Production and Operation Management
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Lecture 43
7 QC Tools

Welcome friends, in our last few sessions, we discussed in detail about the statistical quality control. We discussed about use of quality control charts, we discussed about run test, in which we discussed how to decide the optimum number of runs, we require runs, which is not too large and these are not very small also.

So, how we determine all these things with respect to whether our process is in control or not in control, but that is just the measurement of our particular process capabilities, whether process is producing products as per the given specification or not, but it is also very important that if a process is not giving you results as per the desired expectations, when it is not meeting your specifications, then what are the tools available to you, so that you can diagnose your system. Once you know that there are some faults which are there in your system.

But now, the next issue is that how to diagnose those faults and then once you diagnose, then only you can take some remedial actions. So, in this particular session, we are going to discuss about these quality control tools, which are going to help us in diagnosis of our various problems and 7 quality control tools are very popular. So, the name of this session we have given as 7 QC tools only.

Now, let us start discussions on these important quality control tools that will help us in identifying the problems and then the solution will automatically come.

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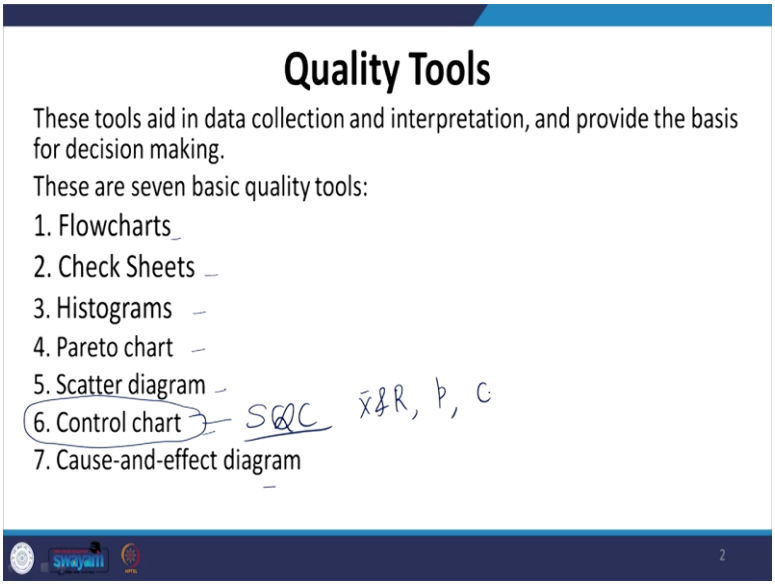

So, these are Flowcharts, Check Sheets, Histograms, Pareto diagram, Scatter diagram, Control charts and Cause-and-effect diagram. These are the 7 tools which are very extensively used to some extent, we have already understood the use of control chart in all our SQC we have discussed about the control charts, where we discussed different type of control chart like X bar and R chart, p chart, C chart, all these are the different types of control charts.

So, control charts are also a type of quality control tools, but there are some other type of QC tools also, which are very effectively and not only in manufacturing setup, but any kind of setup where we can use these quality control charts. Sometime unknowingly also, we may be using these tools, but if you know the scientific method of using these tools, that how these tools can help you in proper data collection and then the interpretation of that data, it will help you tremendously to improve the quality of your organization.

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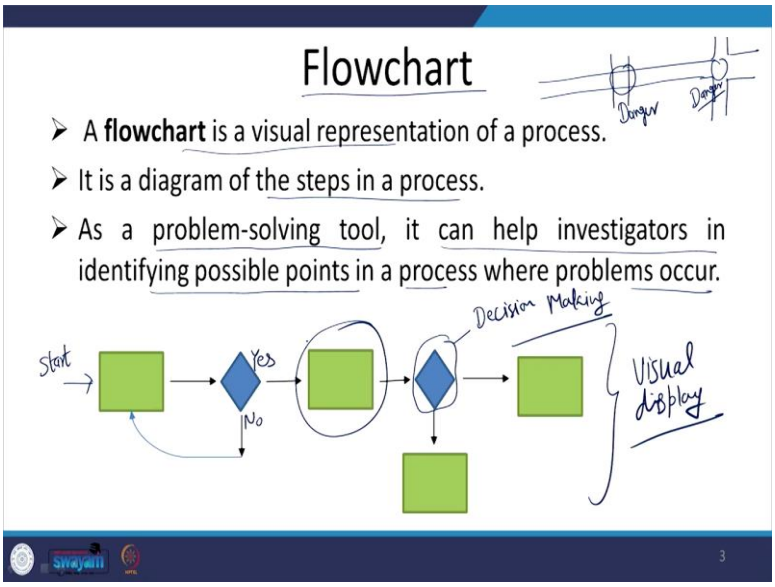

