Total Quality Management - I
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Lecture – 14
Building the House of Quality

Very warm welcome to my friends for the TQM-1 course, this is total quality management. I am Raghunandan Sengupta from the IME department, IIT, Kanpur. So, we were discussing the house of quality and the different attributes and the so called variables based on which one can understand the quality functions. So, in continuation with that you will discuss in the fourteenth lectures, which is as of today.

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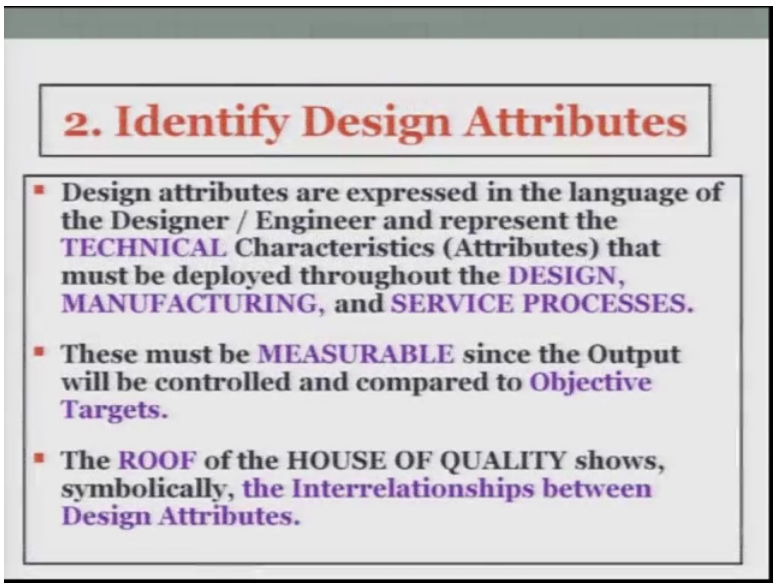

And you should basically identify the design attributes. So, these are the characteristic based on which you will try to find out what are the important points for which design specifications are important, and how such specifications can be utilized to understand the specific quality issues which are very, very important inherent in the design process or the manufacturing process. So, design attributes are express in the language of the designer or the engineer who is working, so it can be either related to the strength of the materials, it may be related to the length of the tie rod, it may be related to the so called viscosity of a fluid whatever you are manufacturing. And or it may be say for example,

related to the surface finish of a very, very sophisticated material which you want to use for telescopes and all these thing.

So, it depends on the language of the designer or the engineer which is technical in nature, and represents the technical characteristics. So, as I mention the viscosity, the length, the weight, the height, the humidity, so all these things would have basically some measure in the engineering framework of discussion. So, these characteristics are attributes that must be deployed throughout the design manufacturing and the service process.

So, if I say that say for example, the product has a tensile strength whatever the specification is that should basically convey the same set of meaning from the designer perspective, from manufacture perspective as well as say for example the customer is trying to utilize that machine or a crane or a material whatever it is. These must be measurable that they must be some unit of measure as I said temperature in Celsius or centigrade or Kelvin; weight in kilogram, tons, quintals; length in inches, nanometers or say for micro meters in kilometers, or in inches, feet whatever it is; weight can be in pound, kgs, grams, milligrams as it may be. Since the output will be controlled and compared to the objective target based on which you are trying to find out.

Say for example, I want to find out the how good the coolant is which is being used in a various sophisticated CNC machine, so obviously, the viscosity is important the specific gravity is important, what is basically the rate of flow at which you will basically pore in that fluid on to the cutting tool is important. If you are fitting a tie rod or if you are fitting a certain specification material in a machine, in a car engine or in a scooter engine or in say for example, the aircraft engine, so those specifications should be mentioned very specifically. The roof of the house of quality shows symbolically the interrelationship between the design attributes and based on which you can make a decision that how good or bad overall quality specifications are from the designers perspective.

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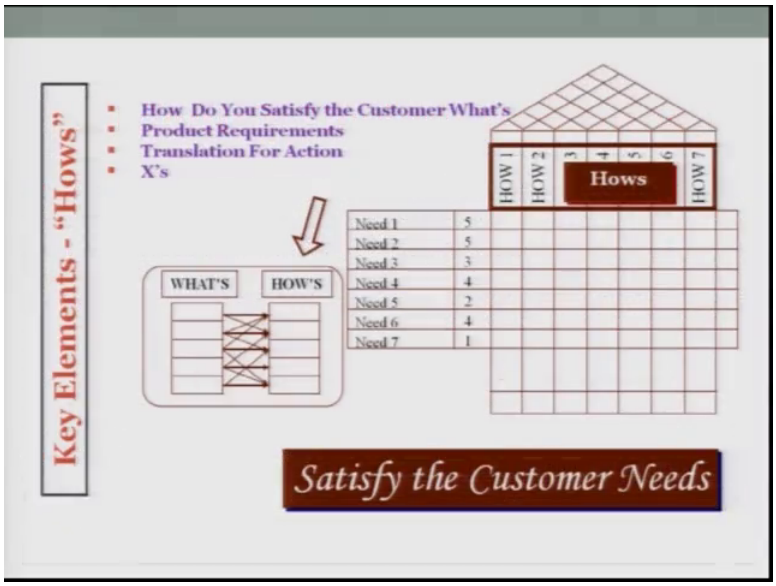

So, you need to basically satisfy their customer needs that is what the actual the need for the manufacture is and the customer need not be the external customer. So, if I am designer, my customer maybe the actual shop floor person who are trying to utilize my drawing. You say for example, I am a manufacturer my actual customer is the sales person, who is going to sell that product. If the product quality is bad; obviously, the customer who is going to sell the product with the outside vendor or outside distributor would face a problem. So, each of the stage, which is going to happen next are the customers based on which the design perspective and the overall analysis should be done.

