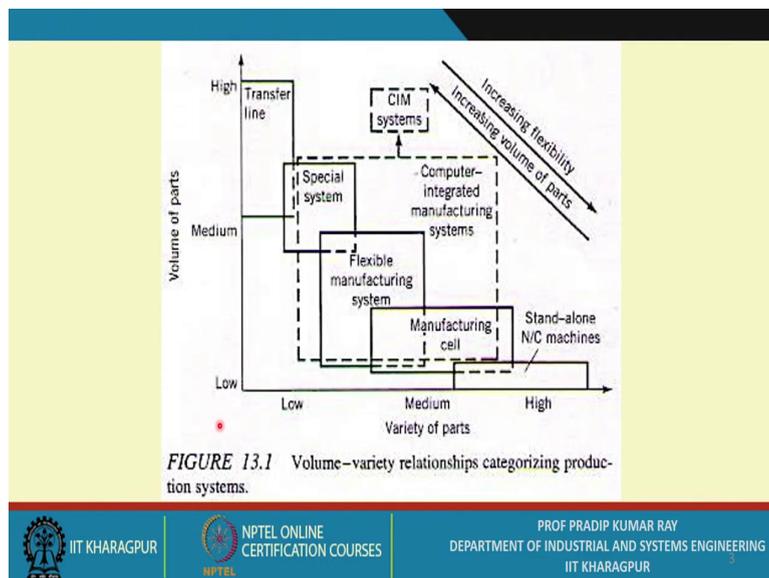


Automation in Production Systems and Management
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Group Technology and Automation in Manufacturing
Lecture - 30
Application of GT for Designing Flexible and Programmable Automation

This is the last lecture session or the 5th lecture session of week 6 and during this lecture session, I will be referring to one important topic called Application of GT or group technology for Designing Flexible and Programmable Automation.

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what we try to apply the GT the principles, the part family is to be formed, part families are to be created and for number of part family formation techniques along with their numerical problems illustrative examples.

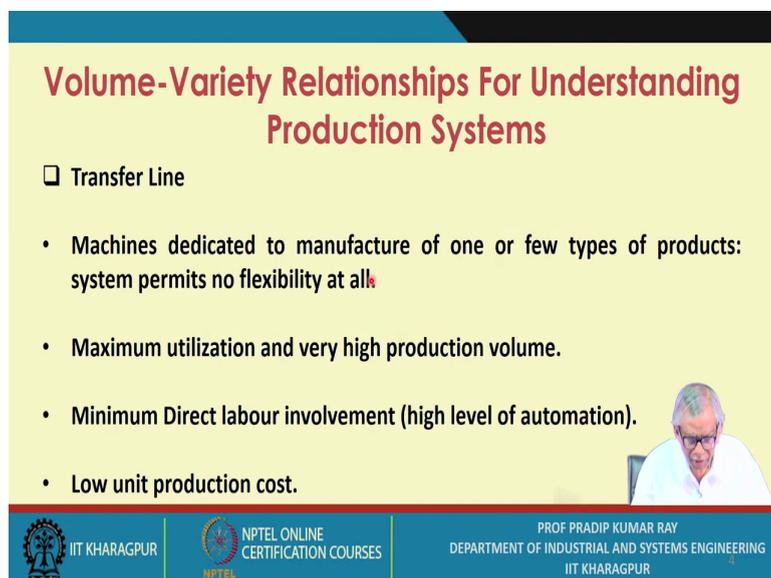
And, as you are aware there are three kinds of an automation are there, hard or fixed automation, flexible automation and then programmable automation.

this particular diagram is the volume variety relationship. There are five types of manufacturing systems.

So, this one is the transfer line the transfer line is sometimes referred to as automated assembly line that is at one extreme and other extreme, that is the standalone NC machines. And, in between you have the special system or special manufacturing system manufacturing cell and for the mid volume, mid variety the relationship, you can propose the flexible manufacturing systems.

Now here within the computer integrated the management system framework what you find that normally you come across three types of manufacturing systems. The special type, the manufacturing cell type and the flexible manufacturing systems.

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Volume-Variety Relationships For Understanding Production Systems

- ❑ **Transfer Line**
 - **Machines dedicated to manufacture of one or few types of products: system permits no flexibility at all.**
 - **Maximum utilization and very high production volume.**
 - **Minimum Direct labour involvement (high level of automation).**
 - **Low unit production cost.**

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We will be discussing volume variety relationships for understanding the production system. Flexible automation as well as programmable automation type manufacturing systems to apply the group technology principles.

