Automation In Production Systems And Management
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Lecture - 02
Types of Manufacturing Systems and Role of Automation

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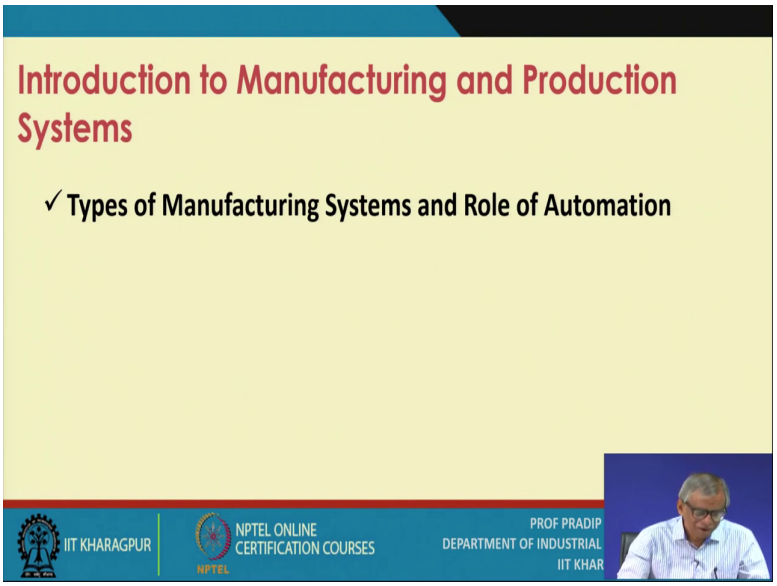

As far as manufacturing and production system systems are concerned, you must know that what type of the manufacturing system you are dealing with. We will classify the manufacturing systems and depending on the type of manufacturing system, what kind of the automated system you will introduce.

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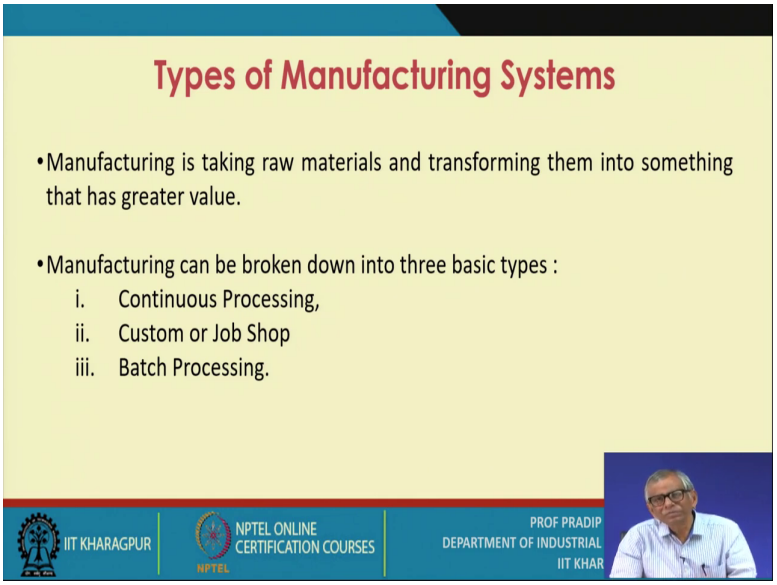

Now, as you may be knowing that manufacturing system is nothing but taking raw materials and transforming them into something that has greater value. In the manufacturing system you start adding values to the raw materials and ultimately, the raw materials shape and size getting changed till you get the finished goods or the product.

When you get the finished product or your finish goods. You say that yes, I am able to produce the product as per the design and obviously, this is a transformation process and this transformation process may have one step or it could have hundred steps, depending on the type of process plan you have.

Once a design is known, then next is you start manufacturing but prior to manufacturing, you must know what is the process plan. The manufacturing process is nothing but a transformation process. Now, this manufacturing process can be broken down into three basic types - the first one is continuous processing, the next one is custom or the job shop and the third one is a batch processing.

At one extreme, you have the continuous processing and other extreme, you have the custom or the job shop and in between, you have the batch processing. 70 to 80 percent of the products that you use, they come from a batch production system.

