Automation in Production Systems and Management
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Automated CAPP (Part-I)
Lecture - 51
Definitions of Process Planning, Functions of Process Plan

During the 11th week I am going to discuss a very important topic called Automated Computer Aided Process Planning.

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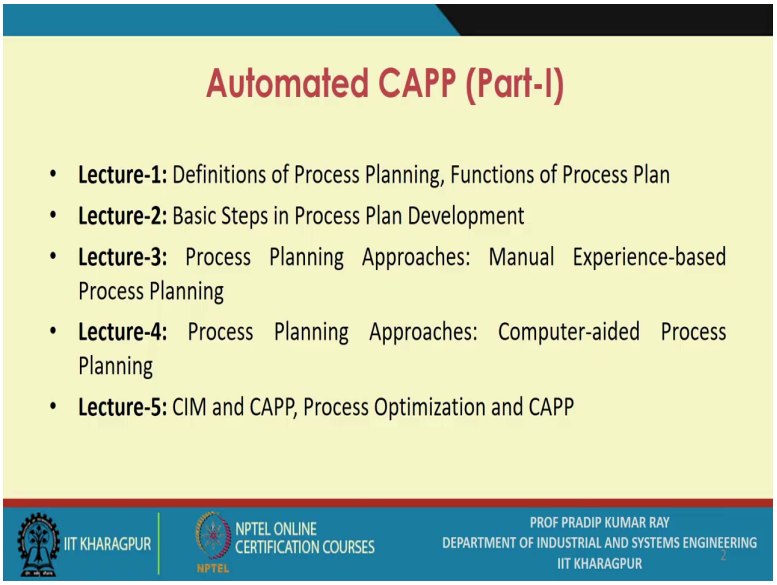

During this week we will be discussing 5 lecture with respect to this particular topic of Process Planning approaches. In Lecture-1 we will discuss Definitions of Process Planning, Functions of Process Plan. In Lecture-2 we will discuss Basic Steps in Process Plan Development. In Lecture-3 we will discuss Processing Planning Approaches: Manual Experience-based Process Planning. In Lecture-4 we will discuss Process Planning Approaches: Computer-aided Process Planning Method. In Lecture-5 we will discuss CIM and CAPP, Process Optimization and CAPP.

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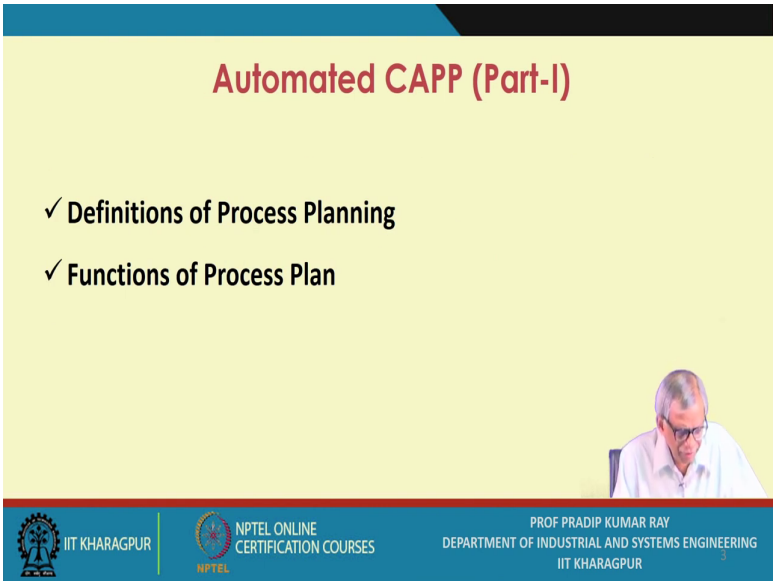

Now, let us refer to the definitions of process planning as well as the functions of process plan.

