Product Design and Manufacturing

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Lecture – 31
Computer Integrated Manufacturing (Part 2 of 2)

Welcome to the course Product Design and Manufacturing.

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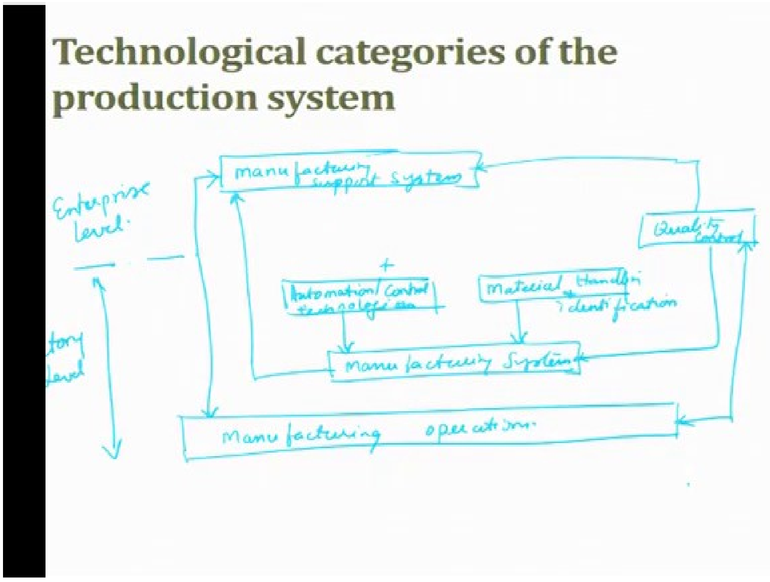

Topic of discussion is technological categories of production system. Here we will have manufacturing operations and then we will have manufacturing systems, manufacturing support group, you will be able to distinguish what we are talking about manufacturing support system.

Here you will have two more system.

- Material handling.
- Automation control technologies.

Here you will have a talking with this dialog between manufacturing operations and the supporting system. And then you will have dialogue between the manufacturing systems and the support system then you will have a link from here where in which we have not touched a new topic called as quality control.

Here manufacturing support group, manufacturing systems and manufacturing operations, quality control systems and you have handling and identification. So, I can divide this into 2 levels, this is called as

- The factory level.
- The enterprise level.

So, these are the technological categories of production system.

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In manufacturing operation, we will try to see manufacturing industries and products, we will study about manufacturing operations, production facilities, product and production relationship , this is a part of manufacturing operations.

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When we talk about industry the industry is divided into

- Primary industries.
- Secondary industry and
- Tertiary industries.

  - Primary industries are industries in which there is cultivation or exploitation of natural resources, is falling under primary industries.
  - The secondary industries are manufacturing, power generation and construction industries are secondary industries in which the output of the primary is converted into a useful product.
  - Tertiary industries are those industries which are predominantly focused on service sector.

So, you have to identify which industry you fall in and accordingly you have to look forward for automation, in service industry, you have banking, education, government, legal service, retail trades and transportation.

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When we talk about manufacturing operations there are certain basic activities that must be carried out in a factory, to convert a raw material into a finished product.

For discrete part products,

1. The processing and assembly operations are part of operations carried out.
2. Material handling.
3. Inspection and testing.
4. Coordination and control.

So, these are very important for discrete part manufacturing and in all of our discussions we are more focused towards discrete product manufacturing. The manufacturing operation is nothing, but basic activities that must be carried out, convert in a factory to convert raw material into a finished product.

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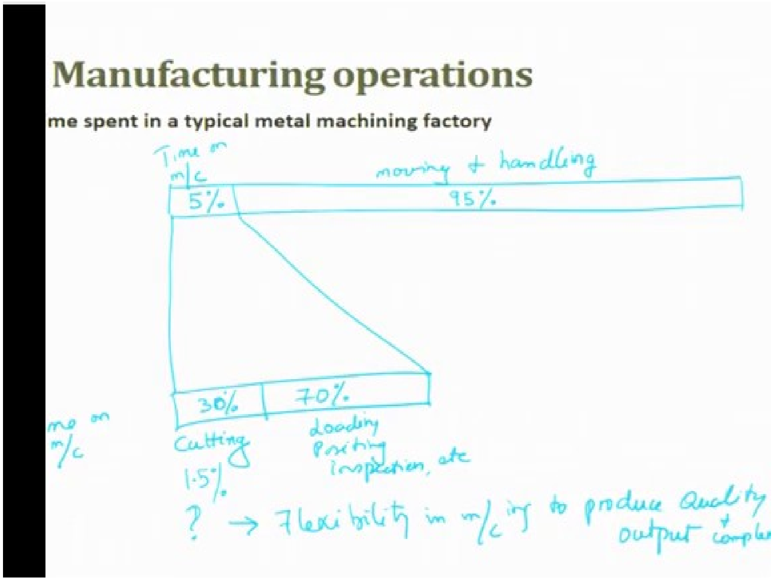

When we look at the time spent in a typical metal machining factory, it is pretty interesting and it is also an eye opener for us. So, if you take this as 100 percent, time on machine, the job spends this much time on the machine and the rest of the time it is used for moving and handling a job inside a factory.

what is this? This is around about 95 percent and 5 percent is used for machining. Now, interestingly this 5 percent is also divided into 30 percent and 70 percent .30 percent of the time is cutting and the rest of the time is loading, positioning and inspection etc.

This is time on machine. The time spent in a typical metal machining factory, 5 percent of the time only the objects spends in machining, out of this 5 percent again 30 percent, means 1.5 percent of the total 100 percent of the time is spent by a part for metal cutting.

Why CNC? Because, automation will reduce this moving and handling, automation can reduce this loading and unloading. So, this is a tradeoff. Even today people buy CNC machine, because it gets into a freedom of flexibility in machine, in machining to produce quality output. This is interesting, because we want a quality product and the complex geometry, for complex parts we go for CNC machines. At one point of time where people thought of Geneva mechanism has to be made by CNC machines. Today people have started making the same using template machining and they do it on a conventional machine.

there are lot of changes which are happening. Even in the automobile, in the hard automation new machines are coming up so, that it can be used for making complex jobs.

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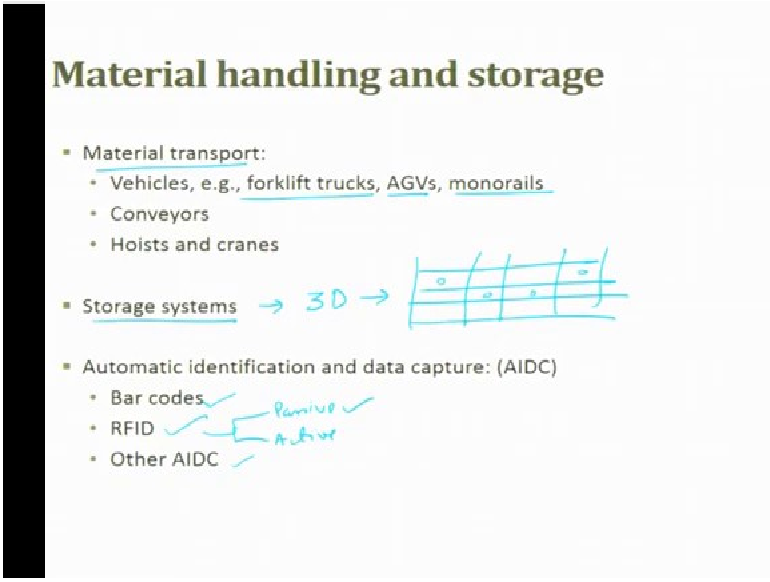

When we talk about material handling and storage it is

- Material transport. So, vehicles such as forklifts, AGVs and monorails are used, conveyors and hoists and cranes are used for material transport within the factory,
- Storage and retrieval system is also there. So, here we talk about 3 dimensional space, so, it is basically an array is made and start dumping parts wherever you want.
- Automatic Identification and Data Capturing, AIDC it is more of barcode, RFID and other techniques.

Bar code is very common today when you buy any product you see a barcode, by reading the barcode it is able to recognize the product name and when you read the barcode, the system finds out which day it was produced and what time it was produced everything is there in the barcode.

RFID are used for checking whether it is present absence and slightly for other purposes also. There are 2 types of RFID; one is passive RFID, another one is active RFID. Today, passive RFIDs are exhaustively used for checking whether the item is presence or absence or it is getting moved out of a particular area or not.

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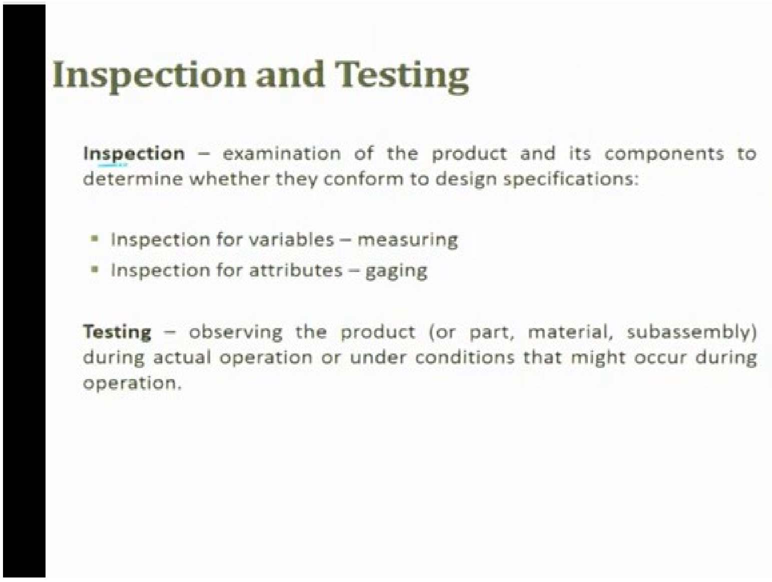

<u>The inspection and testing:</u> inspection is something in which the product is getting validated, examination of the product and its components to determine whether they conform to the design specifications.

- Inspection of variables and
- Inspection of attributes

are possible, in inspection of variables, you try to measure the dimensions, inspection of attributes are defective, non-defective etc. Testing is nothing, but observing the product.

During actual operation or under conditions that might occur during operation is called as testing. Inspection and testing are different, the examination of the product and its components to determine, whether they conform to the design specification is inspection. Observing the product during the actual product operation or under condition that might occur during operation is called testing.

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Coordination and control: regulation of the individual processing and the assembly operations. This is part of coordination.

- Process control and
- Quality control.

The management of plant level activities are production planning and control and quality control. So, coordination and control is also the another thing.

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Processing and assembly, material handling, inspection and testing and coordination and control, these are the varying manufacturing operations which are conducted in a factory.

When we talk about production facility; a manufacturing company attempts to organize its facilities in the most efficient way to serve particular mission of a mic of the plant. Certain types of plants are recognized as the most appropriate way to organize for a given type of manufacturing. The most appropriate type depends on type of products made, production quantity and product variety. The most appropriate type depends on the facility.

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The number of units of a given part or a product produced annually by the plant leads to the production quantity. These are numbers which are tentative in nature. So, the lower production can be even 1 to 10, here they say 1 to 100 units, it depends on the product, when we talk about medium it is 100 to 10,000, higher production is anything about 10,000 to million. These are the categories generally people try to do while talking about production quantity, by looking at the production quantity, the layout of the factory is changed, the machine purchase is changed, hard automation-soft automation is look forward and everything comes into. So, production quantity plays a very important role even in understanding the plant layout.