So, our main question is and the elements are of how; so, how do we satisfy the customer needs what are his or her needs, what are the product requirement. As I said product requirement can be on different technical terms, which I mentioned just few minutes back. And translation for the action should be very well specified like if viscosity is important, how do we control the viscosity; if temperature is important, how we control the temperature; if humidity is a problem, how do we control the humidity. Should we have a dust free environment to produce products is it too costly, if it is too costly there, how we do basically bring down the overall cost perspective and basically have a positive effect on the quality.

So, all the needs and are basically termed and given an weightages, given a rating, given an attribute, they have some qualifications. And we find out that whats and hows; how they interrelated and what is the level of dependence which is there between the attributes at different levels. Different levels means say for example, from level one which is the designer to the next level, which is the customer one, which is basically the shop floor persons. The shop floor person is level two based on his or her output the product goes to the sales person in the internal sales person or the marketing person, industrial marketing goods are being manufacture and basically been sold in the market.

So on and so forth, this linkage continues and the design perspective design ideas basically translated from one level to other where the second level is the customers such that all the aspects of quality control are taken into action accordingly. So, we basically have in the design house of quality, the needs bit depending on what level you are and how you are going to basically meet those needs such that the customer requirements are satisfied. So, this is what we mean by satisfy the customer needs and requirements.

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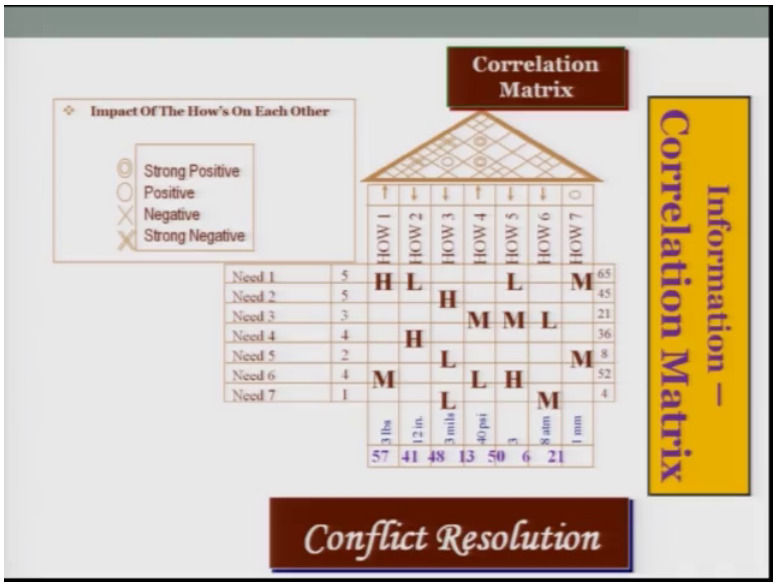

So, impact on how on how each is related to each other. So, obviously, they would be some strong relationship between level one and level two, or level two and level three and so on and so forth. So, some may be strongly positive some may be positive, some may be negative, some may be strong negative. So, when basically we have the correlation information correlation is basically that level of importance which is there

between different levels and based on which we can judge that how good or bad those design parameters are for the actual product which we are trying to manufacture or design.

So, conflict resolution is the main important idea; so obviously, there may be some issues that as you pay more and more attention on the quality, the cost may increase or say for example, you are being too panic about the environment the humidity, but it would basically have not that appreciable effect on the quality. So, you have to make a decision which is good, which is bad based on the design parameters for all the levels on which we are trying to pay huge amount of attention.

So, if you basically see this chart, so which is the correlation matrix now the word correlation basically comes from statistics we understand that. And the correlation basically the values which is from minus 1 to plus 1 gives you the relationship between two random variables. So, here what we are trying to understand is that what level based on the attributes do we have between different attributes which are at different levels. So, these are as if you see the first column, they are from need 1, need 2, need 3 and goes on depending on how many needs are. And the first row which we have is that how they can be done, how the needs can be met and they are given the relationship it is given in the matrix.

So, if you see need 1, and how basically there is a high level of correlation in some case it may be medium level of correlation; in some case it maybe low level of correlation. So, what you are trying to do is that try to understand the level of relationship, level of importance level of not so importance or level of negative importance which is there between different levels different, design parameters, different attributes that we can understand. In the overall scheme that what how we can resolve the conflict such that in the overall set of things we are able to meet the quality in the best possible manner.