So now, let us discuss them one by one. The first of series is the flowchart in the flowchart, it is a visual representation of the process, whatever different steps you are doing in your process from entry to exit. So, you have to visually display that, like this is a small diagram, where we are showing you these different steps, it is a diagram of the steps in a process. So, from here you are starting some activity is taking place, then another activity then another activity then another activity then another activity, some bypass activities are also happening from here, some feedback is also going on.

So, this is a visual display in our operations management, there are standard practices to develop the flowchart. There are proper symbols which we use for representing different types of activities for an example, because we do not want to get into the flowchart only in this particular session for an example, this particular symbol is a symbol for decision making.

So, if you are taking some decision, so after each activity some decision has to be taken. So, either yes or no if it is okay, then you are going ahead if it is not okay you are going back. Similarly here also if it is yes, it is going for grade A product if it is not no, it is going for grade B product, so whatever is the activities we are not discussing because it is more like a generic kind of flowchart, but when you have this clarity, that how different processes are taken one after another, then only you will be able to diagnose the system properly. If you do not have this clarity, then it is not going to help you in diagnosis.

So, this is more like a problem solving tool, it can help investigators in identifying possible points in a process where problems occur like a very common example, you will see that on your highways if there are crossings, there are circles. So, you know that these are the danger points. These are the points where accidents may happen, these are the danger point where accidents are possible if some curve is there.

If some sharp turn is there, that is a danger area, because people may not be able to see who is coming from the other side. So you have to have a complete visual representation of your process and it will help you as an investigator to identify those possible points, which are the bottlenecks.

So, in our language of operation management, we call it bottlenecks. Wherever the chances of accidents wherever the chances of some errors defects are possible. So, those steps are known as bottlenecks that this particular step is generating more defects. So, that becomes a point of our constant observation you need to put your best player best employs at that particular process, so that you can minimize the happenings of continuous errors or you may like to automate that process.

Like for an example, if at this particular activity, more defects are generated. So, you may think that can I replace this particular activity with some robot with some automated systems, so, that I can minimize the happening of errors at this particular point. So, this type of decisions you can easily take when you have the visual representation in front of you. So, that is one type of quality control charts, the one type of quality control tools.

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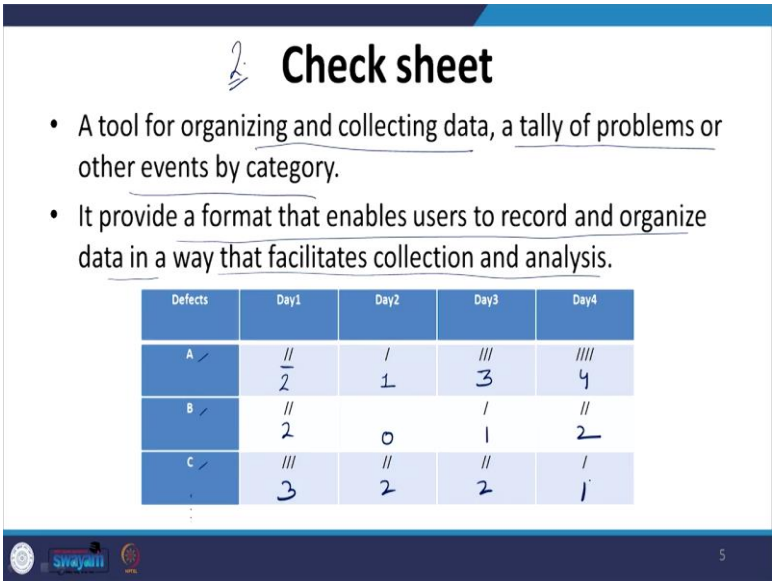

The second type of quality control tool is the check sheet, check sheets are this is a format of check sheet which is a tool for organizing and collecting data. So, to gather data, we use the check sheets. And you must have seen when people go for data collection for their research, at that point also people use the check sheets, because check sheets are very convenient for the data collection in a various kind of shopping malls to maintain the inventories of various items, check sheets are used.

