Computer Integrated Manufacturing
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Lecture No 29
Computer Aided Process Planning (part 1 of 2)

Welcome back to our course, in our course we will now move to the next module. The next module is going to be Computer Aided Process Planning. Throughout the course we were trying to see how computer is involved in reducing the lead time or in increasing the productivity. So, now we have come to a stage where and which, we have an object with us, we have to prepare the process for it as well as we have to prepare some machines, what is required along with the toolings, fixtures and process parameters.

So, in this lecture, what we are going to see is we will see how a process is getting planned and how does it get planned automatically by the use of a computer to lead to a solution, because process planning is a very-very tricky subject. So, if you choose a right process, you can reduce the cost to a big way, there are n number of ways to make a product, for example, if I say a round the shaft, it has to be made you can do it by Rolling, or you can do it by machining.

You can also do by suppose if it is a diameter large, if the L is very large, then you can also do it by casting. But it depends on the number of pieces, what you want in that particular batch. So, you can use any of those processes and today so much of advancements are happening, earlier we use to say that there are only two types of CNC machines, one is horizontal, another one is vertical. Today the technology has gone to such an extent, we are now having CNC machines, where in which both turning and milling setups can be done in one machine.

So, we are all having today Turn-o-milling setups. So, now you do not have to do turning separately and machining separately, we do it in one shot and that gives a flexibility of 5 axis. So, until and unless you choose your proper machine, a proper process, you will not be able to produce high quality products at a lower price. So, Process Planning is very important when we talk about discrete part manufacturing. So, our focus in this series of lectures, in this topic is going to be more focused towards process plan and how computer helps in this process plan.

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The content of the lecture is going to be, first we will try to define, what is a process plan? And then we will see - What is a Computer aided Process Plan? Then we will see - What is concurrent Engineering? Then we will try to move towards Design for Manufacturing. And the last step in this topic of discussion is going to be Advances in Manufacturing Planning.

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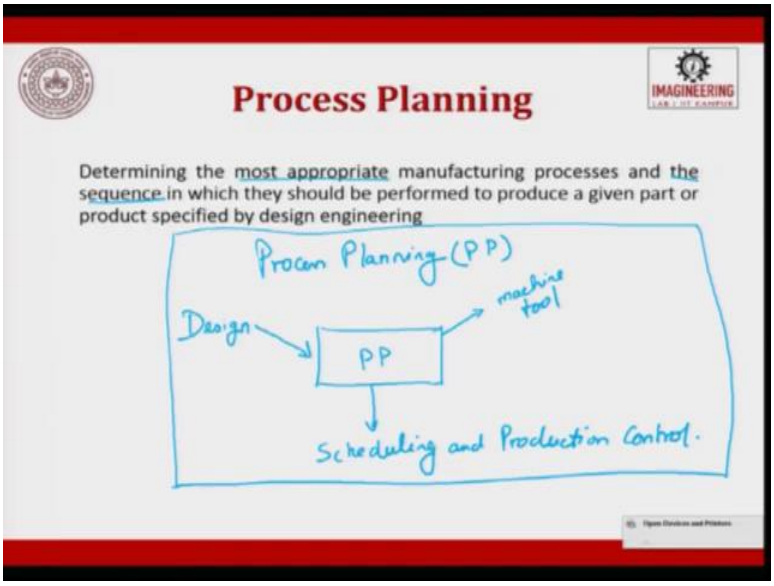

Now, let us see, the definition for a process plan. So, process plan is nothing but it is determining the most appropriate manufacturing process and the sequence in which they should be performed

to produce a given part or a product specified by design engineer. You will not go back and reiterate the design engineers drawing here, you will just listen to design engineer what he says, based on the drawing you will start looking forward for your process which can give you a process which will try to control the quality of the output.

If I want to put it in a block diagram, so process plan, I will put it in a acronym, so process plan gets input from design and then also looks at machine tool and it also looks at scheduling and production control. So, this is what if you try to talk in terms of a process plan, these are the inputs, these are the output, from a process plan.

So, process plan is nothing but determining the most appropriate, there are n number of ways of manufacturing a product, we look at the most appropriate manufacturing process and the sequence, see when we are trying to make a single process a product, for example a water bottle, which is blow molding, a comb and injection molding, plastic comb, if you want to look at a plastic spoon, again it is a single shot product.

So, here one process you get the product, but generally if you look at many products, there will be at least 5, 6, parts and these parts will be assembled to make a product, for example, if you take a car engine is an assembly, is a sub assembly they will say. So, you will have a sub assembly inside the subassembly there are n number of parts which gets inside, which will try to be assembled and you get an output.

So, here that is what we are trying to talk about the sequence, I am sure now you will be able to distinguish, it can be a part, a product, number of parts, a product, number of parts, there might be a sequence of operation and then you will also have an assembly operation. So, that is what is a sequence which we are talking about.

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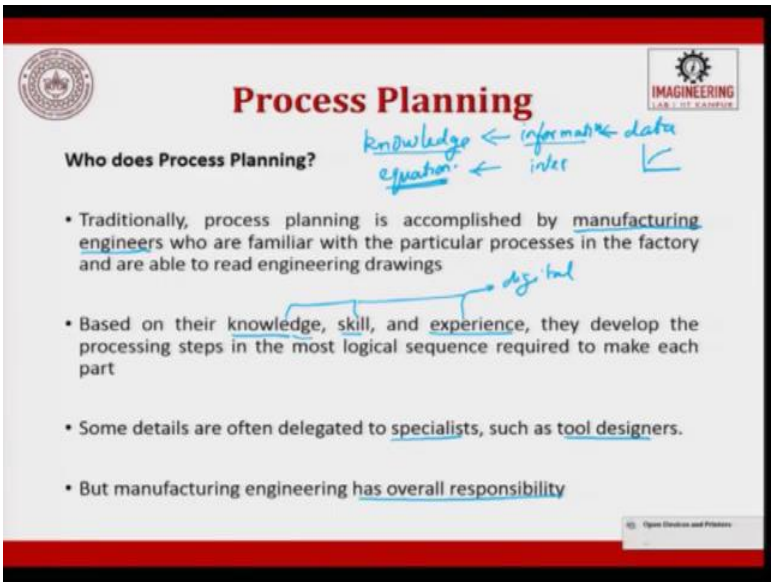

So, who does process planning for you, in an industry who does the process plan? And again process planners are highly, highly skilled job, looking at the drawing he has to think of all the processes which are involved, then in each process there will be fixtures and when he talks about a fixture, he has to look at the datum, which datum has to be fixed and then subsequent operation has to be done with respect to that datum such that, when we do assembly there will not be any problem. So, this is highly a skilled job.