Varieties of batch production system you come across and whatever the new tools and techniques you develop for improving the efficiency and effectiveness of your production system, mostly those are used in batch production system and many a time, they are also referred to as the discrete part manufacturing system.

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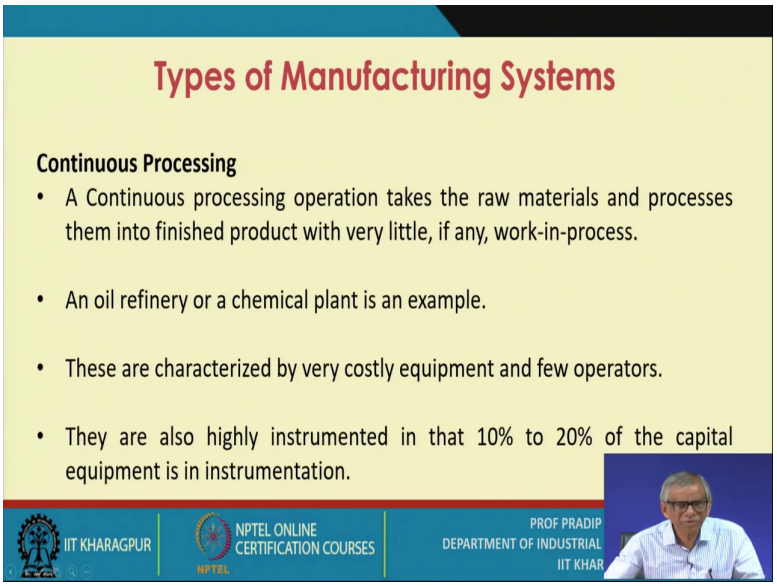

The first type is continuous processing like a chemical plant, like an oil refinery. A continuous processing operation takes the raw materials and processes them into finished product with very little, if any, work in process. An oil refinery or a chemical plant is an example and there are hundred types of the chemical plants. These are characterized by very costly equipment and few operators and sometimes this chemical plant or say continuous processing is nothing but the hard automation or fixed automation.

If you visit any chemical plant, you will find hundreds of actuating mechanisms as well like valves, like the relays, they have been using and in production as well as you will find there are varieties of instruments you need to use that entire system is highly instrumented. 10 to 20% of the capital equipment is in the instrumentation or highly instrumented.

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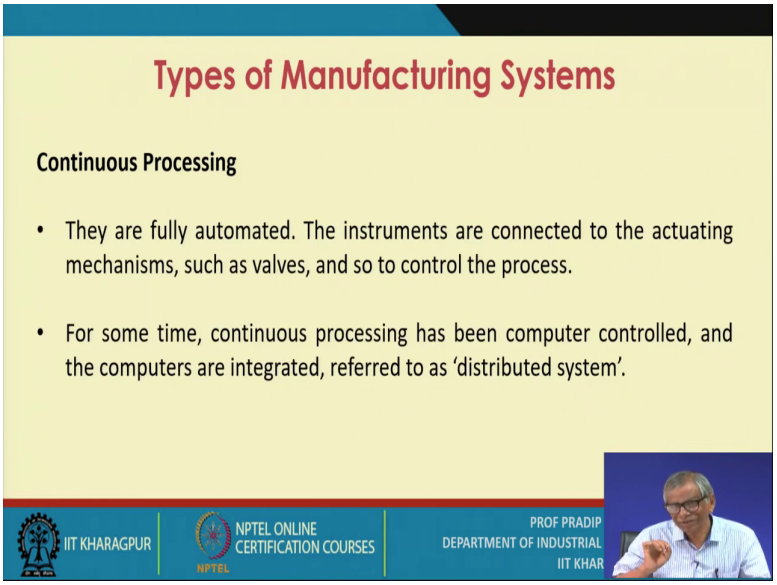

In the chemical plant, in the continuous processing, the different types of actuating mechanisms, you need to use and basic purpose is with these actuating mechanisms is trying to control the process sometimes, continuous processing has been computer controlled and the computers are integrated- referred to as distributed systems.

