Principles of Industrial Engineering
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Lecture 55
Quality Control: SPC.

Hello! I welcome you all in this presentation related with the subject, Principles of Industrial Engineering and you know, we are talking about quality control. All of us expect that we get the good quality products and services from those who are providing the products and services. But many times, we find that the defective products or the poor services are offered by them.

So it is the responsibility of the management, organization and those who are working in the organizations to control the quality of the product and services so that they can provide the reasonably good quality products and services so that the customers can be retained, business can be continue to grow, profitability of the organization continue to—continues to increase.

And therefore, it is very important that the quality of the product and services, which are been provided by the organization is maintained properly.

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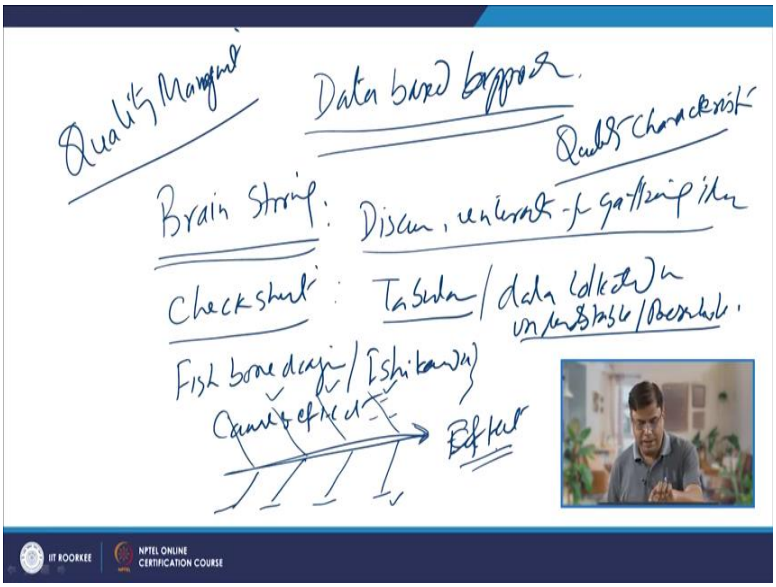

And therefore, proper quality management is needed. So, the quality management will be looking into the various ways what can be done for improving the quality. There can be certain the manpower training programs, there can be improvement in the machinery, improvement in the material control, improvement in the inspection technique. So, there can be various aspects related with the management of the quality.

So, primarily, it works on the like data based approach. Means, instead of using the experience and skills only, the data about the quality characteristics of the products and services is correct is collected. So, what is important is the quality characteristics, which are important for the success for success of the product and service. Those are identified and then that data about those quality characteristics during the manufacturing is established, measured, identified. So, once the data is generated about the quality characteristics that is looked into to see really what can be done for improving the quality?

So, there are certain tools, which are used to manage the quality so that the organizations are in position to provide the good quality products and services to the customers. And theses tool include like the first one, brainstorming, wherein all those stakeholders whether management, shop floor people, customers, suppliers, distributer, all those people related with a particular product and service are brought together and the exchange of ideas help in coming out with the way by which the quality of the product and service can be improved.

So, it is about the discussions, interactions for gathering the ideas to look into a particular problem, which is really very important for the saleability of the product or the profitability of the organization. So, the people are brought together for interactions, discussions so that they can generate the ideas to look into the way by which the quality aspects related with the product and service can be addressed.

The second is like the check sheet. Check sheet is a simpler the tabular sheet which is designed as per need for collection of the data related with the quality characteristics which is of importance so that data is collected in understandable and presentable form. So, this is the purpose. So, as per the need, suitable check sheet is designed for collection of the data so that it can be easily understood and the inferences can be gathered easily.

Then, there is a fish bone diagram. Fish bone diagram, this is also called the developer of this diagram was Ishikawa, so also known as Ishikawa diagram. It is also known as "'cause and effect" diagram because it this is the diagram which in which the team of all those concerned people analyses the various causes for a particular effect. Effect may be in form of like poor performance, excessive rejections, bottleneck of in particular assembly line.