So, check sheet is also used for real when seat allocation in engineering courses used to take place. So, check sheets used to be there and on the basis of check sheet data, we used to decide that how many seats are available in which engineering college in which particular discipline. So, it is a very useful visual tool for collecting and organizing the data in a very systematic manner.

So it tally of problems or other events, you organize by the categories. Now like for an example, defects are ABC and more number of defects, which are possible which are happening in your organization, because you can create a long list of possible defects. If you have seen the kind of reply you get from a bank when your checks are not honored. So, they have a long list of reasons, which are already printed on that particular reply. And they have to just stick on a particular reason that because of this particular reason, your check is not honored, and they also maintain a check sheet.

And all those reasons are written similarly in that check sheet, check sheet, and they prepare this kind of data that on Monday how many checks are returned because of reason 1, how many checks are returned for reason 2, how many checks are returned, because of reasons 3, and there are around 31 such reasons, which bankers have identified for returning a check, maybe it is because of mismatch of signature, maybe it is because of insufficient balance, maybe it is because of wrong writing of your account number maybe because of it is of old data, maybe because of some cutting on the check.

So, all these are the possible reasons because of not honoring of your check and you have a list of those in the column A and then on the day wise, you can maintain the data that why checks are not honored. So you will see that most of the checks are not honored because of insufficient balance.

So that information came only because of this type of data arrangement in check sheets, so it provides a format that enables users to record and organize data in a way that facilitates

collection and analysis. So, like ABCD are there, these are the defects, which we have identified on day 1 for defect a, 2 occurrences are there. So, we make these 2 lines, one for each occurrence on day 2, for defect a only one occurrence to place. So, only a single line on day three, 3 occurrences are 3 for defect A. So, 3 lines are there, on day 4, 4 occurrences are there for defect A, so 4 lines are there, and so on, for defect B on day 1, 2 occurrences there is no occurrence of defect be on day 2.

So, here there is no line, we have kept this cell as blank on day 3, you have single line that means only one occurrence for defect B on day 4, 2 lines that means 2 occurrences for defect B and so on for other defects also you can make. So now, we just draw these lines so, that it is easy to put data on a faster way, but later on, you can make a log sheet out of it, where you can write these in terms of numbers like it is to it is 2, 1, 3, 4, 2, 0,1, 2, 3, 2, 2, 1.

So, later on in your record book, you can convert data into numerical values. When you are at the shop floor. You are using these lines which are like your frequency table development, you must have studied in your elementary classes. So, that is that kind of symbols we use.

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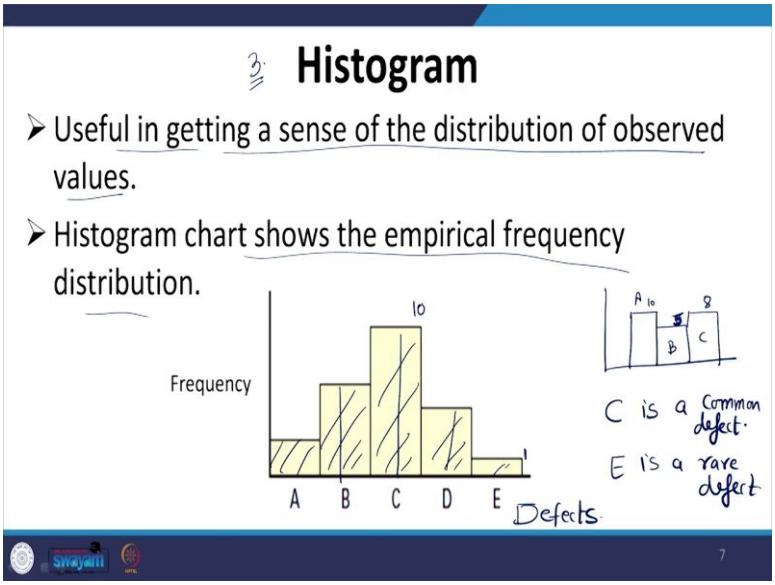

