Total Quality Management - I
Prof. Raghunandan Sengupta
Department of Industrial and Management Engineering
Indian Institute of Technology Kanpur

Lecture – 13
CPM, PDPC and Introduction to House of Quality
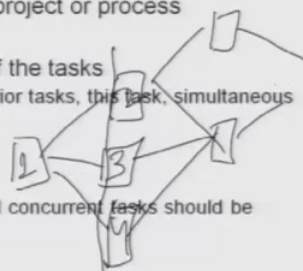
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A very good morning, good afternoon, good evening to all my dear friends and students who are taking this course TQM I, I am Raghunandan Sengupta from IME department – IIT, Kanpur. So, we were discussing about the tree diagrams and the concepts of very simple concepts even though I mentioned it very fleetingly about pert and CPM and I did mention words like gert q gert I would not go into the details, but I will just briefly considered the pert and the main ideas and for CPM also.

So, how to use the arrow diagram? So, they were another broad heading of arrow diagrams. So, list all the necessary tasks in the projects of the process. So, if you remember I did mention on the word of Gantt charts. So, Gantt charts are basically the preliminary work you have to do, in order to basically draw this pert and the CPM or the arrow diagrams to the best possible extent.

So, determine the correct sequence of tasks. So, that would basically be coming out from Gantt charts, create a table with four columns which are the prior tasks, this task the simultaneous tasks and the following tasks. So, what are the priority is how they are related, what is the number of days which are required for the jobs should be noted down.

So, diagram the networks of the tasks. So, time should flow from left to the right as I mentioned or as you have seen for the tree diagram. So, the example which I gave for the tree diagram was from the top to the bottom, from the example which is shown on the slide was basically from the left to the right. So, in this arrow diagram it will be from the left to the right starting from the source to the sink or the start job to the end job, time should flow from left to right and concurrent stars should be vertically aligned. So, if you are trying to basically start 3 sets of job at the same time.

So, if I am basically starting from the left. So, this is job 1, I am working marking as 1 and if job 2, 3 and 4 are starting on the same time. So, they would be vertically aligned

then say for example, you may have job 5, 6 at the same time. So, they are related like this. So, they would be concretely done and it will continue in this manner.

Between each task draw circles for events. So, again let me mention pert and CPM technically, of the arrow diagrams or the precision diagrams can be the overall event of the job can be on the arc or on the node. So, they would be activity on arc and activity or node concepts, but we are not going to go into details in order on understand, but the basic concepts always remains the same.

So, look for 3 common problem situations and redraw using dummies or extra levels of job implications. Dummies are actual events which are not happening, but they give you a relationship between the events of the jobs which are actually happening. So, dummies are given by dotted arrows. So, in the last slide I in shown the relationship between task 1 and task 2 or task 3 and task 4 as bold arrows, but in dummies they would be dotted arrows. So, 2 simultaneous task starts and end at the same time and use a dummy or an extra event to separate them.

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So, this basically this dotted 1 is the dummy one. So, this is basically the dummy activity, which I am talking about; it would have no time as such assigned to it, but it will give you the relationship between the activities which are there.

Now, task so, if I consider this even to further on to consider task C cannot start until both task A and B are complete a fourth task D cannot start until A is complete, but need not wait for B. So, basically C depends on A and B, D depends on A, but has no implications of B. So, if you basically do this you will basically, have the dummy concept which is shown in figure 2 in that the part of the diagram, which is in the bottom half of the slide. So, it will basically you will notice that A and B are running so called simultaneously D would definitely have to be done after A.

So, this is shown here and if you consider, but the B and D the relationship the dummy job does not go from my right to the left, because it clearly mentions that D has some relationship with A, but has no relationship with B, but on the other hand if you consider C it is noted down very clearly that C would have a relationship with A and B. So, that is why as we link up B and C; obviously, the implications of A should also affect C that is basically coming through the dummy diagram which is basically from the left to the diagram so as shown in this slide and the bottom most diagram.

