Manufacturing Systems Technology

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Module – 04

Lecture - 19

Hello and welcome to this module 19 Manufacturing Systems Technology.

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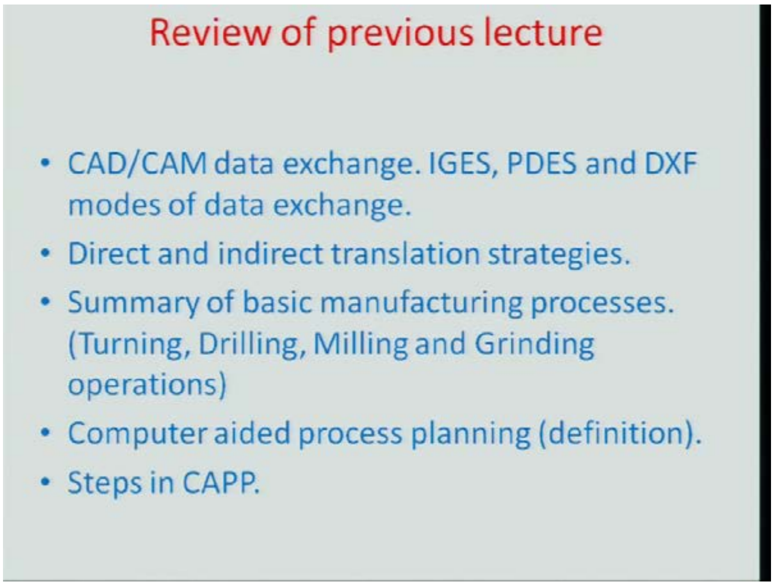

And quick recap of what we did in the last few modules, we talked about the CAD/CAM data exchange process, discussed about the various exchange neutral formats like IGES or PDES or DXF drawing exchange format, so on and so forth. These are the neutral formats, which are made for making the process of data exchange easier between one processor to the other processor or different machines.

We also talked about direct and indirect strategies, how many processors are needed, we had a summary of the various manufacturing processes like turning, drilling, milling, grinding, different operations which necessity, which are the knowledge of which necessitated value or trying to do CAPP or Computer Aided Process Planning. We talked about some definitions and then finally, started the different steps of the CAPP process.

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And just again a quick recap of, what were the various steps we talked about this step 1, to 4 here. In this particular slide we discussed about the analysis of part requirements, what really it means in terms of CAPP. We also talked about the selection of raw work piece material. We further discussed in detail about determining number one the operations, which are involved in making the part number two the sequences of the various operations, whether there is a drilling followed by milling or vise versa depending on the part geometry you know.

So, those intelligent decisions are to be taken at this particular step. We also discussed about selection of machine tools and some of the criteria, which are used there in which, involve the, this selection based on process capability analysis of a machine.

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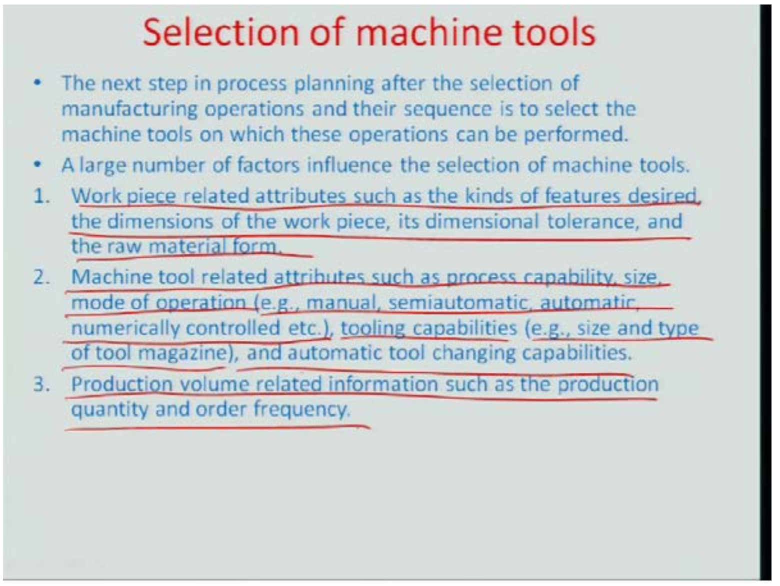

So, in that context we had just begin some analysis regarding you know, how we really do the selection based on the work piece related attributes, such as let say the kind of features, which are desired in the final drawing, the dimensions of the work piece, it is the dimensional tolerances, the raw material, so on and so forth. We also, you know evaluated some of the machine tool related attributes such as process capability, size mode of operation, example whether the machine is manual, semiautomatic, automatic, numerically controlled, etcetera.