Usually, when you have these continuous processing, even if you use the computer, you never use the term called CIM or computer integrated manufacturing. This you can refer to this automated system as distributed system.

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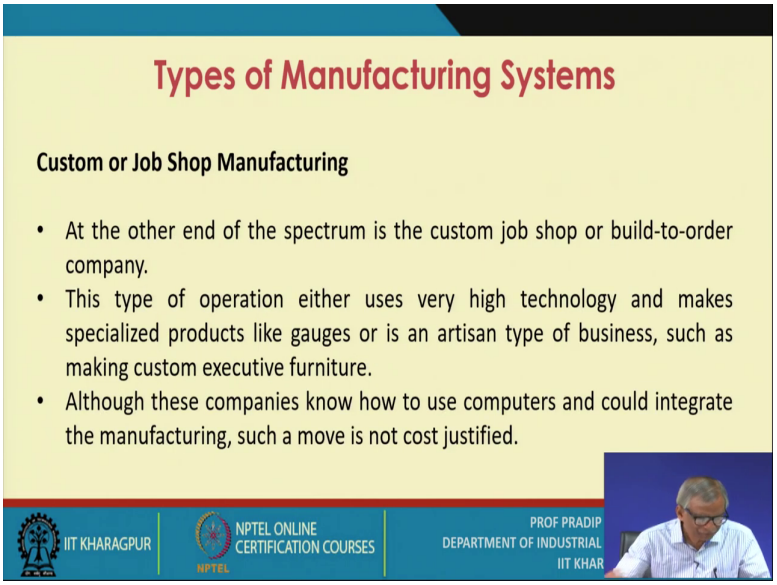

Let me just tell you what are the characteristic features of a typical job shop these al refer to as a custom job shop.

This type of operation either uses very high technology and make specialized products, like gauges or is an artisan type of business such as making custom executive furniture there are hundreds of the specialized products you are required to produce.

A job shop is capable of producing varieties of products of different types. Although, these companies know how to use computers and could integrate the manufacturing, such a move is not cost justified.

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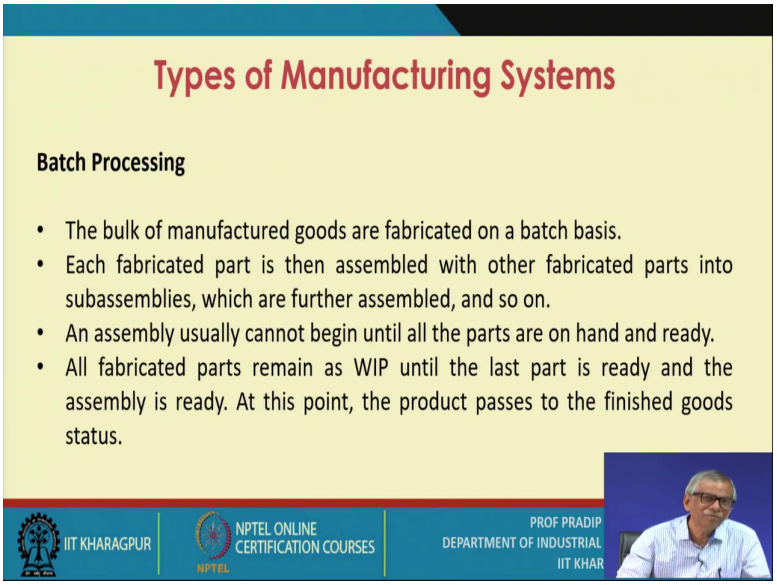

Whenever you visit a job shop, for design purpose you can use the computer; but for the manufacturing purpose, using computer becomes difficult.

The third type is the bulk of manufactured goods are fabricated on a batch basis. Each fabricated part is then assembled with other fabricated parts into subassemblies which are further assembled and in the typical batch production, there are two important groups; one is part manufacturing followed by the assembly and on the number of parts you deal which maybe few thousands; and the final assembly you get only when you have several sub-assemblies.

