Automation in Production Systems and Management
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Automated CAPP (Part-I)
Lecture - 53
Process Planning Approaches: Manual Experience - Based Process Planning

During this lecture session for the next half, I will be discussing the manual process planning approach.

You opt for a manual approach or computer-based automated system.

You have to follow those steps in a sequence one by one when you opt for a manual experience-based process planning approach.

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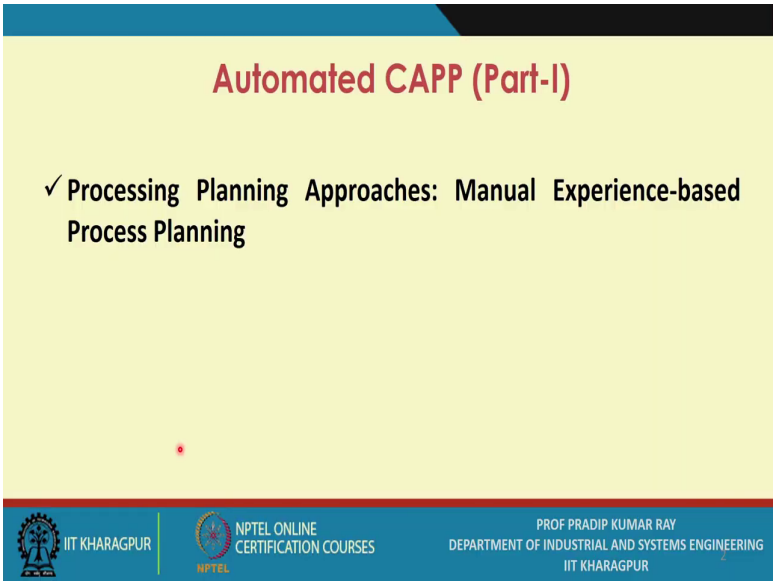

Let me discuss Manual Experience-based Process Planning.

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These are the two main approaches. One is the manual experience-based method that you can use and usually whenever you are start the producing the items or the parts for the first time.

Initially you do not go for an automated system. Initially maybe for the few months maybe for few years, depending on the how many different types of parts you have been using and different volume of production, you adopt the manual experience-based process planning approach.

Based on your experience and the expertise that you gain, you may adopt an automated system for process planning.

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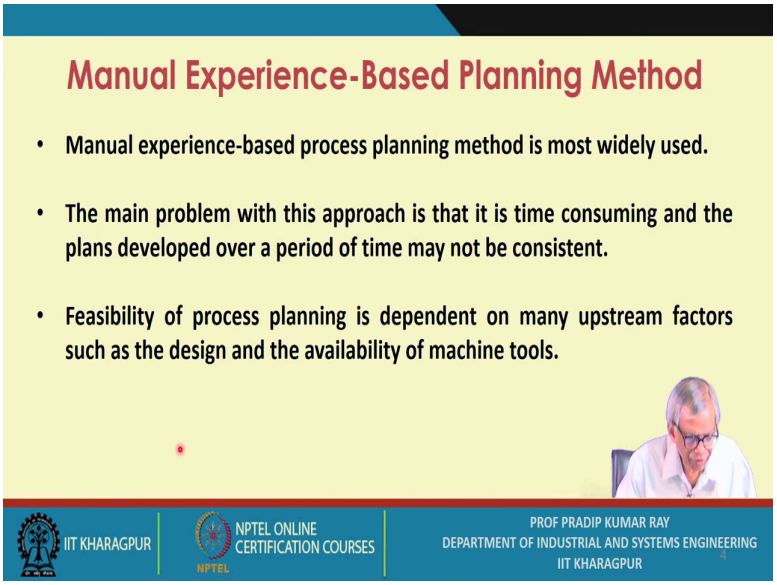

Manual experience-based process planning method is widely used but the main problem with this approach is that it is time consuming. The plans developed over a period of time may not be consistent and it is individual based.

Suppose you ask three persons to write down the process plan for the same part. It may so happen that three process plans you will get and they are all dissimilar and all are feasible. Now, the question is how do you select one out of these three?

It is individual dependent. There are certain advantages, there are also certain the demerits or disadvantages. Feasibility of the process planning is dependent on many upstream factors.

