Project Management for Managers
Dr. M.K. Barua
Department of Management
Indian Institute of Technology, Roorkee

Lecture – 57
Quality Management Sources of Variability and Six Sigma

Good morning friends, I welcome you all in this session raise your aware in previous session we were discussing about cost of quality, and we have seen that there are different costs of quality, we have seen a appraisal cost maintenance cost we have seen internal and external failure cost right. And we have also seen different types of definitions such for as quality is concerned, we have defined quality as inversely proportional to variability right and we have seen other definitions as well. We have seen different dimensions of quality and there were 8 dimensions and there were 3 aspects of quality, quality of design quality of conformance and quality of performance right ok.

Let us move on to the new topic and it is about what are different sources of variability in a product. So, as I said every organization bonds to produce quality product, but because of certain reasons, they do not achieve this particular objective; and there are multiple reasons you can have internal and external reasons you can have you know chance causes and assignable causes right we will see these two causes in detail.

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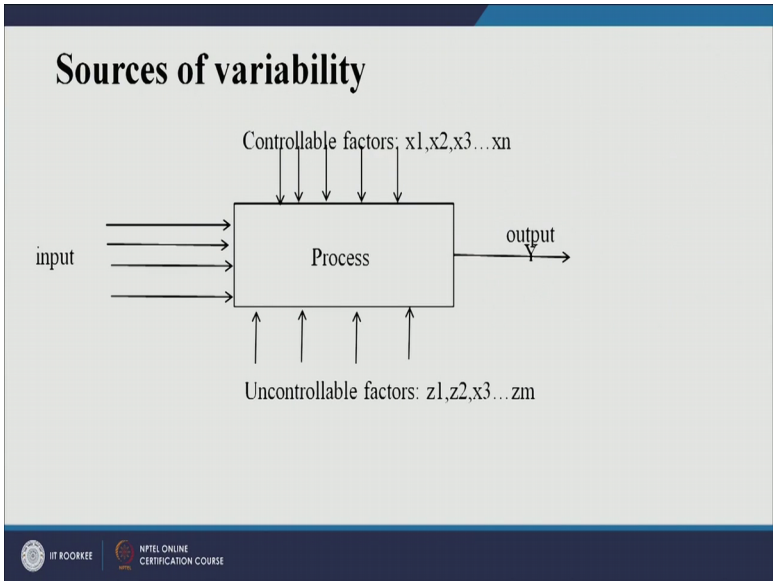

So, if you got certain inputs in your process, then you will have these outputs these are different outputs and output can be a product can be a service, you can have bi product you can have a waste and you can have some tangible you can have some learning right. So, learning is also possible. Now we want to remove variability in the process.

So, we want to know how our qualities getting affected by different factors or let us call them different independent variables. So, we want to find out which are most influential variables which affect value of y. So, y can be quality, can be productivity, can be efficiency or some other objective right let say space utilization or let say a minimization of complicit. So, you can have several values of y right. So, y is here responsive variable right.

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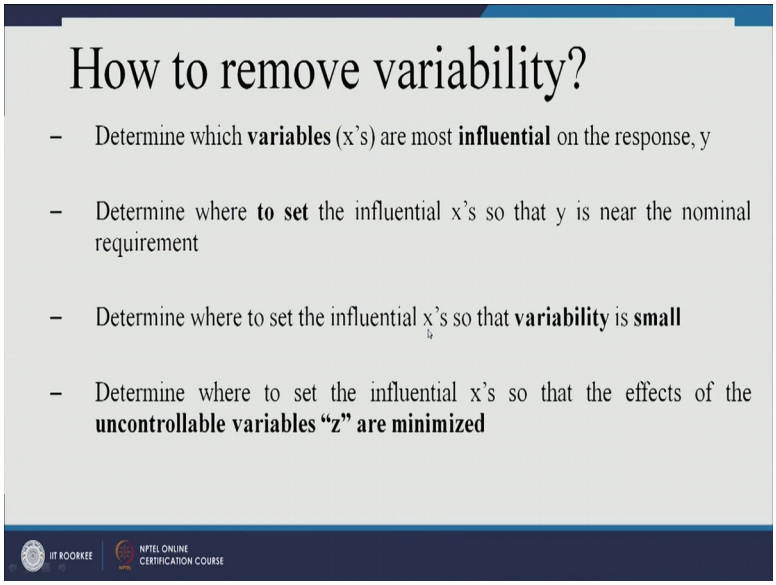

So, once you know which are the most influential variables, you need to set this influential variables in such a way that y is near near nominal requirement right. We should determine where to set the influential variable so that variability is small, this is our objective right and we want to set x variable in such a way that the effect of these z which are uncontrollable variable so, that effect is minimized right.

