Inspection and Quality Control in Manufacturing
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Lecture – 01
Introduction: Fundamental Concepts of Quality Inspection and their Role in Manufacturing

Hello my friends today we are going to start our new course on inspections and quality control in manufacturing, so basically this course will deal about the different types of inspections their control then how we can rectify the problems at the time of designing and then what kind of inspections generally we can do for different types of parts.

So basically, today's lecture is on the introductions of this particular subjects, so the thing is that here mainly here we are going to discuss about the fundamental concepts of quality inspections and their role in manufacturing. So first let us start with that what is inspections. So, inspections from the words itself we can understand that inspections means to inspect something, right so as per the ISO 2859 standard the definition of the inspection is that

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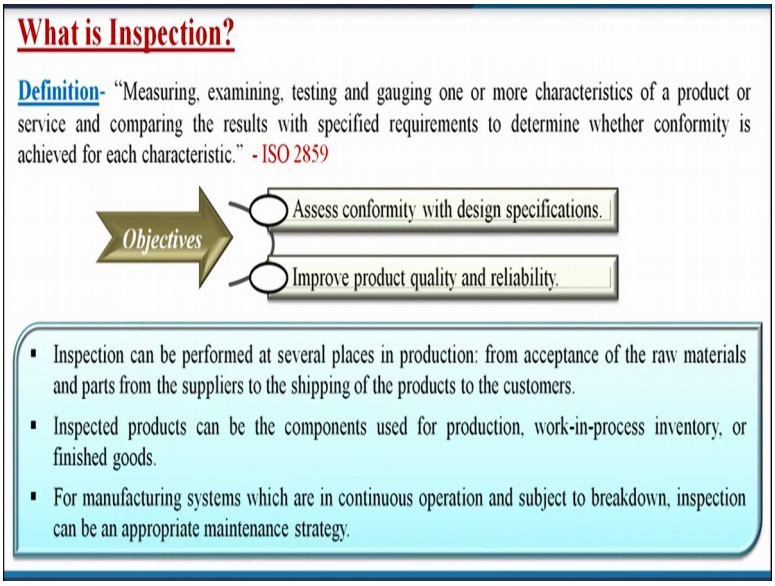

Its measuring, examining, testing and gauging one or more characteristics of a product or service and comparing the results with specified requirements to determine whether conformity is achieved for each characteristic. Generally, what we are doing, so basically, we are doing that

first we are making the design of the particular parts or may be the products and then we are starting for manufacturing the particular parts or may be the products.

So, each and every time after making the particular parts just we are trying to measure that whatever the exact design has been given in the drawing itself whether the parts are the same or not. So now what are the objectives. Objectives first one is the is assess conformity with the design specifications and second one is the improve product quality and reliability.

Yes off course, so first we have to check whatever design has been given to us, that we are making that particular product as per the drawing or may be the design or not if not then we have to rectify those problems and then next one is that unless and until will follow the proper designing so what will happen when we are going to do or may be use that particular part or may be going to assembling that particular part it will give you some faulty results or may be some kind of noise or may be some kind of other error.

So at the end of the day we have to throw that particular product so that means that we have to increase the product quality and also the reliability that means the life of that particular products or may be strength or may be mechanical properties or may be thermal properties of that particular product. So now inspection can be performed at several places yes, as we know that if we are talking about an automobile industry.

So I will give you all the details in subsequent slides, so in that particular case each and every assembly section has its own inspection chamber where we are checking all the parts over there, then after that all over it is coming to the final assembly zone and then we are assembling and not only that, after final assembling also we are doing so many of that particular product then only we are going to send that particular product to the different franchisees or may be the shops for selling.

So now inspection can performed at several places in production from acceptance of the raw materials and parts from the suppliers to the shipping of the products to the customers, that I have already told. Now inspected products can be the components used for production, work- in-

progress inventory or may be the finished goods. For manufacturing systems which are in continuous operation and subject to breakdown, inspection can be appropriate maintenance strategy.

Sometimes while making that particular parts also we are doing the continuous monitoring, sometimes after making that parts also we are doing the monitoring. Now what is the role of inspections in the manufacturing?

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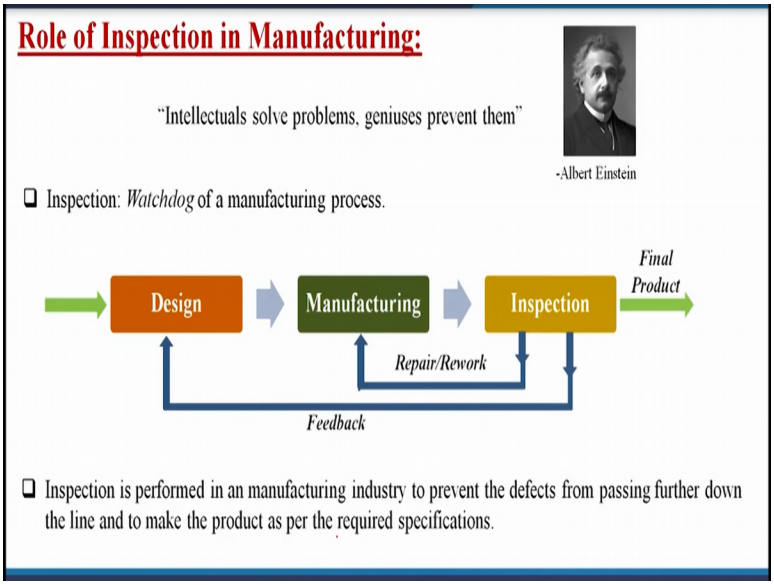

As per the famous scientist Albert Einstein. Generally intellectuals solve problems and genius prevent them, so inspection is nothing but a watchdog of a particular manufacturing process, that means, whatever we are trying to do for that particular manufacturing every time we are going to check that we are following the same design or may be the same part or may be the correct measurement, so that the wastage will be minimum and not only that the product life or may be the life cycle will increase its reliability or may be the the reproducibility of the results is going to be increased. So, these kind of things generally we are going to check.

So now if we see that when we are doing the design part then after designing, we are going to the manufacturing and then at last, we are doing the inspections. Now inspections also there are several types, so first in this particular case, if inspection is absolutely fine means if we after checking the particularly material if we find that all dimensions or may be the product quality or

everything is absolutely fine then we can send it for the final finishing process or may be to the shops or may be the company outlets for selling, if we face some kind of difficulties over there at the time of design so generally we are taking the help or feedback and if at the time of inspections we see something about defects in manufacturing or may be the some material properties has been changed or may be not up to the mark in that case we are following the repair with the rework.

So now inspections is performed in the manufacturing industry to prevent the defects from passing further down the line and to make the product as per the required specifications. Yes when we are making any kind of products they are at several zones, right so if we found any problem at any particular zone, so at that time we are stopping the whole manufacturing and then we are taking out the materials, we are doing the re corrections of that materials if it is possible, if it is not then we are throwing that particular materials then again we are starting from the zero.

So in between that if we see any process or may be the manufacturing process is having some problems, so in that case we should not continue that particular made parts for manufacturing, because, the whatever the fault it has been achieved in some particular zone, that will be carry forward up to the last.

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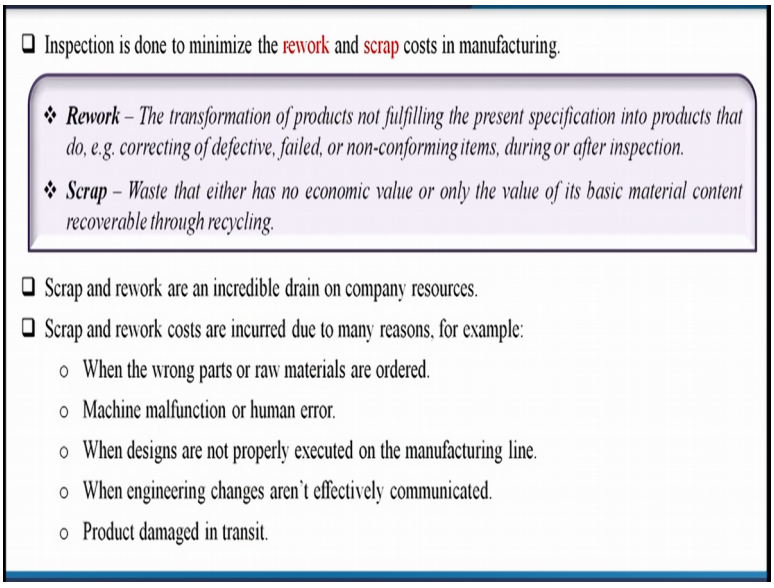

So now inspection is done to minimize the rework that is vital one that is the rework and scrap cost in manufacturing, that means at the last say suppose we are making any kind of product if the material is not good or may be the if I am taking any kind of manufacturing process like casting, farming or may be some kind of process like machining, so if there is any fault into the material properties so what will happen, if the re modification is possible then we can rectify those problems but if in casting, say suppose we are facing any kind of difficulties in the casting process, so in that case what will happen there is no scope to re modify that kind of parts so simple we have to throw it as a scrap.