Now, the word best possible manner does not mean cost, it may basically mean on the customer satisfaction, it may be mean on the design parameters, it may mean on the type of quality of materials which you are using; so, this basically conglomeration of different attributes which we want to consider from the total quality management point of view.

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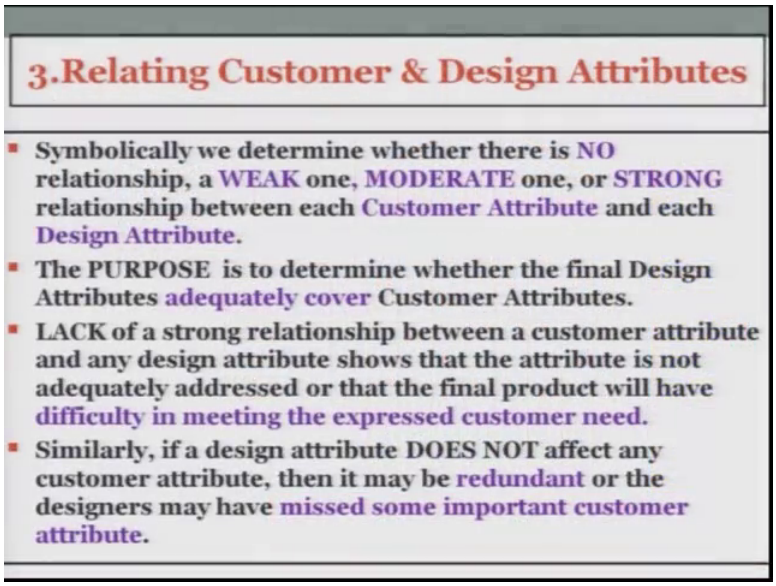

So, relating customer and design attributes is basically means symbolically we determine whether there is no relationship or a weak relationship or moderate relationship or a strong relationship between the customer attribute and each design attributes which is there. So, customer wants say for example, Young's modulus say for example, of a certain value, whether the design parameters Young's modulus I mean the strength of the material which is being produce or made or it can basically mean the level of quality of color which is there for the material which is being produced.

So, or it may be say for example, level of decibels of a sound level if a product is able to produce. So, it can be either a manufacturing boring machine and it will have emit certain level of decibel of sound. So, whether and that maybe a attribute based on which the customer wants to prequel their product. So, the work the work being done by a boring machine maybe very well and good, but if the sound level is very high then it creates a problem for the customer. Or it may be say for a example you are fitting a tie rod, I am coming back to the same example, if the length of the tie rod is not matching the actual requirement of the customer, so obviously there is a problem.

So, basically we analyze the different design parameters with their customer requirements based on the correlation matrix which are based on the attributes which may very strong, moderate and not at all significant based on that we divided. The purpose is to determine whether the final design attributes adequately covers the

customer requirements in general. So, obviously, they would be many conflicts, but in the overall set of things we see that how the customer requirements can be met to the maximum possible extent. So, obviously, there would be there may be cutting down the cost, there may be increase in the cost, there may be something where such sophistication tools to work on those material may not be required. So, all of these things have to be taken into consideration in order to make the best judgment, what is the total requirement between the customer needs and the design parameters or the attributes.

Lack of a strong relationship between a customer attribute or any design attribute shows that the attribute is not at all adequate and addressed not properly or that the final product will have difficulty in meeting the expressed quality needs of the customers. So, some design attributes or parameters are very important, but if the customer satisfaction are not being met so obviously it will mean that in the long run, they would be some clash in of the interest between the design parameters or the attributes and the customer requirements which based on which those design parameters have been really developed. And which are the core values for the product which the company is manufacturing or the design engineer or the manufacture or the shop floor manufacturing.

Similarly, if a design attribute does not affect any customer attribute then it must be redundant, and hence the designer may be may have missed some important customer attribute which is actually not considered, but erroneously some other attribute is being considered which has no consequence on the design aspect with respect to the customer requirements which are there.

So, if say for example, the viscosity of a fluid has no consequence on your design parameters say for example of a particular machine, which uses some coolant to be used say for example, and if the design parameters of viscosity are not coming into the picture when you considering the customer requirements. So, obviously it means either those are not at all consequential food for a decision making or we may have missed some important attributes for the designer point of view or for the manufacture point of view which the customer really had intended to basically consider in our overall design and specification norms when the product was being actually design of thought above.

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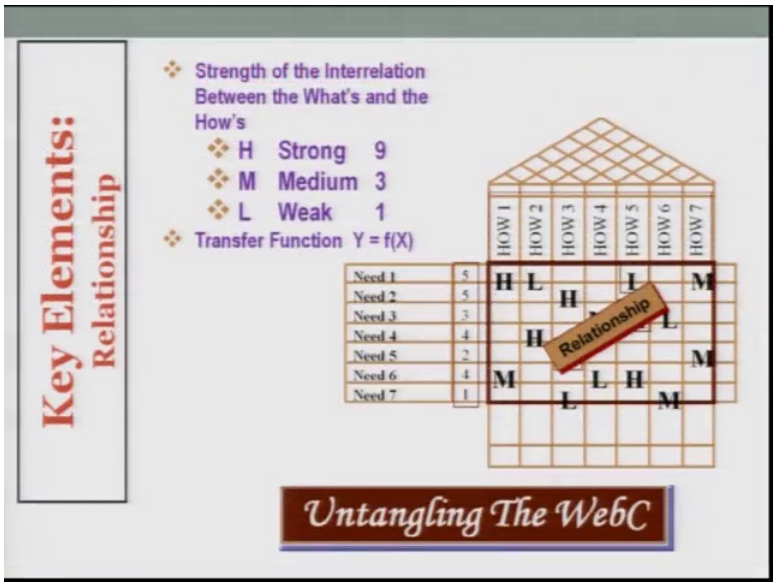

