Principles of Industrial Engineering
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Lecture 54
Quality Control: Fundamentals.

Hello! I welcome you all in this presentation related with the subject, Principles of Industrial Engineering and in previous presentation, I have talked about the importance of the quality products and services, what are the various dimensions of the quality? And how the quality has been controlled over a period of time, means what different approaches which are been developed over a period of time since beginning like the operator quality control, foreman quality control, then Statistical Quality Control, total quality control organization wide, then design of experiments, total quality management.

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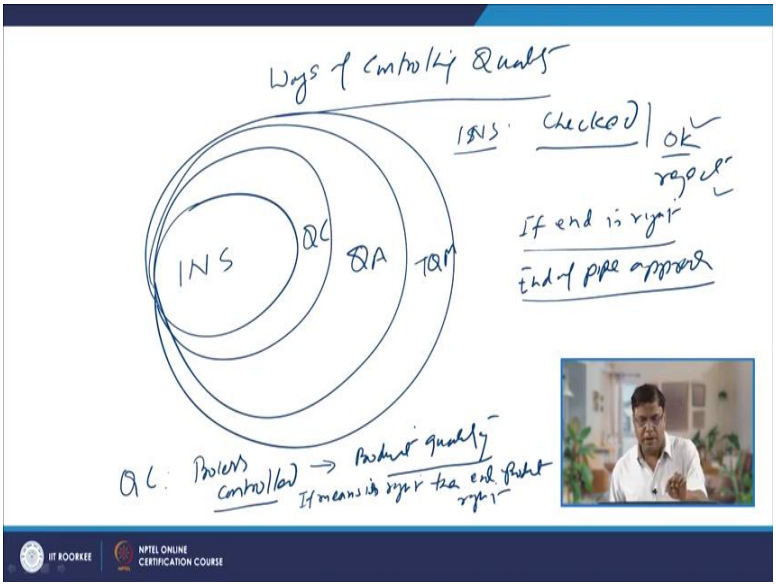

So this, then ISO 9000, ISO 14000 so various approaches have been developed. If we put all those approaches in the way by which the efforts have been made to control ways of controlling the quality. Then, the different all those approaches can be grouped in four categories as far as the evolution is concerned. Initially, it was like inspection. Thereafter, it was like quality control.

Thereafter it was like quality assurance and then, there was TQM. There is a lot of difference in these groups of approaches or the categories of the approaches for quality control. For example, inspection based approach. In this case, whatever is been produced after

manufacturing, it is checked and if it is as per the specification or as per the requirement, then it is accepted or it is rejected.

So, in this case, if we see, the if end is right, then everything is fine. So basically, this is also known as “end of the pipe” approach. Wherein, whatever is been produced is checked at the end. Thereafter if it is as per the requirement, then it is accepted else, it is rejected. If end is right, everything is right.

While, in case of the quality control approach, in this case, the process of making the goods and services is controlled. So, the process is controlled through the proper control of the materials, the process, process parameters, procedures. And it believes that if the process is controlled, the product being produced by the process will also be of the good quality. So, the quality products can be produced through the process control. So, in this case, the general approach is if means or methodology is right, then the product or service will also be right.

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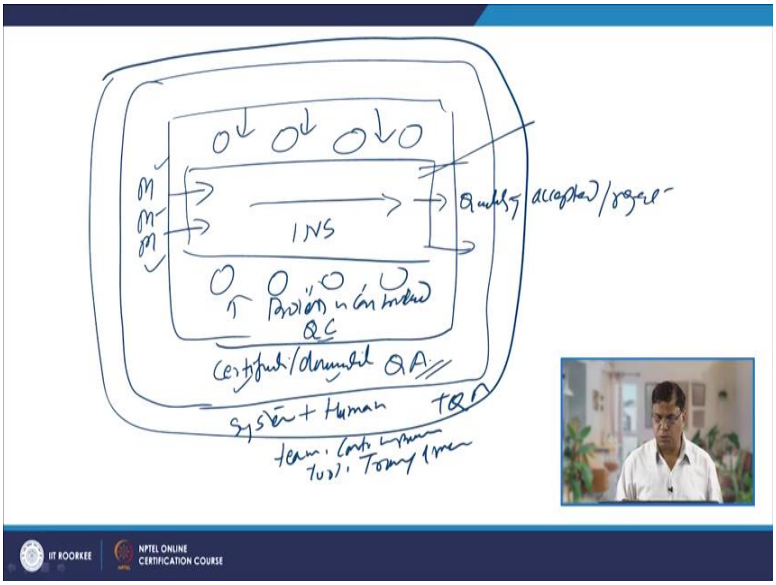

