Manufacturing System Technology - II
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Lecture – 13

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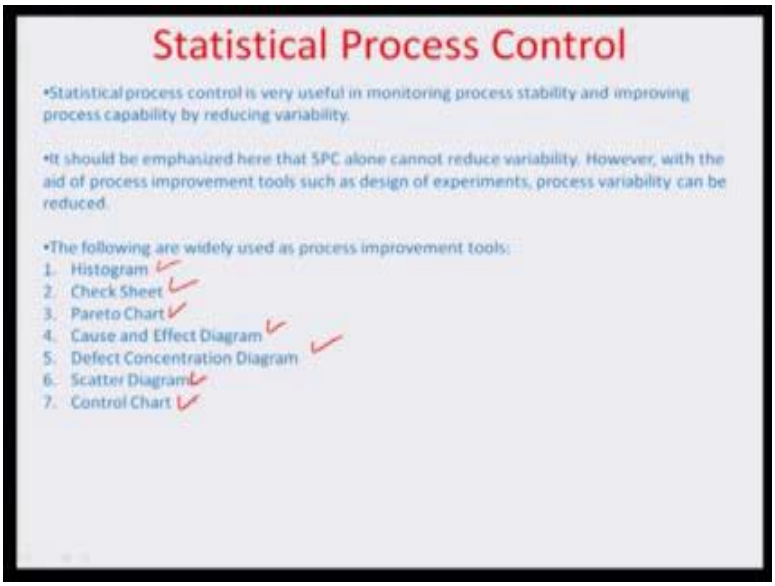

Hello and welcome to this manufacturing systems technology part 2 module 13. In the last module, we had learned in details about the failure mode effect analysis and tried to take realistic situation an automotive paint shop, and try to do an famier based on the realistic nature of the problem on the line, which is concerned with the operators and the supervisors of the particular area. Today we are going to sort of look ahead and see into little more into what are the different tools, and how do you record quality or how do you document quality. So, there about seven tools which exists in this area which are also known as the seven tools of the quality control, and they include the histogram, the check sheet, the pareto chart, and this is all really a statistical good representation of the whole quality problem.

So, that you can add glance take stock of the situation, and see what are the improvements that the situation would need. So, that there is you know final goal of high quality product achieved, you have pareto charts, cause an effect diagram, defect concentration diagram, scatter diagrams, and control chart. So, I am going to look into the individual aspects of all these different systems and give you an idea of what really

the purpose of all these different tools are... So, let us start with the histogram. So, the histogram is a again statistical way of representing the frequency of occurrence of certain, you know product or certain product specification in a production system. For example, if the production system where NC lathe and you are controlling or you are trying to sort of you know produce circular shafts or cylindrical shafts by turning process on design C lathe systems. So, that the shaft would have diameter or record diameter of 1 plus minus 0.05 inches.

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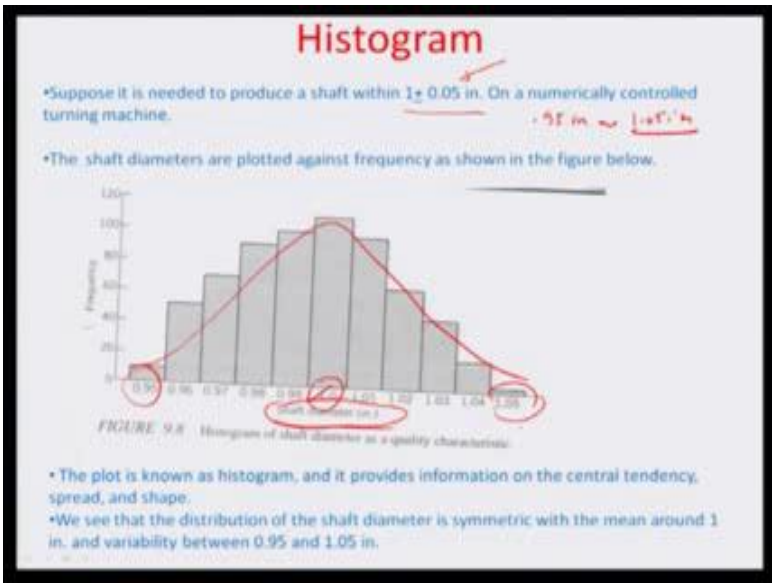