You are a part of the system. This part you are manufacturing using a particular process plan, a particular operation you carry out and the way you carry out this operation, affects the upstream factors such as the design and the availability of machine tools. There are upstream factors, there are the downstream factors. The kind of operation you specify or you are carrying out, is dependent on the kind of design you have.

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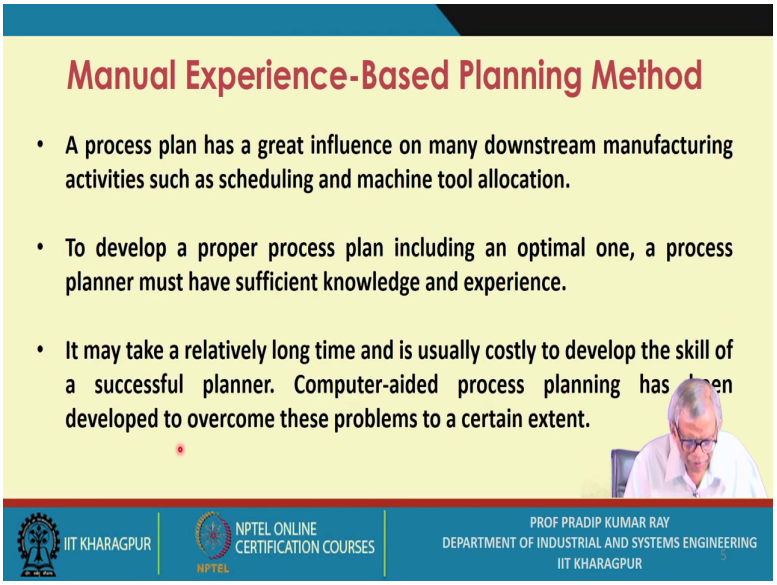

A process plan has a great influence on many downstream manufacturing activities, such as the scheduling and machine tool allocation. That means how much time you require to produce a particular part at the operations level?

For each operation how much is the processing time and with respect to the machine tool, how much is the setup time and against a particular set of what is your lot size or the batch size?

There will be some constraints on the production volume. The way you design a particular process plan affects the upstream factors as well as the downstream factors of a manufacturing system.

To develop a proper process plan including an optimal one, a process planner must have sufficient knowledge and experience. It may take a relatively long time and usually costly to develop the skill of a successful planner.

Computer aided process planning has been developed to overcome these problems to a certain extent, but there could be other considerations also before you opt for computer aided process planning.

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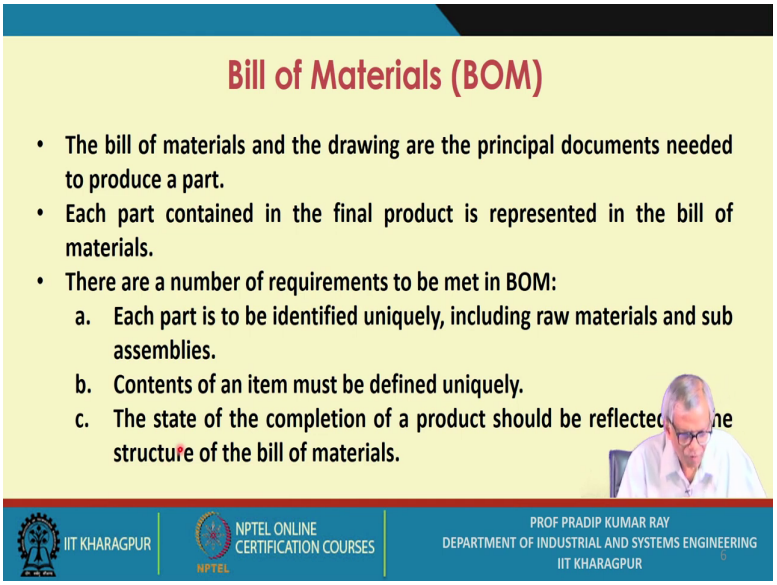

You get the design of a product and this product must be converted into bill of materials. The bill of materials is one of the outputs of design department along with the drawings. These bills of materials can be design in different forms, and from each form or from each structure, you get one kind of information and this information will help you in creating the process plan.

Bill of material is essentially the list of the item's parts, the sub-assemblies that you require to produce one unit of the output. Output means basically one unit of the product.