Assembly usually cannot begin until all the parts are on hand and ready, and in respect of batch production system, we try to develop a condition which is called the synchronous manufacturing. If you can develop an automated system, automated manufacturing system in all likelihood. There will be synchronous manufacturing.

All fabricated parts remain as work in process or WIP until the last part is ready and the assembly is ready.

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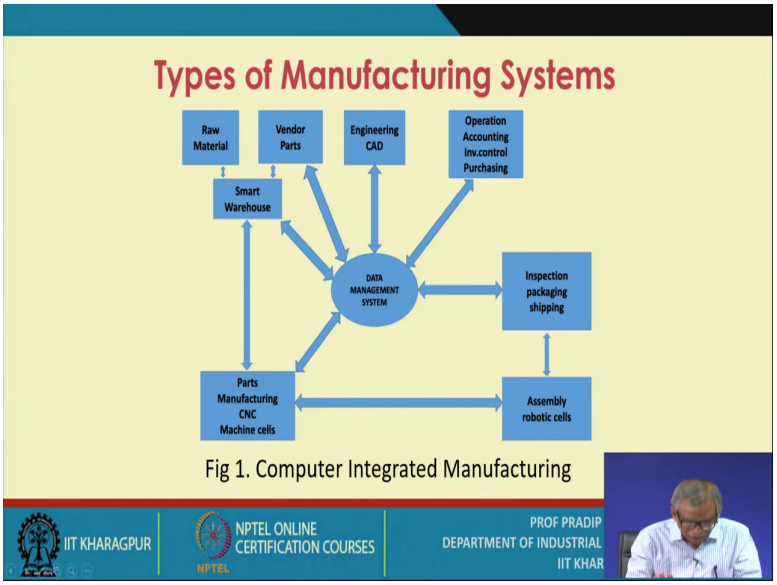

One CIM framework I am just showing to you; you have to create a data management system. First one is raw material; second one is the vendor parts. Vendor parts means basically those purchase the parts which you purchase from outside; those which are purchased from the suppliers or the vendors. Then, you must know the design of the product for that what do you use? The computer aided design as well as the computer aided engineering.

You have operations, you have accounting, you have inventory control section, you have purchasing section or department and then, sometimes we say the smart warehouse warehousing and then, the parts manufacturing, you may use a computer numerical control and there will be machine cells. These are the important issues or the important features of the computer integrated manufacturing.

Another important activity is the inspection activity, packaging activities, the shipping activities and of course, there will be assembly and the robotic cell as same and robots are used for doing assembly this is a typical framework for CIM.

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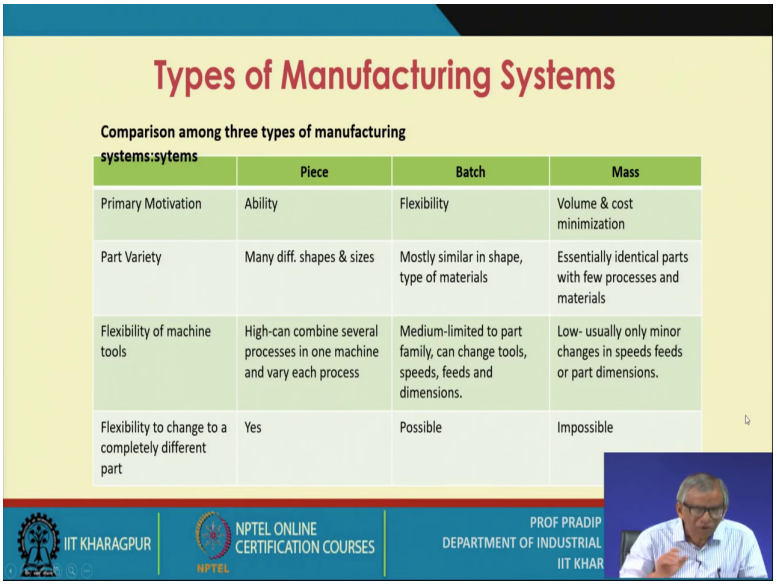

When you try to compare between these three manufacturing systems; obviously, first you select the criteria with respect to a particular criterion, you compare among these three types of manufacturing system. There are seven criteria and against each criterion, the comparison among these three types of manufacturing system is made.