The tooling capabilities for example, size and type of tool magazine, the automatic tool changing capabilities, so on and so forth. And the final important thing that we arrived at was the production volume related information such as production quantity and order frequency.

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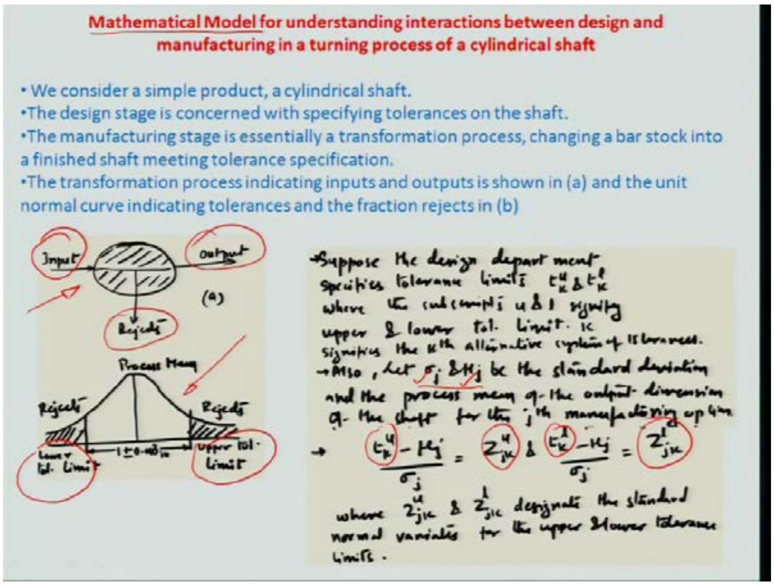

So, in this context we actually did the realistic problem earlier, where we talked about the sort of mathematical module, which will, let you or enable you to select between different machines based on matching the process capability with the design requirements, the tolerances of the particular system. And, so if you may recall we talked about this transformation process about here, where there would be some input in a machine, there is an output from the machine and there are certain rejects.

Before they try to put the normal distribution contained by the particular machine output as a part of its process capability with respect to the tolerances, which are there in design and we computed from the distribution, the mean of the or the process mean in the process standard definition. Obviously, these are mostly given by the manufactures at the time of supplying the technical specifications related to the machinery that they are selling and from there and from the design requirements that we have, we try to calculate the z variate. I think we have done a lot of detailed analysis about, what is the z variate and how normal distribution is obtained.

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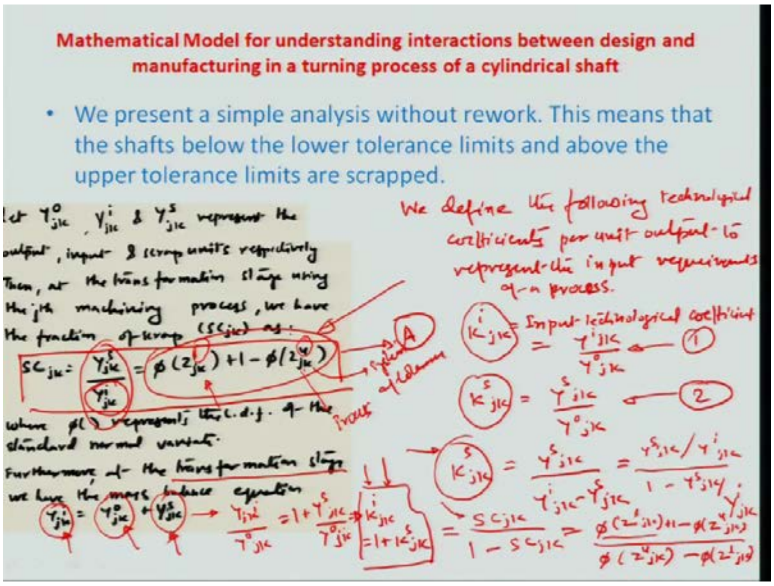

And from the z variate on the upper and the lower side you know, we try to further see, what can be the material balance equation and calculated this is scrap fraction here and this scrap fraction is again fraction of the input. So, how much scrap is generated with respect to how much input for the particular case here. We are talking about the jth process and the kth system of tolerance, so that is, how we kind of modeled this.