The list is given to you and this list is prepared in not only in one form, but a number of forms you can use. The bill of materials and the drawings are the principal documents needed to produce a part. Each part contained in the final product is represented in the bill of material.

There are a number of requirements to be made in bill of material. First one is each part is to be identified uniquely. It is better that against each part you must know its code.

The code is a unique one. Each part is to be identified uniquely including the raw materials and the sub-assemblies, that is point number 1. Point number 2 is the contents of an item must be defined uniquely.

The dimension or the tolerances or material, physical property, chemical composition, all must be known and itemwise you have these set of information.

The state of the completion of a product should be reflected by the structure of the bill of materials. From the discrete part manufacturing system, you get a product and the product consist of several subassemblies and each subassembly consists of a large number of parts.

Depending on the type of product, you must a product structure code. Ultimately at level 0, you get the final assembly. Prior to getting this final assembly, you may have to create many subassemblies.

The subassembly could be the level 1. For creating each subassembly, you must have several kinds of parts and those parts will be manufactured and then you get this one particular subassembly, that is level 2.

First you start with part manufacturing and then you go for subassembly and once all the subassemblies are made, then you get the final assembly. Once this procedure is known and obviously, you will be proposing the process plan.

It becomes easier for you to develop the process plan. The sequence will be known to you. There could be repeat parts, there could be repeat assemblies and, for each part, for each subassemblies, you need to specify the quantity to get one unit of the output. The state of the completion of a product should be reflected by the structure of the bill of materials.

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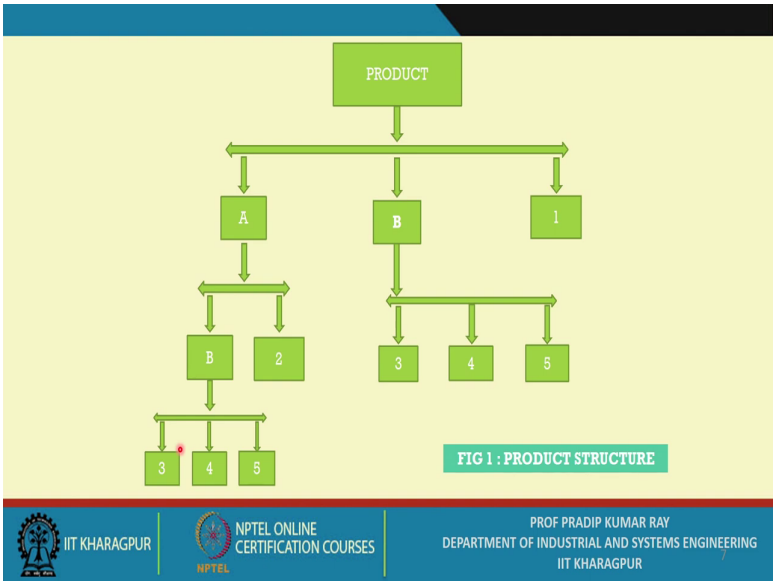

This is a typical the structure. This is sometimes referred to as the product structure code. This is the final product and for creating this product you need subassembly A and subassembly B and one part is one.

Next to produce this subassembly A, you need subassembly B. The same subassembly exists separately, but it is also a part of A. Along with B subassembly, you also need one specific part that is coded as 2. Next is to produce one unit of B, you need part 3, part 4 and part 5.

This is the lowest level; then the next level is this one, and next to next level is this and ultimately at the product stage or the assembly stage, you reach the 0 level.

This is for very simple product with only few items and just two subassemblies, but there are products for which, for one unit of output, you need 25000 parts or even 50000 to 60000 parts. Some 15 levels you may have. We have to develop the comprehensive planning. Product complexity increases in terms of the number of parts and the different types of parts.

Getting a process plan document is a very rigorous exercise and manual intervention has to be there.

