**Automation in Production Systems And Management**
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**Lecture - 01**
**Basic Concepts of Manufacturing Systems, Evolution of Manufacturing Systems**

As a course teacher for the course Automation in Production Systems and Management, I welcome you to the lecture sessions of this very important course. And as you are aware that this is a course to be offered in 12 weeks and total contract hours will be 30. This course is a very important course in today's context and as you have seen that the title of the course is automation in production systems and management.

Now, this is the first week lecture sessions and as you are aware that there will be 5 lecture sessions on the five important topics in week 1 and the same approach we will follow, the same module we will follow for all subsequent weeks for this particular course. Now, during this week, I will just introduce the manufacturing and the production systems, details as well as their characteristic features.

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The idea is that, as you refer to the title of the course, you will find that essentially we will be dealing with automation in production systems and management. Now, when we refer to the production systems, we say that the core component of production system is manufacturing.

During this week, I will be discussing all the important aspects of manufacturing and production systems. Now, during this week, there will be five topics. In lecture 1, I will discuss the basic concepts of manufacturing systems including evolution of manufacturing system.

In the 2nd lecture, I will refer to different types of manufacturing systems and the role of automation; 3rd topic is product–process-flexibility matrix and the four-plane concept of manufacturing.

The 4th topic is product design and manufacturing system, and the last topic is definitions and design criteria for production systems.

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Now, let me just discuss the basic concepts of manufacturing systems and evolution of manufacturing systems. Over the years, the manufacturing system has undergone several types of changes and in today's context, there are hundreds and thousands of manufacturing systems.

Before you take a decision for implementing automation related tools and techniques and approaches in manufacturing systems; you should be aware of in which kind of manufacturing systems you should develop your production system.

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Manufacturing creates between 60 to 80 percent of the real wealth of the major industrialized countries; that means your strength is very much dependent on how efficiently, how effectively you are running your manufacturing systems.

Most of the countries have numerous industry and government supported programs to increase manufacturing productivity as well as manufacturing performance. Within the last six decades; since the late 60s or early 70s, there have been many important innovations in the development of new design aids, manufacturing processes, engineering materials and manufacturing systems.

With these changes taking place, you have to look at the system from a different perspective and you need to design your manufacturing system in such a way that, even if you incorporate new technologies or new design aids or the new design methodologies; you make sure that your manufacturing system is cost efficient and effective.

With conventional production know-how, it becomes increasingly difficult and expensive to improve manufacturing processes or to improve the performance of the manufacturing process.

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You try to implement computer-based systems for your production, the computer offers possibilities for improving the manufacturing technology in many areas.

And today's context you will find that for almost all types of manufacturing systems, the computers have been introduced. When you talk about the automation, obviously the computerized system plays a very important role when you try to automate your manufacturing system as well as the processes.

Computers can directly control production and quality control equipment. There are many advantages of using the computers in manufacturing system. First one is, because the production control is an important aspect; similarly the quality control and what is most important in today's context that you have to adapt very quickly to changing customers orders and new products.

Obviously, you create your manufacturing in such a way that it can very quickly adapt to the changing demands or the changing customer orders for the new products. Suppose a new

design is to be implemented and you have to test its applicability; it is better that you use the computer-based system. They make possible the instant evaluation of data.

Instant evaluation of data to assess the flow of information in the plant and to initiate immediate corrective actions. As you may be aware that Management Information System or MIS is playing a very important role in keeping your manufacturing system as well as the production systems at a particular level of performance which is acceptable to you.

Because after all these production systems, these manufacturing systems you have been using for making in products and these products you should supply or you should produce as quickly as possible; maintaining their standards their quality and ultimately you are able to meet the quality of the design followed by quality of conformance followed by quality of performance.

Ultimately the products of any types are to be manufactured, prior to that are to be designed, then manufactured and then to be sold to the customers. If you use a computer, the computer-based systems can optimize the manufacturing process by their capability to integrate the entire manufacturing system.

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In these context, the two important aspects are; one is definitely the automation, and the second one is integration. Now, as when once you we are able to integrate your system, it becomes easier for you to automate the system.

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Computer Integrated Manufacturing is widely used and it comprises product design, production planning, production control, production processes, quality control, production equipment, and plant facilities. These are the seven important components you need to consider while you develop computer integrated manufacturing.