So here, the approach is controlled and these things we can show schematically like this is the pipe and here, we give all the resources like man, material, machines. These are processed and at the end of the completion of all the steps, the product and service is checked.

So this is basically, inspection-based approach. Here, we will say either the quality is accepted or rejected. On the other hand, if we control the process like this, so if the process is controlled to make the quality products. If the process is controlled, man, material, machines are given as per the requirement, the procedural aspects are controlled properly then it will

automatically produce good quality products. So, this approach forms the quality control approach.

In the third case, what we will be doing? How it will be done? All that is properly documented. So, the certification, documentation and whatever we say that is done and whatever is done that is documented. So, in this is done primarily for those who are the outside organization so that in order to build up the confidence about the products and services being produced.

So, this next outer circle is about the quality assurance. Thereafter so here, so far we talked about the procedurals, documents, the resources, which are, been given. But, even if everything is fine like man, material, machines, procedures and the methodologies which are been adopted are perfectly alright but if the, so which is constituting as a system of the machines and procedures.

But if the human being or the operators/workers, they do not give enough importance to the quality then despite of all these efforts, we may not get at the end, the quality products and services. So when apart from the system, the human component is also considered than it leads to the like TQM. So, what it considers like the system as well as like teams.

Then there is the continues improvement. The various tools like design of experiments, training of manpower. So, the people are equipped with the tools, techniques, training in order to do the quality works so that the good quality product and services can be produced. So, these were the kind of the four broad categories of the approaches, which have been developed over a period of time for quality control. Basically, so the first one is the end of the pipe approach.

At the end if you get good quality that is fine but that may lead to a lot of rejections. Those, which are not accepted, will be rejected leading to the scrap. In case of the quality control approach where process is controlled, if the process is within control, then we will keep on getting the good quality products and services.

So, it helps to reduce the rejections and wastages in that way. The quality assurance helps in doing the things in proper way because everything is documented and in TQM, apart from the system, the man power is also trained and made aware of doing the things in a right way to

produce the good quality products so at the end, we can get the high quality products and services without with a minimum wastage at low cost.

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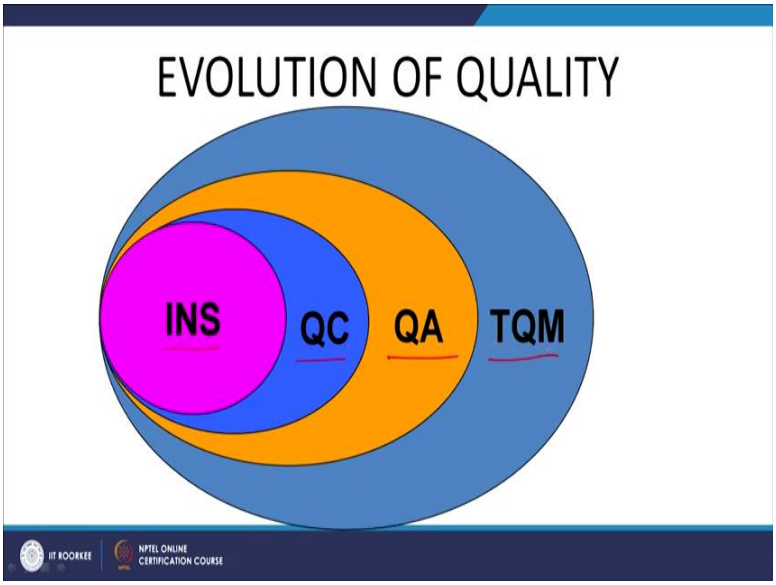

This was about the approaches which have been developed or award so far and this is what has been shown in a schematically inspection, quality control, quality assurance and the total quality management.

