Six Sigma
Prof. Jitesh J Thakkar
Department of Industrial and Systems Engineering
Indian Institute of Technology, Kharagpur

Lecture – 11
Quality Function Deployment (QFD)

Hello friends, hope you are doing well and becoming knowledgeable in the journey of Six Sigma, I hope you must have visited some company and studied some of the best quality practices they have implemented and compared it with what we are discussing. So, that can really help you to internalize your ideas and concept. Now, today we would see Quality Function Deployment as a part of lecture 11 of this series and this is a very very important tool at the design stage to see that my customer requirements are appropriately embedded in my products and services.

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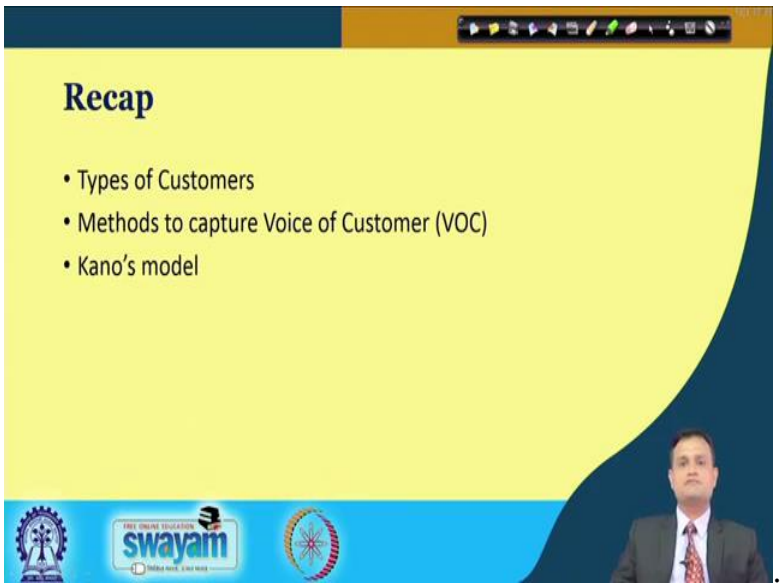

So, if you recall then last time we have talked about say types of customers, methods to capture voice of customer and Kano's model. So, the summary was that, you cannot treat all the customer requirements same. There is the hierarchy and typically there are basic or threshold requirement must be met customer will not think about it he will simply say this must be there. There is a performance requirement and this must be met competitively so that you can put your stem in the market and convince the customer for your technological offerings and superiority. The 3rd one is delighter that is latent hidden

need of the customer and if you can tap it you will really say have better customer loyalty. So, with this we have also seen that what are the ways to capture the voice of customer and how we can be more critical? But, now the question comes once I have captured the voice of customer what next? What to do with this? Because at the end of the day this voice of customer maybe in a very very common language express by the customer and the kind of product or service offering I have is mainly based on some of the technical specifications.

So, just by collecting voice of customer my journey does not end. So, next step is to convert this voice into appropriate technical specifications. And also see that I am competitive with respect to my competitors benchmarks in offering the various technical attributes as well as customer specifications and for that you need to do a detailed analysis through quality function deployment.

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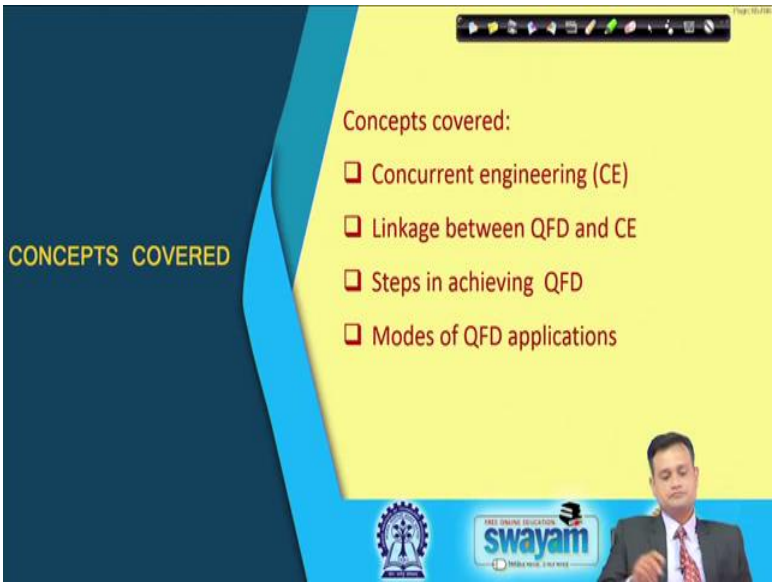

So, we will typically see the importance of concurrent engineering, linkage between QFD and CE and steps in achieving QFD, what are the different phases and modes of QFD applications. So this lecture is interesting and very very important because we are moving one step ahead and once have captured the voice of customer how really it can be converted into the technical requirements and embedded into my product design.

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So, just see this overview of the development process you have the design stage. So, development strategy, idea generation and screening, service package of product architecture formulation, production, feasibility. These are the issues you will try do explore at the design stage. You go one step ahead that is analysis stage. So, here service or product not profitable and you try to analyze that what is the detailed review of market potential and production cost. You go to the third phase that is development and here need to rethink the new offerings or production processes to meet this new set of offerings.

So, you would like to draw detail specifications, process design, marketing program, people training and testing and pilot runs and then you have the full launch of your product or service their market promotions, sales personnel briefed that training distribution process is activated and channelize old services or products are withdrawn. Because, you cannot make the customer really excited for your new offerings if still those traditional old products are present and you may have to withdraw and production of new offerings and ramp up. So, this is a cycle that typically you need to follow in the overall development and product launch phase.

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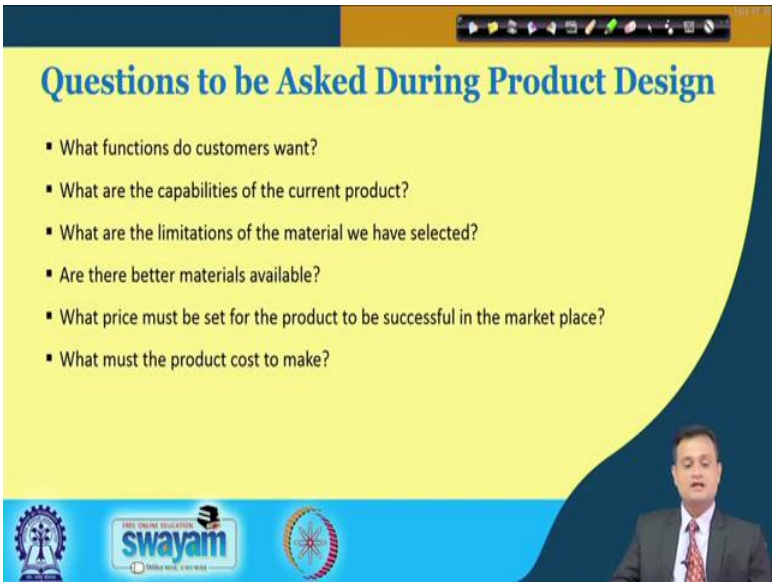

So, there are certain questions to be asked during product design. What functions do customer want? What are the capabilities of current product? Maybe your product or product offered by the competitor. What are the limitations of material we have selected? So, today you can see that if you want to go for a lightweight products there are variety of plastic ceramics many other material available. If you want to have a strength, then you can make use of composites. So many materials choices are available depending upon your performance requirement and the customer expectation. What are the limitations of the material we have selected and are there better material available?

