Automation in Production Systems And Management
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Lecture - 04
Product Design and Manufacturing Systems

During the next the half an hour time I will be discussing two important aspects related to manufacturing and production; one is the product design and the second one is certain the aspects of manufacturing.

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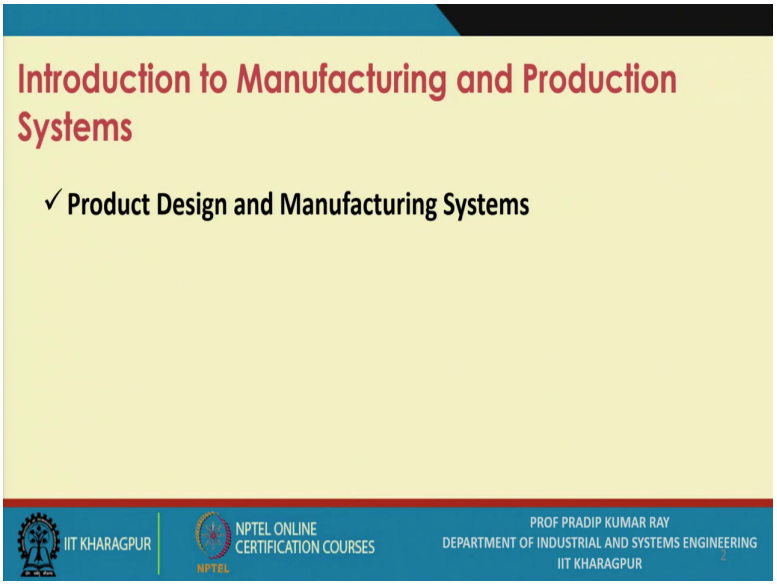

The topic is Product Design and Manufacturing Systems, the product design part essentially defines the manufacturing system and many times depending on the kind of manufacturing systems you have, you also opt for a specific design alternative.

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The product development process has three specific phases; the first phase is product design, the second phase is process design and the third phase is manufacturing.

For product design, we have Computer Aided Design, (CAD) as well as Computer Aided Engineering, (CAE). For process design, we have Computer Aided Process Planning, (CAPP) and then for manufacturing, we have a computer aided manufacturing.

when you refer to CIM framework, there should be proper linkages between CAD / CAE to CAM(Computer Aided Manufacturing) through computer aided process planning. Once design of this framework is made, one can implement this framework in your system, then the integration is possible. An automated system without these integration may not be cost effective. Let us highlight certain important aspects related to product design and manufacturing system. The 21st century business environment can be characterized as expanding global competition and products of increasing variety and lower demand.

The globalization of economic activity has brought about a sea change in the attitudes of customers. Customer individualization is certain to become the central theme of business.

Companies are facing global competition in order to survive the company should produce different kinds of product and product mix should be changed wisely and so is the processes. Otherwise companies will be losing their market. And there are three specific conditions that

each companies should keep in mind, first is maximizing quality, the quality of not only the product, the quality of the processes, quality of the systems. The second one is the minimization of cost, as it is a manufacturing activity and one must have sufficient control on the cost. Losing control on the cost may land one into trouble. And the third one is throughput time, which means the manufacturing lead time which should be as minimum as possible so that supply can meet the demand on time.

Achieving all these 3 goals may improve or maximize profitability as well as you will have the best possible market share because the performance is judged by the customer.

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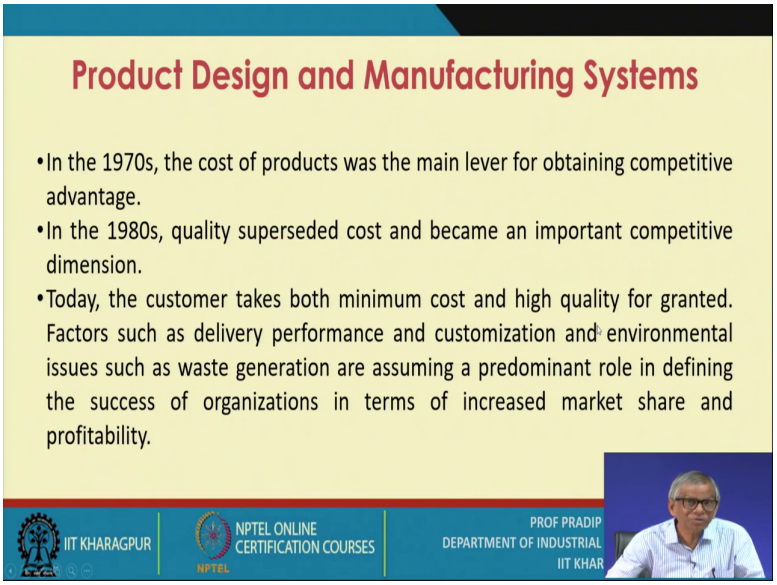

Producing high volume of goods is known as mass production but ensuring that the customer is satisfied at individual level.