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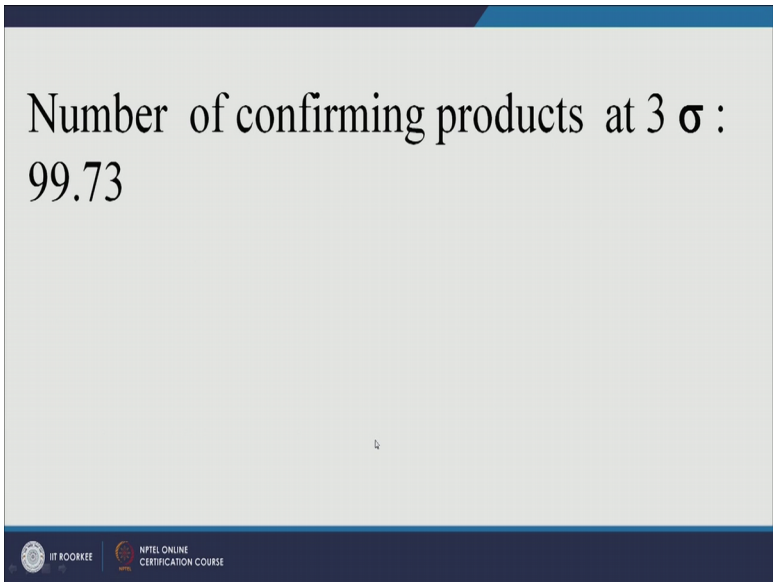

Now let us look at something about different types of quality levels, most of you would be aware of that there is something called three sigma quality. Sigma is nothing, but standard aviation. So, if there is a distribution and you have got mean at the centre and then plus minus three sigma. So, that curve will have area approximately equal to 99.73. So, if you are operating at 3 sigma level quality, then if you produce 100 products then out of 100 products 99.73 products would have would be conforming right would be right products right.

Now, suppose let us take an example, there is a product which is got 100 parts, and the probability that one particular product which is made up of these 100 parts would be conforming at three sigma level is point is 99.73 right. What is three sigma quality? It is you are producing 99.73 products properly right. So, if there is a product which consist of 100 parts right. So, if you assemble these 100 parts you will get one final product right; the probability that any specific unit of product is conforming is what it would be it would be 0.9973 to the power 100 right is not it.

So, at the end of the day your quality is 76.31 percent. Now would you like to have such a level of quality no I do not think you would like to have such a quality level that out of 100 final products you would be having 76.31 correct products right. So, there are certain problems with 3 sigma limits right. Now if you follow let say 3 sigma limits, then there would be 20,000 drug prescriptions each year.

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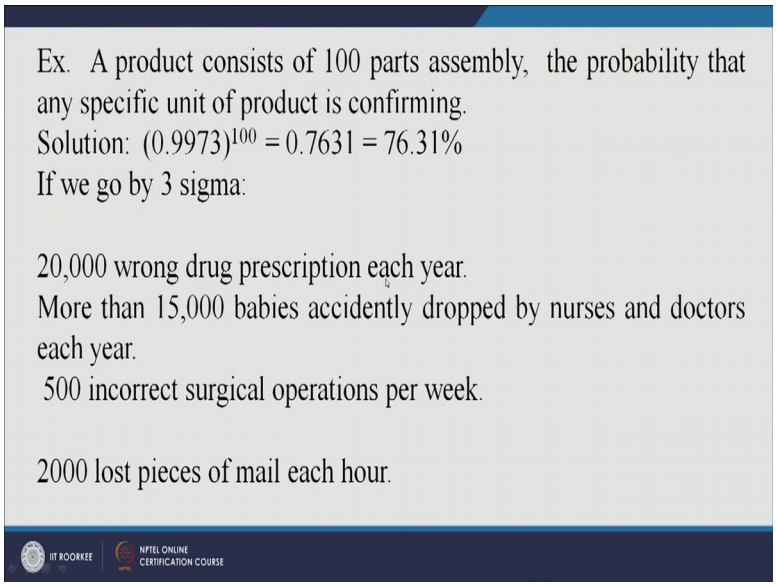

If you follow three sigma limit then more than 15000 babies, would be dropped accidently by doctors and nurses each year, would you like that to happen? No even a 500 incorrect surgical operations per week, you have got 2000 lost pieces of mail each hour, you do not want all this things to happen right.