So, really it would be about starting from 0.95 inches all the way to about 1.05 inches. So, when we want to measure what is the process control at this particular nc system, we would need to do measurements number one, and number two is record the measurements in an organized way, so that you can have some kind of a frequency distribution. So, I think this had been covered in the last module that the frequency versus the particular shaft diameter measurement is represented in this particular way, and we were talking about theory plus samples which we were representing for the various shaft diameters, and this way it would provide you a sort of central tendency of this distribution of the, you know total amount of measurements which have been done in the central tendency in this case as you can see is about one inches which is the correct central tendencies.

So, if there is a deviation in the central tendency or even this spread of this distribution the spread b how far away from the mean is really the, you know the two ends of the whole spectrum of the shaft diameters, then you need process control. So, that is how

you represent in histogram the different dimensions.

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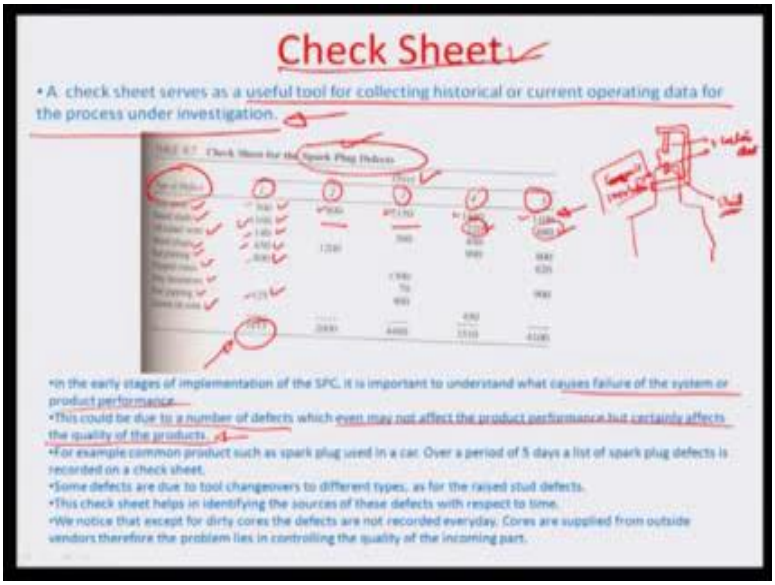

Let us also look at check sheets. So, check sheets are very, very important tool in production control and regular base is you need to, you know fill up these check sheets. In fact, in an automotive shop there is check sheet with every vehicle and there is an inspection done at level of almost 0 defect, where whatever defect has come out, because of the process or the component would have to be corrected before the final vehicle is made assembly. So, that is how the vehicle shops actually go. So, in this particular way in this particular tool the check sheet, it is of the useful tool for collecting historical or current operating data for process, and the investigation I just mentioned about the automotive shops. So, an assembly shop the check sheet is really the mother of all history of the production of the vehicle, this is recorded in terms of the chases number and the engine number, and in fact this is retained for period of almost one life type of the vehicles.

So, that if supposing there is some warranty failure issue which comes up you can refer to this check sheet, and see if there was repair done on the particular vehicle or even you note to an extent of sometimes using that data, towards recalling some of the vehicles which may have potential problems of a certain batch of component being fitted, you must have heard lot of times about Toyota pulling out its vehicles, which have been supplied or even you know some of the other major auto manufacturers, sometimes putting Ambargo on some chases number cut of chases numbers. And then trying to recall that back from the customer because something went un escaped, where they feel

there may be potential thread to the safety of the customer.

So, this kind of tracking bag of production event which has happened way back may be two years back or one and half years back can be possible, because of the check sheet. So, let us look at you know how the check sheet can be made, it is a sort of a recording of the causes of failure of system or product performance, and this can be due to number of defects within the particular, you know product that you we talking about, and it may not even effect the product performance, but certainly effects the quality of the product. So, a common example for example, at the spark plug and so there may be many years various defects in this spark plug like for example, dirty core raised studs of center wire, mixed plugs, bad plating, chip cores, dirty insulators, core gaping, cement on core.