Now we will see who does this process planning? Traditionally, process planning is accomplished by manufacturing engineer, who is familiar with the particular processes in the factory and are able to read the engineering drawing. So, who does a person who knows all the process? Who understands the process and who knows doing this process this is what is output we are going to get only that person can do.

So, who is he? He is a manufacturing engineer. So a manufacturing engineer, who is familiar with a particular process or particular processes in the factory and are able to read engineering drawing can do process planning. So, based on the knowledge, skill and experience, now you see these are the key points, can I convert these three points into a digital data? how did he also learn? He learn by experience and whenever he did learn something he registered it into his memory.

So, here now today the talk of the town is can we convert this knowledge into an equation? So, what is knowledge? Knowledge, so you have data or I will try to change it. So, you can have data, data leading to information, information leading to knowledge. So, more number of data, when you try to consolidate this more number of data, you get an information, lot more of information put together gives you a knowledge.

So, that means to say, if you try to take a graph, this is a graph and from the graph whatever you give is an interpretation and from the interpretation, if I can convert it into a equation. So, now this equation will store lot of data, which is compressed form. So, knowledge is that, so skill and experience I will use it to convert these are coming from the data and information.

Now, I convert this into an equation, this equation is stored, now this equation can be easily read and understood by a computer. So, based on their knowledge, skill, experience, they developed the processing steps in the most logical sequence require to make each part, many of times if you do a cooking in your house, we know that this item has to be made, but as an when we start making it, we see there are some constraints coming while cooking.

So, now then what we do is? These constraints can be limited resources, so what we do is? We try to jump from one resource to another resource, which will still maintain and give us same taste while cooking. So, what did we do? We jump from one place to the other. So, how did this come? I know a very similar effect of this ingredient, when I add to food can also be got by the other fellow.

So, now I have this knowledge, I know which one to use and so that I can go to the required output. So, that is what is process planning, cooking is a process planning, cooking is an operation, is a process. So, you are planning for it is you are also a process planner, if you are chef, some details are often delegated to specialist, such as tool designer, suppose you are very clear that, this has to be done and this is the process to be done and the die has to be made.

So, you need not have a micro-management or micro details about a die, so at that point of time you know okay I have to meet the specialist and get the data. So, some details are often delegated to specialist, such as tool designer. So, he will try to give the input based upon whatever you have passed, but manufacturing engineering has overall responsibility. So, he can go at a time base or a

skill based, he can go and meet experts and get information, but by and large it is the responsibility of the manufacturing engineer.

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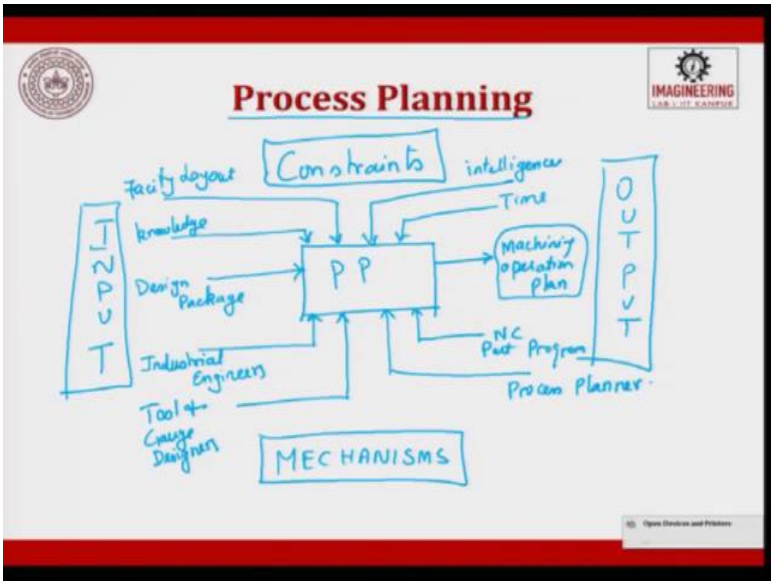

So, when we try to talk about process planning, let us try to do it, so you will have constraints, you will have input, you will have output, then you will have mechanisms. So, constraints as I told you give an example of cooking inputs, then you will have outputs, then mechanism.

So, here is a process plan, so what are all the input required, he has to have the knowledge of every process, he has to understand what are the facility layout, he has to understand Where are the machines? How are the machines? How much time to take this? Then he must have a knowledge of design packages, he should have an understanding of industrial engineering, How many people required? How many machines required? What is the cycle time? And then he should also get the input from, tool and gauge designer, tool is for machining, gauges for verifying, validating the machine depart designer.

So, he gets the input from all of them and then he is a process planner, he gets about NC, when we talk about NC part program also he gets the information and what he gives out is machining operations plan, this is what he gives, but you see I have to add some more inputs.

So, you have to put an input of intelligence and then time. So, all these things are inputs which are given for process planning and the only output what you get is machining operations plan. So, this

is what is a complete schematic diagram of all the inputs given to a process planning operation and what you get out?

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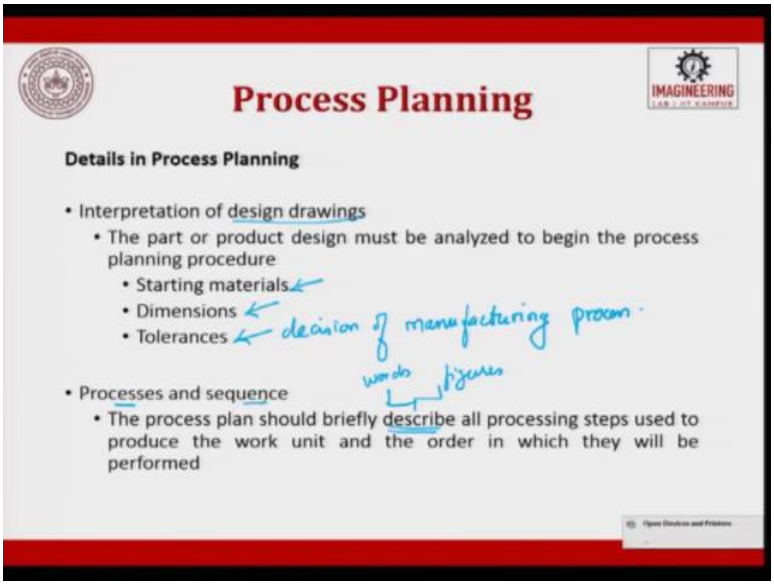

So, when we talk about the details in process planning, first is the first step is Interpretation of design drawing is very, very important. What is a tolerance? Where are the reference planes? And where these reference planes you have to place it in a fixture? And then start machining on the other surface. So, you have to understand the drawing first, so once you know the drawing the sequence of operations can be done very fast.