Group technology principles can be applied for the different types of manufacturing systems.

When you have the transfer line then, it is dedicated manufacturing systems and for producing or a few the types of products types of products, those products are basically in standardized form, the system permits no flexibility at all.

And, if you go for automation, you have hard or fixed automation. Maximum utilization and very high production volume Minimum direct labor involvement high level of automation.

May not be just a 100 percent, but at least the 90 – 95 percent even 80 percent is allowed and the low unit production cost. So, that is an advantage and before you try to apply the GT in a particular manufacturing system transfer line, its characteristic features must be known.

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Volume-Variety Relationships For Understanding Production Systems

Stand-Alone NC Machines

- Highest level of flexibility; workparts can be processed provided machines are capable of producing them.
- Low utilization and low production volume.
- Unit cost of production is much higher than for a similar product manufactured on a transfer line.

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Now, on the other extreme you have stand alone MNC Machines Numerical Control technology. the characteristic features are:

1. Highest level of flexibility; any job can be processed provided it is in the range of process capability of the NC machine.
2. Low utilization and low production volume.
3. Unit cost of production is much higher than for a similar product manufactured on a transfer line.

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Volume-Variety Relationships For Understanding Production Systems

- ❑ Manufacturing Cell
 - Low to mid volume
 - A variety of parts are manufactured in batch mode.
 - A manufacturing cell is in FMS without central control.
 - More flexible than an FMS but lower production rate.

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Now, third type of manufacturing system that is referred to as the manufacturing cell. Essentially cellular manufacturing system or the manufacturing cell is an application of GT group technology.

the characteristic features of typical manufacturing cell are as follow:

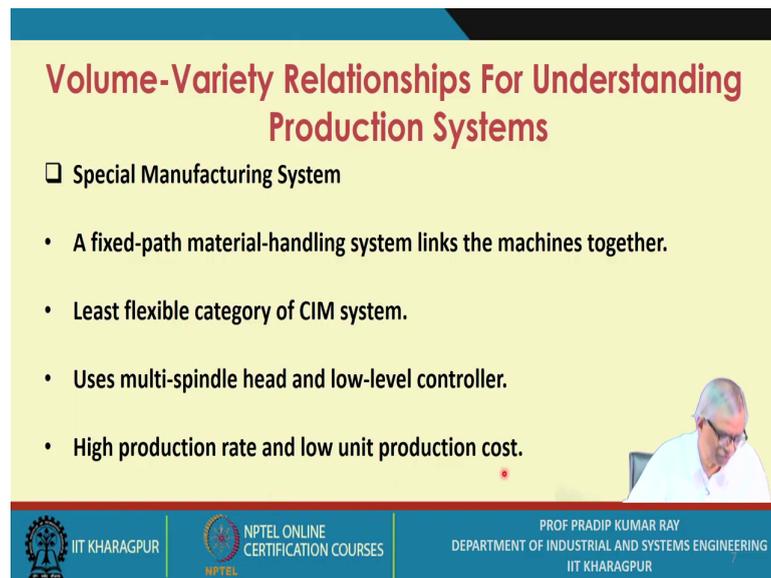
Entire manufacturing system is converted into a number of independent manufacturing cells. one particular machine cell referred to as the work cell or the manufacturing cell should be low to medium volume production.

A variety of parts are manufactured in batch mode; that means, batch size is preferred, batch mode means basically we are referring to the batch production system.

A manufacturing cell is in FMS without central control, when you have created a manufacturing cell you have gone one step ahead in creating the FMS.

So, the primary condition you should fulfill that whether these manufacturing cells are formed or not.

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Volume-Variety Relationships For Understanding Production Systems

❑ **Special Manufacturing System**

- A fixed-path material-handling system links the machines together.
- Least flexible category of CIM system.
- Uses multi-spindle head and low-level controller.
- High production rate and low unit production cost.

