Manufacturing System Technology - II
Prof. Shantanu Bhattacharya
Department of Mechanical Engineering or
Industrial and Production Engineering
Indian Institute of Technology, Kanpur

Lecture – 17

Hello and welcome to this manufacturing systems technology part 2 module 17. We were talking about the different control charts and in context of that we have float the X chart and R chart as illustrated earlier.

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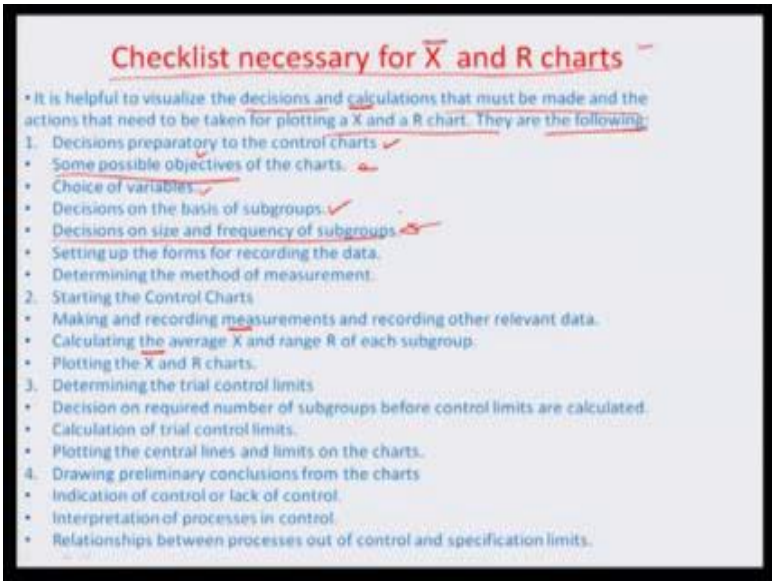

So, let as actually look at some of the issues related to the ((Refer Time: 00:31)) ground realities associated with plotting these X bar in R charts, and I would have a checklist which needs or in which talks about how add the level way are the recording has to be carried out what are the different of aspects that one has to keep in mind before generating this X bar in R charts. So, it is helpful to visualize the decisions and calculations that must be made and the actions that need to be taken for plotting X and R chart they some of the actions are given here. One is the decisions preparatory to the control charts what are those decisions when do you realize to the really control charts needs to be plotted.

So, first of all you have to set some of objectives right. So, for a example you a monitoring a slot width of a milling, you know of a mild product and basically doing face milling operation, and then trained to three or thought milling operation and trained to create a slot within the product and may be one of the observations could be one of the

recording that could be made, in such a control chart in to see whether the particular dimension that has to be plotted is being maintained. And that could be a function of the cutter the way are at which the cutter may sot of the great way or change of the dimension the resulting, because of enough poor machining conditions of may by vibration and charter. So, there is requirement of plotting measurements in that particular manner with the objective of measurement of the slot width of the particular milling systems which is in place.

So, that starts the process you have possible objective I have choice of variables probably the width here the spot width, here is the variable which is the reflective variable of the quality of the process. Then you have to have a decisions of the basis of the sub groups and basically this is really based on what is your average level of production in subgroup size has to be very carefully subgroups basically means that at a enough throughout a production leant. For example, there are that is a 1000 item of having produce you cannot keep on continuously machining everything. So, you have to create small subgroups and between at various point of time during the whole running of the production shift, then will have to keep recording this for the whole batch on time to time. And once you started recording something some observation it has to go on for at least few numbers before you know enough thought of top recording on that particular event period and then go for the next event.

So, there are different event periods like this in the whole production shift, it may be a group of 5 observations, if 5 could be lets a every second or third item on the production line. So, you basically recording every third item 5 times. Let us say the subgroup of sizes 5 and then a weighting for a few you know hours, and then they recording after some more hours the same every fifth every third item 5 times again. So, this kind of a scheme can be develop enough, and that is really based on your practical decision making at the ground root level where you are a supervisor, you want to really associate yourself, you know you have a process knowledge, you know that what kind of variations get happen, what is the interval at which the variations would happen that would really lead determination of the subgroup size. So, there is decision on size and frequency of the subgroups.