So, if somebody is associated with the automotive windows he will sort of realize this little bit better manner is due to the raised studs, and in spark plug really if you look at the overall tip of spark plug, something you know in this particular manner is what the overall design of the tip of the spark plug is, and n fact in this particular spark plug there is some kind of ceramic insulator, and then there are electrodes which are typically metal electrodes.

And when they are talking about the problem of the raised studs they must be referring to a situation when the gap between the electrodes is uncontrollable, because of the way that the stud is embedded into this ceramic outer or the ceramic insulation housing which has been shown here. So, that is what rates has been mean; for example, you know you can have mixed plugs there may be two or more variants of this plugs going into vehicles, and there is possibility that these plugs get mixed up while getting packed into their packages or they are you know boxes which would be used for transporting this to the from the vendor end to the assembly unit.

So, there may be also problems related to the cores; the cores can be dirty, the cores are basically the ceramic cores that we are talking about here, they can be dirty, they can be also probably chipped, you know there may be some possibility that the ceramic housing is because of the handling issues etcetera there may be broken at certain places and chipped at certain places, there can also be a poor gaping; that means, the gap control here has as you see between the electrodes may be not appropriately sort of you know produced or then there can be some kind of cementing on the core, there are many sort of adhesive cements which are used for putting together the core of the particular spark

plugs. So, that can be one of the reasons.

So, all these different aspects or the different type of defects which are produced you know while manufacturing the spark plugs. And what the purpose for check sheet is really to record that on daily basis for example, if there is some production how many of these defects are getting generated, if it is 100 percent inspection. So, supposing there is final inspection person who are related to this spark plug who is actually looking into the quality of these plugs, you would actually try to tally and record, the number of occurrences of a certain you know particular kind of defect and he is trained to look at these plug and tell what defect really the plug has… So, he is actually the day 1 recorded for example, 500 dirty cores, 1100 raised studs, 140 cases of centered wires of about 450 mixed watts mixed plugs, and then about 800 of watt plating, and then obviously, 125 core gaping. So, in total out of whatever number of is spark plug submit in produced in given day he is recorded about 3115 defects of different kinds.

So, basically now you are clubbing together the defects of certain types and these are mind do the defects which are the most concerning once from the fitment point of you, and that is how a whole check sheet is designed. So, the purpose of check sheet is really to record statistically what is the frequency of occurrence of certain defect, in a tabular manner which you are earlier doing in the histogram manner in probably graphical way or in bar chart of presentation. So, similarly you have similar kind of defects recorded in day 2, day 3, 4, and 5. And you may be seeing that you know on certain days there is some kind of pattern here the rays the studs are typically there on day 1, and this most on day 1 probably, and then you know on day 4 to some extent, and then day 5 to some other extent.

So, probably this stud defect is because either it is towards the end of the tool change, and beginning of the tool change, it is causing this and probably you know around this region let say. So, therefore obviously from this check sheet one can interpret that on day 2, and day 3; there are no raised studs probably the machine which is used to pin the studs and place the stud in to the ceramic core, may be behaving in proper manner during day 2, and day 3. And probably there is some of kind of change over between 3, and 4 which causes again some kind of defect, you know on the 4 which increases, because of some deviation within the machine beyond day 5.

So obviously, this is one of the areas where you have to do some quality improvement

related to the machine may be some fool proofing. So, that this race stud defect does not come in the spark plug. You can also look at the fact that dirty cores. In fact, are recorded that defect every day, and this is probably more of control issue from the supplier and because the cores are supplied obviously by another vendor, and the assembly of the spark plug is from the bot cores from that particular vendor along with the different other components. So, therefore, this is related to mostly a supply issue and you can control the quality of supply by either vendor change over or doing process audit or at the vendor end, so that the dirty cores can actually reduced.