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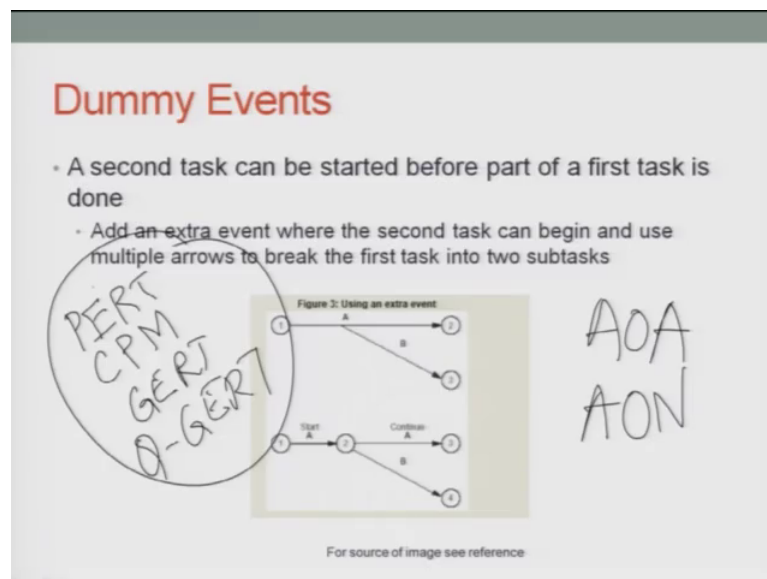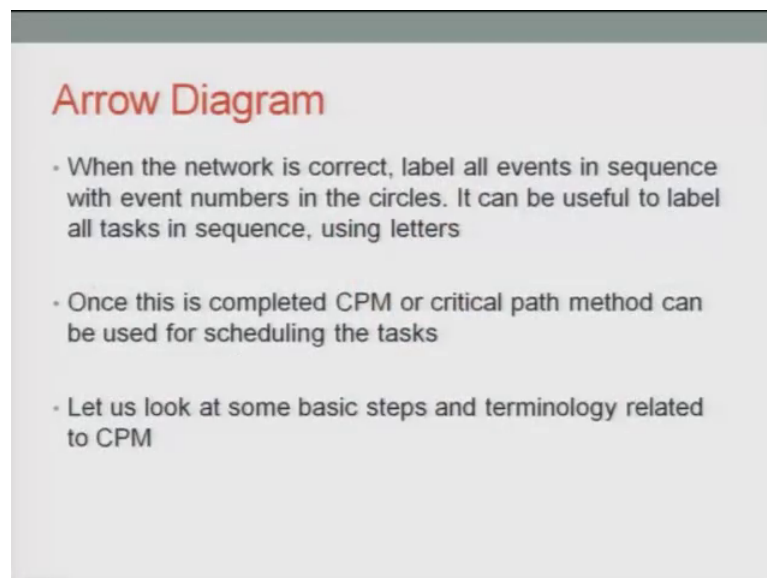
Dummy events to continue further on or second task, can be started before the part of the first task is done. So, what you do is that add an extra event, when the second task can begin and use multiple errors to break the first task into 2 subtasks. So, in this case what you have is basically A and B are there, and what you do is that you break them into nodes further on not to complicate matters, but to understand what is the sequence of the

events which are there. So, what do you have from 1 to 2 you go is basically so called A and then B branches out to basically continue to 3. So, what you do is that you have a some part of A. So, it is basically the A work which is happening you start, you could go to is the stage 2 or the node 2 and from node 2, you branch on further on or for A to continue and B to basically take you from the node 2 to 4.

So, it can be made more level of sophistication can be done and you can basically draw, the overall precedence diagram using the activity on arc. Which is activity on arc or activity on node diagram concept and the different ideas of precedence diagram, as I mentioned can we pert which is program evaluation review technique one is the critical pert method, you have basically gert method also, you have the Q-GERT method also so, they can be utilized in order to understand the concepts of different arrow diagrams.

So, these are just for information, I am not go to discuss them in details because this is not a pert and parcel directly for the TQM once. Somebody is doing project management one; obviously, this pert CPM gert Q-GERT would be important.

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Arrow Diagram

- When the network is correct, label all events in sequence with event numbers in the circles. It can be useful to label all tasks in sequence, using letters

- Once this is completed CPM or critical path method can be used for scheduling the tasks

- Let us look at some basic steps and terminology related to CPM

Continuing further for the arrow diagram when network is correct label all events in a sequence with event number in circles, it can be useful to label all tasks in sequence using the letters it can be A, B, C, D or it can be 1, 2, 3, 4. Once this complete, CPM on the critical path better as well as discussing can be used for scheduling the task.

Let us look at some basic steps and terminology here is it 2 CPM also and; obviously, they can be extended the pert concept also, but for r timing will consider the CPM only.

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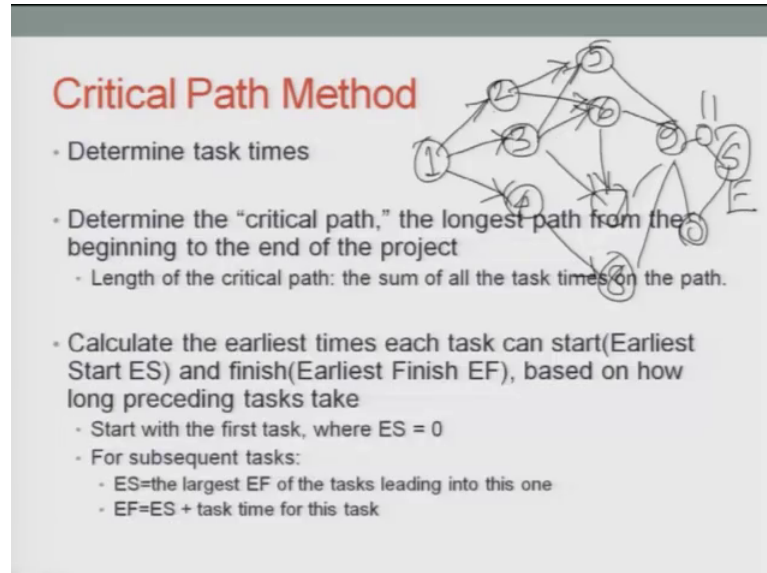
In critical path method, you basically determine the task times that is what is the time taken to finish them, determine in the critical path which is the longest path from the beginning to the end. So, if you basically have the source where you are starting from and these are the jobs which you are trying to do. So, this is 1 and then you will have 2 3 4 5 till the last one which we which all use the word as s s basically means the sink or the end.