So Now what is rework? So, the transformation of products not fulfilling present specification into products that do for example correcting of defective failed or may be the non confo conforming items during or after inspections.

And what is scrap? Scrap is nothing but the wastage. Waste either has no economic value or only the value of its basic material content recoverable through recycling, sometimes it may happen that we are doing any kind of parts that may be having some fault or may be it can be it cannot be used further so in that case what we are doing we are trying to say suppose any kind of metals by casting we are going to give any particular shape but what happen may be there is some fault in the casting point of view, so what we can do again we remelt that particular material if it possible and then we can give again the re shape of that particular material so at that time may be the material can be recycled sometimes it may not..

Now scrap and rework are an incredible drain on company resources yes of course, because when we are purchasing the money raw material we are wasting the money and then after that some persons are working on that and some certain time we found some faults in that particular parts so salary of the operators or the machine running cost and the raw material cost these all are in vein.

So, scrap and rework cost are incurred due to many reasons say suppose when the wrong parts or wrong materials are ordered. Machine malfunction or human error. When designs are not properly executed on the manufacturing line. When engineering changes are not effectively

communicated, and last one is that product damaged in transit, say suppose after making the final product you are sending the particular product to the users and in between that it facing some kind of problems or may be the break down or may be the, some kind of faults

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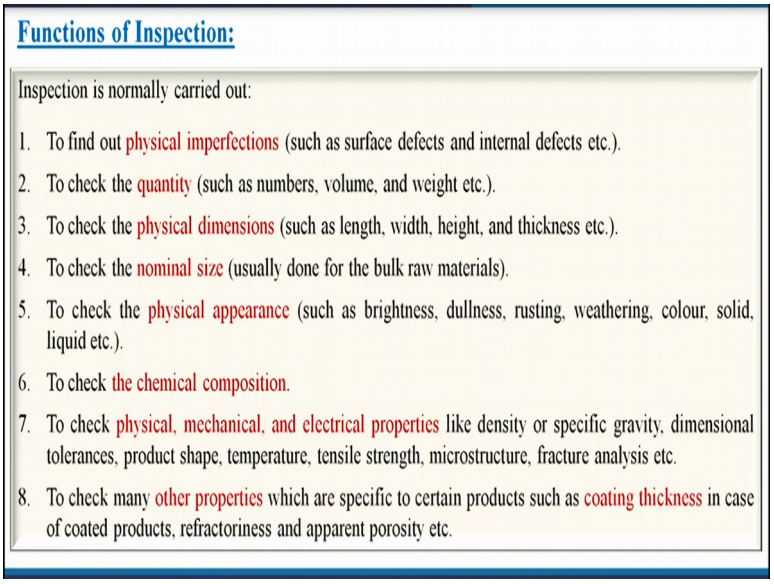

Now what are the functions of inspections inspections are normally carried out first to find out the physical imperfections such as the surface defects and internal defects etc., so second one is that to check the quantity such as numbers, volume and weight etc, third one to check the physical dimensions such as the length, width, height and thickness etc., whatever exactly has been given in the design. And next to check the nominal size usually done for the bulk raw materials.

Next to check the physical appearance such as brightness, dullness, rusting, weathering, color solid, liquid that can be done for any kind say suppose any kind of ornamental products or may be some aesthetic products or may some home décor kind of elements so these kind of things like these generally like the physical appearance is having a high value. Next to check the chemical composition of that particular materials.

Next to check the physical, mechanical, and electrical properties like density or specific gravity, dimensional tolerance, product shape temperature, tensile strength, microstructure, and fracture analysis and etc. To check many other properties which are specific to certain products coating

thickness in case of coated products refractoriness and apparent porosity or may be what temperature that material can withstand or may be what temperature that the material cannot be melted or may be can be used.

So, there are N number of properties generally are checking before selling that particular product or sending that particular product for selling. Now what are the basic issues of inspection

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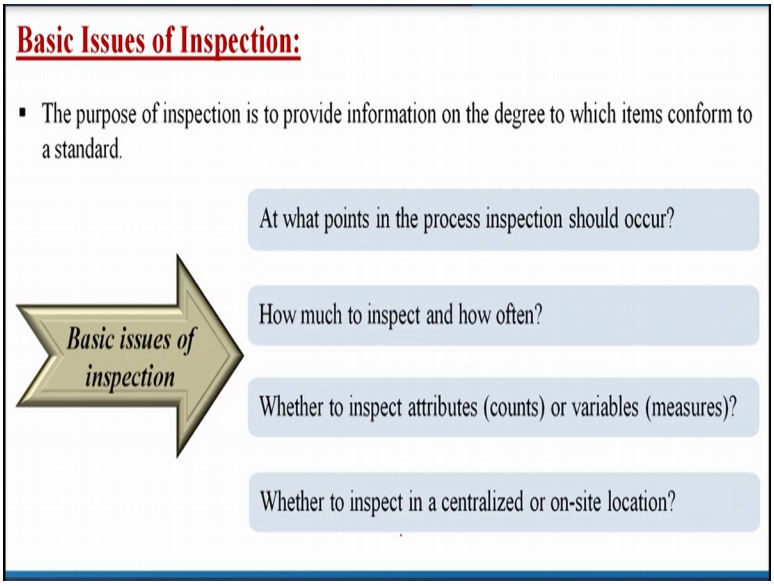

The purpose of inspection is to provide information on the degree to which items conform to a standard. So basic issue what are those; at what points in the process inspection should occur? How much to inspect and how often? Whether to inspect attributes or variables? Whether to inspect in a centralized or on-site location?

So, these all are the vital questions. So generally, now we understood that we have to do the inspections at every point or may be every manufacturing unit or may be the point. Now the basic question is that, what or may be how we are going to inspect those. In which method we have to follow? Which parts? In which way we have to do the inspections? So, these all are the basic questions.

Say suppose you are having one particular product. So now how you are going to check this? From which side you are going to start the measurement? How and what is the strength of the particular material? How we are going to check. That all kind of procedures we should know or

may be generally the companies they are following by which they are inspecting the parts very meticulously and then if there is no fault of that particular parts or may be that machines or may be that equipments, then only they are giving the satisfactory certificate after that only it is coming to the market for selling. Now where to inspect?