So, after decision on the bases of the subgroups, you have also made decision of size and frequency of the subgroup and based on the basis that you have made earlier, and then you set up the forms for recording data. In fact, I am going to show you such a forms just

an about the next line where we can give in organized representation or how this recording of the data can be carried out, and then obviously, you have determining the method of measurement whether it is a related to just for near per caliper, which were inserting in that is slot for measurement or may be something to with the gage that you have build which basically line, and see whether you know particular gage of a certain values going in to through that slot width.

So, many options like these are values. So, once this decisions preparatory to the control charts have been take, and now the question is how to starts the control charts plotting. So, make and record measurements and recording other relevant data, calculate the average X bar for each of this subgroups and the range basically means the maximum observation minus the minimum observations that is the range. So, you have a R bar, you have next double bar, and you have a next bar is the three things X bar is the basically related to whatever subgroup size, you have let us say your 5 sub group size what is the mean value of that particular subgroup and subgroup and R is basically the X maximum minus X minimum in that particular subgroup.

And then you have a many R values of the different subgroups you have measured along our production shift and you have many X bar values. So, mean of means that is X double bar is basically the overall mean of the whole shift and the different range values can accumulate other to form a range bar or a R bar, which is the sort of a mean range enough of the subgroup of event that you are monetary. So, this is how your trying to make extensive observations in a relevant manner, which enough probably you are lining with a thought process on the observation that you have already mean you probably are aware of the cycles as the supervisor, where there may be a chance of defective.

So, your sub grouping and your interview of the grouping will be based on that experiential bases or that experiential domain knowledge. So, it becomes very accurate sample enough based on that experience. So, you have to really as a supervisor provide this measurement, and the subgroups on the very honest and a integrated in manner, and you should be able to justified why you are doing a certain groups size a certain frequency of the group size in terms of the possibility occurrence defects enough which you may see over a large time or rise of time to time. So, plotting the X and R charts is the next you know machine.

So, you have calculated the average X bar you calculated the range for a subgroups, and

you have to make limits, and I am going to show this to you how the limits are being formulated, and there was limits are there, then you keep on plotting the X bar values for each subgroups forever for may be a longer time rise. And for period of let say 30 days enough for cross the whole month once the average has been more or less certain and the upper and lower control limits are defined. So, I am going to go to that step little bit a later when we talk about more the upper and lower control limits, but as of now let us look at what are the check list.

So, then the other once is determining the trial control limits, this is really at decision which is required based on number of subgroups that you have found out before the control limits are to be calculated, and there is a procedure with which we calculated. And show you there how these enough there standard tables which we have to refer to based on let say the group size, you know are the frequency and there are various constant factors which are a associated with that a standard table which will tell you about the how the control limits can be place to the respect to the in the mean of means; that is X double bar and the plotting the central lines and limits.

And then the idea is the that all observations that you are recording would keep on continuing to be between these 2 limits and the central line, and then you can give an estimation of whether process is going to what is one side of the mean to the other side of the mean are away from the control limits. So, all these things can be judge. So, if you have a continuous monitoring of the quality this is the best basis, and whenever there is something going outside the one, the upper control limit or lower control limit. You can say the process is going add of control and take a counter measure. So, that it can come back to normal levels then you have drawing of preliminary conclusions from this charts rights. So, and that also we will to do for a particular example problem. So, it can indicate either a control or a lack of a control, it can indicate or interpret the process which are in control, those are which are out of control where we can change the focus from in control to odd of control process.

You can also have relationships between process out of control, and specification limits very important for measuring process capability, where such of the system machine is producing some abnormal enough range of products with mean which is probably of centered and it... So, happens of the specifications are sort of a specifications are given the design is within the limits that are being setting for the production process of there, you may end of the producing more defectives in that way, so will have to do something,

so that you can control back to normal.