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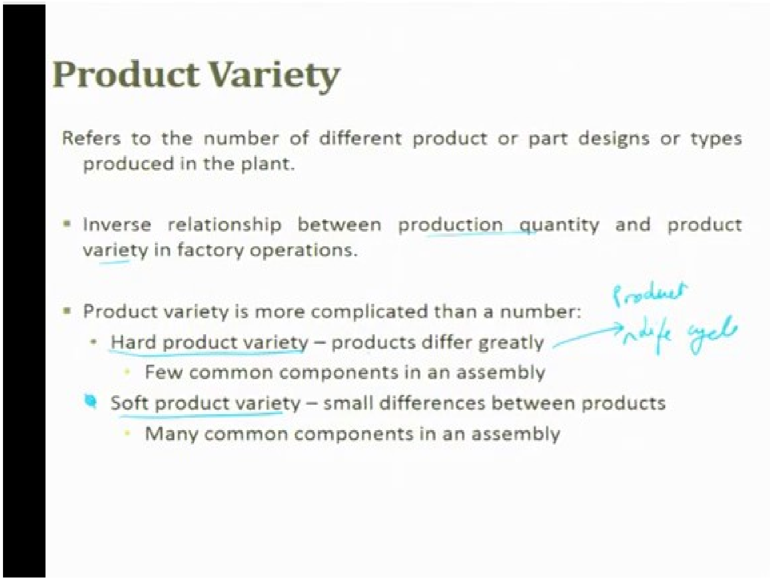

The product variety refers to the number of different products or part design or types produced in a plant. Inverse relationship between production quantity and product variety is established in the factory automation. The product variety is more complicated than a number, hard product variety and soft product variety are 2 different classification.

- The product differ greatly are called as hard product variety,
- Small difference between the product is called as soft product variety.

for example, number of pizzas what you buy falls under soft product variety, for garlic bread if you compare it falls under hard product variety, completely different.

when you compare amongst the pizzas- vegetarian, non-vegetarian, small, big, large, soft product variety is there. Small difference between the products, many common components in an assembly is used, few common components in an assembly used for hard production variety. Depending upon this, they try to dictate the life cycle, or product life cycle. If there is a hard product variety then it takes lot of time for establishing the assembly line or the machines, when it is soft with some small variations can be done.

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There are 2 types of manufacturing metrics and economic, the 2 aspects are

- Production performance metrics and
- Manufacturing cost.

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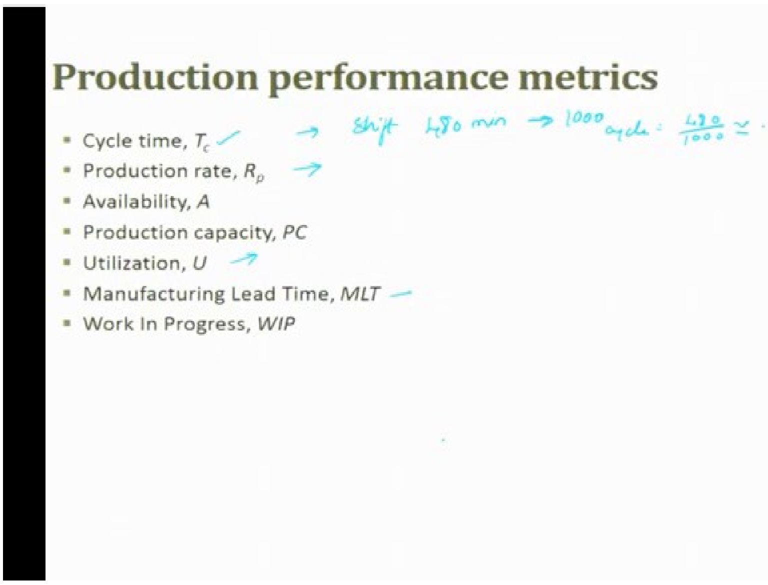

Production performance metrics: talks about cycle time, how do you calculate the cycle time? For example, if in a shift there are 480 minutes of working and if it has to produce 1000 items. So, the cycle time is nothing, but 480 minutes by 1000 and this is the cycle time. The production rate is Rp, the availability is A, production capacity is P C; utilization is U, Manufacturing Lead Time is MLT, Work In Progress is WIP.

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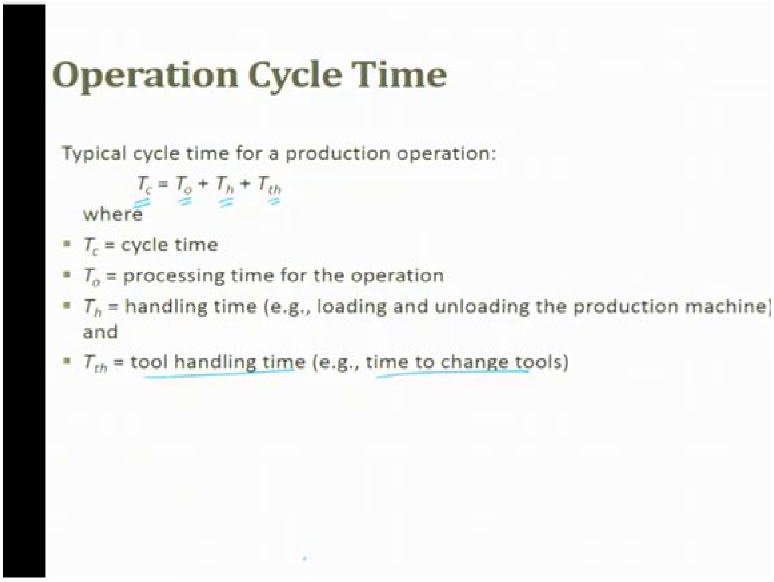

when we talk about the cycle time for a production operation it is

T_c= cycle time for a production operation.

T_o= the processing time

T_h=handling time

T_{th}= tool handling time to change the tool

$$\textbf{\textit{Hence}} \quad T_c=T_o+T_h+T_{th}$$

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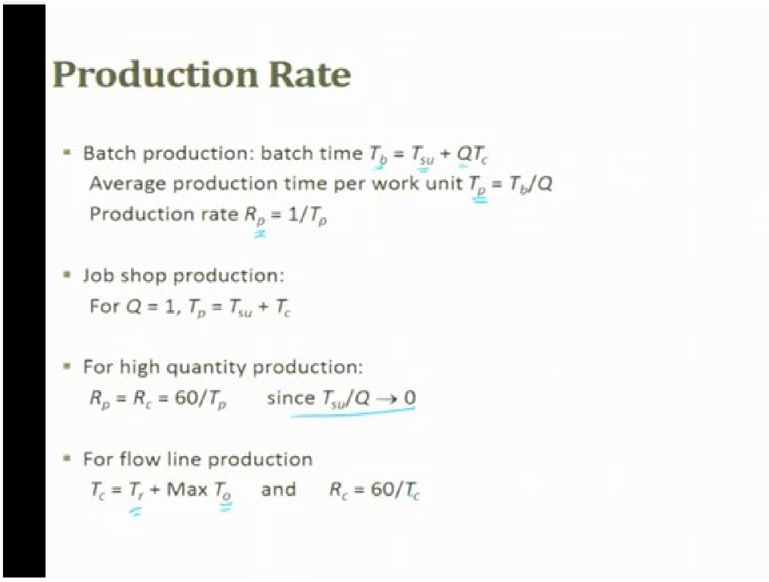

For a batch production, job shop production, high quantity and flow line, how the production rate differs.

$$T_b=T_{su}+QT_c$$

Where the average production time per work unit T_p is nothing, but T_b by Q.

$$T_{p}= T_b / Q$$

T_{su} =is the setting time;

Q =is the number of quantities.

T_c=cycle time.

So, the average production time per u to per work unit T_p is equal to T_b divided by Q; Production rate Rp is nothing, but 1 by T_p is production rate,

$$R_p=1/ T_p$$

when you try to take a job shop production Q is the quantity which is 1.

then T_p becomes T_{su} plus T_c , for a higher quantity production R_p is nothing, but R_c=60

by Tp.

$$R_p = R_c = 60/T_p$$

Since Tsu by Q is tending to 0 for a higher production.

$$T_{su}/Q \rightarrow 0$$

So, where the cycle time is very less, for a flow line production; flow line production means assembly line, where T_c is equal to T_r plus M times To,

$$T_c = T_r + M\,T_o$$

T_o is the maximum processing time

T_r is the rate in which it travels

Rc is nothing, but 60 divided by Tc

$$R_c = 60/T_c$$

we are able to get it. So, this how we get the production rate.

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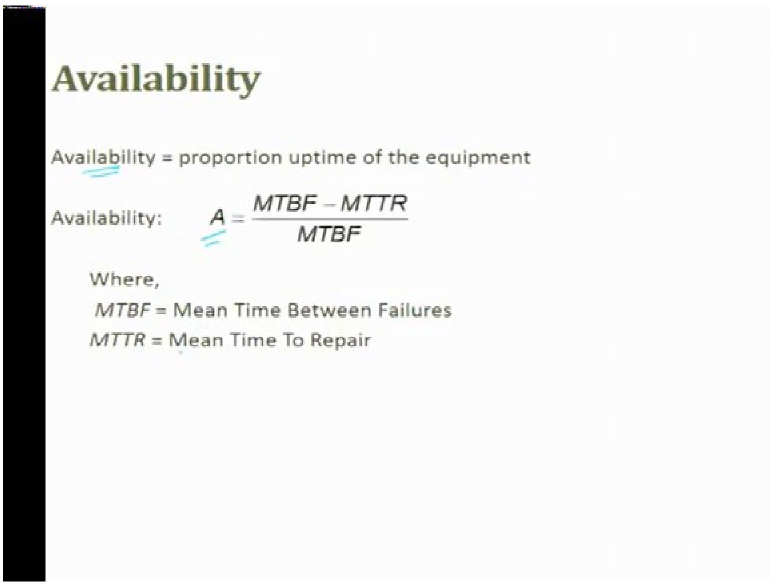

So, if we want to find out the availability of the machine, availability of the machine is nothing, but A, A is the proportion uptime of the equipment; that means, to say available time for machining is called as the availability. So, A can be defined as MTBF that is

Mean Time Between Failures minus MTTR Mean Time to Repair divided by MTBF. So, that gives you the availability ok, mean time between failures, mean time to repair.

$$A = \frac{MTBF - MTTR}{MTBF}$$

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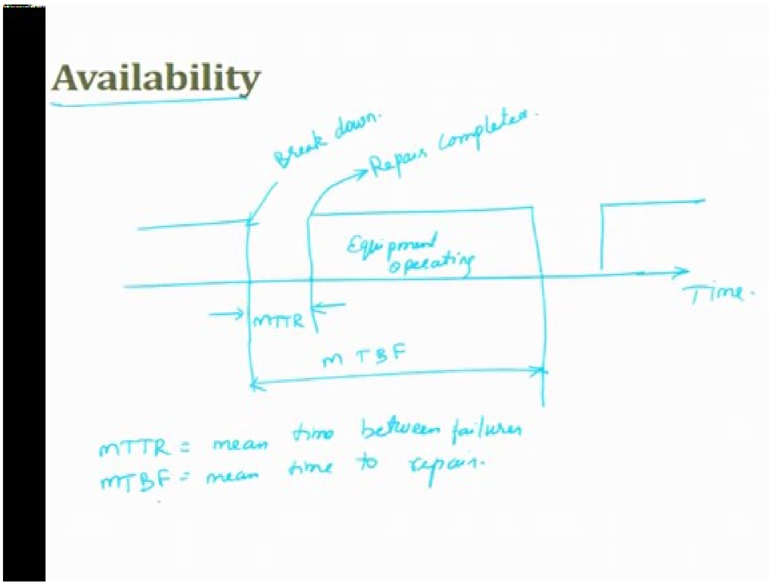

what is MTTR? MTTR is nothing, but mean time between failures and MTBF is nothing, but mean time to repair. And here is the breakdown and here is the repair completed and this is equipment in operation.

we are trying to teach you or explain to you what is the availability, MTTR, breakdown repair mean time between failures and MTBF is mean time to repair.

