Project Management for Managers
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Lecture – 56
Cost of Quality

Hello friends, I welcome you all in this session. In previous session we were about one of the important areas of project management and that area is quality management. And we have seen that quality has got different connotations and whatever is a quality product for you may not be quality product for me and there are different views about quality by different experts. And we have seen 8 dimensions of quality cards; PPF and we have seen three aspects of quality; quality of design, quality of conformance and quality of performance. And we have also seen what are the reasons for studying cost of quality separately; why should not be studied with other costs.

So, the reasons are name mainly you have got product complexities, costs are increasing because of product complexities and you have got lots of repairs and maintenance during usable life cycle of the project. So, these are two main reasons for which due to which you should study cost of capital, cost of quality separately. So, in previous session we also discussed prevention cost; let us look at the second type of quality cost and it is appraisal cost.

Whenever you make a product, as I said you need to take measurement at different stages. So, you need to measure whether things are properly moving or not, so you need to measure dimensions, you need to evaluate if something has gone wrong, you need to audit the product and components and whenever you are receiving raw materials from vendors, you need to inspect raw materials and components. So, all those cost related to you know those things are called appraisal cost; you are ensuring that again the product is confirming.

So, you can say that the appraisal cost and the previous cost which we have just seen; prevention cost, these two are the costs related to conformity of the product. We do not want non-conforming products; now there are different sub cost related to appraisal cost. So, the first is inspection and test of incoming material; since you are getting raw materials, sometimes semi-finished materials from different vendors and if you are a

large organization, you might be having hundreds of such vendor's right. So, you need to either test those incoming materials in your organization or in your plant or you should encourage your vendors to supply you quality product; so, you need not checking your plant, let the vendor produce quality product. So, you can avoid this type in your plant right inspection and test of incoming materials.

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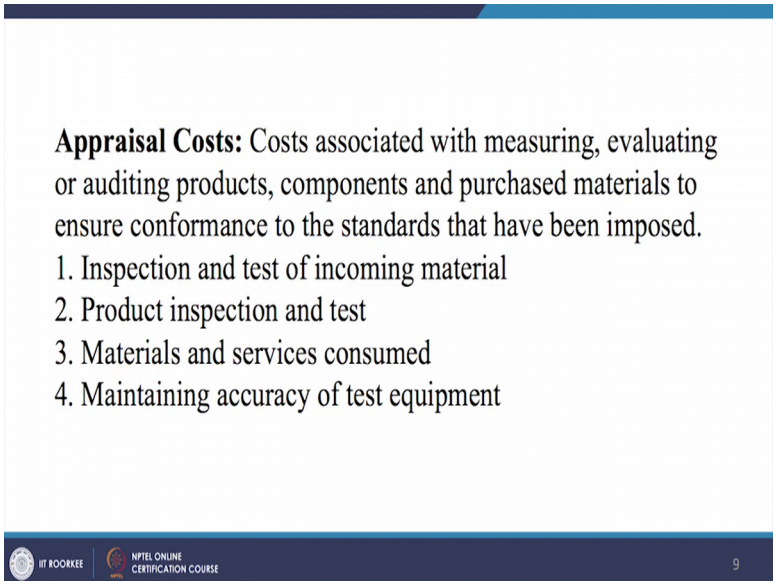

So, you need to make you know make your vendors capable to manufacture quality product. Then product inspection and test of course, the first part was related to incoming material, now since you have started making product. So, product inspection and test you are testing it at different stages; so, that is cost of one of the cost of appraisal type.

Materials and services consume; this is very important, you see what happens many times when you test something, some incoming material or let us say the material which is being manufactured in your organization, you need to consume some materials. Let us say if you are doing a non destructive testing; so, you will have to let us say if in case of let us say you are making bricks; bricks which you use for you know building making buildings. So, to check the strength of brick you need to crush it and during that process the material would be consumed it will not be useful for further use.

So, in this process you are consuming the material let us say if you are making; let us say deo; a body what is called let us say perfume; you are making perfume. So, you want to check quality of perfume; so, you need to spray it. So, when you spray it; it will not be

there in the spray bottle because you consume it in testing itself. So, you need to sometimes consume materials during testing itself; especially in destructive testing.