So, this is more about material and product design and what price must be set for the product to be successful in the marketplace. Fine I am offering fantastic product robust product study product. I will say that my product will last for next 20 years and for that I am charging double the price. Will customer purchase? No. Customer would say why should I continue with the same feature for next 20 years when there will be lot of advancement typically if talk about material and technology, then laptop computers processing speed and has a new technologies are discovered. Why should I pay double the price for using the same product for next 20 years?

I would just share one example. I wanted to purchase let us say an apartment and I visited couple of projects. Project 1; the price of 2 BHK was let us say 7500000 and just 2 kilometers away same locality the price of apartment 3 BHK one additional bedroom,

it was 5000000. The quality of construction was good, the reputation of builder, constructing agency was same. When I enquired I found a mismatch in understanding the customer requirement.

So, the builder 1 who was offering me the apartment at 7500000 rupees smaller apartment 1 bedroom less. I asked him that why your prices are high? He said, sir I will included 3 additional features in this say apartment premise, number 1 swimming pool, number 2 terrace garden and number 3 a small theatre. He think that this 3 will delight my customer and he would be happy to pay 2500000 rupees more.

I look at the swimming pool it was just very shallow and cannot serve the purpose. I looked at the terrace garden would have hardly any utility because there was a long walk way and a very good garden just next to this location and third thing just 1 kilometer away, there is a multiplex theatre if this is available, why would I like to use such a small in house theatre for watching the movie? So, all the 3 offerings where not delighting me and if I just put my 2500000 rupees in bank, then maybe I can earn let us se 200000 rupees of interest and this interest I can have a membership of very good club. So, a customer will not feel delighted and when I enquired deeper, he agreed that almost this scheme was launched 4 years back and still today I am left with 50 percent unsold flats.

So, you can see here that you have misunderstood the customer requirement and something you which you considered as a delighter will have a negative impact. So, what must be the product cost to make?

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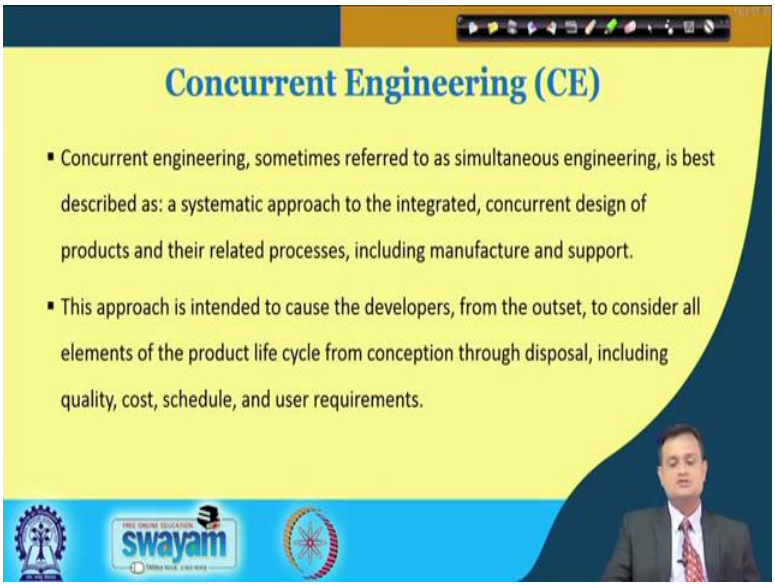

So, there is a concept of concurrent engineering and as I said that it is not your external customer, but your functional managers people working on the processes, sales force marketing people they are very very important source of getting input on customer experience and that is where the team works in a cross functional environment as a concurrent engineering and designer process engineer functional managers customer putting together they try to create new novel and cost effective ideas for better product design and offerings.

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So, typically concurrent engineering it is designing for assembly, availability, cost, customer satisfaction, maintainability, manageability, manufacturability, operability, quality, safety and social acceptability. You just see long list. And if you as an engineer designer working in isolation is trying to built all these features into the product or service you will miserably fail. So, you need to have the inputs of various agencies, various functions, customers in order to see that your product get tick mark on all these various dimensions.

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So, concurrent engineering is about faster development and reduction in time to market. Remember as per authentic service, it has been realized that if you are just 4 months to 6 months late in launching your product, you will almost lose 50 percent of the profit which you may earn during the entire life cycle of the product. Your product will always receive the second level attention substandard attention and the profitability what you will have compared to your competitor will be almost 50 percent less. So, you cannot compromise with this and the only way is the concurrent engineering.

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Now, when we talk about QFD which is the main focus of this particular lecture then quality function deployment basically provide the systematic approach and act as an enabler to concurrent engineering.

So, typical this tool is oriented towards a team of people representing the various functions processes and typically they are involved in the product development and let me have the experience people for marketing, design, quality, manufacturing product support sales and service and so on and it is basically say front end process. So, as I mentioned try to make your product as much competent as possible right at the design stage.

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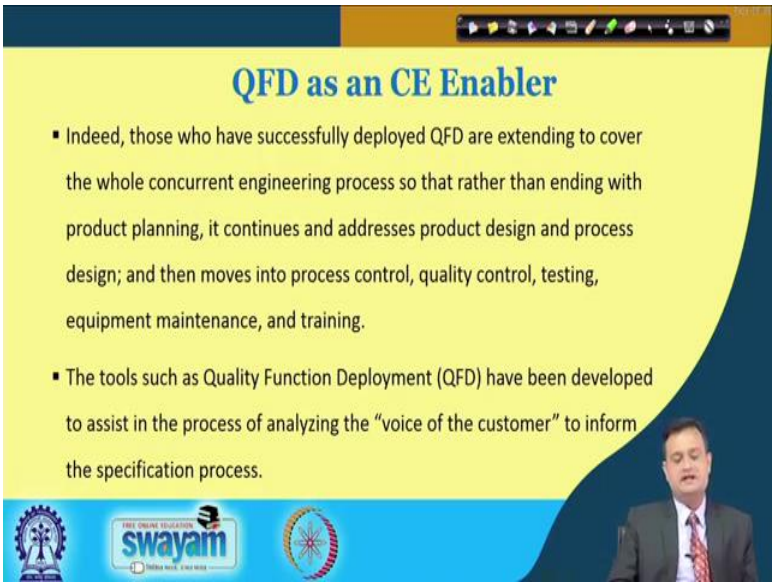

So, QFD typically is an enabler to concurrent engineering and this kind of tool have been developed assist the process of analyzing voice of customer. So, I am going one step ahead in my journey and what we discussed last time voice of customer and identification of various needs using the Kano concept. Now, we are advancing one step how to integrate those with the product design and write at the concept stage.

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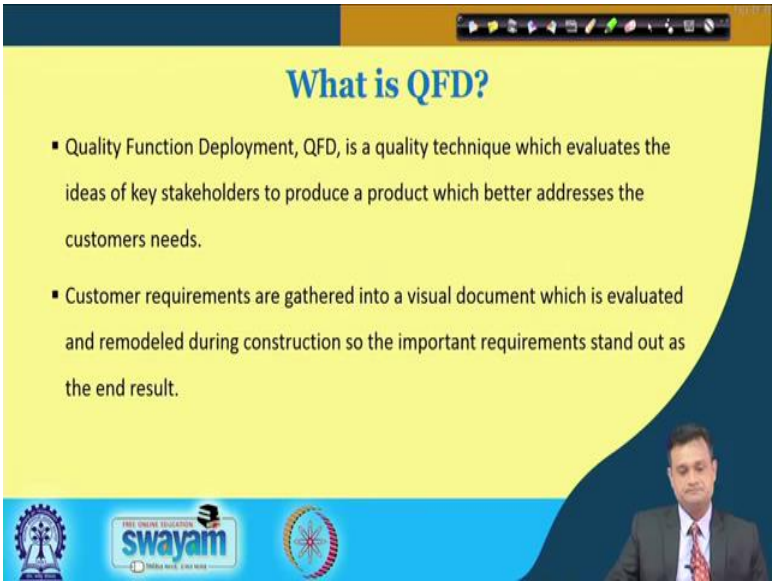

So, QFD typically I can refer technical definition is a quality technique which evaluates the ideas of key stakeholders internal and external to produce the product as well as

service, which better address the customer needs and the requirements. So, you put it in the form of a structure format and that helps you to visualize your product which can lead to maximum satisfaction at the concept stage.