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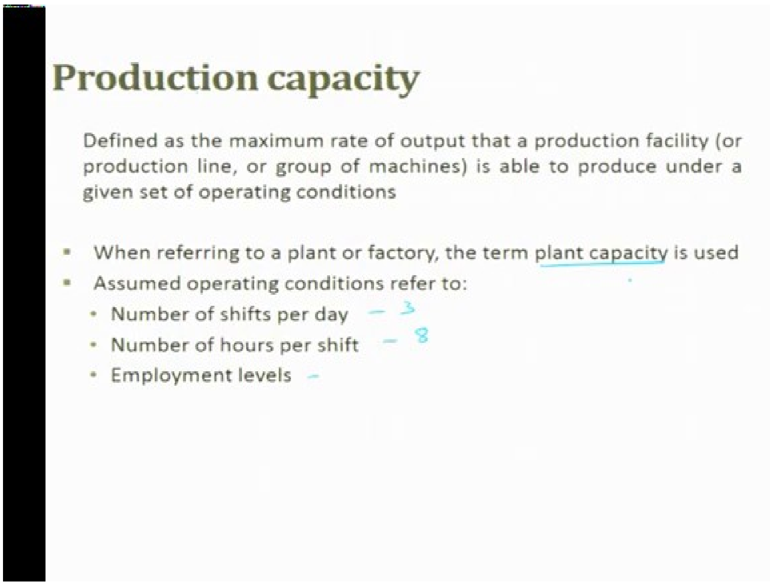

Production capacity: production capacity is defined as the maximum rate of output that a production facility is able to produce under a given set of operating conditions. When referring to a plant or a factory, the term plant capacity is used, production capacity or plant capacity is the same. Assumed operating conditions refer to

- Number of shifts per day.
- Number of hours per shift. So, number of shifts per day maximum can be 3, number of hours per shift can be 8,
- Employment levels is the other variable.

we always try to calculate the plant capacity.

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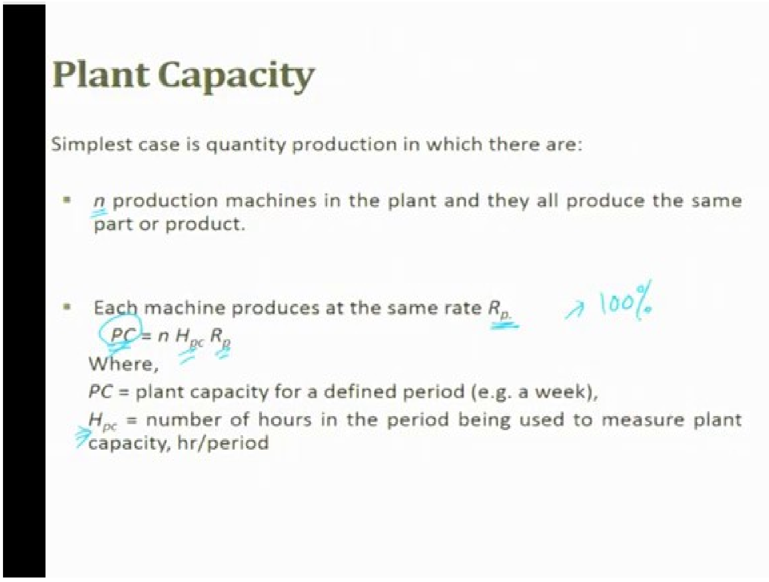

The simplest way of calculating the plant capacity is quantity production in which there are ***n*** production machines in a plant and they all produce the same part or product So, each machine produces at a rate of R_p. So, ***PC*** plant capacity is ***n*** products are produced in H_{pc} into R_p. What is H_{pc}? Number of hours in the period during which used to measure the plant capacity ,hours per period, with this we are trying to calculate the plant capacity.

$$PC = n\, H_{pc} R_p$$

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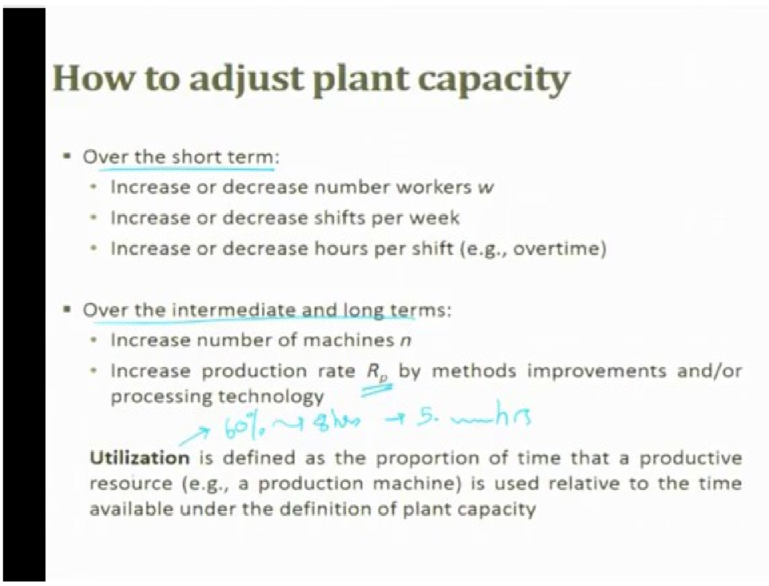

How to adjust the plant capacity? They can be adjusted in two ways one is

- Over a short term period,
- Intermediate or a long term period.

By increase or decrease in the number of workers the plant capacity can be adjusted, increase or decrease the number of shifts it can be done, increase or decrease the number of hours per shift which is also done.

Over a intermediate or a long term, increase the number of machines ***n*** , the capacity can be increased or decreased, the increased production rate Rp by method improvement or by processing technology, changing/automating the machine, the p can be increased. So, these are long term solutions, these are short term solutions, utilization availability is different, utilization is different, utilization is defined as the proportion of time that a productivity resource is used relative to the time available under the definition of plant capacity.

- Utilization is defined as the proportion of time that a productivity resource, a machine is used relative to the time available under the definition of plant capacity. For example, if the machine is used 60 percent of your shift time, so which is 8 hours.

you can calculate 60 percent for 8 hours, it should be approximately 5 hours, 5 point something hours is the time you operate the machine out of 8 hours, rest of the time machine is idle, or tool setting.

This is nothing, but the utilization chart. In many of the heavy industries, the utilization is less than 10 percent, but here what happens because the job is very rare and it is very complex. So, machine utilization is not bothered about, because the complex part feature, the quality which is produced and the reliability which is produced matters here.

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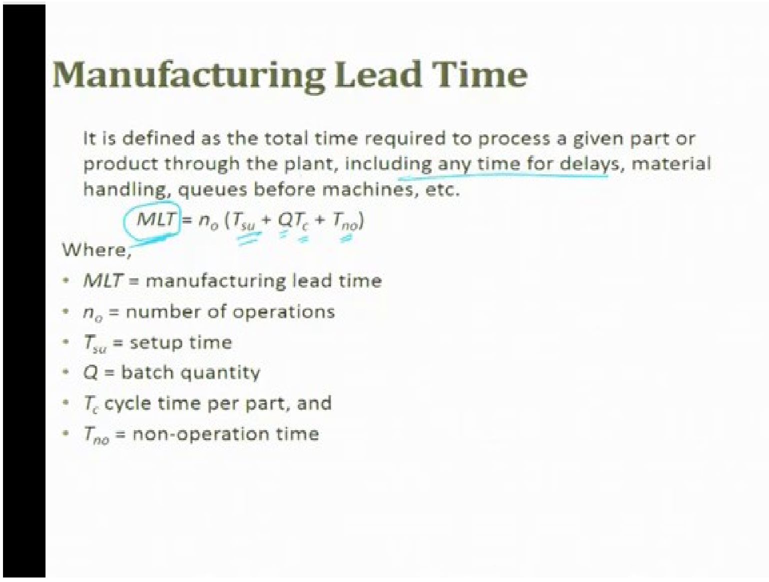

what is manufacturing lead time? It is defined as the total time required to process a given part or a product through the plant, including any time for delay, material handling, queues before the machines, etc.

$$MLT = n_o(T_{su}+QT_c+T_{no})$$

MLT =Manufacturing lead time

n_o,=number of operations.

T_{su} =is the setting time

Q = is number of batches

T_c =is the cycle time per part

T_{no} =is the non-operation time,

There are a set of operations, the order is released produce that part. So, the part gets into the first machine and it keeps undergoing all the operation and it gets out by the time it is getting out that a customer could capture it that is called as the manufacturing lead

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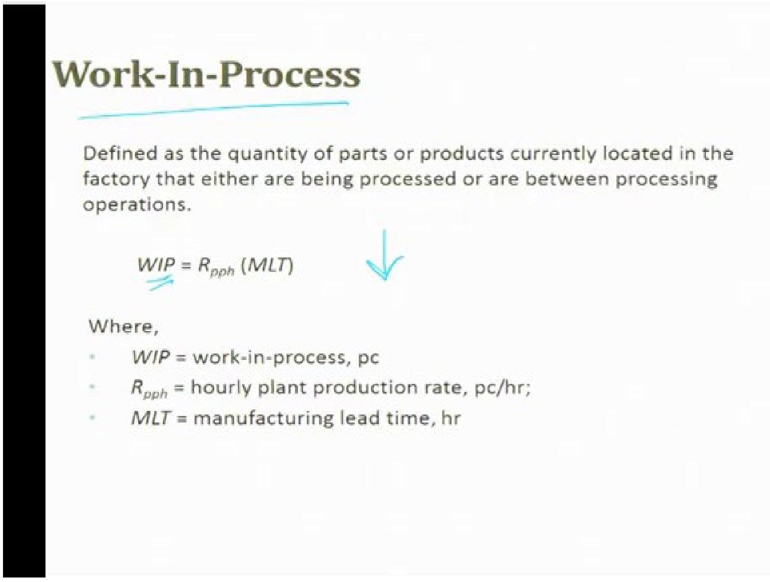

What is WIP? WIP is defined as the quantity of part or products currently located in the factory that either are being processed or are between processing operation is called

$$WIP = R_{pph}\,(MLT)$$

R_{pph} = hourly plant production rate, which is pieces per hour and MLT is the manufacturing lead time. WIP has to be as low as possible, lead time has to be as low as possible. the plant capacity has to be close to 100 percent. So, these are all the idealistic case people would like to have.

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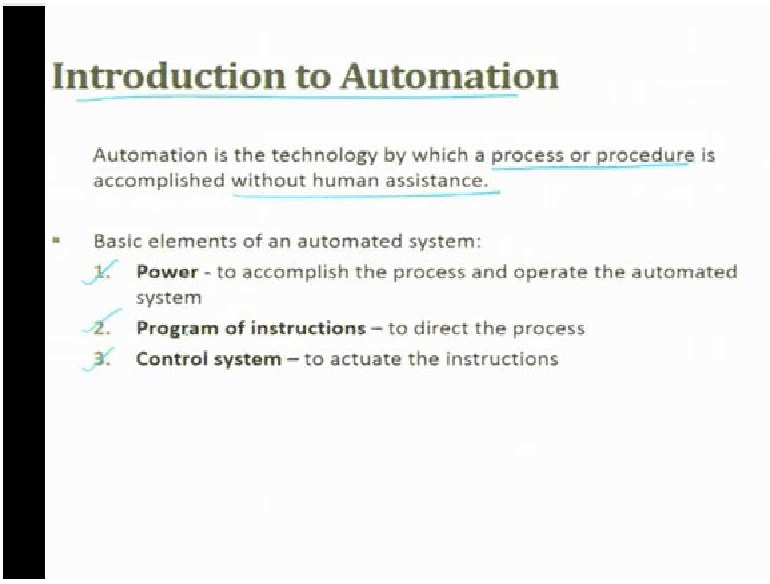

Automation is a technology by which your process or a procedure is accomplished without human intervention or assistance that is called as automation. There are 3 elements of an automated system;

- Power.
- Program.
- Control.

control is actuation system, program of instruction is what is to be done, power is to accomplish the process and operation in automation.

