Automation in Production Systems and Management
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Lecture - 15
Concurrent Engineering Techniques

During this lecture session – the fifth one.

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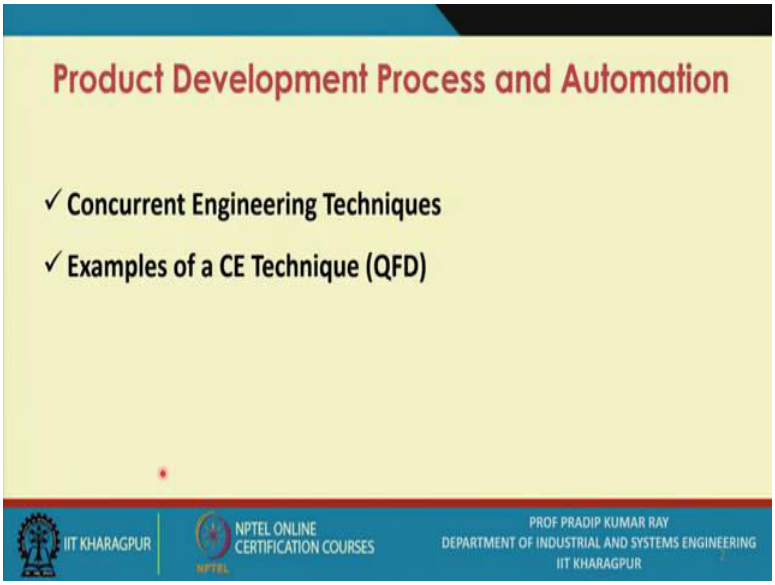

I am going to discuss one particular technique of concurrent engineering called quality function deployment in detail.

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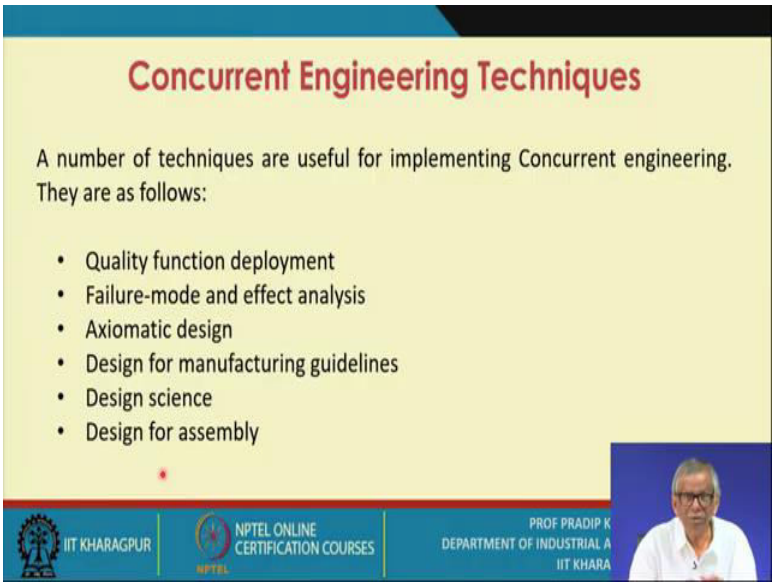

And what are the details of concurrent engineering approach, Including its implementation framework.

If you can implement or if you use this quality function deployment technique for your organization, this integration of for the different functions will be done automatically.

Failure-mode and effect analysis that is also widely used. Axiomatic design, There is another approach. Design for manufacturing guidelines, so there is another technique; design science, designed for assembly.

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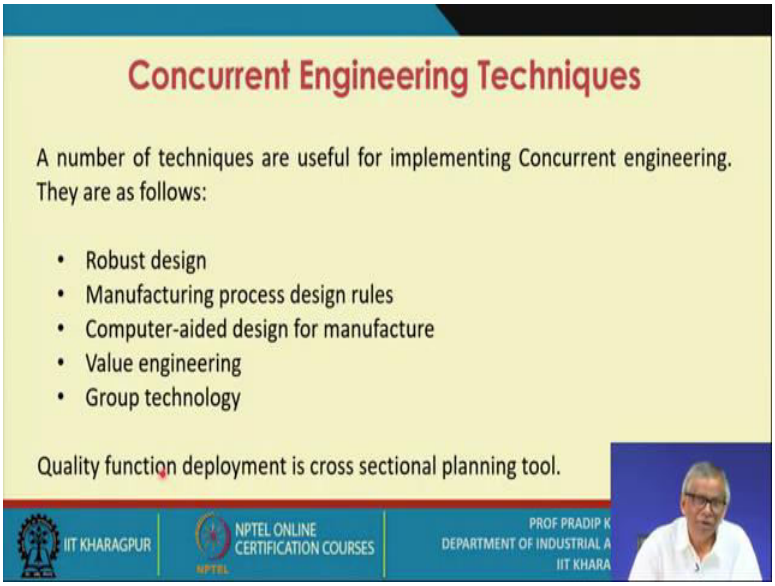

Robust design, if you want to implement there is a method called Taguchi method. Many Japanese companies they have adopted Taguchi method. And by using Taguchi method, You can make your product a robust one.