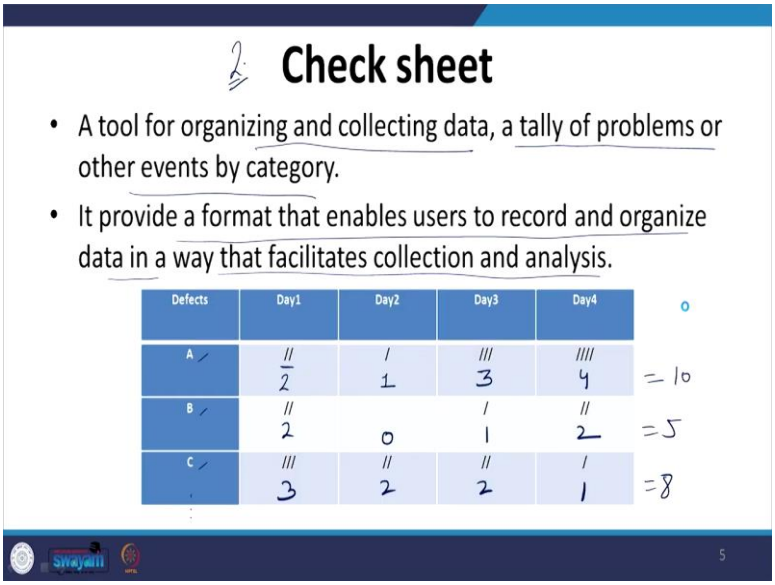

Then, the third important quality tool is histogram. Histogram is also a kind of you can say visual display of how the defects are distributed. So, it is very useful in getting a sense of the distribution of observed values that how other values are distributed. So, if you want to have a proper sense a visual sense, which is going to give you a very quick decision making in that purpose the histogram is very suitable.

And histogram chart shows the empirical frequency distribution like in just the previous case, for A we have 4, 3, 7 plus 2, 8, 7 plus 1, 8, 2, 10, 2, 3, 2, 5, 3 plus 2, 5, 7, and 8. So, 10, 5, 8, we can make a histogram of this type of that it is A 10, B 5 and C 8. So, this type of visual representation is possible, when you are creating the buildings these in our day to day language, we say that these are the buildings which you are creating for different types of defects. So, A, B, C, D, E these are defects and these are the frequency of these defects, maybe it is now you can easily see that C is a very common defect.

From this diagram, we will see that C is a common defect, common defect because it is happening more than any other type of defect and we can say that E is a rare defect, it is not happening regularly, because the frequency is very less for the entire, let us say if this data is for 1 week.

So, out of that, only 1 occurrence is there for E, but there are 10 occurrences of C. So almost daily, either once or twice. You face the problem of C but you rarely face the problem of each type of defect. Then you have the number of B then D, then A. So, the different defects are happening at different rates. So the very purpose of histogram is that just by seeing this

diagram, you will be able to understand that which defect is more common and which defect is less common. So, that is just the interpretation of this histogram diagram.

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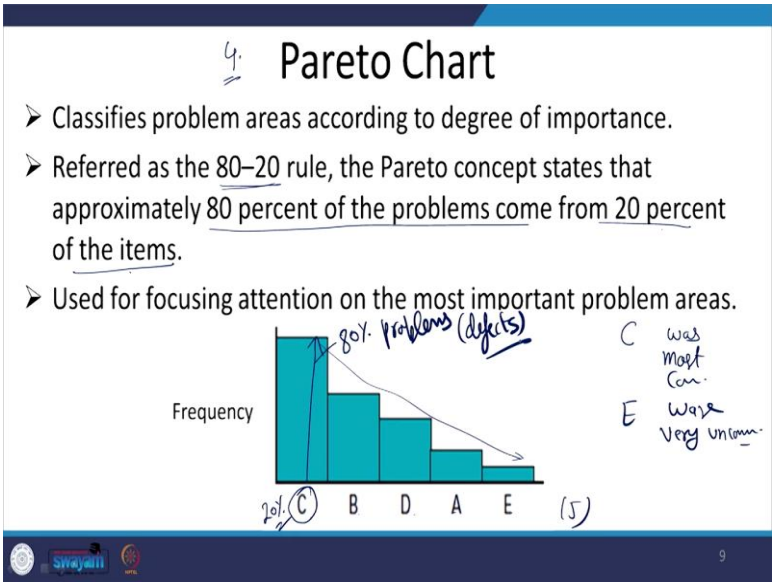