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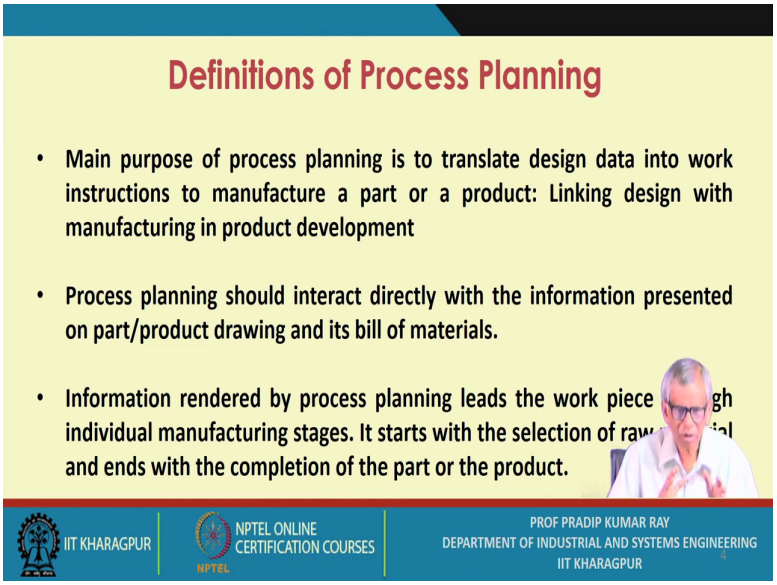

The main purpose of process planning is to translate design data into work instructions. The task of process planning is to translate design data to work instructions to produce a part or a product.

Process planning should interact directly with the information presented on the work piece drawing and the bill of materials. The information rendered by process planning leads the work piece through individual manufacturing stages. It starts with the selection of raw material and ends with the completion of the part.

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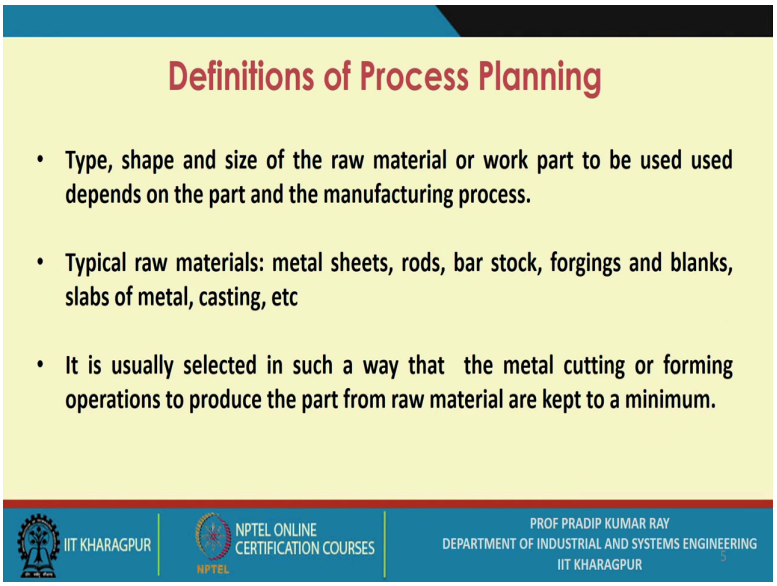

Type, shape and size of the raw material or work part to be used depends on the part and the manufacturing process. The form of the raw material used depends on the part and the manufacturing process. Typical materials are metal sheets, rods, bar stock, forgings and blanks or slabs of metal. It is usually designed such that the metal cutting or forming operations to produce the part are kept to a minimum.

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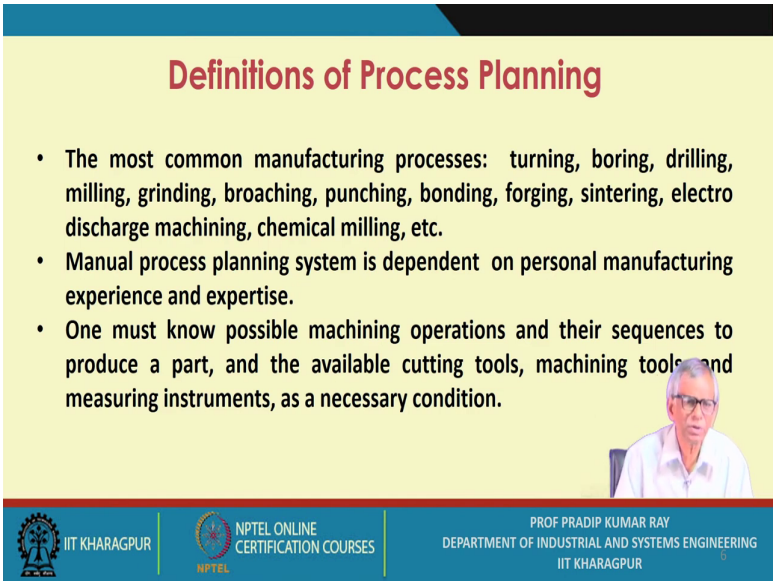

We will be discussing one important topic called process optimization, when we refer to process optimization the most common manufacturing processes are turning, boring, chilling, milling, grinding, broaching, punching, bonding, forging, sintering, electro discharge machining, and chemical milling.