The first criteria is the primary motivation. Suppose you have created a chemical plant or continuous processing what is your primary motivation? if it is a piece production system; piece means essentially actually the job shop.

This is also referred to as the piece production system or the job shop the main focus is ability; if you visit a job shop, we will find hundred different types of the components you produce or even the products you produce. You have the ability to produce varieties of products.

When you refer to the batch production system, we refer to the flexibility part. When you visit a batch production system, you say that this is very flexible; the flexibility is an inherent say the characteristic of a batch production system; but when you go for mass production, essentially your continuous processing is used for mass production or the volume production and cost minimization.

Next important factor is part variety, many different shapes and sizes you can produce within the job shop. In the batch production, mostly similar in shape, type of materials is produced. And when you go for the continuous processing, essentially identical parts with few processes and materials are produced. Then, you take the third factor that is the flexibility of machine tools. As far as flexibility of machine tools are concerned, this piece production system is very high; the batch production system is at the medium level and mass production, if you offer the mass production system, continuous processing, , the flexibility is at low level.

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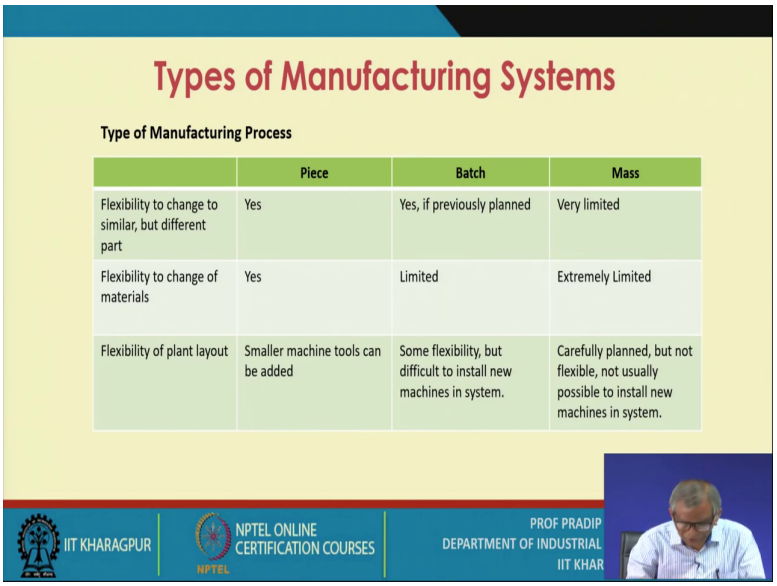

You just cannot start producing and altogether a different product in a continuous processing. Next important factor is flexibility to change to similar, but different part. Yes, for piece rate it is possible; if it is a batch production system, yes, if previously planned; that means, certain preparation is required and if you opt for mass production system, very limited.

The last factor is seventh one that is a flexibility of plant layout; smaller machine tools can be added; but difficult to install new machines in the systems.

If you have a batch production system or discrete part manufacturing system and if you have a continuous processing, then it is to be carefully planned. If you want to install a new

machine or new process in the system, it is to be carefully planned, but not flexible, not usually possible to install new machines in system.

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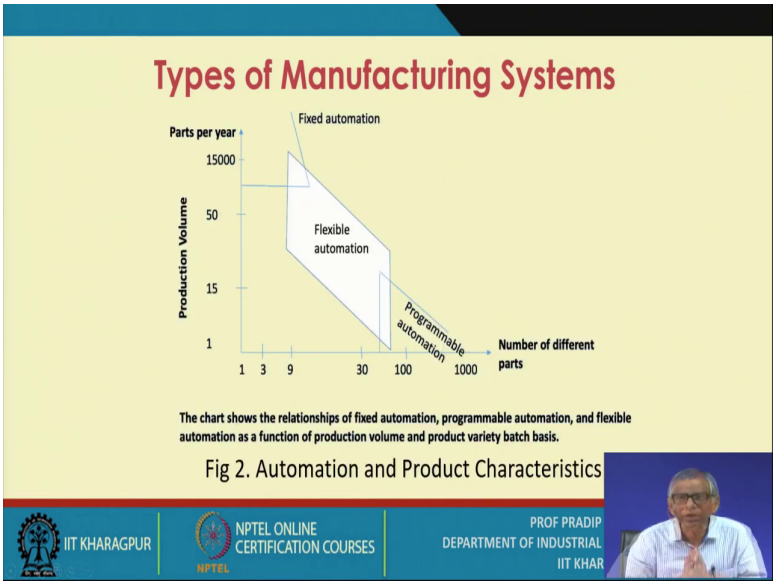