You can also see various other issues like, let say you know things related to of center wire or mixed plugs, bad plating, poor gaping on the day first, whereas some of these defects don not get recorded on day 2 and 3. One of the interpretations could be that the concerned person who is doing the inspection on let say a particular day of the week they he may have he may be over sensitive to recording of the quality, and that is why some of the defects, which are otherwise not recorded on day 2 and day 3 are getting recorded on day 1. So, various interpretations can be possible from this check sheet and then before taking or planning counter measure one has to really look into the process of the inspection who to sort of certain whether the inspection is done on equal basis on all the days or is there parity between day 1, day 2, day 3, day 4, and day 5 of the inspections.

However it is very, very important to gather together this data on regular basis, because this gives you lot of history about how the particular component is being produced and what kind be the process control. So, that the control the quality of the component can be within the control limits, so that is the check sheet.

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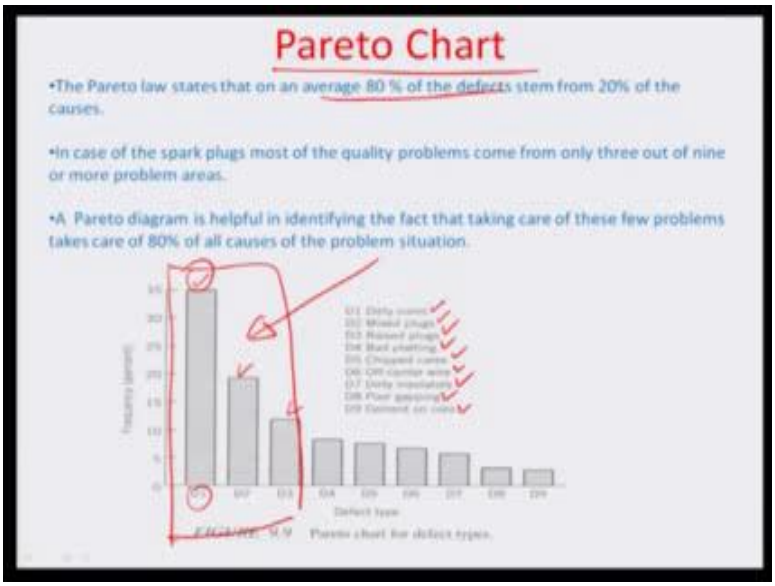

Let us now talk about the pareto chart or the pareto analysis. So, basically it is about identification of the most important or most repetitive or high occurrence defects which need to be controlled in process to have overall quality control. So, typically pareto diagram is also like bar chart, let say for example, if these nine defects for example, what you recorded in the check sheets earlier like dirty cores, mixed plugs, raised plugs, bad plating, chipped cores of centered wires, dirty insulators, poor gaping and cement on core; these all 9 defects are recorded now, in terms of the frequency across one particular week 5 days of week. And you can see that there about closed to 35 percent of d 1 and about 20 percent of d 2, and then about close to 11 or 12 percent of d 3 so and so forth. So, your basically recording defect wise frequency of occurrences percentage out of 100, and then the idea is that once you have recorded this you can identify what are the first 3 defects of top most priority which has to be focused before you know you can, so in order to solve the quality problem.

So, it gives you a sort of prioritization as to what has to be focused first to eliminate. So, that overall level can come down to reasonable level, and then you can actually see if you want 0 defective you can go to the low or once later on. So, it is basically the first priority of the problems which need to be tackled that the pareto chart illustrates. So, you can actually have a good basis of pareto plotting from the check sheet where all these different defects are recorded in different manner. You also have a cause and effect diagram it is also known as the Fish boned diagram or the Ishikawa diagram, this is very important tool towards understanding the real the cause and effect, you know the

relationship between quality problem to happen and the causes there in which would cause this problem to happen. So, typically you have 4 different aspects, which you talk about here. Let say when we are talking about shaft being turned on NC system.