Now, the creation of the products starts in the design department, where the function, physical design and manufacturing methods and processes are established. Upon completion of the design activities, that is your first activity, the design activity sometimes also referred to as offline quality control activities.

These design activities, 70 percent of the manufacturing cost have been predetermined; that means when you free your design and subsequently go for manufacturing and obviously the total manufacturing cost and as well as the production cost is very much dependent on what is your quality of design.

This fact stresses the importance of combining design and manufacturing in a comprehensive CIM systems; like say if you look at the design in separately, then obviously the integration

becomes very difficult to go for integration, you must know what is the relationship between the design and manufacturing.

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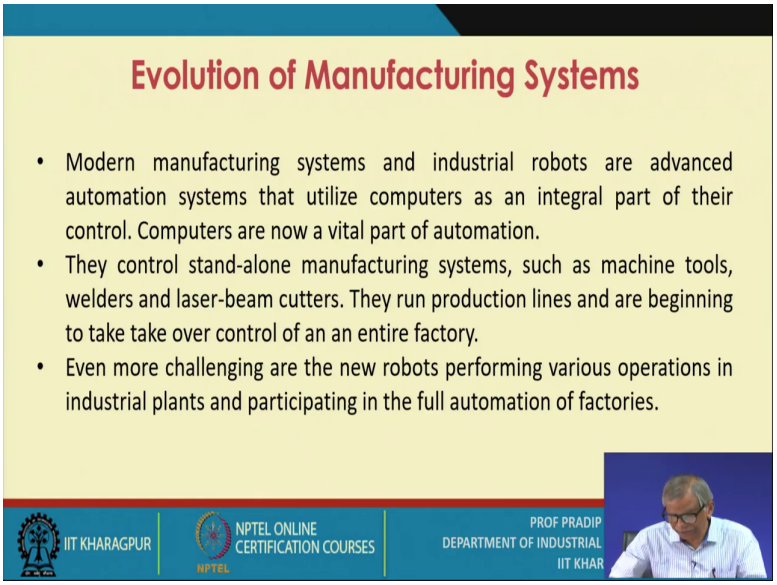


Modern manufacturing systems and industrial robots are advanced automated systems that utilize computer as an integral part of their control. They control stand-alone manufacturing systems, such as machine tools, welders and laser beam cutters. They run production lines and are beginning to take over control of an entire factory.

Even more challenging are the new robots performing various operations; you may be aware of different kinds of robots and their usefulness in manufacturing system these robots perform various operations in industrial plants and participating in the full automation of factories.

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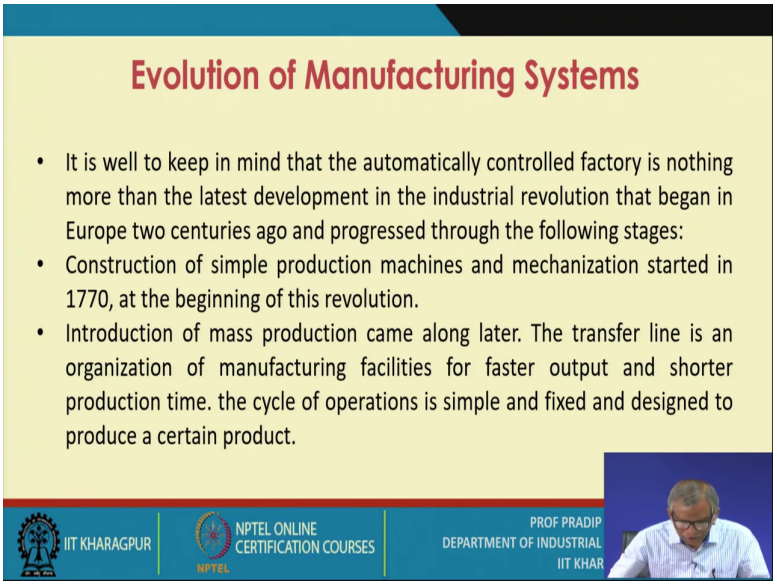


It is well to keep in mind that the automatically controlled factory is nothing more than the latest development in the industrial revolution that began in Europe more than two centuries ago and progressed through the following stages.

This topic is referred to as the evolution of manufacturing systems. Industrial evolution started in England a way back in 1770.