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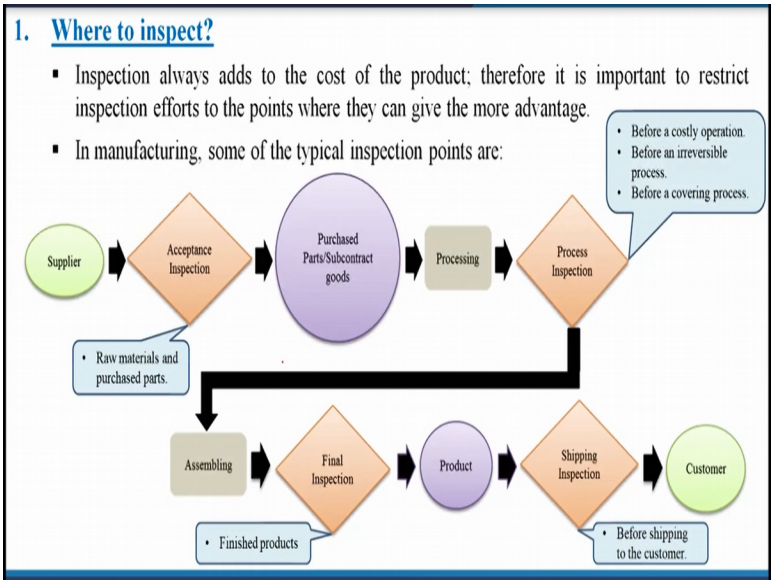

Inspections always add to the cost of the product, therefore it is important to restrict inspection efforts to the points where they can give the more advantage. Yes of course, it does not mean that I am talking about the every point, every point means when you are doing a particular manufacturing process, only at the end of that particular process. You are going to check that particular dimension or may be the you are going to inspect the particular parts or may be the materials, it does not mean at the time of running a particular steps or may be process at every second you have to do the checking, sometimes it is not possible also, sometimes it is not good also.

Because it will increase, because we need the the human labor not only that we have to engage some kind of equipment over there, so automatically the inspection cost will and of course it will be added up for the last for the total cost of that particular product. Now in manufacturing, some of the typical inspection points are, first is the supplier from where we are getting the raw materials, from suppliers it is coming to acceptance inspection, suppose I am going to make any kind of material, say suppose this one, this has been made by some plastics, so first we are

purchasing the plastics from the supplier and not only that, that plastics whatever going to purchase that is also having some physical properties and some chemical properties, all these kind of things right, whether the supplier is going to send us the exact same material whatever we have asked, so first we have to do the inspections.

So that is called the raw material and purchased part, next purchased parts and sub contract goods we are doing the processing operations then we are going to check the process inspections how? Because there is some assembling so after that we have to do the final inspection like for finished products then product has been done then we have to send it to the shipping inspections it does not mean that we have made some product and then our inspection process has been completed, no, because after that we have to do the packing of the particular materials so that it can simply reached to the shop. So that is called the shipping inspections.

So before shipping to the customer, and then also we are doing some kind of precautions because we know now the product now has come to the shop for selling, in the shop also we are maintaining so many kind precautions, so that there should not be any damaged, to that particular part or may be that particular equipment or may be there should not any scratch over there, so that the customer can come and they can easily choose that particular product. Now stages of inspections and testing:

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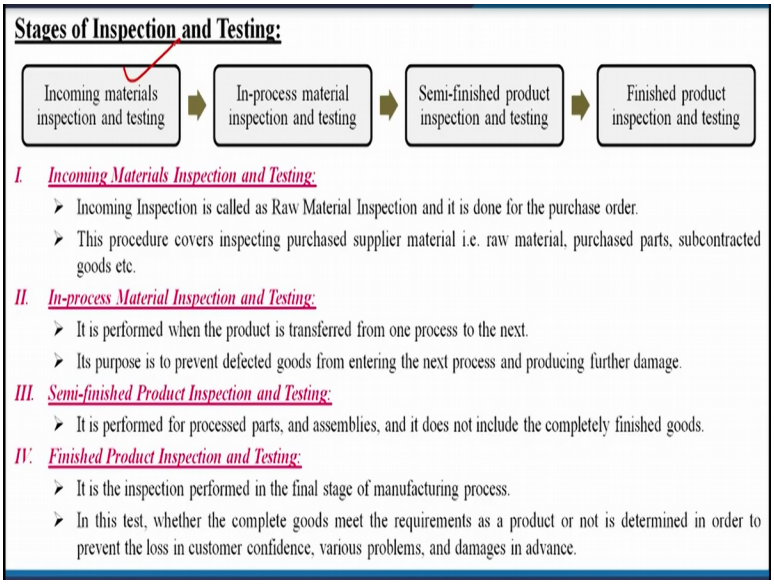

So first is that incoming materials inspections and testing followed by in-process inspection and testing then semi finished product inspection and testing and last one is the Finished product inspection and testing. So, this is the final one, so each and every stages after any particular process we are going to check that particular parts or may be parts or may be materials or may be equipment's.

First one is called the incoming materials inspections and testing what does it means, so first incoming inspections is called raw material inspections and it is done for the purchase order the procedure covers inspecting purchased supplier material that is raw material, purchased parts subcontracted goods etc.

Sometime really we are purchasing the materials from the different vendor and companies or may be agencies sometimes we are purchasing a particular parts as you know for the automobile industry, say suppose for tata, Mahindra and all the automobile companies when they are preparing any kind of car over there not all the materials, they are going to prepare or may be what I can say is that they are going to make in their own shop, no, say suppose head lights or may be some small parts or may be the tire they are going to purchase from the tire company or may be some electrical company so that means what already they have given their design, that our tire diameter should be there may be the radius should be there.

Or maybe this should be properties that should have or may be about some electrical components like the back light or may be front light or may be the head light or the fog light, they have already specified, this much lumens we need, this should have this much of capa…capability 12 volt or may be 20 volt or may be 35volt and what are the characteristics, exactly shape and size they need.

So that thing they are going to give to their vendors and accordingly those vendors are preparing their particular parts and then they are going to send us to the automobile company and then at the time of assembling, the automobile company are using those kind of parts. So that means sometimes they are purchasing the raw materials as a metal sheet then they are preparing the car

body sometimes they are purchasing some kind of parts as receipt from different vendors and they are using it.

So, when we are floating this kind of tender, so in that particular tender we are exactly mentioning, exactly what we need as per our requirement. The different sub vendors or may be the companies preparing their particular product. Next is called in-process inspection and testing. It is performed when the product is transformed from one process to the next, its purpose is to prevent defected goods from entering the next process and producing the further damage.

Next third one is called the semi finished product inspection and testing, it is performed for process parts and assembles and it does not include the completely finished goods and of course the last one that is called the finished product inspections and testing. It is the inspection performed in the final stage of manufacturing process. In this test whether the complete goods meet the requirements as a product or not in order to prevent the customer confidence, various problems and damage in advance.

So as I told you already, when we are just send out the product from the manufacturing company, it does not means inspection has been finished, No, when the material is going to the customer after shipping after packaging, so after opening the particular product also the inspection continues, not only that, when we are mae..using that particular products after certain times, so we are going to the automobile shops or may be the workshops or may be other persons from the company engineer, they are visiting the sites, still they are doing the inspections whether the machines or the car or may be equipment is running perfectly fine or not. So, inspections is a continuous monitoring process.

Say now for example, for the automobile product line, you can see how we are following the whole inspection process.

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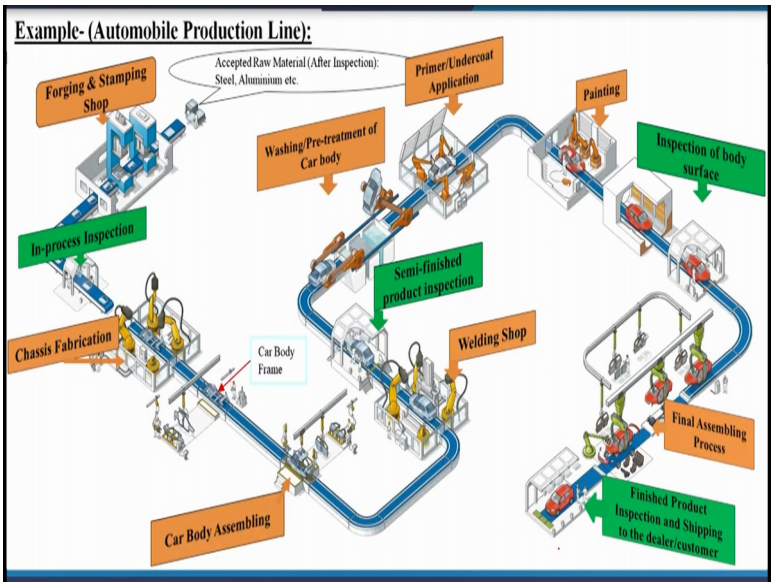

so first in this case, we are accepting the raw material, after inspections like steel aluminum, for the car body or may be the automobile body, then we are doing the forging and the stamping shops, still we are measuring the exact dimensions of that particular products, that is called as the in-process inspections, then we are doing the chassis fabrication over there, so we are making the car body frame, then car body assembling is taking place in this particular case, then after that it is going to the welding shop, then it became the semi finished product inspection in this particular point.