The part or a product design must be analyzed to begin the process planning procedure, starting material, dimensions, and tolerances, what is given in the drawing is only the output. So, for that output you have to prepare a blank. So, blank is the import raw material, which is given for the operation. So, you have to plan for the blank, but what is there is the final part dimension.

So, you have to accordingly plan the blank and when you try to plan for the blank, you also have to understand the process where the blank is made, how is it going to distribute the strength all along the part? So, understanding the starting material, understanding the dimensions of the starting material and the tolerance, tolerance will lead to decision of manufacturing process.

So, this is the first step, then what happens is? He tries to do the processes and sequence, the process plan should briefly describe all processing steps. So, you have a blank now and this blank

is getting modified at each machine and move towards the final part. So, if that has to happen at every machine, what are all the list of operations done and how all the blank is getting changed going towards the output has to be spelt out.

The process plan should briefly describe, if the description can be in words or it can be in figures, figures are very much appreciated. So, figures, all processing steps used to produce the work unit and the order in which they will be performed. So, this description will help you to understand what are the process and their sequence.

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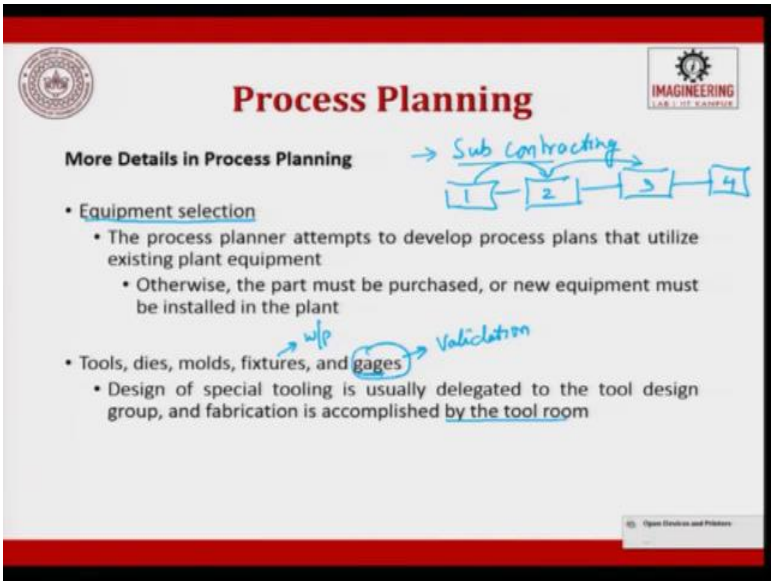

Moment you have understood the sequence, now next comes what are all the Equipments to be decided, for example you have a sheet, which is or a plate of 10 millimeter diameter, it has to be cut, it has to be cut, along a straight line. So, you can do it by water Jet cutting, you can do by plasma, you can do it even by shearing machine. So, any of the three you can choose.

Now, if you are getting a complete plain rolled, complete bundle from there you have to extract the plate of 10 millimeter and make it into a flat pieces blanks for further operations, then three of these processes can be done and now you have to choose the best one for your product and then each machine, what are all the sequences involved and what are all the tools involved.

So, equipment selection is the next big challenge, the process planner attempts to develop process plans that utilize existing plant equipment, if it is not there whether to go for a sub contract or if it

is not there whether the company should buy the machine, all these things will be decided by him and it will be suggested.

Otherwise the part must be purchased or new equipment must be installed in the plant. Today there is a concept of sub-contracting, that means to say let us assume there are this is a part, which undergoes four steps, 1, 2, 3, and 4, towards the final output. So, first I will try to get the blanks from some vendor and start doing the operation 2, 3, and finally I will get 4. Suppose I do not have a machine for two, then what I do is? I try to shift the blank whatever I get, pre machined from the vendor itself.

So, then I do only three and then four to get the final product. Suppose if the machine 3 is also not available, it can be unavailability of machine, it can be that your production rate is slow, you need lot more pieces to be, to produce to meet out your targets, then you will shift it here. So, now what is happening, the blank which was supposed to be got it, first stage is now shifted and gone to second stage, and third stage.

Now, in your company would old only the fourth stage. So, who takes this decision of subcontracting is also during the process of process planning by a manufacturing engineer. So, otherwise the part must be purchased that is what I said, the blank which was the got it at first stage, now it got a third stage. Moment you decide only this process.

So, now tools, dies, molds, fixtures, fixtures are to hold work piece, so if it is a Prismatic you use 3, to 1 principle, we will see that later, if it is a cylindrical job you do not have to use. So, it is a challenge. So, fixturing is also very important, so you will try to choose the tools, dies, molds and the fixtures, and the gauges. So, gauges are only for validation of what was given in the drawing and what you have made how is it that is all gages. Today we have machines have automatic gauging systems.

So, we need not put a gauging station separately, while mashing itself it has a control over it. So, the other information what we need required is tools, dies, molds, fixtures, and gauges. Design of special tooling is usually dedicated to the tool design group, and the fabrication is accomplished by the tool room, same when you have a tool to be modified you might also require a gauge to be

modified to measure the output. So, the room will also be used to modify the existing gauge, so that it can measure the output.

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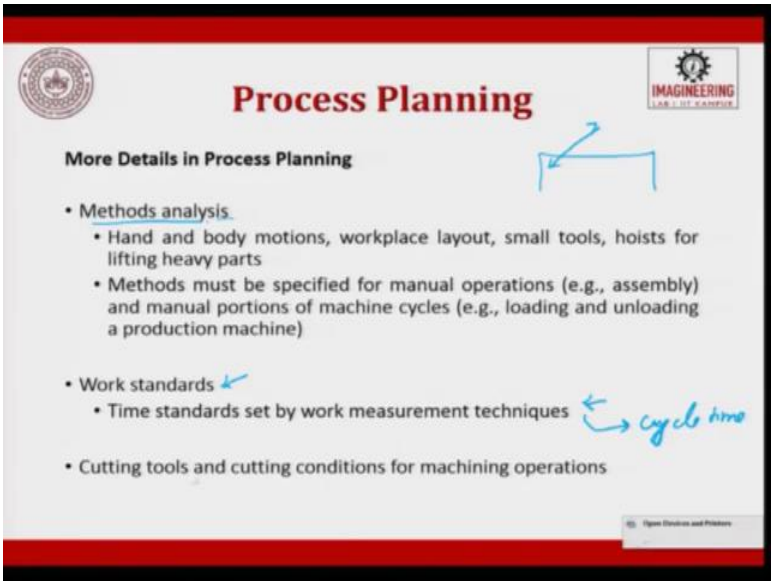

Then we try to do the next study which is Methods analysis, while processing in a machine, what are all the speeds, speeds, depth of cut and what should be the motion, which is given by the operator in converting a raw material into a finished product. So, method analysis such as, hand and body motion, because in a factory you are not going to produce one piece are two piece, may be hundreds, or thousand pieces, when it is hundreds and thousand pieces, every time an operator has to bend a load, unload, which is a tough job.

