Manufacturing Systems Technology

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Module - 04

Lecture – 21

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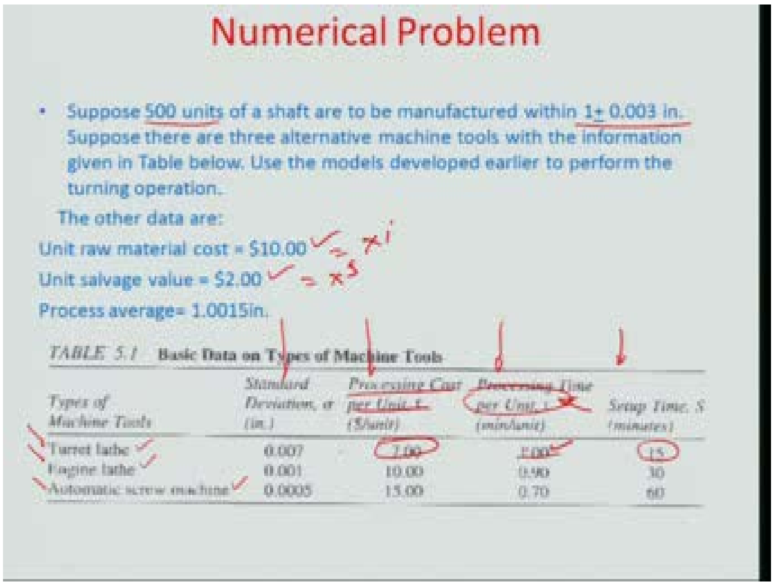

Hello and welcome to this manufacturing system technology module 21. Just quick recap of what you did in the last class we were talking about certain example were case study, where we are talking about turning about 500 units of shaft within a manufacturing process with a design specification of 1 plus minus 0.003 inches. We had three processes among with the selections are to be made was that turret lathe, engine lathe, and automatic screw machine, and this manufacture of all the three machines at provided us with the data in terms of standard deviation the processing cost per unit processing time per unit setup time you know. And then we were supposed to do a process capability analysis of all this three machines.

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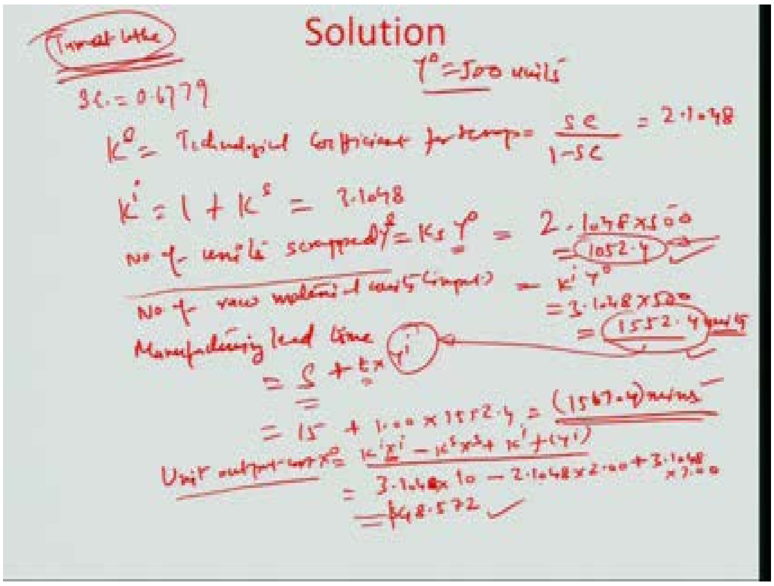

See what is the scrap fraction which would be generated for that we calculated the scrapped coefficient from the normal distribution, and the design tolerance and this came out as just done in the last lecture to be 67 percent it was 0.6779, you also calculated the technological coefficient for the scrap as 2.1048 in the technological coefficient for the input is 1 plus the technological coefficient of scrapped, so 3.1048. So, obviously, the number of units which are scrapped now they come out as the case times of y 0; where y 0 is the output we have already mentioned that the case is about 500 units of turning of shafts. So, this comes out to be 3.1048 times 500 is about 50, I am sorry 2.1048 times off 500, which is record it as 1052.4 units. So, these are the number of units which are scrapped by the process, and the total amount total raw material inputs units would come out to be equal to the technological coefficient for the input times of the 500 output capacity.

So, this can be recorded as 1552.4 units. So, you can see that just by you know certain process selection for the first case, which is the turret lathe you are having a scrap value or scrap quantity, which is almost double the number of the input which has been planned. So, therefore, in order to make a 500 unit output you have to scrap about thousand plus parts in the particular system, if you were to make the choice of the turret lathe, we let you again go along and try to investigate all three in comparative capacities.