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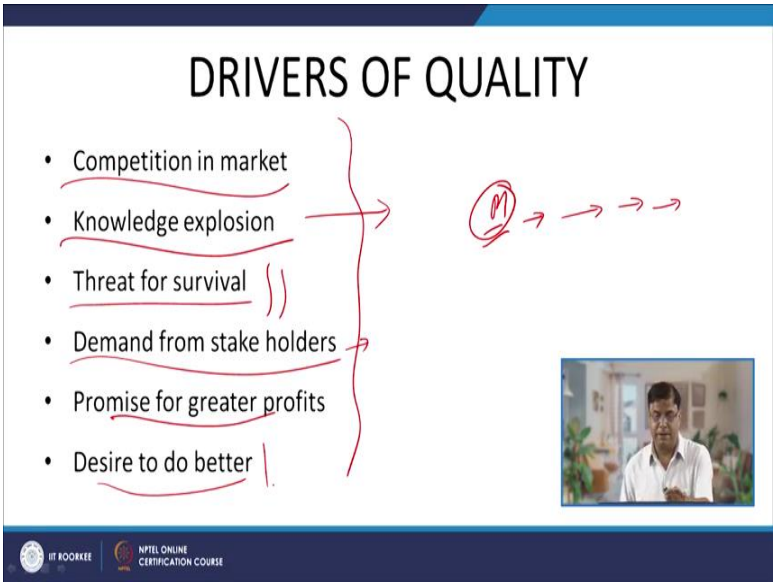

Another important thing is what is the need to work for improving the quality of goods and services. There are various factors that will be dictating to work on the quality related aspects like the competition in the market. If it is a monopolistic then we can keep on doing whatever

we have been. But if there is a competition and the competitors are coming up with good quality products and services, then to remain in market, the company should work on improving the quality of the products and services being offered that too at the competitive price.

The knowledge explosion is another thing like the people, nowadays, information are shared very rapidly. People know what are the various options available now in the market, which are the good quality products? What about the ratings? So those things are kept in mind nowadays by the purchasers or the buyer well going to buy a particular product or service and if he is aware of the factual things about the quality of the products and the services of the competitors also, then they will it will be difficult to retain the customers with the moderate or poor quality products and services.

Therefore, companies must work on improving up on the quality of products and services being offered to the customer. If we do not do this, then we will not remain in the market and our business will be closed and will not able to survive. So, sometimes, the poor quality of products and services may also lead to a situation where the companies may not be able to survive because of the reduced sales.

Demand from the stakeholders. Many a times the movement, the things become old, the quality is degraded. So, the customer themselves or all those stakeholders start asking for improving the quality or the things been provided, else they will shift elsewhere. So the demand can for improving the quality can come from the stake holders as well and you know, if we have the moderate level of the quality, then customers will be retained and then we can keep on increasing the customer base which will help in improving the profits because of the increased income.

And if we are able improve the quality without increasing the cost appreciably then that will further help in consolidating the market position for increase debt profit. Desire to do better also drives the companies to do the better things.