So, what we do is? We also do a method analysis of hand and body motion, workplace layout, small tools, hoists for lifting heavy parts, how are they going to be place near the machines, such that they can be produced, for example if you have an overhead crane, the overhead crane will always come on a gantry layout.

So, now, this can only move across the factory layout, so now it can go to discrete parts pick, do a vertical lift and then move towards the experiment and then it will download. So, all these things we are supposed to think and that is called as Methods analysis, method must be specified for manual operation, example, assembly and Manual portion of machine cycle, loading and unloading has to be all done.

So, this person will also try to talk about whether to automate a machine and while automatic the machine, what are all the operations the machine will do? Then a work study will be done to measure the efficiency of the operator, which will lead to cycle time for every process, then cutting tools and conditions for machining.

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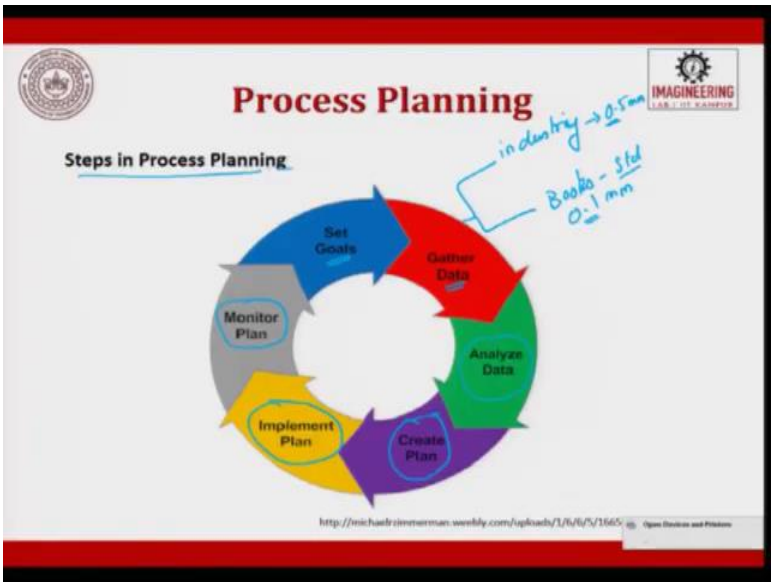

So, if you look at it, these are the following steps in a nutshell, you will be doing, so one is set goals, then for the set goals, you will try to gather data, this data can be of 2 phase, 1, it can be within the industry in your industry or it can be from books, which are standards, suppose you have a very old machine, the book says the tolerances is 0.1 millimeter, but you have very old machine, you know it is not going to come.

So, you go give a tolerance of 0.5 millimeter, so that is what is a gathering of data for the particular process from the book and looking into the machine what you have, looking into the limitation of the skill what the operator has, you decide a tolerance. So, gather the data, then you try to analyze the data, then create a plan, then after creating a plan, we try to implement the plan and see, moment you have implemented a plan, you are also supposed to review the plan whether it is producing the required output what you wanted.

So, what I do? I try to monitor, monitoring is nothing but monitoring and validation comes into existence and moment this is done then what you do is? You know your limitations, you know it

can be improved, then you set for a tighter goals. So, then this is a cycle, which keeps on going, continuously in an industry. So, these are all the steps which are involved in process planning.

So, set goals, then gather data, analyze the data, then you create the data, if you look at it data, information, knowledge, create the plan, implement the plan, when you create a plan you will have 6 or 7 different ways on doing it. So, you will choose the best and implement one and see, whatever you have implemented 1 out of the 6 was done. So, now you will try to monitor, whether your choice was right and if it is right to keep going, if it is wrong again reset. So, these are the steps, which are involved, from process planning.

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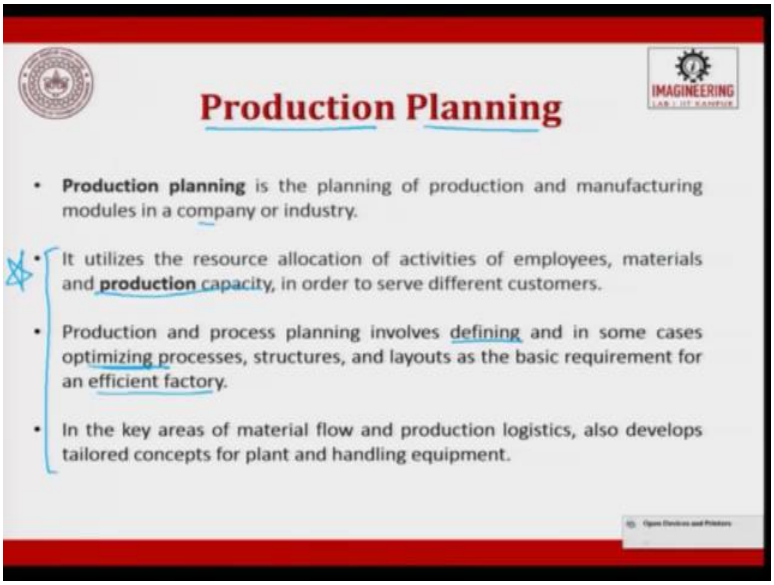

Now, let us move to the next topic, which is Production Planning. Production planning is the planning of production and manufacturing modules in a company or an industry. People always try to confuse or people try to use this acronym, that acronym together P, P when we say people say process planning, some people say production planning. So, production planning is the planning of production and manufacturing modules in a company.

It utilizes the resource allocation of activities of employees, material and production capacity, production capacity, important word, in order to serve different customers. I repeat this is a very, very important thing, it utilizes the resource allocation of activities of employees, materials and production capacity in order to serve different customers.

There are 8 customers waiting for your product. So, how are you going to cattle to all the 8 people? Are you going to give all of them together or are you going to give one after the other after the other? That is what is talked about. Production planning is for example today you have this after the online purchase, you see a delivery boy coming and delivering it in your house.

So, how does he plan that? Is he going to collect everything in that particular area, put it that in his bag and come, or is he going to take okay I will take only heavy items and go deliver it, or light weight items, or high volume items. So, that is what or high cost items, so if you see that he is trying to plan and he is going to take those deliveries put it in. So, that is nothing but a planning, here it is delivery planning.

So, in the same way production planning, production capacity what is the capacity when we talk about this the courier boy? Is the weight what it can he can take and the number of customers he can handle in a given point of time. So, that is what it is. So, then production and process planning involves defining and in some cases optimizing, defining is different, optimizing is different, defining is you define I need to get to this place, optimizing is how quickly I get to this place is optimizing.