So, if you work at three sigma limit, your quality would be very poor. So, that is why you need to reduce variability in the process. So, when you reduce the variability their quality will level will increase right. Let us look at something called 6 sigma, now a days everyone is talking about 6 sigma. six sigma is basically concept where in may reduce variability in the process.

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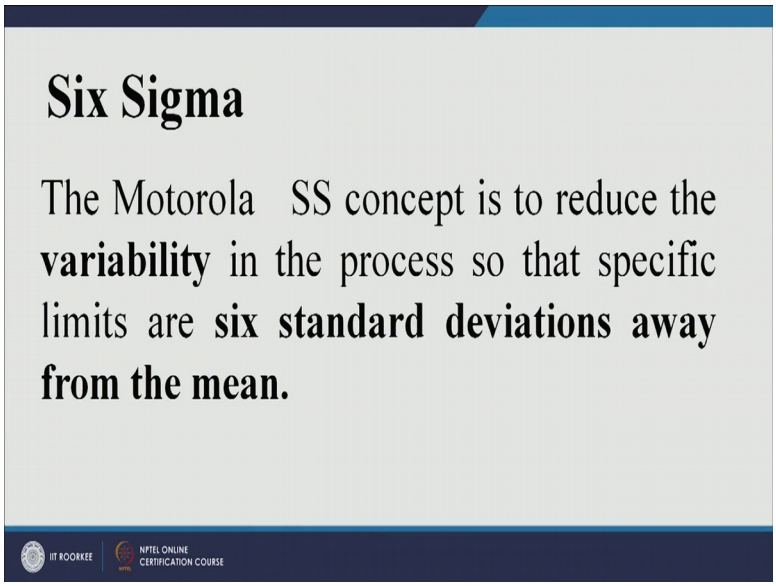

And we reduce variability so that the specific limits you have got upper specification limit and lower specification limit. So, these two limits are 6 standard deviation away from the mean that is 6 sigma. What is 6 sigma? six sigma is a process of reducing variability in the process and the mean value is 6 standard deviation away from upper and lower specification limits right. So, that is six sigma and there are different you know approaches to achieve six sigma quality say you have got df ss design for six sigma right. Let say if you are coming up with entirely new process. So, you need to design the process initially right, but if there is an existing process and you want to implement six sigma then there is an approach called dmaic approach we will see this approach little later right

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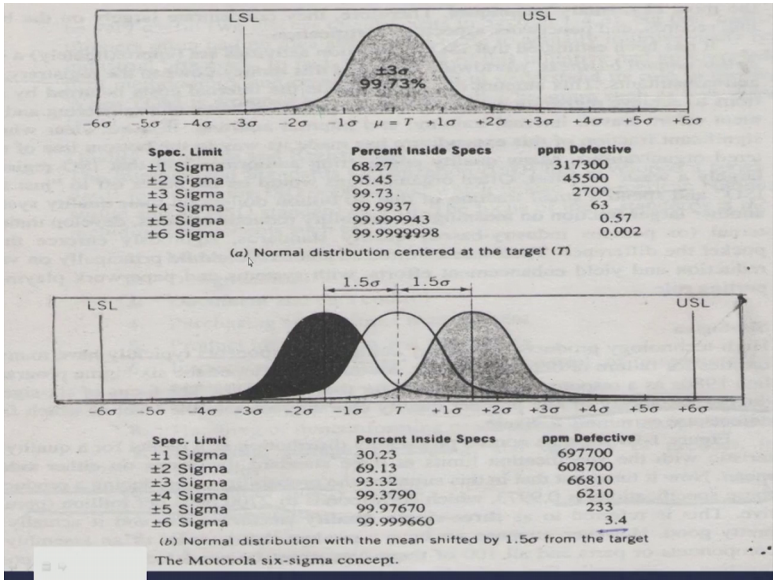

So, there is something called six sigma right six sigma quality, and we will look at how many parts would be defective at six sigma quality right. Now look at this these two pictures. So, this is a right normal distributions centered at target. So, this is your distribution and this is your mean right mean is here.

So, you have got plus 1 sigma, plus 2 sigma, plus 3 sigma similarly this side also, but if you look at in this figure, this LSL lower specification limit and upper specification limit they are three standard deviation away from mean right. This is your mean value right and this and these two limits are 3 standard deviation away from mean, plus side and minus side right. So, if you operated three sigma limit quality then as I said you would be producing 99.73 god products right and if you convert it into parts per million defective, then you will have 22700 parts per million defective if you operate at three sigma level right. Now let us look at this picture right, here this is normal distribution with a shift of 1.5 sigma limit with 1.5 sigma shift in the mean. So, what we are saying in 6 sigma that whenever there is a process going on we will assume that it is mean will shift 1.5 sigma towards positive and 1.5 sigma towards negative.