So, I am using a very simple notation to give the example. So, they can continue like this jobs are there, they are connected to each other and further on this relationship continues in such a way that, you continue the relationship till you end reach the end. So, you have basically 1, 2, 3, 4, 5, 6, 8, 9, 10 and 11.
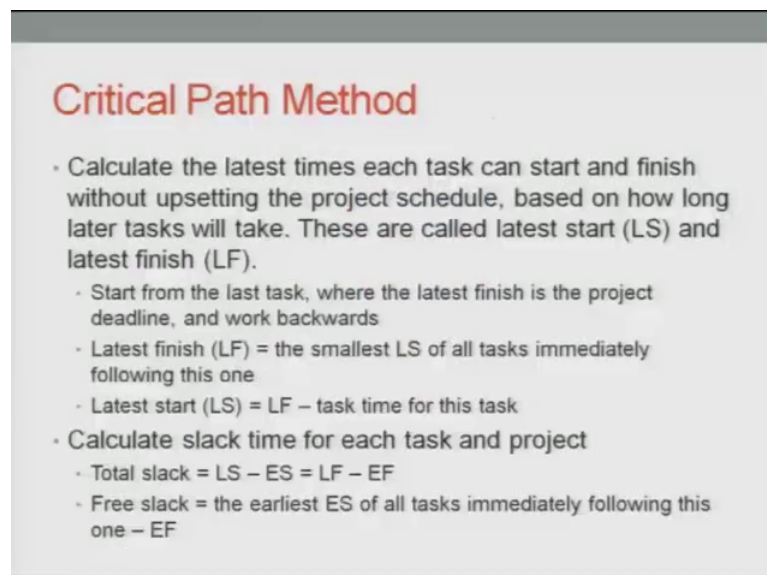
So, the diagrams I have not drawn, I am just showing few of them; what is the relationship. So, from which stage to which stage they proceed? So, once you have that all the nodes would basically have the time, what are the relationship between them what are the actual durations which are happening and once you find out you try to find out what path will take the longest time that. So, that is known as the critical path. So, this is what the second bullet point says, determine the critical path which is the longest path

from the beginning to the end of the project, length of the critical path is basically sum of all the task times, for all the paths or the activities which comprise the critical path.

From this, what you do is that you have basically, the concept of trying to do the forward pass method or the backward pass method; that means, you tried to find out the 2 so called slacks total slack and the slacks which are there for the jobs, starting from the left to the right and I can do it from the right to the left. Which is basically the forward pass and the backward pass method, once you do that you are able to find out the earlier start, the earliest finish, the late start and the late finish. When you do that you will basically have in a table format for each job, the earlier earliest when they can start, earliest when they can finish, latest they can start, latest they can finish and once you have this in 3 or 4 different columns in a chart, I am not giving an example in details here; you will be able to find out what is the slack, the free float and the total slack which is available here.

Start with the first task, where earlier when the early start is 0 for subsequent task, you find out the early start, which is the largest earlier finish. Plus of the task leading into that 1 and add up the time taken to do the job. You continually, this as I mentioned you will have 4 or to 5 different columns, with all the information.

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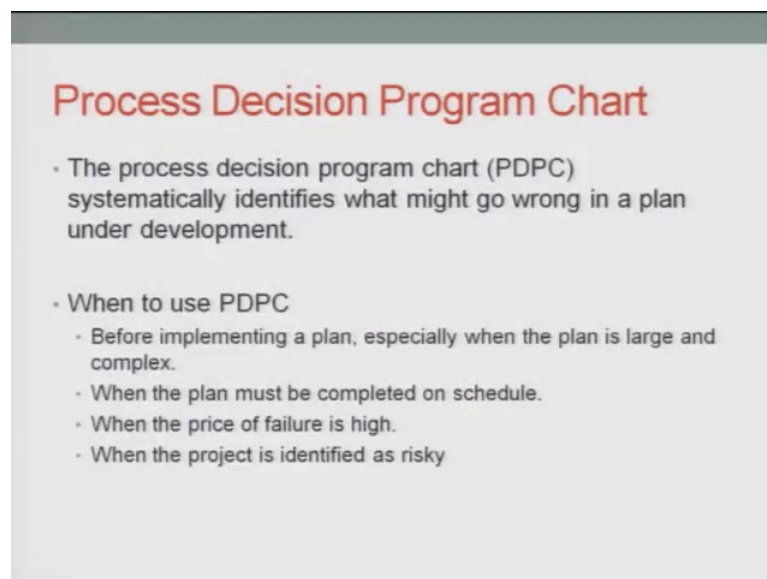Calculate the latest times each task and start and finish, without upsetting the project based on this on how long a later task will take, these are called the latest start and the latest finish which I have just mentioned few minutes back.

Start from the last task which is from the right, when the latest finish is the project deadline and work backwards till you reach the source, which is job 1 or the point where you are starting. So, latest finish is basically the smallest LS, with late start for all the tasks immediately following this tasks which you are trying to analyze, latest task a start would basically be the latest late last finish minus that task time for that for that activity of the job or the time taken. Calculate the slacks they would be one total slack one will be free slack as shown here.

So, I am just reading out what actually the total slack and the free slack means, total slack is the late start minus the early start or exactly it is equal to the late finish, when the early finish and the free slack is the earliest early start for all the tasks immediately following this one minus the early finish. So, once you have this you will be able to forget the critical path and all the information.

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So, the process decision program chart is basically, where the systematically it identifies what might go wrong, in a plan under development and basically you analyze that and when you use the process decision program charts. So, these are not standalone like this PDPC or the tree diagram or the precisions diagram or the cause effect on one our different ways, trying to analyze the problem like the brainstorming sessions and the matrix concept all these things are collectively utilized, in order to analyze the problem into it is utmost detail.