And next after that we are doing the washing and pre-treatment of the car body, then we are putting the primer and undercoat applications, then we are doing the painting, then after that we are doing the inspections of the body surface, then we are coming the final assembling process, then we are doing last the finished product inspection and shipping to the dealer and customer.

From this particular image you can understand only 20%-30% for preparing any kind of automobile vehicles, by this parallelly so many other inspections are taking place, from where we are trying to prepare the engines, we are putting different shapes and hauls and then each and every parts, we are assembling making the engines are coming, then they are putting the engines into the car, all the electrical components are coming.

So, there are N number of parallel inspections and in line production line is running simultaneously for making a particular product, and I can tell depends but generally 10-15minutes or may be 20minutes or may be 30 minutes, it is required to prepare a particular car, from accepting the raw materials to making the final finished products. So you easily understand how meticulously they are following all the steps including the inspections and within half an hour or within an hour, they are preparing the whole car of directly raw material to the final product.

Next is called the how much to inspect? yes of course, now I know that I have to do the inspections, I am going to start inspecting this materials, but I have to know that up to how much I will do the inspections and then where I have to stop.

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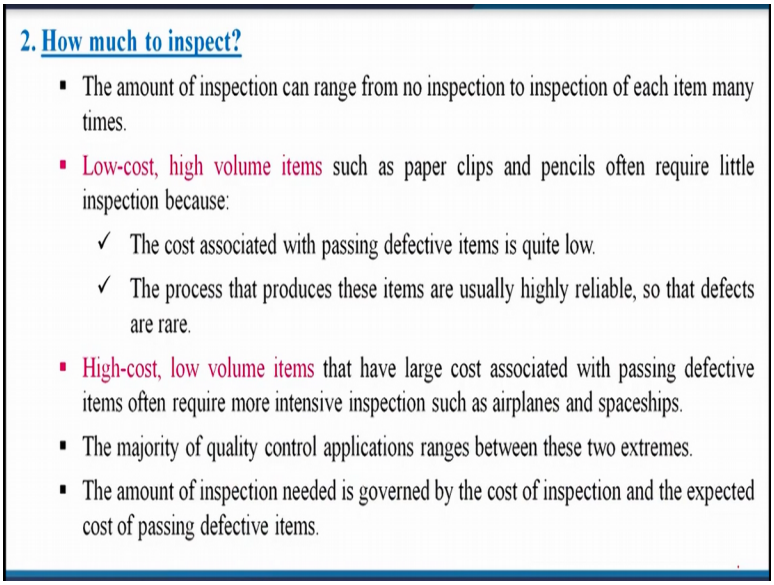

So the amount of inspection can range from no inspections to inspections of each item many times, it may possible, that we are human being, when we are measuring some kind of particular materials or may be parts, maybe there is a chance of error, so what we have to, we have to measure that particular parts or products several times, and then after that we have to take average and then we can say that whether it is exactly the same or maybe there is some kind of tolerance, or may be some kind of default are there.

Low cost, high volume items such as paper clips and pencil often require little inspection because, the cost associated with passing defective items is quite low, yes sometimes we may do not follow if there is any little defects or we maybe overlook those defects, because we know that pencil cost is almost 2 to 3 rupees and so only it is used for writing something that is may be draft work, may be design or drawing, so if there is any fault, so the wastage is very minimum in terms of cost but say suppose for a car of around rupees 10lakhs, 20lakhs, 30lakhs or 50lakhs like that, so if there is any some defects are faults, so for changing or may be for rectifying those defects, you need a huge amount of costs.

So, the process that produces these items are usually highly reliable so that defects are rare. Next is the high cost, low volume items that have large cost associated with passing defective items often require more intensive inspection such as airplanes or may be the spaceships, yes of couse few years you have heard about the Kalpana Chawla, so she went to the space and then while coming back the discovery that has been burnt right.

So of course, at the time of coming they found a small hole over there, they have rectified those problems but they can not, so the problem is that why I am giving this kind of examples is that, each and every time we have to do the inspections, we have to rectify those problems and then we can use that particular product. If we will overlook those kinds of defects, so it may damage the whole product, equipment or it may cause a life threat.

The majority of quality control applications ranges between these two extremes, the amount of inspections is governed by the cost of inspections and the expected costs of passing defective items. Optimal amount of inspections

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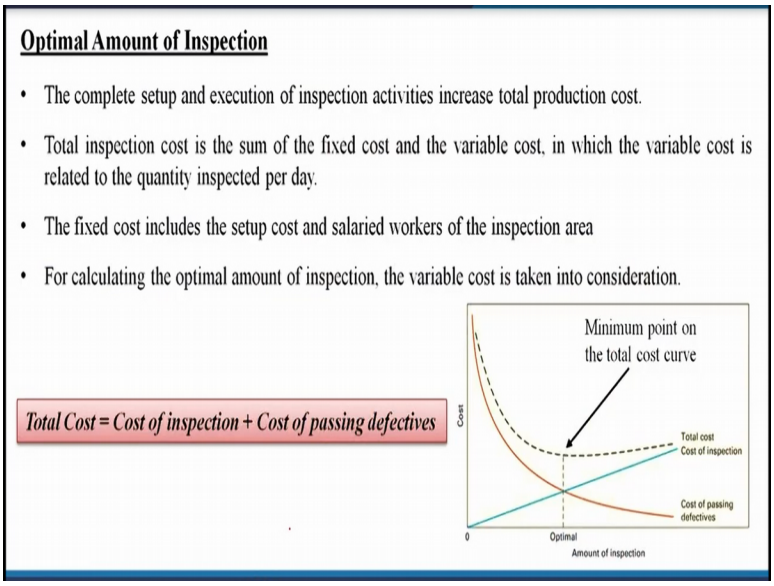

The complete setup and execution of inspection activities increase total production cost, yes of course that 100% true. Total inspection cost is the sum of the fixed cost and the variable costs in which the variable cost is related to the quantity inspected per day. The fixed cost includes the setup costs and salaried workers of the inspection area, for calculating the optimal amount of inspection, the variable cost is taken into consideration.

So, what is total costs, it is cost of inspection plus the cost of passing defects. So, from this particular graph you can understand that when total cost, the cost of inspection will increase if the amount of inspections we are going to increase. Next whether to inspect attributes that means counts or may be the variables that means the measures.

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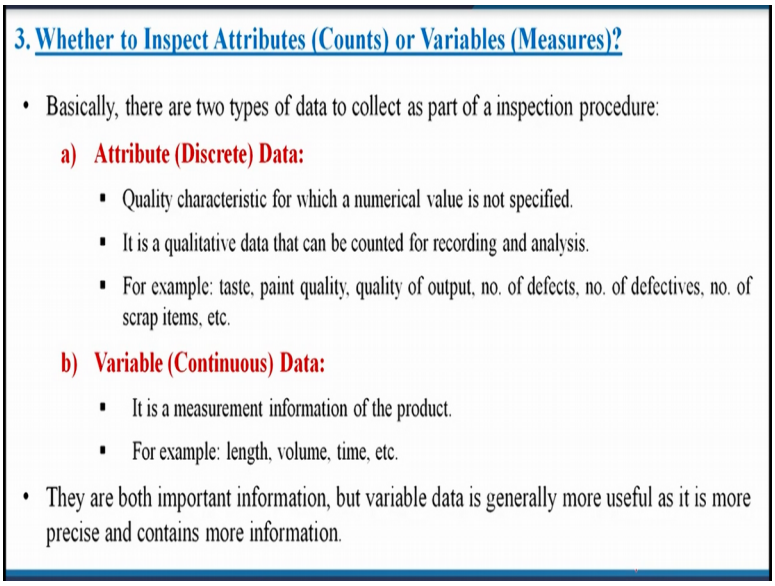

Basically, there are two types of data to collect as part of a inspection procedure. Attribute or may be the discrete data what does it mean, quality characteristics for which a numerical value is not specified, it is a qualitative data that can be counted for recording and analysis. For example, taste, paint quality, quality of output no of defects, no of defectives, no of scrap items etc, and the second one is called the variable which is the continuous data.