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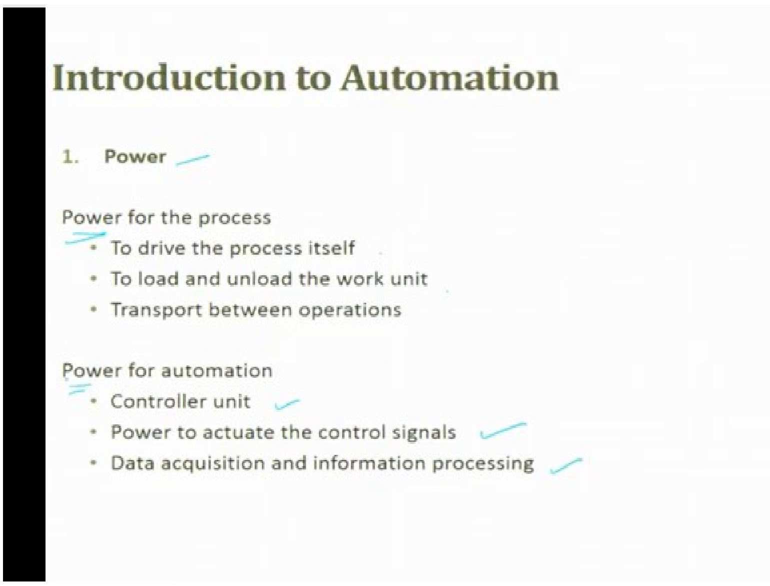

The power for the process is to drive the process itself, to load and unload the work unit, to transport between operations is the powers job. Power for automation is control unit, power to actuate and data acquisition and information processing.

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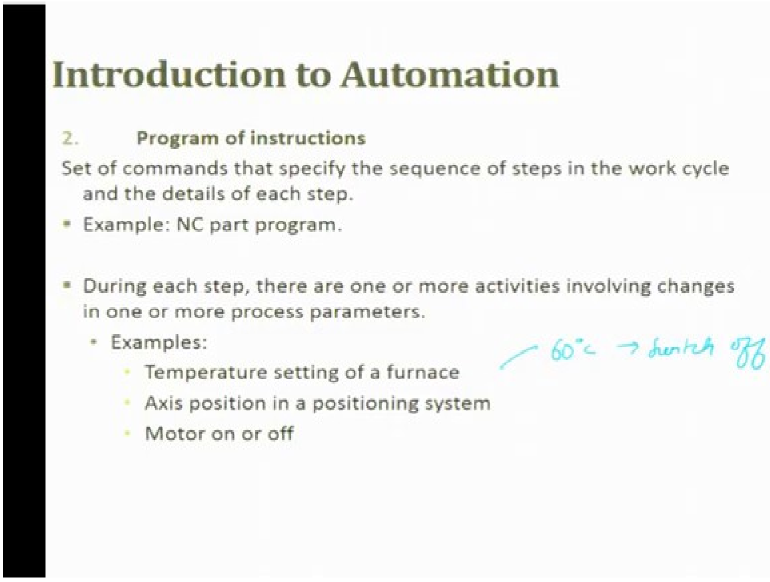

When we talk about program of instructions in automation, it is a set of commands that specify the sequence of steps, in the work cycle and the details of each step is given that is program instruction. For example, in an NC part program every line is called as a block. During each step there are one or more activities involved changes in one or more process parameter. Example temperature setting of furnace is an instruction. So, if it crosses 60 degrees, switch off. So, axis position in the positioning system is also a program instruction, motor on off is a program instruction.

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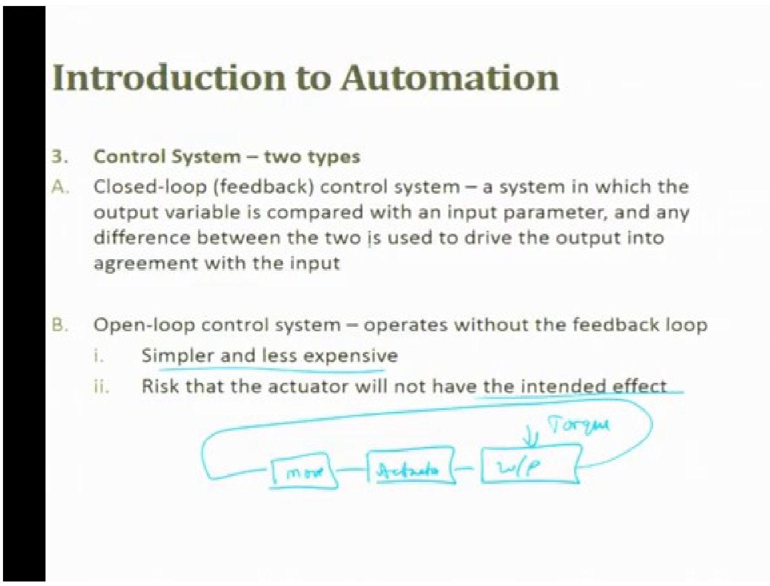

Controls, there are two types of control

- Open-loop control
- Closed-loop control.

- Open loop control is where it is very simple and less expensive. Here, the risk that the actuator will not have the intended effect
- when we have an open loop system, when we say move the actuator is moving and the work piece is moving. So, it is assumed that whatever move is given your actuation moves and the work piece moves, but there can be a way torques are very high. There is lot of resistance for the work piece to rotate or move. So, then there is a slip happening in the signal then there is a need to have a feedback. So, those systems are called as closed loop systems.
- Closed loop systems are a system in which the output variable is compared with an input variable and any difference between the two is used to drive the output into agreement with the input. So, that is called as closed loop control system

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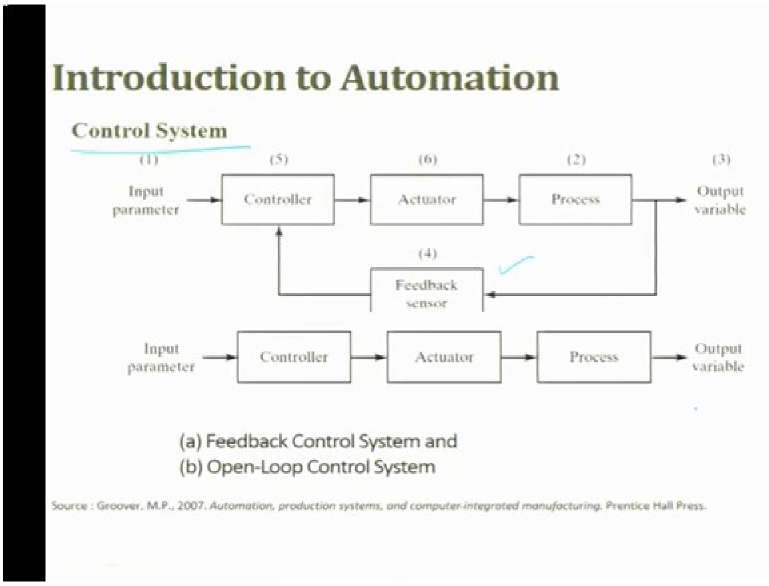

As the input parameter we have controller, actuator, processor. If, there is no feedback it is called as a open loop system, if there is a feedback, it is called as a closed loop system.

Feedback is given and every time it is compared, the error signal is given and the process is operated.

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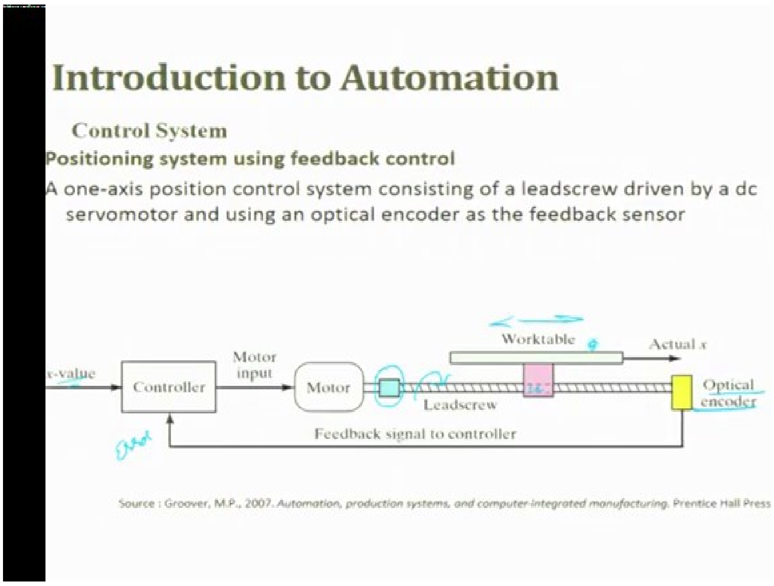

The control system can also be used for positioning. So, here is a system in which the position is controlled .Here is a feedback control system which is used in a CNC machine, the values are given, the controller gives the value to the motor and the motor actuates, there is a coupling.

from the coupling you can see a leadscrew rotating. This leadscrew will rotate and there is a nut which moves the table in the left direction. if there is lot of load here while machining then there is a slip which is happening, then what was intended to move by the work piece, by the table is not moved because there is a slip happening; so, that will be recorded by using an optical encoder, this encoder gives the signal and the error is checked here and then correspondingly it is controlled and the motor is moved.

This is a position system with feedback control, a one axis position control system consisting of a leadscrew by a DC servomotor and using an optical encoder as a feedback. If, you have an open loop system the motor becomes a stepper motor.

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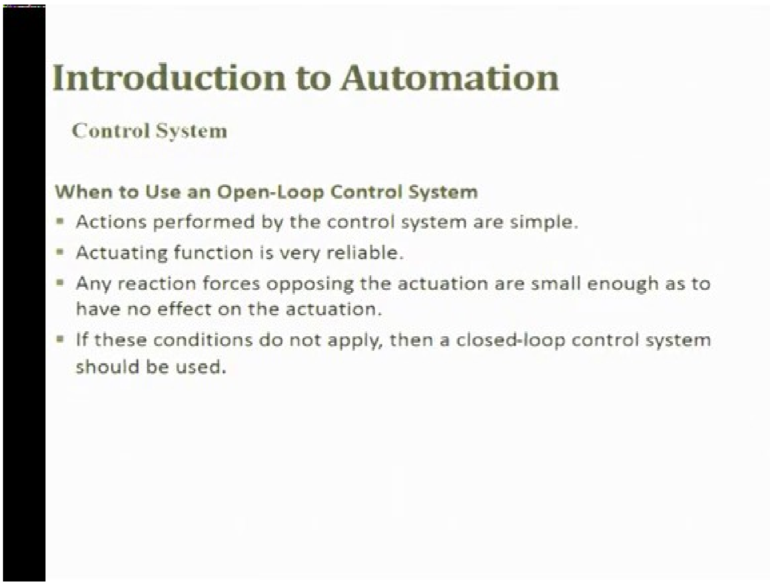

When to use an open loop system,

- when the action performed by the control is simple
- when the actuation function is very reliable
- when area of the reaction force opposing the actuation are very small.

