Six Sigma
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Lecture – 47
Seven QC Tools

Hello friends, you are most welcome to our ongoing Six Sigma journey and I hope you are enjoying the learning of various topics; I can understand that we have gone through many lectures and discussed variety of the topics. So, you need to keep revising them frequently so that you can digest it properly, remember them and also you can apply. Now, we are in the lecture 47; last lecture we talked about Taguchi concept illustrative application. Today this particular lecture is about Seven QC Tools, Quality Control Tools.

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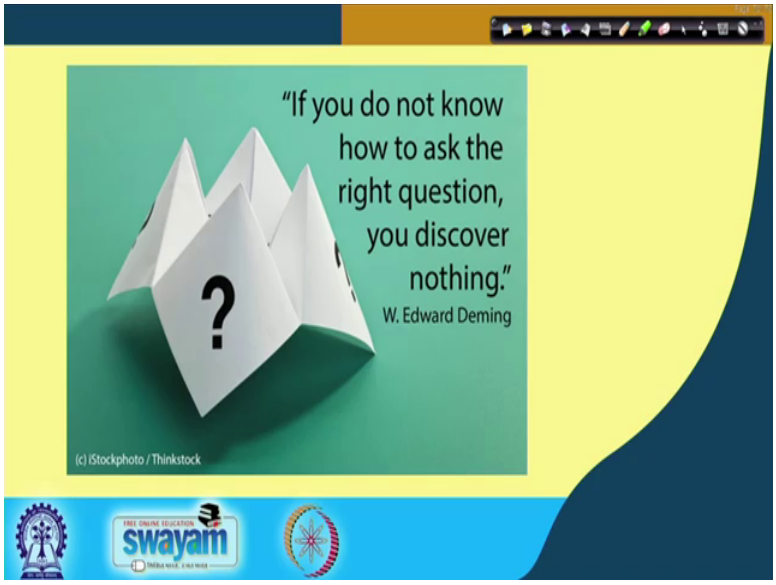

Now, let us begin with a beautiful inspiration. If you do not know, how to ask the right question you discover nothing and this is what is said by none other than the great quality guru W. Edward Deming.

I will just share a small example. Many times at IIT students they come to me and then they will say sir then they will stop. They will just then utter some other word sentence and then they will stop. Now they would expect that without understanding what is their question I would be able to help them, that never happens. So, I never open my mouth,

unless they put their question define their question properly and once it is done I think, almost 70 percent of the problem is solved.

So, if you do not know how to ask the question, you are just say beating around the bush, then you do not achieve anything you discover nothing. It is a very important in great inside and that is why we are going through the various phases of DMAIC.

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Now, we have gone through huge amount of quantum knowledge in this particular course so far and it is a time to have a quick recap what we have studied so far and where are we in our six sigma journey.

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So, let us see we are devoted week 1 and 2 on discussing quality fundamentals and key concepts.

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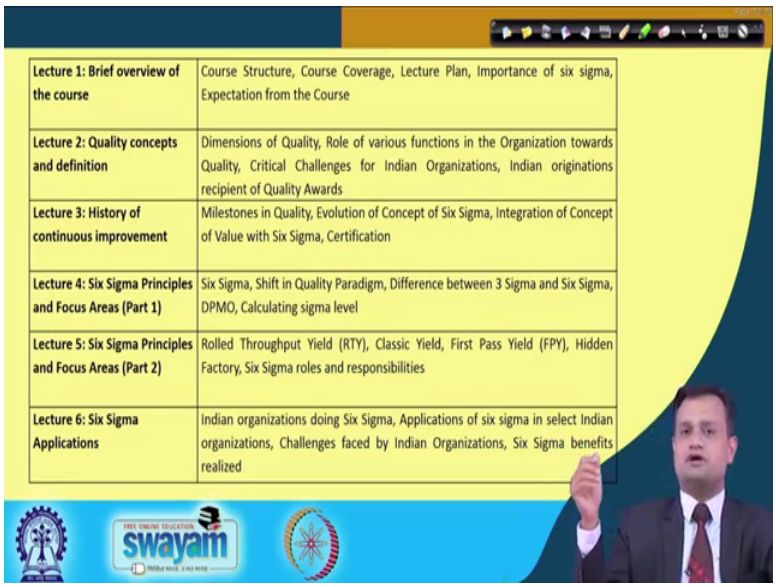

So in that week 1, we have talked about the overview of the course, quality concept, definition, history of continuous improvement, various phases and six sigma principles and focus areas part 1, part 2, six sigma application.

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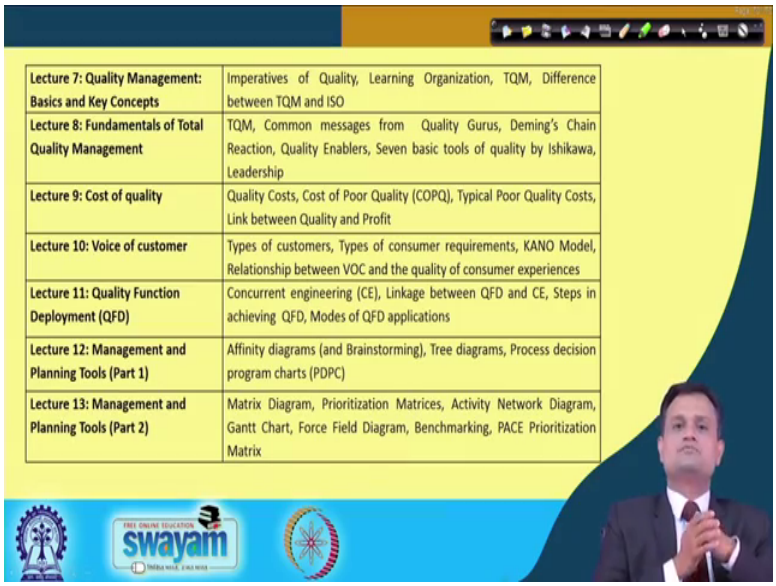

Week 2, we talked about basically quality management, TQM, cost of quality, voice of customer, quality function deployment, management and planning tools and this we have discussed in detail; management and planning tools in part 1 and part 2.

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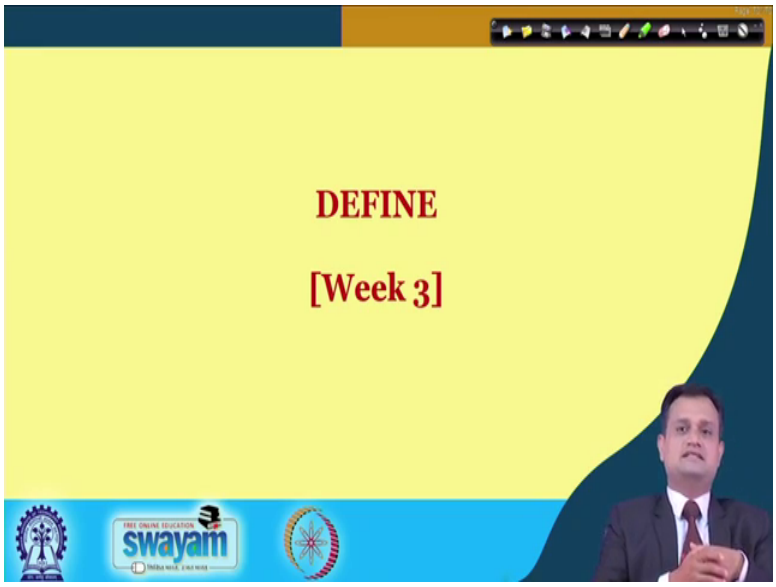

Then, we started with the DMAIC cycle, and the first phase was the define we talked about define phase in week 3.

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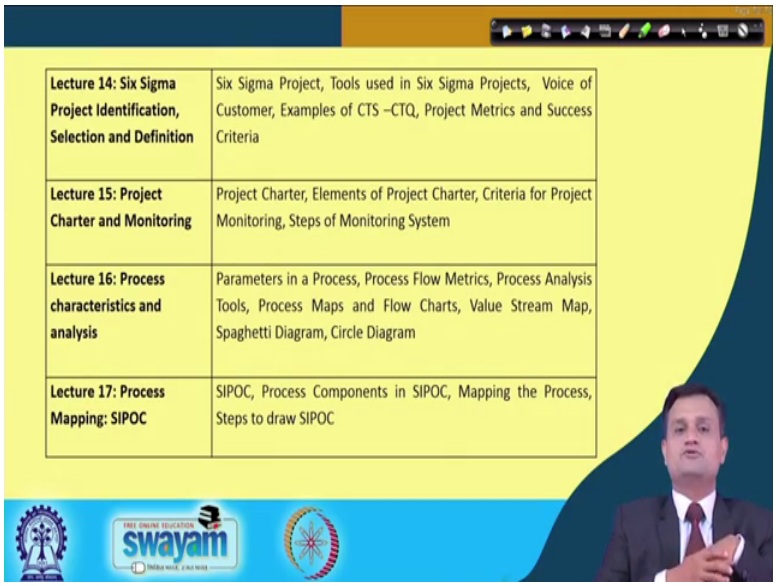

And as a part of that, we have seen the project identification, definition, selection, project charter and monitoring, process characteristic and analysis, process mapping using a very important tool SIPOC.

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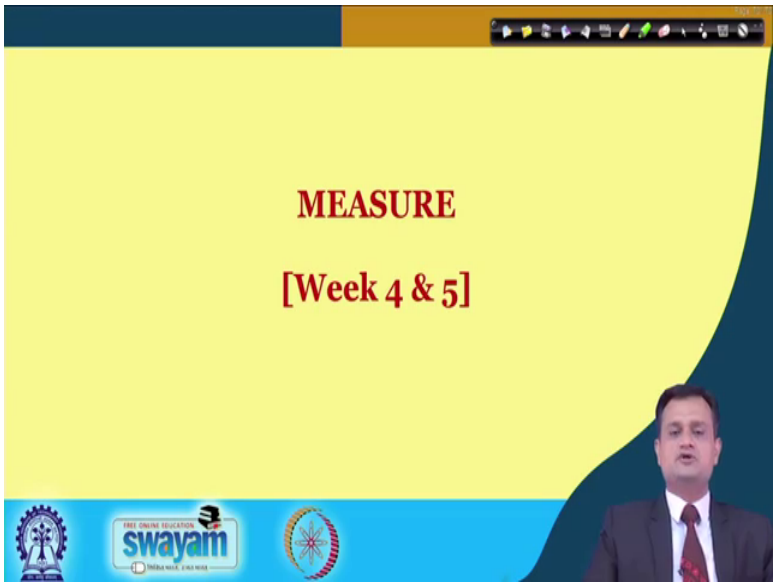

Then we entered into the measure phase week 4 and 5; and this week 4, basically we talked about data collection.

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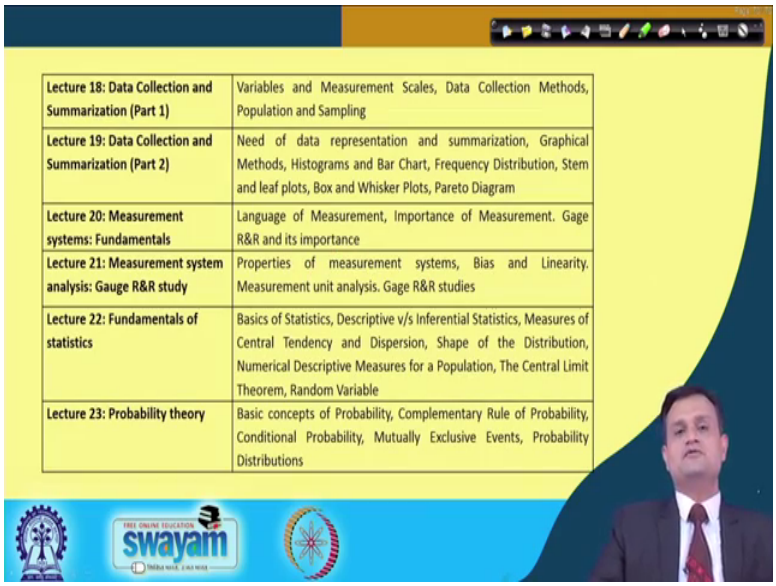

We divided it into two part, measurement system fundamental, measurement system gauge R and R study, fundamentals of statistics, probability theory.

