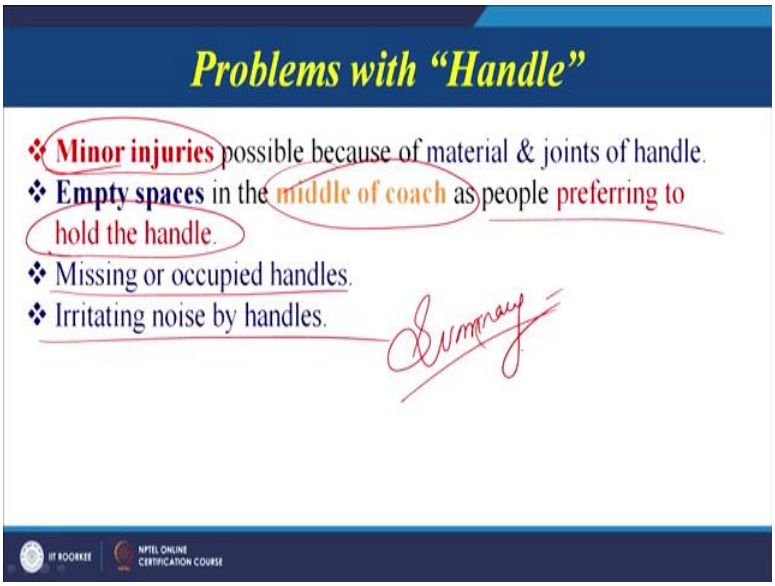

Now, we can see, summarise these problems, minor injuries possible because of the material and joints of the handle, minor injuries are possible; empty spaces in the middle of the coach as people preference to hold the handle. So, space is not utilised properly;

missing or occupied handles irritating noise by handle. So, this is a summary of the experience is given by; this is summary of experiences given by the commuters.

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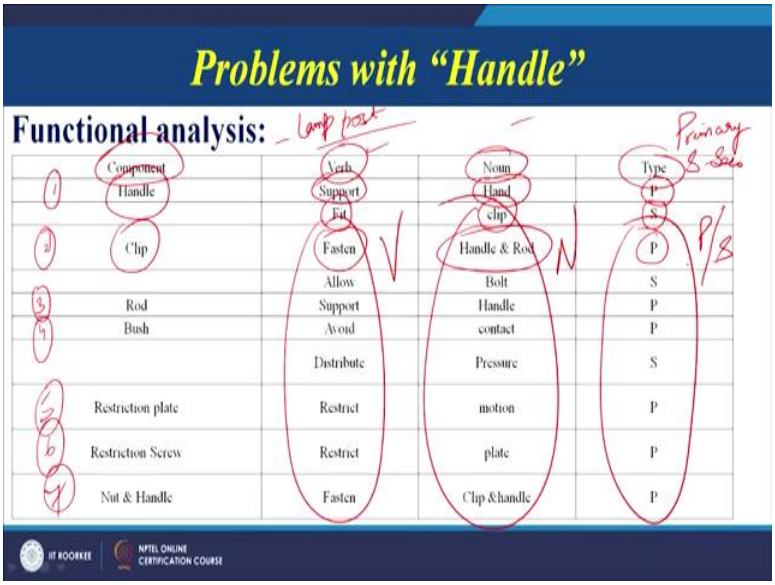

So, we have to know based on these, we have to do the functional analysis now. As I have already discuss the approach remains same. There will be no change in the approach, but the solutions will give us better alternatives which can help us to solve the problems as listed in the objective.

Now, here we can see the problems are understood now, we have to provide a safe mechanism or a safe handle for commuters. So, that the issues related to the existing handles are taken care off. Now, we can see as we do the functional analysis same functional analysis, we have done for the lamp post. So, what do we do there? We have divided or blasted the product into its individual components, and then try to understand a basic as well as a secondary function of each component.

So, here the component is given, the verb and noun definition is given, and the type is given. Now P here can mean primary and S can mean secondary. So, primary and secondary functions are there. Now we see, what are the component? The component is handle. The functional definition is support hand and it is a primary function. Then, there can be other parts like another thing is, fit the clip and it is a secondary function. So, for the clip, it is fasten, handle and rod.