It is the measurement information of the product for example length volume time etc. so they are both important information's, but variable data is generally more useful as it is more precise and contains more information. Now what are the difference between the attribute data and the variable data.

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Difference Between Attribute Data and Variable Data:

Attribute Data	Variable Data
Attribute data focuses on numbers or go/no-go information.	Variable data focuses on measurements on a continuous scale.
Attribute data simply classifies the output as defective or not defective.	Variable data tells that how bad each defective product is: 10% faulty, 20% faulty, and so on.
Attribute data is simpler to gather, so it's a good choice if we are looking at a binary condition, for example: • The product works or it doesn't work. • The parts fit the slot or not. • Students pass the test or they fail.	Variable data can tell us many things that attribute data can't. • With variable data trends are seen allowing for allowing for corrective action to be taken long before the product reaches the reject level.
Example:  On or Off?  Broken or Unbroken?	Example:  Size  Temperature

Attribute data that focuses on the number or go or may be non-go information or may be the no-go information. Variable data focuses on a measurements on a continuous scale. Attribute data simply classifies the output as defective or not defective. So simple it will give you the answer of yes and no. Variable data tells you how bad each defective product is, so it will give you a 10% or may be the 20% or may be the 30% faulty or may be the some kind of measurement.

Attribute data is simpler to gather, so it is a good choice if we are looking at binary condition, for example, the product work or it does not work, the parts fit the slot or not, students pass the test or they fail. But variable data can tell us many things that attribute can not with variable data trends are seen allowing for allowing for corrective actions to be taken long before the product reaches the reject level.

Example for attribute data, whether may be the on or may be the off, broken or may be the unbroken, example here is the size or may be the temperature. Whether to inspect in a centralized or on-site location?

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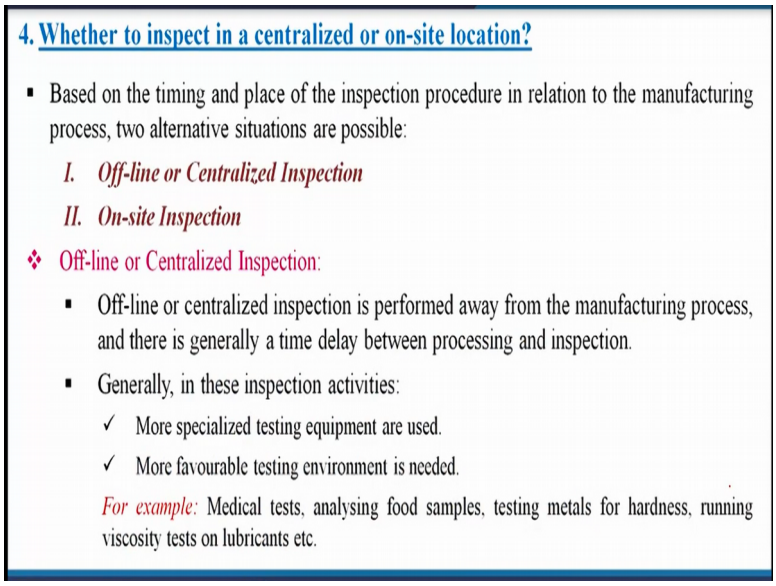

Based on the timing and placed and place of the inspection procedure in relation to the manufacturing process, two alternative situations are possible. First one is called the offline or the centralized inspection and second one is called the on-site inspection. What is offline or centralized inspection, offline or centralized inspection is performed away from the manufacturing process and there is generally a time delay between processing and inspection.

Generally, in this inspection activities more specialized testing equipments are used more favorable testing environment is required. For example, medical tests, analyzing food samples, testing metals for hardness, running viscosity test on lubricants etc so these are test time taking one and not only that we are not doing simultaneously at the time of manufacturing, may be after manufacturing or before manufacturing we are going to do this kind or inspections. But when we are talking about the onsite inspection

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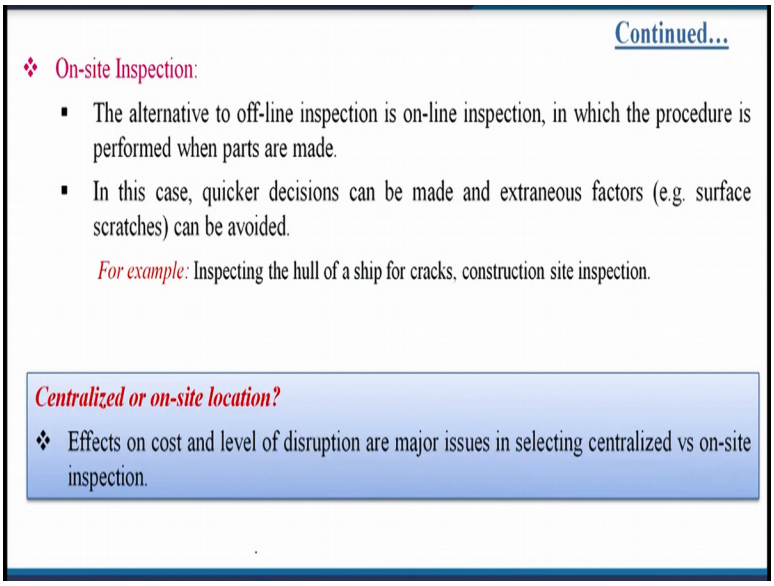

So, the alternative to the offline inspections is the online inspections in which the procedure is performed when parts are made. So, it is a one kind of continuous monitoring of that particular manufacturing process, in this case, quick decisions can be made and extraneous factors example surface scratches can be avoided. For example, inspecting the hull of the ship for cracks, construction site inspection, so these kinds of things, where need the continuous monitoring system.

Centralized or on-site location what does it mean. Effects of cost and level of disruption are major issues in selecting centralized vs on-site inspections. Next come to the very vital thing that is quality, what is quality?

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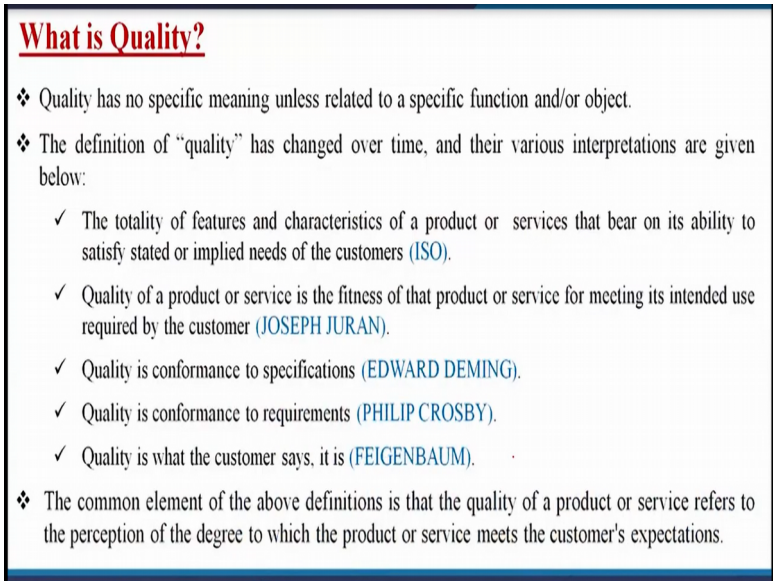

So, Quality has no specific meaning, unless related to a specific function and/or object. Yes of course, that means of course a standard has already been set, so based on that standard we are going to prepare some kind of product or may be the some kind of materials or may be some kind of methods, so anyhow our aim will be to achieve that particular standard. So, the definition of quality has changed over time and their various interpretations are given below.

So as per the ISO, the totality of the features and characteristics of the product or services that bear on its ability to satisfy stated or implied needs of the customer. So this is the technical definitions of the quality, if we take some examples of some quality Guru, so as per the Joseph Juran, the quality means, it is a product or service is the fitness of that product or service for meeting its intended use required by the customer.