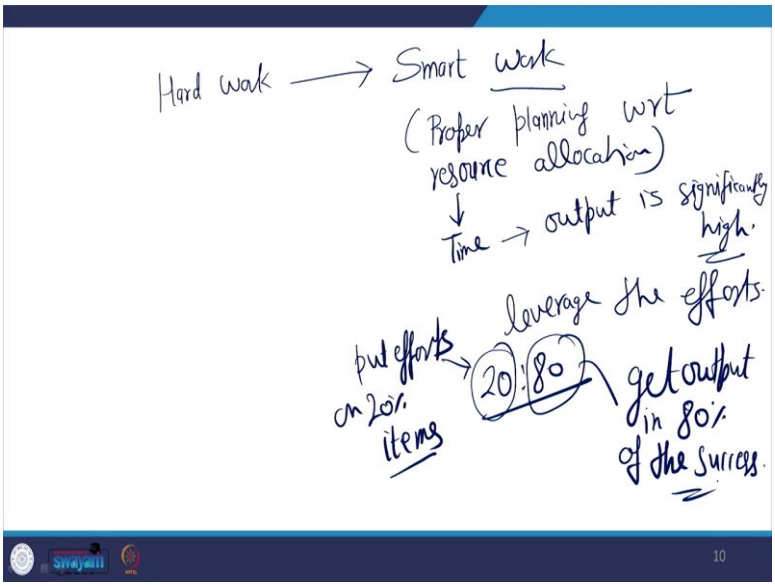

Then, we come to another very important QC tool and this is a very, very popular kind of QC tool. Already we had one small discussion about Pareto principle in our ABC analysis of inventory management, where we discuss this 80-20 rule. And this Pareto principle, you will see is applicable across the fields.

It is not limited to quality control or inventory control, but across the field, you will find the application of the Pareto principle. According to this Pareto principle, there are only 20 percent reasons for 80 percent output only 20 percent reasons for 80 percent output. So, you can understand that 80 percent of the problems come from 20 percent of the items, 20 percent

reasons for the 80 percent output that is, so you can say that, in this world in this global phenomena, there are 20 percent activities, which are driving 80 percent of the phenomena.

So, in an organization 20 percent of the people are responsible for 80 percent performance of the organization. So, this principle 80-20 is applicable in this way in every field. So, 20 percent people are responsible for 80 percent of the output in quality control, we say that 20 percent of the items or 20 percent issues are responsible for your 80 percent quality related problems.

Now, here we have already discussed the histogram. So, it is slight rearrangement of that histogram and if you remember in the histogram, the C was the most common, C was most common and E was very uncommon. So, we have arranged these defects in their decreasing order of frequency. C is coming in the left most corner because it has the highest frequency and E is coming to the right most corner because of the lowest frequency.

So, it is like in this way. So, those which are on the leftmost corner, they are representing the more important and you see out of 1, 2, 3, 4, 5 out of 5 types of defects, one defect see is representing the 20 percent kind of reasons, which is responsible for your 80 percent of the problems, one reason, one reason for 80 percent problems and here my problems are defects. So, one particular reason that is the C reason is responsible for 80 percent of the problem again and again it is failing, there are some defects coming because of this C reason, so that is the meaning of Pareto.

So, when you will go for some kind of improvement exercise when you want to have a better system, obviously the problem which is coming again the defect which is occurring again and again you will try to concentrate on that particular thing. So, whenever given a chance of improvement, I will not like to focus on E, because that is a rare phenomenon, but I will first like to address C, if I can address C first, then a lot of problems will be solved, then lots of problems will be solved.