The manufacturing system can be defined in terms of two important factors; one is the production volume and the second one is the varieties. If your production system is capable of producing multiple products, we say that the varieties are more.

Any production system can be assessed with respect to two important factors; one is the production volume and the second one is part variety this is basically referred to as volume-variety relationship.

At one extreme, if the volume of production is very high, like in the order of say thousands; 15000, 20000, 30000s like this, then obviously, if the volume is very high, you opt for fixed automation or hard automation like a typical continuous processing and other extreme, suppose the volume of production for each part type is very less, but the number of part types is more, the production system is referred to as a programmable automation.

You install CNC machining centers, you can produce varieties of parts; but within a given time period, the volume of production or the number of units in each part could be very less

these are the two extremes, one is fixed or hard automation and other one is programmable automation.

In between, we will say that my production system is the mid variety mid volume, obviously the kind of automated automation you opt for that is referred to as a flexible automation and when you refer to the flexible automation, the best possible flexible automation is referred to as FMS, flexible manufacturing system.

Once you try to define automation, it does not mean that automation can be of just one type. Given a particular production system, you have to the define or you have to suggest or you have to implement a particular type of automation and this type of automation are classified under three categories; fixed automation or hard automation, flexible automation and programmable automation.

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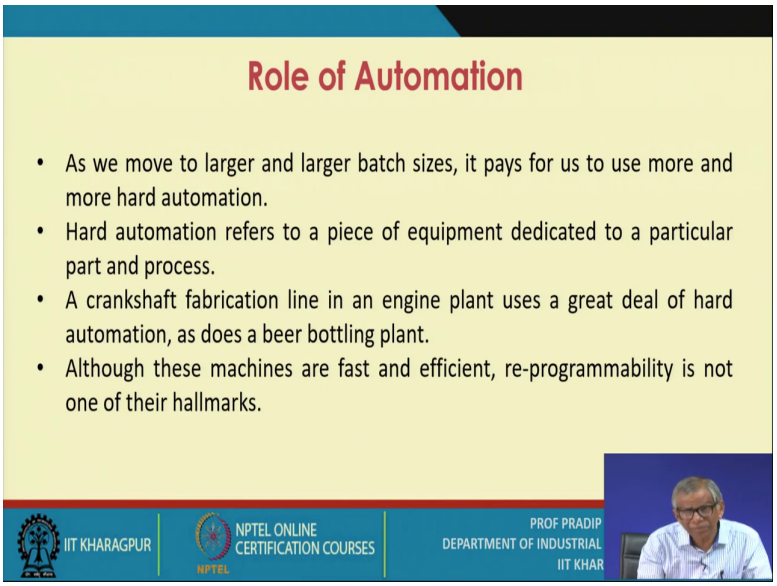

As we move to larger and larger batch sizes, it pays for us to use more and more hard automation. your focus is volume production and minimization of cost, that means a production cost also should be as minimum as possible there could be the different approaches. One approach is fixed or hard automation.

Now, whenever you install a chemical plant; hard automation or fixed automation is in built. Hard automation refers to a piece of equipment dedicated to a particular part and processes. That means, day in day out it is supposed to produce the same product.

Same product means the product with the same design and the same manufacturing processes, like a crankshaft fabrication line in an engine plant uses a great deal of hard automation, as does a beer bottling plant.

Usually, the production rate is very high, the 60 units per minute or maybe say 360 units per minute, the system is running at a very fast rate and you opt for 100% inspection.