So, what is the robust design? The robust design ensures that the performance of the product is will remain at the maximum level even if the product is influenced by not only one type, but several types of uncontrollable noise factors, Like car battery you use.

Manufacturing process design rules, computer-aided design for manufacture, and value engineering, group technology. if you want to create flexible manufacturing system as an automated system, you have to convert your manufacturing system from the traditional one to cellular manufacturing system.

So, you find that there are several list of the techniques which are used for concurrent engineering application. Now, just out of all these techniques, let me discuss the quality function deployment.

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Referred to as a cross sectional planning tool, while you use this quality function deployment, it involves all the three departments – design department, production department, post-production department. And you will also interact with your competitors. So, this is also a Japanese technique.

Quality functional deployment, it is basically a planning tool. So, the major problem with the traditional product development process is that customers and engineers speak different languages. A customer might express a desire to own a car that is easy to start. The translation of this requirement into technical language might be car will start within 10 seconds of continuous cranking. So, this is an example.

Or, a requirement that soap leaves my skin feeling soft that is a customer requirement. Demands translation into, positive hydrogen concentration pH level or hardness specifications for the bar of soap. So, this is a technical specifications and that is basically the customer requirements to how to link them.

So, these are referred to as a voice of customers and voice of customers must be converted into the technical specifications.

The actual intended message can be lost in the translation and subsequent interpretation by design or production personnel.

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The Japanese developed an approach called **quality function deployment (QFD)** to meet customers' requirements throughout the design process and also in the design of production systems. QFD is a planning process to guide the design, manufacturing, and marketing of goods by integrating the voice of the customer throughout the organization. Through QFD, every design, manufacturing, and control decision is made to meet the

expressed needs of customers. It uses a type of matrix diagram to present data information

So, through QFD, every design, manufacturing and control decision is made to meet the express needs of customers, is linking with the customers. It uses a type of matrix diagram to present data information. And this is basically called the House of Quality.

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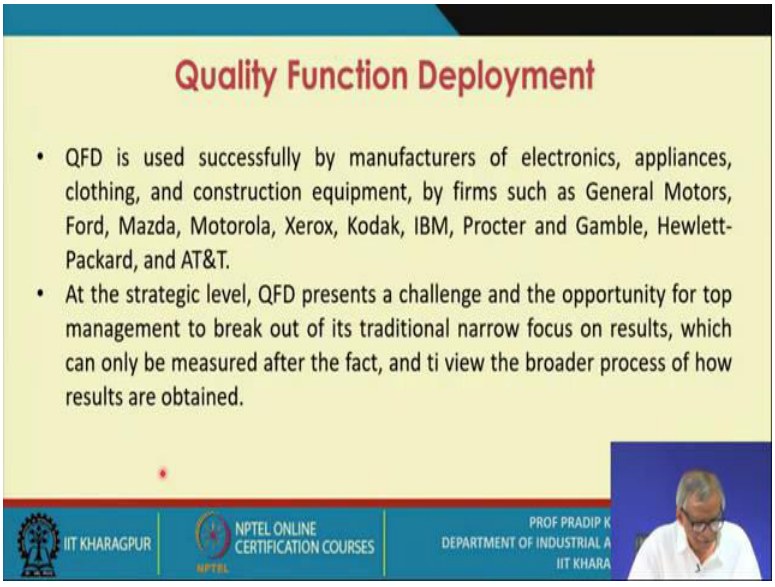

QFD is used successfully by manufacturers of electronics, appliances, clothing, and construction equipment, by firms such as General Motors, Ford, Mazda, Motorola, Xerox, Kodak, many other companies IBM, Procter and Gamble, Hewlett-Packard, and AT and T, So, they have all implemented QFD.

And so at the strategic level, QFD presents a challenge and opportunity for top management to break out of its traditional narrow focus on results, which can only be measured after the fact, and to view the broader process of how results are obtained.