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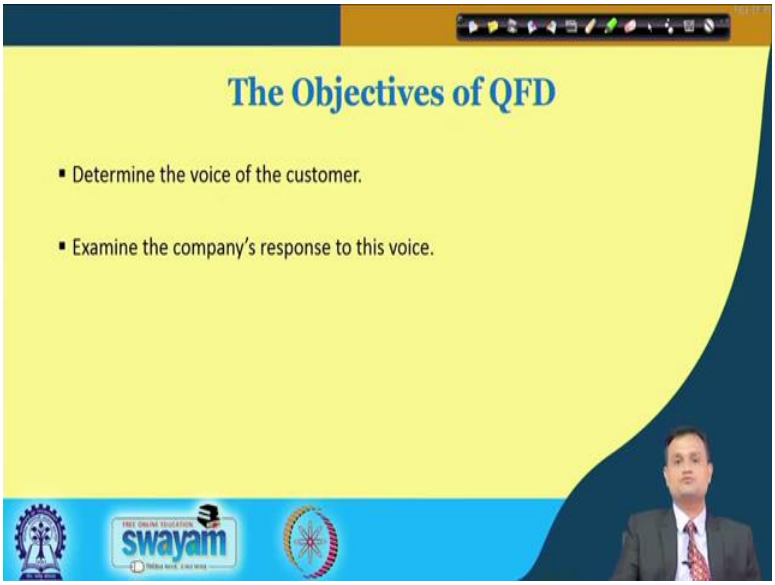

So, determine the voice of customer examine the companies response to this voice. These are the two main objectives of my QFD.

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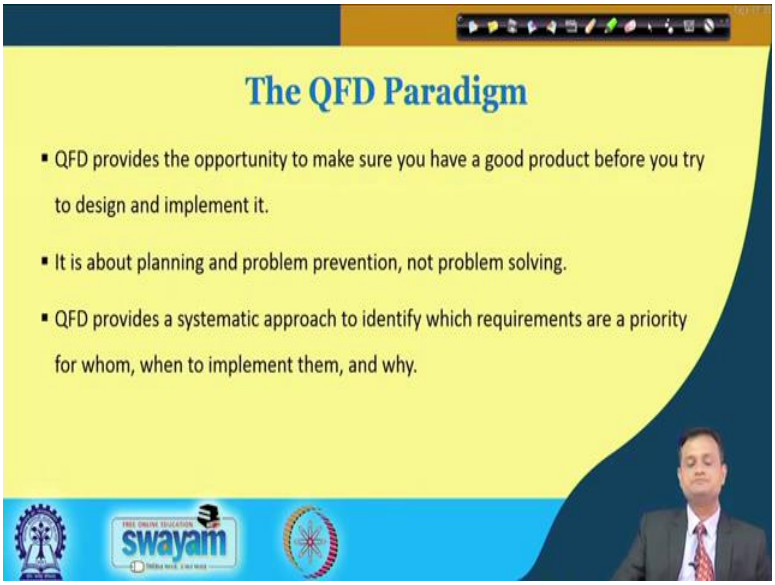

And this provides an opportunity to make sure that you have a good product before you try to design and really implement it. You yourself as a team should feel satisfied that

yes I have developed a product which can really offer better customer satisfaction and service. It is about planning and problem prevention and not problem solving. So, it is a preventive tool and provides a systematic approach to identify which requirements are priority for whom and when to implement them and why.

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So, let us see that QFD is implemented in a systematic phase wise manner and there are total 4 phases of QFD, One is product design, design life cycle, process planning, implementation life cycle, then product planning we are going one step ahead that is product planning including house of quality which is the central part requirements engineering life cycle and finally, your process control that is the testing life cycle.

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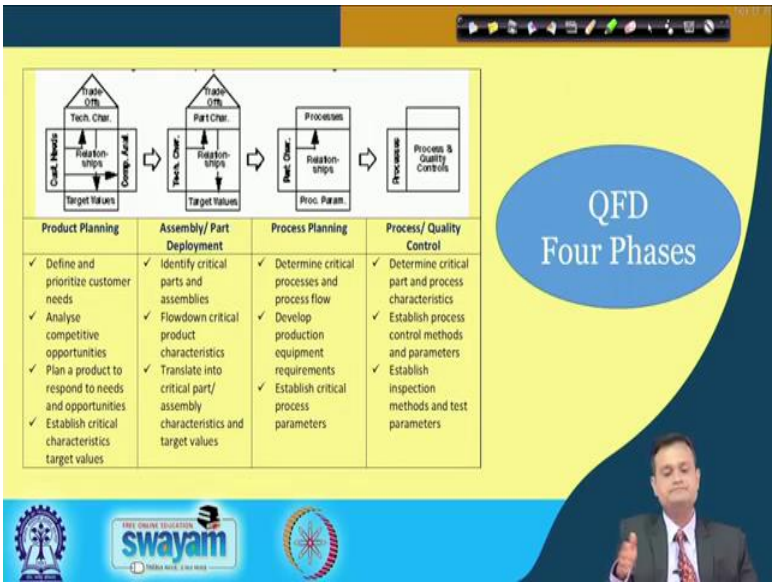

So, these are the 4 different phase of the QFD you can better visualize that what exactly we are trying to tap in the different phases. So, if you see the 1st phase product planning. Typically, I am talking about this particular, then define and prioritize customer needs, analyze competitive opportunities plan a product to respond to needs and opportunities and establish critical say characteristic target values. If we look at the another one, then the 2nd one is your assembly part deployment. So, identify critical parts and assemblies, flow down critical products characteristic translate into critical part assembly characteristic and the target values.

The 3rd one if we see then it is the process mapping. So, determine critical process and process flow because; I have to see that my product gets converted through various processes into the final product. Develop production equipment requirements depending upon the customer requirement identification, establish critical process parameters. And finally, say the 4th phase that basically talks about process quality control. So, determine critical parts and process characteristics, establish process control methods you can have simple SOP checklist kind of method or you can deploy the statistical quality control in establish inspection methods and the test parameters.

So, here you can see that QFD gets rolled out and subsequent phases we try to translate the requirements of the outcomes of the previous phase into mall details phase and then that helps us to really convert our product which is at the concept stage into the reality.