So, production and process planning involves defining and in some cases optimizing processes, structures, and layout as a basic requirement for efficient factory. How do I place the machines? How is an operator going to run between the machines? Am I going to take part by part and then move from machine to machine, am I going to do it in a lot sizing, that is what is all talk about optimizing processes, processes here I am talking about in terms of handling is also a process.

So, processes, structure, layout as a basic requirement for efficient factory, in the key areas of material flow and production logistics, also develop a tailored concept for plant and handling equipments. So, this are the 3 points, which is important and the most important thing is, it utilizes the resource allocation of activities of employees, material and production capacity in order to serve different customers is production planning.

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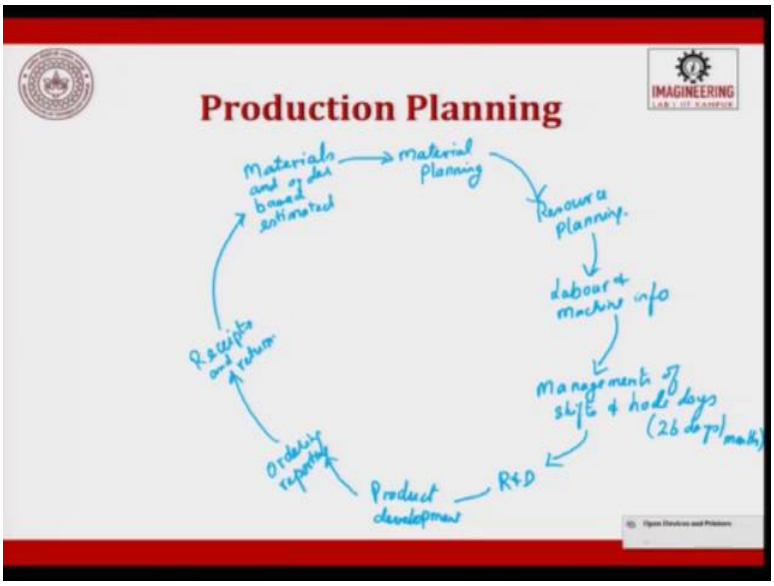

So, let us see the cycle for production planning, so materials and order based estimated. So, from that, what we do is? We do material planning, for example in a house where there are 4 members in a house, how frequently you need to go to market and buy vegetables, to run your home, how frequently you have to go buy milk in your home in a day,3 times, vegetable will be done weekly once, how many times will you go to market to buy butter?

Once in 15 days, how many times will you go to market to buy cashew nuts? By once in a month, or once in 3 months. So, that is what is material planning, and how did you decide why so much of variation? Because it depends on the perishability, it depends upon the cost, should I buy 1 kilo and keep in inventory for rest of the year, or should I buy only hundred grams? That is materials planning. So, from the materials planning, we try to do other resource planning, then we try to do labor planning.

Suppose if there is a marriage or there is a function, how many labors to be called, how many machines to be engaged, machine info, then we will have management. So, you decide that you need, so many men power for producing it, then all the manpower cannot be called in one shot. So, you will have to batch them and stagger when ask them to come, so you will have to manage their shifts and holidays, because holidays are very important and labor cannot work more than 26 days in a month.

So, suppose let us assume, your running a canteen, the canteen has to run for all 30 days. So, now how are you going to plan the operators? So, you cannot have exactly one is to one map, you should have some extra n plus few. So, that is what is for and holidays and shift management, then you will have to also do R & D, then you develop product development happens, then you have ordering, order reporting happens, then you will have receipt and returns, you have to file and this goes to estimate.

So, this all the steps are involved in process plan, when material should come, what are all the resources planning, then labor, how much labor should be done, when should they comes. So, if there is always a mistake, then R & D has to be done, then develop some small changes in the product, then you will try to figure out what are the ordering points, after you have ordered the material has come. So, now you have to accept the material as well as enter it in the main stocks. So, receipts and returns have to done. So, the materials, which have come based on to this, this is a complete cycle which keeps on going for production planning.

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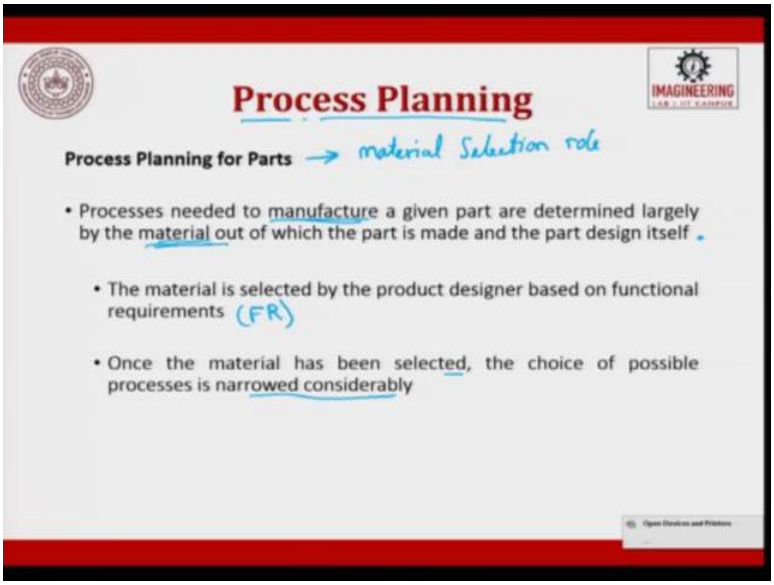

So, when we talk about process plan, the process planning, for a part, the processes need it to manufacture a given part are determined largely by the material out of which the part is made and the part design itself. So, here the manufacturing process is dictated by the material selection and whatever is in design drawing, which is given to you. The material is selected by the product designer based on functional requirements.

So, functional requirements (FR), so if you look at the customer voice, voice of the customer understanding there itself, we put this functional requirements and this functional requirements will try to dictate, what part, what processes has to be used, what material has to be used, once the material has been selected, the choice of possible process is narrowed considerably.

So, the material selection is very, very important, for process plan, material selection plays a very, very, important role, role is very important, this material selection will lead to manufacturing, moment the manufacturing is identified not much of change in your process plan.

