Automation in Production Systems and Management
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Flexible Manufacturing Systems (Part - I)
Lecture - 38
Basic Features of FMS: Physical subsystems

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During this lecture session I will be discussing the Basic Features of FMS, the physical subsystems of an FMS.

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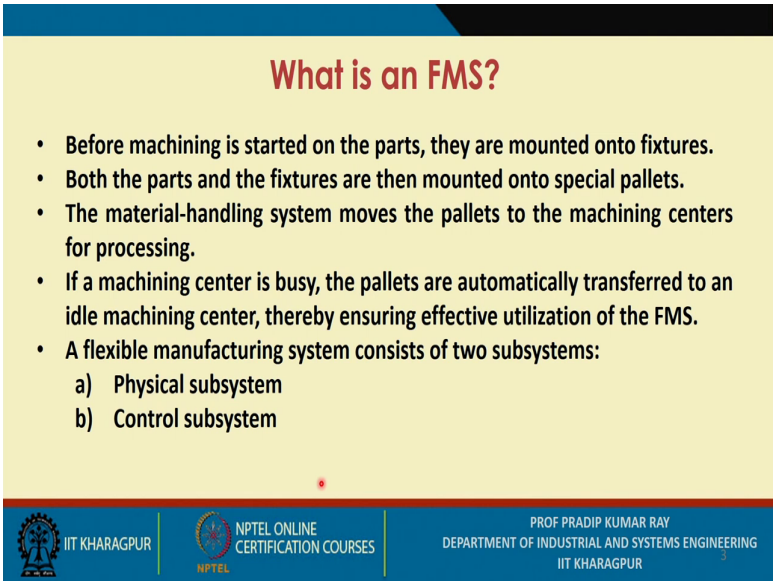

Now, let me again highlight the machining aspect of as an FMS.

Before machining is started on the parts, they are mounted onto fixtures.

Both the parts and the fixtures are then mounted onto special pallets.

The material-handling system moves the pallets to the machining centers for processing.

If a machining center is busy, the pallets are automatically transferred to an idle machining center, thereby ensuring effective utilization of the FMS.

A flexible manufacturing system consists of two subsystems:

1. Physical subsystem
2. Control subsystem

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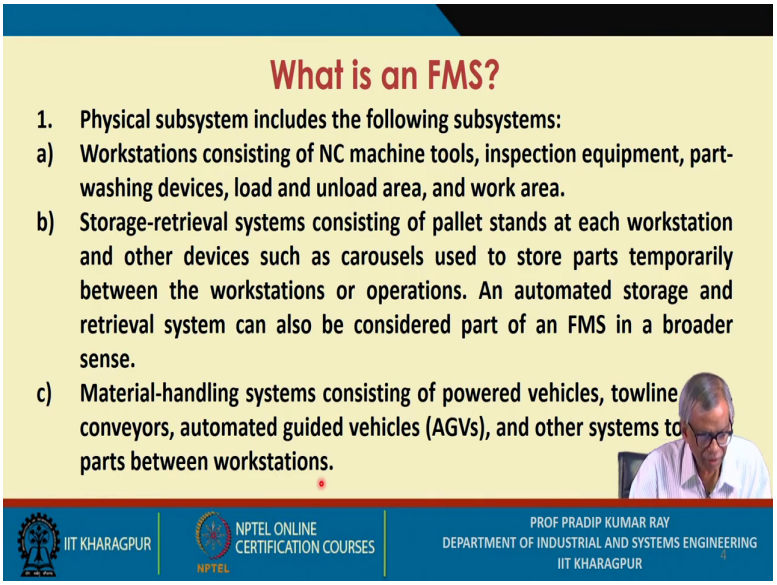

Now, let us talk about the physical subsystem, first subsystem is the workstations, these workstations consist of NC machine tools, one or more inspection equipment, part washing devices load and unload area and work area.

Second one is storage retrieval system. We have a system called ASRS – Automated Storage slash Retrieval System, which is referred to as general storage retrieval system consists of pallets stands at each workstation and other devices such as carousel. Carousel is used to store parts temporarily means, there will be temporary storage is a waiting, there is a queue.

An automated storage and retrieval system can also be considered a part of an FMS in a broader sense.

Third one is material handling systems. So, these systems consist of several different types of material handling equipment.