So, there is a handle and there is a rod, there is a clip which will fasten this handle to the rod. So, it is a primary function for the clip. Similarly we have so many different parts. So, if I name the parts handle is there, clip is there, rod is there, bush, restriction plate, restriction screw and there is a nut and a handle. So, there are seven different parts and we have now identified the verb and the noun definition for each of these parts. So, these are the verbs, these are the nouns, and we can also classify them as primary and secondary function.

So, this is a functional analysis. So, we cannot go because of the paucity of time each and every part, and then try to understand what is the primary and the secondary function. But now since we have done this, the next stage here will be the information phase. We know that there is a assembly of a handle which is tied or which is fasten to the rod and there are large number of such handles, and the issues related to the handles are known to us. Now, let us try to collect all possible information related to these handles.

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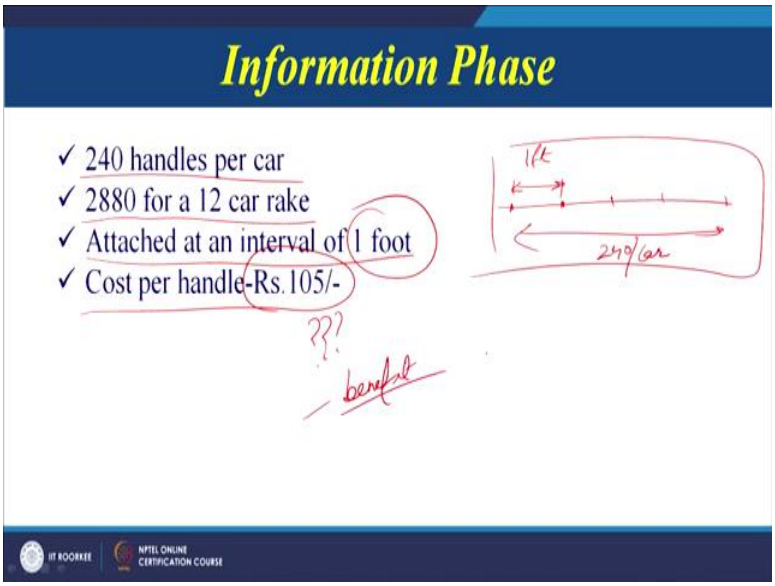

So, there are 240 handles per car, 2880 for a 12 car rake, then attached at an interval of 1 foot, cost per handle is rupees is 105. So, which means that suppose this is a rod, this is one handle; this is another handle, the distance between the handles is 1 feet and their number is also listed. So, this total number is 240 per car, and the total number is also

given to this is one rake suppose and then the total number is also given that what is the total number.

So, we can see that the cost is rupee is 105 for handles. Now whether this cost is railing adding any benefit. The benefit; obviously, is that it is providing a secure place where the customers can hold in order to be secured at a particular position. Whenever the break will be applied, the passenger will be able to be secured or we will be safe at one position only. He will not be post forwarder backward because of this support.

But what can be the possible alternatives? Now, once you know the problem, we have seen that it is a complex assembly of seven different sub components or parts which are assembled together to make the handle, whether this assembly is really required, so, we will brainstorm.