So, the key elements of the relationship would be basically to untangle the overall relationship which is happening. So, strength between the interrelationship between whats and hows can be done in a very simple way where you gave give some points or some level of importance to the attributes. So, they can be done as we see along with the needs and along with the hows. So, the needs again I mentioning along the first column and the hows are along the top most row.

So, if you basically give some points, so for strong correlationships say for example 9; medium correlationship 3, and weak being 1. So, this basically gives you a form of transfer functions or the relationship with basically happens between the correlations between of between the needs and the hows. The points which are mentioned there are 9, 3, 1 are not sacristan, they can be based on any other perception depending on the level of importance design and the manufacturing parameters or the attributes are and what the customers thinks are important for him or her.

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So, basically then you add in the fourth set of points, you add the market evaluation and the key selling points are considered. So, these are done in this way. This step includes identifying important rating for each custom attributes and evaluating existing products and services for each attributes, which are very important for the designing and the manufacturing point of view. Customer important ratings represents the areas of greatest interest which is for them and the highest expectations as expressed by the customer are to be considered.

So, if the customer thinks that the tensile strength is very important then that becomes one of the most important attributes from the design and the manufacturing point of view. If the customer thinks that weight per unit volume is a very important consequences for him or her then basically somebody has to consider, the density in such a way that that it becomes the important parameter to be considered in the design and see for example, in the manufacturing unit. If say for example, the customer thinks that the tolerance level depending on the fluctuation of the temperature is of prime importance for him or her, so those points should be considered by the manufacture manufacturer at its or his or her design and manufacturing stage.

Competitive evaluation helps like say for example, if I am a manufacturer I would basically try to understand the customer's needs and try to judge where my product would be with respect to my rival products. So, whether the design parameters, whether

design attributes of my products with respect to my rival products are able to meet the customer requirements to the best possible extend would be considered. So, it means that competitive evaluation helps to highlighten the absolute strength and weaknesses in the competitive products and will helps us to analyze where we stand with respect to the different type of customers, different type of competitive products which are there in the market.

This step enables designers to seek opportunities for improvement where things can be done in much better way such that the relationship of the importance is highlighted by the type of products at each level with design or manufacture. Such that the link of the QFD to a customer's strategic vision and allows priorities to be set in the design and manufacturing state stay and to the best possible extent.

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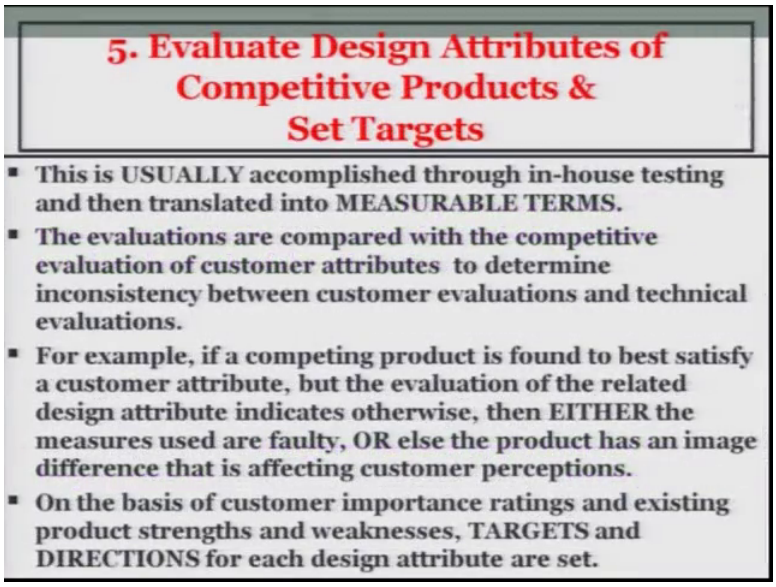

So, in the fifth stage, we evaluate design attributes and competitive products and set targets which are to be met in the best possible manner. This is usually accomplished through a house testing, and then translated into the measurable terms. The evaluations are compared with the competitive evaluation of the products of competitive competitors and customer attributes which have been mentioned by the customer in order to determine inconsistency between the customers evaluation and the technical evaluation which have been laid down by the customers, and how good or bad our products are with respect to the customer requirements.