So, cost of those materials is one of the appraisal cost; maintaining accuracy of test equipment very important. Let us say if you are making shafts and you are measuring diameter of shafts and when you use a let us say vernier caliper to measure diameter of the shaft; What will happen after sometime? The edges of the caliper would worn out and if you continue measuring using vernier caliper, then even you would be clearing those shafts which have got more dimension than the required one.

So, you need to calibrate your machines and equipment time to time. So, the cost of calibration, cost of maintaining your machines and equipment updated; accurately they should measure the products. So, costs related to those are also appraisal cost; now let us look at some other cost; you have got internal failure cost.

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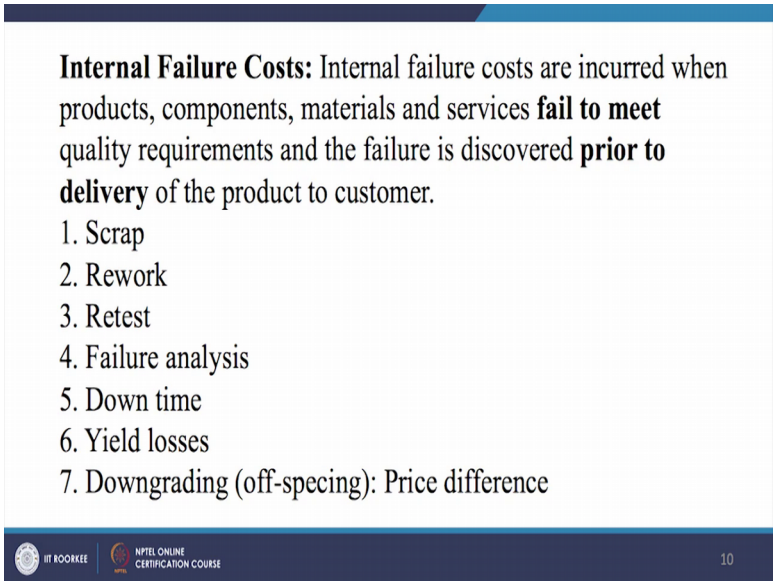

When I say internal failure cost; the cost which you incur in the product, before you supply it to your client or before handing over the project to the client; whenever you incur some cost those are called internal failure cost. And this type of costs are scrap, in a project you will have several scraps because in a project you would be getting materials from hundreds of vendors and scrap is that; that material from which you cannot you know recover any money.

So, let us say if you are making a shaft once again; I will take the same example and the diameter is let us say 3 centimeter and the shaft which is come out of the process is just say lets say two 2.5 centimeter; now it is a waste. You cannot economically recover any money from it, but if the diameter of the shaft is let us say 3.25 centimeter; so, you can rework on it.

So, if you are able to rework it; it is fine otherwise it is a scrap. So, the cost which you cannot economically recover is scrap then you have got rework; I just give you an example if the diameter of the shaft is 3.2 centi 3.25 centimeter, then you need to rework it and for that you need to incur cost, you need to incur machine cost, you need to incur labour cost. Failure analysis; this is good one whenever something goes wrong, you need to find out what are the causes of that failure and you need to do something called cost and effect analysis and there is something else failure mode effect analysis.

So, you need to find out the reasons for failures whether the reasons are due to the mistake of the worker or there is some problem with the machine or there is some problem with the raw material or there is some problem with the manufacturing method or some other problem. So, you need to identify the costs of the failure, so those costs come under internal failure cost. Then you have got down time cost, whenever there is breakdown in assembly line. So, you are not making products that would be loss to your organization, so down time cost.

Then you have got yield losses; yield losses what happens let me give you an example of soft drink company. So, in a bottle you need to have a specific quantity of beverage and let us say that quantity is 300 ml. If you are filling more than 300 ml then it is a kind of yield loss; due to some problem in setting of the machine. So, you need to focus on yield loss losses also and finally you have got downgrading or of spacing.