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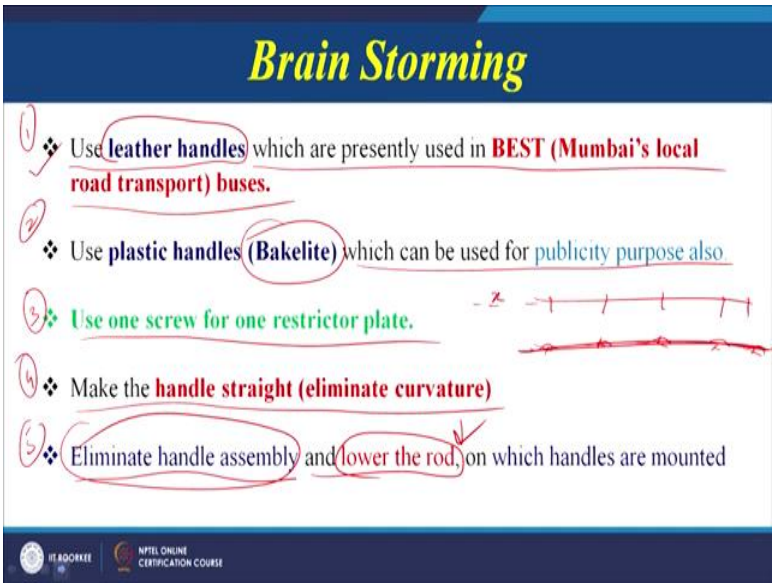

Let us see now what are the results of brainstorming. Use leather handles instead of metallic handles which are presently used in best Mumbai's local road transport buses. So, in best buses, leather handles are being used. So, can those be duplicated in case of trains that is the first idea. Second is use plastic handles made up of Bakelite which can be used for publicity purposes also.

So, some companies hologram or some companies advertisement can also be put on this plastic handles; so, these are the second alternative. Third is use one screw for one

restrictor plate. So, maybe within the design of the existing handle, we are trying to modify that use one screw for one restrictor plate that is another alternative, to modifying the design of the current handle. Fourth one, is make the handle straight eliminate the curvature. So, that is another idea, that curvature can be reduced and it can be made straight, and the last idea eliminate the handle assembly and lower the rod.

So, this is a rod, these are the handles tied here. So, the suggestion is that instead of placing the rod at x level, you bring the rod down. So, then eliminate these handles altogether so that people can hold the rod only. Then, for gripping purpose in the rod, there can be some further modifications which people can hold its securely in order to avoid the sleepage. So, that is fifth idea, eliminate the handle assembly completely and lower the rod on which the handles are mounted. So, these are the five ideas now; now these ideas will further be investigated.

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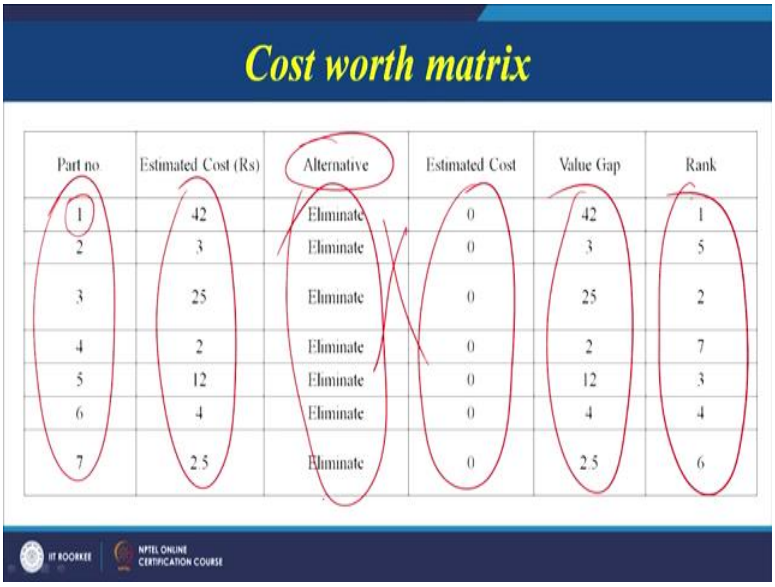

So, here we can see the cost worth matrix. There are 7 parts in the existing design. First we have to see that what these parts and estimated cost per part is also given. Now what is the alternative? If we compare it with the last brainstormed alternative that lower the rod; that means, that we have to eliminate all these 7 parts. So, these 7 parts if we eliminate, there is estimated cost is 0 only because we are not adding anything. At a later stage maybe in the next round off value analysis, we may like to change the design of the

rod which is going to be used for next round or next level or next generation of the railway coaches.