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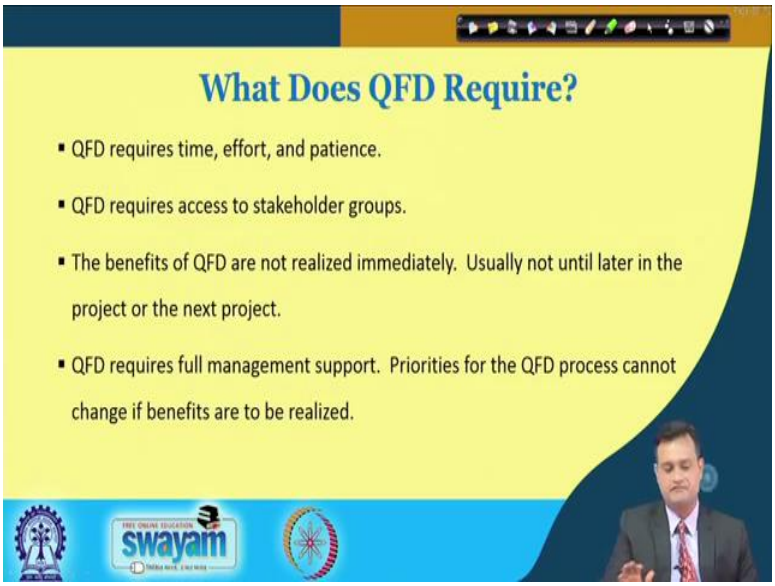

So, we can appreciate that there are 4 important phrases in QFD and typically what does it required? It requires time effort and passions. I will show you small example for this interaction small classroom discussion, but I have seen the QFD. If you unfold the role then it may cover let us say all the 4 walls of the room such an extensive exercise it is and if you do such a detailed exercise right at the design stage concept stage, you can really do wonder in terms of developing the competitive products. QFD requires access tool stakeholder groups. Benefits of QFD are not realized immediately, usually not until later in the project or the next project and this particular tool requires full management support. Priorities for the QFD process cannot change the benefits are to be realized.

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So, these are couple of things that we have to appreciate and there is a small history of QFD. The first time 1966 Bridgestone tire corporation is the very well-known corporation first used a process assurance table. 72 the process assurance tables was retooled by Akao to include QFD process. 72 Kobe Shipyards typically of Mitsubishi Heavy Industries began a QFD oil tanker project and 78 Kobe shipyards publish their quality chart for the tanker and then after various versions variants templates of QFD are popular and industries they are using it extensively to make the product as much robust capable at the concept stage.

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So, we have discussed about various trends and benefits of QFD that it can tap the customer requirement and right at the design stage it gives me the satisfaction that my product will have better capability to perform in the market.

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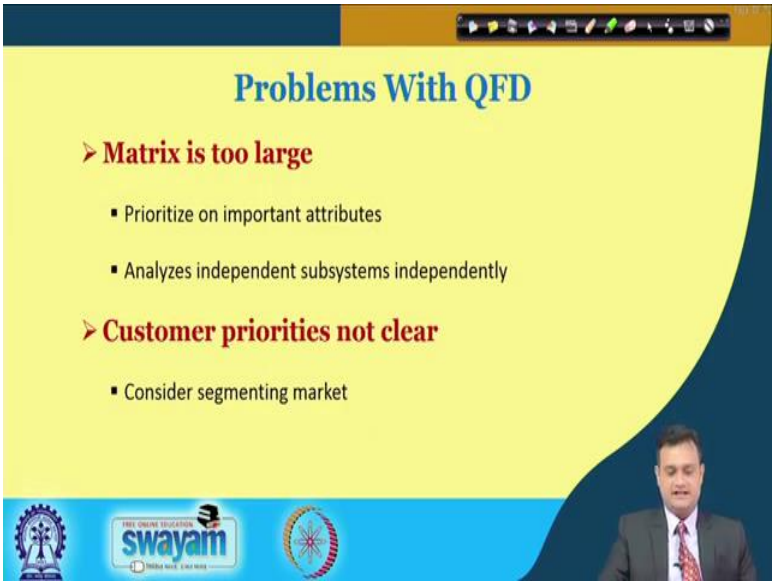

There are some problems with the QFD and as I said that if you just open the QFD paper roll, then it may cover all the 4 walls of the room and it is rigorous interiors exercise so you have to invest the time and the people they have to be say passionate in such exercise. So, customer priorities are not clear then consider segmentation of the market and then you can work on the QFD process.

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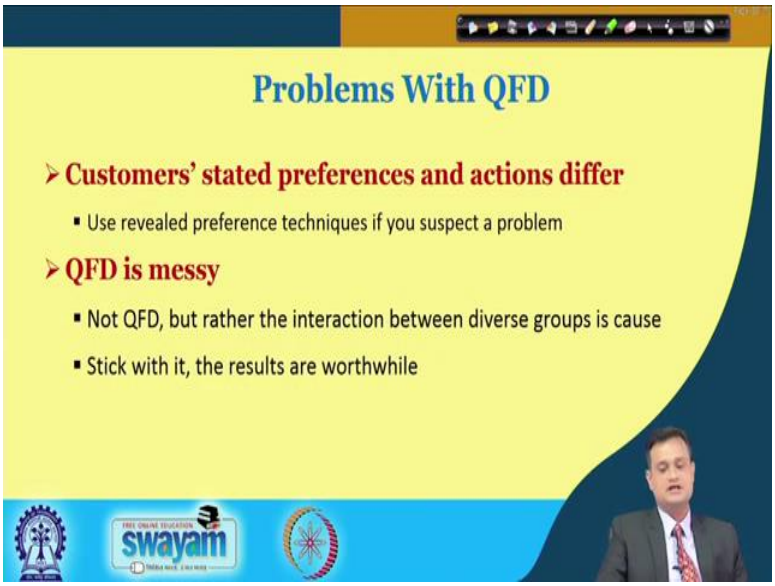

Customers stated preferences and actions differ.

So, here use revealed preference techniques if you suspect a problem. So, customer stated preference is an action differ. So, there is dichotomy when I see the consumer preferences and what exactly they are trying to do or see. So, this is somewhere you can go for the preference techniques and QFD is messy. So, not QFD, but rather the interaction between diverse group is cause. Stick with it the results are worthwhile.

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So, we have seen that it works on customer requirement and step by step it roles out the customer requirement into the technical requirement and sets the benchmark.

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So, there are certain important elements technical specification, which have voice of engineers or designers that is calls "hows", the typical term used in QFD. Interpretation of what is in terms of technical specification or design requirements that is called designers' language, hows how will I meet these requirement.

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Potential choices for product features then each “whats” is item must be converted to “hows” customer will tell what is required what is not required, but that must be converted into how it can be met. They have to be exorable quantifiable measurable, you want to have this much of the efficiency of the automobile, speed, space, agronomies and so on. Free of technology and implementation creates flexibility for design.

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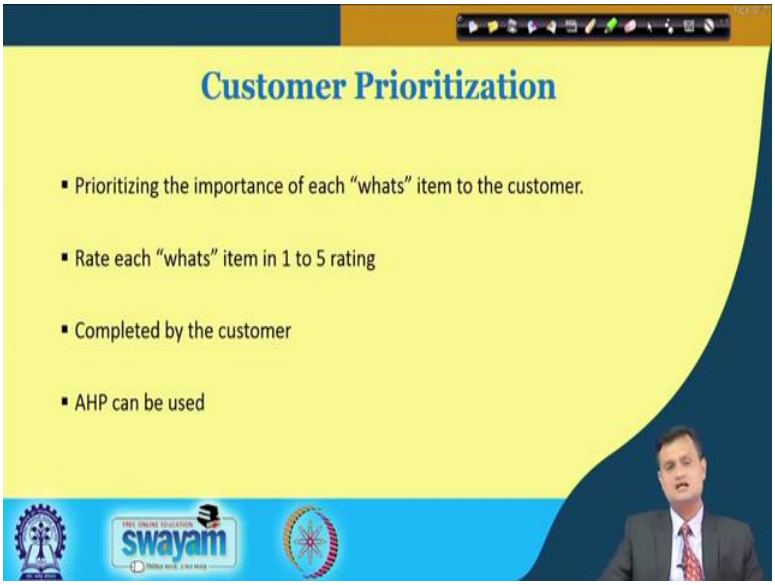

Customer prioritization, so, typically prioritizing the importance of each whats. So, when I said customer voice it is basically whats what they are expecting and you can rate each what is on a scale of 1 to 5. You can choose your scale otherwise you can get it 1 to 5 and this is completed by the customer you can also use multi criteria decision making techniques like Analytic Hierarchy Process AHP topsis in order to figure out the customer requirements.