The construction of simple production machines and mechanization started in 1770, at the beginning of this evolution called industrial revolution and introduction and then in the next phase, mass production system was introduced. The transfer line is an organisation's of manufacturing facilities. Later on you come across a system called assembly line and assembly line when made fully automated, it is referred to as the transfer line. Transfer line was introduced for faster output and shorter production time or the cycle time or the throughput time.

The cycle of operation is simple and fixed. You try to standardise the system that is a very important the consideration or important condition before you go for automate your system; first you have to standardise and prior to that you need to simplify the system.

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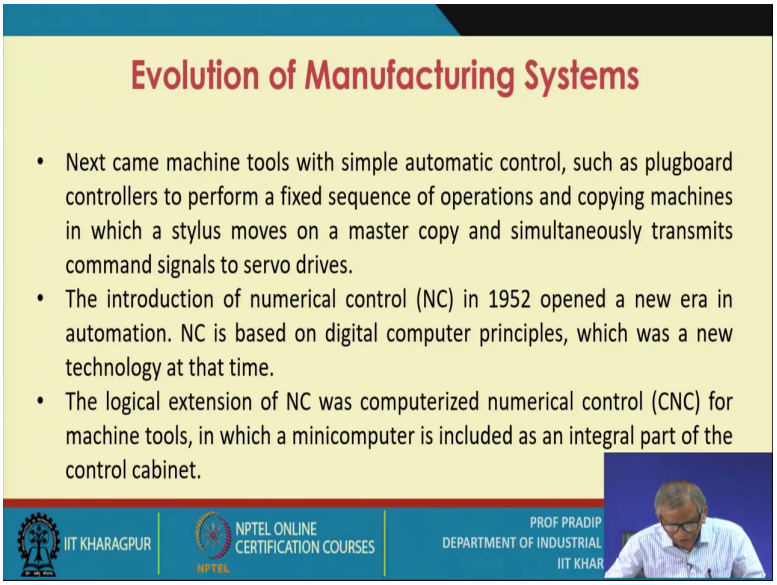


All these activities you carry out to produce a product. Next came machine tools with simple automatic control, such as plugboard controllers to perform a fixed sequence operations and copy turning machines or copying machines.

Copying machines were introduced in which stylus moves on a master copy and simultaneously transmits command signals to servo drives. In the next stage, the NC machines were introduced; the NC technology was introduced way back in 1952 and this open, these NC technology actually opened a new era in automation, that is your starting point for automation.

NC is based on digital computer principles which was a new technology at the time. The logical extension of NC was computerized numerical control or the CNC.

It is essentially you use a mini computer and the computer based system becomes an integral part of the control cabinet of a production system or the manufacturing system.

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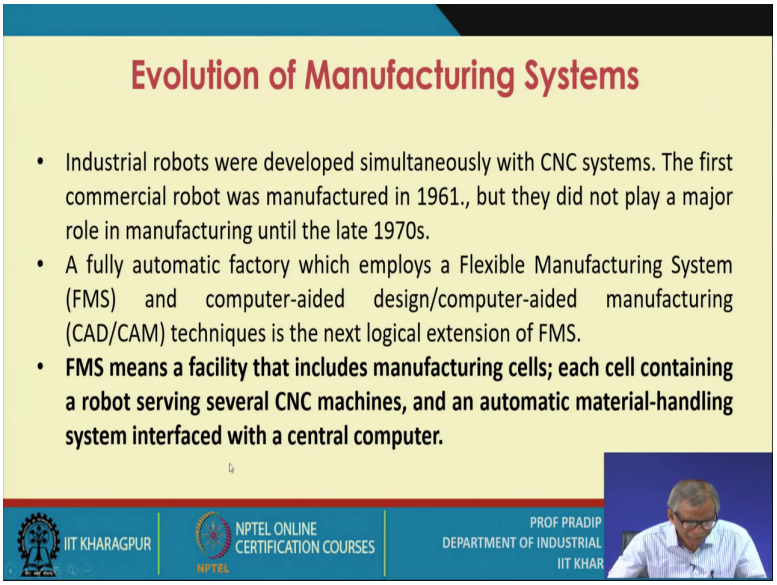


Industrial robots were developed simultaneously with CNC systems. There are the different kinds of robots in fact, or the robots have been classified, like gantry robot etc. The first commercial robot was manufactured in 1961, but they did not play a major role in manufacturing until the late 1970s. Now, you will find that in majority of the state of the art manufacturing system as well as the production system, the robots of different types are widely used.