And then, we further try to create a material balance equation at the transformation stage, where this is the input side and there is an output, which is concerned with the process and then, there is a scrap output, which is there. So, the output and scrap combined together should actually result in the input number of unit, which are going in to the process. So, we will now slightly change gears at this point of time and define a strategy by also formulating certain coefficients and these coefficients are quite standard and they can be used again and again.

So, computationally they become much simpler for use this quotients in all the processes. Remember, we are just handling here one system of tolerance for a particular specific, you know machine or a specific process. There may be n number of such tolerances, which we need to be addressed by, let us say n number of machines I mean or n number of process capabilities related to different processes. So; obviously, the volume of such calculations become quite expensive, when we talk about the whole organization or the whole design that we want to manufacture for the particular organization.

So, therefore, handling all these with certain coefficients and easy representation is the first logical step towards creating a generic representation of the whole situation. So, we define the following, we call it technological coefficients and this can be defined per unit output to represent the input requirements of a process. You see, what we are mostly given in all situations and what should be the process output, what is the demand.

But, we somehow have to formulate by fitting a capability of a certain process on to that particular design, that how much input would be needed to really do that output. If the scrap level is high, then; obviously, input requirement per unit the output would be much larger and that would be a direct cause to the company. So, we are therefore, designing the system in a manner that everything is reflected in terms of the output level, which is the actually a constant defined by the market or the particular situation in which, you know you are producing the design, manufacturing the design through a process and you are unable to select the process now, you are at that kind of a stage in the production in the part.

So, the first coefficient that we define here we represent as k i j k and we call it the input technological coefficient and this is further represented by Y i j k by Y o j k; that means, how much input per minute output are we talking about. We similarly do one for scrap, we call it k s j k and represent this as Y i j k per unit the output Y o j k. And you must understand that these are inter relationship between this equation and this equation and that is written through that; obviously, the k s j k value can be represented as the Y s j k divided by the input minus the scrap, which is the actually the output.

So, if I would represent everything in terms of ratios I would like to have a situation here, where dividing by, let us say the output on both sides we have Y s j k by Y i j k and we have 1 minus Y s j k by Y i j k. So, that is how you represent the scrap coefficient k s j k; obviously, from the equation done earlier about here we call this equation A we find out that the scrap coefficient is represented in terms of number of scrap per unit the number of input.

So, I can easily simplify this as the scrap coefficient for the jth process of the case tolerance alternative tolerance sequence that we are choosing minus one minus of the scrap coefficient of the jth process of the kth tolerance system that we are choosing. And; obviously, I think we had earlier mentioned very well that how you can represent these processes by cumulative distribution functions corresponding to the lower tolerance and the upper tolerance represented in this manner.

And, so I would like to actually right this down in terms of the cumulative distribution function proposed in the equation here and I write this as the cumulative distribution function of the lower variate plus 1 minus of the cumulative distribution of the upper variate divided by the cumulative distribution of again the upper variate of this particular situation here jth process and kth alternative tolerance minus of the cumulative distribution of the lower variate of the system j k.

So, that is how you can be define this technological coefficients of scrap or technologically you know technological scrap coefficient whatever you may call now; obviously, the relationship that happens from this material balance equation if I would just divide the equation here by the output everywhere. So, let us say i divide this by Y o j k this becomes 1, 1 this becomes Y s j k by Y o j k. So; obviously, this can then be more appropriately represented in terms of the case as the k i j k is actually equal to 1 plus k i j k.

So, these are some of the representations of importance one of them is this one of them; obviously, how you represented the scrap coefficient and we will take all these numbers from here. In terms of the cumulative distribution functions of the lower and upper variates and the technological coefficients, which are given in this particular domain here to solve a cost equation, which will really lead us decision making about the process selection if they are many more than one process, which are there, which we need to select how we do the selection would be on the basis of this coefficients and ultimately the cost of the material; that is going into the process.

