Manufacturing System Technology - II
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Lecture – 05

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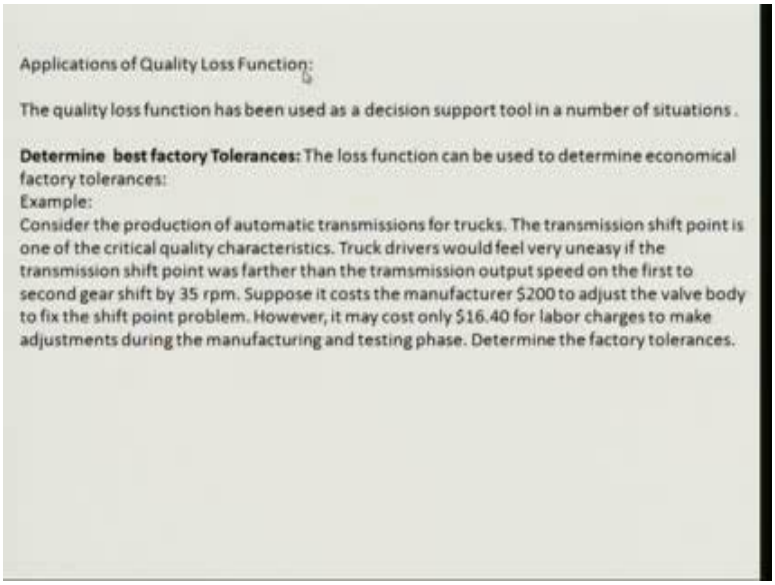

Hello and welcome to this Manufacturing Systems Technology Part two - module 5.We were talking about the average quality loss and tried to desire for a three different cases as nominal the better, smaller the better and larger the better in each case we calculated a separate average quality loss. Let us look at a different module now where we are actually applying these quality loss functions to have some kind of a management decision regarding the process selection or may be the tolerant setting related to a certain process. So, this is a situation which has been a described here about automatic transmissions you know and the production line associated with that particularly for trucks.

So, let me just comment that at this particular time that all of you are probably aware of automatic transmissions. These are for particularly you know giving user comfort to the driver and basically there is an auto gear changing associated to correspond to certain rpm ranges. So, there is a obviously, the gear gets automatically shifted from first to second to third whatever based on whatever is the rpm range, which is set as a cut off. So, it is really very disturbing for the driver particularly when this does not happen in the

intended range and happens a little bit beyond. So, this is a very uncomfortable situation and particularly in heavy vehicles like trucks etcetera. It is imperative that the changeover of the gear takes place at the right rpm range whatever has been setup or whatever is a target value and whatever the driver is used too. The moment that happens faltering back there is obviously, a pressure on the driver about getting more fuel or less fuel in the system from time to times so that it the vehicle can operate smoothly.

So, the transmission shift point in such a case is one of the very critical quality characteristics and this situation is about the transmission shift point determination really. So, let say we have a case with truck drivers from user research or customer survey, it has been found would feel very uneasy, if the transmission shift point was taken farther than the transmission output speed on the first to second gear shift by 35 rpm. So, we are now talking about exceeding the rpm range intended rpm range for the first to second gear conversion - auto conversion by shifting this point to 35 rpm ahead. So, it is very uncomfortable for the truckers if it happens 35 rpm or beyond.

Now, supposing if you look at the manufacturing cost of how to repair this in the market ((Refer Time: 02:54)) how the cost would be executed at the production level if some quality check point or some adjustment is done, before the transmission gets produced, it has been found out that the cost to the manufacturer is about 200 dollar to adjust the walls body to fix the shift point back to normal, once this shifting has happen beyond 35 rpm. However, if we look at only the in process development the only thing we need to do is to sort of attach a cost of 16.40 dollar for labor charges to make the necessary adjustment during the manufacturing itself. So, that this problem does not go out in the market and it does not bother the customer any more. So obviously, we will have to determine what is the factory tolerance which is a going to be setup in a manner so that, this plus minus 35 rpm is never exceeded and the truckers always feel easy because of that.

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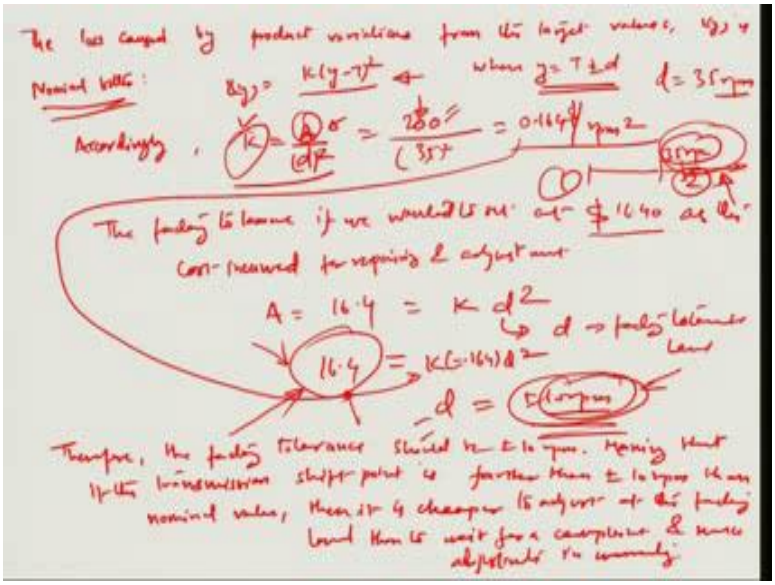

So, let say in this particular case, the loss caused by the product variations from the target value let say l y is given by the function y minus T square obviously, it is nominal the better case you have to remember that the question is, how much are we on the target or how farther we are from the target which causes degree of, uncomfort in the user who is the trucker who is actually operating the particular system. So, this is where particularly the limit of rejection of this particular you know sample is that for cases where it exceeds 35 rpm plus minus we want to sort of reject those kind of cases.