So, continuing where to use PDPC, they are used when implementing a plan specially when the plan is large and complex and their different type a relationship between them. When the plan must be completed as on time or unscheduled, when the prices of failures is higher on the project is identify as risky you take in the decisions accordingly.

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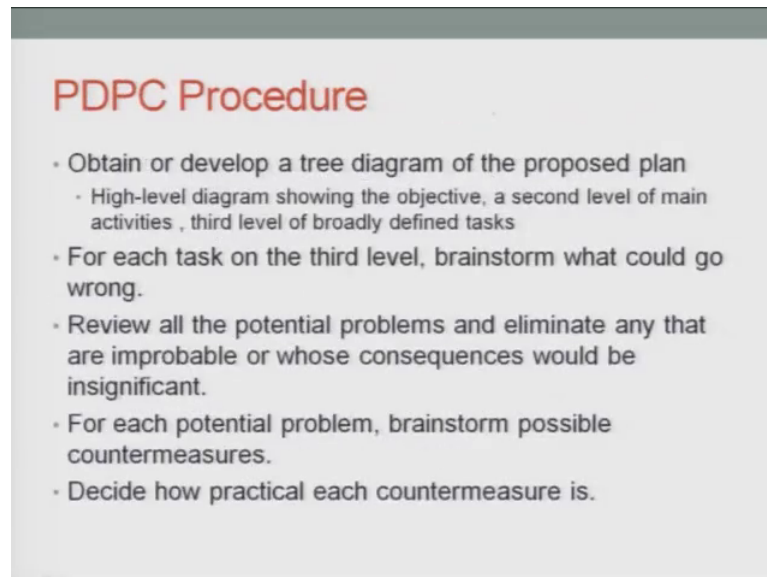
PDPC procedures are obtained at or develop a tree diagram, for the proposed plan that is high level of diagram showing the objective a second level of main activities and the tertiary levels are done accordingly, which gives you the level of importance for each and every act so called work or the activity or the plans which is there for all the further tasks. For each task on the third level brainstorming is done and doing time to analyze what are the problems, you go to the fourth level, the fifth level and in continuing the same sequence of analysis.

Review all the potential problems and eliminate any that are improbable or they are not actually happening and try to track tackle all those things which can be handled in order to reduce the cost for each potential problems brainstorm storm possible countermeasures and take actions, and basically write down or understand them, how they can be tackled. Decide how practical each counter measures are or they are they can be taken into consideration and you basically make a plan of action for that.
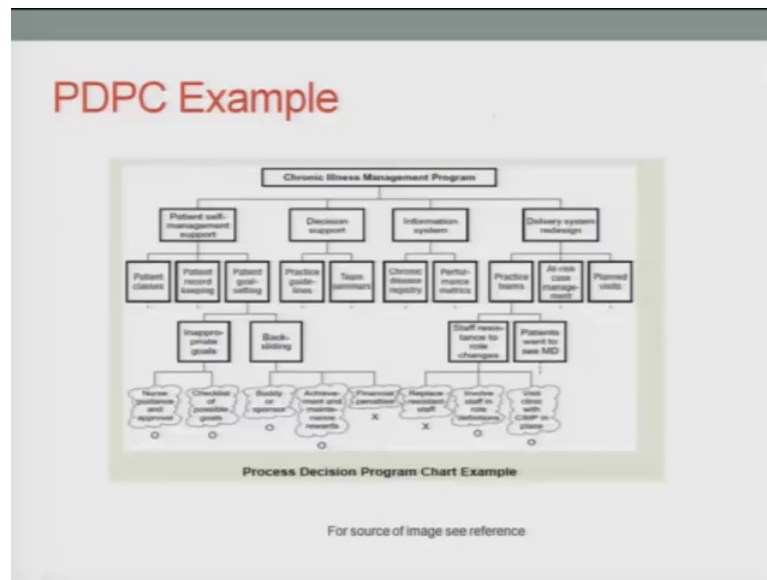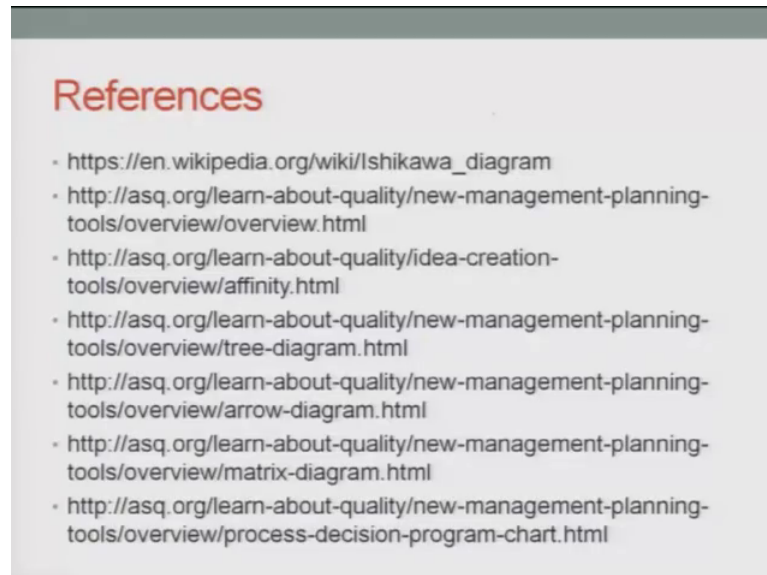
So, were typical PDPC example is given, where it is basically chronic illness management programs you are trying to do, for the hospital the patient self management support is there. So, the patient classes they record keeping and patient. What the patient wants to what you want to achieve for the patient, whether he is suffering from suffering the fever or if the problem is related the heart or the problem is related to some skin disease. So, all these things are considered, the age of the patient what medication he or she is going into, what is the genetic profile of the patient and all these things analyze whether their history of ailments for the patient.