Now let us say you are making a product and its price is let us say x rupees, but there are some problems in that product. So, because of those problems you are not able to sell in in x rupees; so, you will sell it at some lower price; let us say x minus delta x; isn't it? So, that would be the price which you would be getting for that particular product. So, you will have different prices for the same product, so that is known as downgrading or off spacing.

So, for the same product you will have different prices, so that is also a part of internal failure cost. Now apart from; and this cost will be there whether it is a manufacturing organization or service organization; so, these costs will be there. Let us look at the forth type of quality of cost and this is external failure cost. It again it depends on what kind of product you are looking at, what kind of market you are looking at, what kind of organization you are in, what kind of sector you are in.

So, look at external failure costs; now these are the cost which you incur once you supply the project to the client. That is why they are called external failure cost; so, you are getting different complaints from different customers about product. So, you need to have people in your; let us say customer complaint cell. So, you are employing certain people in that customer complaint cell and they would be having different equipment, complaint register system will be there; isn't it? So all those costs related to complaint.

Then you have got return product and material; since the product is using; let us say guarantee period and there is a complaint in the product, so you need to get it back. So, there is something called return product, so either you may get it from let us say either from dealer or from retailer or from customer sometimes.

So, costs related to returning of products; then you have got warranty charges. You have got warranty and guarantee claims, so these costs also come under external failure cost. Nowadays, since customers are more knowledgeable, they have got several information with them and whenever something goes wrong with the product, they are ready to go in court of law. So, the cost related to the litigations and so on are liability costs, so you should be careful about theses litigations and all those things.

And apart from these four costs complaint, return, warranty, liability; there is something called indirect costs. Now these are costs which are difficult to measure because let us say if customer is not happy, so he might go to some other product. So, it is very difficult to measure that cost, so the cost related to customer dissatisfaction; it is very difficult to calculate. So, these are couple of let us say the customer is not happy with the brand now; so how to measure that cost isn't it?

So, these are couple of indirect cost; so, all these are external failure costs. So, we have seen four types of costs prevention cost, appraisal cost, internal failure and external failure. So, we can say that the internal and external failures are the cost related to non

confirming items. So, we want to convert those nonconforming items to confirming items; while prevention and appraisal costs are to ensure that we make confirming products. So, these are different cost of curves and we have got let me draw this curves on board.

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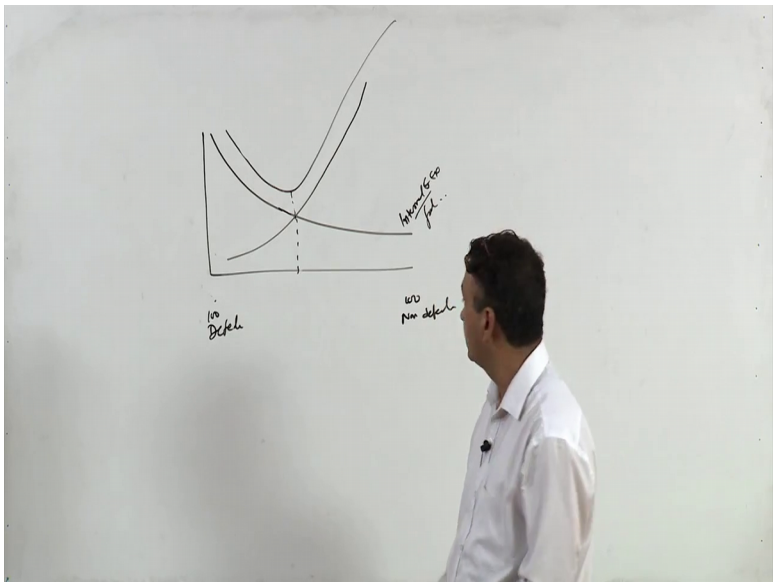

So, you have got let us say on X axis; you have got the quality. So, let us say you have got 100 percent quality product here or let us say hundred percent defective product here. So, 100 percent defective product here and you have got 100 percent correct product or 100 percent non defective product. So, you have got these costs; this is cost curve it is called internal and external failures.