For example, if a competing product is found to be best satisfy a customer's attribute, but the evaluation of the related design attribute indicates otherwise then either the measures used are faulty or there are some issues about that or else the product has an image which is different and is affecting the customers perception, based on which his or her customer requirement have been basically designed. So, if say for example, the customer requirement has given us one set of requirements for the product and we are getting some second set of requirement based on what we think are the perception of the customer then there is obviously, mismatch, so that has to be made zero or reduced to the maximum possible extent. Theoretically made zero because it will basically be able to meet the requirements of the customers, if the customer's actual requirement are translated in the design and the production stage.

On the basis of the customer importance of rating and existing product strengths and the weakness, targets and directions for each design and manufacturing units are then taken into consideration by the manufacturing unit in consultation with the design and the stuff loads such that the customer requirements are best met with the design designers and the manufacturing attributes.

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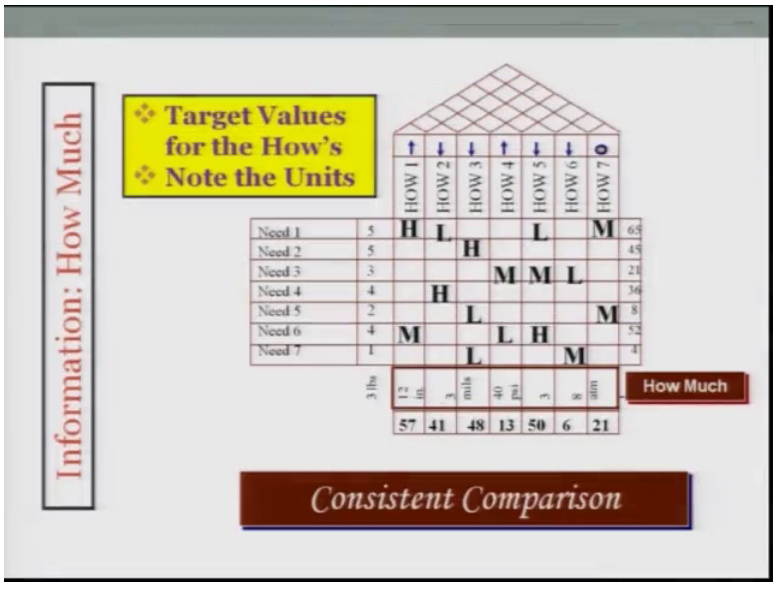

So, once if it is done we need to basically have a consistent comparison. So, this information is again done with respect to the needs in the house. So, what we do is basically you target the values of house and basically note the number of units which are

there. So, if the relationship is very strong, obviously the points given accordingly would be coming out very high. So, you need to evaluate each combination of needs and hows such that you get the maximum ratings where the designer and the manufacturing attributes should basically match with what the customer requirements are. If they are very negative or they are very low, obviously it means there is some misconception or some miss fitting between what the designer and the manufacturing attributes are with respect to the customer requirements.

So, the word customer again I mentioning it does not mean the external customers, it basically means both the internal and the external customer that means, from set one or stage one if you pass on the products to stage two then stage two is the customer of a stage one. So, the best direction has to be taken in which direction your overall requirement should be met. So, basically what you do is that you information are again collated on the needs and the hows, again the needs are along the first column and the hows are along the topmost row. So, more or less whether is better or worse basically they are understood in trying to basically understand whether we should increase the design and the; and the level of importance for the manufacturing attributes or basically try to reduce that.

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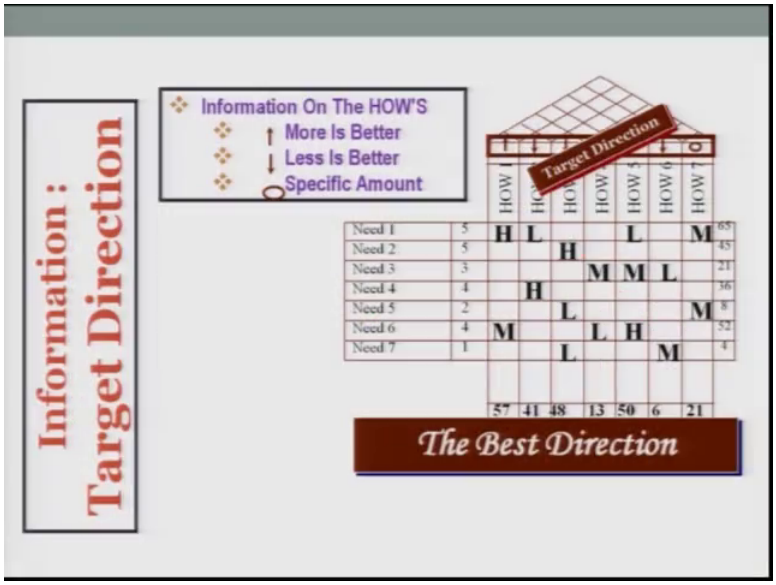

As we note that the positive and negative points which we give basically comes out in a much better way such that we are able to collate the overall information to give some

points between the needs and the hows. So, the best direction is done and we find out that in which direction the point direction the point should move. So, say for example, if you see as in the slide the rightmost column, so there are points given as 65, 45, 21, 36, 8, 52 and 4. So, this would mean that between the needs and all the hows they are you would basically have a weightages or the or the level importance which is given on a scale.