With a conventional manual system the planner relies heavily on personal manufacturing experience.

One must know possible machining operations and sequences to produce a part, and the available cutting tools, machining tools, and measuring instruments.

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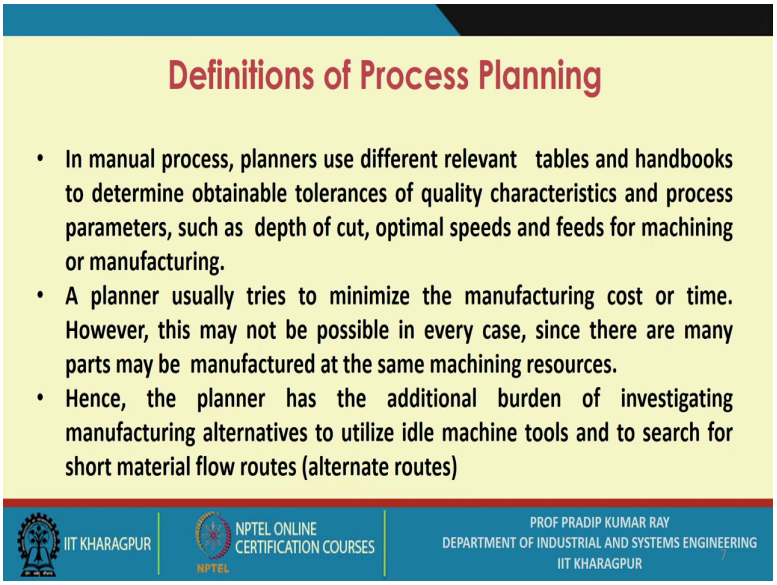

In addition, one needs tables and handbooks to determine obtainable tolerances and surface finishes as well as the depth of cut, optimal speeds and feeds for machining. A planner usually tries to minimize the manufacturing cost or time. However, this may not be possible in every case, since there are many parts completing for the same machining resources. Thus, the planner has the additional burden of investigating manufacturing alternatives to utilize idle machine tools and to search for short material flow routes.

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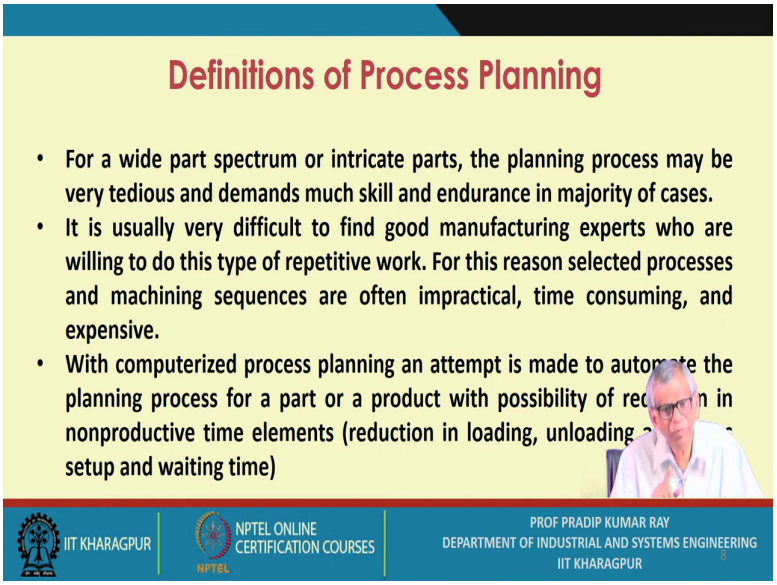

With a wide part spectrum or intricate parts, the planning process is very tedious and demands much skill and endurance. It is usually very difficult to find good manufacturing experts who are willing to do this type of repetitive work. For this reason, selected processes and machining sequences are often impractical, time consuming, and expensive. With computerized process planning, an attempt is made to automate the planning function and to reduce the nonproductive residence time for a part in the factory.