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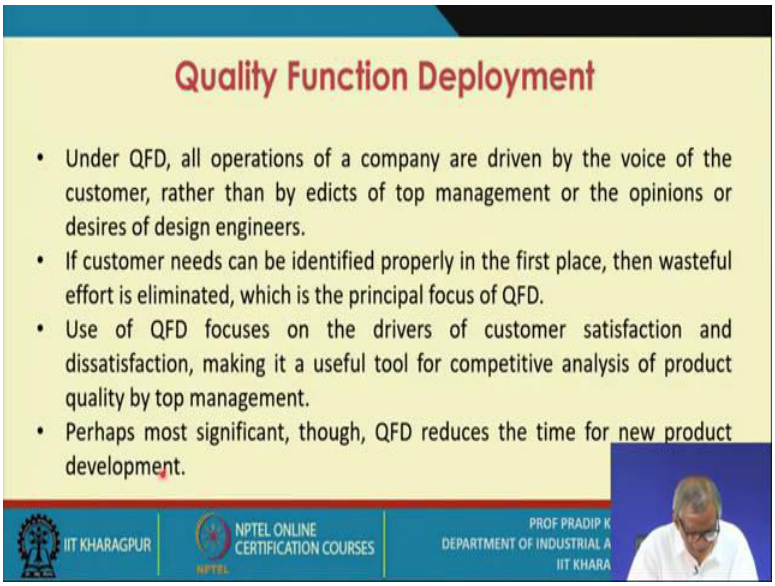

Under QFD, all operations of a company are driven by the voice of the customer, Rather than by edicts of top management or the opinions or desires of design engineers. So, if customer needs can be identified properly in the first stage, then wasteful effort is eliminated, which is the principal focus of QFD.

If customer needs can be identified properly in the first place, then wasteful effort is eliminated, which is the principal focus of QFD. Use of QFD focuses on the drivers of customer satisfaction and dissatisfaction, making it a useful tool for competitive analysis of product quality by top management. Perhaps most significant, though, QFD reduces the time for new product development.

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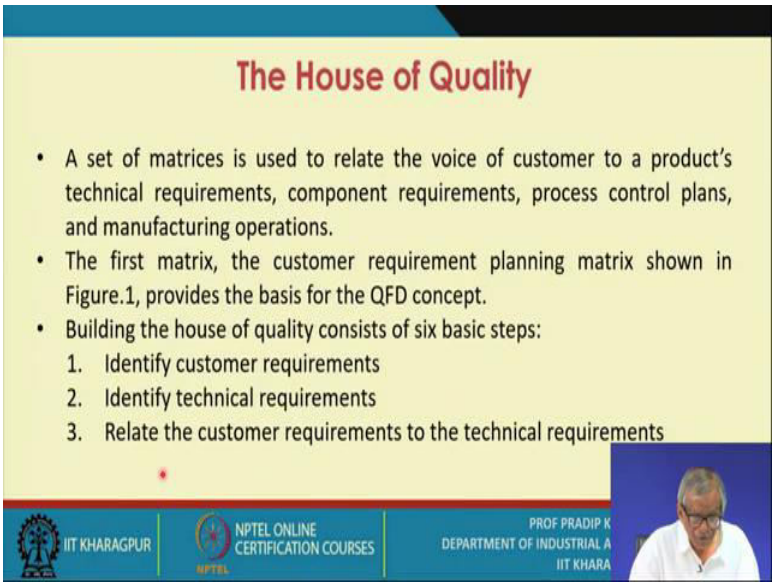

House of quality is a set of matrices to relate the voice of customer to a product's technical requirements or technical specifications, component requirements, process control plans, and manufacturing operations, one after another .

So, all the functions are to be linked and ultimately you reach at the shop flow level that is where you carry out different kinds of manufacturing operations.

The first matrix, the customer requirement planning matrix shown in figure 1 provides the basis for the QFD concept. Building the House of Quality consists of six basic steps. First one is identify customer requirements, the next stage – you identify the technical requirements, third stage – relate the customer requirements to the technical requirements that is the matrix is formed.

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Then the fourth stage- conduct an evaluation of competing products or services. When you create the house, the foundation is to be made first, And the foundation must be made very strong.

So, this foundation is defined in terms of competitive advantage with your competitors, So, conduct an evaluation of competing products or services. Evaluate technical requirements and develop targets. Determine which technical requirements to deploy the remainder of the production or the delivery process.

In House of Quality, you have to create the foundation, the side wall, and create the rooftop.

To illustrate the development of the House of Quality and the QFD process. I have taken up one example. If you have to design a new fitness center in a community with two other competing organization and in that same area or in the same community or in the same place other two other competitors are there.