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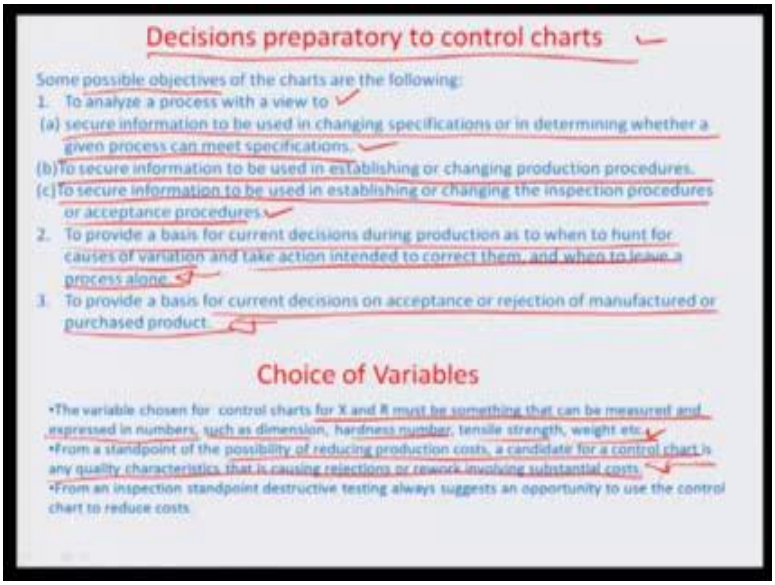

So, that is regarding checklist in a necessary for a X bar and R charts. Let us look at decisions preparatory to the control charts will have to have some objectives possible objectives lay out. First of all you have to analyze a process with a view to secure and information to be used a changing specifications in determining whether a given process can meet specifications or not. So, there has to be view of that.

So, basically if you view of manufacturing process is giving going to out of bound critically economic decision has to made whether the machine needs to be change or whether the designs specifications need to be revised. So, that the process being the same can be we can having more expectability rate. So, these are some of the management issues which are invalid, it has to be very seriously done, that is very important. So, again to secure information to used in establishing or changing production procedures to secure information to be used in establishing or changing the inspection procedures or acceptance procedures. This is some of the enough possible objectives that could be lined up for describing the analyses process behind control chart, also you have to a through a control chart to provide basis for current decisions during production as to enough really the time period to when you have to hunt for the causes of variation, and take action and then also check whether the action.

So, just has been implemented and because which the process comes in to control again, and then obviously you have to provide basis for the current decisions on acceptance or

rejection manufactured or purchased product where few are end customer from a vendor, you can public screen of those which are fealties post to those lots to which are... So, this is again other very important aspect enough, which can be possible objective for a chart or control chart. So, regarding the choice of variables the variables chosen for control charts for X and R must be something that can be measured or expressed in numbers, it could be dimensions, it could be hardness number tensile strength parameters weight; these are all numbered quantities, as you can see these of a quantity which we can daily measure, and from a stand point of the possibility of reducing production costs a candidate for a control chart is any quality characteristics that a causing reflections or rework involving substantial costs of that decision making is really your business enough, you are the process on your associated with the daily maintenance enough production activities related to process, you are the best judge really comment about what are those perennial causes that could be done by the peritoneal dialysis, some other analysis is are mention before which would lead to the rejections at the rework.

And particularly those where is substantial coast are in ward, because of rejection and view are those are the sort of enough points which you could pita terms of measurable quantities which you, then in to control enough using the control chart logic. And also from an inspections stand point destructive testing always suggests an opportunity to use the control chart to that is costs enough don not want destroyed, all the products which are being made we have to do that on the sample basis. If you have a like for example, ultimate yields strength of material, you cannot really get this parameter without coming to destructive sample, so the production process all the samples are measured, you not going to have anything at the end of the day.

So, therefore on a subgroup basis or on a certain frequency basis, if we could have a sample to probably which could be one percent of the whole production large, and if the sub grouping and the timing of the subgroup selection is then in a propagate manner, this one percent to be able to give you a fair estimate of the whole population. So, that is again how the choice of award of that is again what condition, you should sot of keep in mind while choosing the right variable associated with the control charts.