Each and every unit, you need to produce; you need to inspect each and every unit. Like say you are producing medicines at a very high rate and the medicine needs to be inspected. Similarly, suppose the baby food; each produced unit is to be inspected.

Many time, you find that 100% automated non-contact inspection, there are multiple designs on this in many time, as far as continuous processing is concerned.

you have to make the system automated and it is 100% automated say non-contact inspection system you have to install. It has not only for the manufacturing. Manufacturing system will be automated, as well as the inspection system.

And if the inspection system is not made automated, for such products, for essential food items, or say suppose vital items, you focus on the manufacturing automation; but you do not bother about the inspection automation, then the whole system does not solve any purpose.

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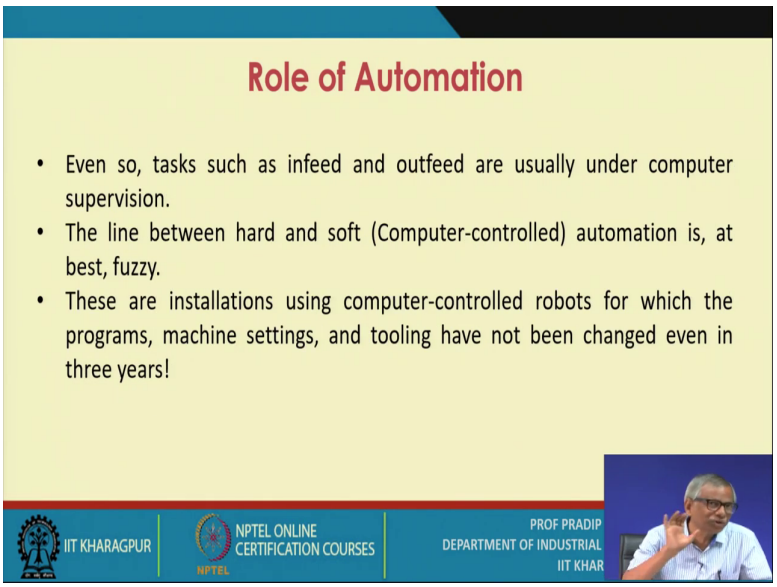

When you refer to flexible automation, re-program ability is an important characteristic, that means, if you want to produce another part, you write down a different program.

By changing the program, you start producing a different component of the part which is not required for continuous processing tasks such as infeed and outfeed are usually under computer supervision when you discuss FMS. The line between hard and soft computer-controlled automation is, at best, fuzzy.

These are installations using computer-control robots for which the programs, machine setting; first one is the programs, second one is the machine settings and the third one is a tooling have not been changed even in three years.

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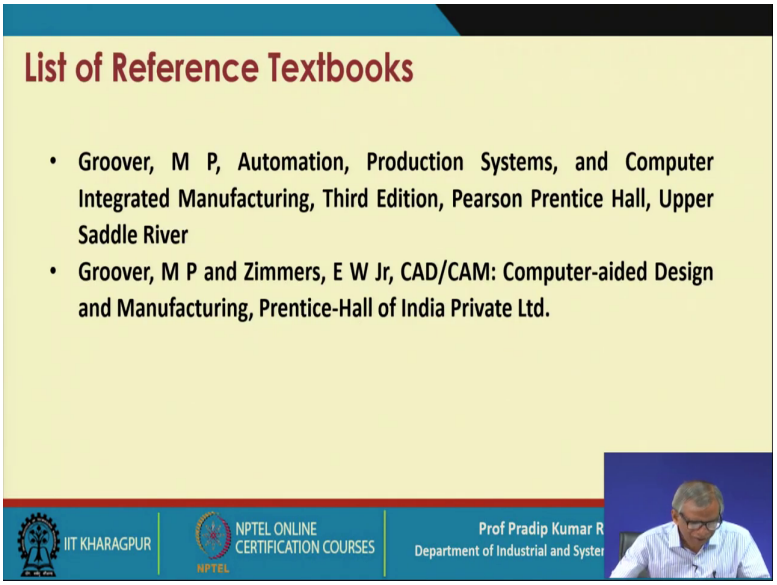

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