Then, you basically have a decisions support the information, set which is basically collated and gets all the information of the patient and then you basically try to design a deliverable systems, such that you can monitor the progress of the patient and take actions. What drug should be given, which doctor should visit him or her, how the medication should be taken, whether the person should be put in the ICU, what the person should be put in the actual normal room. Whether some preventive quarantine mechanism, need to be taken for the patient; if he or she is suffering from some disease which can spread very fast.

So, all these things are analyzed and once you have that you basically get the nurse guidance and approval checklist for possible medication things and what are the financial

implications for the patients and the innovative staff rules and how they can be analyzed all these things are done accordingly.

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References

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- http://asq.org/learn-about-quality/idea-creation-tools/overview/affinity.html
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- http://asq.org/learn-about-quality/new-management-planning-tools/overview/matrix-diagram.html
- http://asq.org/learn-about-quality/new-management-planning-tools/overview/process-decision-program-chart.html

So, these are the few of the references, for these areas of fishbone diagram, tree diagram, PDPC diagrams, concepts the matrix analysis the precedence diagram. So, one can go through either the Wikipedia or the different books are there and one very good book, just I am mentioning nothing to do with total quality management a book which is there in the market, which 1 can study in order to analyze the precedence diagram. The pert and CPM is known by the authors, which have been written by both of them, which is levy and waste. So, this is pert CPM and precedence diagram is available in the market and 1 can have a look and in this areas.

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So, continuing our discussion for quality, now will even though it is the lecture number is the same, will start a different area of the concept which is basically known as quality function and deployment or QFD. QFD is structure method that is intended to transmit and translate customer requirement. So, that is what is the voice of the customer, what the customer wants is it related to quality, is it related cost, is it related to delivery of products right on time is it related to after sale service, what it is you need to understand. Through each stage the product development and the production process the voice of the customer is analyzed know.

Now if I am the design person for me, the customer is not the customer to whom the product will be sold my customer, would be the sales. The person who is there on the shop floor, who will be utilizing my design and trying to utilize the raw materials, which has been supplied to him or her and take the product.

So, I will basically try to get the feedback from my customer and who may be internal for me and try to analyze where the problem lies, how it can be improved; that means, the problem can be rectified. These requirements are the collection of customer needs including all satisfiers, whether their problems, whether this satisfies, what are the issues and how they can be tackled. So, you do again an analysis and try to go into the root cause of what the problem is and take corrective actions accordingly.
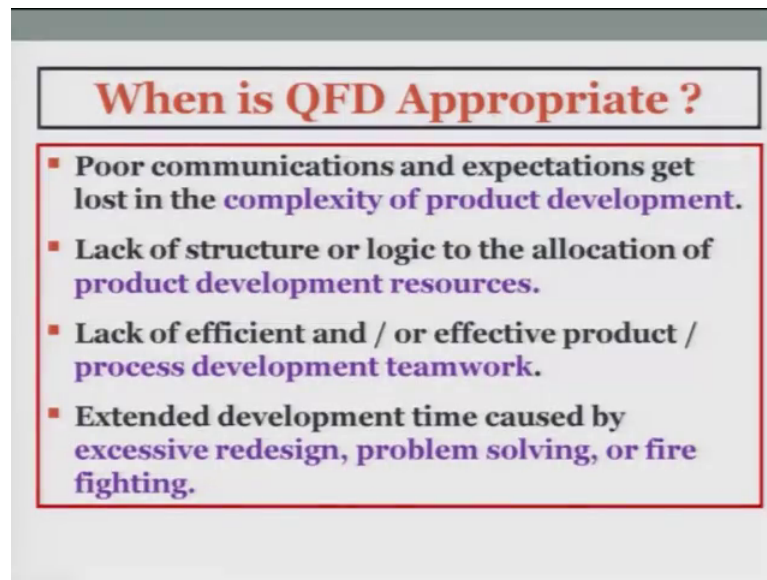
When QFD is appropriate are applicable, poor communications and expectations lost in the complexity of the product development. So, here rather than analyzing the macro level, you will go into the micro level and try to analyze the QFD from for each stage. Lack of structure or logic to the allocation of product development resources are there, in many of the cases. So, you will try to utilize the QFD in order to understand, who the customers and how the customers are affected so called vendor the word vender I am not using in a very specific term is very general.

So, if the customer in the shop floor as I said and for him or heard the main supplier of the vendor is basically the design team, then you need to basically understand the whole sequence of flow of work, which is happening between the design and the and the shop floor person. Or say for example, it may be that the sales person, who is basically the customer for the product, which is coming out of the shop floor and then the sales person has to sell it to the customer. Customer means the end customer and gets the customer feedback or try to design the customer after sales services.

So, those would be linked in such a way that, you will be able to understand what the flow process. So, called responsibility and how does or the how the work being done inform, what first stage affects the work which is to be done in the second stage, such that the output first third second stage becomes the input, with the third stage and carries on accordingly.