So, there is a shift of 1.5 sigma both the sides right. So, in this way this is your mean and this is your upper specification limit and this is lower specification. This upper specification limit and this is lower specification limit right. So, mean is 6 standard deviation away from specification limits right. So, if you look at the number of parts per

million defective at six sigma it is 3.4 parts per million defective right. So, this how you should get this value 3.5, 3.4 ppm defective. We should whenever we are saying that we should get whenever we say that in six sigma the number of defectives are 3.4 ppm, we should always say that with a shift of 1.5 sigma limit right with a shift of 1.5 sigma both the sides right left side as well as right side.

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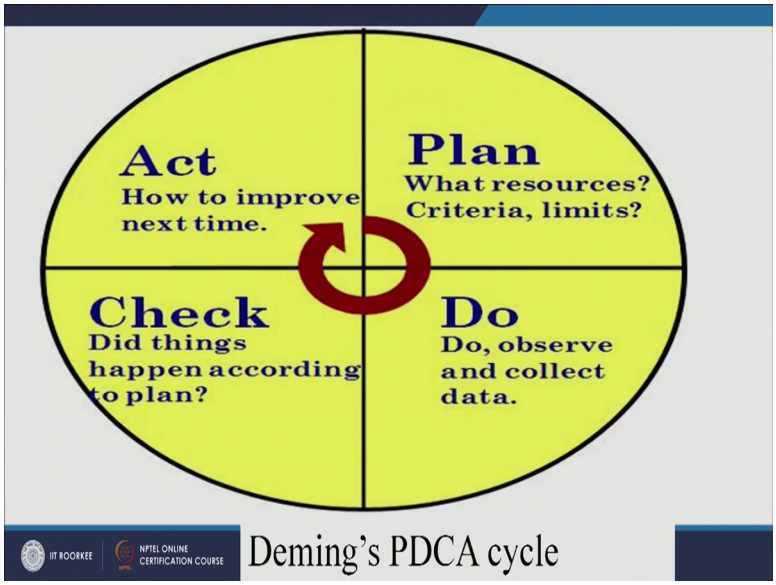

So, this is six sigma concept, now I talked about this PDCA cycle when we were talking about project control. So, one of the methods of project control is d is PDCA cycle right. So, you should plan, you should do then check whether you made any mistake or not and then at right. So, this is known as PDCA cycle, applicable almost everywhere. In our daily lives we plan something then we execute that whatever you have planned and then we check we compare it with whatever we have done with the planned one bite. So, if there is any difference or if there is any variation then we (Refer Time: 12:37) it right. We try to minimize that deviation between whatever we have planned and what we have done right.

So, dmaic PDCA cycle, now the ` sigma approach which is dmaic is refinement of this cycle only. So, this is six sigma process and the process and the approach is dmaic approach.

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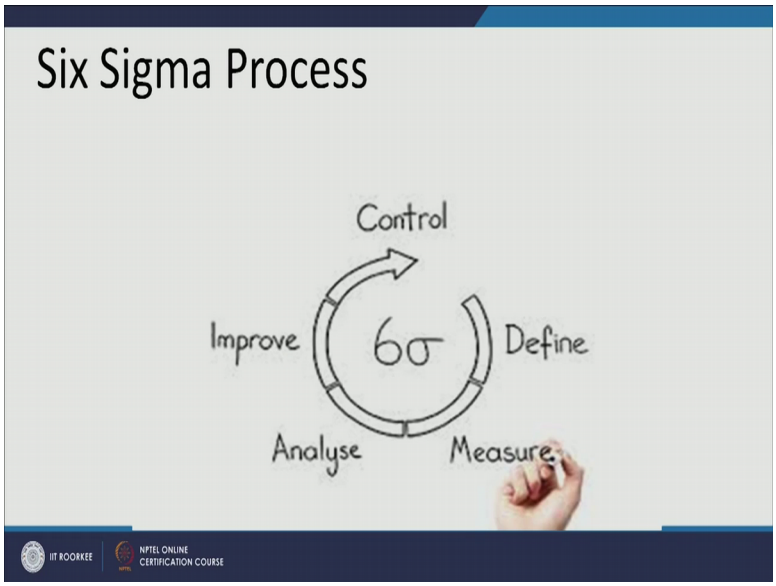

So, define measure analyze improve and control what to define what to measure right. So, let us look at this six sigma process, let us look at something more about six sigma quality.