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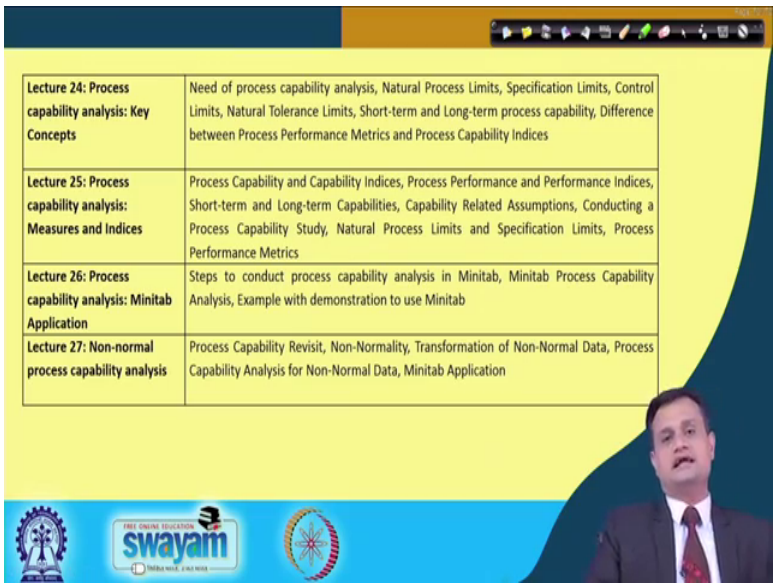

And in week 5, we talked about process capability analysis, indices, process capability analysis in mini tab and non normal process capability also with application in mini tab.

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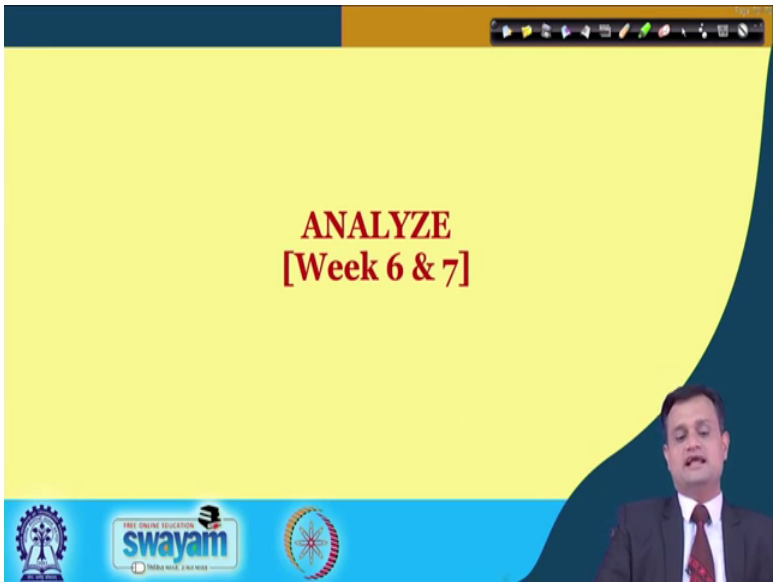

Then we entered into the analyze phase. So, DMA we are going in a very very structured manner so that, lifelong you will not have any difficulty in understanding the concepts of sigma and applying this concept for the selected problem. So, analyse phase was covered in week 6 and week 7.

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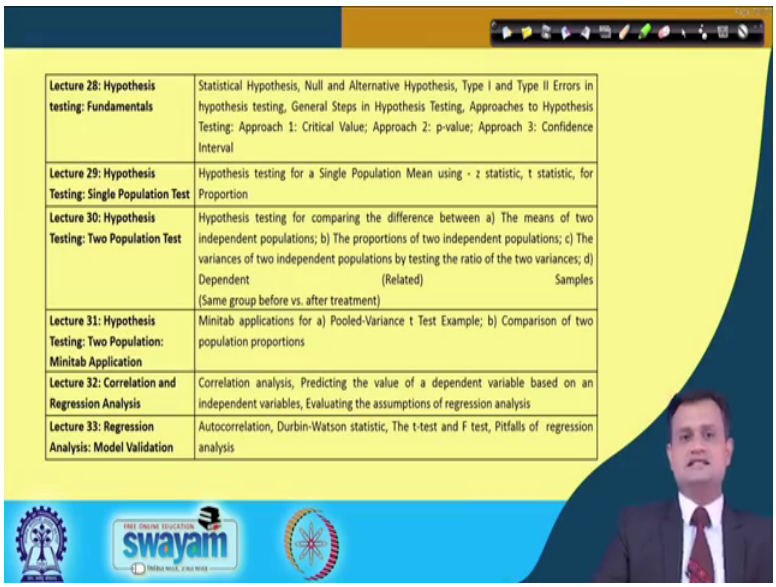

And week 6, basically we talked about, analysis through hypothesis testing, hypothesis testing for 1 population, for 2 population and we had also seen for the convenience; how

this can be done in mini tab, correlation, correlation and regression analysis and model validation of the regression analysis.

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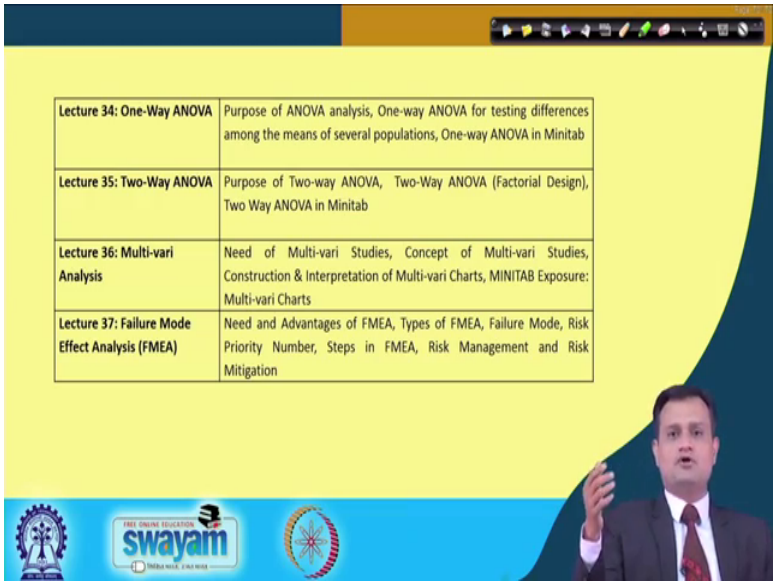

Week 7 we continued in the analysed phase and we talked about one way ANOVA, two way ANOVA, multi vary analysis and failure mode effect analysis.

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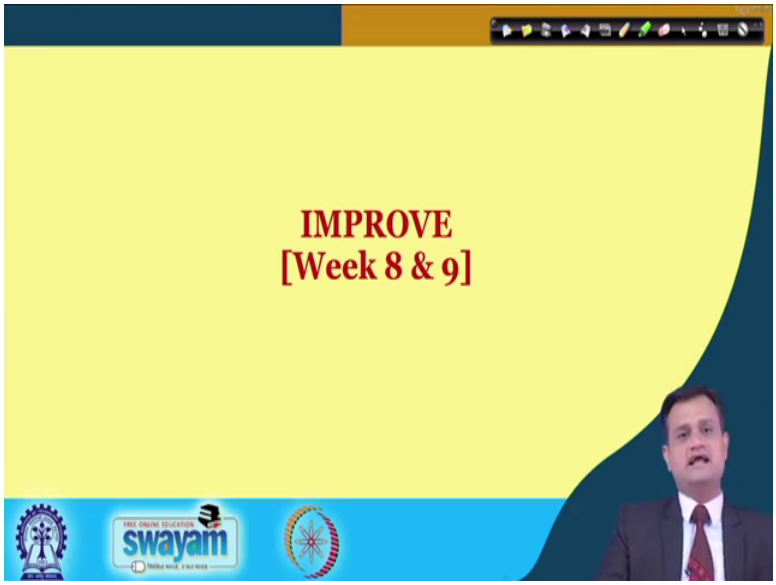

Then we entered into the improve face and week 8 and week 9 were devoted.

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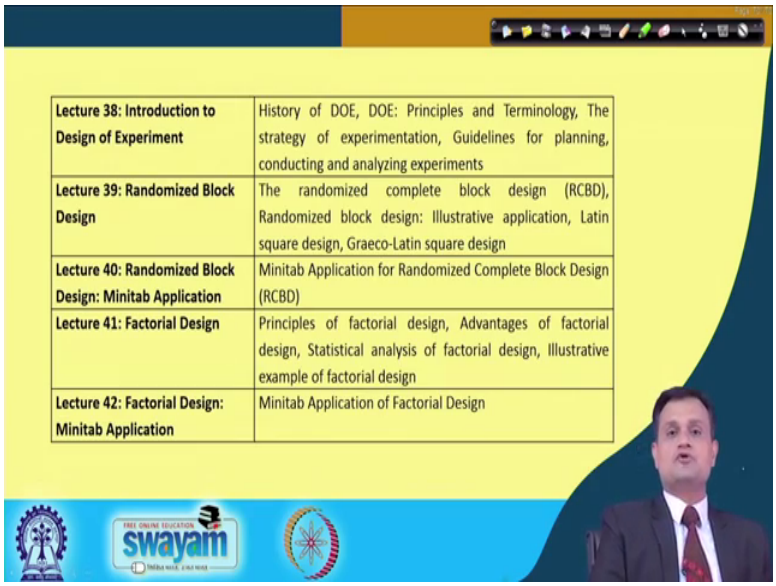

So, week 8 say basically talked about introduction to DOE, randomised block design, randomized block design, miniature application, factorial design with mini tab application.

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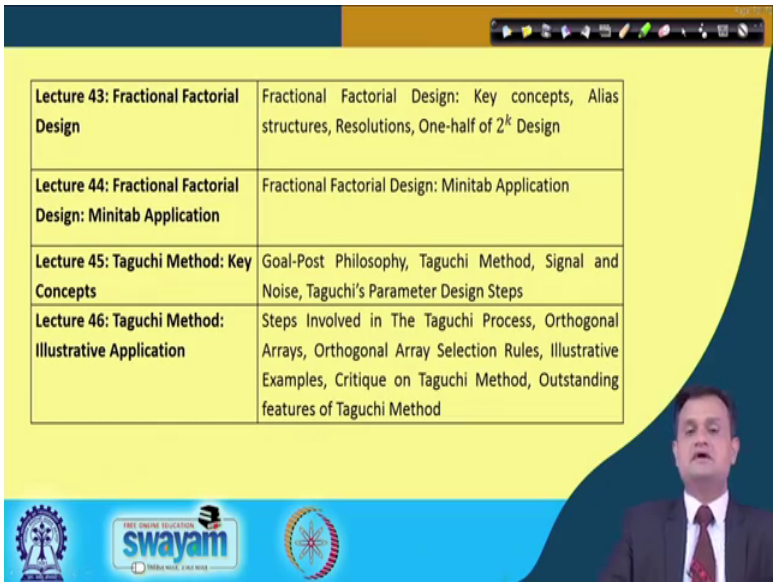

Week 9, we focused on fractional factorial, fractional factorial in mini tab, Taguchi method and illustrative example of the Taguchi method which be covered in the last lecture. So, you can see that we have covered a huge amount of say quantum, in our systematic journey of DMAIC.