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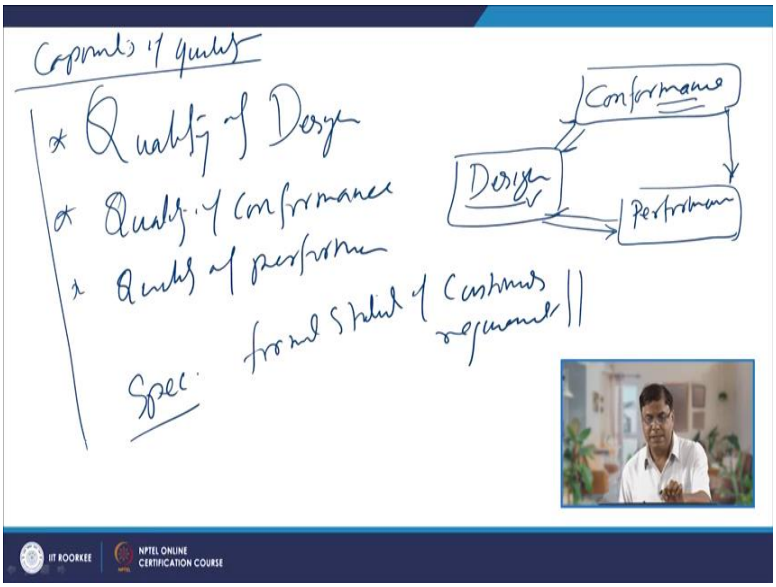

There are three important components related with the quality that is about the quality of the so these are basically components of quality quality of design. So, the quality depends on these three aspects, quality of design, quality of conformance and quality of performance and all these three are very closely interrelated like the design, quality of design.

So, as per the requirement of the customer, the products and the services are designed so that the customers can be satisfied or rather they are delighted by exceeding their expectation. Whatever is produced is according to the specification or standards that is about the conformance. Product has been designed product or service has been designed. Then whatever is been offered is according to that so the conformance.

Thereafter, after the conformance, there is performance like this. So here, the product and services are designed and checked if these are according to the requirement, according to the specification or not and if there is a problem in realising the designed features, then the feedback is given back to the design so that the design can be improved, modified. So that the features and the specifications as desired by the customers can be incorporated for conforming the specifications as per the requirement.

So basically, if we talk of the specifications, specification is about the formal statement of customer's requirement. What customer is looking for? Whether regarded to the various dimensions of the quality. So, considering the requirement of the customers, products are designed and then they are manufactured and if there is any deviation then feedback is again

given to the design people so that it can be modified or altered accordingly to make it as per the requirement of the customer so that it confirms to the specification or requirement of customers.

Once the product or service has been developed according to the requirement of the customers after the conformance, it is made available to the customers and then customer will identify how good it performs during the use and if there is any problem then the feedback is given to the design people and design people may interact with the users directly for the best performance.

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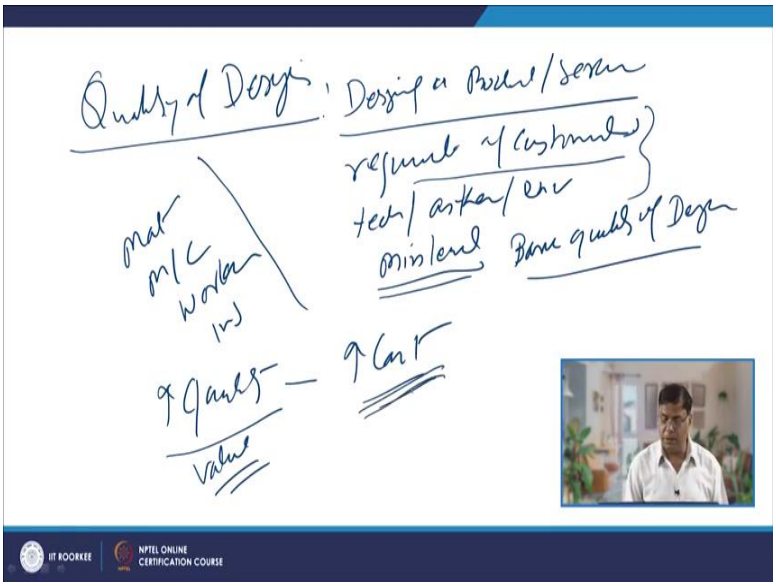

So, the scope of these three things will be talking in detail starting with the quality of design. Quality of design means the designing a product or service considering the requirement of customers. So, whatever the technical, aesthetic, environmental, all those features which are need to be considered for coming up with the product and service are kept in mind while coming up with the design and these design features must be of the minimum level so that the customer requirements can be satisfied.