If the conditions do not apply then a closed loop system will be used

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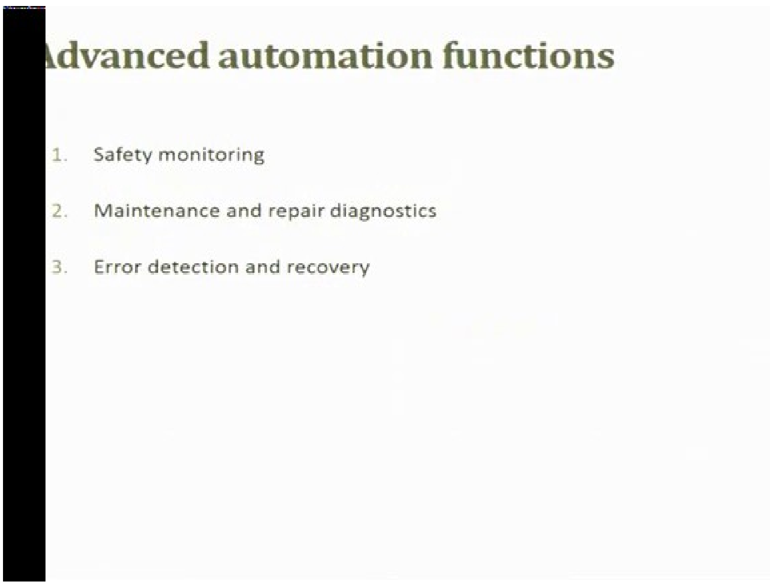

What are the advanced functions in automation? One is safety monitoring is there and maintenance and repair diagnostics, and the error detection and recovery are some of the advanced automation functions which are given today.

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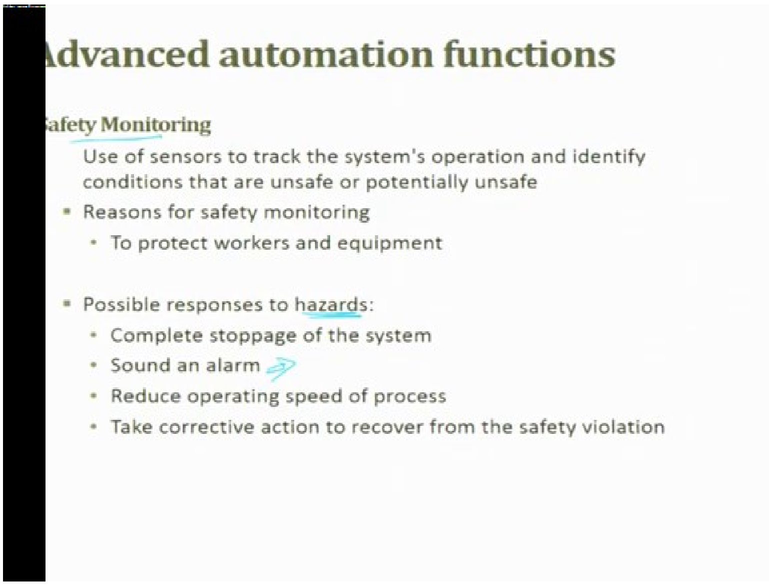

Safety monitoring: we use sensors to track systems operation and identify conditions that are unsafe or potentially unsafe, this is safety monitoring, reason for safety monitoring is to protect a worker or equipment, if there is a dangerous thing or if the machine is running and if you open the door the machine will stop. Otherwise, there is a possibility the hand can be put in and there might be any accident. The possible response to hazard is complete stoppage of the system, sound an alarm, reduce operating system of the process take corrective actions to recover from the safety violations.

these are the responsible for hazardous environment, safety monitoring is there in the banks we used to have a burglar alarm. So, that is also safety monitoring that is part of automation.

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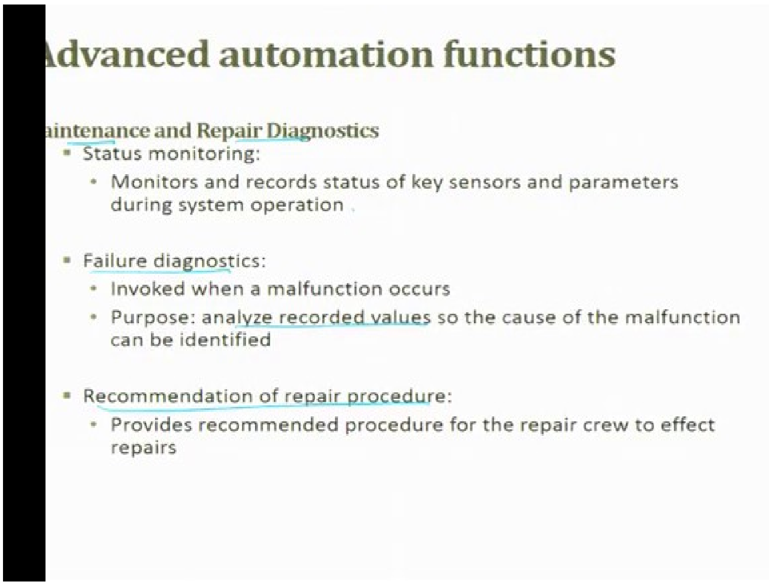

When we talk about maintenance and repair,

- The status monitoring,
- Failure diagnostics and
- Recommendation for repair procedure,

these are falling under advanced automation functions. Status monitoring monitors and records status of a key sensor and parameter during the system operation. For example, if the filter in the automobile is choked then, it monitors what is the amount of fresh air it can come and then it quickly says that there is a lot of reduction. So, immediately the status monitoring signal is raised and you try to do some necessary actions.

Failure diagnostics invoke when the malfunction occurs for example, I was recently traveling in an auto one day, there was a sensor which was fixed to the auto tyres, when there is a pressure difference or when there is a misbalance in the vehicle, immediately the alarm is raised and the auto is shut down, the fuel to the engine is shut down and the auto stops, that is failure diagnostics. The moment there is a jerk or vibration or a pressure difference leak then immediately, invoke when a malfunction occurs purpose is analyzed recorded value. So, the cause of malfunction can be identified immediately.

Recommendation of repair procedure: provides recommendation. So, once you diagnosed and then you give a recommendation. For example, if that sensor particularly fails, then immediately it says please check the following items

As soon as the higher end car enters inside a garage or service centre, the service engineer come and connect his laptop in EMU of the engine. And then he tries to collect all the data and when he collects all the data the status is monitored, it is reported that these are the sensors which are malfunctioning. These are the failures which has happened and it also says please do this to replace and this is how the procedure is for replaced. So, that is recommendation for repair procedure.

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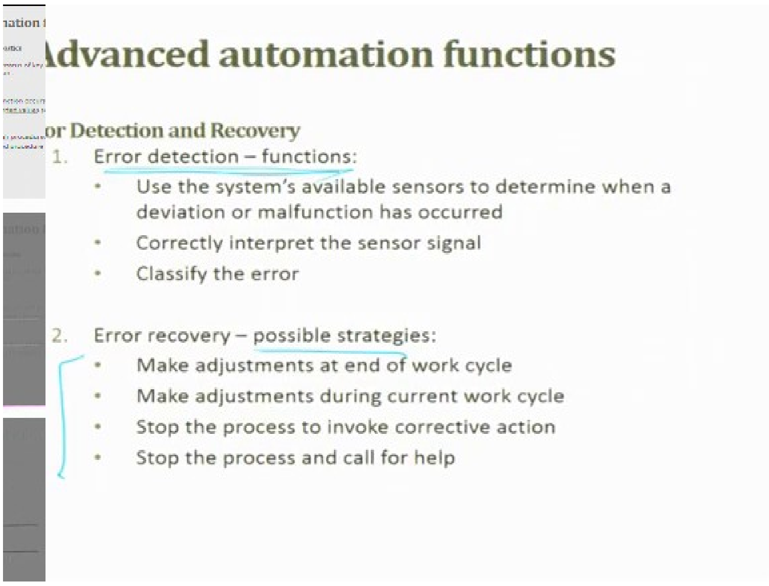

The error detection and recovery: error detection function uses these systems , sensor to determine whether deviation or a malfunction has occurred. Correctly interpret the sensor signals and classify the error that is error detection and function. Error recovery and possible strategies make adjustment at the end of the work cycle that is error recovery and possible strategies. Make adjustment during the current working cycle itself, stop the process to invoke corrective actions and stop the process and can call for help, these are some of the error recovery possible strategies. In Error detection and the error recovery there are two important things which are followed today.

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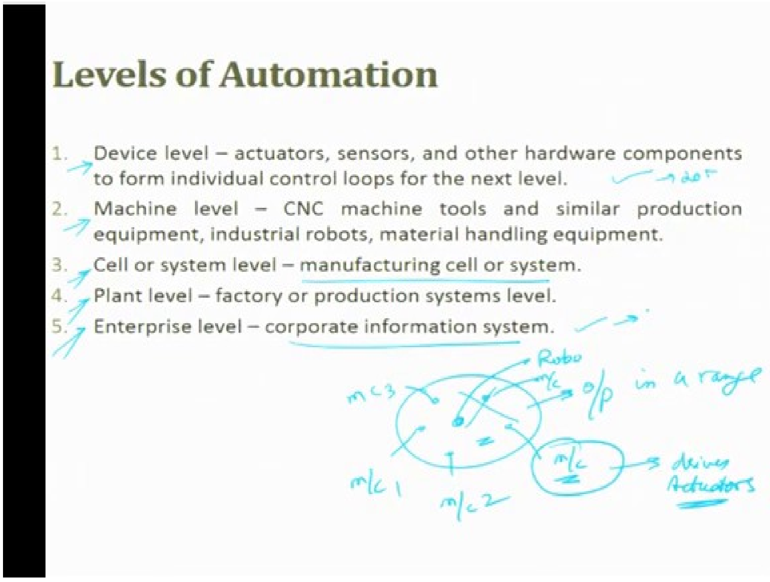

The levels of automation: there are five levels of automation, automation can happen at device level, it can happen at machine level, it can happen at cell level, it can happen at plant level and it can happen at enterprise level, these are the 5 levels. Enterprise level is the highest level where corporate information is used, plant level, the factory and production systems are used. what is a cell? A cell is a closed area in which we have dissimilar machines, which can cater to the need of producing outputs in a range.

These machines are dissimilar machines, In factory you will have several cells. So, if one machine fails and one cell fails, then only that cell is effected, but rest is not effected. Within their cell, they try to have a manufacturing system automation.

Here you will have a man or your Robot. This robot will try to man the machines properly. For example, CNC machines and device is an actuator sensor and the other hardware components inside a machine you have drives, you have actuators.

So, those are the lowest level of automation, machine is the next, the cell is the third several of this put together forms a plant and several of this plant put together forms an enterprise. So, these are the various levels of automation. There is lot of data to be handled here, there is less data to be handled, less data in the sense dynamic data, time based data.