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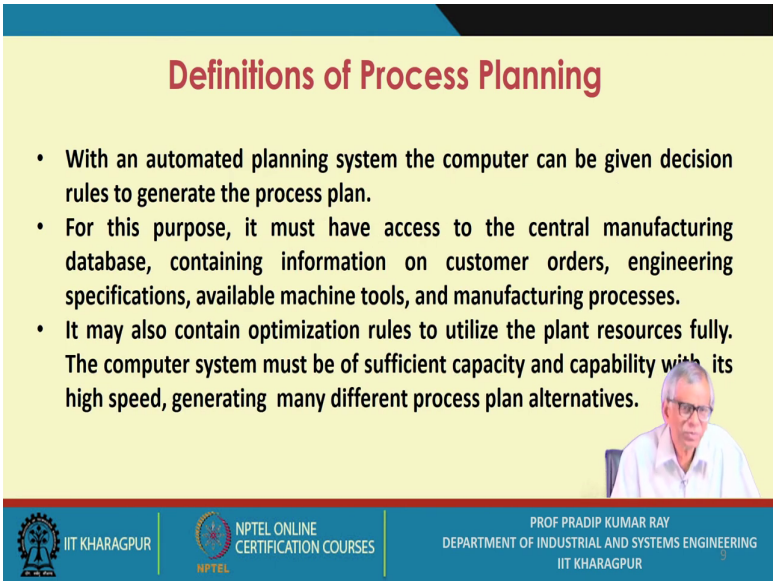

With an automated planning system, the computer can be given decision rules to generate the process plan. For this purpose, it must have access to the central manufacturing database containing information on customer orders, engineering specification, available machine tools, and manufacturing processes. It may also contain optimization rules to utilize the plant resources fully. The particular asset of the computer is its high speed which allows investigation of many different manufacturing alternatives.

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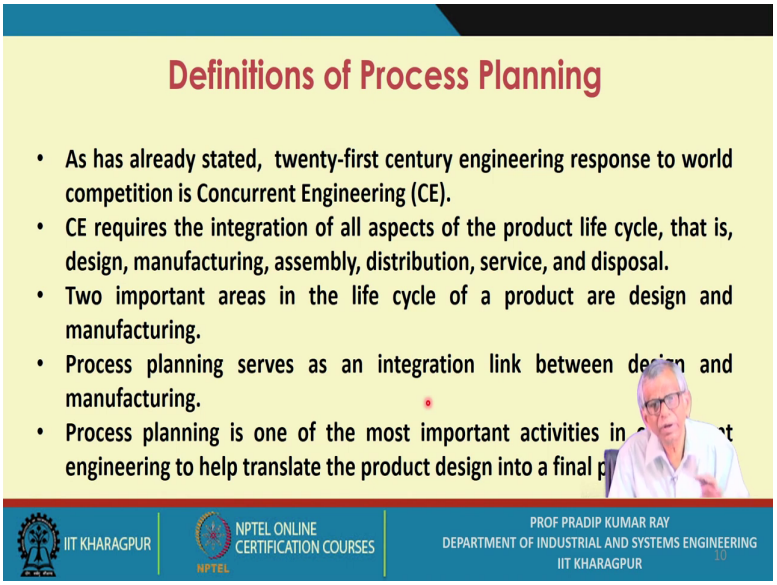

What is the process capability? Process capability is the ability of a process to produce as per the specifications. The 21st century engineering response to world competition is Concurrent Engineering (CE). CE requires the integration of all aspects of the product life cycle, that is, design, manufacturing, assembly, distribution, service, and disposal. Two important areas in the life cycle of a product are design and manufacturing. Process planning serves as an integration link between design and manufacturing. Process planning is one of the most important activities in concurrent engineering to help translate the product design into a final product.

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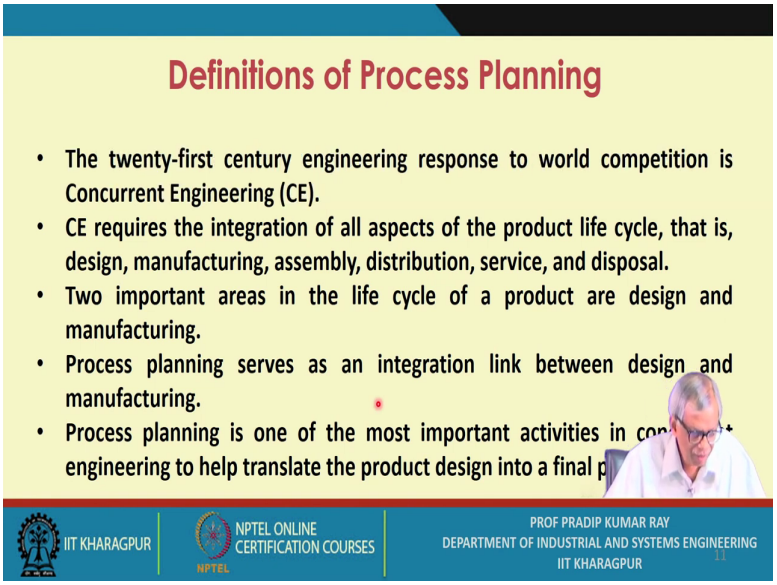