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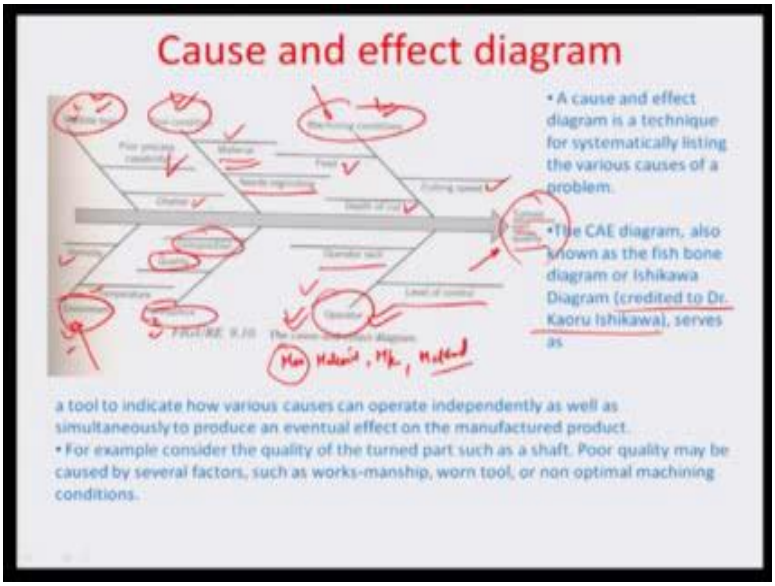

So, the concern here really is the quality of the turned part or quality of the shaft which has been passed through the NC turning process. And there may be many issues related to the turned parts. So, typically you call it the 4 m, the man material machine and method that is how you describe this pareto analysis, sorry this cause and effect analysis or fish bound diagram. So, here for example, if you look at man is basically the operator. So, all things related to the operators skill or level of control that the operator has does he do inspection from time to time of the output, that is coming out of the system is basically a part of the human skill or we can call it grouped under the man cause. The machining conditions and you know the tool conditions as well as the machine tool; these all different aspects are really related to the turning process.

So, if you look at let say the machining conditions for example, is the feed correct is the depth of cut not varying is the cutting speed is also not highly variant, these are some of the things you should investigate for mentioning the quality of the of the turned part. For the material you know in particularly the tool condition the insert condition whether the material is appropriate, it is hard enough to sort of flow on the work piece and trying to create you know a turned component or does it need re grinding. So, that the blunt tool can be again sharpened back, and the material removal can be faster or in more accurate or predictable manner; these are related to the materials side. And then obviously, this the

method side which may include a lot of, you know systems or aspects; for example, is there machine chatter in the overall method which is creating, for example, wobbling of the turned part which may result in some kind of poor surface finish.

We can also talk about whether the process capability of the system is poor, is it really producing the mean distribution of the outgoing quality, which is deviated from the specification mean or may be is the process an out layer completely from the specification which has been given or is the machine really ready to support this specification. Can it have a sigma which is tight enough, you know can it have deviation which is tight enough. So, that it can live within this specification. So, these are the issues which would address in the methods area, and then the methods can also have also some noise factors like the humidity control, the temperature control which is the environment control or even let say the or even the sub part of the material which may include the work piece material the quality of that material or the composition of the material that you are machining etcetera. So in fact briefly speaking you have divided this whole variable factors, which would cause this quality problem in the turned part into man related which is this operator line here.

Material related which can be related to the tool condition and the work piece condition. machine related which is really related to the machine tool conditions and the method related which may include the machining conditions as well as the environmental condition which are noise factors. So in fact, all process defects can be recorded as the Ishikawa diagram or this kind of fish bound diagram and this credited to doctor Kaoru Ishikawa who actually was the inspector for this kind of concept. So, if you have several such Fish bound diagrams illustrating your quality of the part, it is really very organized study as what would be the causes and what would be the effects. So, once it has been distributed as cause and effect, you can sort of try to do process improvements or you know improvements in the methods or improvements in the, let say the man related training aspects etcetera or even the materials.

So that over all the quality problem get sorted out, because of these addressing of the various issues which cause a non compliance of the quality of particular product or part. So, that is how you can analyze the cause and effect. So in fact, we have recorded the histogram, the pareto analysis the check sheet analysis and the cause and effect diagrams. So, 4 important tools of qc. Will again in revisit this problem in the next module when will actually try to lay out the other 3, which are equally important for studying of the

quality control function. So, as of now we will like to end this module.

Thank you.