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How to create this House of Quality? Referring to the figure of House of Quality, we have voice of customers, the technical requirements, and the relationships matrix, the priorities of technical requirements. So, here this is your foundation, and this is your rooftop. That means, you have several technical requirements. So, you go for design optimization.

So, here are the priorities of customer requirements and competitor evaluation. the competitors evaluation is for the technical requirements, And these technical requirements are to be fulfilled.

So, if you opt for a specific design it could be a optimized design, And here what you try to do, you are competing with your competitors. If you are reaching to your customers, That means, you are bypassing your competitors.

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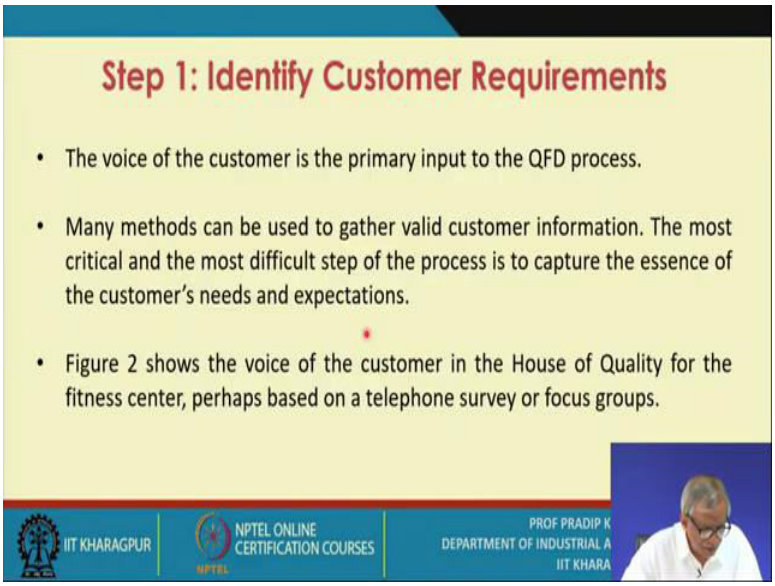

The voice of the customer, the step 1 is to identify customer requirements. Like the voice of the customer is the primary input to the QFD process. Many methods can be used to gather valid customer information, there are many approaches. The most critical and the most difficult step of the process is to capture the essence of the customer's needs and expectations. The figure 2 shows the voice of the customers in the House of Quality for the fitness center, perhaps based on a telephone survey of the focus groups.

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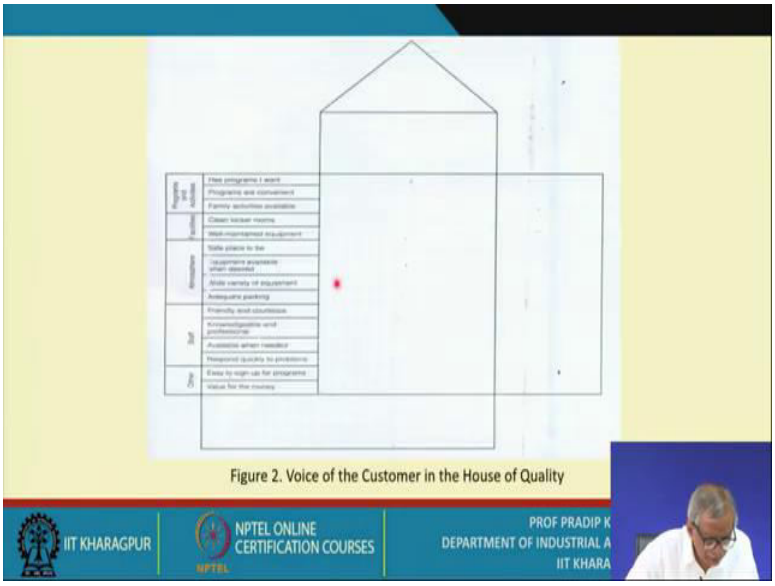

Look at this particular figure, the voice of customers are grouped under several categories, the second one is your facilities, third one is basically your atmosphere, fourth one is the kind of staff and there are certain the factors coming under it. So, you list down all these factors. Just look at them.

This is the voice of the customer in the House of Quality. So, there could be several such requirements. And what you try to do, you classify them under a certain number of categories.

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And the next one- List the technical requirements that provide the foundation for the product or the service design, essentially this is basically the responsibility of the engineering department or engineering cell. And sometimes this function is referred to as a product development cell, or specifications engineering.

you will get the voice of the customers from the marketing and the market research function. And the voice of the customers is referred to as the product brief, when the product brief reaches this product development cell or the design department, then this product brief is converted into engineering specifications.