As per Edward Deming, quality is conformance to specifications, as per Philip Crosby, quality is conformance to requirements and as per the Feigenbaum quality is what the customers says, it is. So, it is totally defined by us, that means the end user, the common element of the above definitions is that the quality of a product or service refers to the perception of the degree to which the product or service meets the customers' expectations.

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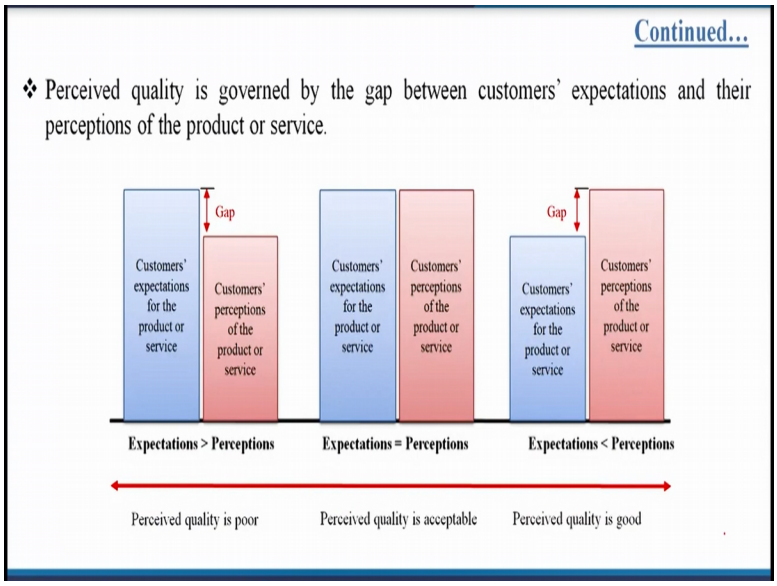

Perceived quality is governed by the gap between customers expectations and their perceptions of the product or service, so if you see expectations and the perceptions, so in this particular case exceptions are higher than perceptions. Customer's expectations on the product or the service, customer's perceptions on the product or service. So of course, there is certain gap. In this is particular case, the Expectations is equal to the perceptions and in this particular case, the expectations is lower than perceptions.

So, if expectations is higher than the perceptions, then is perceived, the quality is poor, when it is equal or may be equal to perceptions perceived quality is acceptable and when the expectations is less than the perceptions that time the perceived quality is good. Next dimensions of product quality

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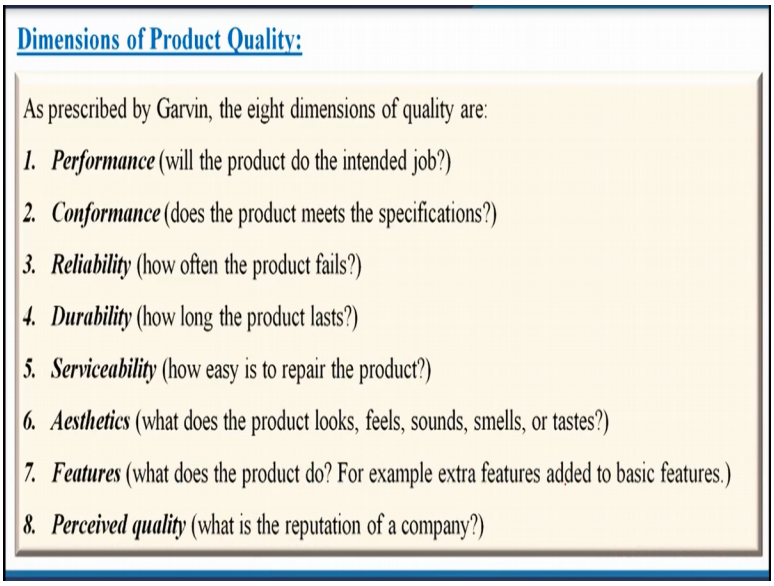

As prescribed by Garvin the eight dimensions of quality are first one is the performance- will product do the intended job? Second one is the conformance – does the products meet the specifications, third is the reliability- how often the product fails? Four is the Durability- how long the product lasts? Five is the serviceability – how easy to repair the product? sixth is the aesthetics- what does the product looks, feels, sounds, smells or tastes?

Seven is the features-what does the product do? for example extra feature added to basic feature. Eight is the perceived quality – what is the reputation of the particular company, that is also the vital one. Because, if there is some good company or may be well established company, we can easily trust on their product, because we are have that mind set, yes that is a very good company, whatever the product they are going to prepare that will be good or may be that product is having may be 100% it will satisfy the customer.

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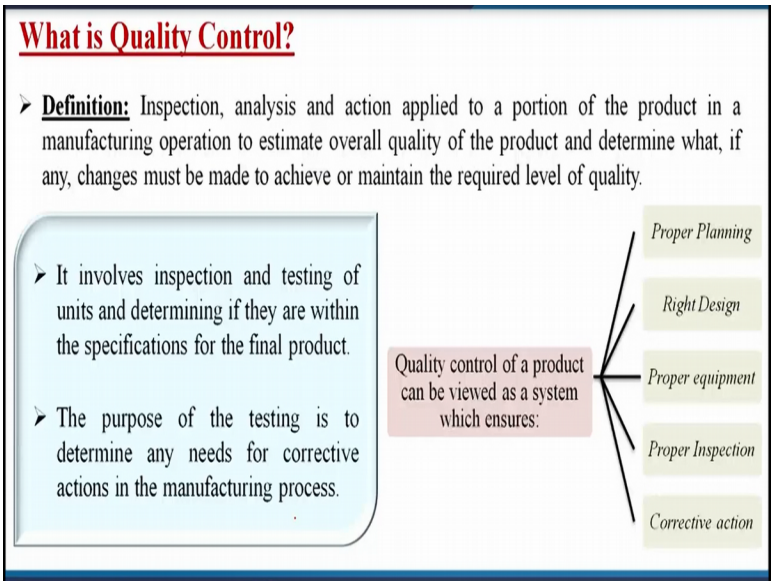

Now what is quality control, as per the definition it means inspection analysis and action applied to a portion of the product in a manufacturing operation to estimate overall quality of the product and determine what, if any, changes must be made to achieve or maintain required level of quality. It involves inspections and testing of units and determining if they are within the specifications for the final product.

Because when we are making any kind of design, in that particular design, you can see that we are putting some kind of plus and minus value, that means we are giving some allowance or may be tolerance, so it does not mean every time my product should be having the diameter of 30millimeter no, may be it can be less plus or minus 0.05 millimeter, so that means there should be a range.

The purpose of the testing is to determine any needs for corrective actions in the manufacturing process, how are we doing the quality control, so the quality control of the product can viewed as a system which ensures- proper planning – right design- proper equipment –proper inspection and the corrective action. Now what are the benefits of quality control.

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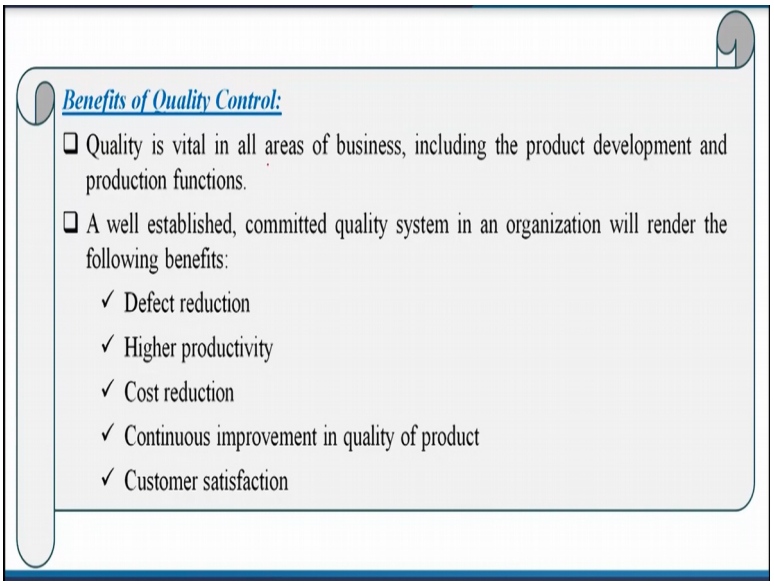