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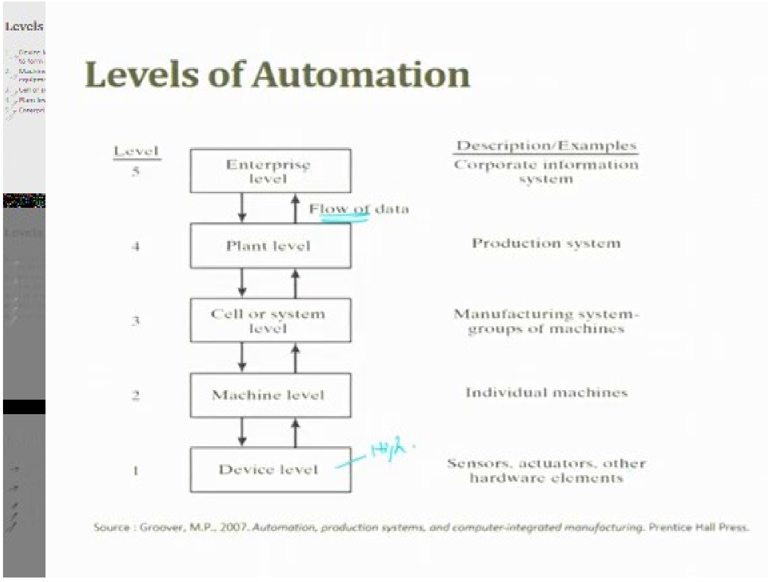

The flow of data happens here, corporate information system is enterprise, production system is plant, manufacturing system group of machines is cell, individual machines is machine level, devices, sensor, actuators and other hardwares

These are the 5 levels of automation, lower one is device level, higher one is enterprise level. The amount of data handle is very high here as compared to this because they have time based data.

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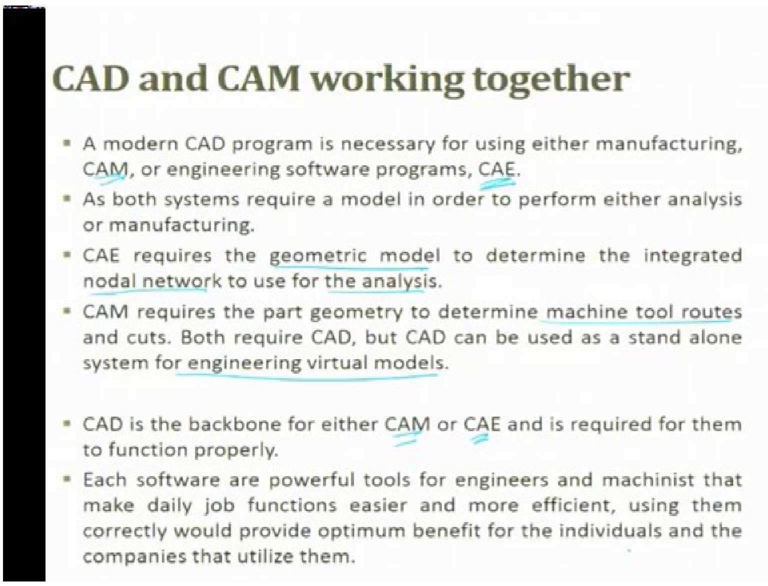

The CAD and CAM working together: a modern CAD/CAM program is necessary for using either manufacturing CAM or engineering software program CAE. As both system require a model in order to perform either analysis or manufacturing, we try to integrate these two, CAE is nothing, but Computer Aided Engineering, requires the geometric model to determine the integrated nodal network to use for the analysis.

CAM requires a part geometry; a CAM software cannot exist without a CAD software. So, a CAD/CAM requires a part geometry to determine a machine tool route and cut, both require cad, but CAD can be used as a standalone system for engineering virtual modeling. CAD is the backbone for CAM or CAE, CAE and CAM can be interchanged and is required for the functional to function properly.

Each software are powerful tools for engineers and machinist that make daily job function easier and more effective, using them correctly would provide them optimum benefits for the individuals and better utilization for the company, computer aided engineering.

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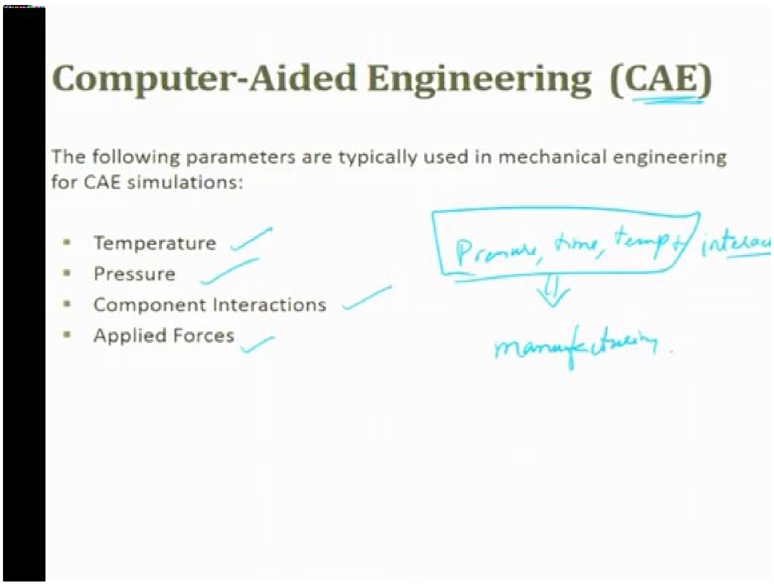

The computer aided engineering, the following parameters are typically used in a mechanical engineering for CAE simulation- pressure, time, component interactions and applied force. So, pressure, time and temperature are 3 major parameters which involves in manufacturing. we try to have interaction between the parts that is what is talked about in interaction.

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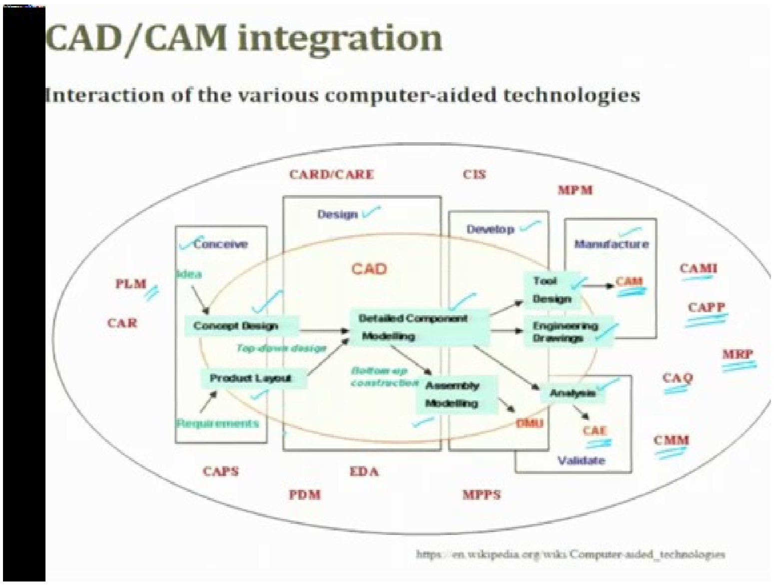

if you look at the interaction of various computer aided technologies, this is the overall ellipse you have and you can see here PLM, Product Life Cycle Management. This is CAD whatever is there, inside CAD you have conceptual design, product layout, you have detailed component modeling, assembly modeling, you have analysis, engineering, drawing and tool. So, when you talk about tool it comes under CAM when you talk about analysis, it goes to CAE.

So, coordinate measuring machine, computer aided quality, manufacturing resource planning, computer aided process planning, computer aided manufacturing and inspection. if you see here conceiving, designing, developing and manufacturing. So, your CAD is a overlap which comes in all the area and you try to get conceived, design, development and manufacture.

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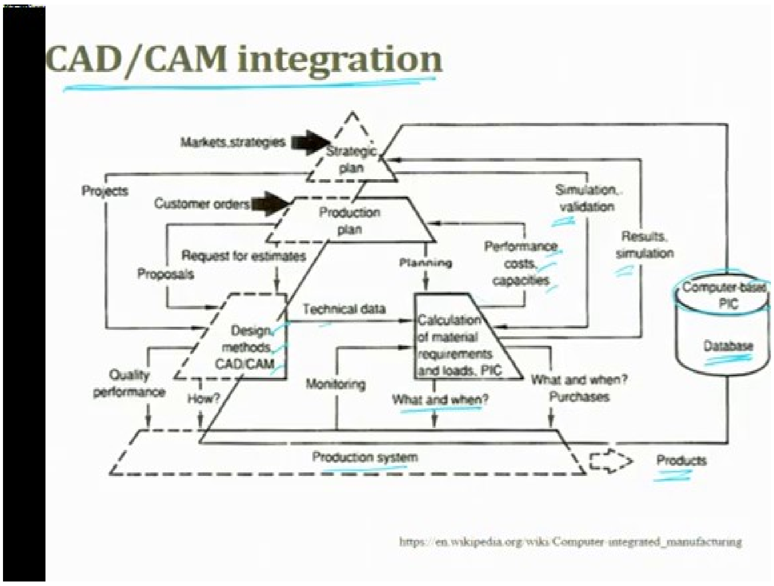

when you look at CAD-CAM integration, strategic planning, production planning, then calculations of material and then you will have production systems, this is how a product is done, market strategy planning is here, which needs for simulation and which needs to look at results of simulation, calculate the material requirement and load.

When we talk about production planning, it is more of performance, cost capacity, planning technical data and require for estimates. So, here you will have designed methods and CAD-CAM.

So, a CAD-CAM integration integrates marketing strategy, customer order, proposals, design, quality performance and finally, you produce the output. So, the entire thing goes around a single database. The single database makes a big change in the CAD-CAM integration, if you have data of different-different machines and if these machines could not talk to each other then the data becomes a problem and the integration becomes a bigger problem.

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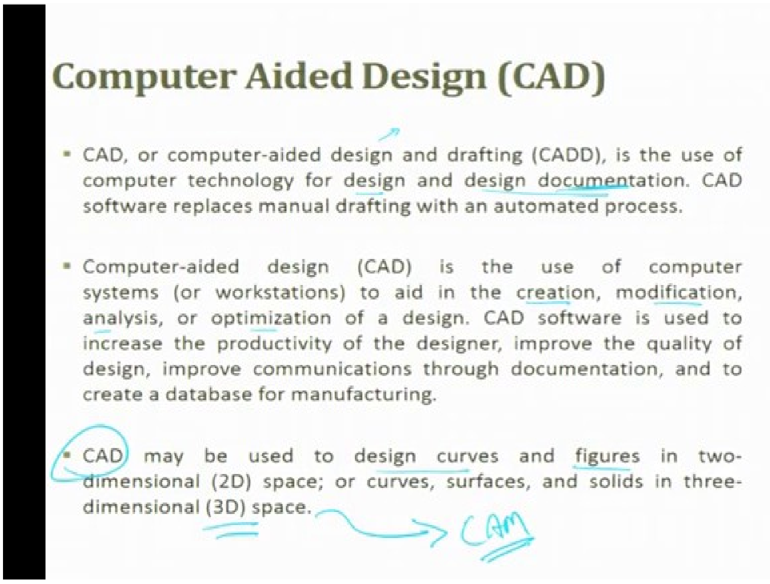

computer aided design: computer aided design and drafting is use of computer technology for design and design documentation. The biggest advantage of design is for design optimization on top of it documentation. CAD software replaces manual drafting with an automated process.

Computer-aided design is the use of computer systems to aid in the creation, modification, analysis, optimization of design. CAD software is used to increase the productivity of the designer, improve the quality of the design, improve communication through documentation and to create a database for manufacturing. CAD may be used to design curves and figures into 2 dimensional space and 3 dimensional space.