A fully automated factory which employs a flexible manufacturing system; we will discuss in detail the FMS and the computer aided design, computer aided manufacturing like CAD, CAM techniques is the next logical extension of FMS. FMS it is the defined as 100% automated, mid volume, mid variety, central computer controlled manufacturing system.

FMS means a facility that includes manufacturing cells; each cell containing a robot serving several CNC machines, and an automatic material handling system interfaced with a central computer.

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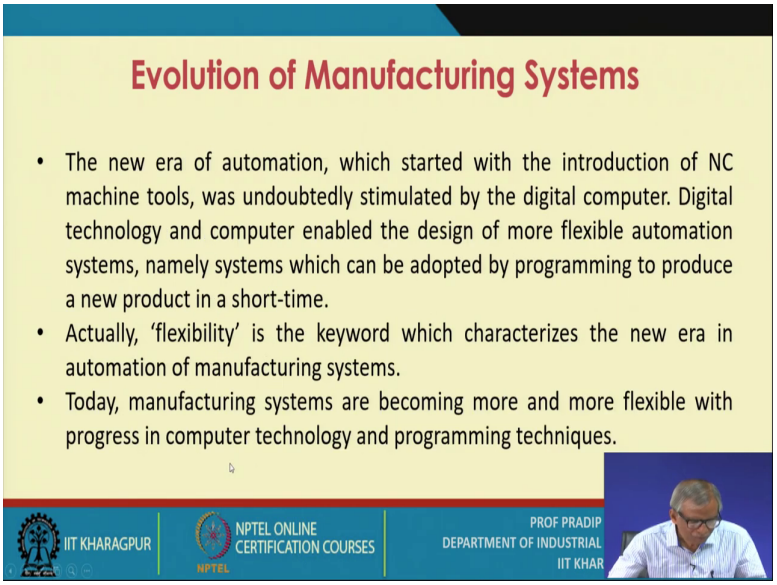


The new era of automation, which started with the introduction of NC machine tools was undoubtedly stimulated by the digital computer, the digital technology and computer enabled the design of more flexible automation systems, namely systems which can be adopted by programming to produce a new product in a short time.

Actually, flexibility is a key word which characterizes the new era in automation of manufacturing system. Today, manufacturing systems are becoming more and more flexible with progress in computer technology and programming techniques.

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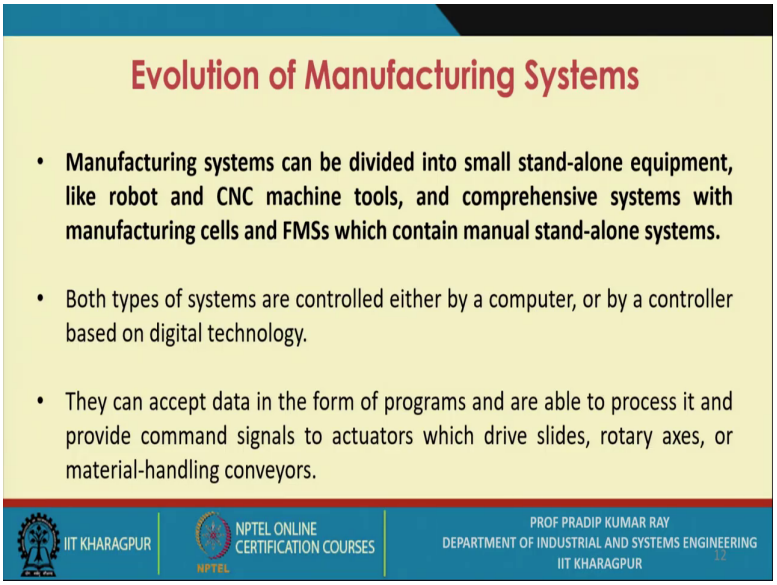


Manufacturing systems can be divided into small standalone equipment, like robot and CNC machine tools and comprehensive systems with manufacturing cells and FMS; when you try to implement FMS, what kind of the production system layout you should opt for like group technology.