So, this cost is more if product is defective or non confirming. If product is non defective then you will have less of this internal and external failures. On the other hand you have got prevention and appraisal cost; since you want 100 percent non defective part or non conforming item, you need to incur more and more; isn't it? So, this the relationship between these two curves and there would be a total cost curve. So, this would be like this just a minute, so this is this and the third one which is total cost curve is like this.

So, this total cost curve is symbol of right; isn't it? right symbol. So, this is the form of total cost curve and this is your optimum cost. So, your product should have this much of quality in into it; if you infuse more quality then total cost will increase. So, this is optimum quality level; now we have seen one of the definition says as that quality is

inversely proportional to variability and variability is what it is basically dispersion. Let us say if you are making a pane of 6 inches height and if you are making panes having different heights, then it is called variability.

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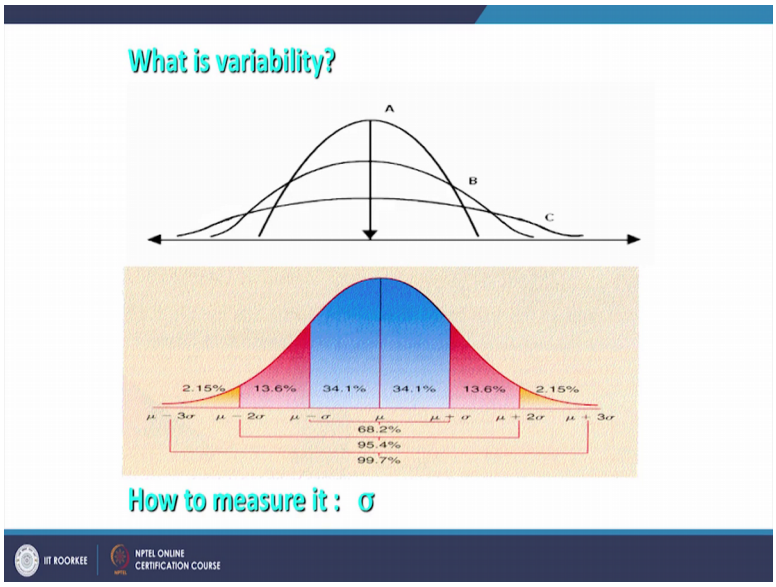

And if you look at this variability in this particular figure; so, there are three curves or three distributions. So, you have got distribution A; this is your second distribution, this is B and this is third distribution C.

So, which has got more variability here or more dispersion is in curve C; isn't it? Similarly, for if you look at curve a least dispersion and the variability is measured in terms of; there are various methods of measuring variability. The first is range; range is the difference between maximum to minimum value. So, let us say if you are making 100 panes of size; let us say 6 inches and the maximum height of a pane is let us say 6.25 centimeter and minimum is let us say 5.9. So, the difference is and the difference between these two numbers will give you the range. So, range is one of the measures of variability but a range is not a good measure of variability because it considers only two points; maximum point and minimum point.

So, there is another method it is called standard deviation. So, it is we denote it by sigma; so sigma is nothing but a standard deviation and standard deviation is what method of measuring dispersion or a method of measuring variability. So, let us look at this curve very important curve; all of you would be knowing that a normal distribution curve, a

bell shaped curve, it is a symmetric curve and other properties of this curve are within 1 sigma limit.

So, you will have 68.2 percent quality product, within 2 sigma limits you will have 95.44 quality products; if you are making 100 products. Similarly, if you are making 100 products then 99.73 products would be confirming products or non defective products or right products.

So, this curve will help us in knowing what is 6 sigma quality definition. So, let us move on to next slide; this is basically an example I wanted to share with you. This is in fact, there is an American automobile company; which is got a plant in US and that plant manufacturers transmission system for the automobile. And the company also gets transmission system from a plant based in company based in Japan.