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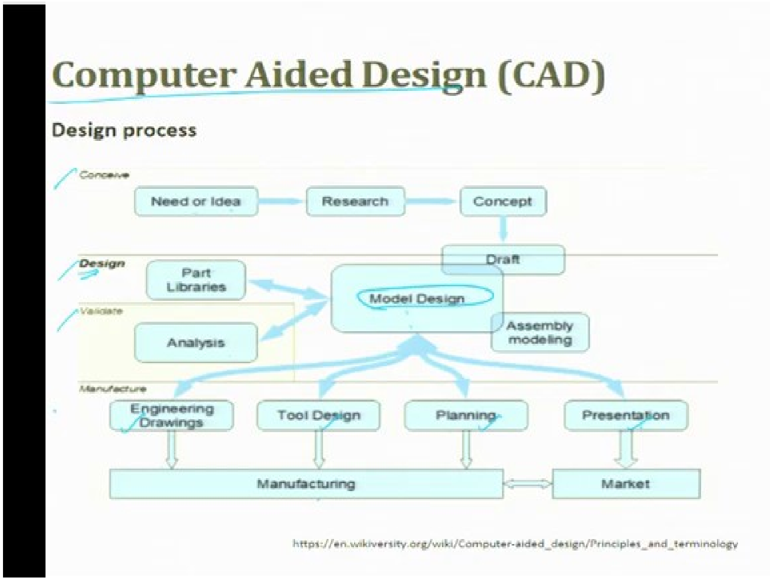

when we talk about computer aided design, conceiving the need or the idea research and concept development, then in the design you do drafting, modeling of model design in which we use part libraries and we do analysis. Part libraries are already existing library functions in the CAD system in which you automatically pull out and add it to your drawing and start using it.

And all these part functions, part library functions, these parts will have a standard CAM; that means, to say a standard processing sequence. So, this is CAD then analysis, you will also have assembly and then drafting. In the model of design you will have engineering drawing, tool design, planning and presentation all these things are attached to that model design.

Tool design, planning and engineering drawing is given to manufacturing, presentation is given to marketing. So, this is how your computer aided design process works, these are the main subdivisions conceiving, designing, validating and manufacturing.

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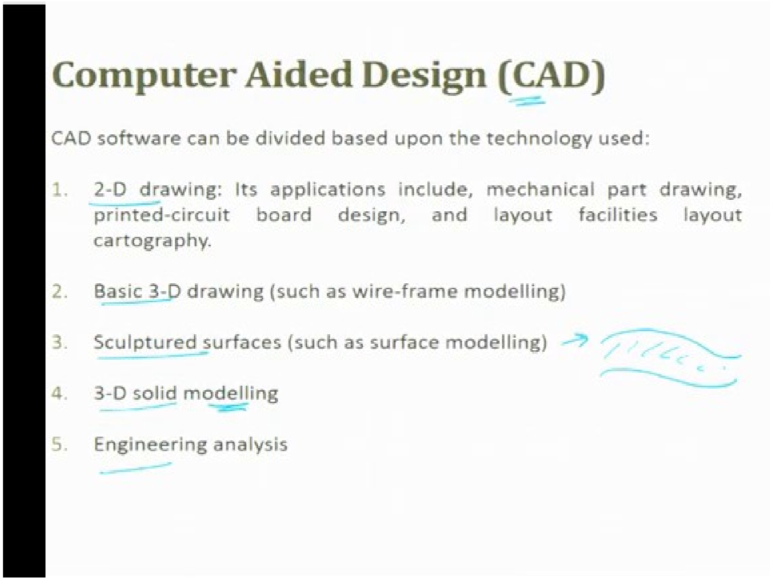

In computer aided design there are 2-D drawing, then basic 3-D drawing, then you have sculptured surfaces, then you have solid models and engineering analysis. 2-D wireframe, sculpture that is surface modeling, solid modeling and engineering analysis; We use surface modeling if we want to see along the surface, what is the drag.

you can use surface modeling if you are least bothered about the volume, when you want to do analysis cycle or torsional analysis or load analysis, volume is very important so, we use solid modeling.

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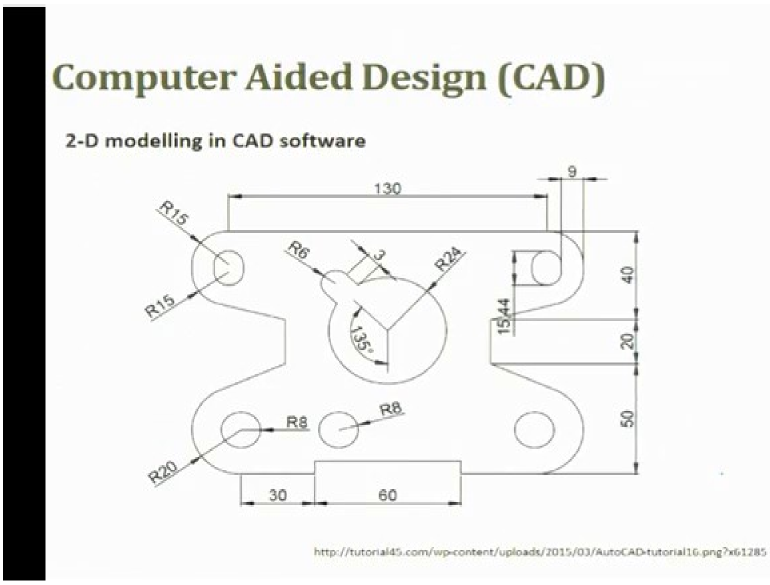

this is a 2-D model in CAD software as shown in figure, you can just draw and thereviews are not given, by looking at it you do not know what is the thickness you do not know whether it is a sheet or a block you start using it, this is nothing, but a 2-D drawing. In order to have an interpretation of the 2-D drawing, we try to give multiple views by looking at different views the author or the customer can find out what is this part.

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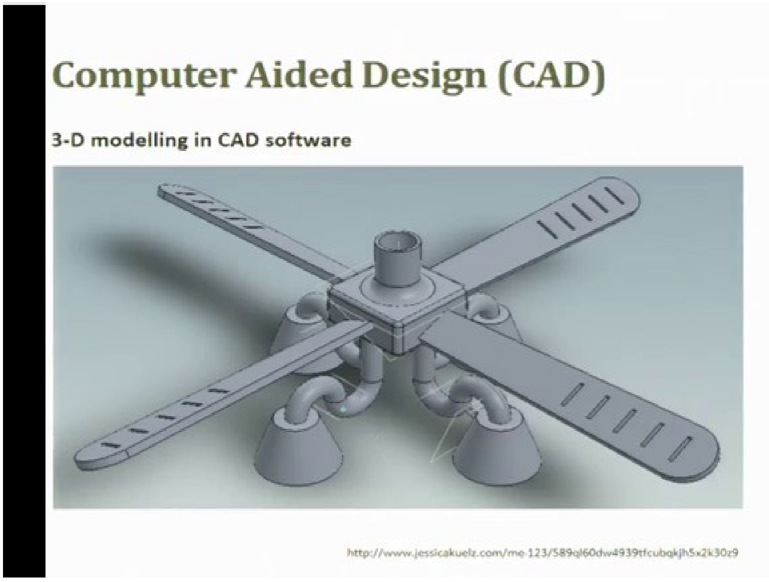

This is a 3-D model, CAD software product. You can see these are the parts or the sub-assemblies whatever it is, but here you do not get to see the dimensions, you do not get to see the assembly inside the part. So, these are 3 D model in CAD software's which tries to give us the overall impression, but you do not get much of dimensional and assembly informations.

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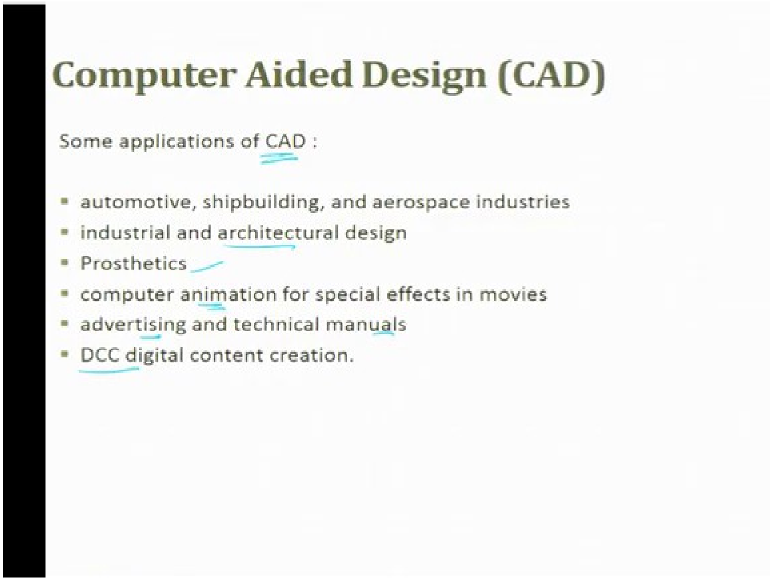

Some applications of CAD are,

- it is used in automobile,
- it is used in shipbuilding industry,
- it is used in aerospace industry,
- it is used in architectural industry,
- it is used for prosthetics development,
- it is used for animation of special effect movies, advertisement and technical manuals and digital content creation,

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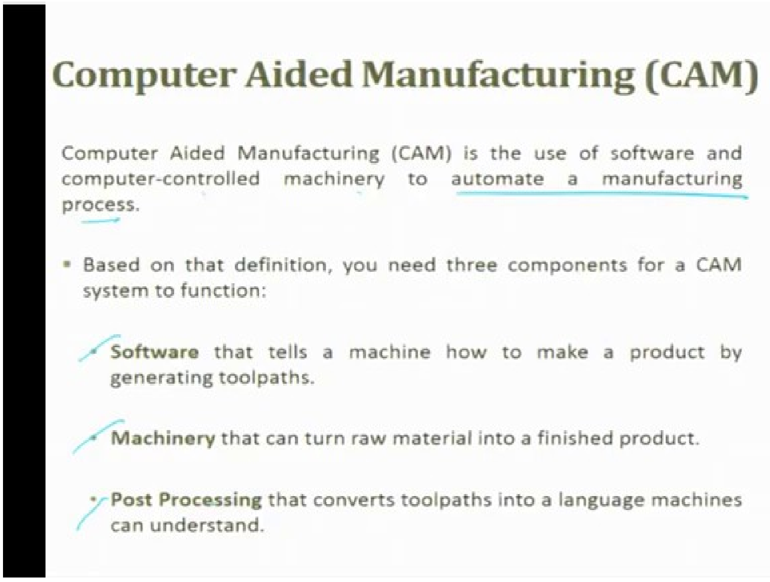

CAM is a software and computer control machinery to automate a manufacturing process. Based on the definition you need 3 components for CAD software, machinery and post processing. Software tries to tell the machine how to work on the product, machinery processes the raw material into finished product; post processing converts the tool part into a language machine understanding.

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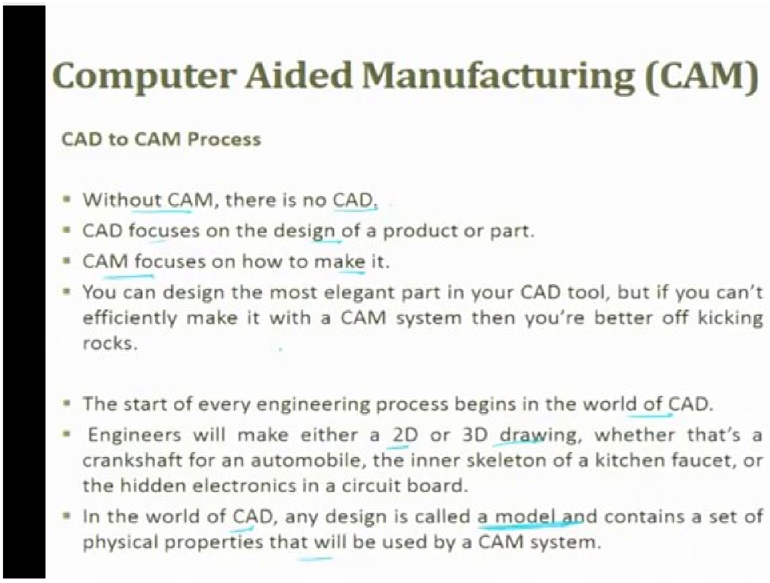

CAD to CAM process without CAM there is no CAD, the CAD focuses on design of a product CAM focuses on how it is to be made. You can design the most elegant part in your CAD tool, but if you cannot effectively make it with a CAM system then you are better off kicking rocks.