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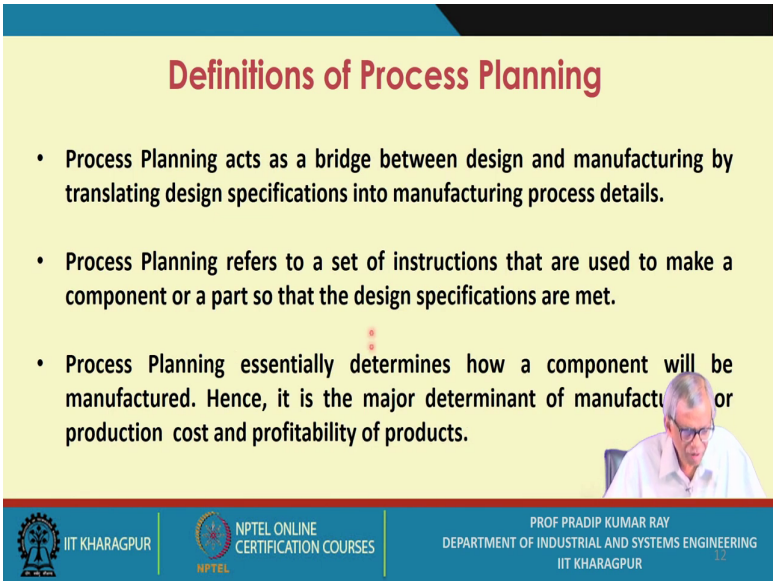

Process Planning acts as a bridge between design and manufacturing by translating design specifications into manufacturing process details. Process Planning refers to a set of instructions that are used to make a component or a part so that the design specifications are met. Process Planning essentially determines how a component will be manufactured. Therefore, it is the major determinant of manufacturing cost and profitability of products.

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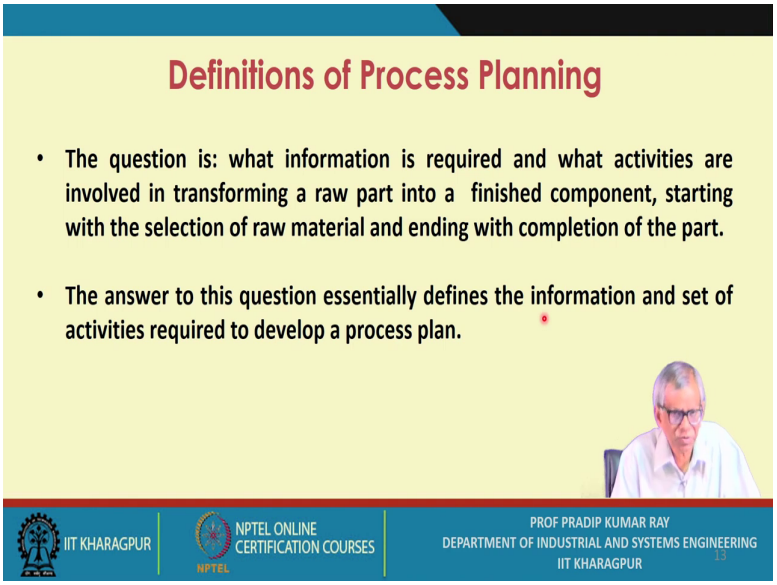

The question is: what information is required and what activities are involved in transforming a raw part into a finished component, starting with the selection of raw material and ending with completion of the part. The answer to this question essentially defines the information and set of activities required to develop a process plan(s).