So, the American company found that the warranty and guarantee cost were very high in case of transmissions coming from company based in US or the manufacturing plant based in US. While the warranty and guarantee claims were very low for the transmission systems made in a company based in Japan. So, they try to find out the reasons for this; why there is more guarantee and warranty claims. When they analyzed this in detail; they found that it is the variability; the transmission systems which they were manufacturing in American plant, they were having more variability while the Japanese plant; their variability was small.

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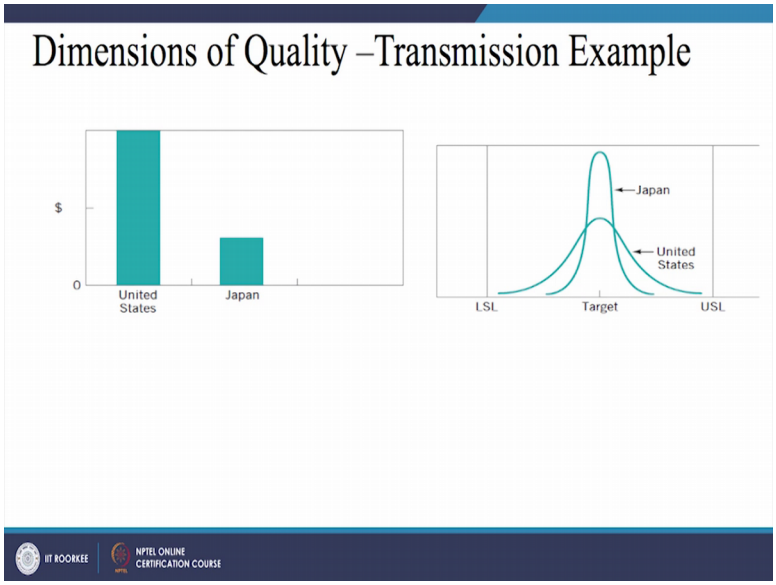

And when they did it further analysis they found it that the Japanese plant was using 25 percent of the specification band and what is specification band? You have got lower specification limit and upper specification limit, so this total is called 100 percent band.

So, for making transmission system; the Japanese company was using only 25 percent of this band. While the American the plant which was there in US; it was using 75 percent of the total band, so that is why they were having more variability. So, this is just an example how you can improve quality of a product by reducing variability. So, let us look at one more point before I finish this session; there are several sources of variability in fact, every organization wants to produce quality product in first time. No organization wants to do rework or they do not want to recall the product, they want to do it for the first time. But they do not do it; why? Why they do not do it for the first time? Because of several disturbances and disturbances are internal disturbances and external disturbances.

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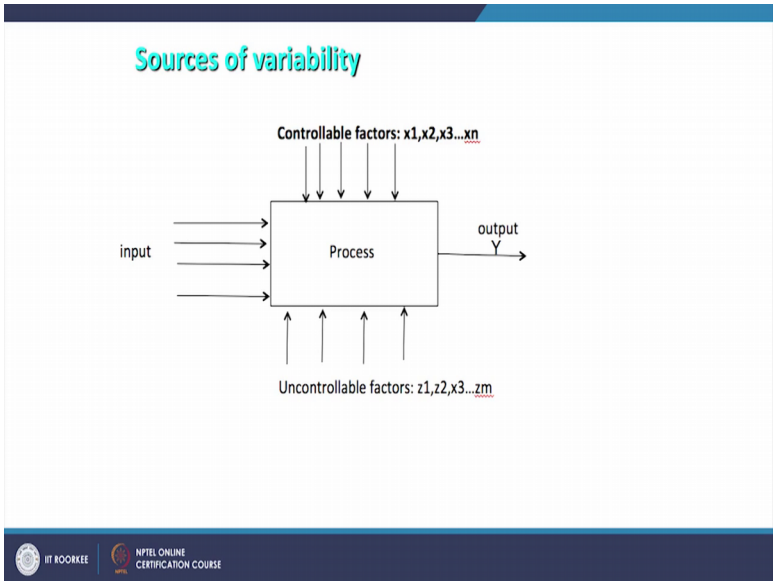

So, let us look at a process; in a process there are several inputs; you will have several input variables; maybe in terms of let us say labour input, material input let us say method input and so on.