Then finally, take a decision with turret lathe should be scrapped at this stage or not, but what do will find out is that you know based on the various capabilities with the capability of machine is higher; obviously, the cost is going to be higher as well of the particular machine. So, also of the oppression cost the overall oppression cost of the system, but on the other hand, if the cost of the machine is lower and capability is not. So, good is basically loose in terms of scrap materials from the process. So, there is a sort of trade off, which needs to be made between these two aspects when you are doing in selection or a choice. So, the manufacturing lead time in this particular case can be represented by the setup time plus processing time per unit value in case of turret lathe is recorded as 1.00 minutes per unit, and the setup time is recorded is about 15 minutes.

So, the total manufacturing lead time will then be the in terms of the setup time plus the input quantities, which has been borrowed from this expression earlier times of the time processing time needed per unit per input or per raw material input to the manufacturing system and. So, this you would come out to be in this case of turret lathe equal to15 plus 1.00 times of 15 52.4 units, that is about close to 15 67.4 minute. So, that is how big, if this is going to be time wise in terms of 15 67.4 minutes, that is the manufacturing lead time and the unit output cost x 0. Then comes out to be equal to k i x i minus k s x s plus k i the technological coefficient for the input times of the processing cost add the input level y i, this is borrowed from the derivation done in the earlier modules, and this case the k i value comes out the 3.1048 times of the x i, which is actually the cost of the input raw material.

So, if you look back here the cost of the input raw material the unit cost comes out be about 10 dollars per unit. So, the salvage cost again x s comes out to be equal to 2 dollars this is x i, this is x s and based on these in the processing cost again per unit for the turret lathe comes out to be a seven dollars in units. So, that is how distribution is laid, and we have 3.1048 k i times of x i, which in this case about 10 dollars in unit minus of the k i as which was 2.1048 times off the unit salvage cost within this case is about two dollar again plus the technological coefficient of the input times of the processing cost, which is again in this case about 7 dollar is just pointed out. So, this brings us to an output cost level x o of about 48.572 dollars. So, that is per unit cost the per unit output cost in this particular case.

So, we have several things now derived to be take a management decision particularly for the turret lathe case, we talk about the number of scrapped units, we talk about total input requirement, we also talk about the lead time manufacturing time for a processing this whole 15 52 units of a raw material, and then finally also talk about the unit output cost which comes out from all these process.

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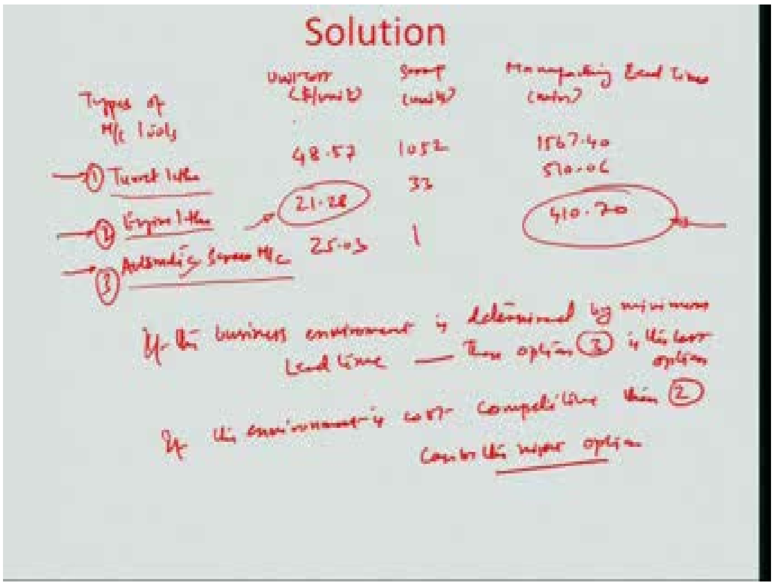

If you just try to summarize for the all the three systems. So, we have summary table here let me just write it down. So, you have type of machine tools and there are three types of machine tools that we are trying to consider for this process selection decision one is turret lathe, another is engine lathe, and third is an automatic screw machine. So obviously, the unit cost is 48.57 dollars in unit 21.28 dollars in unit, 25.03 dollars in unit. So, similarly this scrap in terms of number of units in all the three categories happens to be 1052 units in case of the turret lathe goes down the 33, and one unit in the case of the engine, and automatic screw machine one of the reasons why probably, they are costlier is their capabilities comparison to the turret lathe is very gross turret lathe is thing. And then of course, to you also have the manufacturing lead time that you have calculated and the this manufacturing lead time comes out to be 15 67.40 500 10.6 400 10.70, and then we have take a manufacturing decision here.