So, accordingly the A Q L can be calculated and you can assume that the unit cost lost because of this whole target going away by more than d value from so that it crosses the usl and lsl so that in this case is about two hundred dollars because; obviously, it means that this much cost has to be invested once it goes beyond the 35 rpm range which it is intended to you, remember the d in this case is 35 rpm. So, whatever be that range over which the first to second gear shift would automatically happen is not shifted by a maximum of 35 rpm beyond which and this particular region the trucker feels really uncomfortable. So, we can say that this divided by square of 35 is actually going to give us a loss constant K where in this case it is 0.164 dollars per rpm square so, that is what the last constant is in the particular case.

Let us look at the factory tolerance side. So, the factory tolerance, if we wanted to set at 16.40 dollar as the cost incurred for repairing and adjustment, so obviously, in this particular case, following again the nominal the better type the cost a which is 16.4 dollars gets equal to K times of d square where this d would be the factory tolerance

level. So, even find this out very easily by borrowing the K, because the K are the last constant characteristic does not change in this particular case 0.164 times of d square, and d becomes equal to plus minus 10 rpm. So, in order to ensure that this 35 rpm is not crossed over; you have to ensure that a very tight tolerances of ten rpm is introduced in the factory level and there is some adjustment which is also taking some cost.

So, this is really the loss which is happening because of this adjustment, but you can understand that loosing 16.4dollars is much better than losing this 200 dollars here. So; obviously, the tolerance design now which is a decision that the management has to be taking is much skew would if you talking about the in process or factory management kind of a situation. And if you provide the tolerance to be plus minus 10 rpm then the rpm range that you are considering where the truckers starts feeling uncomfortable then obviously, there are not many cases we should go into the market where it will cross over the 35 rpm limit where really the truckers starts feeling uncomfortable so that is how you can design the factory tolerances.

So, I would say that in this particular case therefore, the factory tolerance should be plus minus 10 rpm which means that if the transmission shift point if farther, then plus minus 10 rpm then the nominal value whatever has been given in the particular range of rpm, then it is cheaper to adjust at the factory level then to wait for a complaint and make adjustments and warranty. So, in a nutshell that is how we basically doing the designing and planning of the tolerance related to the transmission system.

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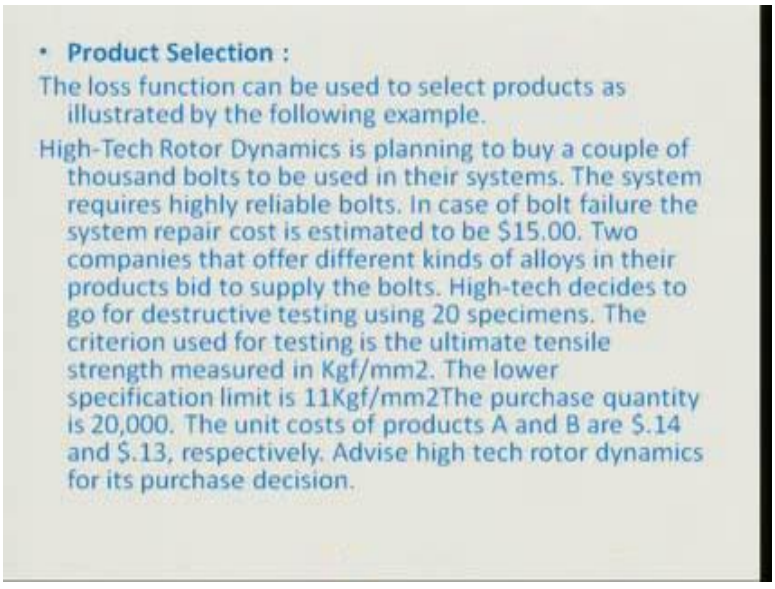

We have another problem example which I will described here; here also the same loss function analysis can be used for doing a selection decision about two or more parts. Let say there is this fictitious company High-Tech Rotor Dynamics which is planning to buy a couple of thousand bolts which are to be used in their systems. And further the systems require highly reliable bolts; in case of bolt failure, the system repair cost is estimated to be about 15 dollars. And two companies that offer different kind of alloys in their products bid to supply the bolts. Here you know are sort of considered in this process of elimination and selection.

And the High-Tech Rotor decides to go for destructive testing to see whether both these suppliers are equally good or bad or one of them is better than the other, and it uses about 20 specimens to do that. So, the criterion used for testing is that the ultimate tensile strength measured in kg force per millimeters square should be some value of this particular bolt; obviously, because it is a ultimate tensile strength this is a case where it is simply the bigger, the better or the larger the better case. So, in this case we will have to use that analysis for our final specifications and measurement etcetera. And the lower specifications limit in this particular case is 11 kg force per millimeters square which is the minimum limit that should not be crossed over so that that becomes serious problems you know, and impose the serious problems to the particularly Rotor using these bolts.

And further, it is available that the purchase quantity is about 20,000 units of these bolts. And unit cross of products from A and B - two sources are given to be 0.14 about 14 cents and 13 cents per bolts respectively, so about 0.14 dollars and 0.13 dollars respectively. So, let do advice now, we will to make a management decision what would it use for its purchase whether it is bolt B that they would refer or bolt A that they would refer. So, we are towards the end of this particular module though, but in the next module, we will try to a look at the data for all these different 20 specimens and their test values and try to take a management decision based on our average quality loss calculated.

Thank you.