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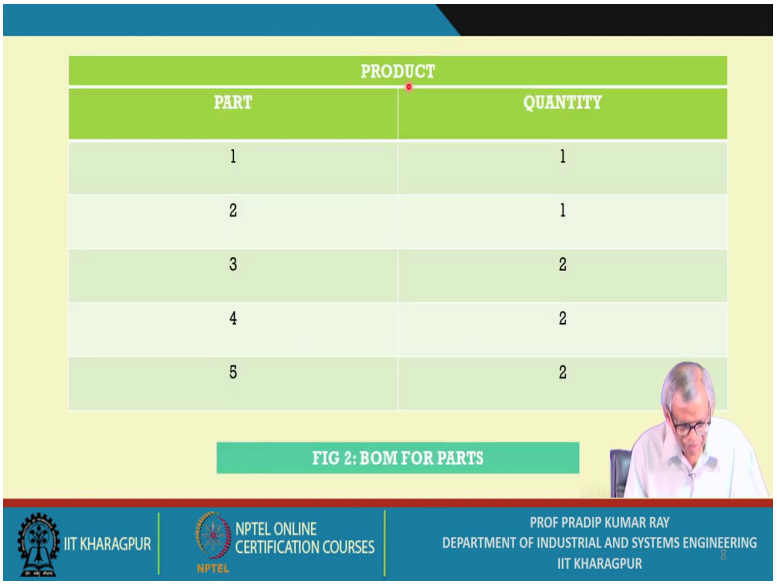

Next one is bill of material by parts. How many parts you have at the lowest level? Part 1 part 2-part 3-part 4 part 5. These are basically the code.

This is another way you present your bill of material by parts.

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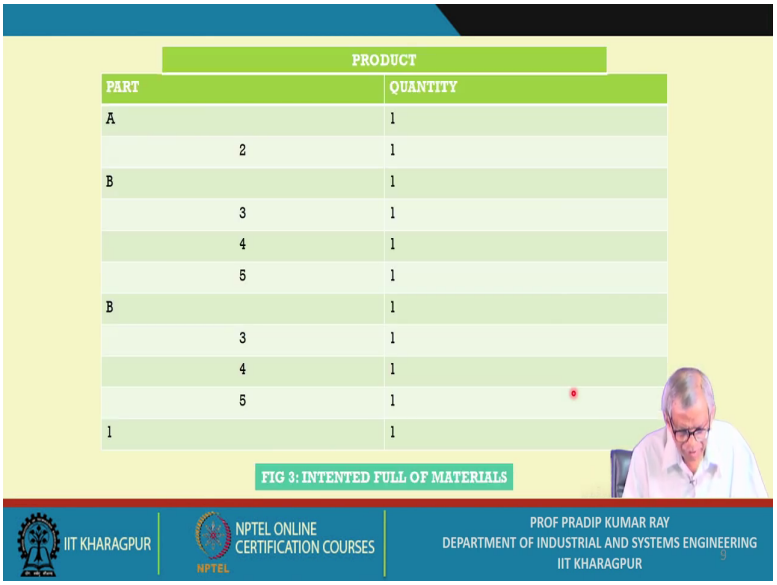

Third variety is called indented bill of materials. When you look at this table, on the left-hand side, you will find three subassemblies. You have to create two subassemblies.

First you create this one. Along with part say so part 2. For subassembly A you need just one unit of subassembly B. First one unit and B at the second level, you need another unit and similarly at this level, you need part 3, part 4 and part 5 all in one unit.

In the next level you need part 3 part 4 and part 5 as one-unit bases. Look at this particular format you find how many different types of subassemblies and parts you require, their quantities also will be known and at what level which part you require and their quantity.

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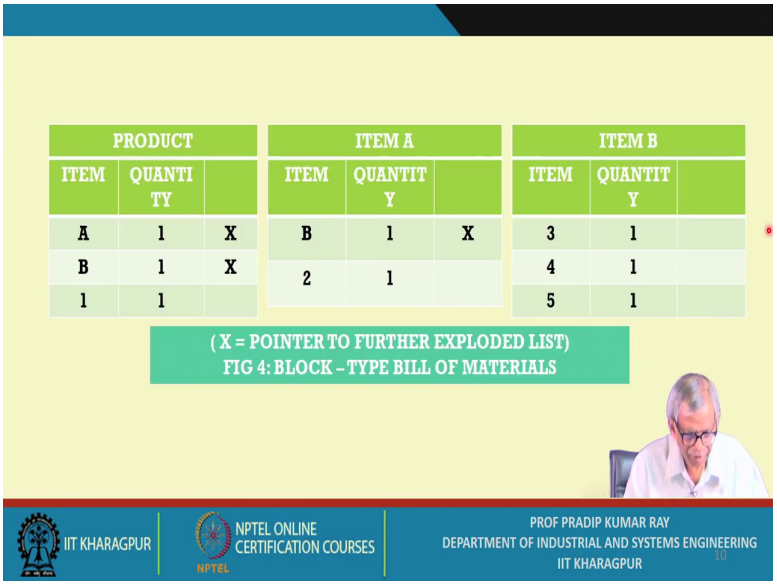

This is another way you look at this particular bill of material.