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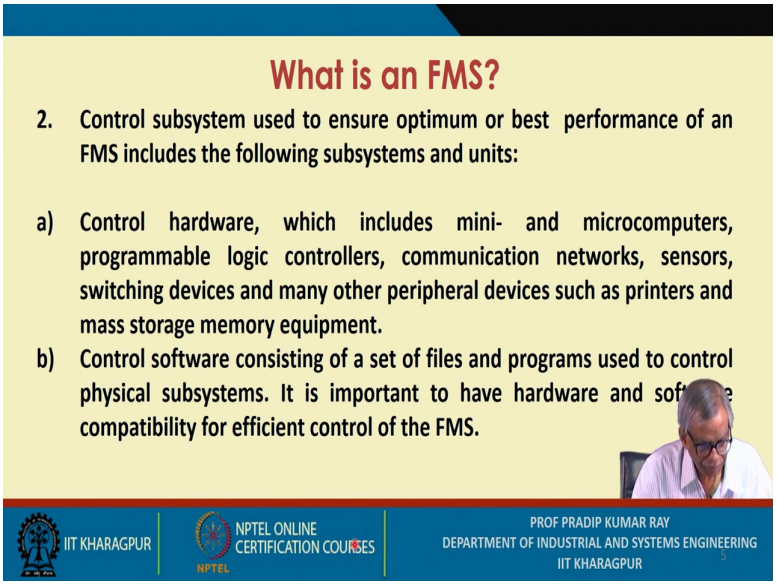

Now, the next one is the control subsystem used to ensure optimum or best performance of an FMS includes the following subsystems and units.

Control hardware, which includes mini- and microcomputers, programmable logic controllers, communication networks, sensors, switching devices and many other peripheral devices such as printers and mass storage memory equipment.

Control software consisting of a set of files and programs used to control physical subsystems. It is important to have hardware and software compatibility for efficient control of the FMS.

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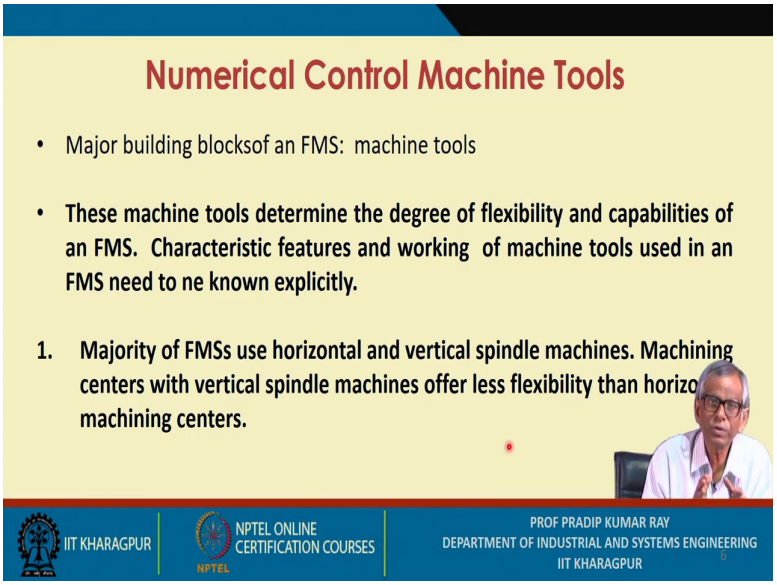

Major building blocks of an FMS machine tools that is the NC machine tools. These machine tools determine the degree of flexibility and capabilities of an FMS, that means, the capability is ability of machine tool to produce or to manufacture a part as per its specifications.

Characteristic features and working of machine tools used in an FMS need to be known explicitly. In FMS usually the quality of conformance is absolutely of the highest level means, that the part quality component quality the assembly or the product quality could be of very high.

If you want to produce high quality product, you will go for FMS with intricate shapes and sizes majority of FMS use horizontal and vertical spindle machines.

Machining centers with vertical spindle machines offer less flexibility than horizontal machining centers.

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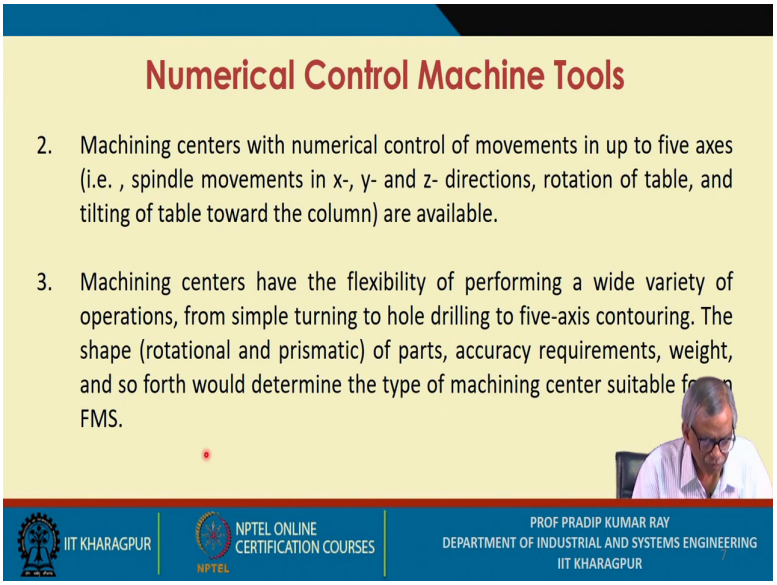