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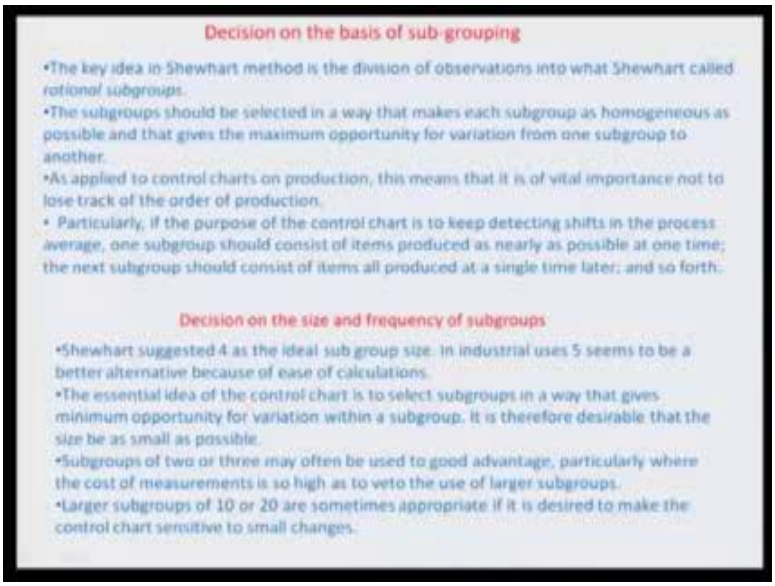

So, once you have this, all the parameters the question of the, what basis to be followed for the sub grouping needs to be picture. So, enough this really idea is first time it was a posed by Shewhart who enough the key idea behind this methods just by Shewhart is the division of observations into so called rational subgroups, and the subgroup should be selected in a way that make such subgroup as homogeneous as a possible, and that gives the maximum opportunity for variation from one subgroup to another as a something which we have to really group is the supervisor.

So, what points of time we have to make the observation. So, that you have good homogeneity during one section of subgroup collection the movement you change to another time domain in another subgroup, there is some variation enough between the subgroups. So, these give a very good estimate of the actual health of the process. So, as applied to control charts on production this means that it is of vital importance not to lose track of the order of production, because control chargers only an assist knowledge. Remember that the final goal is really the output of the production control chat can only be a domain information collection system, which should not really (( )) the main cost which is really the high level of production at the particular centre.

And if the purpose of the control chart is to keep detecting shifts in the process average one subgroup should consist of items produce as nearly as possible at one time the next subgroup should consist of all the items of items all produced at a single time later, and so forth. So, that with time also you have could space in all those subgroups than come the decision of the size and frequency of the subgroups Shewhart when he did his control

chart is experience. So, just 4 as an ideal subgroups size, but enough in industrial uses 5 seems to be a better alternative, because of the ease of calculations particularly enough talking about a coded variable analysis. So, that the competition reduce you have just seen in the last lecture about a coded variable can be done multiply of 5 or 10 is always a better calculator or a easier calculator in comparison in to may be a sort of a group size like 4 or 6 enough.

So, the 5 seems to be better although 4 was considered to be an ideal subgroup at that time the essential idea, the control charts is select the subgroups in a way that gives minimum opportunity for variation within a subgroup. Therefore, desirable that the size be as a small as possible of the subgroup of 2 or 3 may often be used to good advantage particularly, where the cost of measurements is very high. So, you know you can safe some cost by creating a smaller subgroup size only thing, you have to be worried about is that subgroup size has to be representative of the population. So, that something that is really the challenge that supervisor of a line faces, who is actual doing this recording, and that is way are the experiential domain knowledge comes and a picture of a direct association with the process of the coincident process.

So, the larger subgroups of 10 or 20 are sometimes appropriate, if it is desired to make the control chart sensitive to small changes, but generally the principal followed are publish subgroup of not more than 5 words of... So, based on that now you have the size frequency, you have all the other decision criteria like the basis of this is sub grouping the check of selections the charts of variables.