So, this Pareto gives me the idea that, which is a priority area and which is a less priority area. In our discussions of principles of management, right priority is very important. The Pareto principle helps me in identifying the right priority area, that where should I focus my efforts, if I focus my efforts on less priority areas, so my resources will be consumed, but the result will not be appropriate, because 20 percent things are affecting the 80 percent output.

So, I need to identify those 20 percent reasons, those 20 percent items, which are responsible for 80 percent success of my organization. So, it helps you in utilizing your resources very, very effectively, and that is the success of this Pareto system. And we use this Pareto system in various activities knowingly or unknowingly.

Whenever you are a student, you see that how to study smartly, so that if you study smartly, some important concepts will help you in understanding the whole subject in a better way. And if you are not able to understand that what are the key area of this particular subject, you will be wasting a lot of time, but without any significant output.

So, what is the smart work? Many of us say that, we have to move from hard work to smart work, and what does it mean? That we need to do proper planning with respect to resource allocation and one of the resource is time, one other resource is time. Now, you should invest your time in those activities where output is significantly high or you can say that you can leverage your efforts.

The point which I am trying to mention that leverage the efforts and leveraging the effort is only possible when we have this understanding of 20-80, put efforts on 20 percent activities, put efforts on 20 percent items get output in 80 percent of the success. So, these 20 percent items are determining 80 percent success of your organization, so this is tremendous leveraging the efforts, that is what a Pareto principle and that is water, this is smart work tells us.

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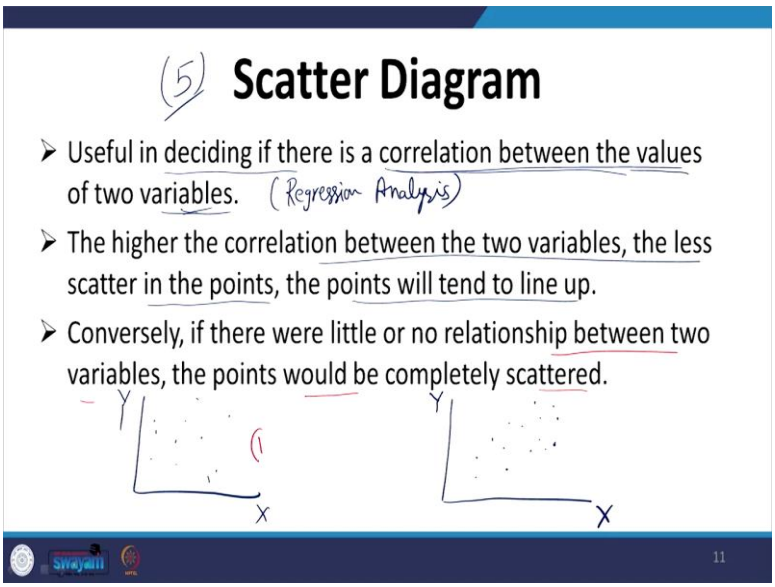