In 1970s, the cost of products was the main lever for obtaining competitive advantage. In the 1980s, quality superseded cost and became an important competitive dimension because many companies used to enjoy the monopoly market, basically a sellers' market. Today, the customer takes both minimum cost and high quality for granted. Factors such as delivery performance and customization and environmental issues such as waste generation are assuming a predominant role in defining the success of organizations in terms of increased market share and profitability.

Now, the question is that what is the relationship between cost and quality?

As we know that when we define quality; the quality is always defined with respect to the price that you pay. The quality is having a strong relationship with the cost; previously it was believe that improving qualities will increase cost but now a days, there are many tools and techniques, already getting implemented in several other companies throughout the world, where you find that even if the quality is increasing, cost is remaining constant and in many cases the cost is decreasing. And when an automated system is installed, like robotics or use of robots changes production system from the conventional functional layout to a cellular manufacturing system.

But still reducing cost and improving quality parallelly is a very challenging assignments where two more important aspects should be consider, financial performance and sustainable production system.

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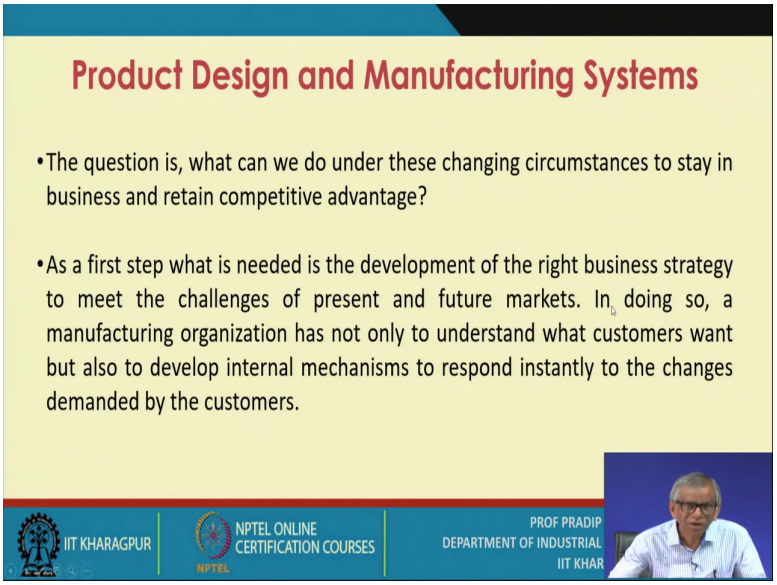

There are three aspects of sustainability; first one is economic sustainability, the second one is environmental sustainability, and the third one is social sustainability and almost all the

types of companies, all types of manufacturing system, production systems are facing this problem.

And whenever an automated system is introduced, one must make sure that there is enough control on the life cycle cost as well as the system remains sustainable. So, the question is, what can we do under these changing circumstances to stay in business and retain competitive advantage?

As a first step what is needed is the development of the right business strategy to meet the challenges of present and future markets. In doing so, a manufacturing organization has not only to understand what customers want but also to develop internal mechanisms to respond instantly to the changes demanded by the customers.