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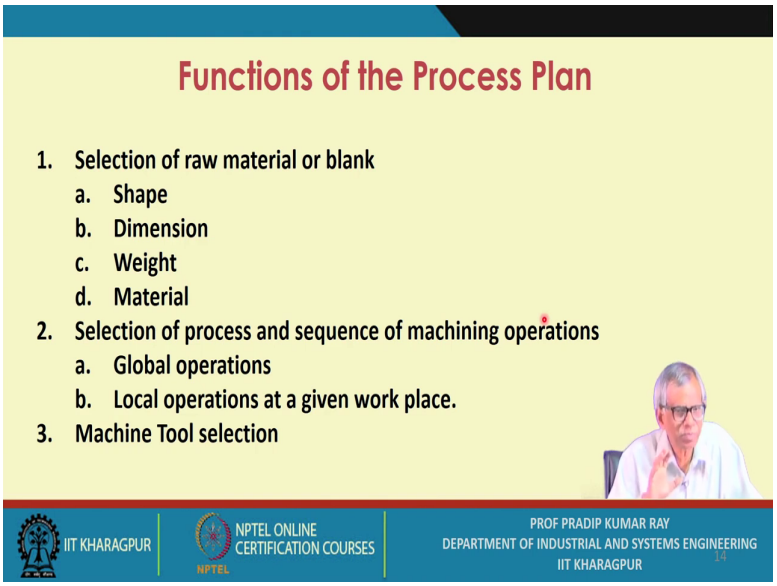

What are the functions of a process plan? First you have to select the raw materials depending on the type of part you produce. While you select the raw material, the shape of the raw

material should be specified. These are the determining factors: the dimension, weight and the material.

Then selection of the process and the sequence of say the machining operation which includes global operations and local operations at a given work place.

Next important activity is selection of the right kind of the machine tool.

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Then we will be referring to the auxiliary functions when you prepare this document, you will be always referring to not only the primary functions, but also the auxiliary functions such as the fixtures, tools, manufacturing specifications and measuring instruments. This is basically the work holding devices.

And the 5th important point is the manufacturing times these include Setup time, Processing time, Speeds and feeds and Lead time.

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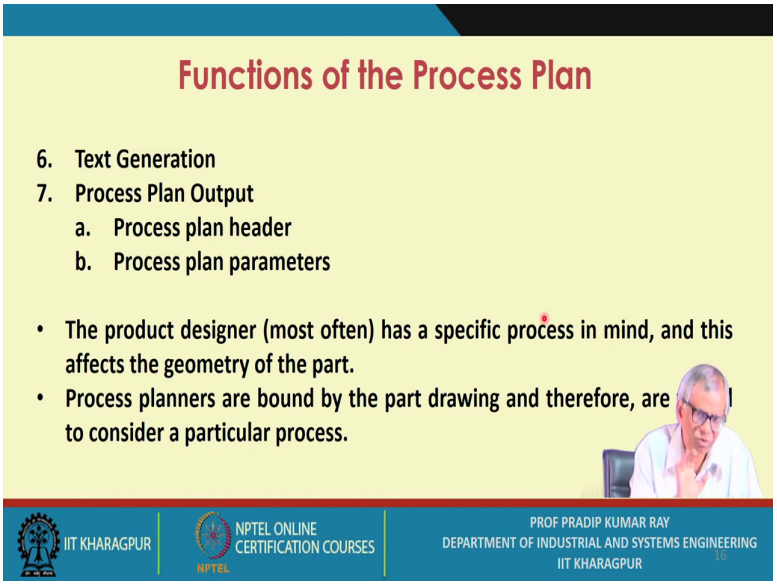

Now, the text generation document is prepared then you refer to the process plan output. This is the 7th item that is the process plan output; process plan header and the process plan parameters.

The product designer (most often) has a specific process in mind, and this affects the geometry of the part. Process planners are bound by the part drawing and therefore, are forced to consider a particular process.