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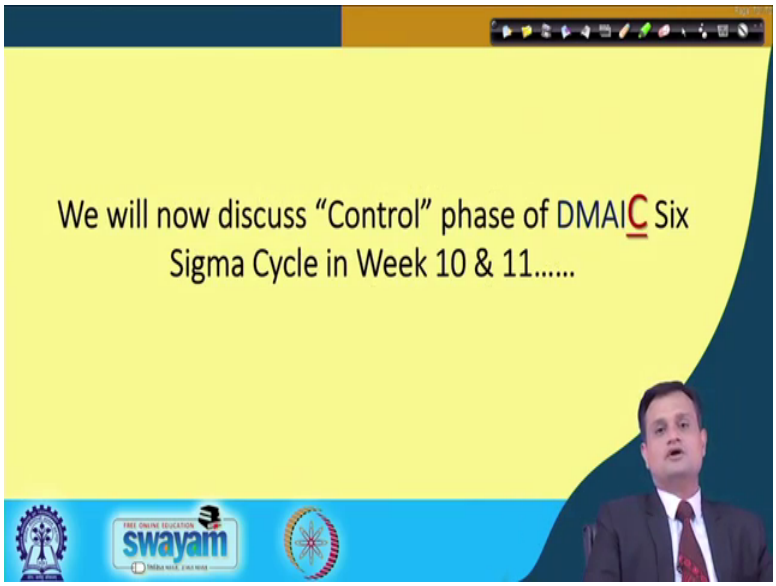

And now, you will have a little feel of relaxation that we are now in the final phase of our DMAIC cycle that is the control phase. So, week 10 and week 11 is devoted towards the control phase of my DMAIC cycle.

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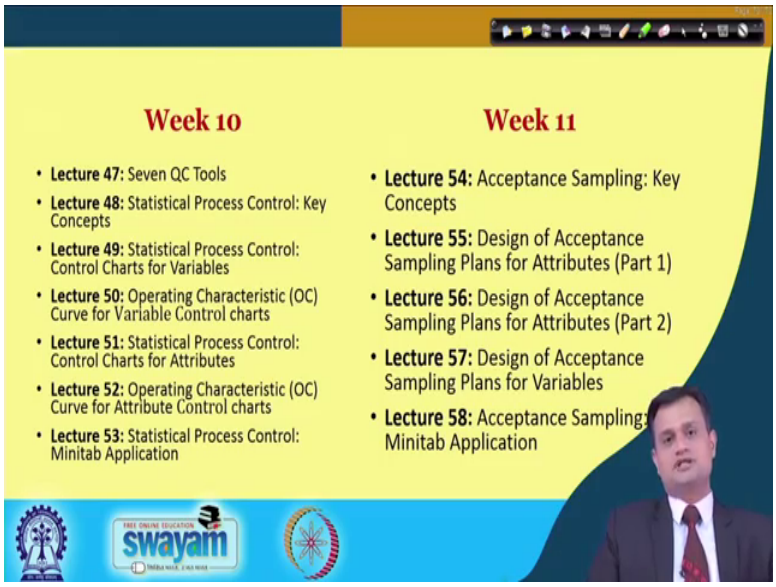

And as a part of this, I would like to discuss lecture 47 that is this lecture seven QC tool, 48 statistical process control key concepts, statistical process control for variables, then operating characteristic curve for variable control charts, statistical process control for

attributes, then statistical operating characteristic curve for the attributes. Very systematically the plan is drawn.

So, that you do not have any confusion and then the application of statistical process control in mini tab. Week 11; Lecture 54 is about acceptance sampling key concepts; 55 design of acceptance sampling for attributes, it is a long topics. So, it is divided into part 1 and part 2, lecture 55 and 56. Then lecture 57, design of acceptance sampling for variables and 58 acceptance sampling in mini tab. So, you can see that week 10 is totally devoted on statistical process control and week 11 is acceptance sampling which is also a part of statistical process control.

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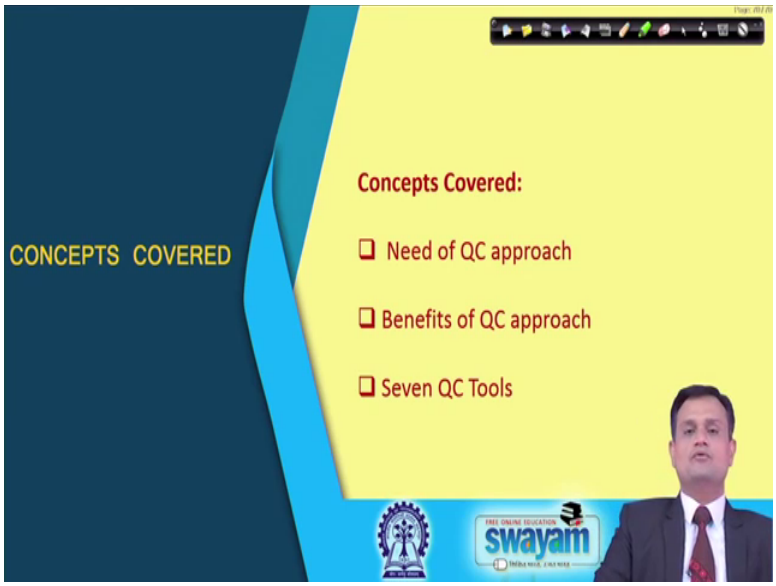

So now we would like to cover in this particular lecture, need of QC approach, benefit of QC approach and there are traditional seven QC tools. Couple of them we have already discussed. But I would just like to have a quick revision because, usually any book if you refer then it is a classical topic that, what are the seven QC tools.

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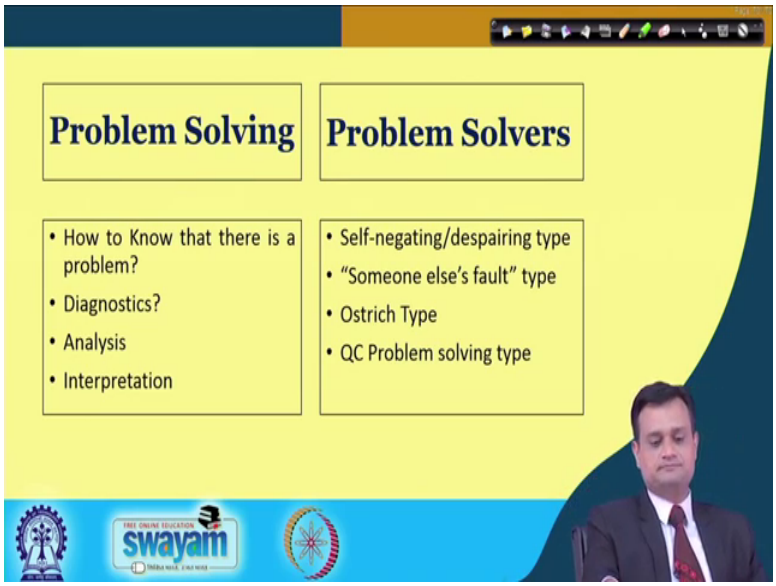

So, let us see that problem solving and problem solver. And when I say, how to know that, there is a problem, diagnostic, analysis, interpretation it is about problem solving. Now, when you just solver, you may have self negating or despairing type, you may discuss and self negating approach you may have. Someone else fault types it is not my fault, you will just try to get rid of that, then ostrich type and you can have QC problem solving approach. So, obviously, we need the solver, which are scientifically design and can really help me to avoid the conflict internal or external and convince the people for the right cause of the problem.

So QC tool; basically, is a seven QC tool helps me to get hold on my situation problem in scientific way and convince the people about the real cause of the problem.

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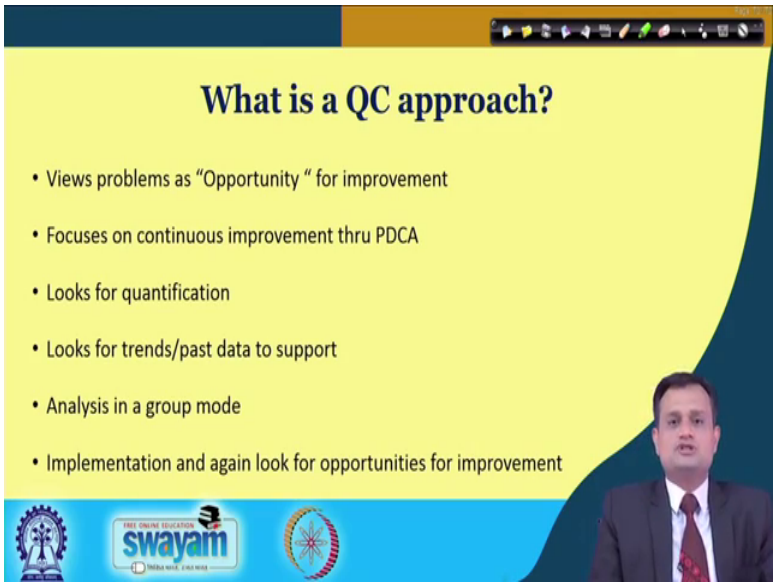

So, what is the QC approach? So, typically views problem as opportunity for improvement very very important. Many a times in the life, personal or professional we just try to avoid the problem, we just try to hide the problem, but QC approach says consider the problem as an opportunity. Then focus is on continuous improvement through PDCA; Plan Do Check Act, we have seen this cycle also, looks for quantification, then looks for trends past data to support that what is happening and what can happen in the future. Analysis in group mode; so nobody can blame. You are taking the inputs from the people you are doing brainstorming so, it is a group based approach.

And implementation and again look for opportunities for improvement. So, it is a complete PDCA cycle keep revising, keep checking, keep planning, doing, acting and then you can reach to the six sigma level.

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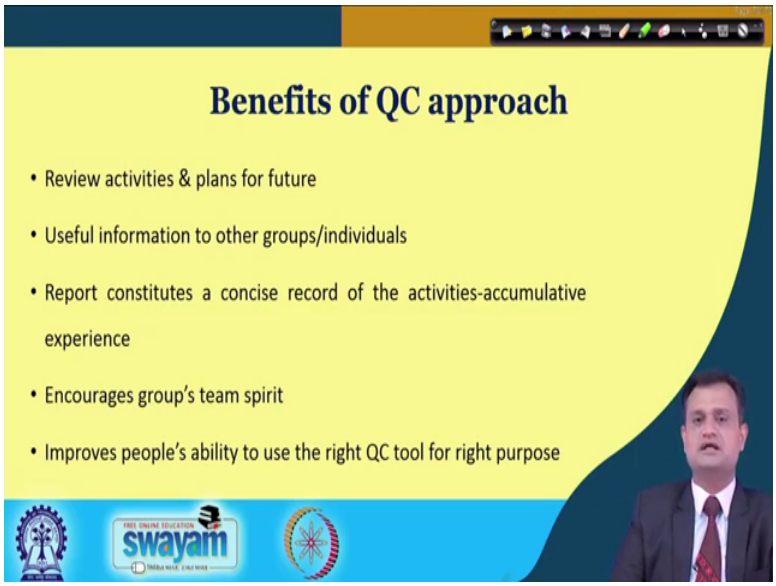

So, there are various approaches as I mentioned that it basically helps you to get hold on the situation and improve it continuously, and when you are involving the people it also improves the moral participation of the employee.