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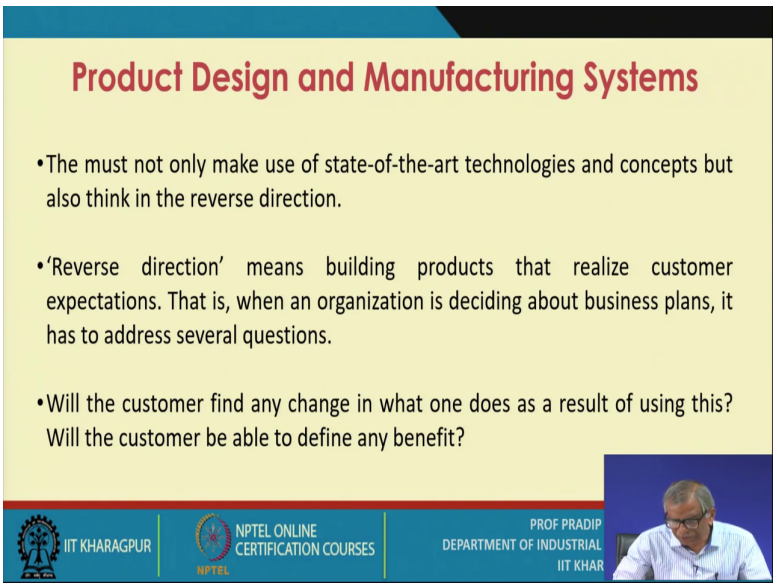

They must not only make the use of the state of the art technologies and concepts, but also think in the reverse direction.

Reverse direction means building products that realize customer expectations. That is, when an organization is deciding about business plans, it has to address several questions.

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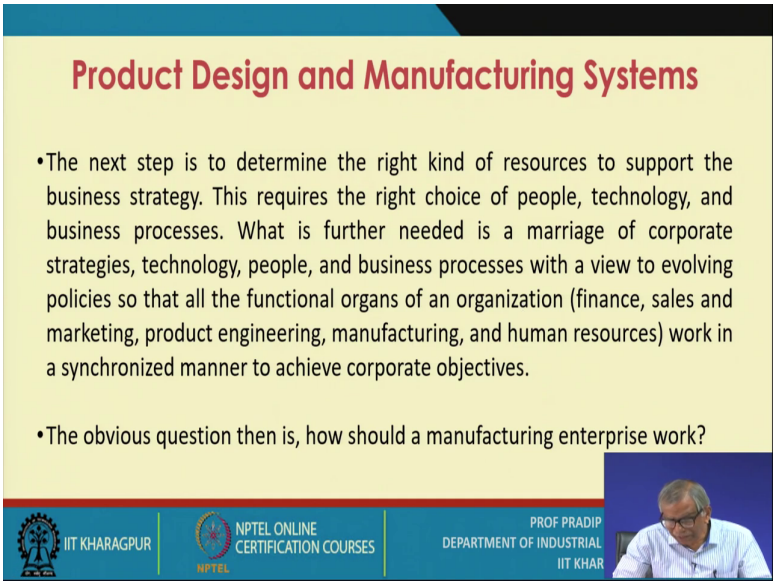

The next step is to determine the right kind of resources to support the business strategy. This requires the right choice of people, technology, and business processes. What is further needed is a marriage of corporate strategies, technology, people, and business processes with a view to evolving policies so that all the functional organs of an organization (finance, sales and marketing, product engineering, manufacturing, and human resources) work in a synchronized manner to achieve corporate objectives.

The obvious question then is, how should a manufacturing enterprise work?

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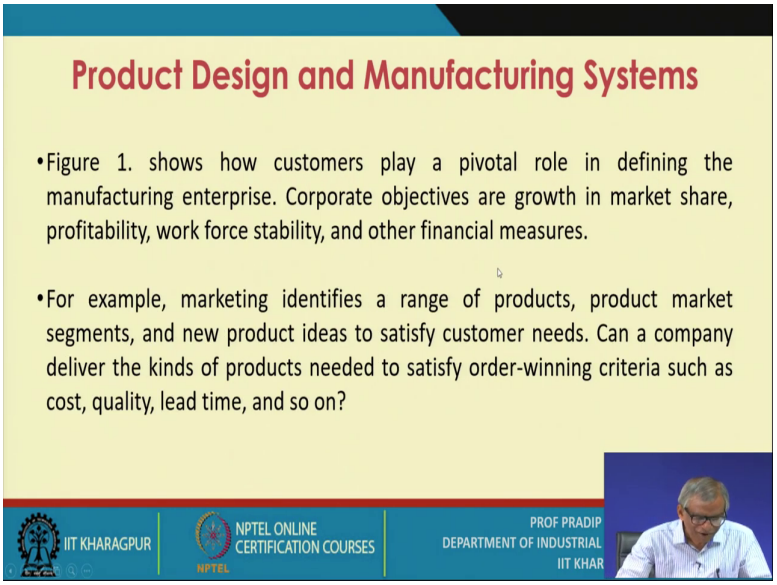

The cost of the product as well as the price of the product plays a very important role in determining the value of the product.