Once a product satisfies the customer requirement, then only will be going for procurement or purchase of that product or service. So, there has to be minimum basic level of the quality of design and if it is not there, customers are not going to buy that. So, that can be improved upon by using the good quality material, using the sophisticated machines and the like the workers, 100 percent inspection or extensive inspection so that whatever is made perfectly satisfied the requirement of the customer.

So since, the quality of the material, machines, workers, the inspection procedures are if that is made on the higher side then increased quality can be realised through the increased cost. So, of course, with the improvement in the man, material, machine, worker procedure, the quality or the value of the product will be enhanced but at the cost of increased cost. So, how to come up with suitable design features so that requirement of the customer is also satisfied while the cost of the component of the product is maintained within the limits.

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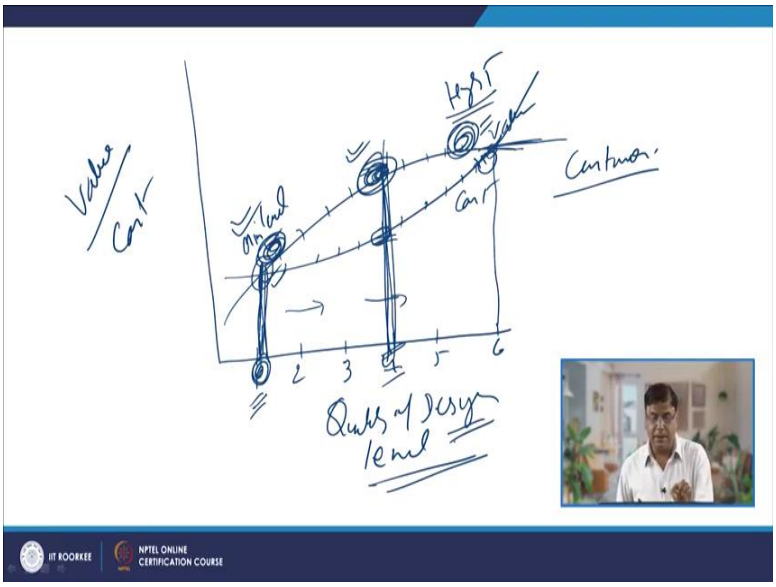

For that, we will see a schematically diagram which will show like the quality of design levels. We may write anything. This is just a quality to 1, 2, 3, 4, 5 and 6 and in the Y-axis; we have the value or the cost. The kind of the value addition, which is being which is taking place or the cost, which is occurring, due to the various levels of the quality.

So, there will be certain how the value addition will be taking place with the quality with the increasing quality of the design like increasing the quality of material, machine manpower, procedures etc., which are been adopted. So, that may go like this. So here, it is showing the value addition in production. On the other hand, if we talk of the cost, it may go like this.

The cost component, so if we see if this is the minimum level of the quality of the design that a customer is looking for, so with the addition with the increasing level of the quality of the design, the cost will also be increasing and what we can see that, with the increase in cost increase in cost with the increase of quality of design is taking place at the same time there is increase in value of the product.

But what we can see here at the level 1 quality of the design of the level 1 is leading to the minimum cost but on increasing the quality of the design level, the cost is increasing very rapidly at the high side and the value addition increase in value is very marginal. So, this is the point when we will say that cost is increasing very rapidly but there is limited or no value addition in the product is taking place.

So in any case, the product must be designed to have the minimum disquality level. But if we see the balance between the value and the cost, then the level of the quality, say this one, wherein the gap between the quality and the cost is maximum which shows that if we the quality of the design level is 4 then it will cost minimum and it will lead to the maximum value addition in the quality of the product.