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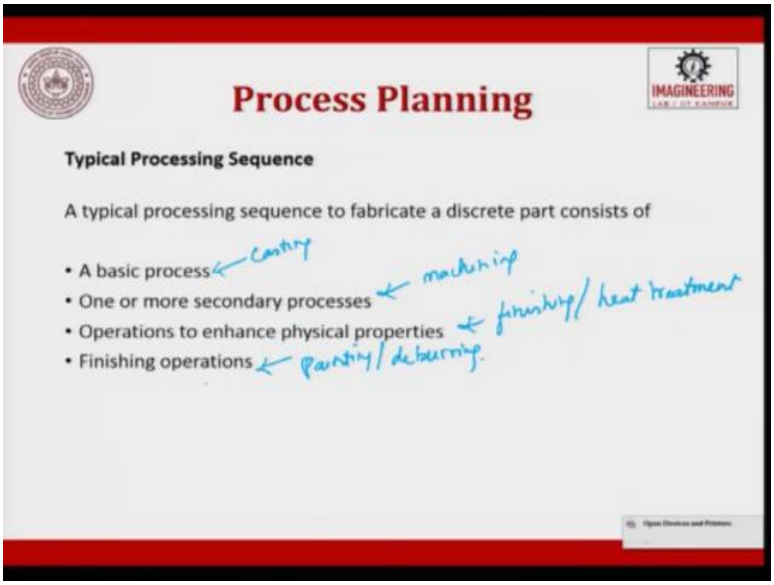

So, Typical Processing Sequence, first will be a basic process we will understand, then what we do is one or more secondary processes we will do, then operations to enhance physical properties and finishing operation, for example casting, let take a simple example it is casting, then we do secondary operations is machining, then we try to do finishing, or we try to do heat treatment enhancing, see it and then finally we try to do painting, or deburring whatever it is.

A typical process sequence to fabricate a discrete part consists of, a basic process, then secondary process, then enhancing the physical property of the part, and then finally finishing, these are all the typical steps, which are involved.

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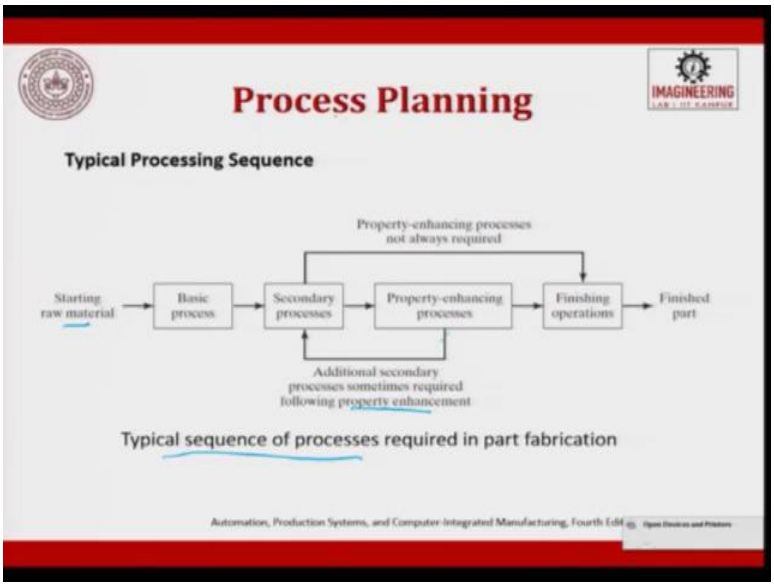

So, starting raw material, basic process, secondary process, then we try to do property enhancing process, I said it can be additional secondary processes sometimes required following property enhancement, or it can be even heat treatment whatever it is, after heat treatment it can do 2, 3, stages of heat treatment.

So, you try to play with time, temperature, you try to get different micro structure, if you feel the heat treatment it is not required, you directly jump to the finishing operations and then go for the finished parts. So, these are all the typical sequence of operation, which are involved in process planning.

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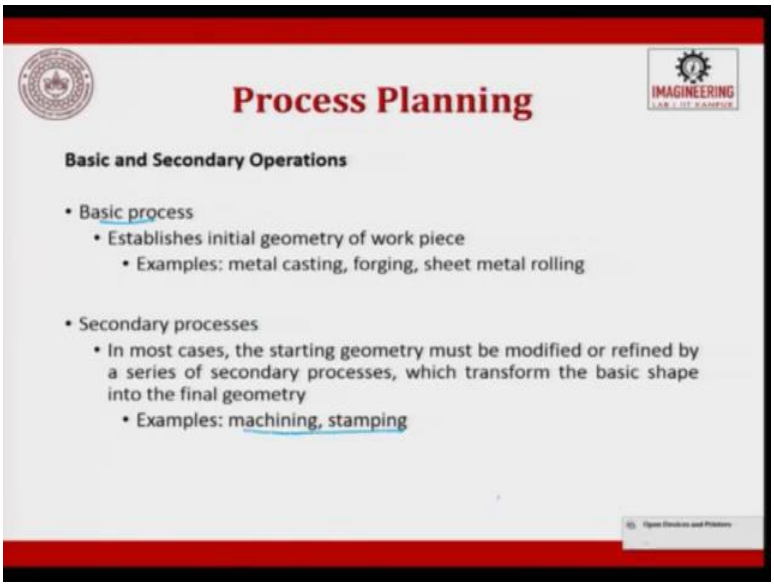

So, when we talk about the basic process is established by initial geometry of the work piece, it can be a casting process, forging process, sheet metal making process, whatever it is. The secondary processes can be machining, and stamping as I told you, which tries to convert a blank into a part as required.

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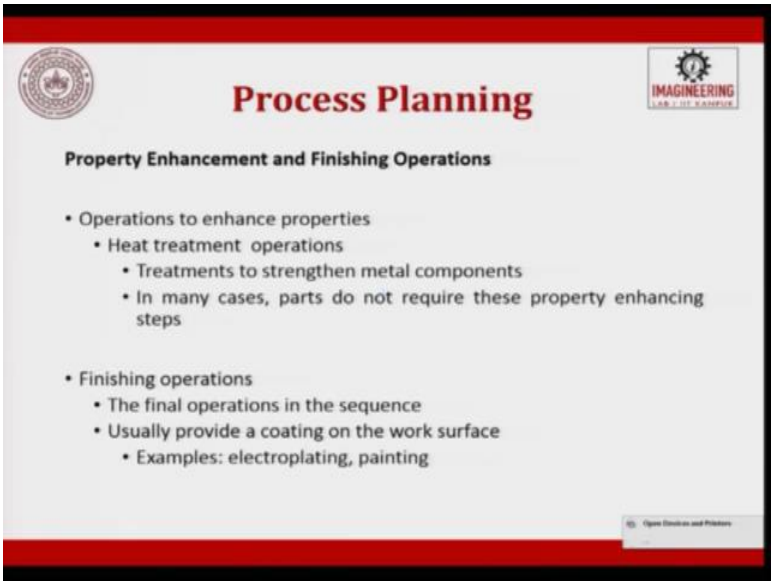

Then heat treatment, I have already discussed and then finally, it is painting, coating whatever it is, anodizing all these things happened.