Lack of efficient and on in effective product process, development teamwork if it is there then it basically entails the appropriateness of the QFD. So, extended development time caused by excessive redesign, problem solving or firefighting issues are very important, we should be considered when you are trying to analyze the QFD issues whether they are important or not.

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So, very brief history of QFD; so, origin of QFD and how it can be utilized is basically comes from the Kobe shipyard Mitsubishi Kobe shipyard and started in around about 1971 and 72. It was developed by Toyota and his suppliers expanded to other Japanese manufacturing, related to consumer electronics, home appliances, clothing in integrated circuits, apartment layout planning whatever it is. It was also a broad adopted in the end of about10 years from 1972 in the 1980 and 1981, by Ford and GM and by other players in the market, related to Hewlett-Packard, AT and T IIT so and so far.

So, foundation is that believed that products should be designed to reflect the customer design and taste rather than your test who is basically the supplier. So, you are basically the supplier of the product or the design of the equipment or the services to the customer, who should be satisfied. So, quality functional deployment house of quality if you consider.

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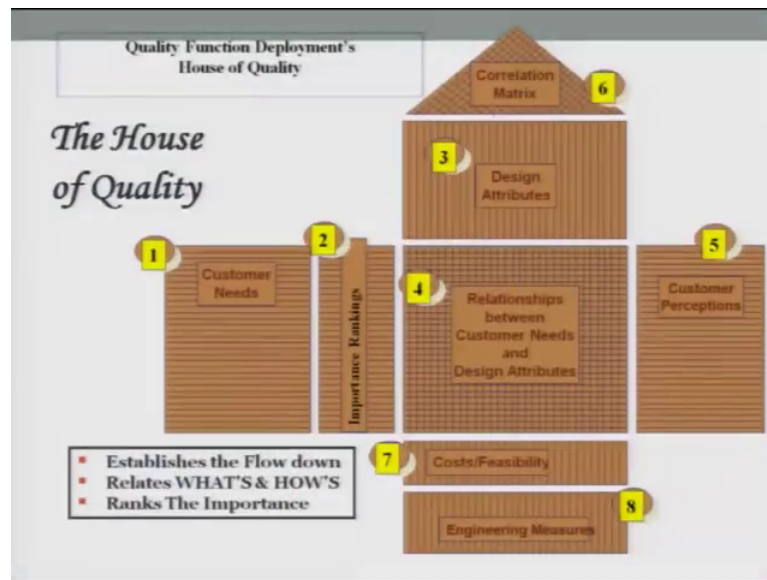
So, it basically would consider consists of the following one. So, here the diagram here in front of you, basically gives you the house of quality. So, it will be the main focus which we are trying, to analyze is the relationship between the customer needs and the design attributes. Whether the design which you as a company arm is making, whether it meets the criteria, what the customer wants. So, they would be some customer perception based on the customer perception, the design attributes should be should be tailored to they would obviously, be some cost feasibility concept engineering measures.

If the design requirement based on the customer requirement is very tough then; obviously, the cost would increase. So, you have to basically make appropriate planning, in how in order to meet the customer is recovering to the maxim maximal possible extent and if required; obviously, you have to talk with the customer and try to check that how rigorous or how good or bad the requirements, with the customers are is actually needed at his or her end.

So, they would be the design attributes, they would be importance of ranking and the customer needs everything is combined, in order to find out the relationship between the different points which basically makes the house of quality. So, he basically establishes the flow down, flow process and what is the relationship, relates to what an house and how they are related ranks the import level of importance such that one can take a rational decision, what is the relationship between the customer his or her demands. The

cost factor the design factor and the needs of the customer and all these things can be considered.

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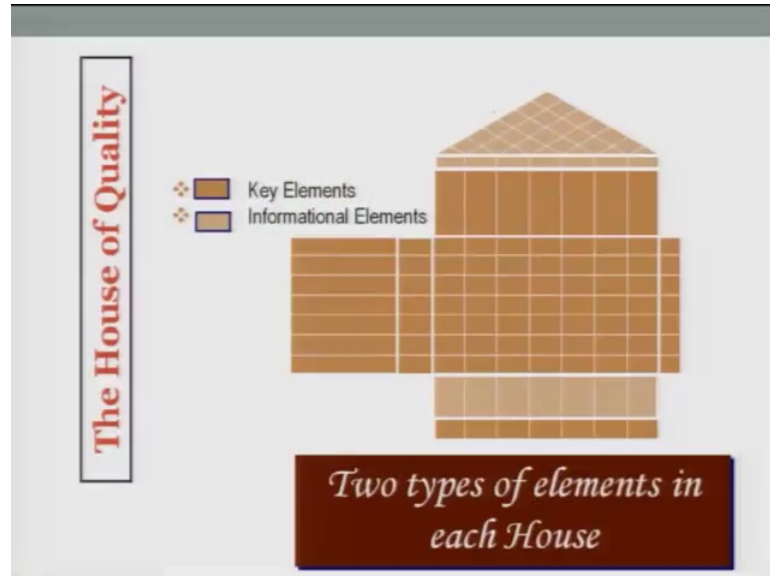
So, the house of quality basically would have a set of key elements and the informational elements made into a in matrix forms. So, the 2 types of elements in each house basically are clubbed together, such that you get the maximum information by the relationship which is given by the matrix.