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Customer market competitive evaluation that is another element of my QFD. So, comparison of the developers product with the competitors product. So, I also want to compare my conceptualize product with my competitor and just see the trade off that how close we are in terms of offerings product features as well as the price. So, this you can rate on 1 to 5 and identify the gap.

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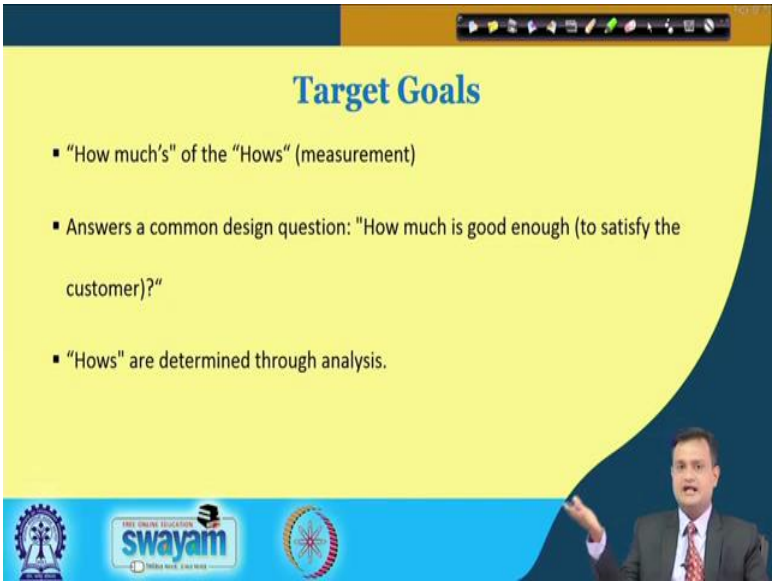

There are target goals how muchs or hows measurement. So, here answers the common design question. How much is good enough to satisfy the customer? I would not like to

say spend 1000 rupees on purchasing 1 water bottle; obviously, I am not talking about a silver bottle or gold bottle, but let us say if I want to purchase a simple plastic bottle; however, excellent it maybe I would not like to spend 1000 rupees.

So, typically I need to figure out that my designer team maybe obsessed with offering too many features, too much safety, but what is that which is adequate performance and that can satisfy my customer.

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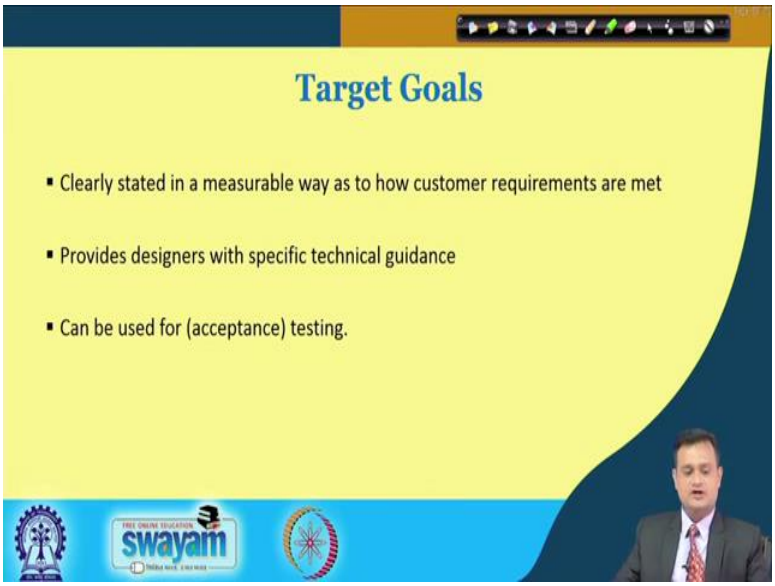

So, target goals clearly stated in a measurable way and used for accepting testing.

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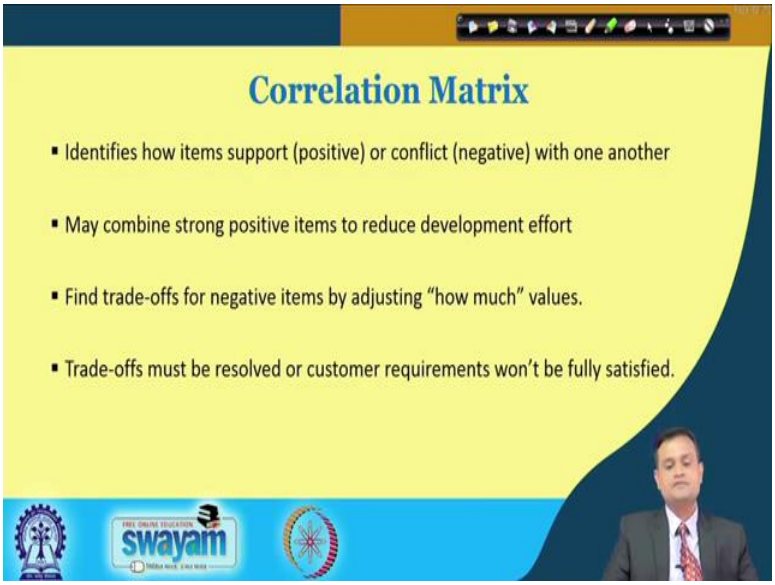

There is a correlation matrix this is another element of QFD and typically this identifies how items support or conflict with one another. How I want to build in? I have technical specifications, but my correlation matrix will try to see that suppose you are let us say providing more space in the automobile 4 wheeler or you are making your 4 wheeler bigger then what consequences it will have on mileage. What consequences it will have on aerodynamic shape and other aspects?

So, here there is a need to see the correlation among the technical features and how much is to be decided through the trade off?

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So, technical specification competitive evaluation is also important and similar to customer market competitive evaluation that is how that is whats, I would also like to see that what my competitor is offering? So, suppose my competitors says a restaurant that I will deliver a medium size pizza in this price within 30 minutes, I also need to see that what could be my offering.

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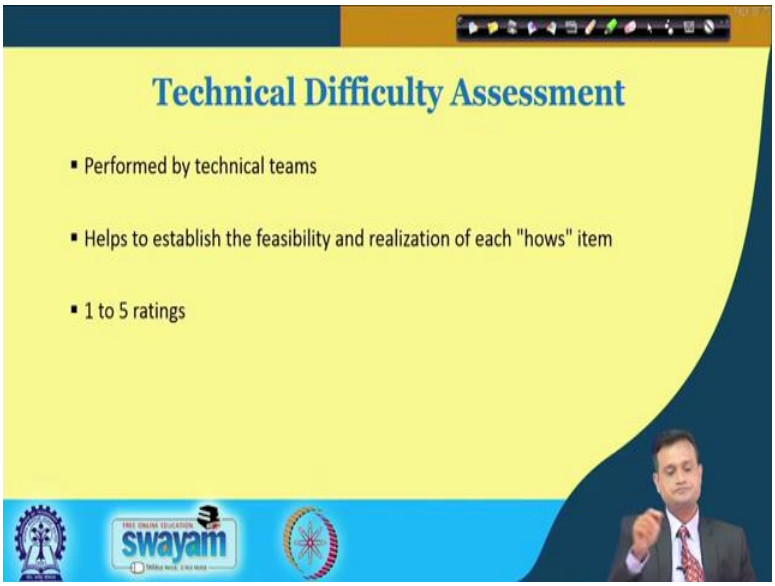

Technical difficulty assessment perform by technical teams and this helps to establish the feasibility and realization of each hows item. Many a times it is difficult to get the benchmark from the competitor, but if you can little bit study, then you can at least get some reasonable benchmarks to compare your whats and hows typically customer requirement and technical specifications.