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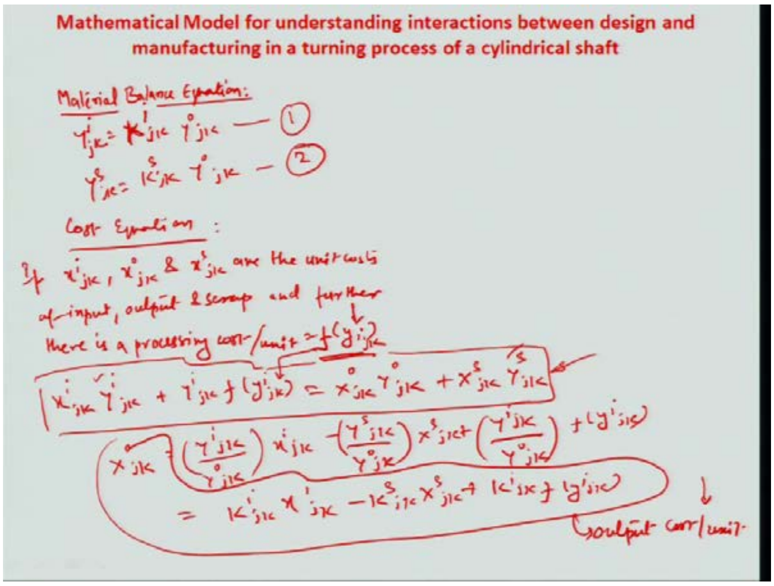

So, let us look at that, so now let us again sort of summarize our material balance equation. So; obviously, the input is represented in terms of the technological coefficients formulated here k i j k times of the output and, so is the scraped formulated by technologically you know technological scrap coefficient or scrap, scrap fraction times of technological coefficient of scrap times of output level of the process.

So, that is regarding the material balance equation and we now, start calculating cost we will lay down the cost equation here. So, we will have to make some assumptions let us say in our situation if you assume that x i j k, x o j k and x s j k are the unit cost. Obviously, of input output and scrap respectively and further there is a processing cost per unit and we intentionally define it is the function of the input, because; obviously, if this inputs side is of the material is more than the processing cost would be lower and vise versa.

So, processing cost definitely depends on, what is the input side of the component we could back sizing you could do many thing in terms of set up times etcetera to have reduced cost processing cost. So, we just call it a function of the input; obviously, and then we do the cost equation here, so the input given into the system cost x i j k number of inputs here is Y i j k. So, therefore, this is the total cost from the input plus the processing cost of the input, which is again number of unit times the per unit processing cost as defined from this particular step is the total cost that you are adding to the input for making into the output.

And this can be the represented in terms of; obviously, the output unit cost times of the output level this is the cost at, which the is the cost to the to the customer which the production system of the manufacturing system is taking from the customer and that plus the scrap cost times of number of units of the scrap. So, this is actually the cost balance equation one has to be able to at least balance this cost to create manufacturing system which is almost cost free; obviously, there is a profit angle and other things, which can be coupled up later.

So, that there is an expansion of the manufacturing system, but just from cost balance point of view this is at least the minimum condition that any process should meet. So, then therefore, the output cost here can be very easily determined from this equation as the k i; obviously, you can define or you can you can start of divide where ever there is you know representation of Y i j k as given in one or Y s j k again as given in two in terms of output.

And, so I can say that this can be represented as let us just write the full form of it for ah you guys to see this more appropriately this goes as Y i j k divided by Y o j k times of x i j k minus of Y s j k by y output j k times of x s j k plus Yi j k by Y o j k times of function of Y i j k the processing cost. And, so it can be more appropriately represented as the input technologically coefficient times the input cost unit cost minus the scrap technological coefficient times the scrap unit cost plus the input technological coefficient times the processing cost, which comes in picture.

And that is how you can find out the output cost per unit of the particular manufacturing process the jth process that is in question. So, I think in we are kind of done about this cost balance equation. So, what we did is we started with the normal variate and we calculated from the normal variate cumulative distribution function and from there we could record, what is the scrap fraction we developed technological coefficients and tried to address the material balance equation.

And then finally, the cost equation, where in output cost was reported, now I am going to now probably in the next lecture take up a practical problem from industries stand point and see that when such a decision criteria is applied, what would be the fundamentals associated with taking such a decision, so we will do that in the next module.

Thank you.