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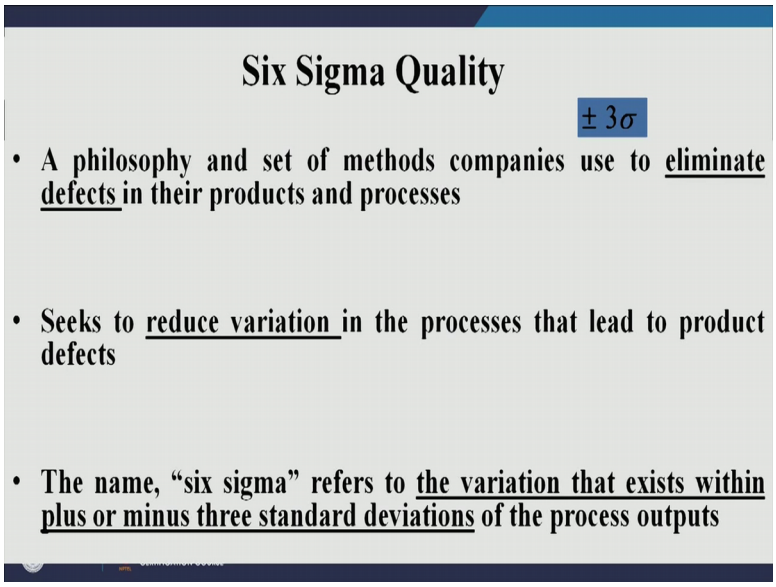

So, six sigma is basically a philosophy and set of methods because in six sigma you would be applying a several statistical tools to reduce variability. So, it is a set of methods especially statistical methods. So, these methods can be used by a company to eliminate defects in the product or in the process right. Of course, objective is to reduce

variability, the name six sigma refers to the variation that exist within plus minus three sigma the standard aviation is nothing, but three sigma right. So, three sigma of the process output.

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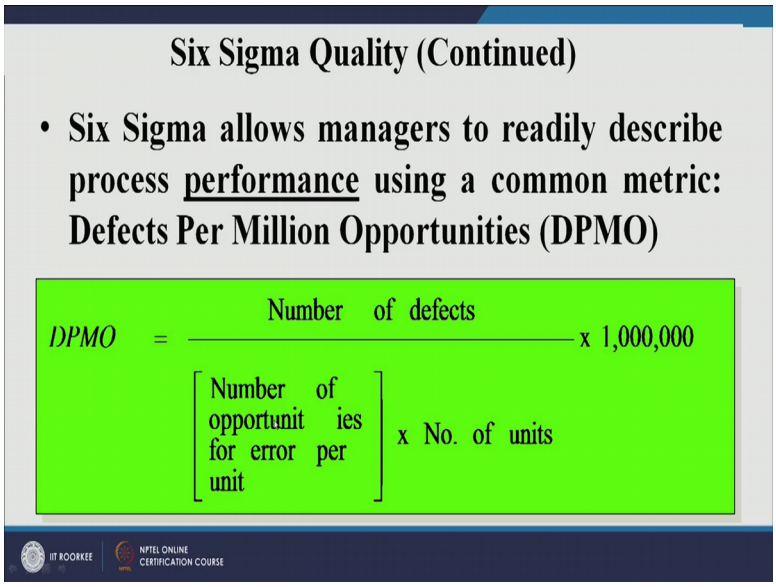

Six sigma allows managers to reduce to readily describe process performance using a metric called DPMO its defects per million opportunities. So, let say there are two processors going on, and you want to compare those two processors. So, how will you compare? And the there is a common method a common metric is DPMO defects per million opportunity. So, if in first method DPMO is more than that is not a good method right. So, you should have defects as low as possible right. So, six sigma it is a basically what you can DPMO can be used to compare multiple processors performances right.

So, defect per million opportunities this how you can calculate this value. So, number of defects divided by number of opportunities for error per unit. So, this is opportunities right into number of units multiplied by one million right. So, this is the formula for calculating DPMO defects per million opportunity right. So, let us look at one example and we will calculate what is DPMO in that example right.