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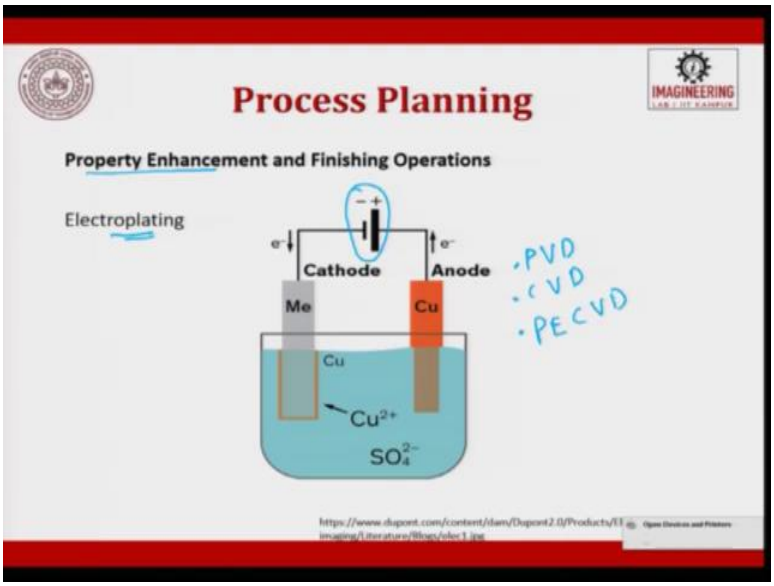

So, Property Enhancement, and Finishing Operation, one such property enhancement, is electroplating also, I was always talking about heat treatment electroplating, electroplating is you have a power supply to Anode and the Cathode, wherever there is a anode. So, you can see the material given and wherever it is a cathode, you can see a deposition happening. So, you can see Copper getting coated on top of this emit.

So, this is electroplating, so electroplating is nothing but to give a protection or to give a color, or to enhance the surface properties, for example tribology and then high temperature all these things can win, you can also do a vapor deposition technique rather than electroplating you can do physical vapor deposition, you can think of chemical vapor deposition, you can do plasma enhance chemical vapor deposition. So, many processes are coming up today.

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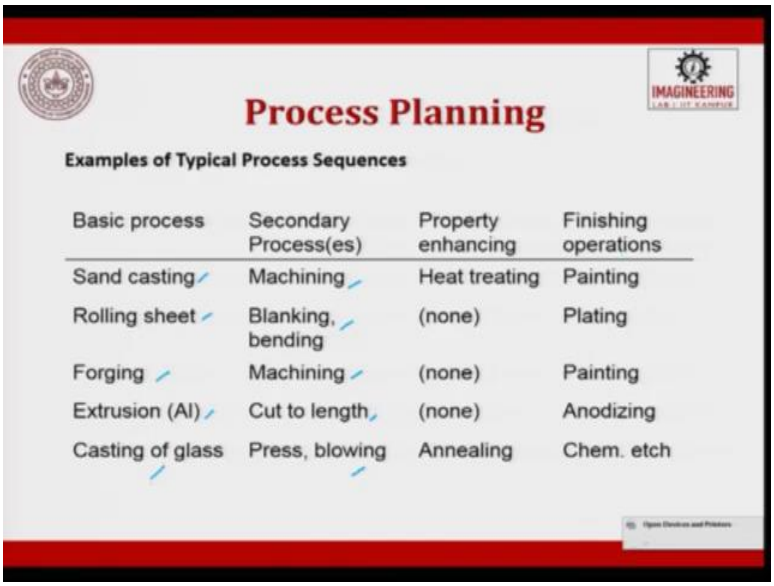

So, when we talk about the typical processes, just an over view, you have the basic process can be Casting, Rolling, Forging, Extrusion, and Casting of glass. The secondary processes can be machining, when we talk about rolling, it is blanking, it can be that is sharing or bending, forging it can be machining, cut off length and the press and blow is only exclusive for glass.

So, blowing is, if you want to make a glass, a bulb, incandescent bulb, so what we do is? We take glass and we blow glass. So, that is what is blowing. Press it is nothing but making Petri dish. So, we press put a blow press it there. Property enhancement, heat treatment, Annealing is also there, painting, Anodizing and other chemical etching process are done to get to go towards the final product.

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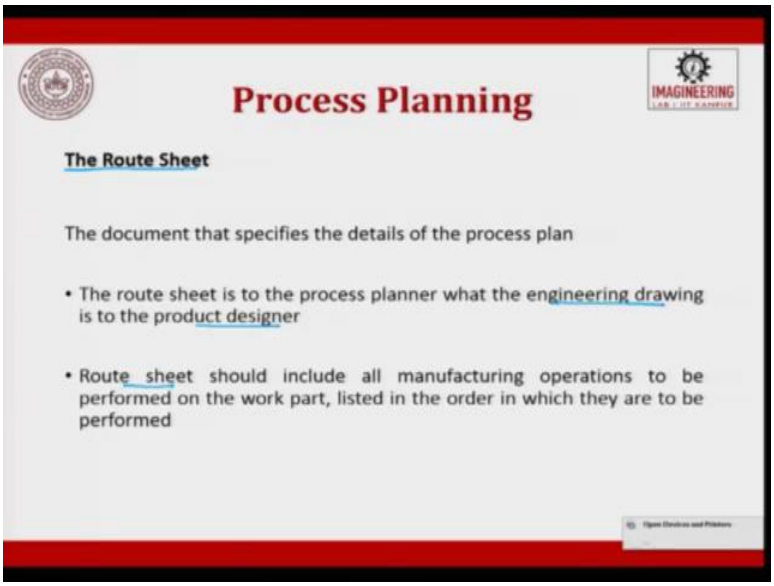

There is another important thing which comes in process planning is a routing sheet, the document that specifies the detail of the process plan. So, routing sheet is to the process planner, what the engineering drawing is to the product designer, routing sheet should include all manufacturing operations to be performed on the work part, list in the order in which they are to be performed.

Today you can do all these things digitized, when we talk about the ERP software MRP software, ERP software, what happens for every part, there is something called as a routing sheet and you just put the part you get the complete routing sheet online, it can quickly try to tell you.