So, there we can try to see further improve on the design of the rod also, but currently, we feel that if we reduce or if we remove this handle assembly completely and lower the rod weight can be a better alternative. Now the value gap is given, and the ranking is given to these alternatives. So, we can say that first one was the handle assembly; so, we that is getting rank 1. But all together in this case study we are trying to eliminate all the parts and try to compare it with only rod which can be used for holding purposes.

So, let us see that the ideas. Now, this is related to, there the two have been compared. When we completely eliminate the handle assembly, all the nuts and the restrictor plates and everything is removed, we are only lowering the rod. But that is not the only idea, there can be other ideas as well.

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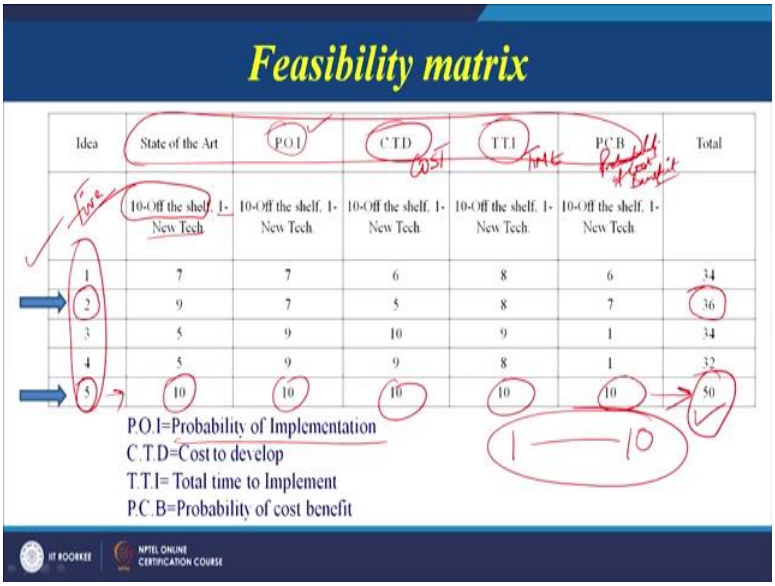

So, we have seen that in brainstorming, we had five ideas. Now in these five ideas, we are trying to compare them or evaluate them based on this criteria. Now, what is this criteria POI? POI means Probability of Implementation, sometimes idea may be brilliant, but it is difficult to implement because for that we need to bring about a lot of infrastructural changes.

For example, if we take a new design of a building which is green, which is self ventilated, which is using a natural sunlight, which is recycling the water which is being used in the toilet. So, we have a completely new concept of a green building, but it is difficult to implement, why? Because the existing structure has to be completely demolished, and then this green building can come up.

Sometimes, we try to integrate some of the features of the green building whatever possible in the existing structures also. So, in the second case there probability of implementation is mode. But if we say a complete demolition of the existing structure as per the rules sometimes, it is possible when the building is made, you cannot demolish it for the next 15-20 years. So, there the probability of implementation comes down.

So, the first criteria for comparing these five alternatives is probability of implementation. Second is cost to develop; sometimes the cost required to develop the new idea may be very high. So, therefore, we have to compare that which idea will help us to get our functional requirement, but at a minimum possible cost. Now TTI is Total Time to Implement. So, what we are trying to compare is the cost associated with the idea, the time for implementation associated with the idea and the probability of cost benefit that if we implement whether we are going to get some cost benefits or not.

So, we can see the probability of implementation cost, time and probability of cost benefit. Based on the earth the ranking is also given, 10 is given when the idea is off the shelf, we need not changed much and one is given if completely new technology has to be implemented.

So, based on that just on the scale from 1 to 10, the rankings are given and we see that the idea number 2 and idea number 5. The idea number 5 where we want to lower the rod on which the handles are mounted and completely eliminate the handles that is getting a score of 10 on almost each of the parameters or get a total score of 50. And the idea number 2; if we can go back and see that what is the idea number 2.