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Then you go for the overall importers ratings. So, only time when math is required. So, practitioners they always like to use the approach, which is simple, intuitive in nature helps them to provide their view include their views and this is where the QFD is.

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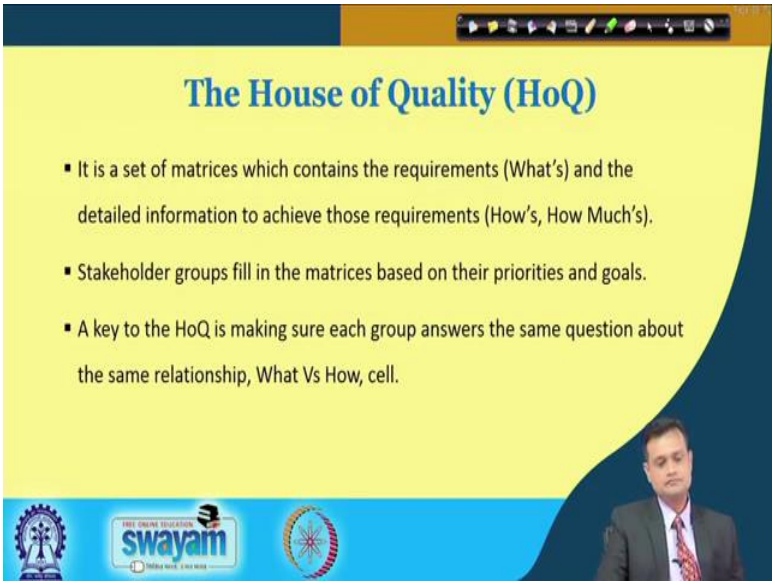

House of quality, typically it is a set of matrices which contains the requirements whats and the detailed information to achieve those requirements so, how's and how much's. So, house of quality I will just tried to present for one product is the central part of your QFD and a key to HoQ is making sure each group answers the same question about the same relationship what verses how cell.

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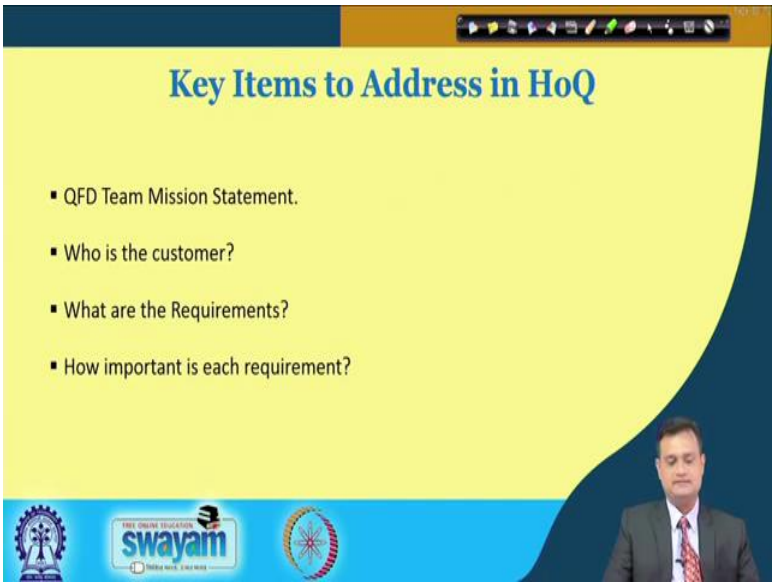

So, key items to address in HoQ, QFD team mission statement, who is the customer what are the requirements and how important is each requirement.

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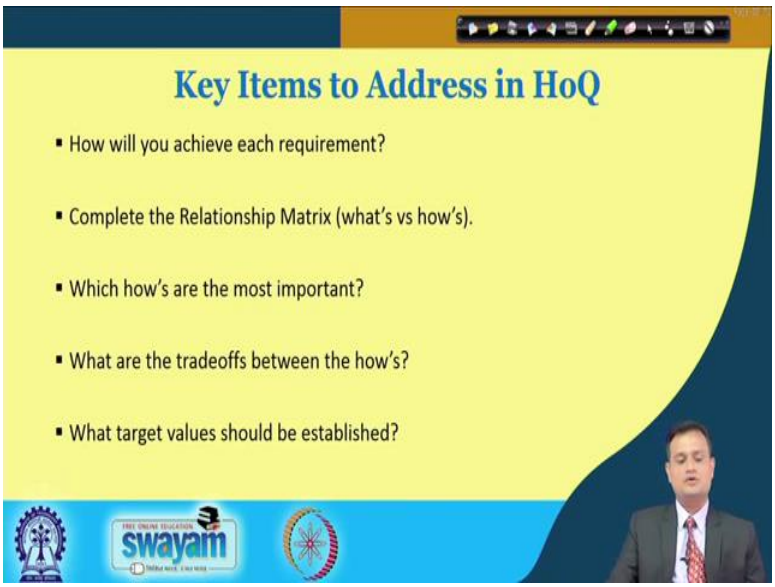

So, couple of more things that you would like to include in your HoQ, how will you achieve which requirement complete the relationship metric, which hows are the most important? What are the tradeoffs between hows and what target value should be established?

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Let us see the example so you get a fair idea on house of quality which is the central part of quality function deployment.

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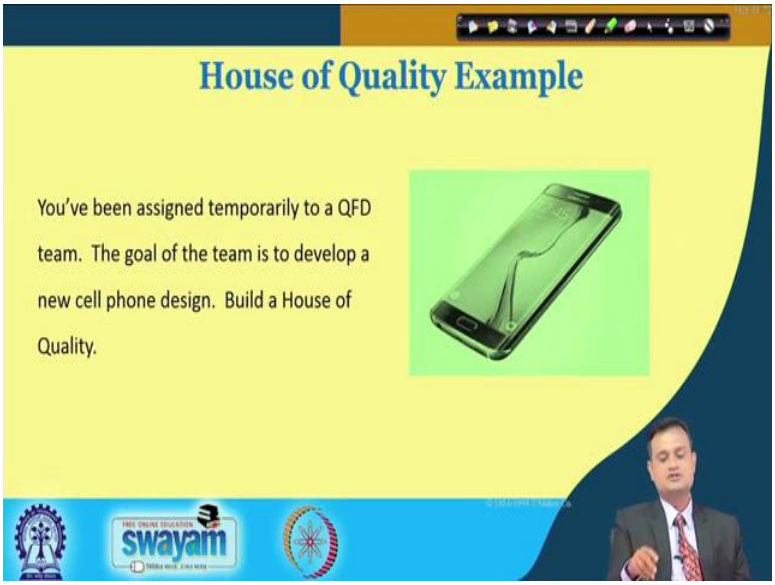

So, I have just selected a product we use day in day out mobile and let us say you are supposed to develop house of quality for this particular product mobile.