So obviously, if the business environment was something, which would be going by minimum lead times, then we will chose, let us say we call it option 1, 2, and 3. So, if the business environment is determined by minimum lead times, there are situations where you have this kind of business environment. So, then obviously, option three is the best option, and if the environment is Environment is cost competitive then two can be the right option.

So, if you are planning to buy cost wise and see minimum cost engine lathe comes out would be the right option, if it is lead time based demand from the environment of the one, who will be having the minimum lead time has to be consider for this particular process, we will have to chose the automatic screw machine for that purpose. So, that is all you actually take us is a decision criteria for the scrap process at the case of machine selection. So, that you could choose a particular machine for a process. So, you already saw how you chose a machine for a turning process and this particular zone. So, I am going to sort of go ahead.

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Go to the next section which is about determining machining conditions, that is cutting speed feed depth of cut manufacturing times like, let us say setup time, processing time, and lead time etcetera.

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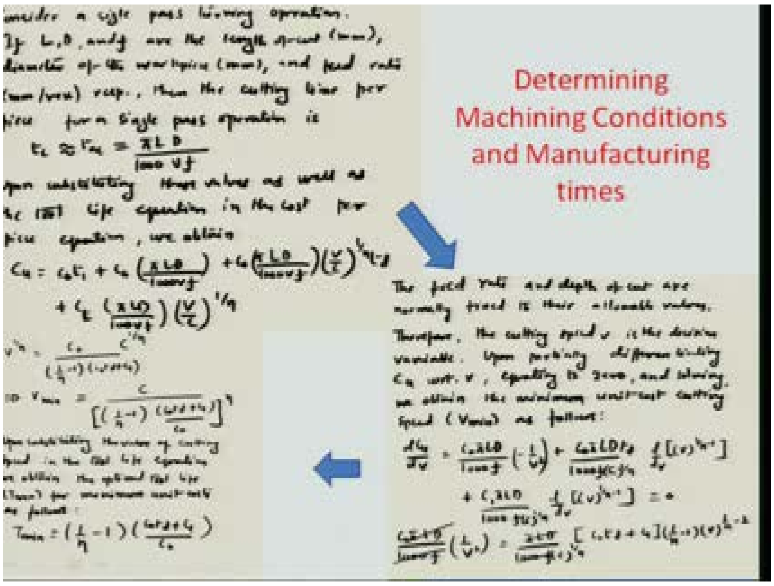

The idea here again is that as far as possible we want to complete all these steps in single goal. So, that you know in a very intelligent manner not all only you able to decide what is the sequence, what is the operation itself, but their sequences and also over the right kind of machines tools work holding devices and machining conditions. So, that you have a complete optima in terms of the manufacturing process.

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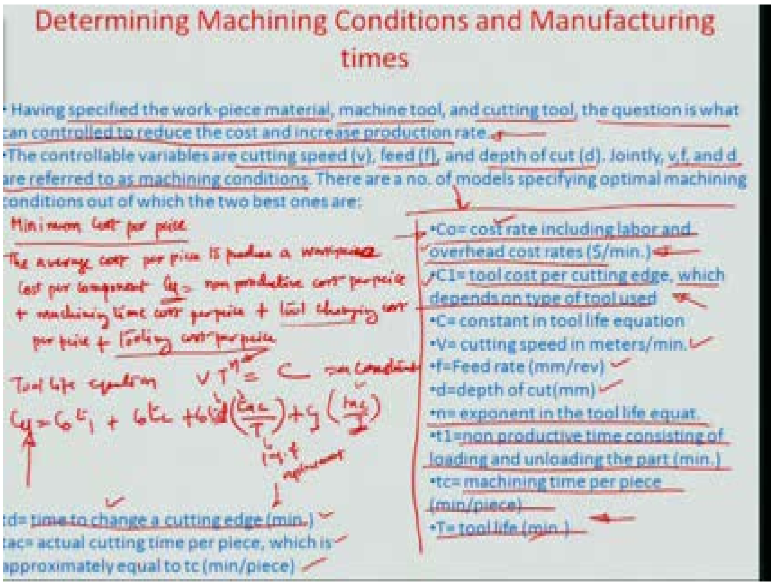

So, for doing that how to determine the machining conditions. Now we will have to do this you have to first specify the actually working material. So, you specify the work piece material and the machine tool, and the cutting tool and the question is what can be control to reduce the cost and increased production rate; obviously, the controllable variable here are the cutting speed the feed the depth of cut and jointly the v f and d; all the three parameters are referred to as machining condition. So, there are number of models specifying optimal machining conditions and out of which best ones are the minimum cost module. So, you have one module, where you have to really consider the minimum cost per piece, and another criterion that is used the model two for the optimal conditions is the maximum production rate model, where you talk about minimum lead time manufacturing lead time.