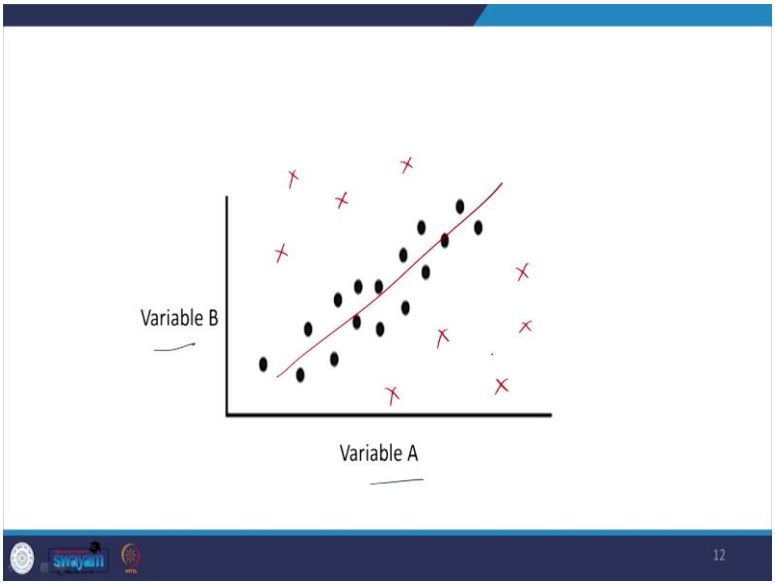

Then we discuss another important QC tool that is a scatter diagram. A scatter diagram is a very simple we all have probably studied during our classes of probability and statistics in 10th and 12th classes, but how we are going to use it in our QC tool. So, it is useful in deciding if there is a correlation between the values of two variables. It is like to some extent regression analysis kind of thing that how to particular variables are moving, whether you have this type of values of two variables X and Y.

Now, based on this scatter diagram, where you can find that, yes this diagram is representing a kind of straight line, but there is a possibility where the diagram is highly unorganized this type of diagram, where you will not be able to understand any pattern between the values of two variables. So, this relation between the values of two variables that we have already discussed in our forecasting classes in the form of regression analysis.

The higher the correlation between the two variables, the less scatter in the points and the points will tend to line up. So, if you see this diagram between variable A and variable B here, these points are very closely available to each other. So, these points can fit into a kind of line like this, but there can be another situation where points are like this. Now if points are scattered like this, like red crossing signs, then this red line is not a good representation of the scatter diagram.

So, that is one important output. Conversely, if there were little or no relationship between two variables, the points will be completely scattered either like diagram one or the second case, where the points are too much scattered. So in this particular case, you will not have any significant relationship and then you will have the implication for the quality that these

variables are unrelated. If the points are too much scattered and you are not able to get any kind of relationship between variable A and B, then you say that these two variables are unrelated.

So if you are going to work on variable A, it is not going to impact variable B, so you need to work separately on these two variables to take decisions or to take some corrective actions with respect to these two variables. So, that is about a scatter diagram.

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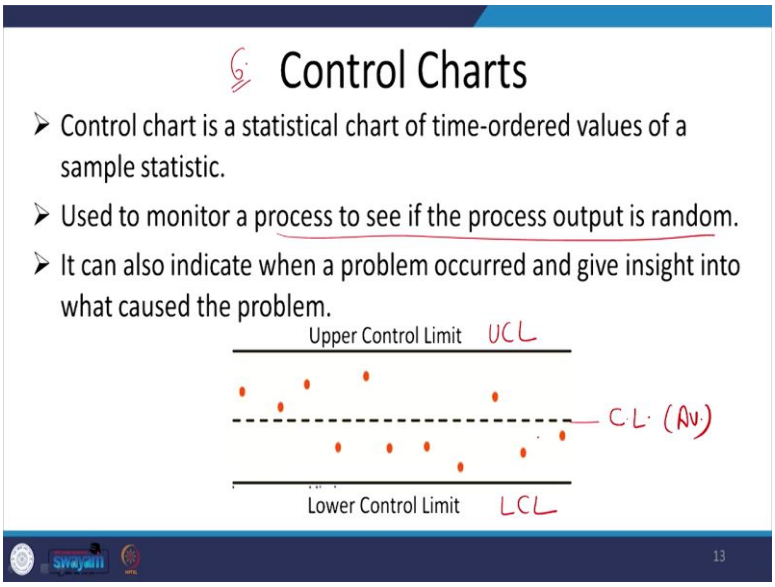

Then the sixth Quality Control tool is control charts, we have already discussed in detail about the control charts, that is the central line value or the average value the upper control limit that is UCL, the lower control limits are LCL. Now, these are used for monitoring the process output and we expect that the process output should be random, there should not be any kind of assignable reasons in the process output. So, these dots are representing the values of our samples with respect to a particular variable or with respect to the attributes over a period of time. So, these values must be within the limits of UCL and LCL.

If these limits are crossed, then we will see that there are presents of some assignable reasons and that is again a kind of indicator that we must stop our process and we need to work on the improvement of those particular reasons and then only we can again start. So, we have already enough discussion in the form of X bar R, p and c charts with respect to control charts discussion.