So, the effect may be the kind of the kind of a the feature that is of interest either to increase or decrease. Like reducing the rejection or increasing the performance. So, effect is mentioned on the right side and then one line is drawn. This is like the central bone, looks like a central bone

of the fish and then there are other bones are indicated like this. So here, the major these represents to the major causes like the procedure or the material or the worker or the management.

So, the first the major causes for particular effect are identified and thereafter further through the brainstorming and through the discussions, the minor causes related with the major causes are also identified and based on the based on the voting pattern or based on the in a democratic way, the minor causes are identified in such a way that the action can be taken on those minor causes to get the particular desired effect.

So basically, it helps to identify the various causes, which can lead to the particular effect and then the most significant cause, which is leading to a particular effect that is also identified democratically and then action is taken on those causes to get the suitable, desirable effect.

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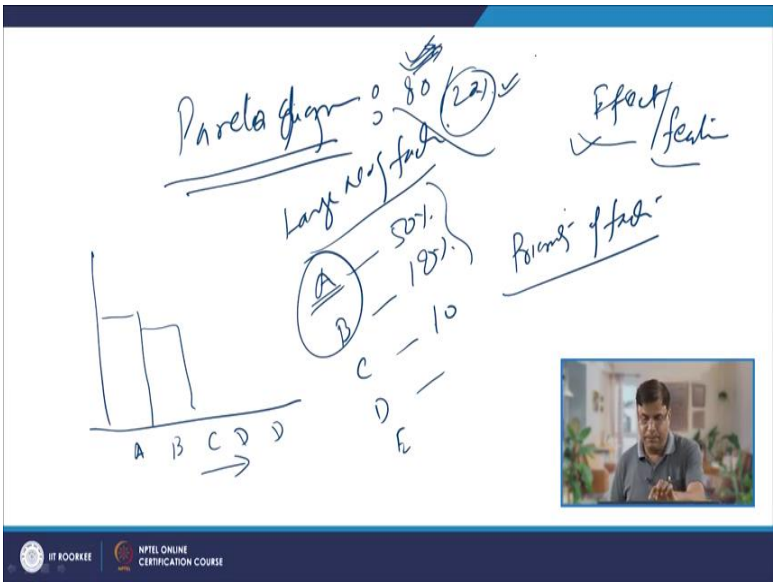

Then, there is a Pareto diagram. Pareto diagram, this helps in prioritizing the various factors leading to a particular effect like there is some effect or the characteristic or the desirable feature, which is in which organization is interested. So, these effects or the features may be influenced by a large number of factors. So, the data is collected to serially. What is the frequency of occurrence for this effect due to a particular factor?

So, like say there are many factors A, B, C, D, E and what is the frequency of occurrence for a particular effect by a particular factor that is quantified and if it comes out to be like this like A factor is contributing to the like say, 50 percent of the time particular effect is caused by the

A factor, then, 10 percent like 18 percent time the particular effect is caused by the B factor. Then, 10 percent is caused by the C factor and likewise.

So, this total percentage will continue to will keep on decreasing and that is how it is quantified. Basically, the data is collected in such a way that what is the percentage of occurrence for a particular effect by a particular factor. That is what is quantified and then plot is generated here. Like here we have the different factors A, B, C, D and the of their significance they are plotted.

So, what we find that there can be like 50 percent here then remaining 20 percent say 18 percent is due to the B. So, this is how it is plotted and when we plot it in cumulative manner, we find that, like say, 70 to 80 percent of the effect is been caused by these two factors. So basically in Pareto diagram, we are able to prioritize the various factors which are more important and having the greater effect on the certain desirable feature of desirable effect or undesirable effect which is to be reduced.

So basically, the Pareto diagram helps in prioritization of factors and then accordingly those factors are given more importance as compared to the other factors. This is also known as like a 80-20 rule wherein 80 percent of the problems are caused by the 20 percent of the factors. So, there are very few factors, which are mostly troublesome and there are many factors, which cause fewer problems. So, based on this means there are 80 percent of the time, the problem is caused by the 20 percent of the factor. Like our 80 percent of the time goes in 20 percent of that activity. So, most of the time we are doing very few things.