Now, you are proposing a design, and when you look at the design, you will come to know that what are the technical specifications. So, list the technical requirements that provide the foundation for the product or the service design, that is step 2. the technical

requirements and the design characteristics that describe the customer requirements are expressed in the language of the designer or engineer.

Technical specifications must be measurable because the output is controllable and compared with the objective targets. That is why if they are referred to many cases or engineering specifications.

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For the fitness center, these requirements include the number and type of program offerings and the equipment, times, staffing requirements, facility characteristics and maintenance, fee structure and so on. Figure 3 adds this information to the House of Quality. So, the roof of the House of Quality shows the interrelationships between any pair of technical requirements.

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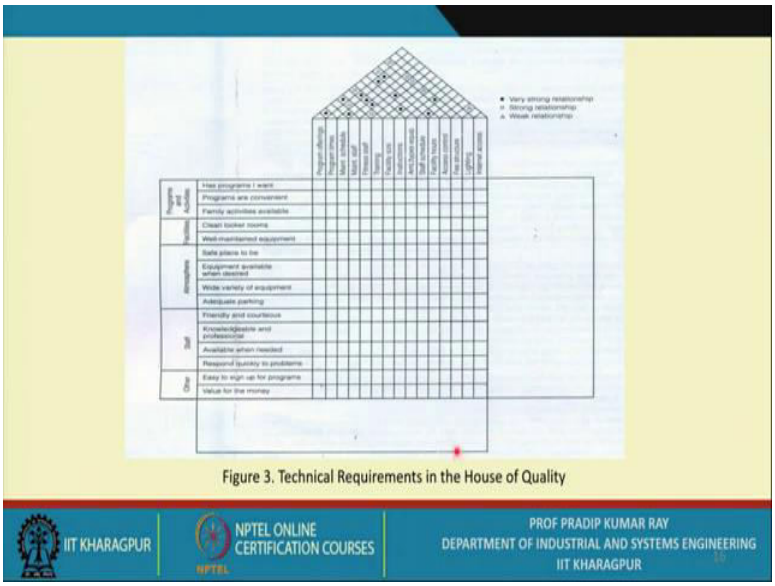

Now, let us go to the next figure. There are some technical requirements, those are listed. And this is the interrelationships between these, technical relationships, because you are going for the optimized design. Now the interrelation should be known, that means we use these notations. Like the relationship could be very strong or it could be simply strong relationships, or it could be weak relationships,

Look at this particular interrelationship, this is referred to as the rooftop, So, how strong your design is and at what extent you are able to meet all the requirements, that actually defines the rooftop, this is the technical requirements in the House of Quality.

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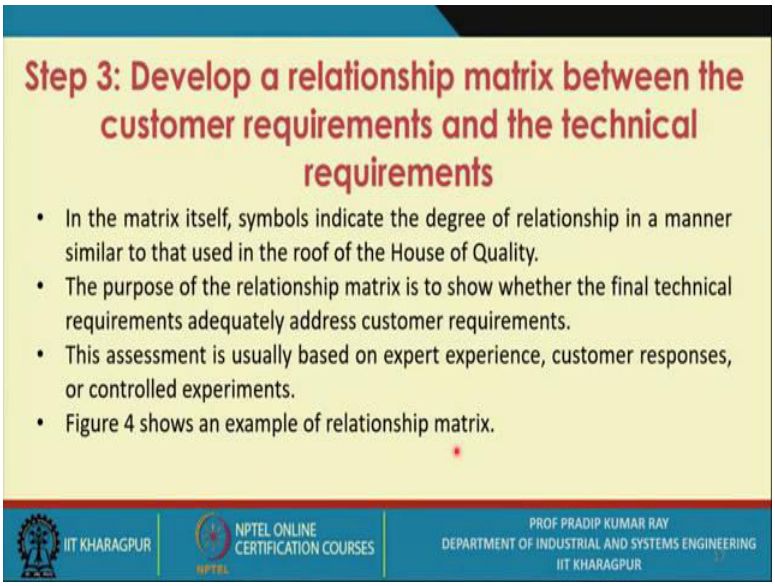

Next, You develop a relationship matrix between the customer requirements and the technical requirements . where you create matrix symbols which indicate the degree of relationships in a manner similar to that used in the roof of the House of Quality.

The purpose of the relationship matrix is to show whether the final technical requirements adequately addressed customer requirements or not. So, this assessment is usually based on expert experience, customer responses, or controlled experiments.