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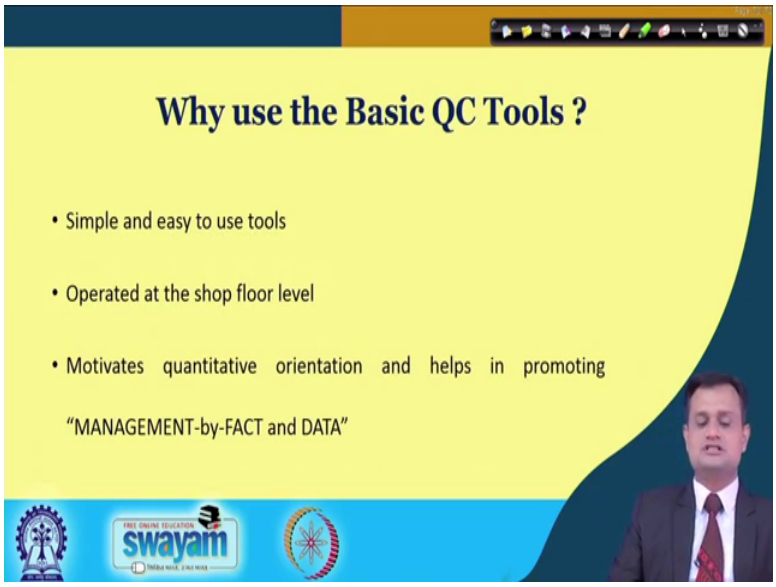

So, simple and easy to use tools, motivates the people to go by MANAGEMENT-by-FACT and DATA, not by Whims and Fancies, not by intuitions, let us have black and white. So, let us try to separate it and let us try to convince the people for the real cause of the problem.

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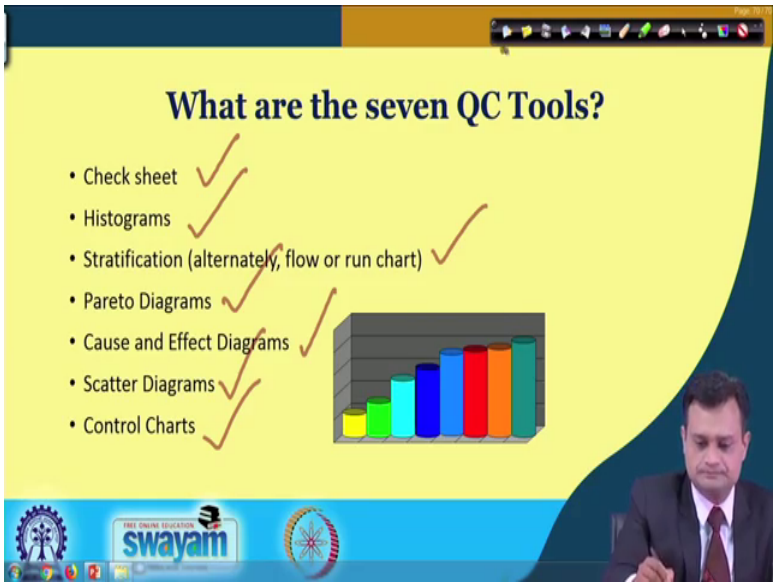

So, what are the typical seven QC tools? So, you can see here that check sheet, it is a very well known tool, histogram, then stratification, pareto diagram, cause and effect, scatter diagram and control chart.

So, I will give you the brief idea of each of the tool and control chart, I will give you the brief, but as you have seen we will discuss this particular topic in a greater detail and we will see the design of control chart for variables as well as attributes.

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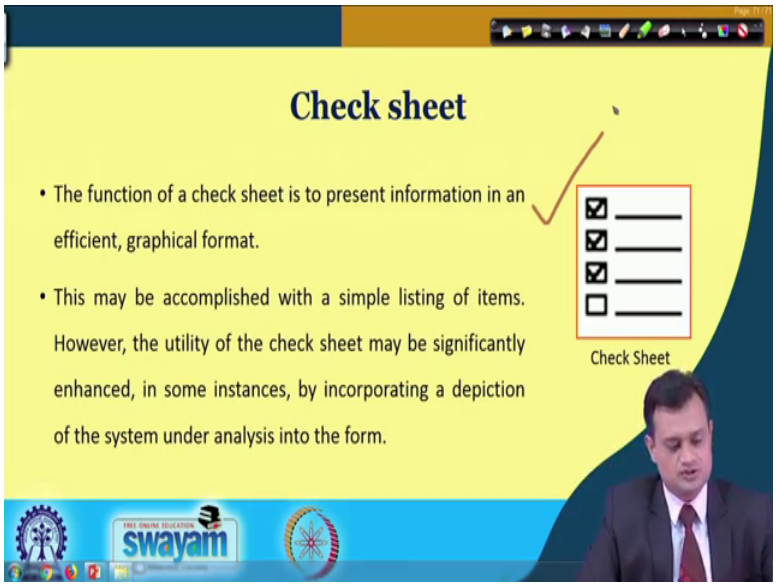

So, with this say brief overview, let us try to study the tool quickly, because many of the tools you know or we have discussed previously. So, check sheet is a very very simple tool. Say you will find a check sheet hanging on the machine panel and let us say it is a check sheet for cleaning, check sheet for maintenance. And then a person is only need to check it out. You will find, if you visit airport then just back side of the door you will find the cleaning schedule in check sheet. Similar way cleaning schedule is displayed in the form of check sheet in hospitals. So, it is a very simple tool, to see that where the process stand, what is the present progress and what is to be done, what is left over.

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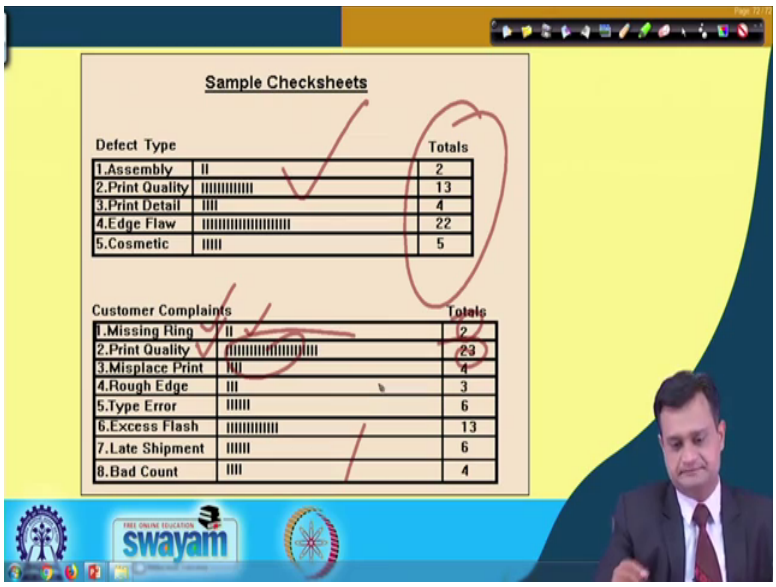

So, this is the benefit of check sheet which is a very simple tool to follow by even a very very less knowledgeable person say unqualified person and you can also say put a tally here and count the total, that how many times this is being checked, how many time this is being cleaned. So, missing ring to tallies to print quality, so many 23 and then you will get an idea; so, this is my check sheet.

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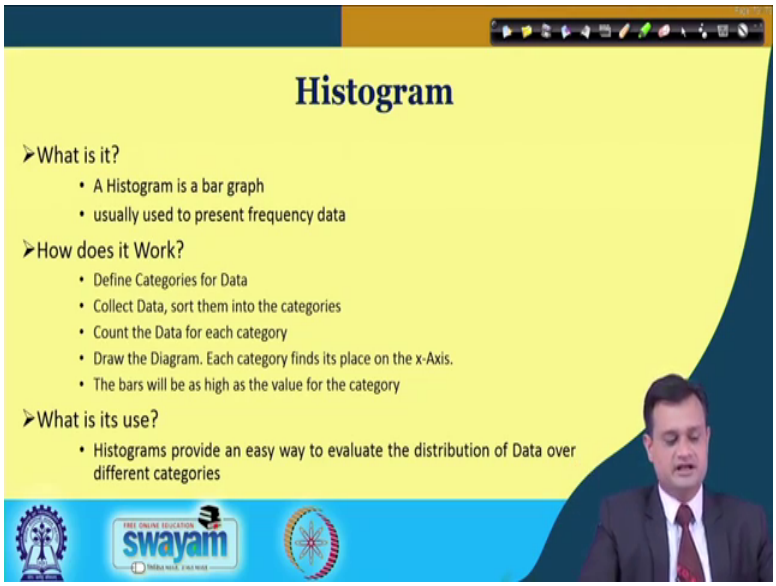

Now, the second one is histogram, basically it is a kind of bar chart and bar graph and typically used to present the frequency data. So, define the categories for the data, sort them out we have seen this in detail. And this provides an easy way to evaluate the distribution of the data. So, we have seen that whenever say you try to analyse your validity of your model regression or rather, your mini tab output will give you the histogram, as well as normal probability plot. So, first end idea you can have the how my data is distributed.

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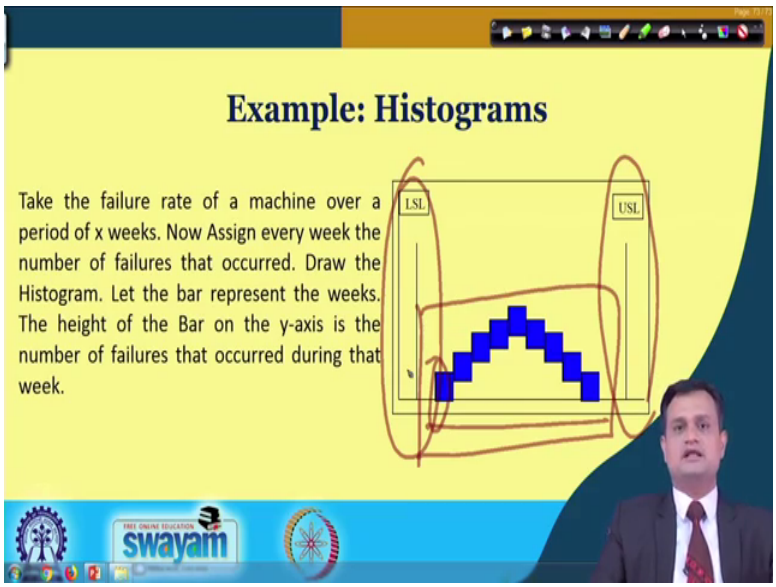

So, this is what is histogram all about and just see these example; that my machine is failing and over a period of x week I want to see. Suppose this is the maximum limit or upper specification, lower specification within this the failure of machine, this is the number of time machine has failed in a particular week, how the distribution is. I can at least figure out that whether in a particular week or particular month or particular day whatever may be the time window, something is really going worse or it is just a normal phenomena.

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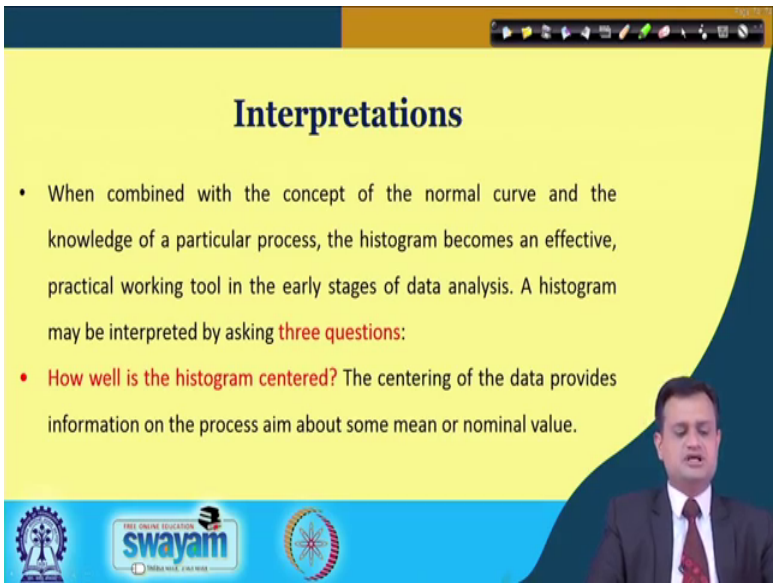

So, the interpretations are three; basically, how well the histogram is centred? So, centring of the data provides information, that whether my process is centred at or nominal value or not. What is the spread? So it gives me the idea about the variability of my data set and shape, it may be skewed.