So, these are the two criticality is in terms of any manufacturing system; one is the cost and another is the lead time as you also saw in the process capability analysis base case selection done in the earlier case study of the problem example. So, let us now focus a little bit about how what really is meant by this minimum cost per piece of certain, you know machining situation or conditions. So, the average cost per piece to produce a work piece can be a combination of several cost coming from different, you know in a particular machining situation several different cost coming from different aspects. So, let us look at some of the cost which can really bother us while we a talking about machining.

So, let us look at what is this side of the slide here right here. So, there can be a cost rate, which includes labor and overhead costs there can be a tool cost for cutting edge, which depends on the type of tool that has been used there also can be based on these the different timing for example, that can be a non productive time. So, this is actually per minute as you see all the costs are time driven. So, we had to have a time domain also. So, that we have a overall cost.

So, one of them could be non productive time consisting of loading and unloading the part to the machine there can also be the actual machining time per piece in minutes per piece and obviously, something needs to be done with the tool life, because when we are talking about the tool and quantum of the number of minutes that a tool would have to wear down.

So obviously, after that wear down the changeover would be needed. So, therefore, the time to change a cutting edge would be also critical and also the actual cutting time per piece which is approximately equal to t c, but some time there may be other fact there is which may lead to this t a c being different than that t c. So, as of now we can say there it is a approximate approximately equal to the cutting time, and we are assuming that some of the weight periods before the coolant starts or coolant stops or something like that is not considered in the differentiating t c from the t a c at this particular process step. So, what are the parameters which are to be optimized; obviously, the cutting speed in meters per minute needs to be optimize the feed rate need s to be optimize the dept of cut needs to optimize, you know there is an exponential n which is related to the tool life equation and tailors equation so on and so forth.

So, we have given all these constraints now right, the average cost per piece to produce a work piece, if you splitted up in to the different costs, which some outs to be the average cost. Let us say the costs per component you call this u in a particular case is unknown cost, it will be broken down into the non productive cost per piece for the machining time cost per piece, you can also call it the productive time plus again the tool changing cost per piece plus the tooling as such. So, the tooling cost per piece. So, that is how you define the average cost produce a work piece, and if I really look at some of these parameters that have illustrated on the right here and some in the lower portion of the slide right here we can first do something about the tool life.

So, that we have an idea of how frequently you need the tool changing or those issues, so obviously the tool life equation is the standard format of the tailor equation v t the power n equal to c into the constant, and of course is the index which we are talking about in this particular case. So, the overall cost per piece then would be in terms of the total overhead cost which includes labor and overheads both co times of the time which is the non productive time. So, at this cost goes in whenever there is a some kinds of decision regarding productions to be started. So obviously, these are the additional bundled cost which come into picture plus the lower overhead, which their times the actual time of machine in t c, which would be the productive cost which is added to the system. Now obviously, there is a tool changing cost which is there. So, the tool changing cost in this case would be really dependent on what is the actual time of cutting for the particular tool vis a vis the tool life.

So, let us say if capital T were the tool life and t a c in this case is, in this case the actual cutting tool, we can say number of times the tools needs to be replaced is really, you know in a particular actual cutting time per piece, we can get t a c by capital T replacements you know. So, this is the frequency of replacement and this can be bundled up within the time actually to cut the tool. So, much time is now needed to cut to change the tool, I am sorry change the cutting edge. So, this is the frequency number of times, the time per tool makes the overall time of cutting a changing or tool changing and during that time the cost rate of the labor again is assumed to the c 0, and then there is a bundling of the tooling cost which comes because of such changes.

So, you have the total overall again cost as the number of times that you need to change a tool while one cutting cycle is on times off the tool cost per cutting edge. So, these are the number of edges that, you would need times of c one the per cutting edge. So, that comes out to be the overall cost per piece and we have to do something by varying these parameters like the v f and d parameters in cutting condition. So, that you can optimize the cost per work piece of the particular sample. So, we come to the end of this module, but in the next module we are going to sort of try, and see how we can do this optimization or minimization, and what is the emergence of a particular velocity cutting velocity that will come out given that particular optimal condition.Thank you.