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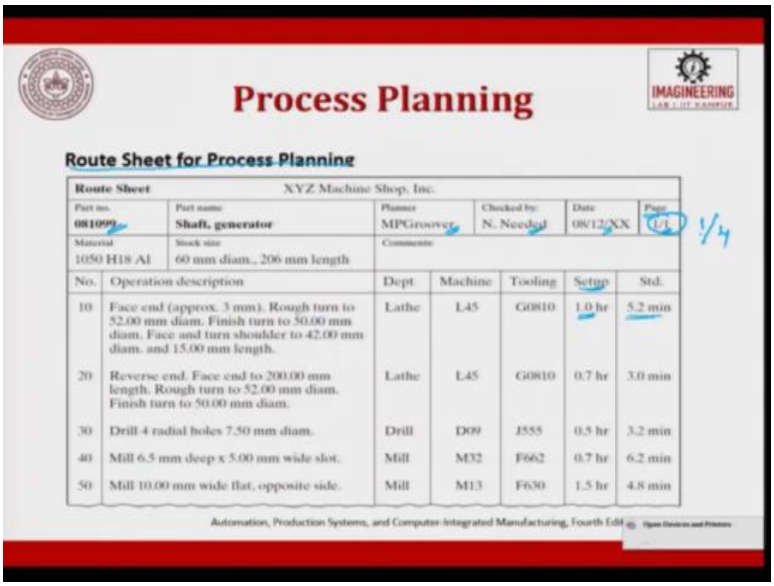

This is a typical route sheet for process planning, for example these are the operation number, this is the description of the operation, this is the department in which the operation has to be done, in the department which machine to be used, in this machine what tool to be used, what fixture to be used, what is the standard, that means to say what is a cycle time. So, setting time, so this is a tool, which is to be used on this machine to produce the part,

So, now when the tool is there, so it has the tool has to be set for setting let's say whenever it takes for producing 1 piece it is 5 minutes. So, here in which you try to say which machine, which department, which machine, what tool, how much time it is going to take to load the tool, and after loading the tool, how much time it is going to take for machining the job 5.2.

So, like this the entire detail will be given, if you look at it, this is the part number, because to write the part number by name, it is going to be because if you take an automobile there are 10000 pieces, if you take a rocket, there are more than 1 lakh pieces, Aerospace, aeroplane, it is more than 10000 pieces, of pieces or different parts, when I say pieces is different parts.

So, it is very difficult to write name, so what we do it is? We give a number, when you are a student you get a roll number, it is something like that part number. So, then we try to write who is the planner, who was made this, who has check this information, when he has checked ,what is the data? They see this is a very interesting way to write one by one, suppose if they write only page

1 and we do not know, whether there is a page 2 page 3, page 4, for it. Suppose if we write it as 1 of 4, then you know there are 3 more sheets to be followed.

So, this is the best way of writing, when we try to make notes also, when there are bundle of papers we just say 1, 2, 3, 4, we do not know if the last sheet is missing, you do not know whether it is missing or there, in between some sheet is missing, also it is very difficult for you to figure out. So, if you write it as 1 of 4, 2 of 4, or 3 of 4, or 4 of 4, then you know okay, there are there should be only maximum 4 sheets in this bundle, all the 4 sheets are there.

Suppose if there is 1 sheet coming from another bundle. So, then you will, if the number matches then you are it is misleading information. So, it is very nice to see, so this is talks about the material and what is the stock, these are all the operations, this is a typical routing sheet, which is done by a process planner.

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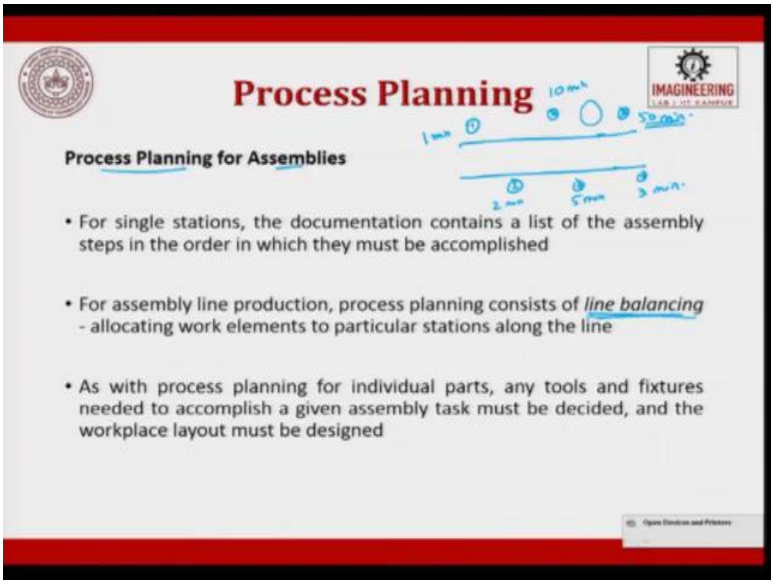

Then this is for a single part, as I told you for a complete assembly if you want to do process planning for assemblies is also done. For a single station the documentation contains a list of assembly steps in the order in which they must be accomplished. For assembly line production, for example a car getting assembled along a conveyor belt it moves, it gets assembled.

So, first in a car what happened, they put a shuttle, then there will be a bottom assembly which is done on the shuttle, then the shuttle moves from station to station to station at each station, there

will be parts added. So, that you get of complete car, for assembly line production, process planning consists of line balancing. So, that means to say so you have a conveyor. So, there are several machines, which are there.

So, now what we are trying to say is, if there are 6 machines and if you try to take 1 minute here, 10 minutes here, and 50 minutes here, and let it be 1, 2, 3, 4, 5, and 6. So, now here, it takes 2 minutes, here it takes 5 minutes, and here it takes 3 minutes. So, if you look at it this machine would have done his all these machines would have done his operation, but this machine where there is 50 minutes of time, which is the fifth station.

So, it is going to take 50 minutes, now all the other machines will be Starving for a new product to come until this fall of finisher set. So, now we have to balance the line such that almost all the cycle times are uniform. So, that is what is called as line balancing, how do you do line balancing? You add more machines or you add inventories in between, both ways you can do.

So, for assembly line production, process planning consists of line balancing, allocating work elements to a particular station along a line, as with the process planning for individual parts any tools and fixtures needed to accomplish a given assembly task must be decided and the workplace layout must be designed. So, you plan the machines, you plan the cycle time and you plan the operations which has to happen and then you try to see, what is to be done in the process planning.

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So, what are the objectives for a production planning, its objective should be effective utilization of resources, steady flow of production. So, that means to say throughout the month all 3 shifts they should give employment, eliminate the resources, unnecessary resources whatever it is there, then ensure optimum inventory, because inventory should not be there for a long time, because inventory is nothing but you have invested money of brought it and holding it without utilizing it.

So, ensure optimum inventory, coordinate activities between the departments, minimize wastage of raw material improve labor productivity, labor productivity means, output by input and input should be minimize, man, material and machine, so, on and energy whatever it is. So, you minimize, to minimize man, machine and material to get the required output.

So, that is productivity, so help to capture the market, then provide a better work environment is very important, because if you make a factory where it is not healthy working condition. So, then it is not good, so that is also responsibility for the production planning, facility facilitates quality improvement. So, there has to be tools, when we plan, fixtures when we plan, you also plan for gauges, that is 1.

So, that is what is quality improvement we are talking and rather than offline quality measurement you try to make it online quality measurement, then results and customer satisfaction reduces the production cost all these things are objective of the production planning. So, you see how

interesting it is, it is not only to produce but produce for the minimum cost and get maximum satisfaction from the customer. Thank you very much.