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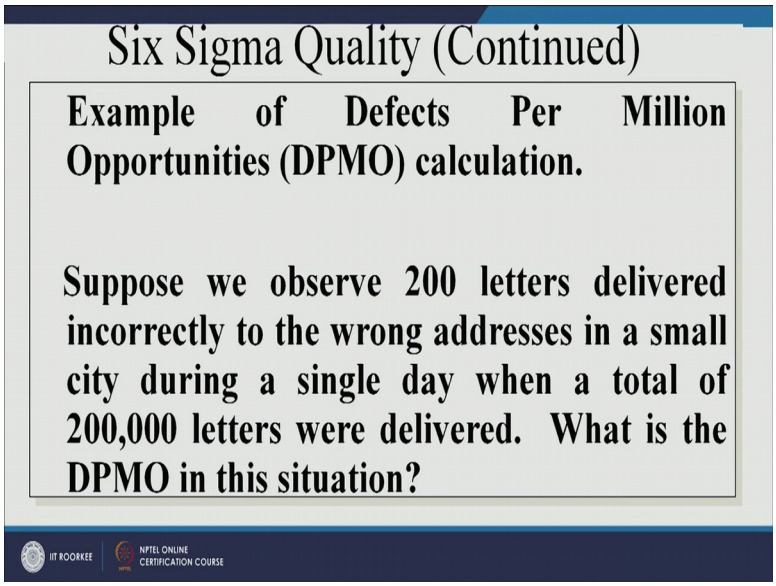

Suppose we observe 200 letters delivered incorrectly to the wrong addresses in this small city on a particular day, when a total of 200000 letters were delivered, what is DPMO in this situation. So, we have observed 200 letters were delivered incorrectly out of 200000 letters calculate defect defects per million opportunities calculate DPMO. So, we know what is what is our formula? Formula is this right number of defects. So, in this case 200 number of opportunities for error per unit its 200000 right is not it.

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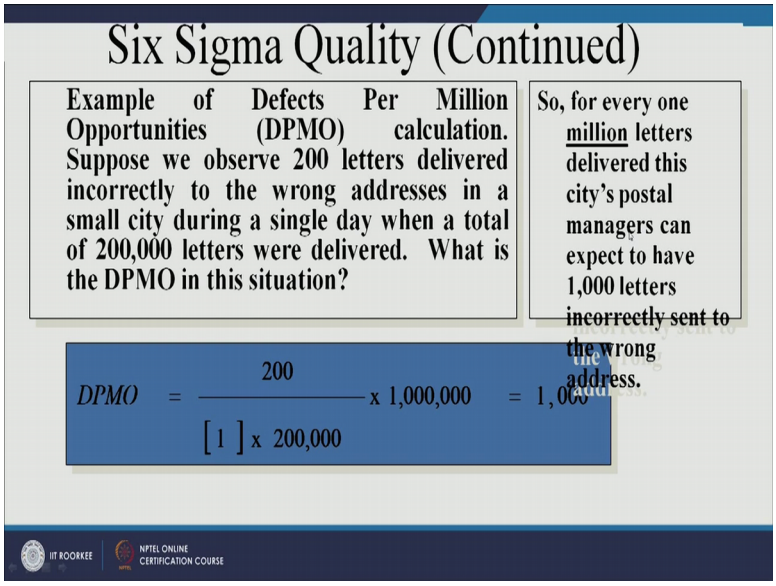

Let us look at this answer. So, in this case these are total number of number of units right number of opportunities for error per unit is one. So, answer is this 1000. So, what we will say that? We will say that for every one million letters delivered in this city postal managers can expect to have thousand letters incorrectly sent to wrong addresses right. So, this is how you can calculate DPMO. Now let us look at six sigma approach right and the approach is dmaic. Dmaic is the approach to improve existing processes right. So, let us look at dmaic approach the first is it is developed by jee and the overall focus of the methodology is to understand and achieve what the customers want right.

So, with this focus in mind six sigma process has been developed right. So, distance for define you should define what customers want or what is the problem right.

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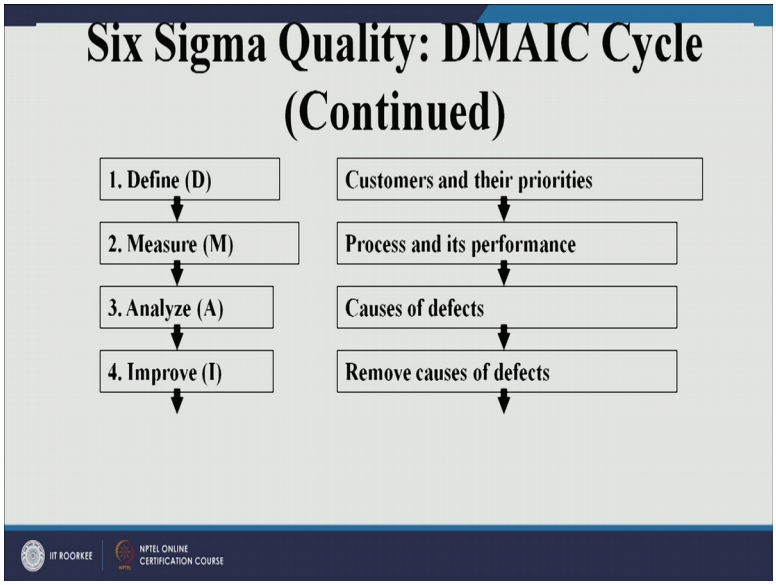