Our 80 percent expenditure goes in very few activities while very less expenditure goes in many activities. So, this is a universal law, which states that in this particular case, 80 percent of the quality problems will be caused by the 20 percent of the factors. So, we need to focus on those 20 percent factors, which are significantly affecting the quality aspect related with particular product, so that is the Pareto diagram.

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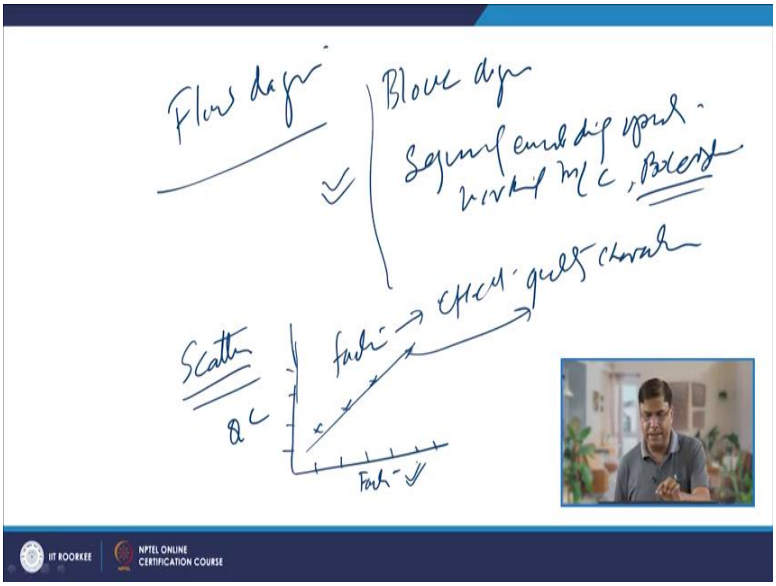

Then we have the flow diagram. Flow diagram helps in this is basically a block diagram which shows the sequence of events during the operation or working of a particular machine or the entire manufacturing procedure being adopted for a particular product or to deliver a particular service. So, the block diagram will be indicating the sequence of steps and events in which the various things ae done to deliver the product or service.

So, once we have the better understanding of this, we will be able to relate it the kind of particular step. The way by which the particular step can affect the quality characteristic, can affect the product or can affect the process. So, better understanding of the entire procedural aspects is possible through the development of the flow diagram for a process of a product or for a manufacturing sequence, so that is very useful in analysis.

Then, we have the scatter diagram. Scatter diagram, basically, like there are various factors and they have effect. So, effect may be of importance from the quality characteristic's point of view. The various factors are affecting the various quality characteristics. So what we want, like in X-axis, we have that factor that is affecting the quality characteristic.

So, in X-axis, we mention the factors and in Y-axis that particular quality characteristic, which is of importance and then plot between the two is developed so which may show the way by which the particular factor is affecting to the quality characteristic and then to establish the particular relationship between the factor independent factor and the quality characteristic, we may go for calculating the correlation coefficient or can also do the regression analysis to see

the kind of effect is there of particular factor on the given quality characteristic which is of importance and that can be used for analysis.

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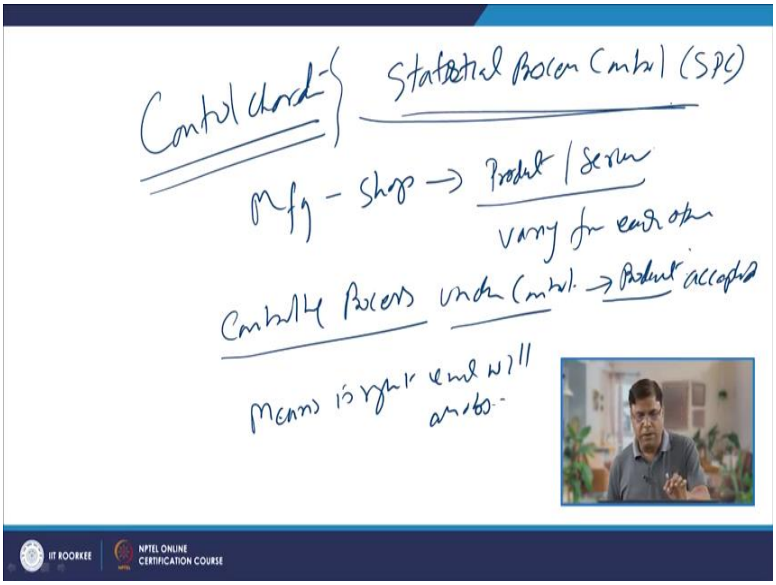

So, that is the scattered diagram and finally, we have like the control charts.