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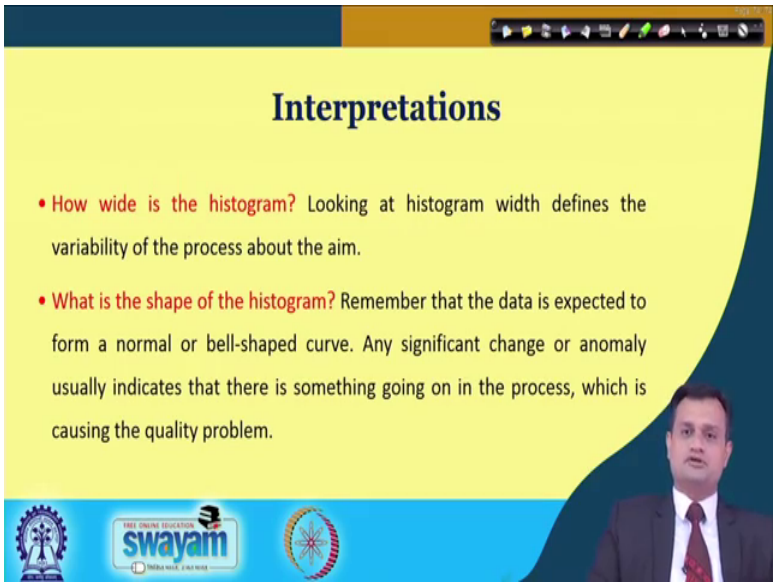

So, if my assumption about the normality is not valid, then my majority of the model rather regression, my statistical analysis or my control chart everything based on the normality assumption and if it is not valid then my analysis will lead to the wrong conclusions.

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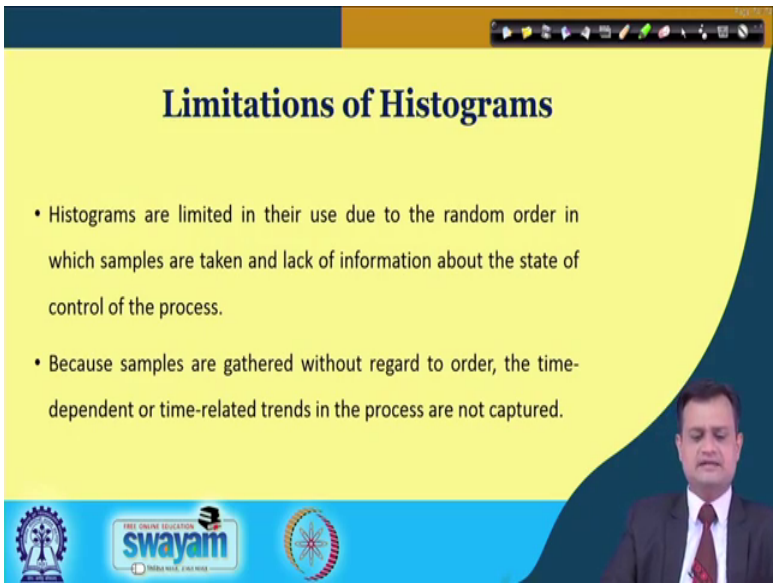

There are certain limitations that you cannot do inferential statistics; obviously, you will just get a bird's eye view that, what is happening how my data is spreaded or is queued.

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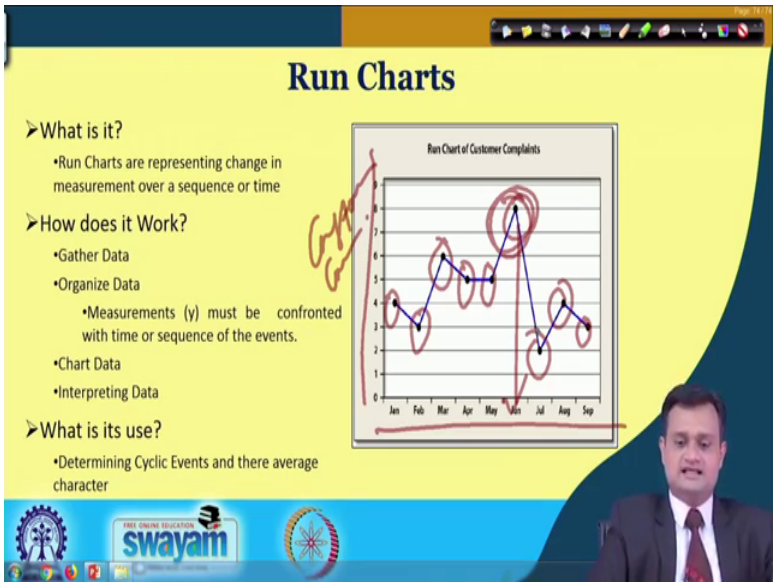

This is the run chart and you can say that, let us say this is the month, January, February, March, April and so on, and this is the run chart for customer complaints. So, these are basically the customer complaint.

What does it tell? It is a simple representation that there are 4 customer complaints in January, there are 3, there are 6, there are 5, 5, 8, 2, 3 and again 3 and this is 4. So, it is a very simple visual representation that helps me to understand that, how my customer complaints are changing, whether a particular month here is really of importance or critical. For example, the maximum number of complain you receive in June.

Now you can investigate that whether my people were on leave or my sales representative or if it is a case of restaurant, waiters were different or some other reason for prevailing or there was a heavy rush. So, you can figure out that why the number of customer complaints were more. So, just gives you that how your data is placed with respect to a time window and you can analyse with respect to say previous or succeeding data.

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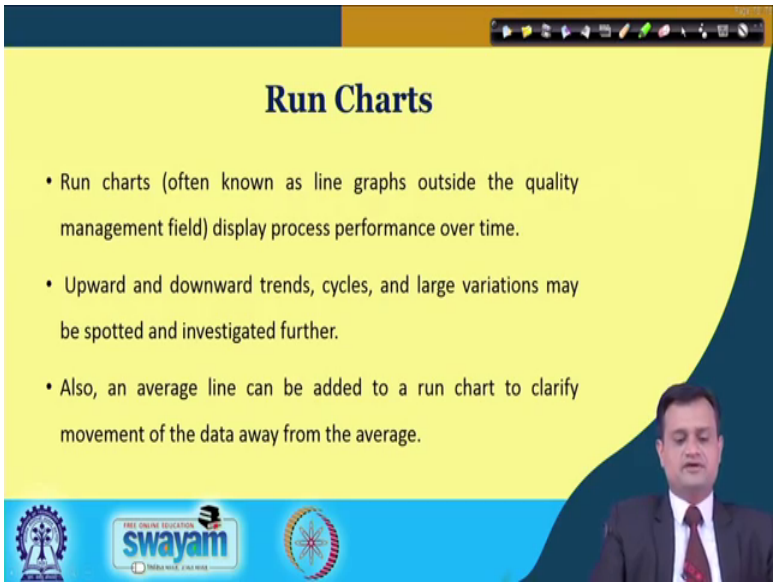

So, this is my run chart and displays the process performance over a period of time.

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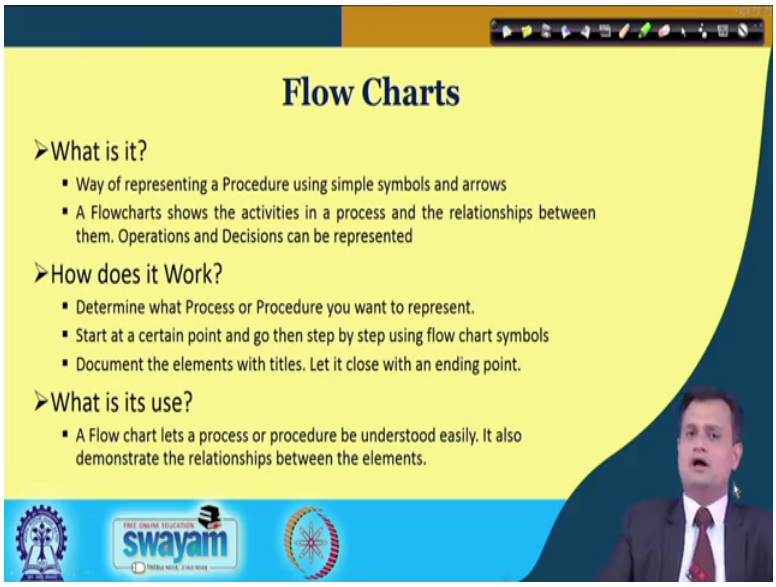

You have another tool which you have used right from your schooling that is the flowchart and typically it helps me to map the process, define the important junctures of my process and also the decision points.

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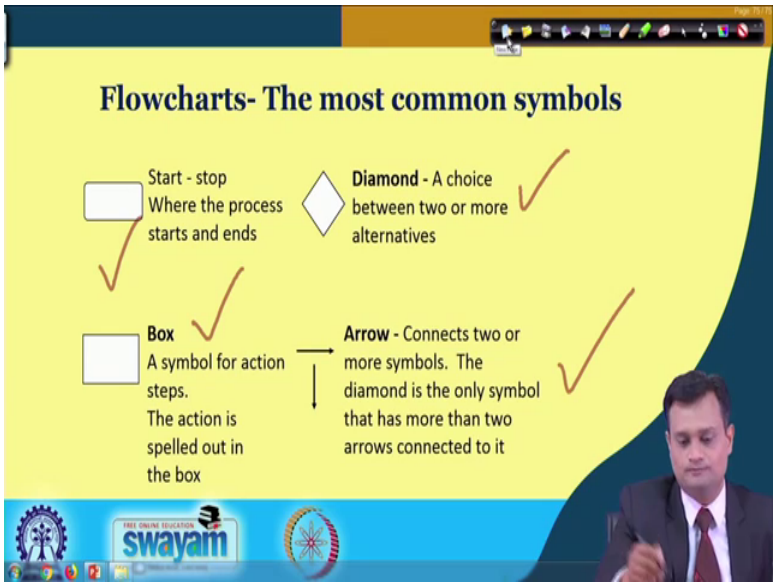

So typically, if you want to indicate the start and stop, then this is the symbol you use if you want to say action, so, some processing is going on or something is happening then it is a box, then diamond it is about choice, decision making, arrow it connects the various symbols and shows the flow.

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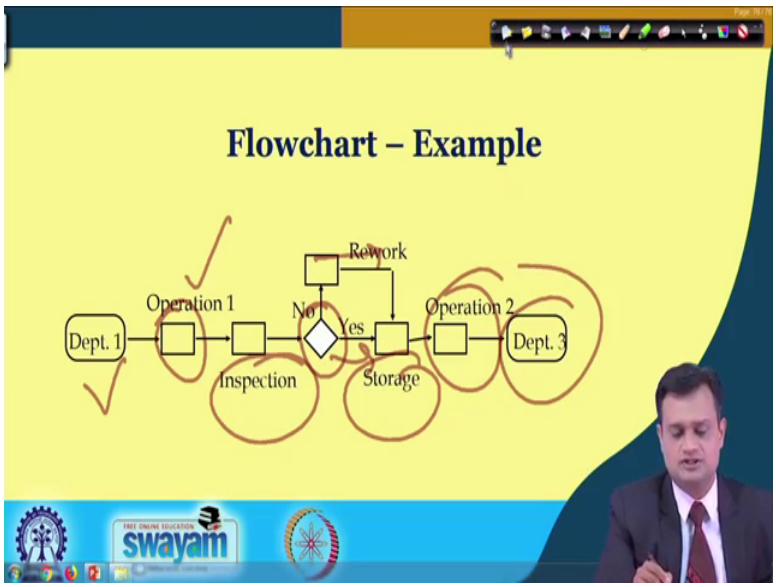

So, this is what is my flowchart and you can just see the example flowchart, there is a department 1 and there is operation 1 so, I have used this. There is inspection something is happening, so, box. This is on point no or yes, whether you have to go for rework or

you will pass it, storage, operation and then it will go to department 3. So, this is a very very simple understanding of my flowchart.