Now, the machining centers with numerical control of movements in up to five axes that is the spindle movements in x-, y- and z- direction, rotation of table, and tilting of table toward the column) are available.

Machining centers have the flexibility of performing a wide variety of operations that is why they are referred to as the machining centers from simple turning to hole drilling to five-axis contouring. The shape rotational and prismatic of parts, accuracy requirements, weight and so forth to determine the type of machining center suitable for an FMS.

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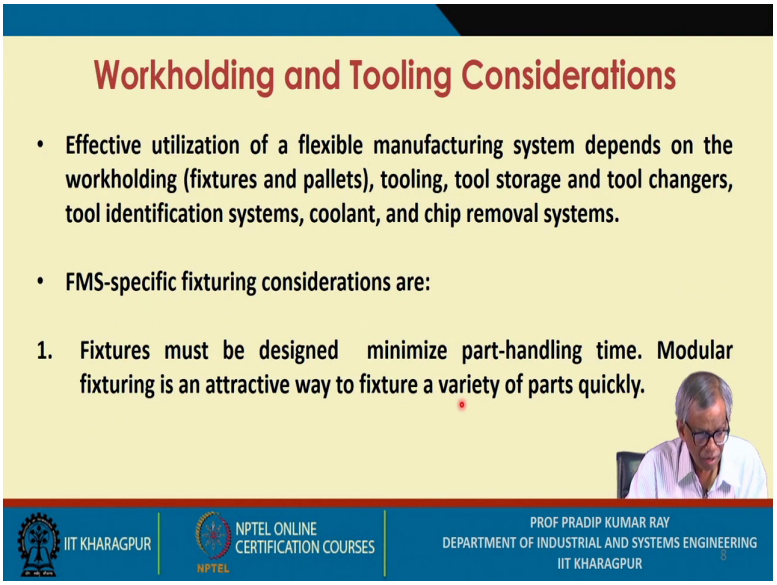

Now, as far as work holding and the tooling considerations what you have basically now you have fixtures, you have pallets, and you have the work holding devices, the tooling, tool storage and the tool changers, tool identification systems, coolant and chip removal systems. All these systems must be working simultaneously concurrently.

So, there must be perfect the coordination or perfect integration, between all these sub elements, so first you consider all these aspects when you go for a trial running, now under different conditions you just start operating your system your FMS by engaging all these subsystems, and then you check that which particular settings your performance of the FMS is the best one.

Effective utilization of a flexible manufacturing system depends on the work holding (fixtures and pallets), tooling, tool storage and tool changers, tool identification systems, coolant, and chip removal systems.

FMS-specific fixturing considerations are:

Fixtures must be designed minimize part-handling time. Modular fixturing is an attractive way to fixture a variety of parts quickly.

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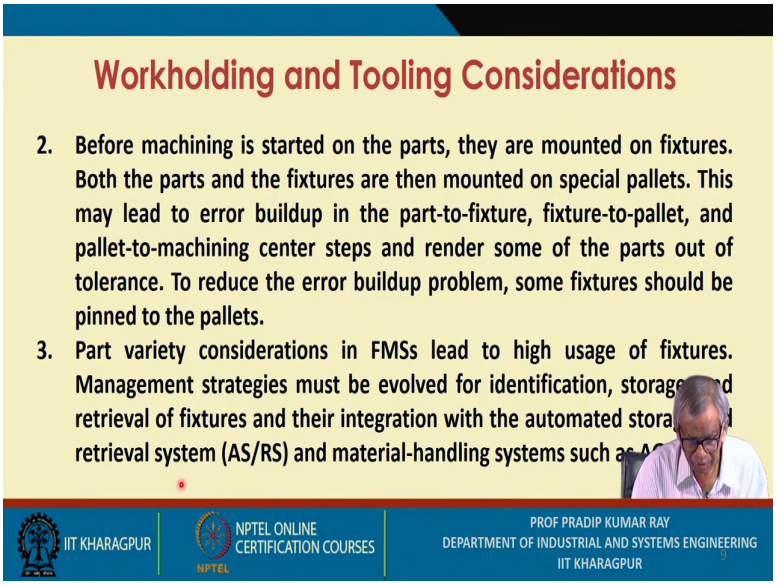