Control charts. So, the control chart is one of the tool related with the statistical process control. This is known as SPC. We know the variability is very normal thing and this something, which cannot be eliminated. Two things will never be same. There will always be variation of one or other kind. Whether it is been created by the God or they are been manufactured at the shop floor.

So, when something being manufactured at the shop floor, the products, like say whatever products, even the same product may have lot of variation within the product itself or when with the other products which are being manufactured in sequence. So, whatever the products or the services been developed, they will always vary from each other and this is very much normal thing. But, if the variation is within the limits then everything appears to be simple, acceptable and it looks to be good, acceptable to the customers and the users.

When the variation in the characteristics of the product is too high and when it goes beyond the acceptable limit, then people will say, “no it is not good, it is not working”, and the things are rejected. So, the thing is it works on statistical process control. This approach works on the idea of controlling the process. So, during the manufacturing, if the process is under control,

then it will produce the products, which are acceptable. So, means if the if the means is right, end will also be right.

So, if we do right things, then at the end we will get the right product. This is the concept of the statistical process control. So, the process efforts are made to keep the process in control so that we can keep on getting the products, which are acceptable, and the rejections are minimised.

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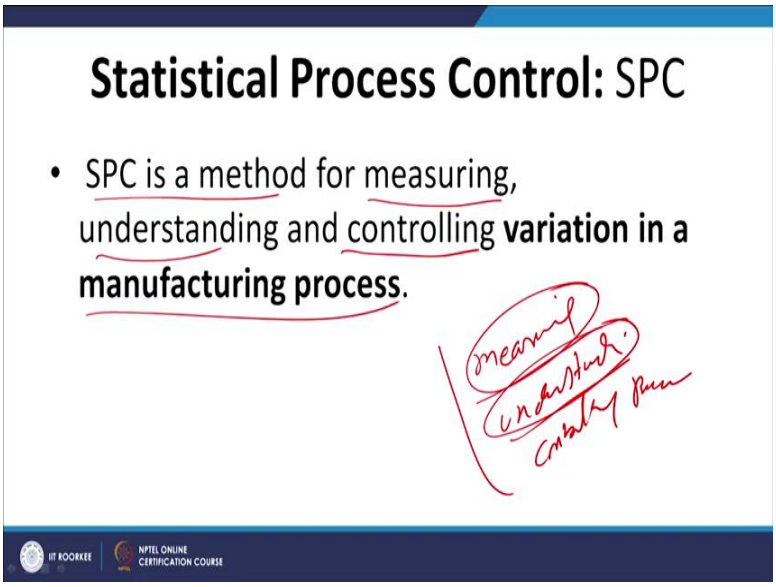

So, we will see the statistical process control. In statistical process control, what we have? This is a method of measuring and understanding and controlling. It helps in measuring if the process is in control, it helps in understanding when what is going to happen or what is happening to the process as far as it is controlled or the possibility of loss of control so that so, in that situation, the products will be produced, which may not be acceptable.

So, understanding the process, means what is its status, and if we can leave it alone and continue to make the things which are acceptable and if it going out of control, what we can do? So, controlling the process. So, these are the three aspects in which the statistical process control tool helps in manufacturing process when it is applied, measuring the kind of status of is there of the process understanding what is the status if the process is doing well? And what can be done when the process starts going beyond the control.

So, controlling the things, understanding the things and measuring the things, measuring the status of the process if it is doing good or not.