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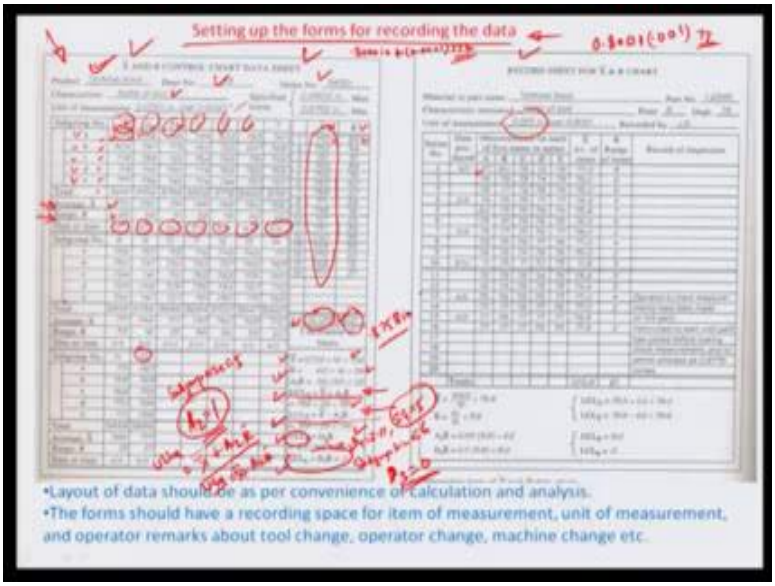

Now, you are already to record the data. So, let us look at the ideal form for recording the data, you have to display this typically add to the production center way are things are being continue, and they are enough particularly when you talking about a process related control chart. So, you can see that in one page which we can probability this play somewhere down the line enough in the place which is the production center, you have to measure and recorded all and for doing that in this particular case. For example, they are measuring the width of a milling slot as I had already told you enough, and this in fact some information which is been supplied by a line of company or they talking about a terminal block which is a actually a more of an electrical component, and there are some fit issues figures like the department number the order number so on so forth, but then you can actually see how detailed description can be made in some of these representations, they given in unit of measurement which says that this 0.001 inches over 0.8000 inches; that means, typically what you are doing is that you have made the same coded variable analysis, you have made all these values that you can see here are reported as 0.8 plus 0.0001 times of the value that is in question. So, basically this actually represents 0.8772, this0.87756, this also again 0.8756 something like that.

So, the coded variable here is really that it is 0.800 inches plus the factor which has been given 0.0001 inch times of the observation which has been recorded, and this is the easier where other than writing decimal place and writing the whole values a trying to have a could it variable in to picture. So, this is how you late how you can see there are different subgroups here for example, there is subgroup one subgroup 2, 3, 4, 5, 6 enough there are about close to 16 subgroup may be, these are based at certain is tenses of time. And you can look at the subgroup number you can see that there are already exactly 5 elements is subgroup a to e and they recording is taking place at different points of time, and you have a option of calculating the average by calculate the total. So, you have group average which is been calculated we have a range, which is actually represented by on the minimum minus on the maximum minus minimum observation and then you have the date or time of the recording.

So, here for example, you have for example, the date or time given here is you know seventh march. So, there are three subgroups on seventh march three on eighth march three on ninth march. So, basically it is three groups every days three subgroup everyday of production for a period varying between third march, all the way to sort of second of April. So, you have completed like a one month observation here in this particular

control chart. So, having said that now you can actually see that there is a option for X bar and R. So, all the X bar is here which are reported on this particular enough average X bar and R range, R range have been replicated here again 770. For example is the first average of the subgroup and the range there is 85. So, the reporting 85 and so this way between 1 to16 days that the recording has taking or 1 to 16 subgroups at the recording as taken place you have the various X bar and you have the various ranges. So, the total of all X bar on the total of all ranges from that you can calculative average by just dividing it by 16 the number of subgroups, and that way you can calculate what are the X double bars and R bars; that means, the mean of means basically 12 129, the submission of all the X bar divided by 16 which comes out to be about close to 758, which is meaning to say that the mean of means has the mentioned 0.8758 of an inches. And then the R bar has the range bar has standard out to be 39, in this particular case it is the submission 621 of all these different ranges divided by the number of the subgroups.