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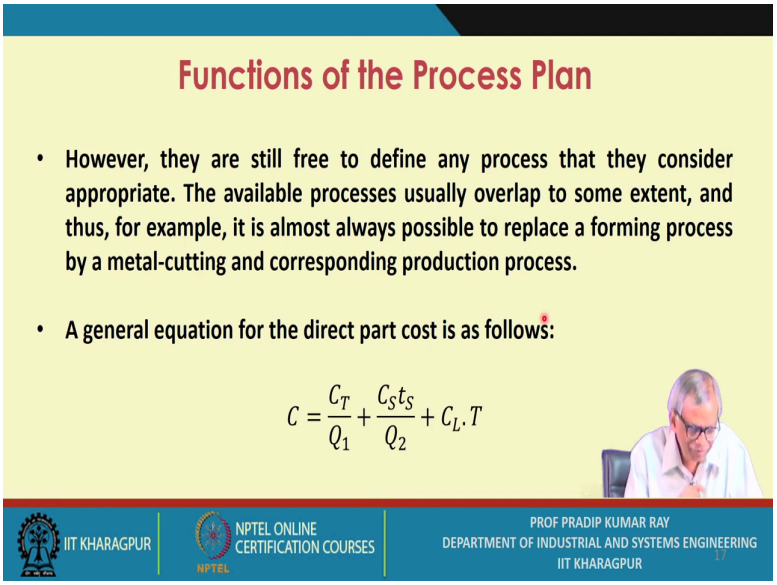

However, they are still free to define any process that they consider appropriate. The available processes usually overlap to some extent, and thus, for example, it is almost always possible to replace a forming process by a metal-cutting and corresponding production process. A general equation for the direct part cost is as follows:

$$C = \frac{C_T}{Q_1} + \frac{C_S t_S}{Q_2} + C_L . T$$

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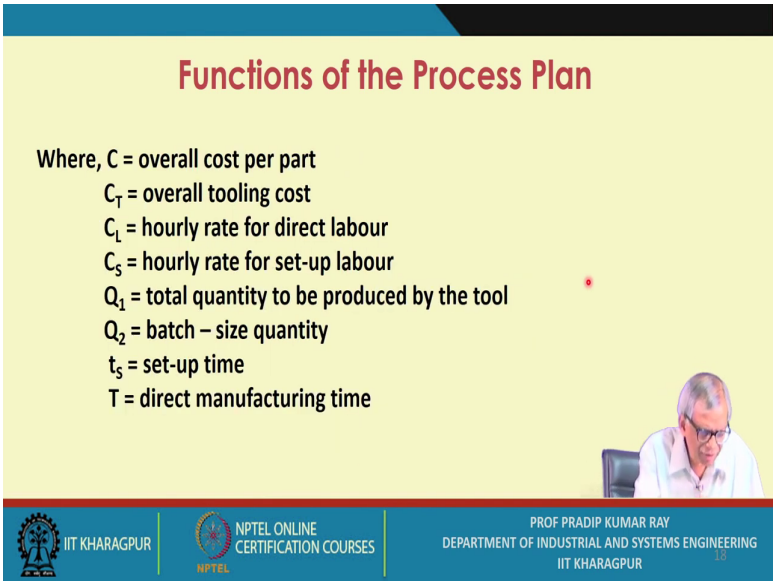

These are the cost elements you need to consider

Where, C = overall cost per part

C_T = overall tooling cost

C_L = hourly rate for direct labour

C_S = hourly rate for set-up labour

Q_1 = total quantity to be produced by the tool

Q_2 = batch – size quantity

t_S = set-up time

T = direct manufacturing time

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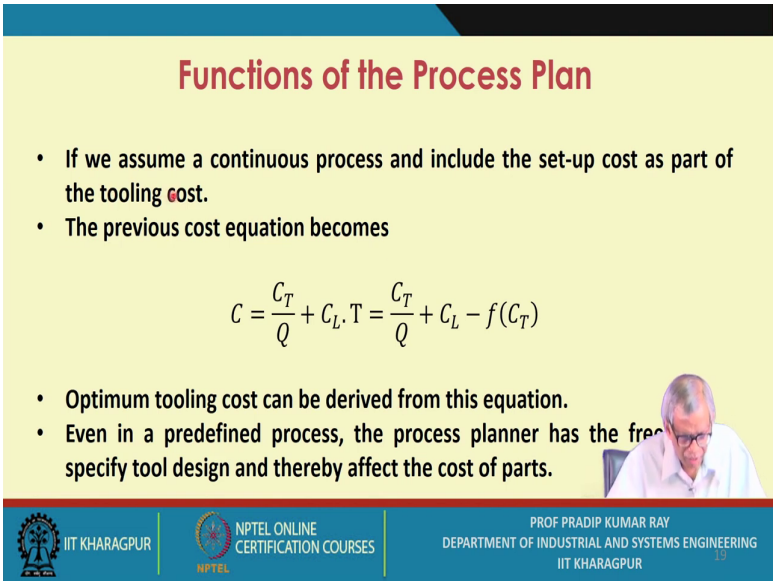

If we assume a continuous process and include the set-up cost as part of the tooling cost. The previous cost equation becomes

$$C = \frac{C_T}{Q} + C_L.\mathrm{T} = \frac{C_T}{Q} + C_L - f(C_T)$$

The optimum tooling cost can be derived from this equation. Even in a predefined process, the process planner has the freedom to specify tool design and thereby affect the cost of parts.