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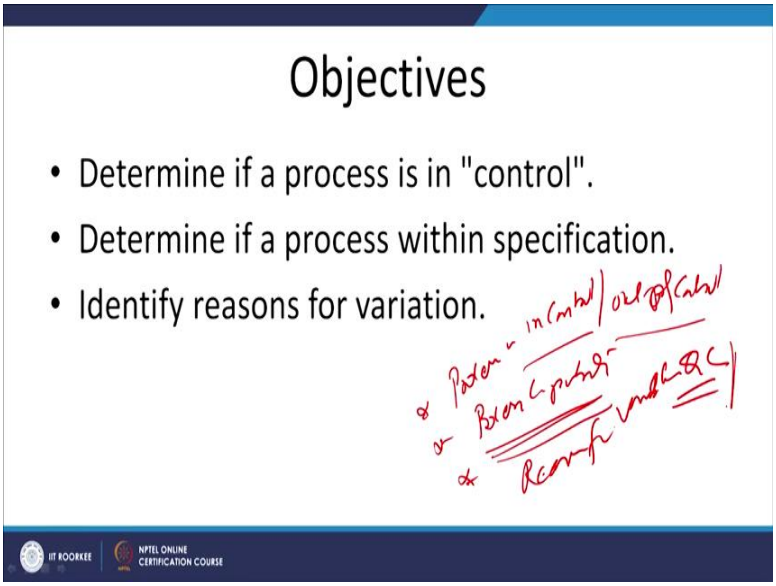

So, when the SPC is applied to a particular manufacturing process, it helps in establishing the two simple things, one is to understand that the process is in control or out of control. Out of control during the manufacturing process, when the SPC is applied, we can understand, we can know. So, objective is to establish if the process is under control or if it is out of control.

The second is, it also helps in establishing the process capability. If the process will be able to make the products of given specification effectively or not. So, determining if the process can make the products of a given specification or not that is assessed through the process capability. And if at all, the process is going beyond the control, then when to take the corrective action and what type of corrective action is needed.

So, the reasons for variation, variation in the quality characteristics of the products being manufactured by a particular process are also established and which help in taking the suitable corrective action.

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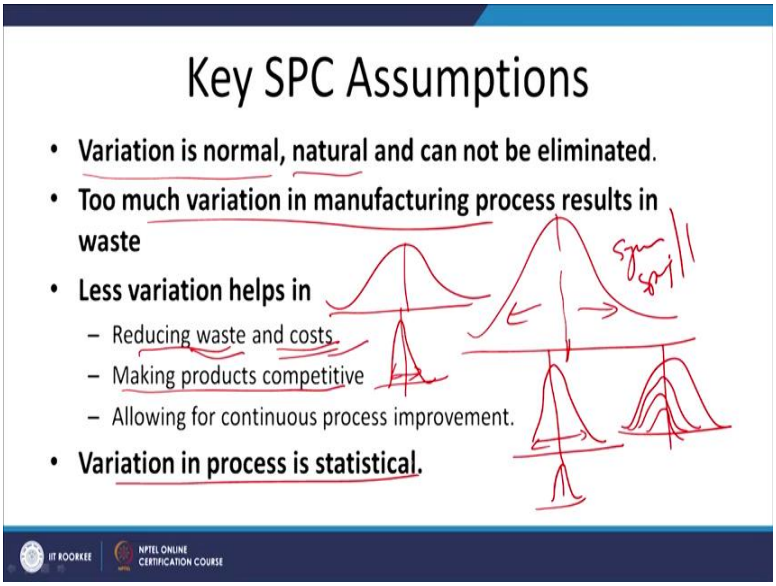

And SPC, statistical process control, works on the certain assumption that whatever variation is there that is normal. Means, normal variation means there is somewhere the process the characteristic of a particular product being made by a particular manufacturing process has got an average and the distribution of the characteristic is very normal. So, this variation is normal, natural, it is non-random. Natural variation means, whatever variation is there on the higher side, the same is the degree of variation in the lower side and the variation is symmetrical and spread about the average both the sides equally.

So, this variation is very normal and it is always there, it cannot be eliminated. But, what can be done? This extent of variation can be reduced like this, the spread is reduced. The spread can be further reduced but it will always be there. Now, it will depend upon like many a times variations, we are not able to quantify, then we say that no two things are same but actually, it may not be. So, when we say that the difference in the characteristics been quantified, we cannot measure because of our limitation, then we say the two are same.

Actually, there may always be some kind of variation, which we may not be in position to quantify. That is why; the variation will always be there, it cannot be eliminated, however it can be reduced. Excessive variation, when it takes place during the manufacturing, then you will see that many things are being manufactured beyond the specification limits, beyond the acceptable quality and then it leads to the lot of variation and the lot of troubles like lot of things which are being manufactured or not acceptable beyond its specification.