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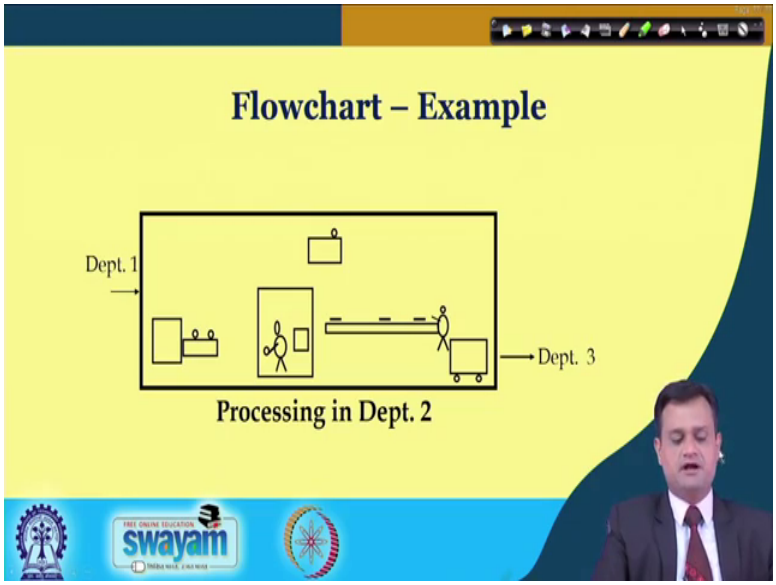

And processing in department 2 can even be captured through a systematic flowchart.

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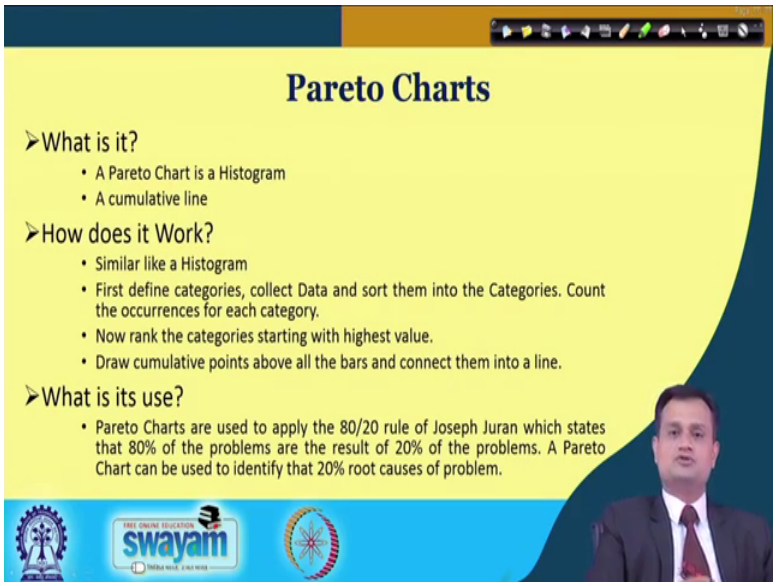

And that will give the people workers a very simple and easy way to understand that how the things are streamlined. Now, Pareto chart as we have learnt that it follows the 80-20 rule, and a renowned economist Pareto, gave this particular logic and he realised that 80 percent of the wealth of the world is in the hand of 20 percent of the people and only 20

percent is available for the 80 percent. So, he came to a conclusion that there is no point in focusing on all the problems if you can figure out vital few, then the 20 percent can really cause the 80 percent of the problem and rest 80 percent are only responsible for the 20 percent of the problem.

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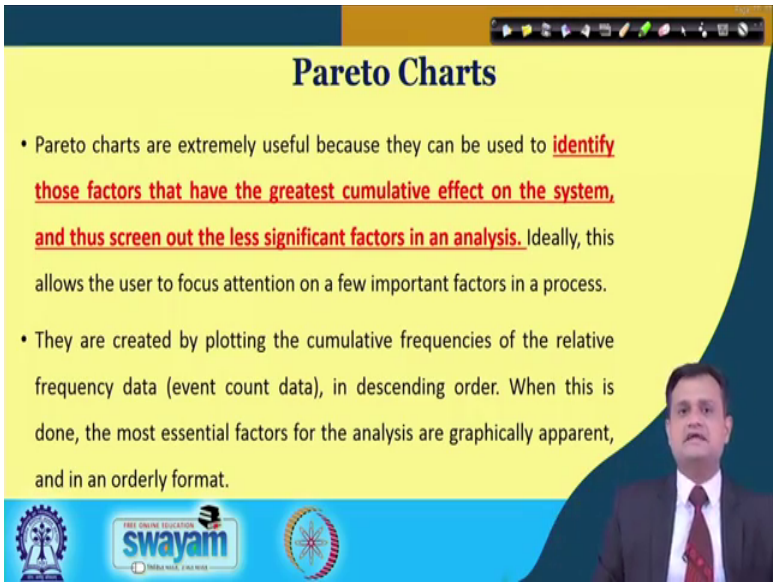

So, this is what he has done and typically it identifies the factors that of the greatest cumulative effect on the system.

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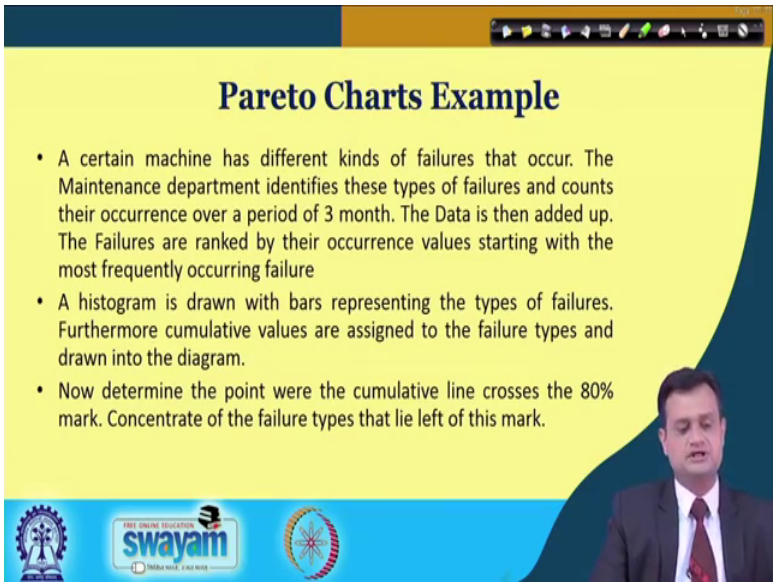

And I can represent my typical Pareto chart like this.

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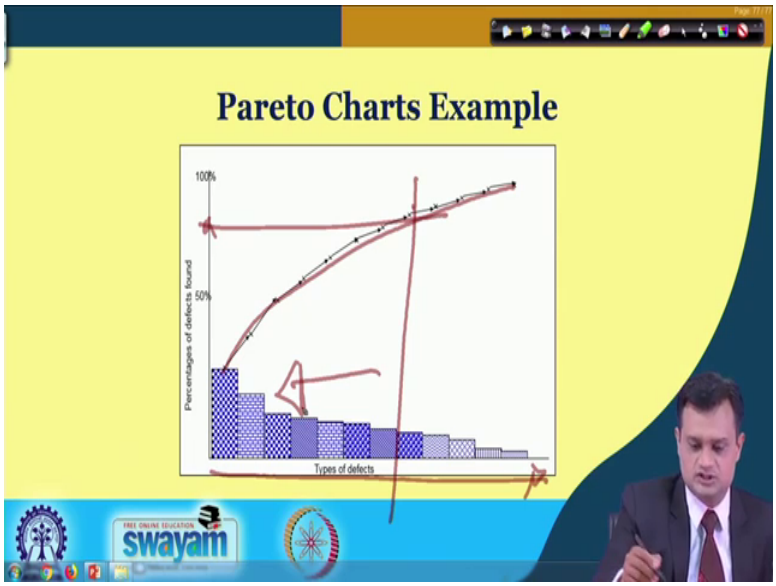

So, you have this data arranged in the descending order and then you find the cumulative frequency and then you try to see that at a particular 80 percent where it cuts. So, 80 percent say, it cuts at a particular point and all the problems below this are really of importance because they contribute to 80 percent and I will focus on these problems first.

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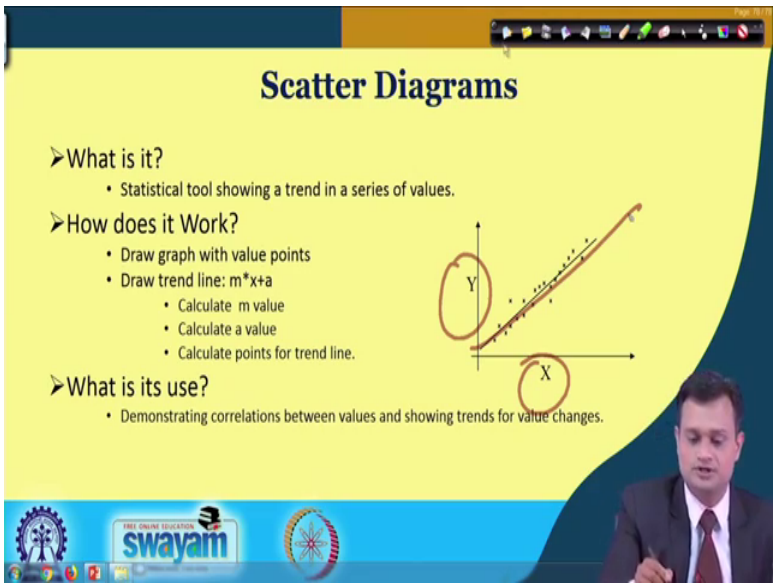

So, this we have previously also seen with the example. The another is scatter plot and we had seen in correlation analysis also that there is some scatterness in the data and you try to capture this or you try to find out a best fit line or correlation.

So, scattered plot basically says that, how my data is distributed, how my data is scattered with respect to maybe variable X and variable Y in the space and can I fit some best fit line, y is equal to mx plus a. So, this shows the trends over a period of time suppose it's a productivity and suppose X is the time and Y is my productivity then I can say that how my productivity is increasing with respect to time.

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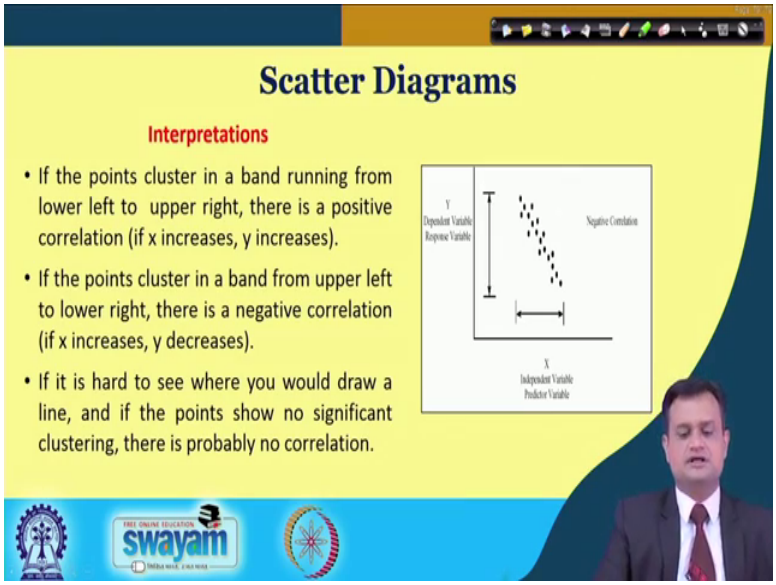

So, this is about the scattered plot, you can refer couple of examples.