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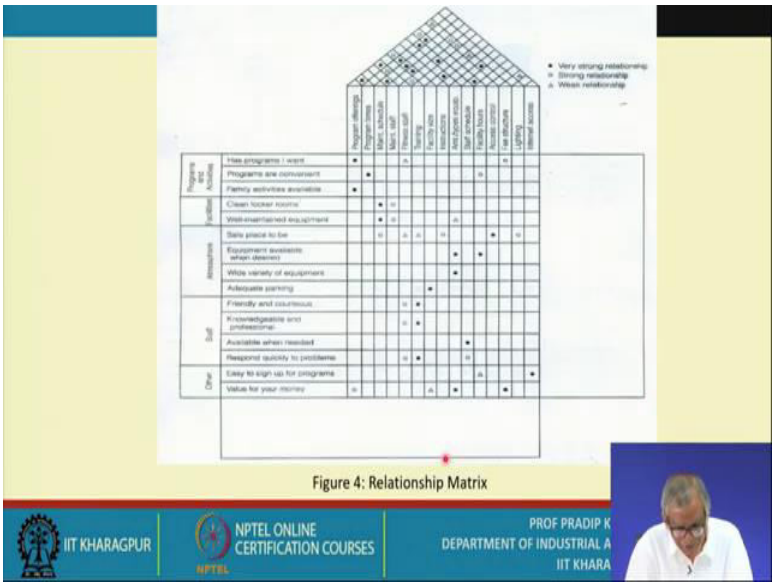

The interrelationship matrix is formed, you will get an idea that which particular specification requirements or specifications are meeting a particular customer requirement or not.

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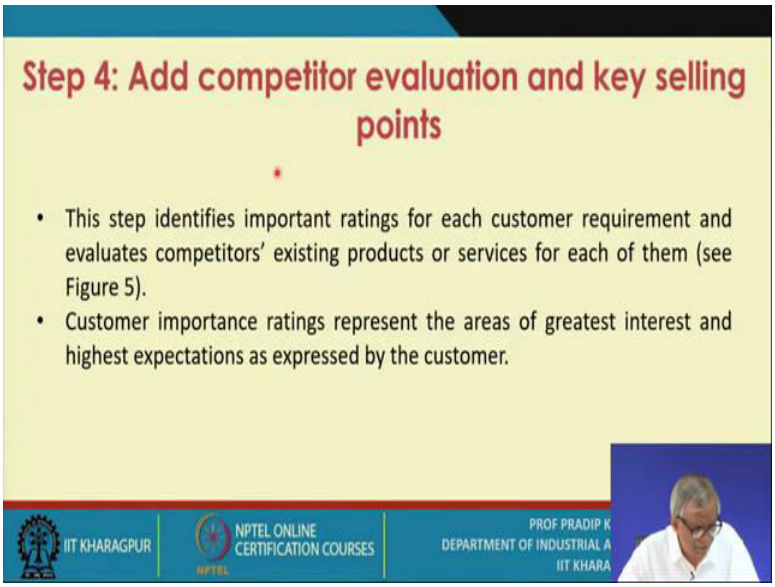

Then you go to step 4. Add competitor evaluation and key selling points. So, this is also a must.

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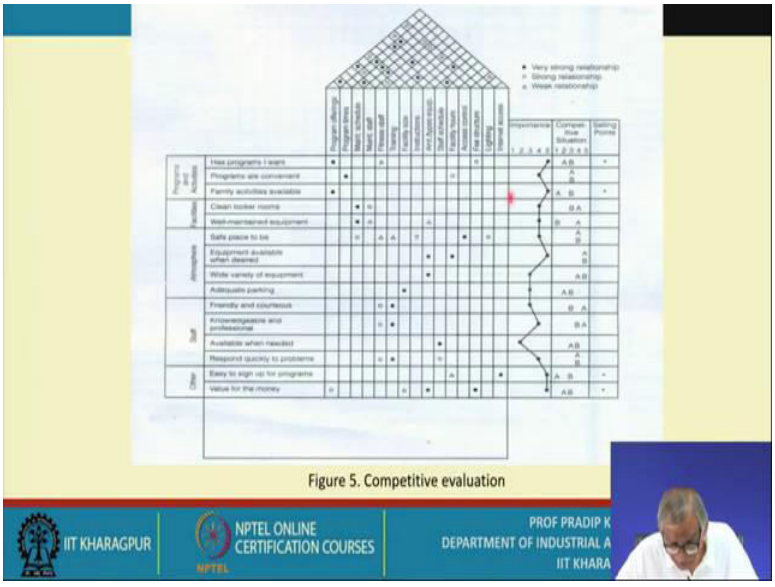

That again all these customer requirements provide the importance course. Here is the example, here is 5 point scale we use. And then the companies competitive situation, that means, you have two competitors – company A and company B.