So, this is the maximum quality of the design level, which will be leading to the high cost. There after there not be any increase in the value addition. This is the level 4, where the level of the quality of the design level 4, will be leading to the moderate cost but the maximum increase in the value of the product and the quality of the design level 1 will be the minimum required in any case to make a product sellable and this will be leading to the minimum cost and the acceptable quality of the product.

So since making the too high quality of the design will make the product very costly without significant there may be increase in the value of the product but customers may not be looking for so, as per the customers, there are various types of the customers. Few will be focusing on the high end products, means the maximum value. Few will be focusing on the moderate values and few will be focusing on the minimum level of the quality requirement.

So accordingly, the same product may be designed using the different levels of the quality of the design. So, very high end products will be costing high but will be coming up with the higher value as well. Moderate quality and here, the moderate quality and the moderate cost and then the minimum required quality level and the minimum cost. So, as per the target group of customers, the products are designed suitably for the different levels of the quality of design.

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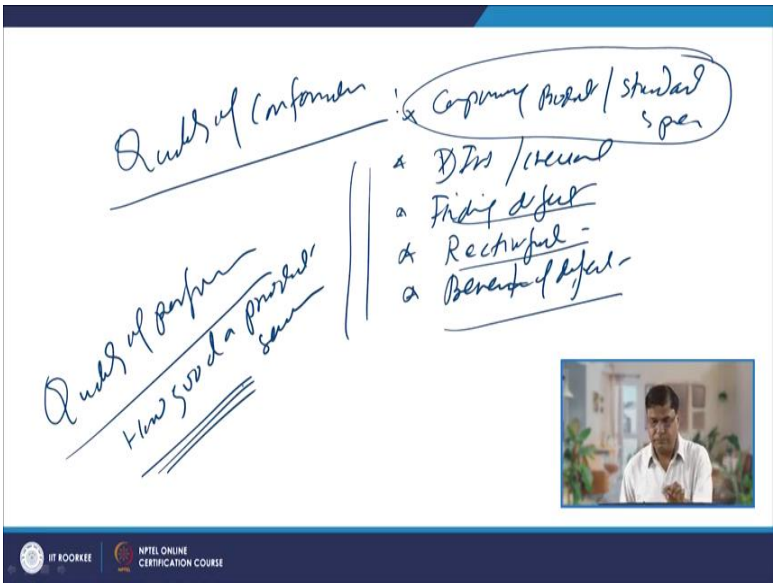

Then, next is the quality of conformance. Primarily, quality of conformance is about the degree to which a product conforms to the specification and that is determine by comparing the product or service with the standard or specification. So for this, what we need? We need inspection. Inspection and checking of the things. So, finding the defects through the inspection is one thing.

Then, after the defects are identified, the rectification of these defects and further to avoid the occurrence of such kind of defects, the prevention of defects. Prevention of defects. So basically, the conformance quality of conformance involves primarily the confirmation of the degree to which the product or service conforms to the standard specification or requirements and this involves the inspection and testing, finding the defects, rectification and the prevention of the defects.

Then, the quality of the performance involves like how good a product or service performs when it is delivered to the customers. So, if there is any problem related with the performance, so whatever the requirements of the customers were there, the customers will be checking the suitability and the performance of the product during the use. So, that is what is checked and if he finds few of the issues then the feedback is given to the design group, which will be incorporating the feedback of the customers to come up with the improved quality of the product.