And then when you try to implement the group technology for your manufacturing system for your production system; entire system becomes a cellular manufacturing system, that means the entire production system is divided into a number of machine cells, and then we refer to say the cellular manufacturing system.

Both types of systems are controlled either by a computer or by a controller based on digital technology there are different types of configurations available, you will come to know in fact; like say NC, from NC you move to a direct numerical control, then computer numerical control, then you have distributed numerical control or DNC.

In an automated system, data can be accepted in the form of programs and are able to process it and provide command signals, actuators which drive slides, rotary axes or material handling conveyors.

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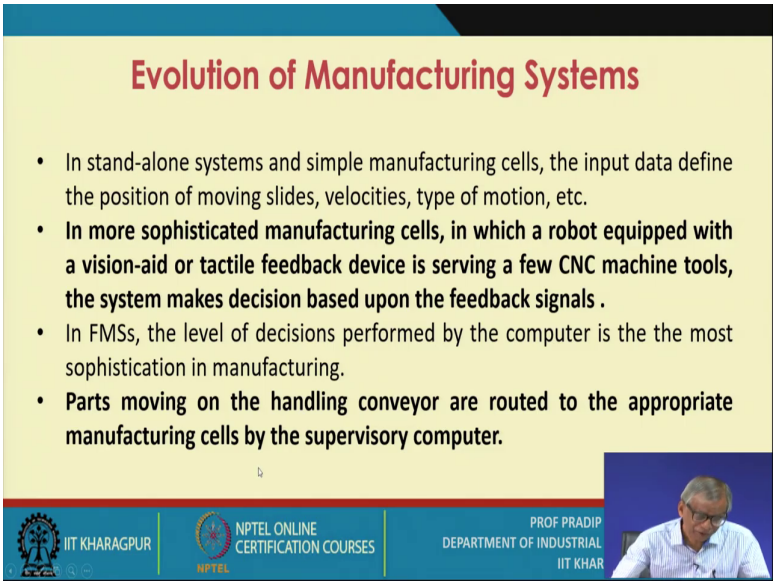


The input data defined the position of moving slides.

In a more sophisticated manufacturing cells, in which a robot equipped with a vision aid or tactile feedback, is serving a few CNC machine tools, the system makes decision based upon the feedback signals parts moving on the handling conveyor are routed to the appropriate manufacturing cells by the supervisory computer.

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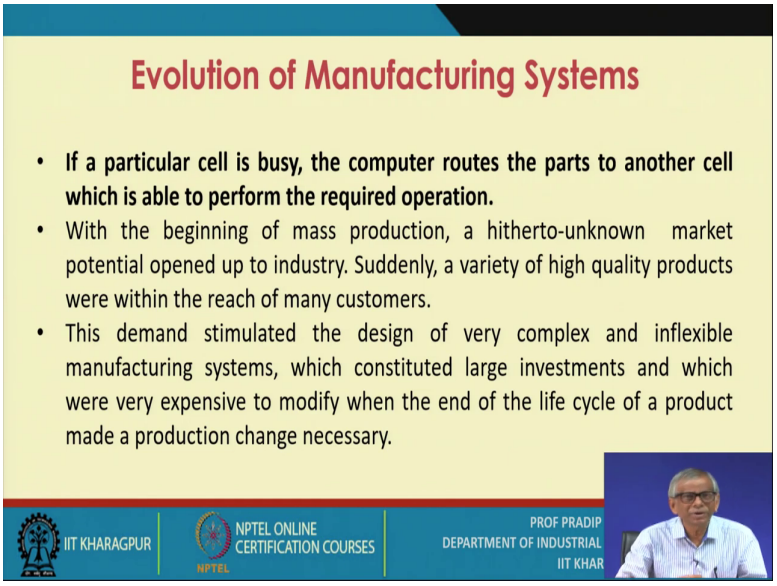

If a particular cell is busy, the computer routes the parts to another cell; when you discuss the FMS in details. Before you go for implementing automated system in organization; ins and outs of the manufacturing system as well as the production systems you must know, including its working.

You must have an adequate knowledge; otherwise simply as you may be knowing that the production system is a very complex one and day by day the level of complexity increases, but then, you have to make the system an automated.

Certain important aspects of manufacturing systems we have highlighted, as well as you have come to know the evolution of manufacturing systems now, in the next lecture session, I will move to the next topic.