So, you get this information from company A. Like for this particular customer requirement, you are giving an important score of 5. Whereas, your competitor A is giving an important score of 2, and your competitor B is given importance of 3. So, this way you create and you get an idea about that vis-a-vis the competitors of preference which particular customer requirements you give priority. So, this is basically a comparison exercise.

This is called basically a bench marking exercise, product benchmarking as well as the process benchmarking is a must. So, this is a competitive evaluation.

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In the next step evaluate technical requirements of competitive products and services and develop targets.

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So, what you try to do?

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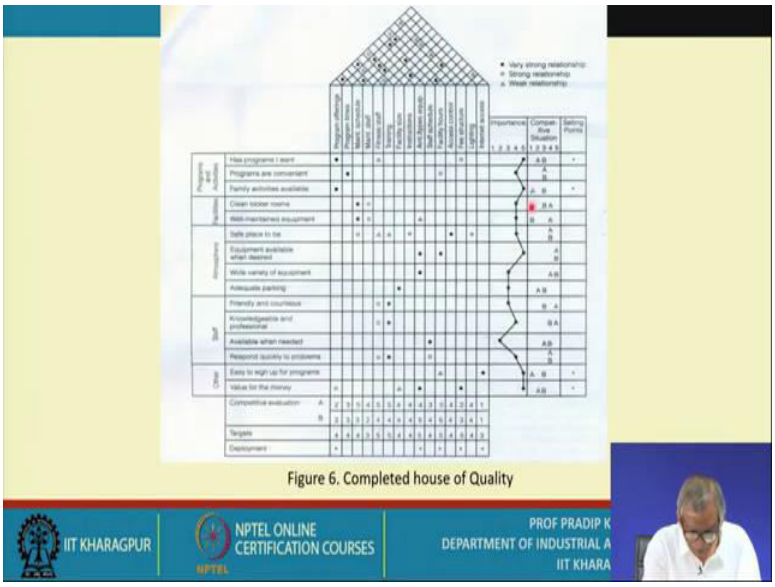

You refer to this particular figure. Now, you create the foundation over here. So, this is your technical requirements. Now, your competitor is competitor A as well as the competitor B, company A and company B.

This is the foundation you can create with this structure provided, the target values you specify and then you go for the deployment.

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So, once this is acquired, then you deploy your resources.

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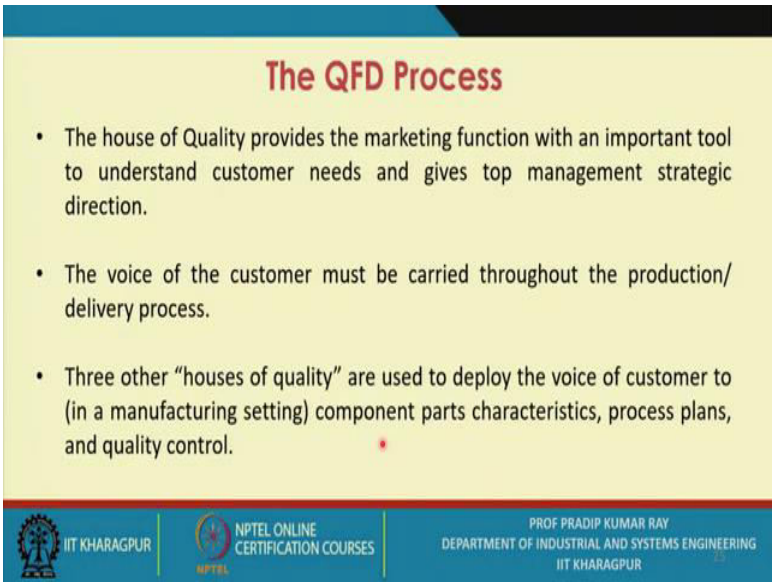