The idea number 2 is used the plastic handles which can be used for publicity purpose also. So, the second idea is also get a second highest score of 36. So, we see that which idea we must see that which is getting the maximum score. So, which means that off the shelf, it is available. We need not change much in order to implement this idea. No new

technology is required to implement this idea; not many infrastructural changes are required to implement this idea.

The time to implement is also good, the probability of implementation is also high; the total time to implementation is also low. So, we see that idea number 5 is the best idea that you lower the rod and eliminate the handles.

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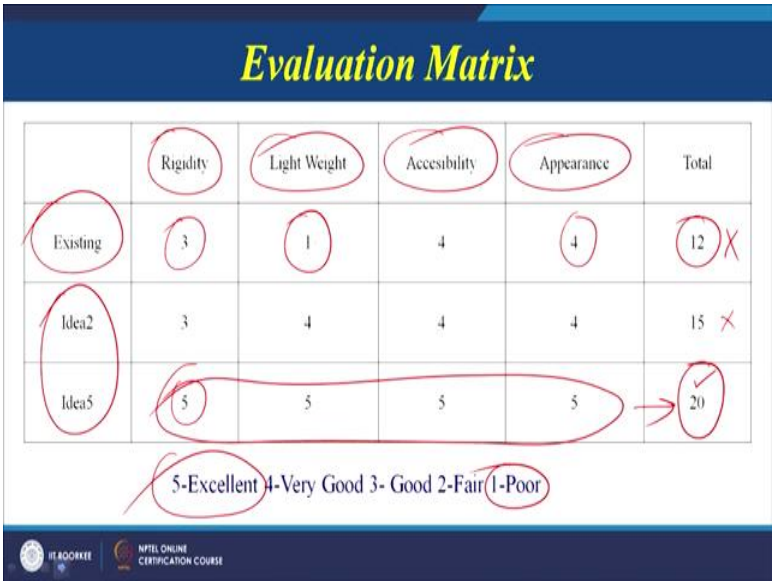

So, the next is the criteria based on rigidity, lightweight, accessibility, appearance and based on that when we compare these two best ideas. What are the two best ideas? We can again go back; we can go back and see what are the two best ideas. Second idea is using a Bakelite or a plastic handle and fifth idea is that lower the rod that and eliminate the handles.

So, these are the two ideas and when we compare these two ideas based on rigidity, lightweight, accessibility and appearance. Again idea number 5 is getting more rating as compared to idea number 4 which is getting only 15 and existing, we can see is getting a score of only 12. So, we see that it is not light in weight, only a score of one which is poor, because we are using metallic handles which are very heavy weight.

So, the light weight is also issue here, rigidity is also an issue, appearance is also an issue; appearance is still better than rigidity. So, we see that existing is completely ruled out 12, idea two, 15 better than the existing, but at least not as better as the idea number

fifth which is lowering the rod. So, here the ranking is from 5 to the least ranking is 1. So, the 5 means excellent and 1 means poor.

So, when we get this idea, when we analyse or compare these two best ideas with the existing one; we get that the last or the idea number 5 is better as compared to the idea number 2 and both are better than the existing design.

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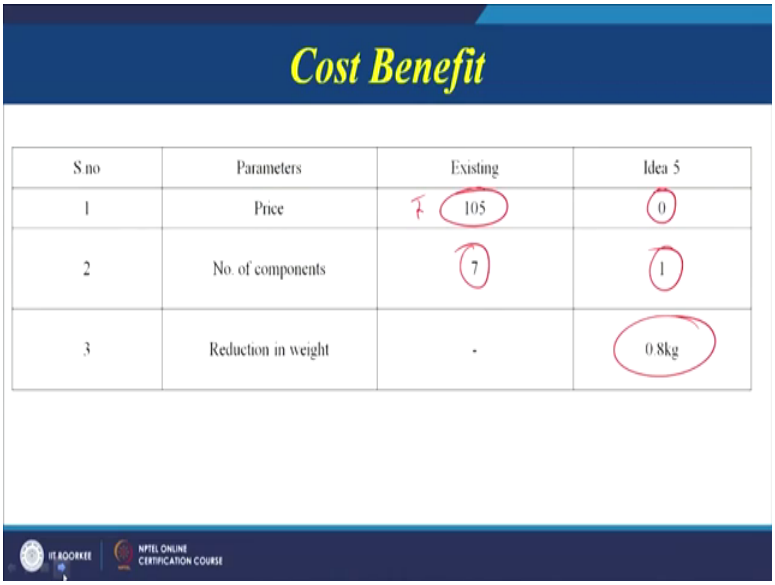