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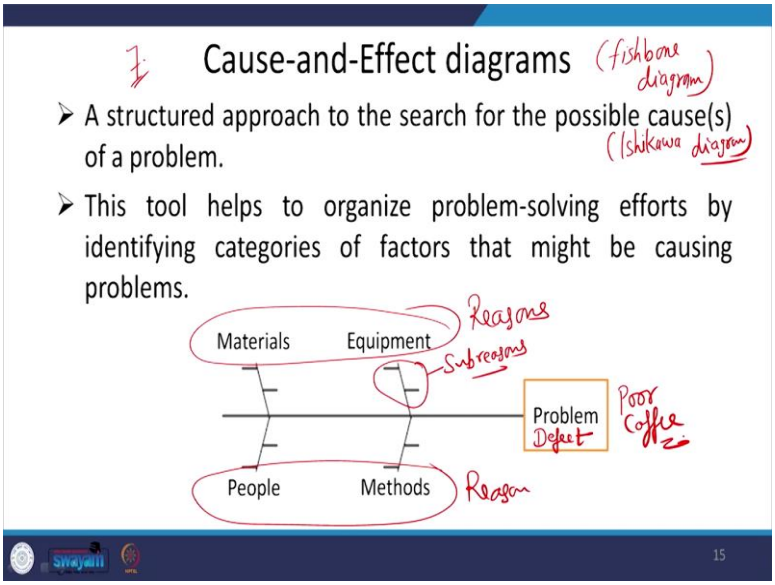

Now, the seventh QC tool, which is a very popular QC tool, which is known as cause-and-effect diagram. Now cause-and-effect diagram is known by various names. Another possible name of this cause and effect diagram is fishbone diagram. This is also known by the name of, who gave this particular diagram, that is Ishikawa diagram. In our discussions of modern quality gurus, we took the name of Ishikawa also if you recall, and Ishikawa was the person who gave this cause-and-effect diagram or fishbone diagram.

Fishbone is because the shape of this diagram is like fishbone. Here, we have this particular kind of diagram, where you have various branches available, and these branches are sources of problem. And as a result of these sources, you have finally the defect. This problem is basically the defect and these are the reasons of defect and these are the sub reasons.

So, you have materials, equipment, people, method, these are the various reasons because of which some defect may occur. For an example, if I say that I am not able to make good coffee, that is the problem that poor coffee, now poor coffee is possible because of various reasons. Maybe the milk quality is not good, maybe the coffee powder is not good. So, that type of these issues are related to material, maybe the pressure gauge which I am using for preparing the coffee, that pressure gauge is not working properly.

It is showing the wrong reading. I thought it is enough pressure but the pressure was not so much. The method I do not know how to make the quality coffee, so because of that particular reason, I am not able to make the quality or I used a wrong method of making the

quality people there is no training given how to make the quality. So, these are various types of reasons, which are possible for the issue of getting a poor coffee.

Similarly, you can think of different types of problems and different types of problems are coming because of various sources. So, these are these sources the left side of this diagram is the source and the right side is the result. So, these are the causes these this is the effect, so therefore, this is known as cause-and-effect diagram based on this cause and effect diagram, you can develop your checklist that these are the possible reasons because of which this defect may come based on this cause-and-effect diagram, you can develop a checklist for your Pareto diagram.

So, different type of issues can be handled once you know that what are the various causes of this particular problem. So, we need to do a lot of brainstorming for developing various causes. So, in organizations we do a lot of problem solving with the help of this cause-and effect-diagram.

And nowadays, the use of cause-and-effect diagram is not limited to quality control, you can use it for a variety of other problem areas also. So, whenever you find that there is a problem which may not be related to quality, but you want to know the reasons of this particular problem, you can very well use cause-and-effect diagram for solving that particular problem.

So, these are the 7 important Quality Tools which help you in identifying the reasons in organizing the data, in collecting the data and then finally interpreting that data, so that you can take some meaningful decisions, you can take some meaningful actions for improving your quality of the product. So, with this, we come to end of this session. In our next session, we will discuss few more issues related to statistical quality control. Thank you very much.