Against a particular product design level, there is a value, you must be able to quantify this value and the cost and you will opt for that particular design level or design alternative, for which the difference between value and cost is maximum using formula (value-cost).

Marketing identifies a range of products, product market segments, and new product ideas to satisfy customer needs. In fact, there are the multiple functions you that should be looked into

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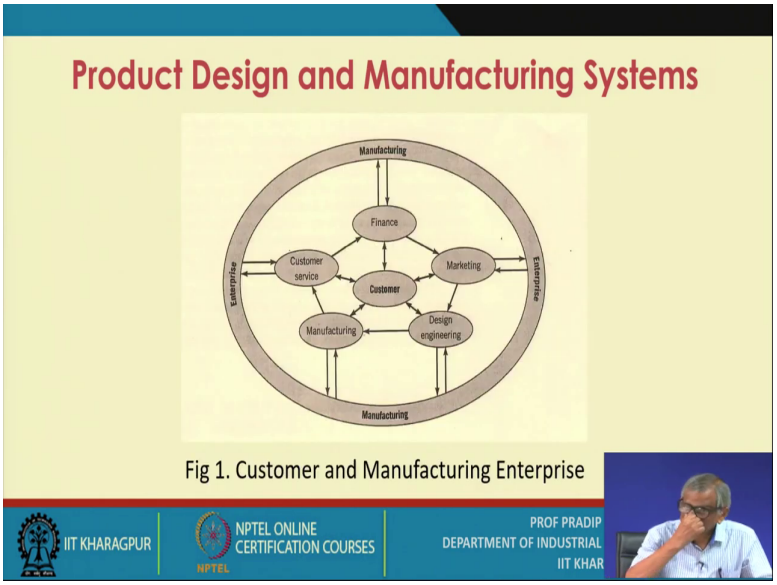

Normally, there is a concept called quality loop. And the quality loop as per QS 1994 standards equivalent, given by ANSI SQC, it is basically equivalent American standard for ISO 9001. It has eleven listed functions to look into, when we talk about automation, manufacturing and production system is the key, but then again you need to the look into what extent automated systems can be used or can be adapted for other functions also.

when we talk about the relationship between product design and manufacturing systems, the customer is basically the main focus, we have several functions like customer service, manufacturing, design engineering, marketing, finance.

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let me explain what are those 11 functions one by one.

Though finance is there but what is more important for customer is marketing, therefore, market research is the first one.

Second one is your design department, which is sometimes known as the specifications engineering,the specifications engineering means referring to the product development. (very important function). And again when product development or specifications engineering is referred, you can identify several activities to what extent those activities can be made automated, that is the challenging assignment.

Third one is the procurement.

Fourth one is process planning and control. The base is created, the foundation is met and production is opted and while you start manufacturing the product, now different processes you will be dealing with and for each manufacturing stage whether you are able to say the introduce automated systems are not, there are varieties of tools and techniques we may use. Then once the production is over, then the final inspection, examination and the testing that is done for the final product. In many inspection system can be made automated. While fifth function is production and sixth one is inspection.

Then after, seventh one is sales packaging and storing, once it is done, eight one is essentially the sales and distribution which is also an important function.

Ninth is the installation and operations. Then the tenth one is essentially the maintenance and services, maintenance and services and the last one 11th one is disposal after use. This disposal after use or the waste removal can be made automated, many companies they have adopted and it is a part of the system.

Design and manufacturing are the core activities for realizing a marketable and profitable product, the starting point is design, then CAD; which is linked with CAM through CAPP (Computer Aided Process Planning).

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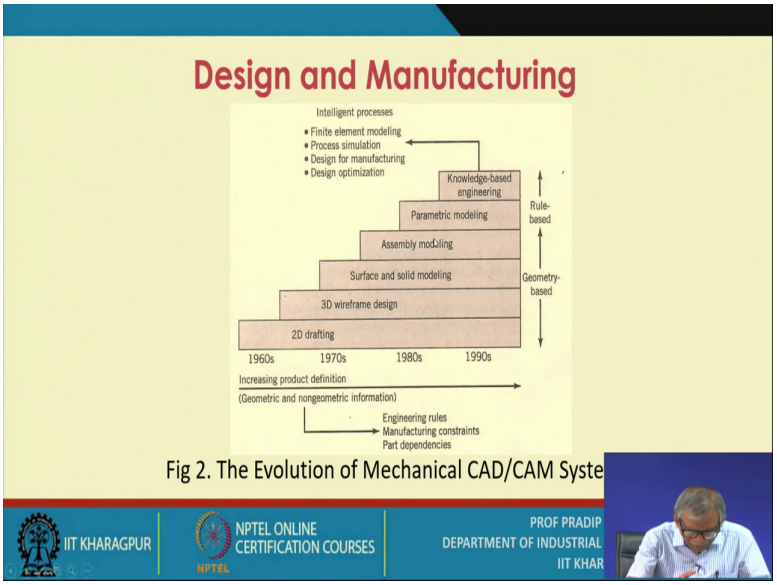