So, you have got certain inputs and you are processing those inputs to make some final product and final product is your output. So, the final product could be a product or the output could be final product, it can be a service or you can also have a waste; isn't it?

Waste can also be one of the outputs, so you can have several inputs and you can have several outputs; either product as an output, service as an output, by product as an output, waste as an output and one more intangible output is learning.

In fact, pollution is also an output; so, one of the intangible outputs is learning from the process. What went wrong, why you wanted to make something but you would not make it. So, there would be learning's also. And then there are certain controllable factors; now those factors which you can control, they are under the control of management. But there are certain uncontrollable factors and these are problematic factors because of these you do not get quality products or quality project.

And let us say these uncontrollable factors are what; these uncontrollable factors are; let us say competition is uncontrollable factor. So, you have got competitors and you may have competitors coming in day by day; so that you cannot control. But, if you talk about manufacturing process then the uncontrollable factors are let us say temperature, pressure, humidity, inherent qualities of incoming materials. Since you are getting raw materials from different vendors and all the vendors will not have same quality of raw materials. So, you do not have control over these things rand they are uncontrollable factors.

So, you need to control these controllable factors and try to minimize the effect of uncontrollable variable on value of y. So, we will see in next few classes how to design your experiment so that you minimize variability in your output. So, we do not want variability here; so, what we want? We want to know which are those controllable variables affecting y; is the first thing you want to know; which is the most important controllable variable which is affecting y.

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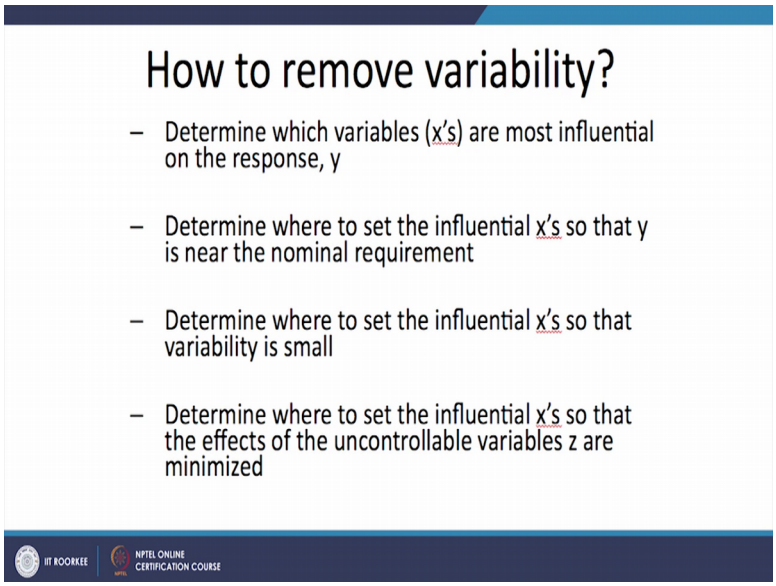

We want to set these variables x 1, x 2 and x 3 and x n in such that we get value of y as near optimum. So, determine where to set the influential variable so that y is near optimum or exactly optimum. Determine where to set all influential x so that variability is small. Determine where to set the influential axis so that variability is small, we want to minimize variability. In this step what we wanted? We wanted to have value of y near optimum.

Here we want to minimize variability and determine where to set the influential x so that the effect of uncontrollable variable that is z are minimized. So, let me give you an example; let me compare this process with the classroom situation. So, in a classroom let us say there are some good students and there are some naughty students. So, this good students are controllable variables and output is at the end of the day learning.

Learning is the output, so as a teacher; I want to control all my good students. I should control them in such a way that at the end of the day total learning of the class is more and more. But there are certain naughty students, so I want to control them naughty students. So, what should I do? I should ask a good student to accompany a naughty; so, that I will minimize their affect on learning process.

So, these are couple of things which you should remember in this session and in next couple of sessions; we will continue to talk about quality management and we will see

what is design of experiment, what are different quality control tools and so on. So, with this let me finish here.

Thank you very much.