It will be leading to the wastage and wastage if the things being manufactured are just been send to the scrap because of the poor quality in terms of the dimensions, weight, characteristics, whatever important and then so increased wastage or increased rejection will be leading to the increased material loss or increased cost.

So, reduced the productivity, making the product competitive. So, when the variation is less when the variation is less, it reduces the wastage, it reduces the cost because we will be reducing the waste. We will be increasing the productivity and the number of rejections will be reduced. When the variability is really less, the variation in the quality characteristic is reduced like this.

In that case, the process is the things will be manufactured with a very less variation, which will improve the quality of the products. Its functionality features and that in turn will help in improving the competitiveness of the product and once, through the certain steps, if the variability has been reduced earlier the variability was more by taking the certain steps, if the variability is getting reduced so, keep on working continuously to reduce the variability so that the process can be improved continuously.

And, this variation in the process is statistical, then only we will be able to apply the SPC tools for taking the different steps and actions for improving the quality.

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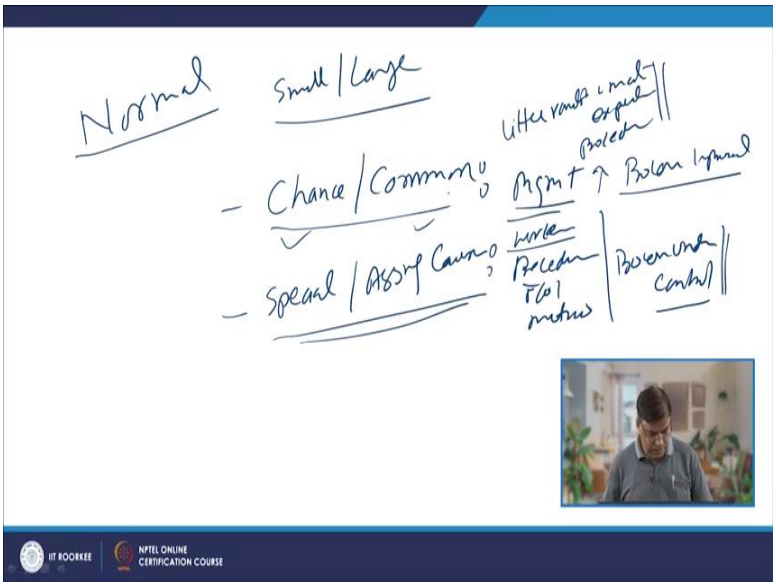

As I said, the variation is very natural thing. Variation is very normal. Means, it is always there, it is not something like which is very abnormal and can be eliminated completely, it is always

there. Now, the variation may be small or large. If it is large, going beyond the acceptable limit, then we will reject, if it is small, then we will accept it and this variation is caused by the two types of factors.

One is called one is termed as like the chance or the common causes and the second is the special or assigning causes. The causes, which can be assigned or fixed. The common causes are like very normal like the little variation in material quality. Little variation in the expertise of the worker. Little variations in the kind of vibrations which are been offered by the machine during the operation.

A little variation in the procedure. So, minor variation, minor things are always there and theses cannot be eliminated. However, these can be reduced. So, the common causes are always there and they will be causing little random variation in the quality characteristics. And the management is supposed to work on reducing the common causes so that the process in general, can be improved. Once, the process is improved, then the extent of variation being caused by the common causes that will be reduced.

When the assignable causes are present like the worker is really not he does not understand what is to be done. He is following completely incorrect procedure, incorrect tool is being used. Method of processing is completely incorrect means, something wrong is happening while manufacturing and leading to the excessive variations, rejection, decreased quality. So, here, we need to bring the process under control.

And, when we bring the process under control so that the excessive variation can be reduced and the unacceptable quality products can be reduced through the reduction in the variation. So, these are the special or assignable causes and these are the chance causes and common causes. Now, I will summarise the presentation. In this presentation, basically, I have talked about the seven tool of the quality management and what is the basic approach of the statistical process control for quality control of the products and services. Thank you for your attention.