These are the developments over the years, in 1960s there was 2D drafting,1970s is the era of 3D wireframe design, then you have the surface and solid modelling, in 1980s assembly modelling was started followed by parametric modelling and knowledge based engineering system during 1990s.

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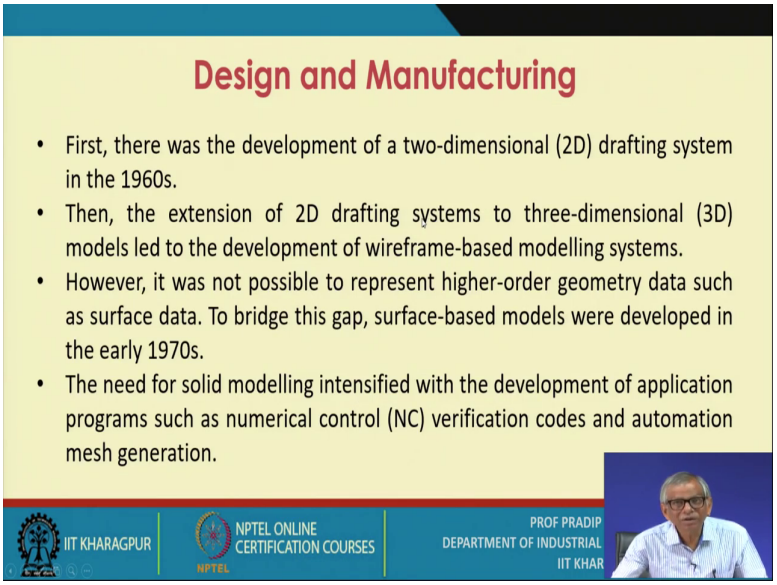

First, there was the development of a two-dimensional (2D) drafting system in the 1960s.Then, the extension of 2D drafting systems to three-dimensional (3D) models led to the development of wireframe-based modelling systems. However, it was not possible to represent higher-order geometry data such as surface data. To bridge this gap, surface-based models were developed in the early 1970s. The need for solid modelling intensified with the development of application programs such as numerical control (NC) verification codes and automation mesh generation.

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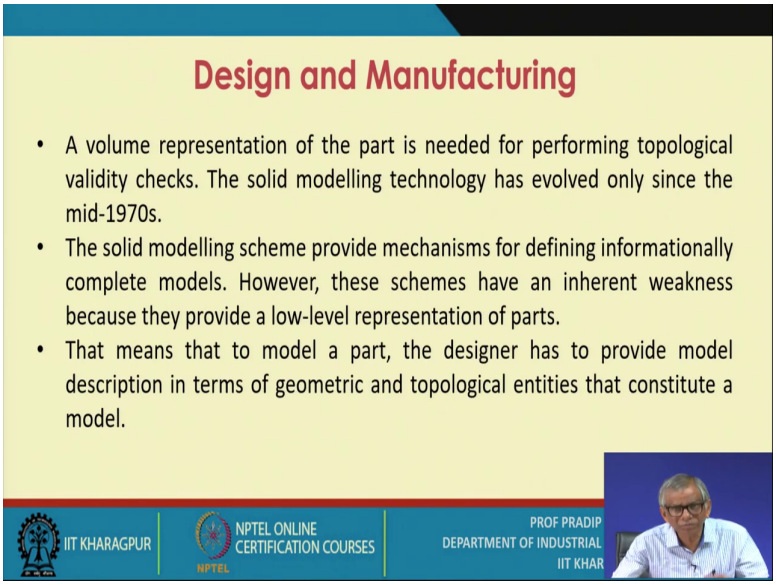

A volume representation of the part is needed for performing topological validity checks. The solid modelling technology has evolved only since the mid-1970s.