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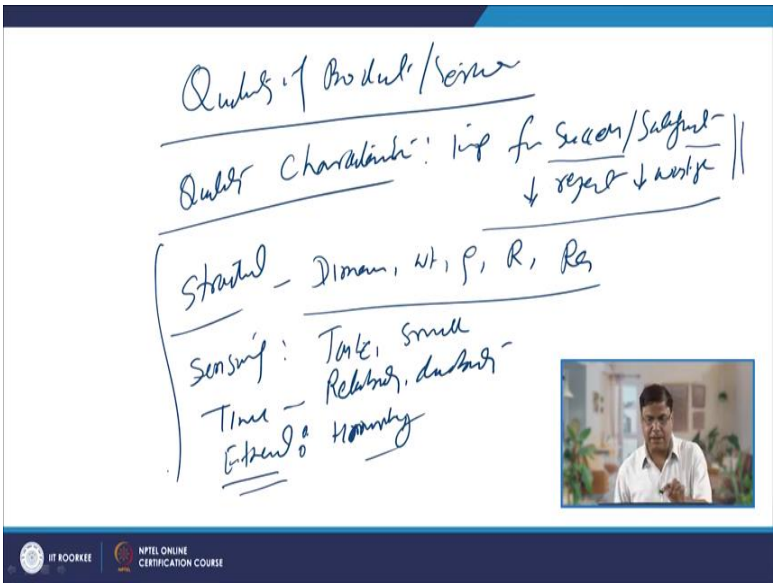

So, now we will see, if you want to improve the quality of a product or service then a what are the features or characteristics on which the designer should work, manufacturers should work and it is therefore, important that the quality characteristics which are important, important for success, satisfaction, minimum rejection, minimum wastage. Anything that is important.

The quality characteristics, which are important for success of a product or service and achieve the required features in a given product, are considered for proper control because there are hundreds of the characteristics, features, properties. But, all may not be equally important. So, if we just try to see there can be structural characteristics which involves like dimensions, weight, density, electrical resistance or conductivity, then surface roughness.

So, there can be number of the features, which are structural features, measurable features. Then there are few non-measurable kind like sensory features sensory characteristic like taste, smell, odourness. Then there are like time related characteristics, which is about reliability, durability. Then, the kind of the performance and the after how long time it needs repair? The kind of the service it needs. Then, ethical.

So, these are some of the characteristics, like the honesty, the friendliness of the people with whom the company is dealing or the honesty of the dealer, the friendliness, courtesy, etc. Those will be the ethical characteristics.

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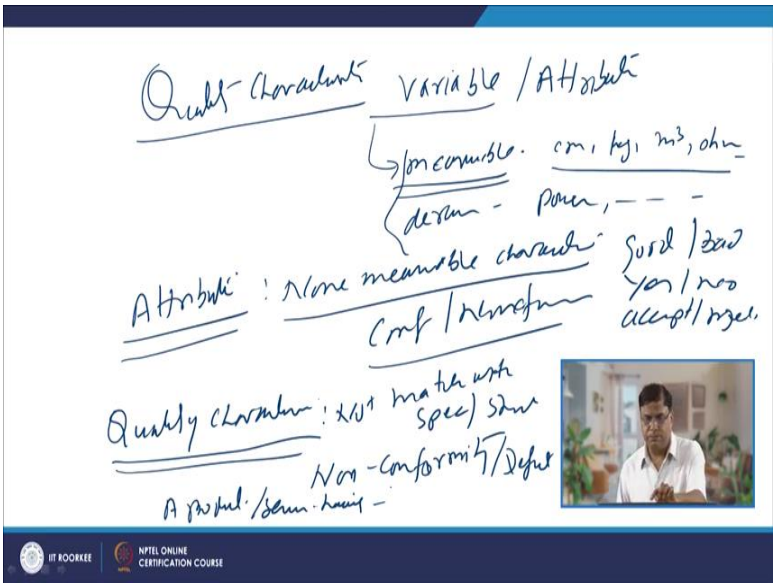

So, among these, the certain characteristics, which can be measured. So, as I said, there can be number of quality characteristics but all quality characteristics may not be important for success of the product and service. All the characteristics may not be of equal importance from the customer satisfaction point of view. So, those which really matter for success of product, those which really matter for the satisfaction of the customer, those should be selected for proper control.

So, quality characteristics are selected in such a way that they are really important, they are. So, based on the characteristics nature of the characteristics, there ae two types, variable and attribute. Variable characteristics are those, which are measurable using suitable instrument and we get the data in term of like say centimetre, KG or the meter cube or the electrical resistance in Ohm or any other features.

