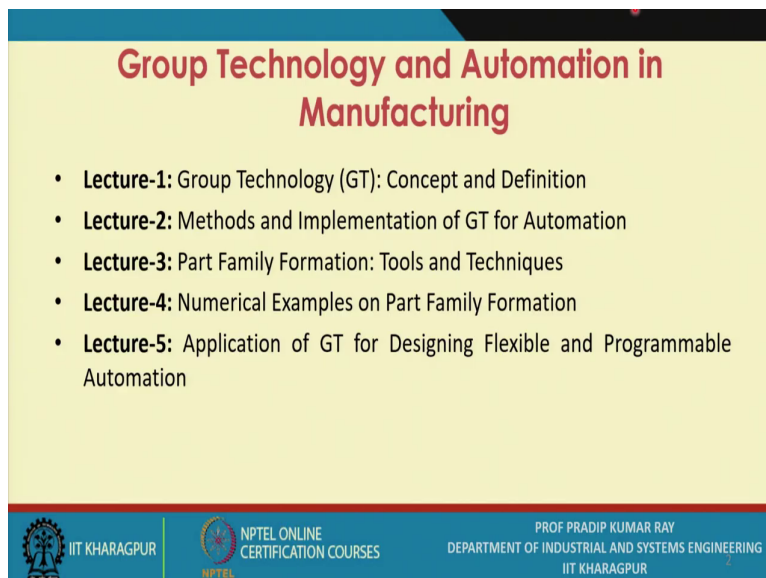


Automation in Production Systems and Management
Prof. Pradip Kumar Ray
Vinod Gupta School of Management
Indian Institute of Technology, Kharagpur

Group Technology and Automation in Manufacturing
Lecture - 26
Group Technology (GT): Concept and Definition

During the 6th week we will be discussing a very important topic called Group Technology and automation in manufacturing.

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Group Technology and Automation in Manufacturing

- **Lecture-1:** Group Technology (GT): Concept and Definition
- **Lecture-2:** Methods and Implementation of GT for Automation
- **Lecture-3:** Part Family Formation: Tools and Techniques
- **Lecture-4:** Numerical Examples on Part Family Formation
- **Lecture-5:** Application of GT for Designing Flexible and Programmable Automation

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In the 1st lecture session, I will discuss the group technology related the concept and the definitions of different terms and terminologies you need to know.

In the 2nd lecture session methods and implementation of group technology for automation.

In the 3rd session I will be referring to an important topic called part family formation.

4th lecture session we will be referring to a number of numerical examples on part family formation and towards the end in 5th lecture, will be referring to application of GT principles for designing flexible and programmable automation.

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Group Technology and Automation in Manufacturing

✓ **Group Technology (GT): Concept and Definition**

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Let us now discuss about the group technology, its concepts and the definitions.

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Group Technology (GT): Concept and Definition

- Batch manufacturing is a dominant manufacturing activity in the world, generating a great deal of industrial output. It accounts for 60 to 80 percent of all manufacturing activities.
- A high level of product variety and small manufacturing lot sizes are the major difficulties being faced in batch manufacturing or production.

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There are three kinds of the manufacturing system, first one is continuous processing and then job shop and the third category is the batch manufacturing or batch production and Batch manufacturing is a dominant manufacturing activity in the world, generating a great deal of industrial output. It accounts for 60 to 80 percent of all manufacturing activities. The

major difficulties in batch manufacturing are due to the high level of product variety and small manufacturing lot sizes.

Batch manufacturing is the dominant manufacturing activity across the world, generating a great deal of industrial output. As far as volume variety relationship is concerned for the batch production what you find that the product variety is more whereas, the production the volume against each variety is low, high level of product variety and small manufacturing lot size are the major difficulties being faced in batch manufacturing or production.

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Group Technology (GT): Concept and Definition

- As product variations are more and large, design engineers need to design hundreds and sometimes thousands of parts individually.
- Decisions made at the design stage significantly and differently affect manufacturing cost, quality, and delivery lead times of individual parts/components.
- Impact of these product variations in manufacturing is high investment in equipment, high tooling costs, complex scheduling and loading, lengthy setup time and costs, excessive scrap, and high quality-control costs.
- However, to compete in a global market, it is essential to improve performance and productivity in batch manufacturing systems.

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Group technology is one such approach with which even if you have lots of varieties as well as less lot size against each variety or against each part type, the group technology principles will help you establish a high-performance based system.

As product variations are more and large design engineers need to design hundreds and sometimes thousands of parts individually, it is a typical batch production system.

Decision made at the design stage significantly and differently affect manufacturing cost, quality and delivery lead time. These are the three primary issues we should be bothering about. First one is the cost of production, second one is the quality of output, quality of parts

are the components and or the manufacturing lead time, sometimes this is referred to as the throughput time.

Impact of these product variations in manufacturing is high investment because varieties of machine tools you have to install. Different types of purchase you have to procure plus the kinds of materials you use kinds of raw materials you will use is the different types.