Certain aspects of the process planning can be made automated. The information is to be stored in the computer and you need to retrieve that information. Many a time you have to edit the basic or the master process plan.

This is referred to as the block type bill of materials. First one is A-B-1 to get the final assembly. Next is item A and item B. You create one database for this, one another database for item A, another database for item B and you permanently store them in the computer.

Suppose you opt for a modular design and you opt for the computer-based process planning then you may opt for this particular structure.

The design is modular. This is one module; this is another module and you offer the product in different modules. There could be different combinations of these modules and for each combination you get one type of product or one part of the model of the product.

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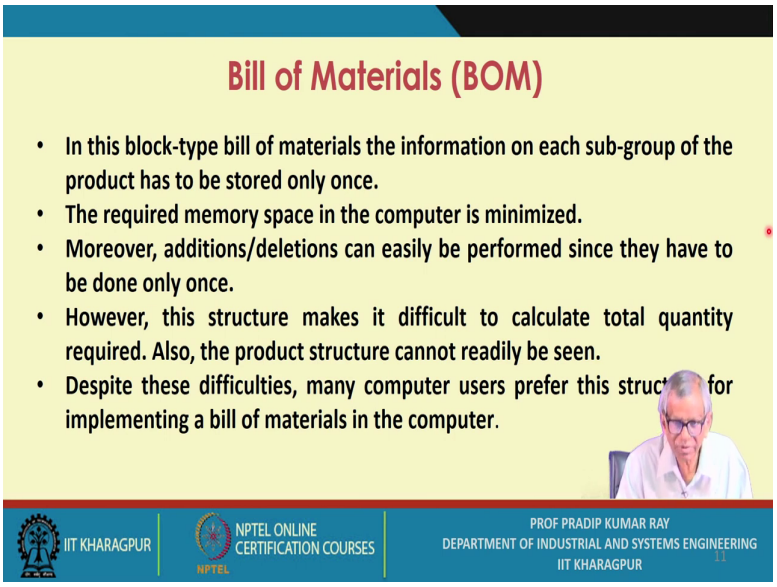

Before you go for computerization you must verify whether the modular design can be adopted for the given product or not. To propose a process plan for developing an automated process planning approach, in the block type bill of materials, the information on each subgroup of the product has to be stored only once. You refer to this particular figure-one subassembly for item A, another subassembly for item B.

The required memory space in the computer is minimized. Moreover, additions/deletions can easily be performed since they have to be done only once. However, this structure makes it difficult to calculate total quantity required.

If you look at the product structure code then only you will come to know how the product is getting manufactured, what are the steps involved and it becomes easier for you to write down the process plan steps.

For a specific purpose the block type bill of material is used. When you opt for computerization or you want to automate the system as far as possible, the bill of material should be converted into block type.

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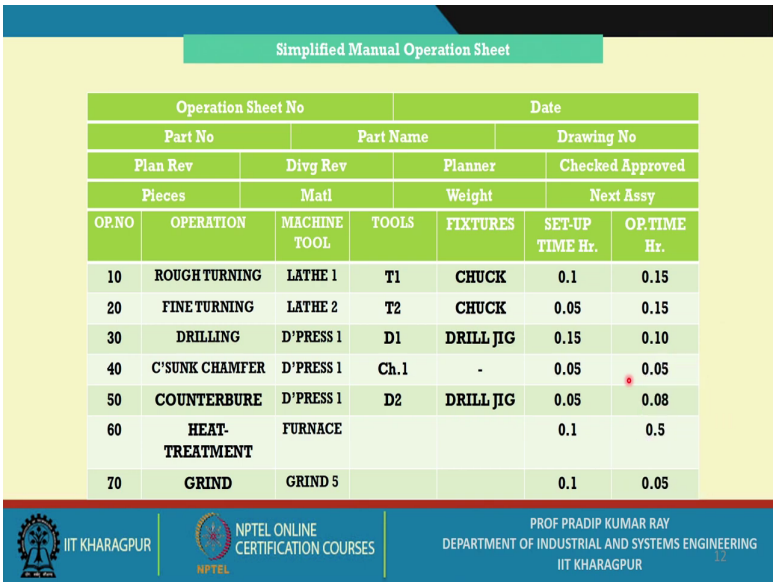

This is one example. One look at this particular structure and you will get an idea that a process plan is a very comprehensive document.