You see in a product customer may want let say first requirement is availability of the product right. For me the first requirement is that it should be at reasonable price, for someone else the priority is it should be durable product, for someone else it should be reliable product. So, each one of us has got different requirement. So, first a of all define what is the requirement. If there is an existing process let say if you want to minimize number of transactions which are taking place in banking sector and you want to minimize the incorrect transactions. So, first of all define what is the problem right.

Once you define problem then you measure it, it should be measurable there should be some number is not it how to measure? There are different tools available for defining

problem also there are certain tools available, then you have got analyze the problem analyze what? What are the reasons for on that particular problem? There might be several reasons there might be one reason right.

So, analyze the cause and effect what are the causes and what are the effects right and there is something called cause and effect diagram we will see that diagram, then you have got improve. So, once you have analyzed you should try to find out solution right remove the reasons for that particular defect. If the defect in the process is due to let say worker, then you need to train worker right. So, this how you improve it right and finally, control right. You maintain whatever you have done in fourth step right you should see that now no problem should occur right. So, this is dmaic approach and there are different tools as I said available for each of these stages right.

We will look at couple of six sigma tools and one of them is flowchart and there are several types of flowcharts one of them is this how we are receiving material from vendor. So, let say material received from supplier, you have placed an order and now you have received it right.

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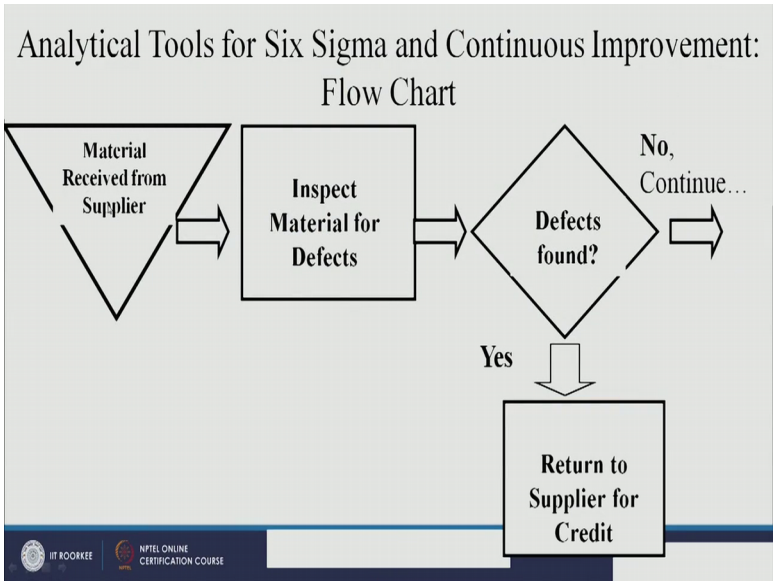

So, what to do now once you receive material from supplier you need to inspect it right why you should inspect because you do not want to accept forty raw material right. So, you just check it for defects right. If there are defective parts you should return those defective parts, now this is again a very important step here. Are you checking each and

every part which you have received from vendor or you are going for sampling is not it? So, if you are going for sampling then you need to decide what should be the sample size let say if you receive a lot of let say a thousand nuts right or thousands bolts right. So, you have received a lot of a lot containing thousands bolts. If you pick 5 units and if you get 3 defectives, then either you reject the whole lot or you should not reject the whole lot it depends upon the agreement which you have signed with the supplier initially right.

So, I at this stage you need to decide whether you are going for sampling or you are going for 100 percent inspection of those thousand bolts right. So, that is a decision you need to take here right at this level right. So, if you want to return it, return to supplier if lot is defective otherwise accepts it right this is a very simple flowchart. So, you can have different types of charts main machine chart then you have got 200 process chart and so on right. So, this is one of the tools right flowchart and there are some other charts we will see. So, can be used to find out quality problems right then you have got run chart. In run chart let say there is a process and at different time intervals you are collecting let say sample to check its quality.