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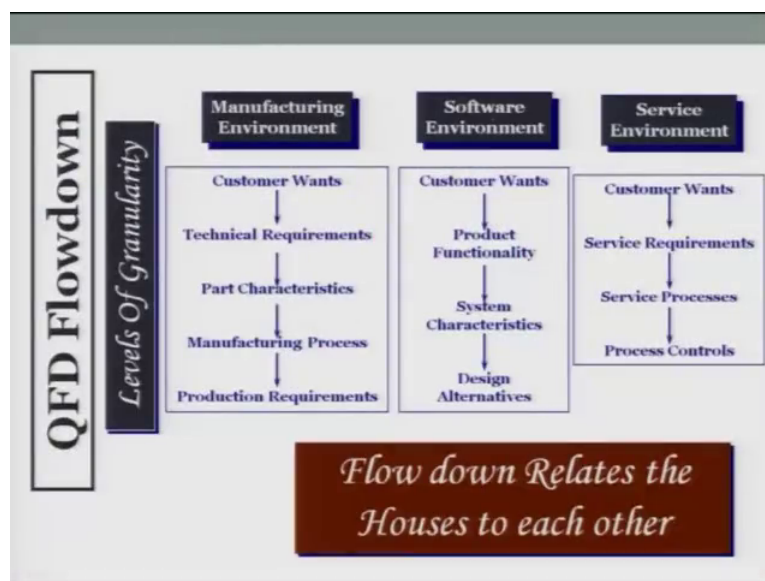
So, the key of the flow down, would be basically for this a concept, which your considering would be the manufacturing environment, would be in the software environment, would be in the service environment. So, the customer would have someone's based on that you will have some technical requirements, they would be spant characteristics given for each and every equipment or the subgroups we had which are going to become combined in order to make the product, which the customer wants they would be manufacturing process, specified for that they would be production requirements all specified for that.

So obviously, when you come to the software environment, it would relate to customer ones product function ability systems characteristics and design alternatives similarly they would be server, service environment related to customer service processes and requirements and process controls.

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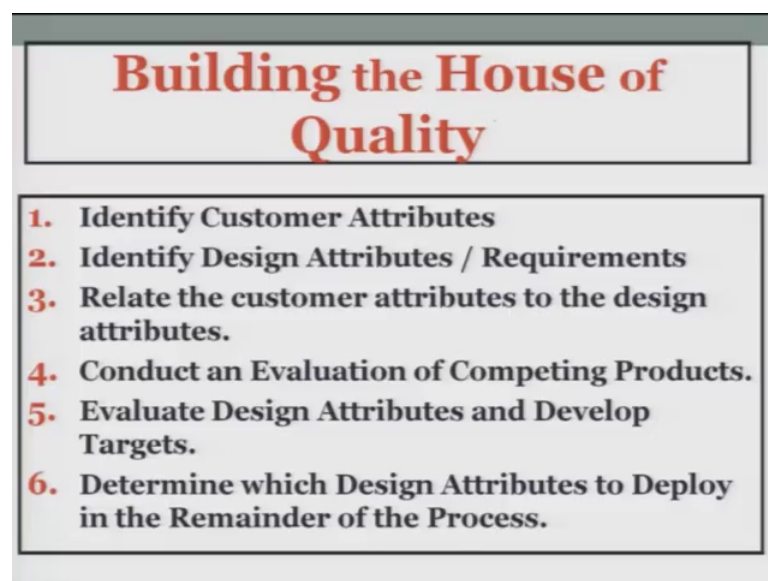
So, when you are trying to build the house of quality, the main points which you should consider and obviously, emphasis should be laid on. Would be like under identifying what is the customer attributes, what does she wants. What are the tangible intangible benefits the customer wants, what are the tangible and intangible benefits or the working or the product which the customer is requiring say for example, in any restaurant you are able to supply say for example, some vegetarian food, but if the customer wants less oil or more chilies or less of vegetables; obviously, you have to meet the criteria and the
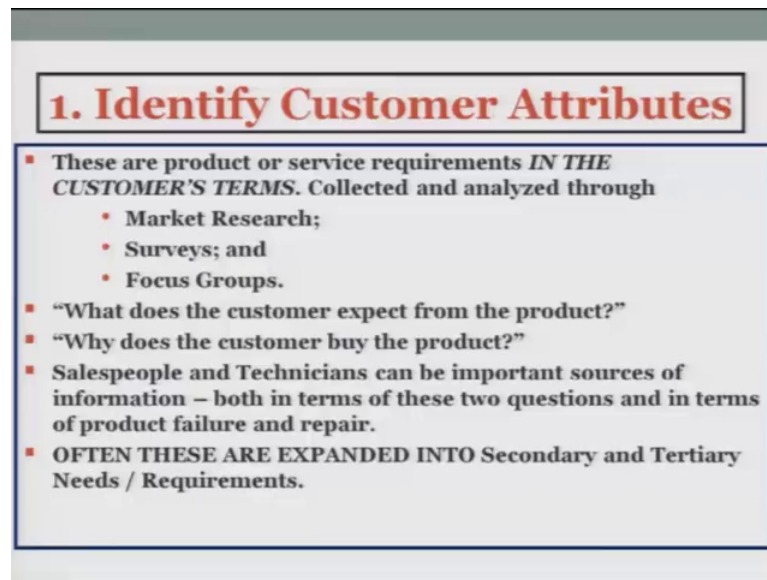
customer wants and tailor your production process, production person means the process are you making the food accordingly.