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The next stage it is referred to as the special system or the special manufacturing system. Its characteristic features are:

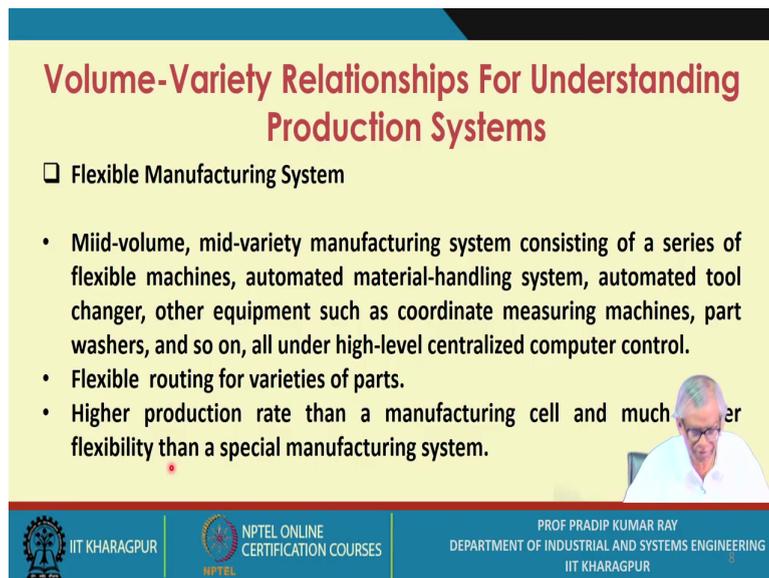
A fixed-path material-handling system links the machines together.

Least flexible category of CIM system.

Uses multispindle head and low-level controller.

High production rate and low unit production cost.

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Volume-Variety Relationships For Understanding Production Systems

❑ Flexible Manufacturing System

- Mid-volume, mid-variety manufacturing system consisting of a series of flexible machines, automated material-handling system, automated tool changer, other equipment such as coordinate measuring machines, part washers, and so on, all under high-level centralized computer control.
- Flexible routing for varieties of parts.
- Higher production rate than a manufacturing cell and much higher flexibility than a special manufacturing system.

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Now, when we refer to the flexible manufacturing system. True mid-volume, mid-variety manufacturing system consisting of a series of flexible machines, automated material-handling system, automated tool changer, other equipment such as coordinate measuring machines, part washers, and so on, all under high-level centralized computer control. Permits both sequential and random routing of a wide variety of parts. Higher production rate than a manufacturing cell and much higher flexibility than a special manufacturing system. These are the features.

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GT-related Design and Manufacturing Objectives

- Engineering System
 - Reduction in new parts design.
 - Reduction in the number of parts through standardization.
 - Reduction of number of drawings.
 - Reduction of number of similar parts, easy retrieval of similar functional parts, and identification of substitute/alternate parts.

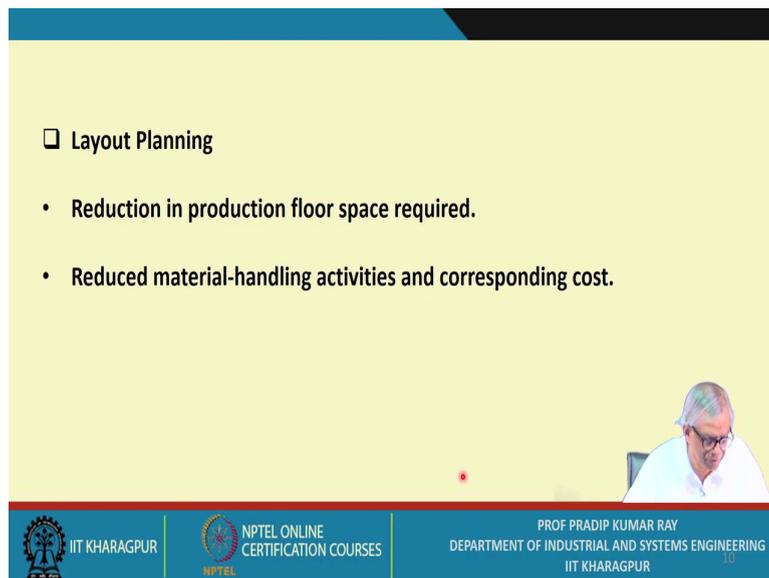
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As far as engineering system is concerned, group technology principles how to use in different types of manufacturing systems.

when you look at a particular manufacturing system, the several kinds of the activities several kinds of the functions you are referring to like one function could be the engineering system.

Reduction in the number of parts through standardization. Reduction in new parts design. Reduction in the number of drawings through standardization. Reduction of drafting effort in new shop drawings. Reduction of number of similar parts, easy retrieval of similar functional parts, and identification of substitute parts.

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Layout Planning

- Reduction in production floor space required.
- Reduced material-handling activities and corresponding cost.