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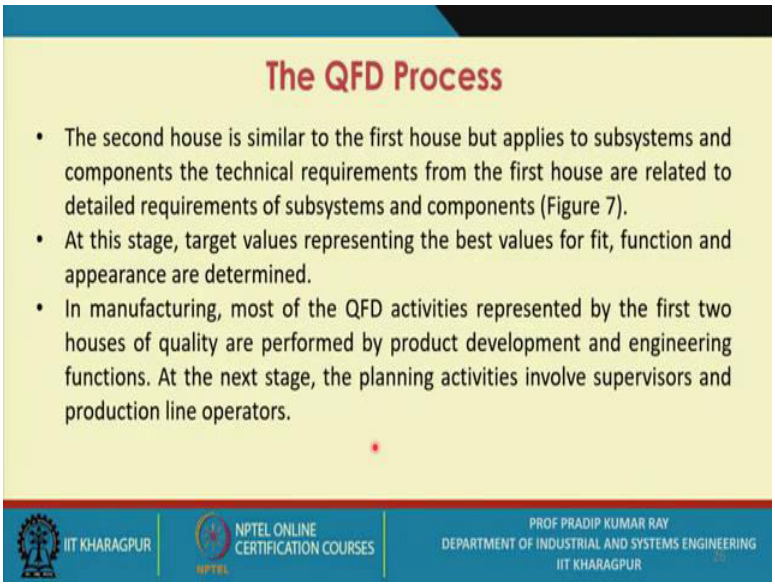

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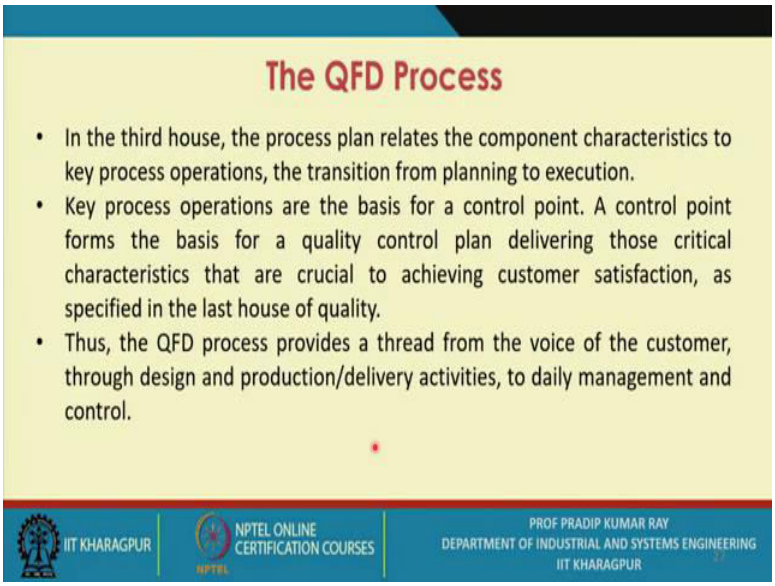

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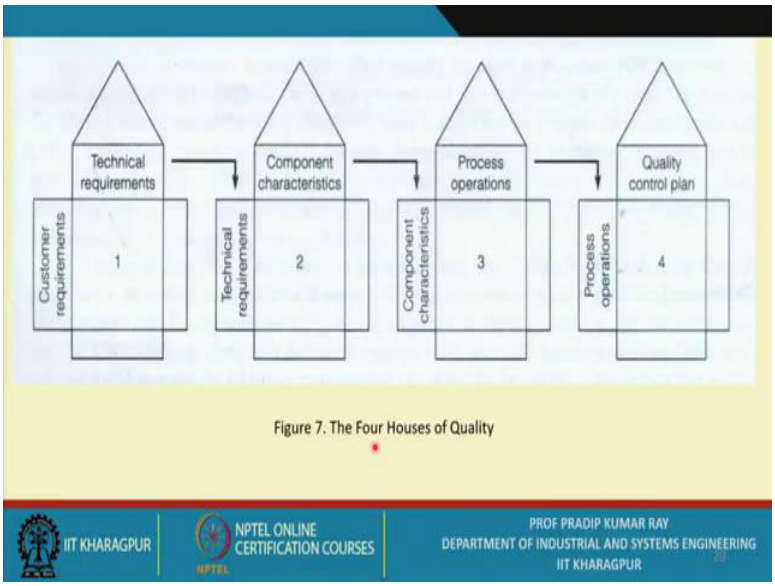

Figure 7. The Four Houses of Quality

And ultimately what you try to do you go for this deployment exercises, from the customer requirements, you go to the technical requirements. Technical requirements is converted into the Component characteristics.

Then you reach to the next level, component characteristics to the process operations. So that means, against each component you must know the process plan, the process operations will be known. And then the process operations are related to quality control plan.

And then what you ensure that for the design, for the best possible process plan. And the process plan is executed. And in such a way the quality of the each part, each component, each assembly, each sub assembly is guaranteed.

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