The structure is very standard. Ultimately, you are getting this output- this process plan document.

This information you must have: part number, code, part name, drawing number, etc.

The databases are to be created and then you have a revised one. Suppose, you propose one particular process plan. It does not mean that it remains frozen forever; it may so happen that you need to change the process plan because the manufacturing processes are also changing over the time period. Some machine tools are becoming obsolete; some particular machine tool is replaced with another machine tool with a state-of-the-art technology.

There will be changes in the process plan.

If the lot size gets changed; suppose today for a particular part the requirement is 100 units and usually it is 100 units all through.

You will have one type of process plan, but suppose the requirement changes to 1000, the same machine tool you may not use. So, you need to use another machine tool. As soon as you start using another machine tool or different types of cutting tools, work holding devices; the process plan will change.

The main portion of the process plan is the operation number. Many times there is a code against an operation number. 10 rough turning lathe 1, there is one unique identification code for these resources and this is the cutting tool.

The T1 type and this is a fixture. The setup time must be mentioned against a particular lot size. In one setup how many units you can produce and then the operation time, per unit time.

First is the rough turning then the fine turning, but you need to use another machine tool not the same machine tool. This is lathe 2 and you need to use another cutting tool, but you the same type of fixture you use, the setup time will be different if you opt for a different machine tool and the operation time is almost same.

Now, you go to drilling operation. The drill press you use; there are the different types of the drilling machines whether horizontal drilling machine or the vertical drilling machine. The kind of tool you use is D1 and the drill jig you have to use. You specify the kind of drill jig, then this is your setup time and this is your processing time.

Same you do for other operations like counter sunk chamfering. Again, the same drill press you use and this is the chamfering tool you use. This is a counter boring operation. Again, the same drill press you can use and you determine its setup time as well as the unit processing time.

Next, you send it to its a heat treatment. Furnace details you should specify and you specify setup time as well as the processing time per unit and once it come outs from the heat treatment then it goes to the grinding. The grinding machine is referred to as the grind five.

This is a typical process plan with respect to manufacturing operations, with respect to metal machining, along with the heat treatment or many other operations like sometimes you include pre-treatment, sometimes you include finish painting. It all depends on the kind of manufacturing systems and the production stages you have.

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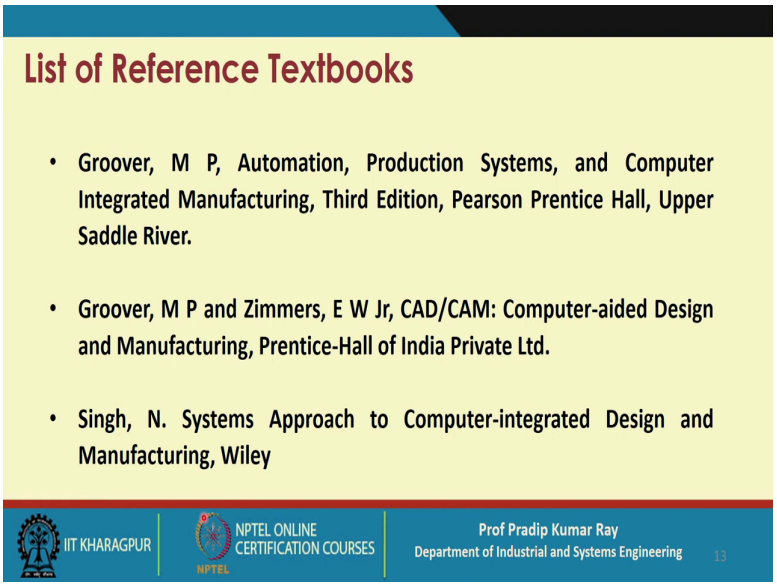

You have the knowledge of how a particular process plan is to be designed and what are the specific information's you must include in a process plan document. It is a comprehensive document and once someone studies this process plan, he will come to know ins and outs of the manufacturing system.

No process plan is the best one.