Whatever the scale it can be from one to hundred it can be one two hundred whatever is. On a scale it is 65, based on that we are able to basically judge that whether we should be really concentrate on those attribute based on the needs and the hows and try to find out where the duff telling can be done between the requirements of the design and the manufacturing attributes with respect to the customer requirements. I am using the word requirements of the customer in a very generic sense.

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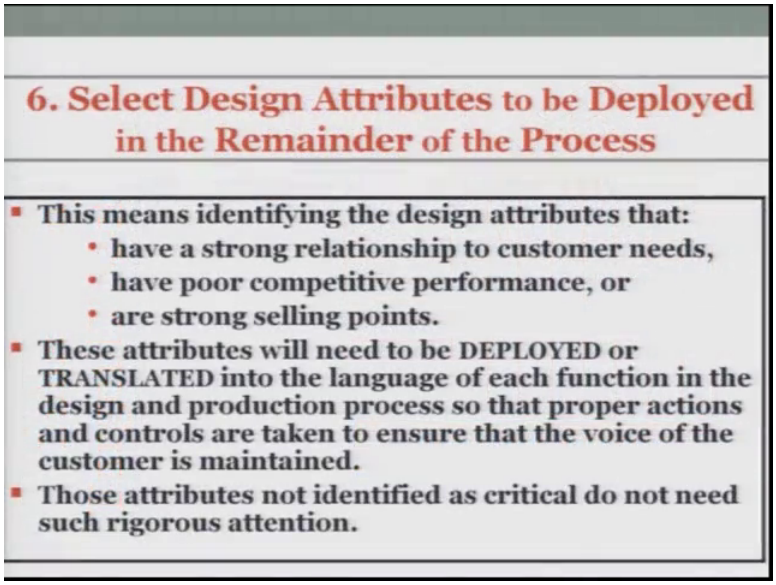

The sixth step or stage means select design attributes to be deployed in the remainder of the process, this means identify the design attributes that have a strong relationship between the customer needs. So, what the customer needs, you may not be able to understand, but try to basically inculcate that in your design and the manufacturing units of that basically information comes out to the maximum possible extent. Have a poor if it attributes that have poor competitive performance or a strong selling point. So, basically they would be done in such a way that those cannot be replicated by your competitors.

So, if you have some unique property of your design and manufacturing unit or manufacturing quality is there for the design perspective also try to basic highlight that that such that the customer requirements are met, and your competitors are not willing or not in a position to basically replicate there. And they should also be very strong selling point based on the customer requirements from the technical point of view.

So, these attributes will need to be deployed or translated into meaningful actual attributes which the customer can understand. So, in the language that each function in the design and the production process. So, that the proper actions and controls are taken to ensure that the voice of the customer is maintained and the actual requirement of the customers are met to the maximum possible extent. Obviously, we will all try to meet the customer requirement 100 percent of the times all the time, but obviously, they would be many mismatch, or there may be some mismatch which will try to minimize to the maximum possible extent. So, those attributes not identify at critical do not need such rigorous analysis those which are important obviously, more stressed should be made based on which the customer requirement would be met with from the point of view of the designer and the manufacturing point of view for the attributes.

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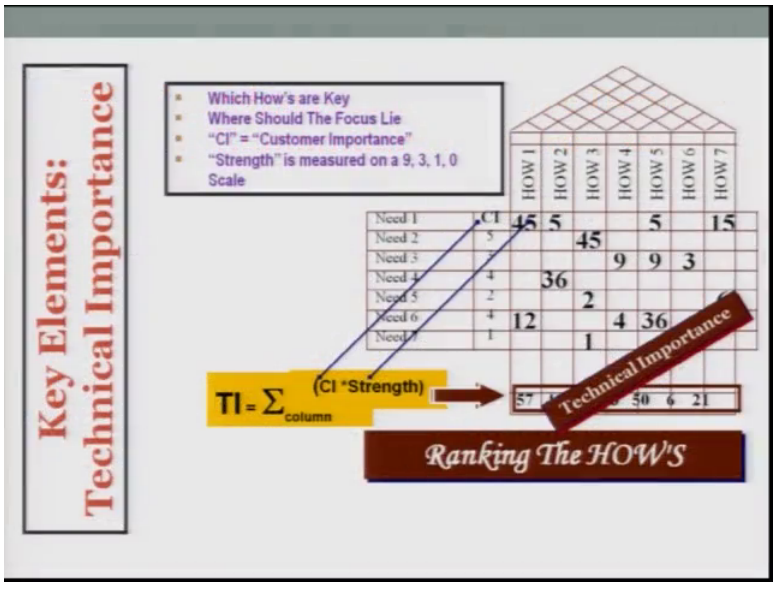

So, key element in the technical information are. So, you want to basically find out the strength. So, what you will do is that you will basically try to find out the overall level of points which you are trying to analyze for the needs and the hows. So, what you do is

that you try to basically find out the customer importance level which is CI and the strength which is already given by you based on what you think as the from the designer point of view from the manufacture point of view the level of importance.

So, those points is that you are given a scale of 9, 6, 3, 1 and so on and. So, forth or it can be different point based such that gradations are possible and they give you a very nice feeling that what are the different type of customer requirements and the designer and the manufacturing attributes which can basically given some points are that they come out in the actual analysis very carefully.