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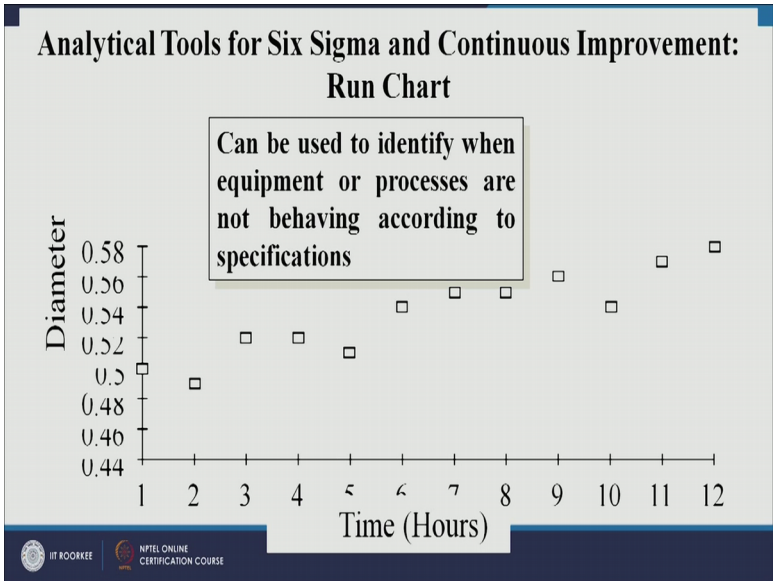

So, let say again you are making a wire right. So, first hour when you checked you just picked up one wire and you checked its diameter 0.5 centimeter right second hour you just pick one more wire diameter less than 0.5 and so on right. So, this how you will develop run chart right. So, you are measuring quality over period of time right.

So, what is the purpose of this? This type of chart can be used to identify when equipment or processor not behaving according to specifications, see the point here is this is run chart this is not a control chart right. So, you will get an idea in what direction your process is going because if you look at this, this particular chart there is an increasing trend right just see this if you fit line over these data points then you will get an increasing trend; and it is possible that after let us say this chat is only for 12 hours right it is possible that after 24 hours the process might go out of control right. So, run chart is an important chat it will help you in knowing the trend of the process right.

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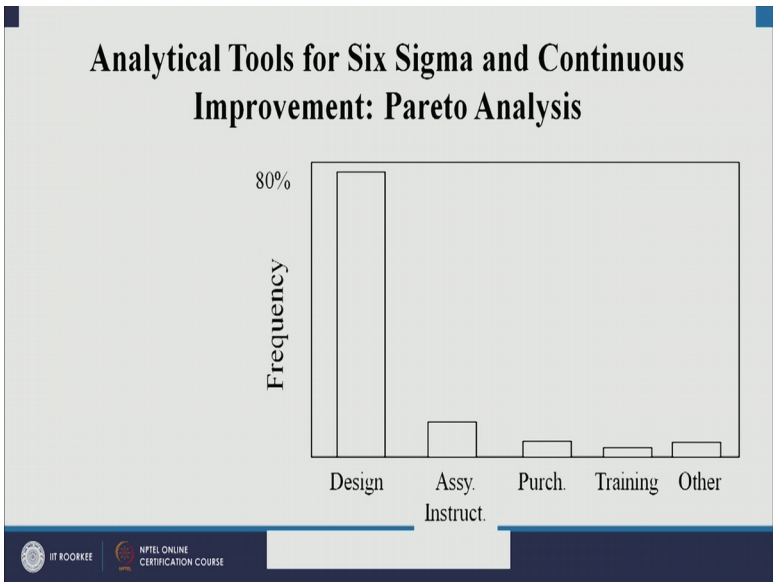

Let us look at one more chart it is called Pareto chart; this is applicable in almost all the situations. So, let say in a process a let say in an organization there are several defective parts, let say we have found that 80 percent faults are due to design problems. Then there very few percent defects are due to not following assembly instructions, not properly purchasing right product due to workers problem and these defects due to some other problems. So, this nothing, but a Pareto chart it is also known as its 2080 rule right.

So, we will say that in an organization 80 percent quality problems are due to 20 percent defects is not it and this rule, you can apply as I said almost everywhere. In a class 80 percent problems are due to 20 percent naughty student's right. Let say let us take one more example in a car 80 percent of the cost is because of some important 20 percent items or 20 percent parts is not it. So, you can apply the situation in almost everywhere

this known as Pareto analysis right. So, can be used to find when 80percent of the problems may be attributed to 20 percent of the causes, very important chart and you should look at this chart carefully. So, let me summarize what we did in today's session, we have looked at what is six sigma, we have looked at what is dmaic approach, we have looked it how to find DPMO and we have looked at couple of six sigma tools right. So, in next session we will continue with some other tools of six sigma.

Thank you very much.