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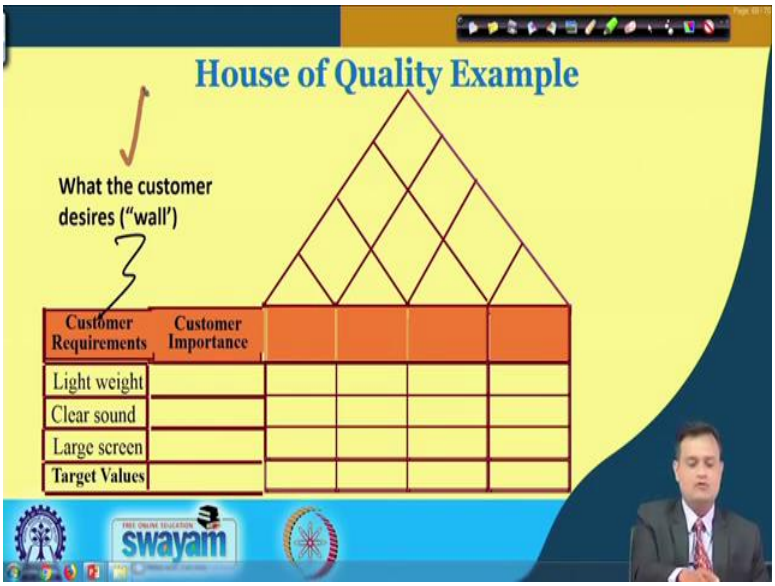

So, just see this is the skeleton structure which I follow. And you can see here that there is what the customer desires and this is something I have put it in the form of customer requirement.

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So, with this templates, say we can fill up the various requirements like I want lightweight mobile, I want clear sound, I want large screen and some customer importance based on survey or customer interaction I am just putting it.

Now, if you see the engineering say this is the part I am referring engineering characteristics to satisfy the customer requirement. So, you cannot just satisfy the customer requirement once it is collected in the verbalism. You have to built in through appropriate technical features. So, I would like to put here, you can see this fiber parts, metal parts, phone apps and network IC. I consider through cross functional concurrent engineering thus these are some of the component or technical specifications that I need to look after in order to meet the customer requirements.

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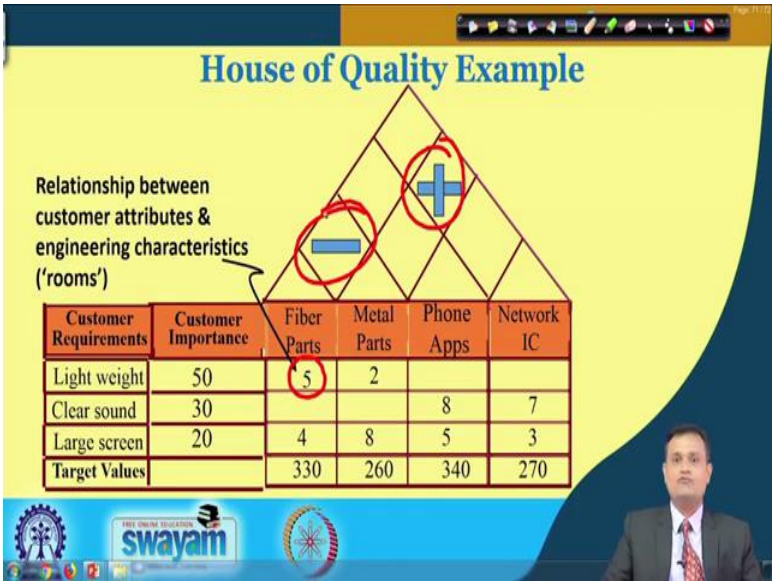

So now, we see that some numbers are filled in and you have let us say for example, the number 5. So, this number 5 says that. So, for my customer requirement lightweight is concerned and fiber part my typical rating is let us say 5. Similar way you can see phone apps metal parts so, meeting a perticular requirement what is the rating of a particular technical specification. You can also see here this plus and minus.

So, output plus and minus I am just presenting a very, very elaborated say display of house of quality. So, that you can appreciate and then I will show you the exhaustive example. So, plus and minus means this two requirements they are positively related, they are negatively related. So, if there is a positive synergistic then I may try to improve more upon this correlated requirement. If there is a negative impact, then I have to see that in what way the negative impact can be minimized.

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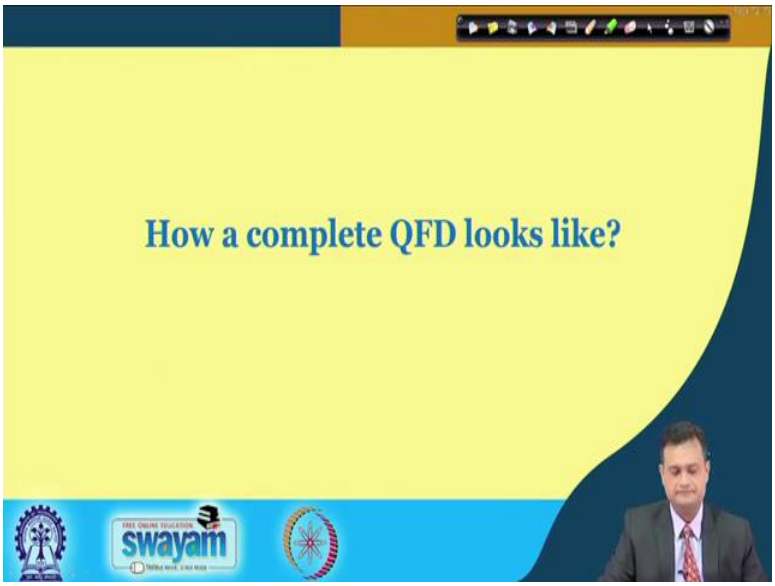

So, this is about a say my house of quality. Now, you would be eager to see that how a complete QFD looks like? What I have shown is just a preliminary house of quality, but if you develop the complete QFD, which is quite rigorous and sometimes clumsy process, then a typical complete QFD would look like this.

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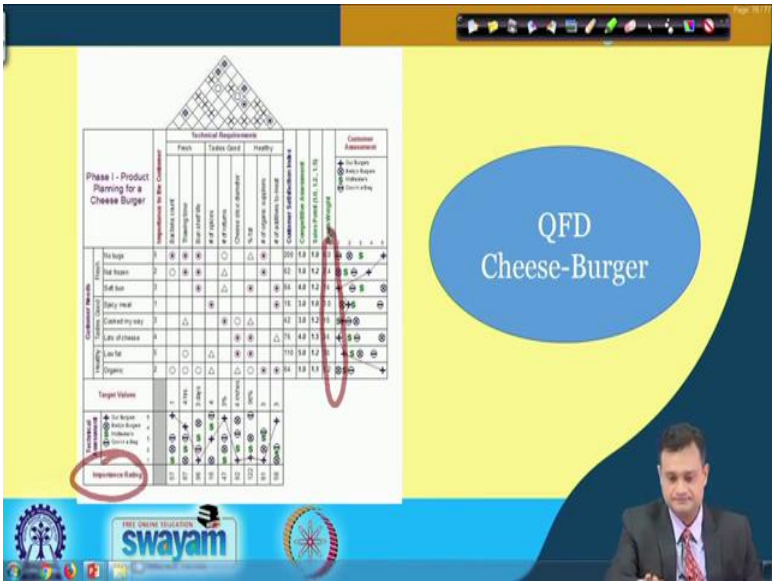

So, here you can see that this QFD is developed for a very very generic product like Cheese-Burger. On this side I have put the customer needs like no bugs, not frozen, soft bun, related to freshness of the burger then taste good so, spicy meet then cooked my

way, lots of cheese then healthy, low fat, organic and so on. Similar way here you will see that I have put the technical specification typically called hows. How will I need this whats? And here it is say various requirements like one shelf life, then different types of spices you are using and cheese diameter or the quality and so on and what do you see here in between that I have used the symbols to relate my what is and hows and typically this symbol represent the strength between whats and hows.