So, the total level of technical importance or TI, which is there you will basically find out the sum by multiplying the level of customer importance with the strength and there is some name of along the column. So, once you find out the column sums, you are able to find out the technical importance of each and every such combination of need and how. Such that you can place them in a ranking order where you can play more emphasis on the TIs which are of high level of importance from the customer point of view with respect to your design and manufacturing attributes.

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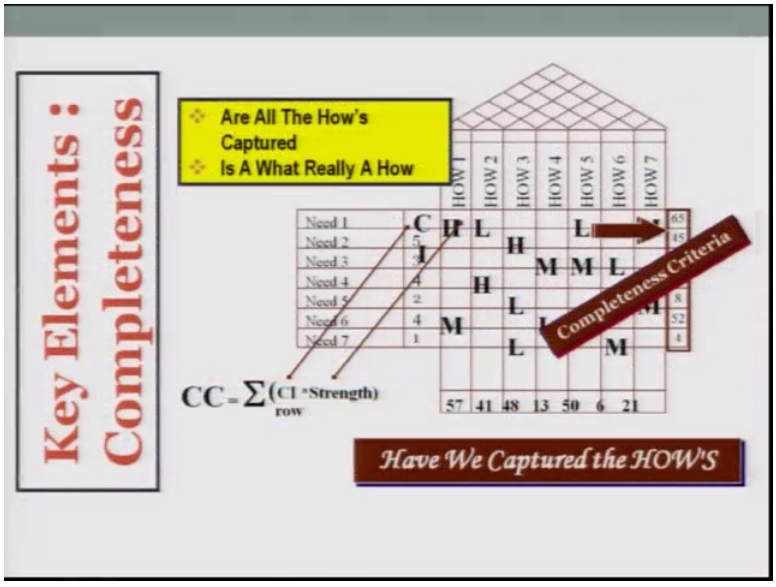

You also capture the completeness criteria, so that will give you the level of how complete your overall coverage of the needs and hows are. So, what you will do is that you basically sum up all the points along the rows. So, what you are doing is that you are trying to find out the overall level of from hows also as well as from the point view of

the needs also such that there is a one to one correspondence between those level of points which you put for the hows and needs. Such that dichotomy or so called miss fitting of all the needs and what you can deliver are minimize to the maximum possible extent.

So, again I am repeating the total customer points are measured along the columns you sum them up, and also the completeness criteria based on each needs and hows summed up along the row and you find out the level of points such that one-to-one correspondence adobe telling can be done. Between the customer requirements as well as what you are able to deliver from your point of view you are the manufacturer from your actual set of attributes which you think are important.

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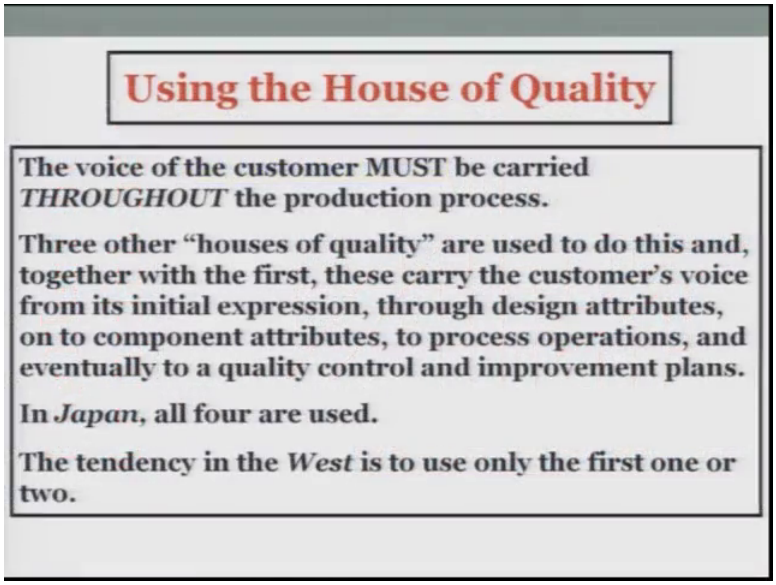

So, using the house of quality, the voice of the customer must be carried throughout the production process and each point should basically portray that. Three other house of quality are used to do this together with the first they carry out the customer voice from his initial expression through the design attributes to the manufacture attributes onto the component attributes and the process operations are considered. So, they are considered in such a way that you go straight by stage from the designer to the conception of the idea to procuring of the material to the manufacturing unit and so on and so forth.

So, in Japan all these four sets or house of so called consideration are used. The tendency in the waste is to use only the first one or the first one and two based on the level of

important. But, obviously, in Japan we know the level of quality consciousness is to such level that they want to basically analyze each and every and the customer requirement for with each and every primary tertiary and so on and so forth level of important from the designer and the manufacturing attributes which are there.