Before machining is started on the parts, they are mounted on fixtures. Both the parts and the fixtures are then mounted on special pallets. This may lead to error buildup in the part-to-fixture, fixture-to-pallet, and pallet-to-machining center steps and render some of the parts out of tolerance. To reduce the error buildup problem, some fixtures should be pinned to the pallets.

Part variety considerations in FMSs lead to high usage of fixtures. Management strategies must be evolved for identification, storage, and retrieval of fixtures and their integration with the automated storage and retrieval system (AS/RS) and material-handling systems such as AGVS.

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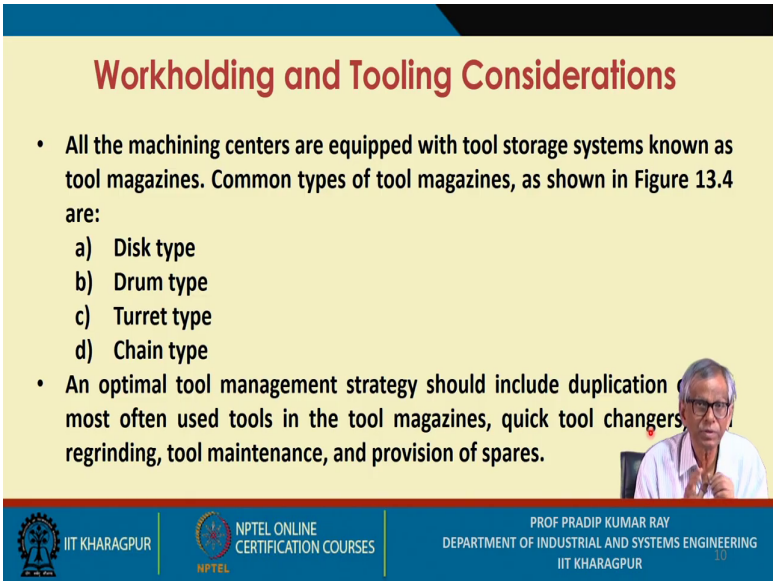

We are emphasizing on essentially the integration aspect of various the subsystem as well as the among different sub subsystems. All the machining centers are equipped with tool storage system, this term tool magazine and the tool magazine capacity could be used. The tool magazine the capacity is defined or measured with number of slots.

There could be 30 slot tool magazine there could be 60 slot tool magazines, there could be 120 slots tool magazine. So, a greater number of slots you ha the different types of tools you may store in the tool magazine. It all depends how many different types of the tools you should the store in the tool magazine in an FMS depends on the kinds of parts and their process plans

There are four types. First one is the disk type, second one is the drum type, third one is the turret type and fourth one is the chain type. There are many kinds of the problems you need to deal.

An optimal tool management strategy should include duplication of the most often used tools in the tool magazine, quick tool changers tool regrinding, tool maintenance and the provision of spare, and diagnostics.

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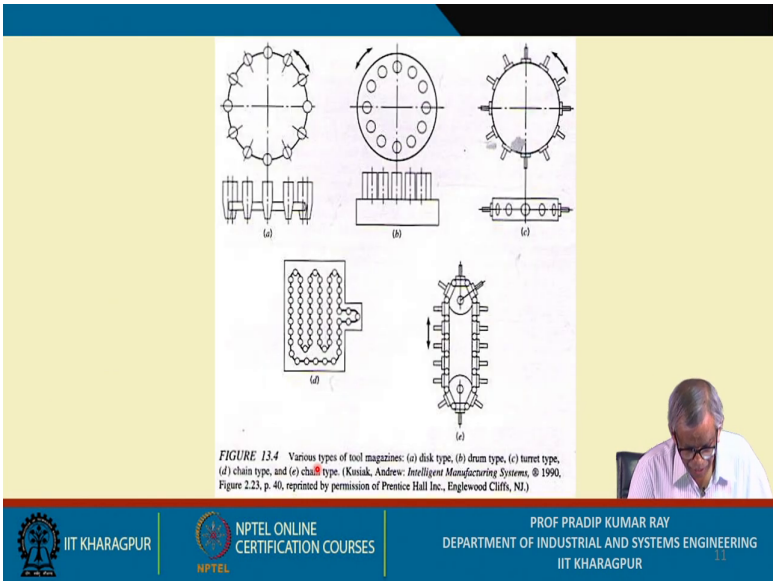

These are the four types of say tool magazine various types of tool magazine. This one is the disk type, this is the disk type tool, this is the drum type, this one is the turret type and this one is the chain type. There are two types chain you observe.