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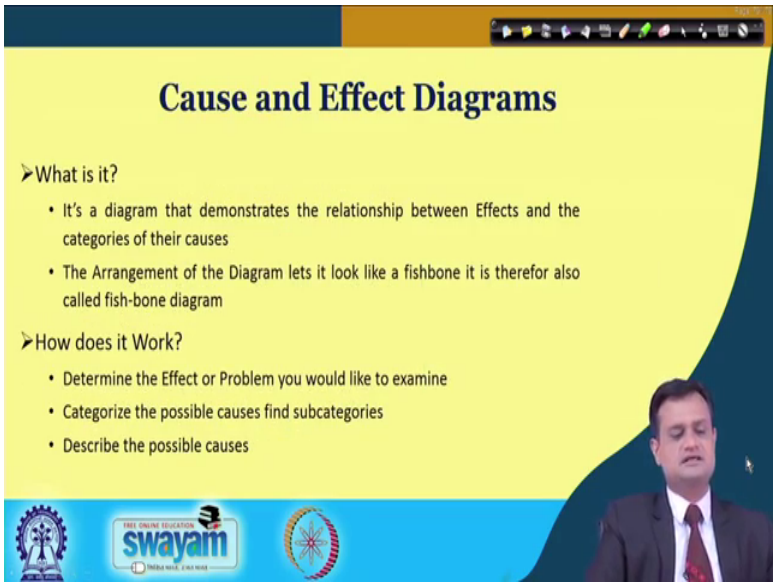

Cause and effect we all know that this is the most important approach for conducting the initial brainstorming exercise and identifying all the possible causes that can lead to a particular effect. So, it is also called (Refer Time: 21:06) diagram, fishbone diagram and cause and effect.

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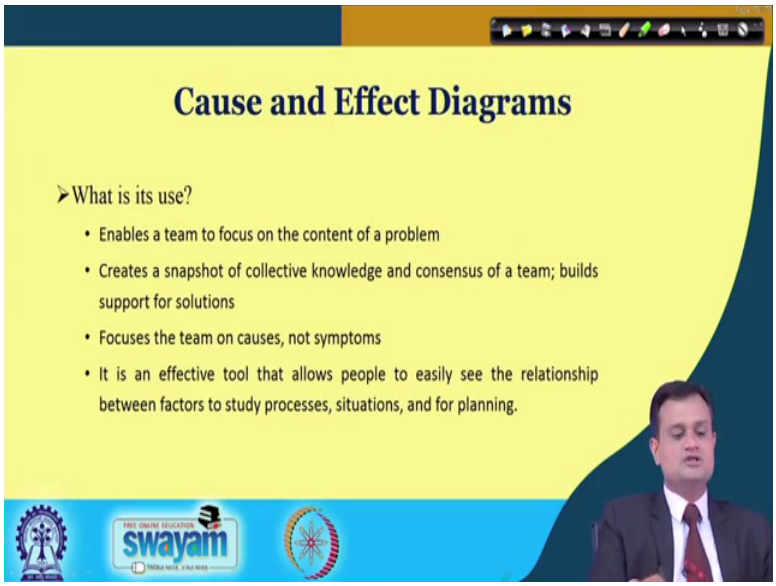

So typically, your cause and effect diagram enables the team to focus on content of the problem, find out the causes and symptoms and allows the people to easily see the relationship.

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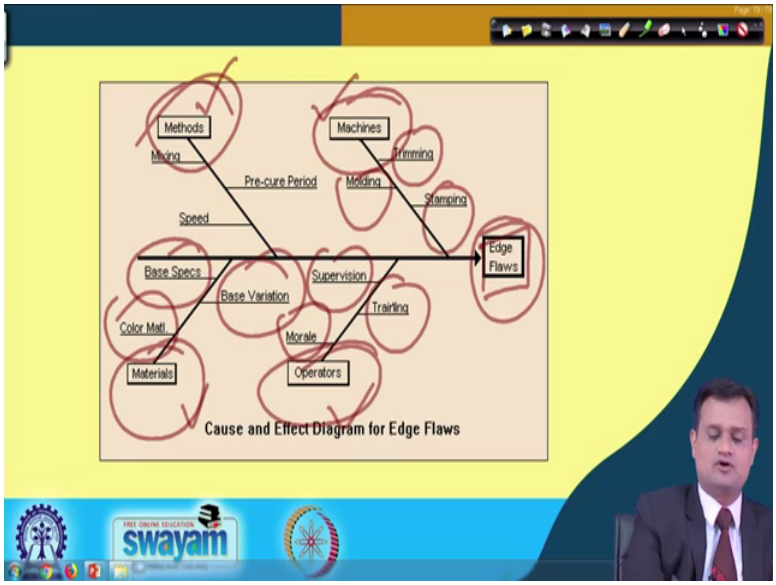

So, just see this there is a problem with the edge flows in manufacturing process, there could be machine related problem like timing, stamping, moulding, there could be operators training, supervision, moral, material, specification, colour of the material, base variation and there could be problem with the methods. So, you have the effect, you have the causes; causes are further separated as the main causes and within the main cause you have the branches which are your sub causes.

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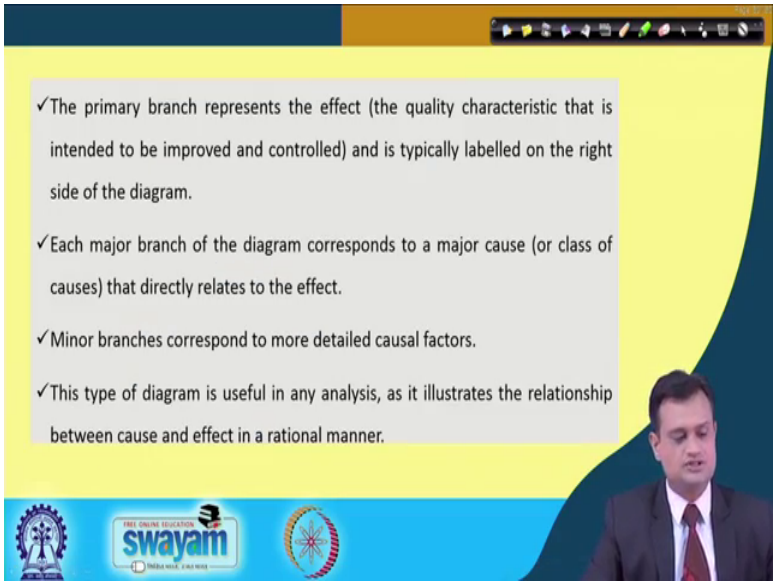

So, this is what I have just written here.

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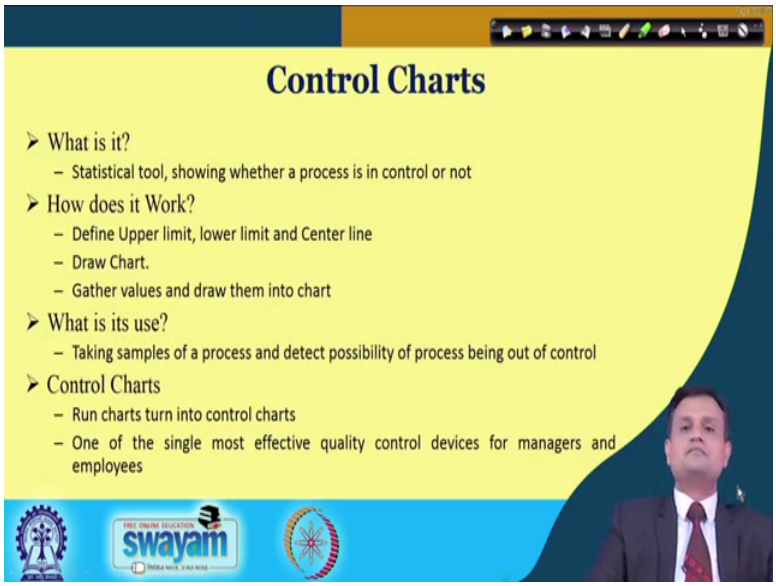

Now, coming to the last tool in my seven QC list; so, the 7th tool which is the most important and widely used tool on which we will devote couple of lectures in detail and that is the control chart. So, all other tool can also help you to control my quality or get hold on my problem, but control chart because they are statistically driven it is really a scientific tool to achieve better control on my processes and take the corrective action at the right time. So, it works with the upper limit, upper control limit, lower limit and central line and the moment you see that your point is going outside the control line just I am giving you a brief then there is an indication that something is going wrong and you may think about a corrective action.

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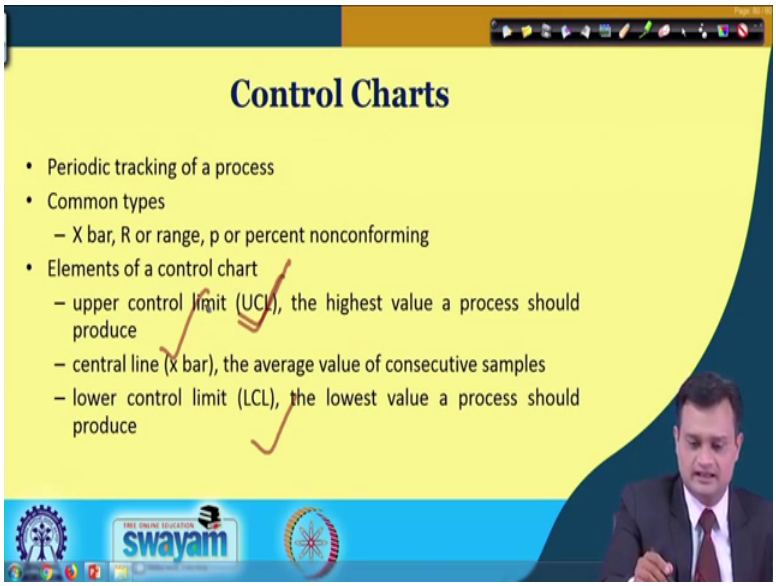

So, there are different types of control charts for variables and attributes. For variables X bar and R chart or X bar and S chart or sigma chart for attributes you have p chart, you have c chart, you have np chart, you have u chart. So we will see, how to construct the control chart how to design them and what is the purpose of each particular chart in the subsequent lectures. And typically, it sets the lower control limit, upper control limit, lower control limit and central line. This remains same for all the control charts irrespective of their nature for attribute or variable and we can have the idea about the process control.

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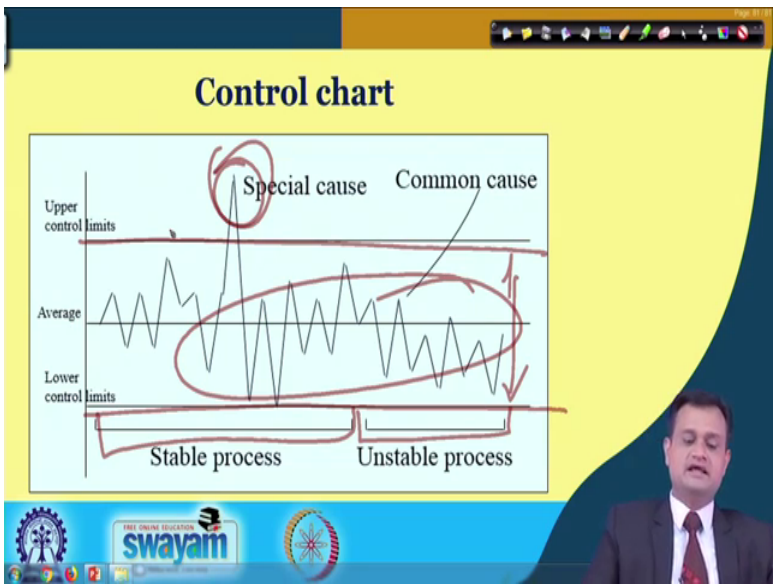

So, just see this that, this is my upper control limit, how to determine. We will see, lower control limit, you can see that up this there is a stable process, these are some of the special causes. You may say that there is something unstability, but these are the common causes. So, whenever you see that the randomness is within this particular limits, this is just because of chance cause, random, common you cannot avoid it any process will have some variability. For example, if you measure your blood pressure in the morning maybe you get fantastic reading 110 and 80.