Quality is vital in all areas of business, including the product development and production function. A well established, committed quality system in an organization will render the following benefits, first one is that defect reduction, number of defects will decrease, Higher productivity, yes, the number of items will be more, cost reduction overall cost of the particular product is going to be reduced, continuous improvement in the quality of the product and last one is called the customer satisfaction. Now what is cost of quality:

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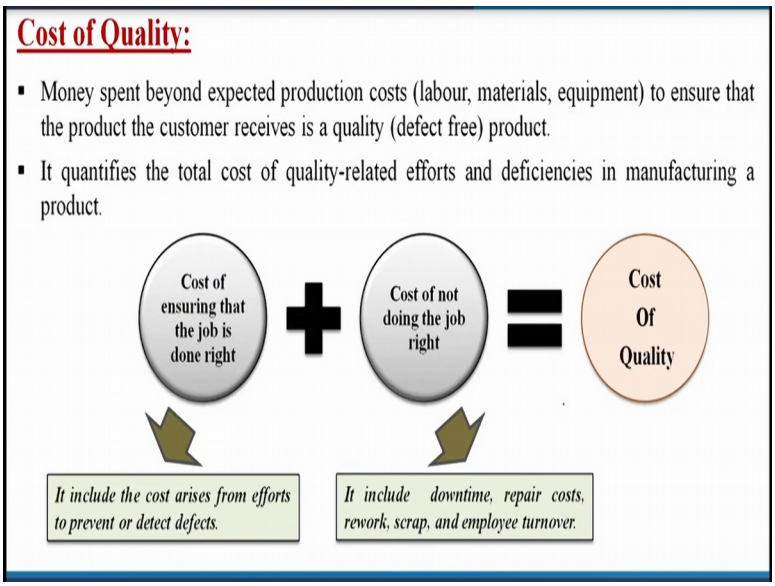

Money spent beyond expected production costs like the labor, materials, equipment to ensure that the product customer receives is a quality defect free product. It quantifies the total cost of quality – related efforts and deficiencies in manufacturing a particular product. Cost of ensuring

the job is done right, it include the cost arises from efforts to prevent or detect defects plus cost of not doing the job right, it include downtime repair cost, rework, scrap and employee turnover. So, if we add this two it will give you the cost of quality. Now four cost categories related to quality

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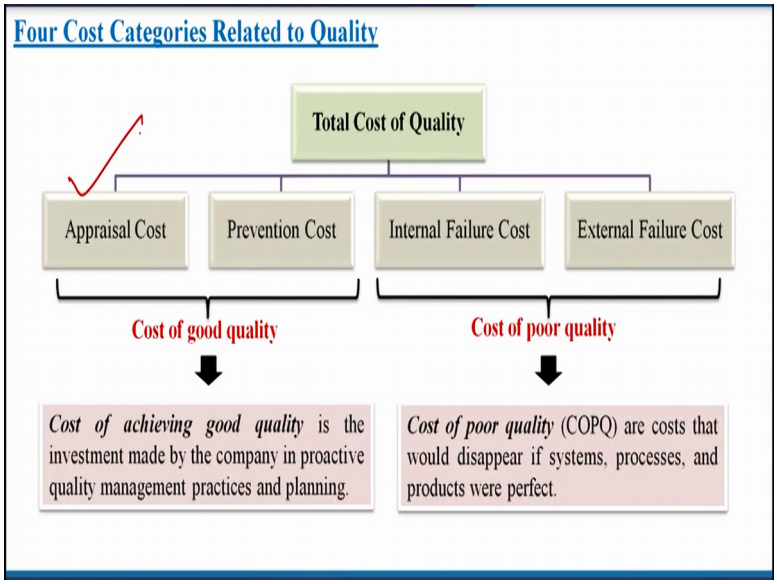

What are those? First one is called the appraisal cost second one is called the prevention cost these two cost deals with generally cost of good quality and next two is called internal failure cost and the external failure cost generally the combination of these two is known as the cost of poor quality. So, what is cost of good quality, Cost of achieving good quality is the investment made by the company in proactive quality management practices and planning and cost of poor quality are costs that would disappear, if systems, processes and products were perfectly fine.

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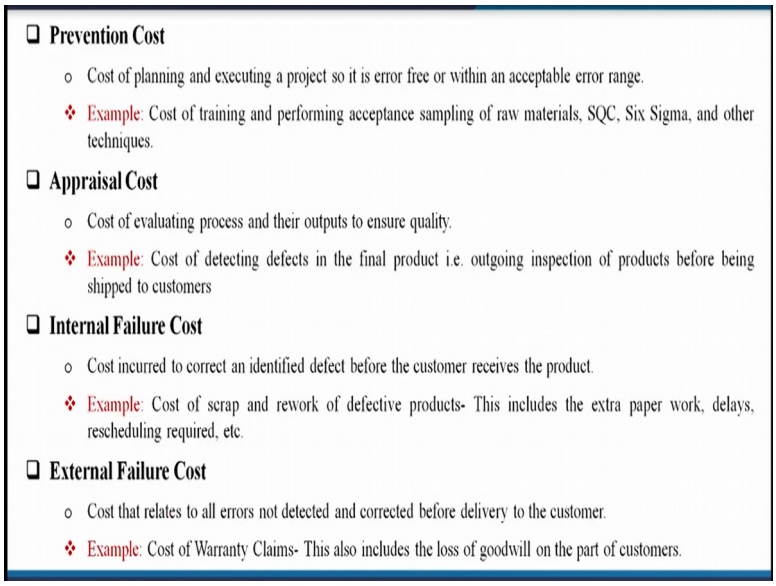

So now what is prevention cost? Prevention cost is the cost of planning and executing and project so it is error free within an acceptable error range. Example, cost of training and performing acceptance sampling of raw materials, SQC, Six sigma and other techniques. Next one is the appraisal cost. Cost of evaluating process and their outputs to ensure quality. Example, cost of defecting defects in the final product that is outgoing inspection of products before being shipped to customers. Next one is called the internal failure cost.

Cost incurred to correct and identified defect before the customer receives the product. Example, cost of scrap and rework of defective products, this includes the extra paper work, delays, rescheduling required or not etc. And last one is the external failure cost- Cost that relates to all errors not detected and corrected before delivery to the customer Example, cost of warranty claims- this includes the loss of goodwill on the part of customers. So, you can see each and every point we are doing the inspection process.

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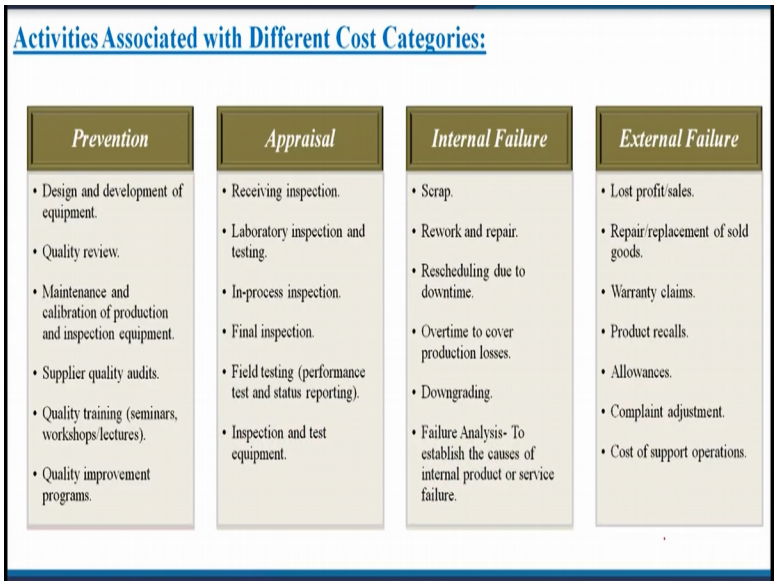

Now activities associated with different cost categories first one is the prevention what does it means design and development of the equipment, quality review, maintenance and calibration of production and inspection equipment, supplier quality audit, Quality training like seminars. Workshops or may be lecturers, and quality improvement program. When we are talking about the appraisal, it is in receiving inspection, laboratory inspection and testing, in-process inspection, field testing and inspection and test equipment.