Which means to say you are not getting anything without CAM, there is no CAD,

CAD focuses on design, CAM focuses on how to make it. The start of every engineering process begins with the world of CAD. So, engineer starts with 2-D or 3-D to make the output, the world of CAD any design is called a model and the contains a set of physical properties that will be used by CAM.

The part was created now, the geometry details were given. Now the tool part simulation is what we are talking about the post processing; post processing that converts the tool part into a language machine can be understood.

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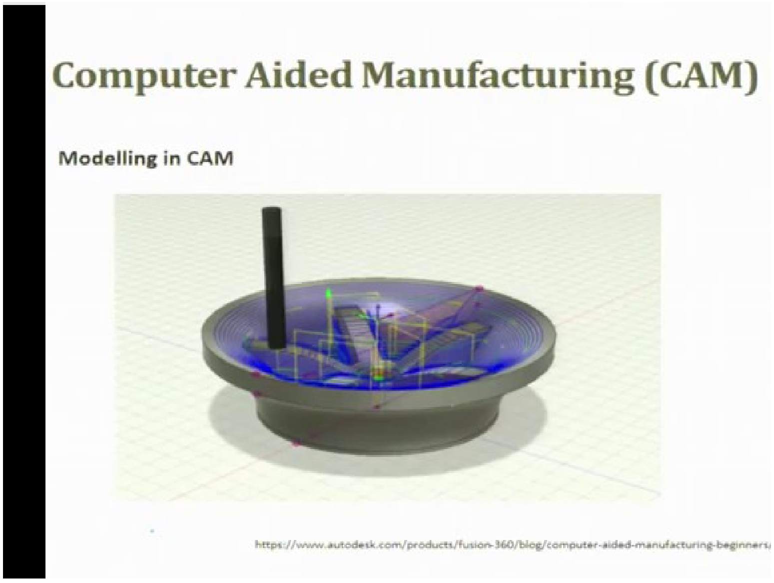

There is a cutter which is trying to create creative parts.

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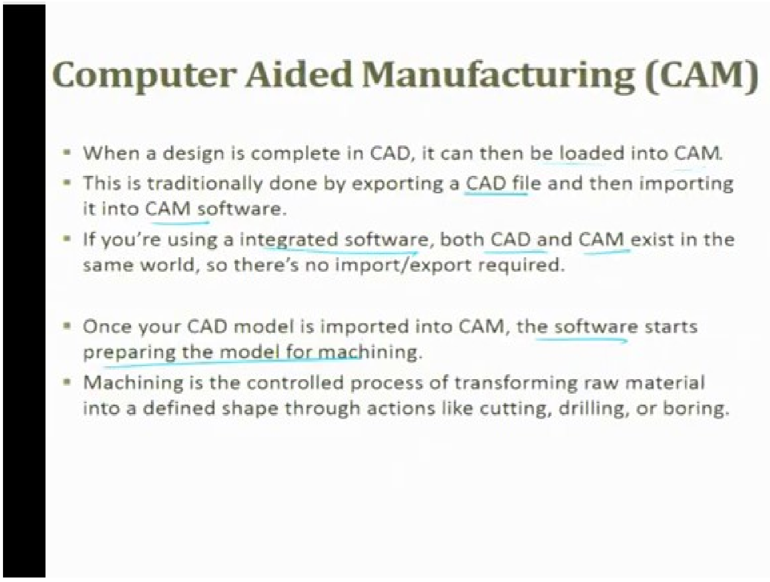

In computer aided manufacturing, when a design is complete in CAD, it can be loaded into cam, it is traditionally done by exporting a CAD file into your CAM software and importing it into a CAM software. And then using an integrated software both CAD and CAM exists in the same world. Once your CAD model is imported into a CAM the software starts preparing the model for machining and the machining is controlled which converts into the raw material to finished product.

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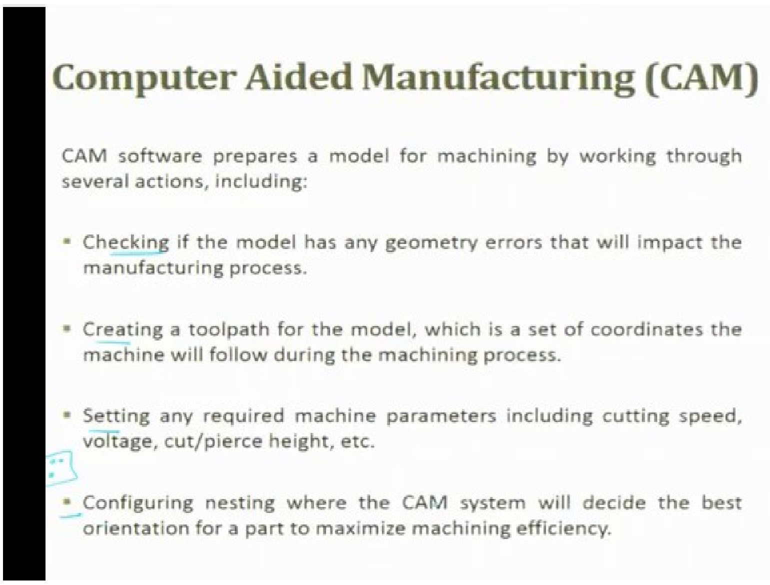

The CAM software prepares a model for machining by working through a several actions including checking if the model has any geometrical error, creating a tool part of the model, setting any required machine parameters and configuring listing, when the CAM system will decide the best orientation for a part to maximize the efficiency.

Checking the model, creating the tool path, setting of parameters, configuring nesting, what is nesting? If you have a flat and you want to make several holes and pierce and remove material. The geometry you should keep such that you will get the best out of it is called as nesting.

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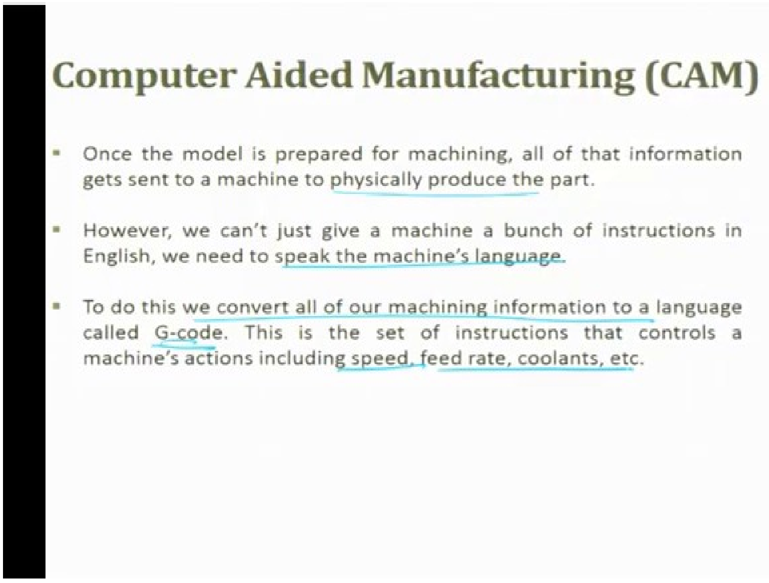

computer aided manufacturing CAM, once the model is prepared for machining all the information set into the machine to physically produce the part is done by CAM. So, after the CAM has given it a clearance then we focus on producing the physical part, because the part is done, the tool part geometry is done and then we try to take this CAM and then start producing it. However, we cannot just give a machine a bunch of instructions in English; we need to speak the machine language. To do this we convert all the machine information into G-codes as far as CNC machine is concerned. This is the set of instruction that controls the machine action including speed, feed rate and coolant etc.

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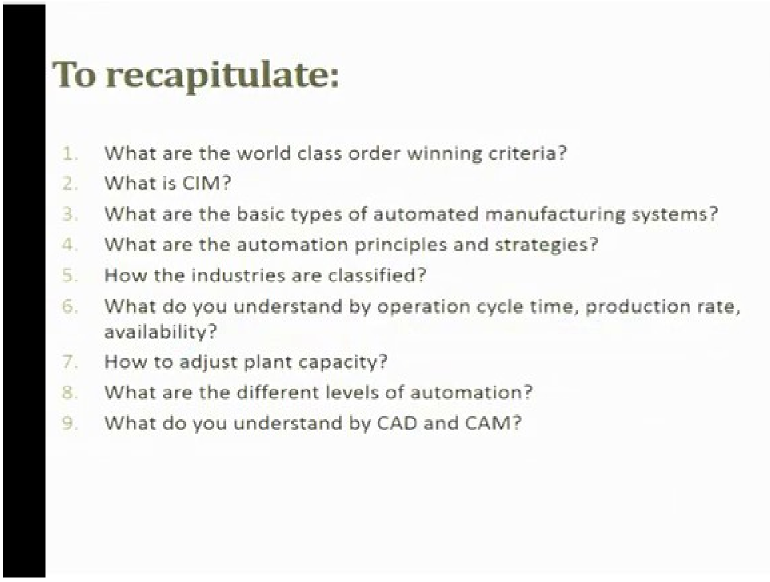

- we saw what are the world class order winning criterias?
- What is CIM?
- What are the basic types of automated manufacturing systems?
- What are the automation principles and strategies?
- How the industries are classified?
- How do you understand by operating cycle production rate availability?
- How do you adjust plant capacity?
- What are the different levels of automation?
- What do you understand by CAD and CAM?.

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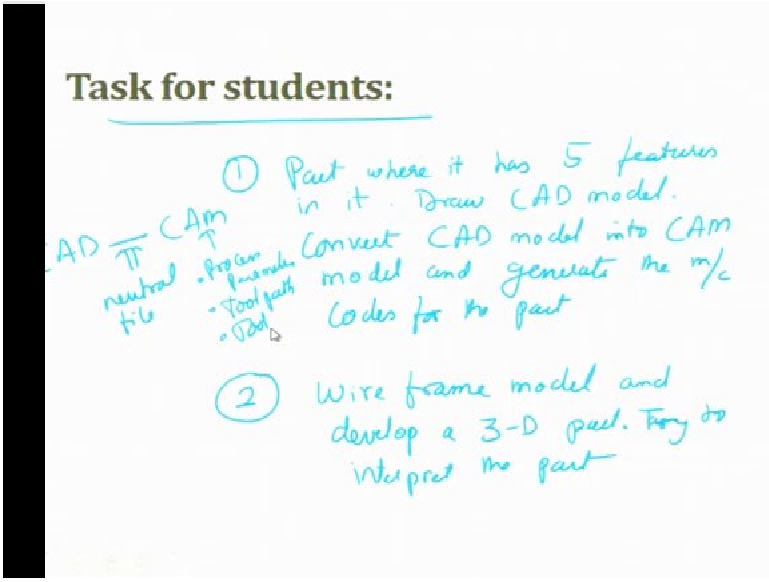

STUDENT'S ACTIVITY

Take a part where it has 5 features in it. Draw CAD model, convert CAD model into CAM model, and generate the machine codes for the part. Second , you are supposed to try to use wireframe model and develop a 3-D part, try to interpret the part So, these 2 are the assignments.

Neutral files are the files which converts the CAD drawing into a CAM understanding thing. And in CAM you talk about process parameters, process parameters for machining along with tool path