But, if you measure it in the afternoon it may be 120 and 80 or 85 and if you measure it in the evening when you are extremely tired it may be little higher 130 and 90. So, it is ok, it is all well within the range and it is acceptable. So, so long this variations are well within this limit, they are acceptable. There are some special cases when if some typical trend prevails, then that is an indication of some abnormality assignable cause that we will see in detail letter on. But, just for the simplicity we assume that if the point is falling outside the control limit there is a concern and there could be and assignable cause prevailing if it is all within the control limit I need not to worry.

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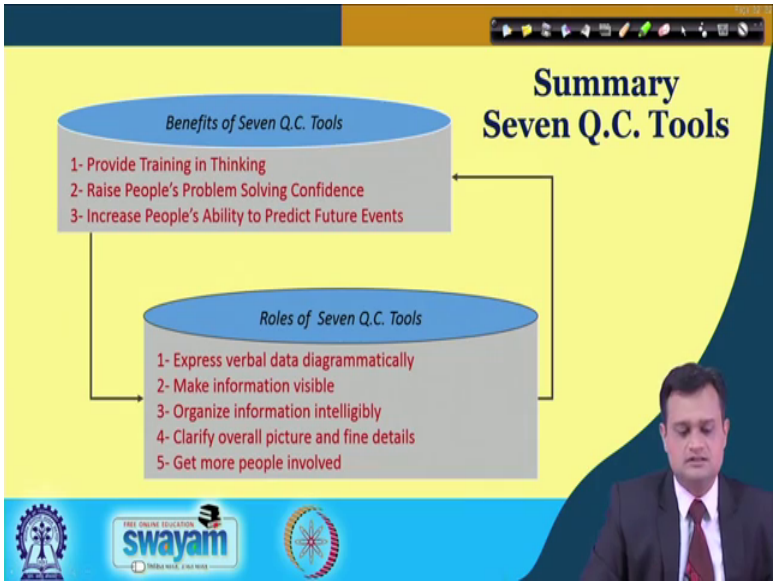

So, there are benefits of control QC tools, it provides training in thinking remember. When you execute this, it triggers your thinking how to think in a more scientific way, rigorous way, directional way, raise peoples problem solving confidence. You stand with the data, you stand with the trend, you stand with the facts and then you have better

confidence in your results and recommendations and you can also convince the other people and top management. Increase people ability to predict future events. So, you are not only struggling with day to day life, but you can say that what will happen down the line.

So, you must have seen the insurance company they are asking that, are you a smoker, do you have diabetes, do you have blood pressure, do you have you gone through some critical surgery; if yes then you will find that they will raise the premium. Because they have some standardised table available that if you have this problem and if you are a smoker then what is the risk to your life and then they can better predict the consequences that may occur in the future.

So, these are the couple of benefits of the seven QC tools and there are various roles seven QC tools that it express verbal data diagrammatically, information visible, organised information intelligibly and clarify overall picture and got get more people involved.

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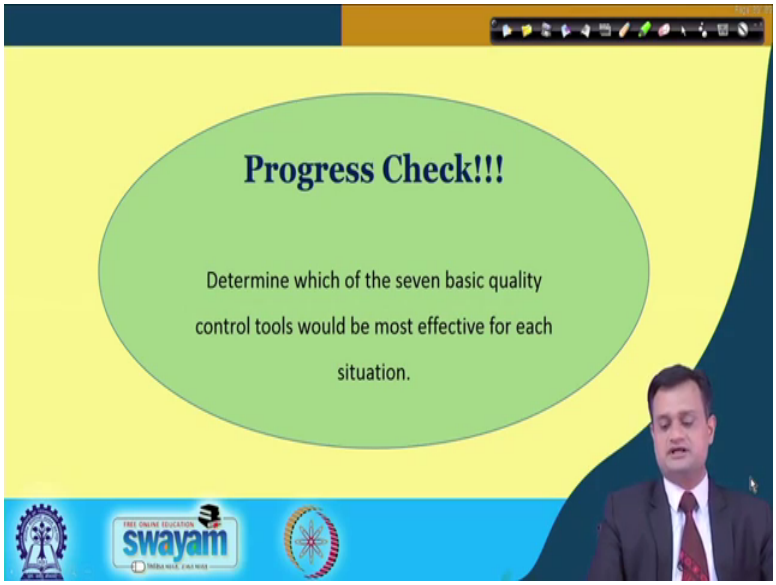

So, progress check determine which of the seven basic QC tool would be most effective for each situation. I want to put you in little bit thinking process.

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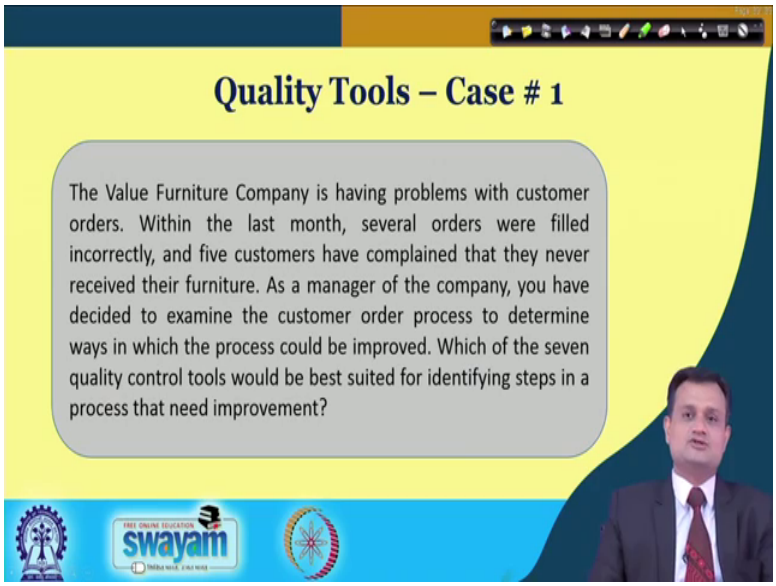

Let us say this is case 1 and is like this. The value future company; furniture company is having problems with customer orders. Within the last month several orders where failed in correctly and five customers have complained that they never received that furniture. So, as a manager of the company you have decided to examine the customer order process to determine ways in which the process could be improved.

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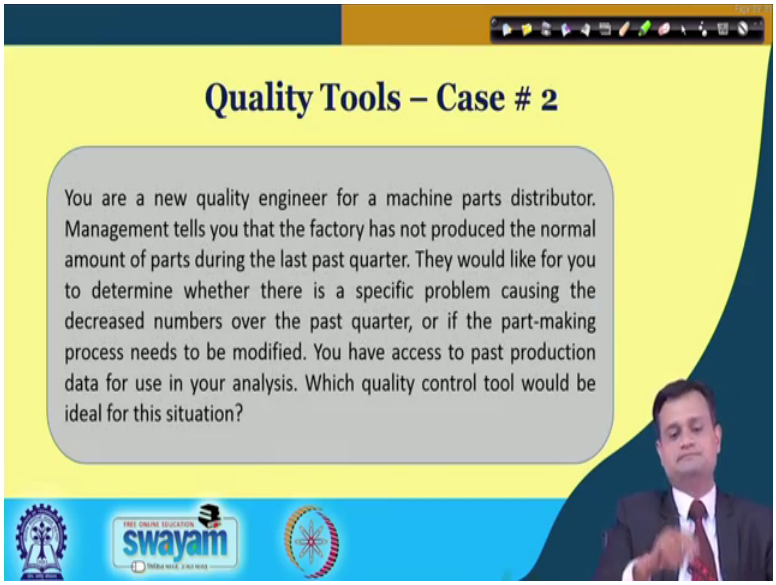

So, which of the seven QC tool would be most appropriate and what kind of steps would you like to follow to address this problem.

Let us see the case 2. You are a new quality engineer for a machine parts distribution and management tells you that the factory has not produce the normal amount of parts during the last say past quarter. So, they would like for you to determine whether there is a specific problem causing the decreased number of say over the past quarter production or if the part-making process needs to be say upgraded updated or modified. You have to access to pass production data for use in analysis, in your analysis and which quality control tool you would like to use to propose an amicable, reasonable practical solution to the management.

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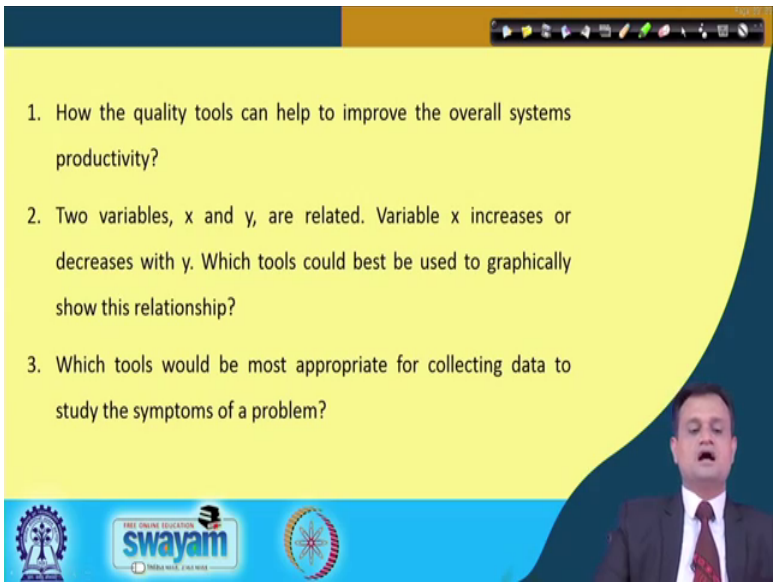

So, think it. How the quality tools can help to improve the overall systems productivity? Two variables x and y are related. Variable x increases or decreases with y. Which tool could be or tools could be based used to graphically show this relationship? Which tools would be most appropriate for collecting data to study the symptoms of the problem? So, just try to introspect and that would help you to digest the concepts better.

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So, these are the references you can definitely refer.

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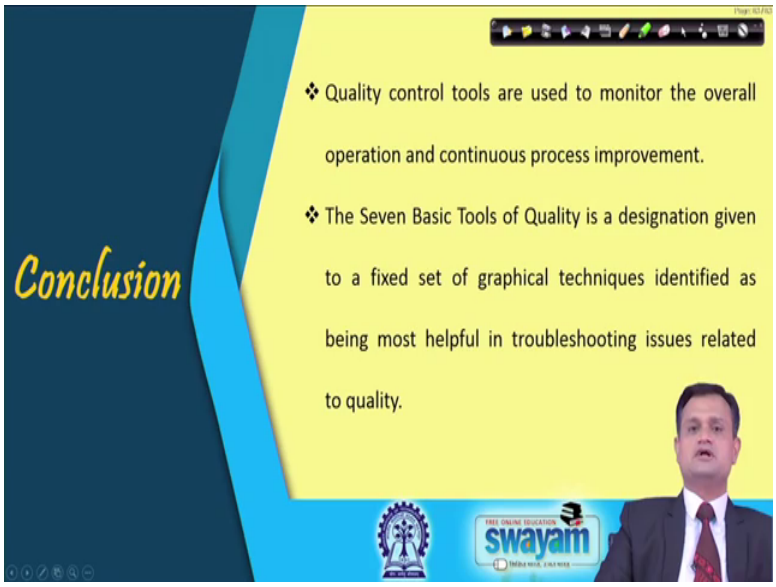

And quality control tools as I mentioned provide a directional way to attack on your problem and convince the people for your recommendations.

So, thank you very much for your interest in learning seven QC tools. I hope this video would have help you to appreciate the importance of these tools. We will do the detailed analysis and develop a greater understanding on various quality control charts in the subsequent lectures till that time keep revising be with me enjoy.