The solid modelling scheme provide mechanisms for defining informationally complete models. However, these schemes have an inherent weakness because they provide a low-level representation of parts.

That means that to model a part, the designer has to provide model description in terms of geometric and topological entities that constitute a model.

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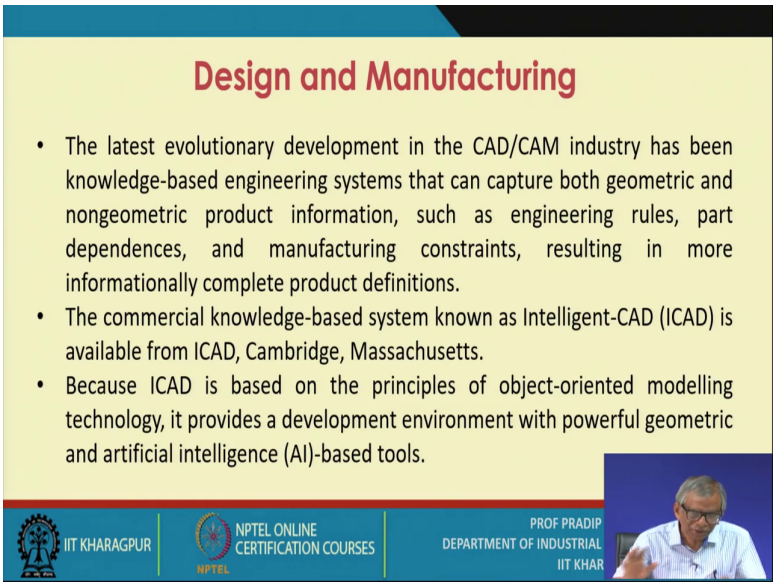

The latest evolutionary development in the CAD/CAM industry has been knowledge-based engineering systems that can capture both geometric and nongeometric product information, such as engineering rules, part dependences, and manufacturing constraints, resulting in more informationally complete product definitions.

The commercial knowledge-based system known as Intelligent-CAD (ICAD) is available from ICAD, Cambridge, Massachusetts.

Because ICAD is based on the principles of object-oriented modelling technology, it provides a development environment with powerful geometric and artificial intelligence (AI)-based tools.

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Manufacturing plays a very important role and manufacturing is not just the transformation of raw materials into value aided output meeting specific, it has broader meaning.

Manufacturing is a series of interrelated activities and operations involving design material selection, planning, production, quality assurance, management and marketing of discrete consumer and durable goods, that means total systems approach is required. It is not that manufacturing system is a closed system.

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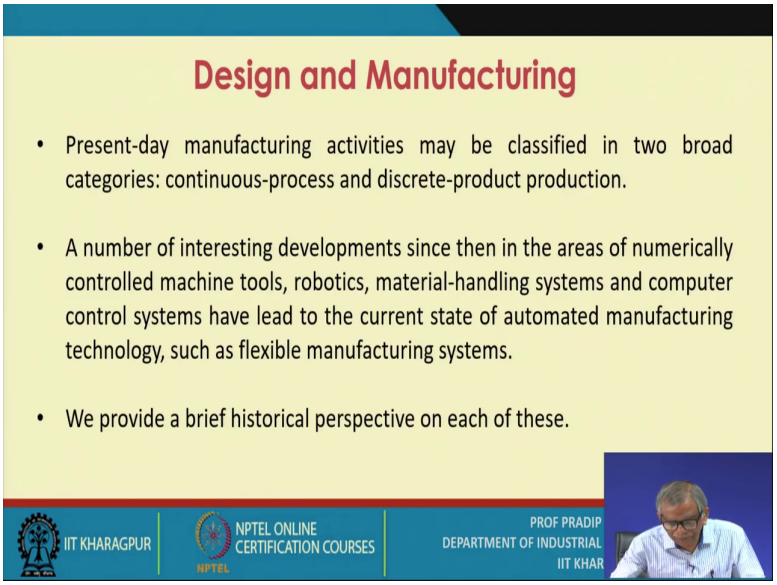

Present-day manufacturing activities may be classified in two broad categories; continuous process, and discrete product production. A number of interesting developments since then in the areas of numerically controlled machine tools, robotics, material-handling systems and computer control systems have lead to the current state of automated manufacturing technology, such as flexible manufacturing systems.

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