Now, the next is the existing price, cost benefit is rupees is 105 which we have already seen. And idea number 5, the cost is 0 because we need not do any modification, we are not redesigning the handles, we are just lowering the rod which people can hold and travel safely.

Earlier the number of components were 7, now there is only one component that is the rod which a person can hold, reduction in weight in this case is 0, but here we can see a reduction in weight of 0.8 kgs per handle we can say and if you multiply it by the number of handles. We can see how much weight saving, we are doing, and the train has to carry that much less kgs of weight which means the efficiency of the train will also improve.

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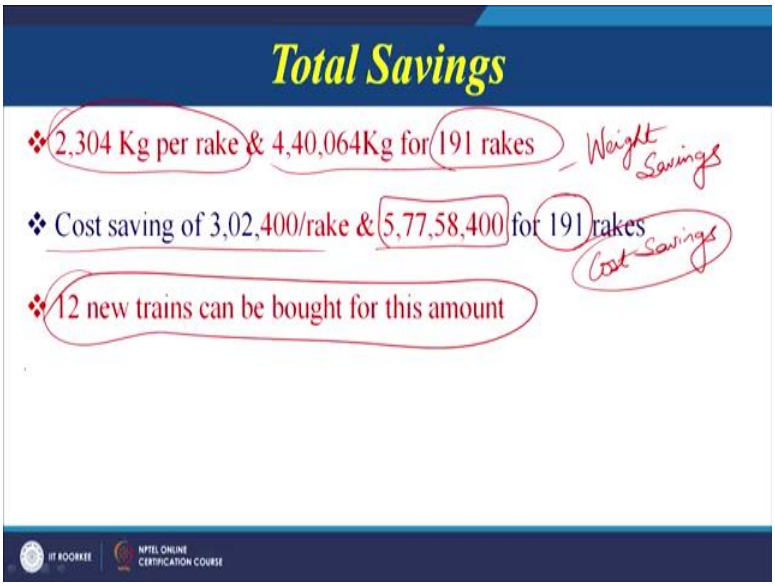

So, we can see total savings 2,304 kg per rake and 4,40,064 kg for 191 rakes. So, we can see the weight saving by removing this heavy handles. first benefit are the weight saving, then cost of saving also rupees 3,02,400 per rake and we can see if you multiply it by 191 rakes. There is a huge cost savings also.

So, we are saving the weight, we are saving the fuel, we are making them more efficient; we are saving the money also cost saving. And with this savings that we are producing 12 new trains can be bought for this amount. So, we can see that by systematically analysing the functions of a particular product in a local train, the engineers can try to save money for the organisation as well as save weight. And when the weight is saved, the energy efficiency of the local trains will; obviously, improve which will be beneficial for the environment also.

So, this is just one case study that we have tried to analyzed which has been published by the authors in Mumbai. So, we can see that within our local network, just focusing on a simple part or a component, the savings can be realised. So, if we use the same philosophy, same thought process, same approach or a step by step approach; we can save a lot of money for our organisation.

So, with this, I will conclude that today session. I think the session might have been helpful for the learners of the concept of value engineering in context of product design. In framing their problem statements; in framing your personal problem statements,

where you identify a product around you, and analyse it in the light of the knowledge that you have gained in the field of value engineering. And this will help you to redesign the product which will be better than the existing product, and will give you savings in different aspects, here we can see, the savings are in terms of weight, savings are in terms of cost.

So, with this we conclude the 3rd week of our discussion. In next session, we will start the last and the final week of our discussion on this course on product design using value engineering.

Thank you.