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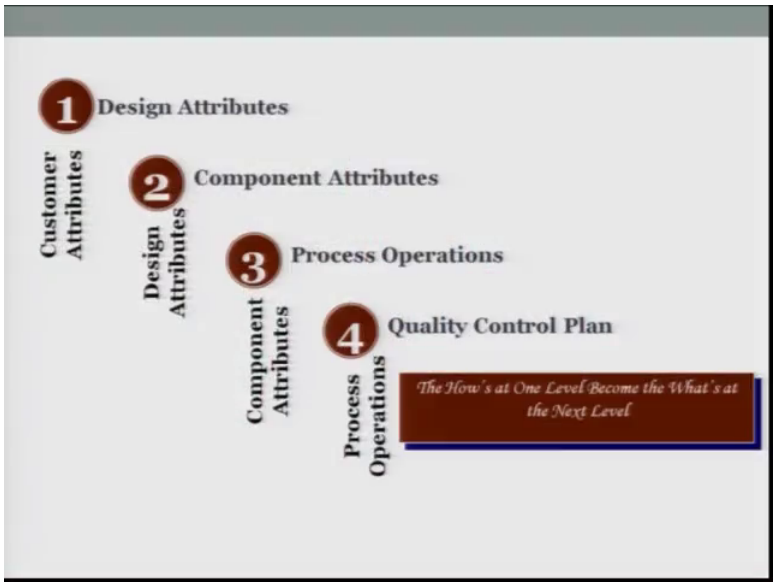

So, these are if you see the four set of combinations which are there. One is basically a combination of the custom attributes with the design attributes. Second is the design attributes with the component attributes. The third is the component attributes with process attributes and the and the fourth one is basically the process operations attributes to the quality control plan. So, when I say the Japanese are they consider that they go one at a time. So, if you see the first, second, third, fourth at each stage you basically consider both of them and in the next stage you are considering one of them such that the characteristic which I getting in the initial stage are all being brought down in the second stage such that there is a continuity in your consideration.

So, if you consider the design and the customer attributes, the design attributes goes to the second level. If you consider the component attributes and the design attributes, then the component attributes goes to the third level. If I consider the process operations and attributes along with the component attributes, then you see the process operation attribute goes in the fourth level. So, in a very holistic sense, all the combinations between the customer needs and the requirements with the design and the production and

the procurement of material everything from the point of view the attributes and the requirements are met to the maximum possible extent. Obviously, it will mean that you have to very thorough in your overall total quality management process, but it actually give you some positive benefit in the long run.

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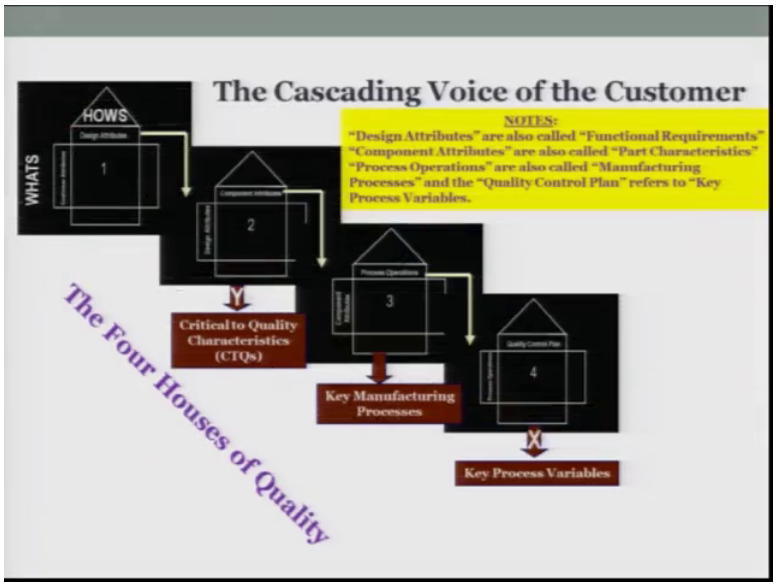

So, the cascading voice of the customers are design attributes are also called functional requirements and based on this we do. So, whats and hows are done at each stage. So, the four houses of quality as I mentioned consider them such that they go from one stage at a time and you consider all of the feedback considering the primary one which is stage one, one of them go into the stage two. Again between the combination in in in stage two one of them goes to the stage three and go so on and so forth. So, if you see the nodes are design attributes are called functional requirements which I am again repeating component attributes are also called part characterization based on which you find out the characteristics of each and a part of the components.

Process operations are called manufacturing attributes or the qualities. And the quality control plans refers to the key process variables which are very important in trying to basic analyze the design and manufacturing actual set of things which are very important for the customer. So, you go stage one, stage two, stage three, stage four and also as I mentioned that and if you see for example, stage two, stage three the component

attributes comes as one of the inputs for the for stage three and then process operation goes into stage four.

So, one thing is very important to note, the how and the needs basically the house of one stage goes and the need for the second stage. So, it proceeds in such a way that the logical sequence of relationship between each and every primary, secondary, tertiary attributes and the characteristics are very well developed between stage 1, stage 2, stage 3, stage 4 considering step 1, step 2, step 3, step 4, all the house of qualities which you have talked about. With this, I will close this fourteenth lecture and continue with more discussion in the fifteenth and so on and so forth.

Have a nice day, thank you very much.