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As far as layout planning is concerned, reduction in production flow space required. If you apply the GT principles in your manufacturing system to what extent this production the floor space requirement would be less. Reduced material handling activities and corresponding cost.

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GT-related Design and Manufacturing Objectives

Specification of Equipment, Tools, Jigs, and Fixtures

- Standardization of equipment (machine tools).
- Development of cellular manufacturing systems (CMS).
- Reduced number of tools, pallets, jigs, and fixtures.
- Significant reduction in up-front costs incurred in the release of new parts for manufacture.

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Now, other aspects are the specifications of equipment, tools, jigs and fixtures, it is a part of the manufacturing system, here you need to check to what extent all these equipment tool, jigs and fixtures can be made or can be standardized.

The standardization of equipment or the machine tools, development of cellular manufacturing system (CMS) that is great advantage, for the manufacturing cell or based on the cellular manufacturing system, almost all the GT principles you can apply.

Reduced number of tools, pallets, jigs and fixtures. This is another advantage, and if you want to reduce the number of tools, pallets, jigs and fixtures, you need to use the group technology principles. Significant reduction in upfront costs that is very important.

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GT-related Design and Manufacturing Objectives

- ❑ **Manufacturing: Process Planning**
 - Reduction in setup time and production time.
 - Alternative routing leading to improved part routing.
 - Reduction in number of machining operations and numerical control (NC) programming time.

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Manufacturing process planning should be considered like design, the design is to be converted into the process plan and that process plan is used for manufacturing purposes.

Now, there are different approaches in process planning and one particular approach is the variant type process planning. And the group technology principles are used. So, the reduction in set of time and the production time is one major aspect.

Alternate routing leading to improved part routing. Reduction in number of the machining operations that means, there could be further simplification in the design and you can combine the parts also under certain conditions.

And, if you reduce the number of parts, the number of machining operation is expected to be less, and numerical control programming time.

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GT-related Design and Manufacturing Objectives

- ❑ **Manufacturing: Quality Control**
 - No/minimum rework and scrap: Quality Assurance.
 - Highest level of acceptance of output: Quality of Performance and Quality of Conformance.
 - TQM: Increased involvement and empowerment of employees leading to implementation of total quality system for all the functions of an organization.

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Then the quality control is an important aspect in any manufacturing system like online real time quality control system, quality assurance system whose objectives is minimum rework and scrapped when you create such a condition this is basically referred to as a quality assurance system.

Higher level of acceptance of output quality of performance and quality of conformance these are two important issues. First you go for the quality of design and then you go for quality of conformance, your manufacturing system is able to manufacture the products or parts or assemblies as per the given specifications.

The level of conformance that is referred to as is basically the quality of conformance and ultimately the product used or and performance is judged.

And ultimately it will be easier for you to implement total quality management system, certain important aspects related to total quality management is that ultimate objective is to create a condition called employee empowerment.

Increased involvement and empowerment of employees leading to implementation of total quality system, as the group technology principles are used, there will be grouping of parts and for or the part families.

And for producing the part families, you have to create the machine cells to run a particular machine cell not only one operator, but a number of operators we will work on a particular in a particular machine cell and whatever the output you get that is basically the result of a combined effort.

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GT-related Design and Manufacturing Objectives

- ❑ Purchasing
 - Coding of purchased parts: Standardized and systematic purchasing.
 - Purchasing becomes a Problem under Certainty: knowledge of raw materials and purchased parts requirements.
 - Reduced number of purchased parts and raw materials.
 - Supplier selection and evaluation: simple and better leading to just-in-time purchasing.

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As far as purchasing is concerned, standardized and systematic purchasing procedure should be adopted. you can a go for purchasing becomes a problem under certainty. Knowledge of raw materials and purchase parts requirement will be knowing with certainty. So, that is an advantage .

And whenever you apply the GT principles ultimately you are making your manufacturing system a standard one. So, reduced number of purchase parts and the raw materials. Supplier selection and evaluation: simple and better leading to just in time purchasing.

That means whatever required you are going to purchase number of raw materials or the purchase parts in a given period of time, there will be the least chance that you will have the excess stock or the dead stock or under stock situation.

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GT-related Design and Manufacturing Objectives

- ❑ Customer Service
 - Service and purchase cost estimates are more accurate.
 - Efficient spare parts management, leading to better customer service.

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And, one more point that is the customer service. Service and purchase cost estimates are more accurate, and efficient spare parts management leading to better customer service.