Identify design attributes and requirements which have been stated, like requirements that the customer wants, that he wants hot food or he wants less oil or he wants no milk. So, all these things should be considered. In case when you are trying to basically sell a car to a customer, the customer wants considered that he or she wants that the luggage space for that particular car should be better or say for example, rather than the bucket seat in a big sue. The customer wants a continuous seat. So, you have to basically make those adjustments accordingly. Or maybe say for example, the customer wants that rather than having a child lock, only at the back doors it may be possible. The customer wants a child lock in all, what the photos I am just stating some facts, which may be a very important points for the customers and they have to be taken care by the manufacturer or the service provider, who is basically giving the services or the product to the customer.

Conduct an evaluation of competing products, which are there in the market and try to see that, whether those products would be able to meet their customer requirements and whether you need to basically change your overall process of manufacturing, the product or trying to basically give the services to the customers, as that you are able to meet the customer requirement to the maximum possible extent.

Even a design attributes and develop targets, for each stage or of the work which you are trying to do. Determine which design attributes to deploy and in the remainder of the process and how these this different type of attributes can be are basically giving the overall, throughput based on which you are able to satisfy the customer demands in the long run. So that means, customer wants our product and whether the product is able to meet all the design specifications or the working specification based on which the customer has ordered that product to you.

So, when you are identifying the customer attributes, these are the products or service requirements in the customer terms. So, the customer has said, I want a blue colored car or the customer says that, I do not want the child ought to be present only at the rear doors; they should be present at the four doors or say for example, the customer wants the headlight rather than have having some voltages of bulb, it may be say for example, he or she is drives along the highway in the night.

So obviously, the requirement for high beam light is important or coming back to the same example say for example, you are serving food and the person wants as again repeating, the same example it may be less oil less chili or more oil more chili less salt. Whatever it is you have to basically meet that criteria for your product or services based on the customer terms specified by him or her.

So, they would be collected and analyzed through market research surveys and focus groups. So, if I am trying to sell a product like a fridge or a refrigerator or a washing machine or some car or some mixer in the market, I will try to basically get the customer feedback based on that, I will try to analyze and make my product accordingly. So, you will try to understand what does the customer expect from the product, why does the customer buy the product is it absolutely necessary or is it that the customer has some requirement, he or she is not able to get that from the market or the costs are higher for your competitors. That is why he or she is buying that product or is basically and one of

a kind product which you only you as a company can make it. So, is it based on that fact that the customer has come and stated the requirement for the product. So, you have to be a basic analyzes accordingly.

Salesperson and technicians can be important source of information. So, if the salesperson goes to for doing a survey, you will he or she will get different in a set of information, qualitatively you will try to analyze and collate them and try to go into the depth of the of the analysis of the data which you have collected through your sales person, through your technicians in order to analyze that where the requirements the customer is. So, those sales persons and technicians would basically be the best source of information, both in terms of these questions and the in terms of the product failure and the repair or the after sales services concept which are there.

Often these are expanded into secondary and tertiary needs and requirements, such that you are able to analyze the problem. Drop now I will not use the; what problem the requirements more in depth.

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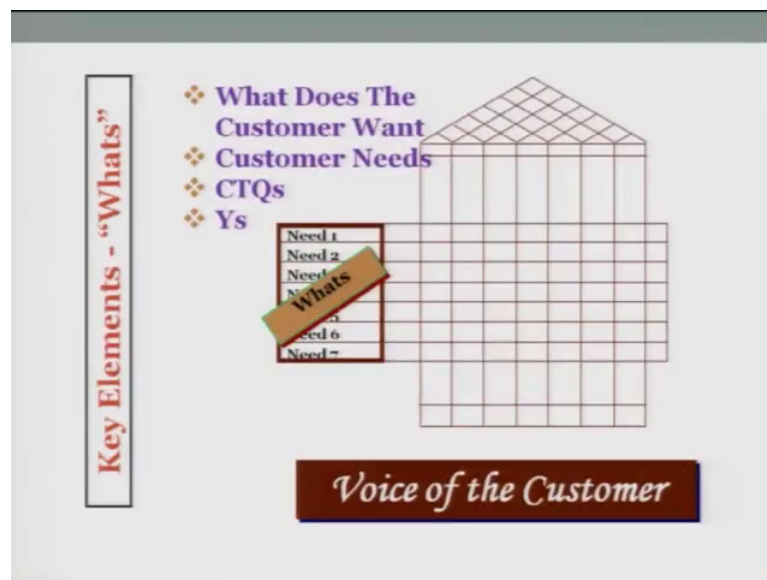
So, the key elements of what are if you basically, trying to analyze the voice of the customer, it would be what does the customer want, what are the requirements, what are the customer needs. So, does the requirements in the needs match if not obviously, you can as the supplier of the product or supplier of the services, you can basically state in terms of what the customer needs. So, the all these requirements and needs are basically

calculated in a matrix formulation, such that you are able to understand what is the linkages, and how the relationship holds between different type of customer requirements and his needs and wants in a very simple manner.

So, continuing with the voice of the customer. So, how important are the watts to the customers and what the requirements are he has he or she has place and whether is able to meet the requirements you will analyze them, again do our rankings combine them in the matrix formation and continue doing this in such a manner it will give you a much better understanding what the requirements of the customers are with respect to his or her and her needs.

So, with this I will end this lecture and continue the voice of the customer in the QFD concept, in more detail and then we slowly go into the different quantity parts, which would be 1 of the main important focus of the TQM 1 course; have a nice day.

Thank you very much.