So, having said that now you have to go back to the sue word control method way are they really talk about the factor which are a associated the plot the exchange. So, typically; there are 2 control limits that have to be set one is the upper control limit of X, and other is the lower control limit of X, and I am going share that able with you little later among the process, but as of now you just think of it this manner that based on the subgroups size that you have a obtain you can actually select the a 2 value, and a three value as you can see here the enough the 2 value basically, which is you no giving the upper control limit, if you plus X double bar plus a 2 R bar. Let us just look at this u c l X value here you have a X double bar plus a 2 R bar, and you also look at l c l X value here a X double bar minus a 2 R bar. It is very clear from these expressions that the enough the u c l X bar, and the l c l X bar R coming out to be corresponding to a subgroup size of the 5 of the a 2 value is actually one and that is given in the Shewhart table and I am going to share that table later on.

So, subgroup size 5 subgroup size 5, it 2 is 1. So, the plotting happens X double bar plus a 2 R bar as the upper control limit u c l X and X double bar minus a 2 R bar as the lower control limit l c l x. So, having said that these are how the u c l X in the l c l X bar various, and then we will also have the u c l R right, which is basically the upper control limit of the range charts. So, you have a chart describing the ranges when you have a charts describing the X values of the quantity the measurements, so here when you do a subgroup of less than 6. Shewhart method says that for subgroups size less than 6 the b 3

which is actually recording the lower control limit is actually 0. So, half of 6 there is a always a lower control limit for the range, which comes out be picture, and these are simple statistical observations which have been recorded is a chart out of many such control charts to see is the process in control are out of control.

And than the before value is here recorded has 2.11 in the Shewhart control chart corresponding to a subgroup size of 5. So, these d 4 is recorded as 2.11 and. So, you can have a upper control limit for the range and the lower control limit for range in this case because is a subgroup is less than 6 is equal to 0. So, this is the whole control logic behind plotting the control chart. Now you just have to enough draw the mean value the upper control limit and the lower control limit, whether it is range chart of the whether it is the X double bar chart, and these 2 charts typically are graphically plotted in one paper.

And then all you need to do you is to have your subgroups of observations beyond this periods enough this period as been used is the basic period for calculating the control limits, but beyond this period also this production exist. So, you need to just keep on plotting an extending the various mean, and the range values an similar manner the only thing you need to change is to sot of change this record form a every time from a month, and probably between April and may you will have another form between may and June, you have another form between the same date has have been given and for these period the extension of the mean and the control limit kind of goes where as the separate points which you are generating for each month recording is being extended on the same line. So, you can have a very quick plans over a time origin range of 6 months of a 7 months of quickly save whether a month production is going out of limit or not an accordingly take a counter mention.

So, that is how you do the control chart X bar and R control chart, I am going to show you the plot and the just little bit later, you can actually also do this in a little different manner by saying that, now you do not want to create situation where you have a third digit of the decimal you have a created second digit of the decimal. So, you say that this can be represented in the coded manner is 0.800 plus 0.001 times of whatever is the value recorded here you a recording only 2 digits of the decimal. And in the similar manner you can have a little bit lesson accurate analysis for doing this plot width measurement.

So, the only issue here is that there may be here slight problem, in this over all in that is supposing, if the operator for gets to enough look at the temperature of the particular work base enough after billing process is over, it is always that the work pieces over heated and because of which there is dimensional leaner dimensional like expansion. So, he supposing the operator who is recording this if he accidently for gets to take that in to issue, there may always be a under size enough, because the part would have extended along the slot, and there would be always tendency of the slot would lesson in width. So, that issue he needs to understand; obviously, the supervisor was a controlling authority who is decided the sub grouping etcetera has to have these over view in mind and at the place where this milling slot his being produced.

So, you think of a width at the process is clearly divided in to... So, many such milling drilling different kind of machining operations of even fitment operations, but the same logic and can be use that every level of the whole production system. So, having in said that I will probably like to close on today's module in the interest of 9, but we will go head and see some of the associated issues about what is the control logic that is use to interpret something about the process. So, that you correct action taking may be taking. So, we will do that in the next module.

Thank you.