In a particular type you just check that how a particular tool is held, and which one you will select whether drum type or disk type or turret type or chain type.

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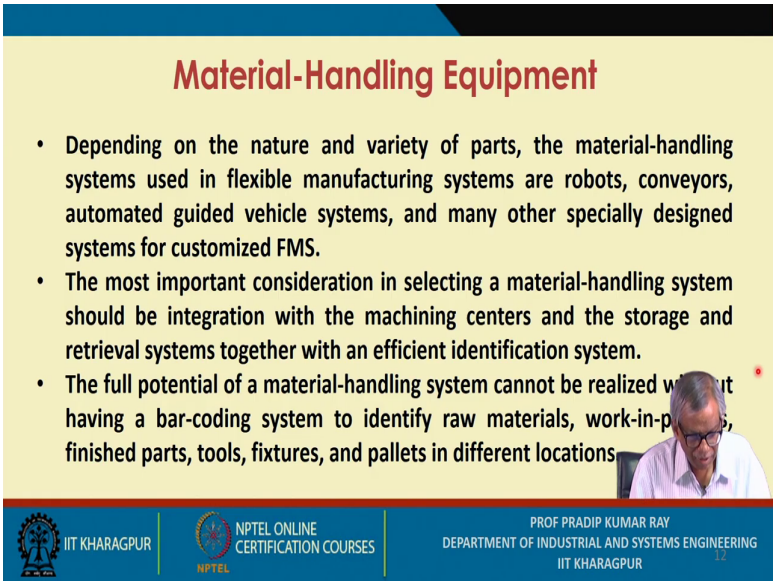

Depending on the nature and variety of parts, the material-handling systems used in flexible manufacturing systems are robots, conveyors, automated guided vehicle systems, and many other specially designed systems for customized FMS.

The most important consideration in selecting a material-handling system should be integration with the machining centers and the storage and retrieval systems together with an efficient identification system.

The full potential of a material-handling system cannot be realized without having a bar-coding system to identify raw materials, work-in-process, finished parts, tools, fixtures, and pallets in different locations.

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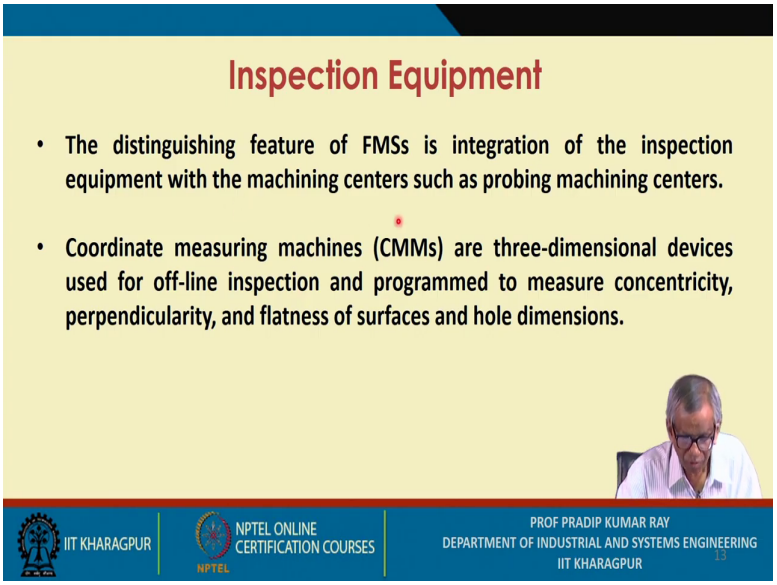

The distinguishing feature of FMSs is integration of the inspection equipment with the machining centers such as probing machining centers.

Coordinate measuring machines (CMMs) are three-dimensional devices used for off-line inspection and programmed to measure concentricity, perpendicularity, and flatness of surfaces and hole dimensions.

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Environmental considerations require that there is a central coolant and chip separation system with the capability of recovering the coolant.

The FMS has deburring and cleaning stations. The combinations of parts, fixtures, and pallets must be cleaned to remove dirt and chips before operations and inspections.

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