When we are talking about the internal failure that is scrap, rework and repair, rescheduling due to downtime, overtime to cover production losses, Downgrading etc when we are talking about external failure, so it is a lost profit or sales warranty claims, product recalls, allowances complaint adjustment and so on. Next is the cost of rectifying error over the product development stages.

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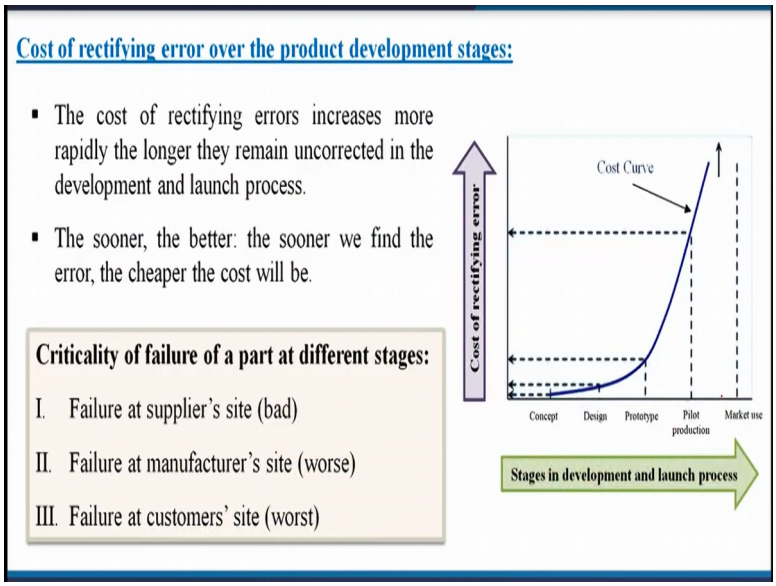

The cost of rectifying errors increases more rapidly the longer they remain the cost of rectifying errors increases more rapidly the longer they remain uncorrected in the development and launch process. The sooner the better, the sooner we find the error the cheaper the cost will be. Already I have discussed. Criticality of failure of a part at different stages, first is the Failure at suppliers' site that is the bad, failure at manufacturer's site that is worse, failure at customers site that is the worst. Next one is that impact of quality management on costs.

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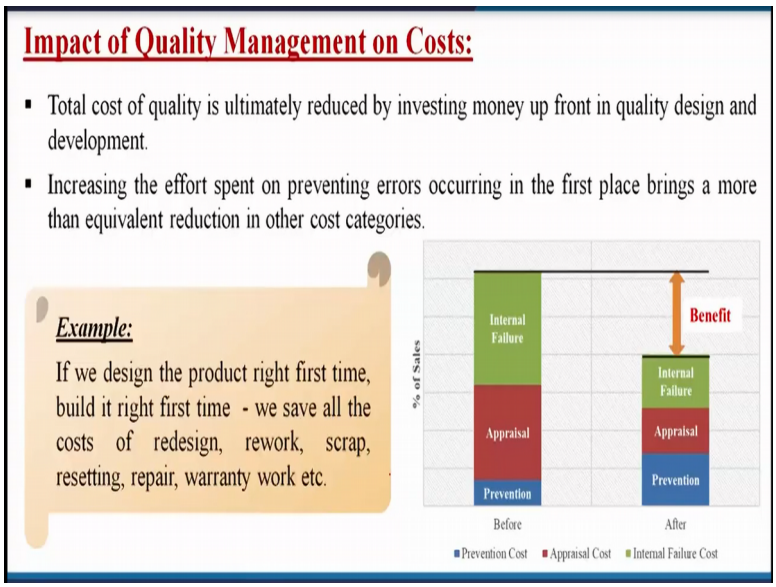

Total cost of quality is ultimately reduced by investing money up front in quality design and development. Increasing the effort spent on preventing errors occurring in the first place brings a more than equivalent reduction in other cost categories. For example, if we design the product

right first time build it right first time, we save all the costs of redesign, rework, scrap, resetting, repair, warranty work etc. So, percentage of sales in the Y axis and it is the before and after so you see how benefit actually, we are getting. Next one is that impact of higher quality on value.

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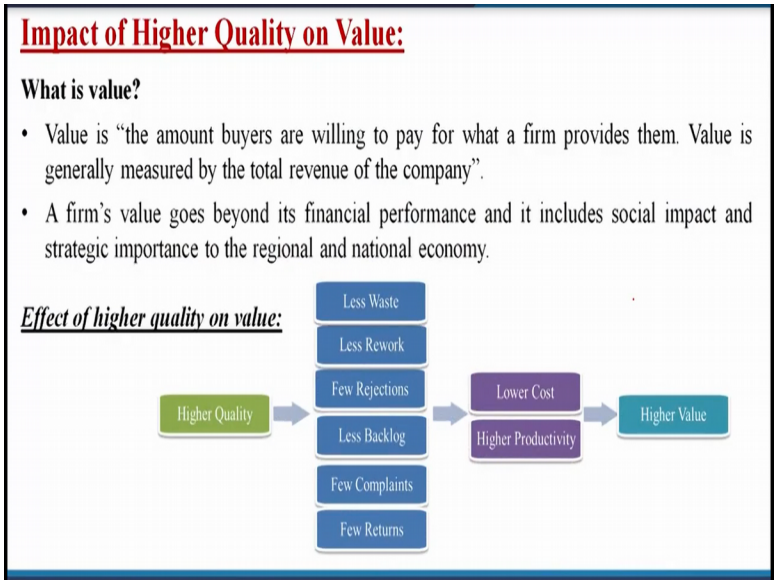

First let us know what is value- Value is the amount buyers are willing to pay for what a firm provides them. Value is generally measured by the total revenue of the company. A firm's value goes beyond its financial performance and it includes social impact and strategic importance to the regional and national economy.

Effect of higher quality on value. What the higher deals, less waste, less rework, few rejections less backlog few complaints, few returns that means it will reduce the cost and it will increase the productivity so automatically it will acquire higher value at the end of the day. Now we have come to the last slide of this particular lecture just we have to summarize the whole lecture in this particular slide.

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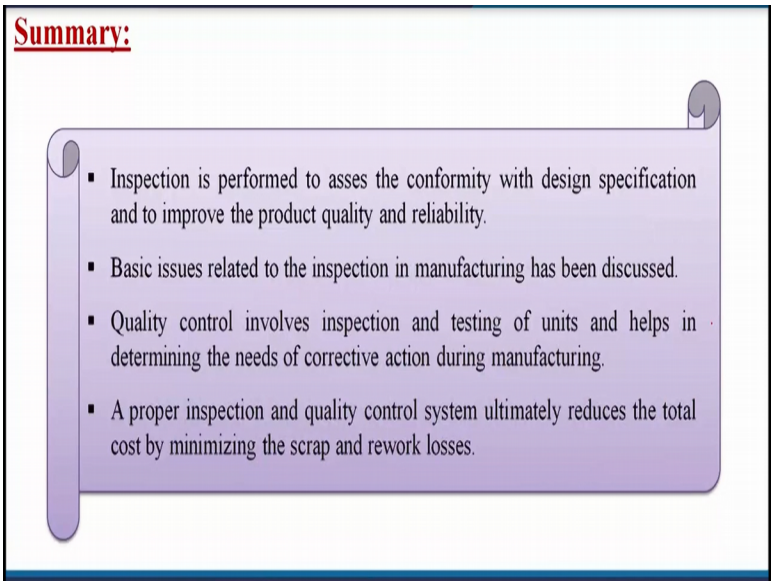

Inspection is performed to assess the conformity with design specification and to improve the product quality and reliability yes of course it is true. Basic issues related to the inspection in manufacturing has already been discussed in this lecture. Quality control involves inspection and testing of units rather I can say each unit and helps in determining the needs of corrective action pr may be preventive actions during manufacturing.

A proper inspection and quality control system ultimately reduces the total cost by minimizing the scrap and rework losses. Thank you very much for your patience.