So, you have a freedom to choose your own symbols or rating and then you can see that find these 2 customer requirement and technical specification how strongly they are related. Now, if you see further, then I put here roof of my HoQ and as I mention I have selected some symbols to depict strong, weak and moderate relationship among the technical specification typically hows and that will better help me to see that when I am making a design or I am producing a final product how the different things will interact with each other.

Also you can see here that I am providing customer assessment and here I have considered scale of 1 to 5 and how considered 4 different types of say benchmarks or comparison one is my own burger my product and three they are other competitors and I am just trying to compare each particular customer requirement of my product with respect to my competitor on a scale of 1 to 5.

Similarly, you can see here that I am trying to set the target value as well as I am trying to compare the technical specifications assessment with respect to say competitors of my product and as a result I am receiving the importance rating here and you are getting let us say needs weightages here. So, this is something complete house of quality exercise and you can really then figure out that what is to be added what is to be deleted and in what way you can really say make your product more competitive? As I mentioned there are 4 phases in QFD this is not the end you have to roll it out and subsequently you need to figure out the process requirements, part and assembly requirements and then finally, you should see that your product converges to the initial concept or expectations of the market.

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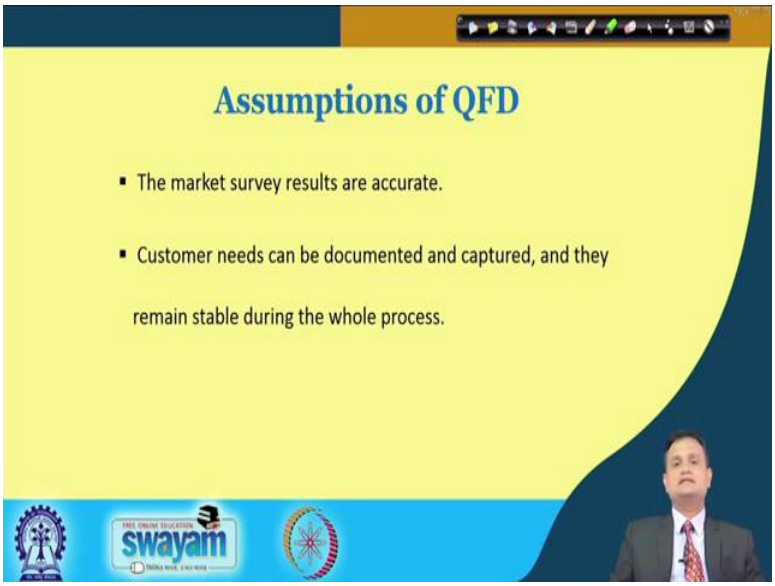

So, with this understanding we can say that there are certain assumptions of QFD. That market survey results are accurate; obviously, if you cannot tap the customer requirement properly, you will fail miserably and customer needs can be documented and captured and their remains stable during the whole process. We agree that customer requirements are dynamic, but at least it should remain stable for a particular period of time.

So, I would like to end the session with couple of think it question which can give you a quick review of the discussion and some internalization of the concepts.

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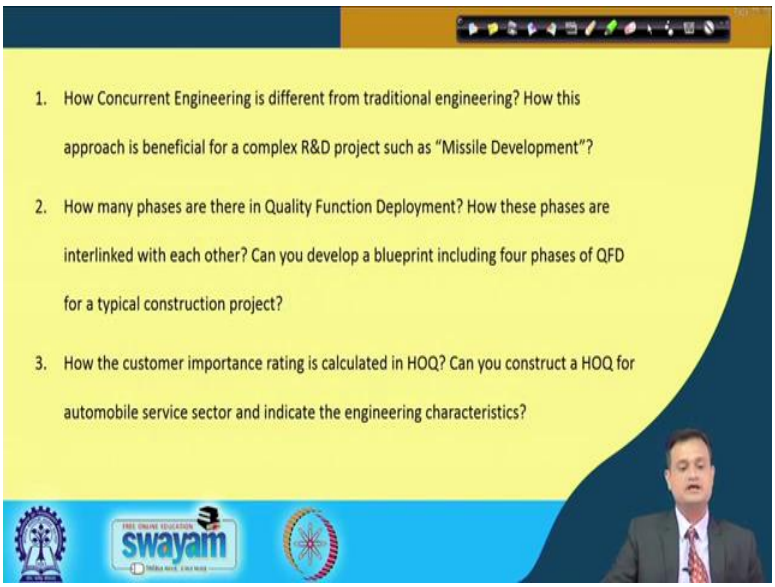

So, how concurrent engineering is different from traditional engineering? And how this approach is beneficial for a complex R & D project such as missile development? Just think 2nd question how many phases are there in QFD and how these phrases are interlinked with each other can you develop a blueprint including 4 phases of QFD for a typical construction project? Consider a very small construction project maybe say constructing your house and can you roll out the 4 phases of QFD and 3rd how the customer importers rating is calculated in HoQ, can you construct HoQ for automobile service sector and indicate the engineering characteristic?

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So, with this I would say that there are couple of references, we have also publish the paper in QFD in 2006 you can refer the QFD develop for educational institution and see that how the customer requirements were identified and related with technical requirements of the institute.

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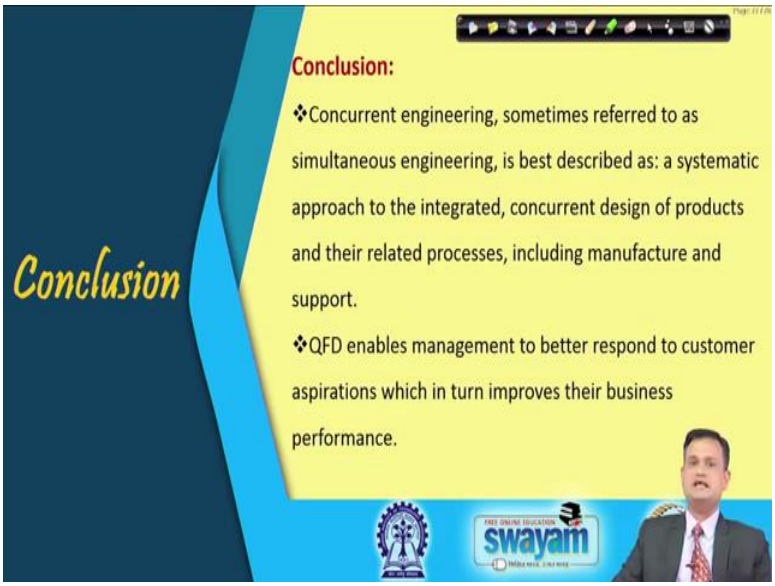

So, c is an important tool and which really helps you to reduce your cost and helps you to have better product in terms of customer expectation satisfaction right at the design stage and QFD is a means to achieve realize the real benefit of the concurrent engineering.

So, thank you very much and we have discussed a very, very important topic today quality function deployment. Keep revising brushing up your concepts, relate them and try to see that how you are advancing in your journey once again visit a company considered a real life project and try to develop one small QFD as an exercise. We will meet again with a new topic.