So, characteristics, which are important for the product and are measurable, those falls in the category of the variables and the variable characteristics can also be derived characteristics also like the power. So, these can be the derived characteristics also. On the other end, these can be measured. On the other hand, attributes, attributes are the non-measurable characteristics.

So, we say that it is good or just bad, yes or no or accept or reject. We do not quantify them. It is conforming or non-conforming like this. So, these are the non-measurable characteristics like taste or smell or the colour or the aesthetics. So, those are the those are considered as

attribute. So, when a quality characteristic quality characteristic it does not match with specification or requirement, whether it is attribute or variable.

So, quality characteristic not matching with specification or standard, then it is termed as non-conformity, non-conformity. A product this is also termed as a defect. Defect is a non-conformity in a quality characteristic. Then, a product or service having at least one non-conforming quality characteristic will be termed as non-conforming unit.

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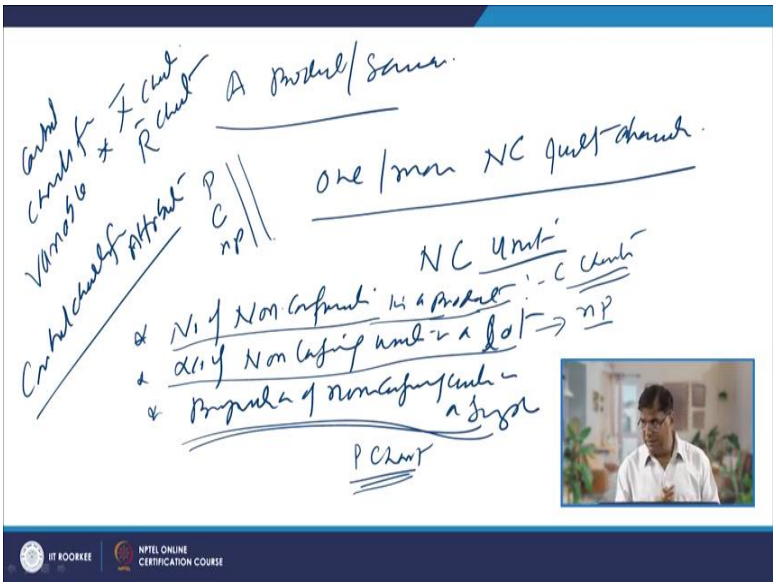

So, the thing is a product or service having at least one or more non-conforming quality characteristic, then it is termed as non-conforming unit. So, what we do basically in case of the attributes? There are like say, number of non-conformities that like in a product, how many number of the non-conforming non-conformities are there?

Means number of defects are there. So, number of non-conformities in a product. This is one. Or the number of non-conforming units in a lot or proportion of non-conforming units in a sample. So, these are the three ways, which are very commonly used when we consider the number of non-conformities, non-conformities in a product, number of non-conforming units in a lot or proportion of non-conforming units in a sample. So, the number of proportion is termed as the when we us this data, proportion of non-conforming units in a sample, it is termed as P-chart.

So, when the control chart is developed using the data of proportion of non-conforming units in samples, then we call it as a P-chart. When we talk of the number of`non-conforming units

in a lot, then it is termed as a N-P chart and when it is about the number of non-conformities, then it is called C–chart.

So, here there is the different types of the charts for attributes and the different types of charts used for the variables. So, variable charts for control charts basically, quality control charts for variable. There are two charts like one is X-bar chart and R-bar chart. Similarly, the control charts for attributes include like P chart, C chart, N-P chart. So, these are some of the common control charts for attributes.

Now, I will summarise the presentation. In this presentation, basically, I have talked about the different components of the quality like quality of conformance, quality of performance and quality of design. How do we select the suitable level of quality so that we have the maximum addition in the value of product at minimum cost? And then, we have seen that what are the quality characteristics and how do we choose the quality characteristics for developing a control chart. Thank you for your attention.