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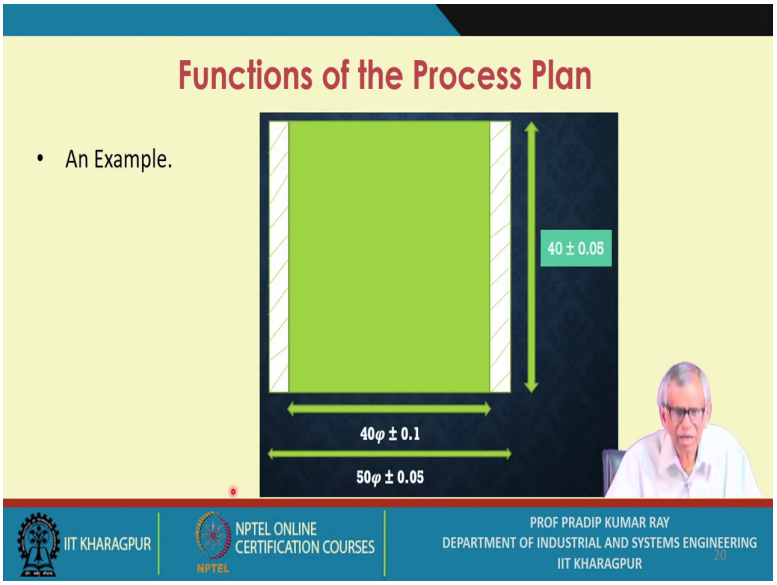

The tool design is very important aspect and when you act as a process planner it is natural that ins and outs of the manufacturing processes as well as their working.

This is an example. It is a cylindrical part and the length is 40 ±0.05 and this is the inner dia 40 ±0.1. So, these are the tolerances we have specified and this is the outer dia 50 ±0.05.

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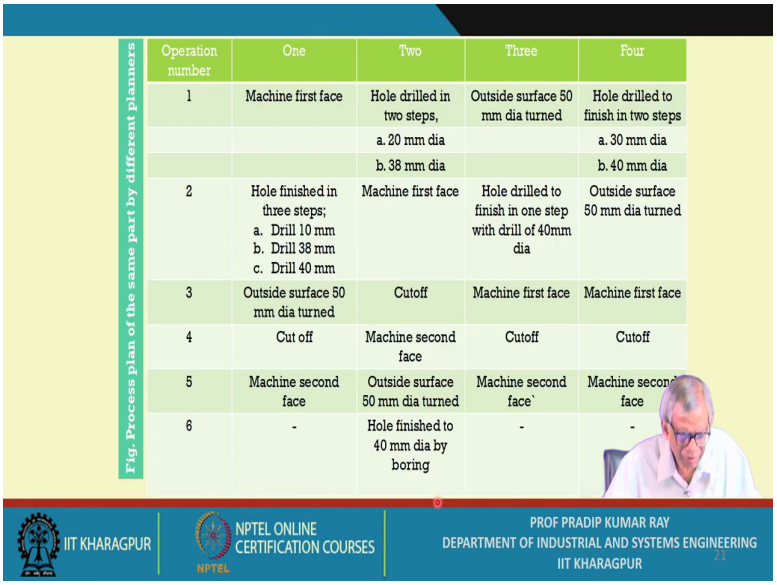

It is very simple size component. For such a simple cylindrical part. You can have four process plans

The first one is machining first for the facing operation. Against a particular operation, what kind of machine tool you need to use.

The hole finished in three steps it is not that you get 40 mm dia with one particular drill. you have first 10 mm hole then you get 30 mm and this is the finishing operations. So, this is the rough drilling followed by the finish drilling.

Then outside surface 50 millimeter turning operations you have to cut off parting that is another operation and then on the second phase on the second surface you go for the facing operations. This is one process plan and you may have another process plan. Suppose you use some other tool or some other machine tool same for the manufacturing the same part you may propose another process plan.

As you change the process plan you also may be changing the kinds of the machine tools or the cutting tools you have to use.

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