First one is the high investment in equipment, high tooling costs, complex scheduling and loading, because there are hundreds of scheduling techniques and primarily a particular scheduling technique is dependent on the kind of manufacturing.

Complex scheduling and loading, lengthy set of times and costs. Setup time sometimes itself is considered to be a bottleneck, few hours, certain machine tools you need to have the set of time is huge, how to reduce the set of time and as you may be knowing that the set of time is essentially a non value adding activity.

Setup time and costs excessive scrap and high-quality control cost high quality control costs. These are the problems you face. To compete in a global market, it is essential to improve performance and productivity in batch manufacturing systems.

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Group Technology (GT): Concept and Definition

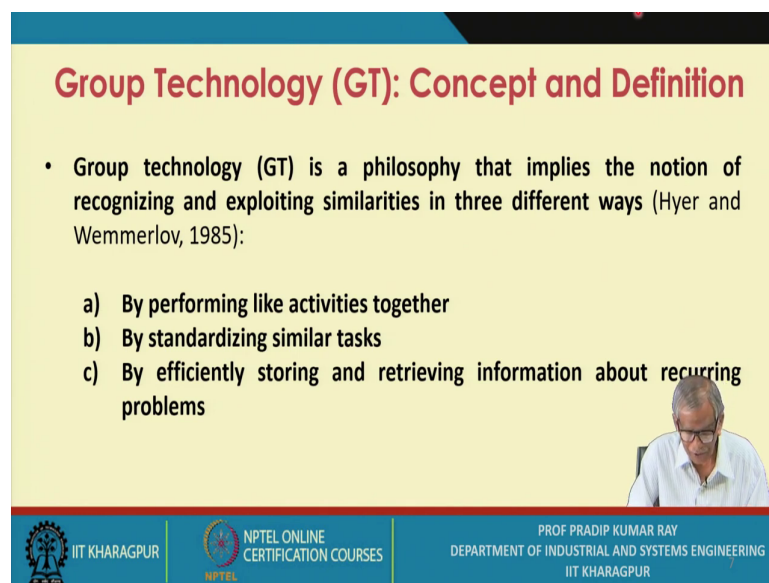
- **New/innovative methods** are needed to reduce product cost and lead time and enhance product quality to help increase market share and profitability.
- A **high level of integration of the design and manufacturing activities in a company is a necessity.**
- **Group technology provides such a link between design and manufacturing.**
- The adoption of group technology concepts, which allows small batch production to gain economic advantages similar to those of mass production while retaining the flexibility of the job shop, will help address some of the problems: **Merits of Small/Large Batch Size – Product and Process Layout**

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Some innovative methods are needed to reduce product cost and lead time and enhance product quality to help increase market share and profitability. What is also needed is a higher level of integration of the design and manufacturing activities in a company. Group technology provides such a link between design and manufacturing.

The adoption of group technology concepts, which allow small batch production to gain economic advantages similar to those of mass production while retaining the flexibility of the job shop, will help address some of the problems.

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Group Technology (GT): Concept and Definition

- Group technology (GT) is a philosophy that implies the notion of recognizing and exploiting similarities in three different ways (Hyer and Wemmerlov, 1985):
 - a) By performing like activities together
 - b) By standardizing similar tasks
 - c) By efficiently storing and retrieving information about recurring problems

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Cellular manufacturing is basically the application of group technology application of group technology. The group technology is a philosophy.

The group technology is a philosophy that implies the notion of recognizing and exploiting similarities.

The first you have to recognize and then you have to exploit the kinds of similarities you may have among the parts and the components. Against a particular product you have the bill of material and when you explore the bill of material you will come to know what are the different types of parts and components you need to produce and what are the kinds of sub

assemblies you have and normally this bill of material is given in a hierarchical form at different levels.

The final assembly level is level 0, then you have the sub assembly level, Level 1 and then you have the sub assembly level maybe level 2 and then you have the part of the component level, this is the hierarchical structure in which a bill of material can be presented.

When you have this list of hundreds and thousands of the parts, you check or you verify the similarity between these parts or among these parts. The similarity is when one part is a part A is similar to part B, it means that we can perform the activities together that is one advantage.

You do not need to carry out these activities for both the parts separately by standardizing similar tasks, these parts are different from definitely from one another, but still, you need to identify there could be some common tasks.

By efficiently storing and retrieving information about recurring problems, because the problems you might face of same nature with respect to the problems you face and there of the same nature, then you might say that yes for part A I have same kind of problem when we deal with part B. So, with respect to the problems you encounter, the part A is similar to part B.

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Group Technology (GT): Concept and Definition

- The primary advantage of GT implementation is that a large manufacturing system producing a set of parts may be decomposed or grouped into smaller subsystems of 'part families' based on similarities in design attributes and manufacturing features.
- The decomposition, based on similarities of design attributes, and manufacturing features and functions may result in improved performance and productivity mostly in functional areas of an organization.

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The primary advantage of GT implementation is that a large manufacturing system to produce a set of parts can be decomposed into smaller subsystems of part families based on similarities in design attributes and manufacturing features.

The decomposition based on similarities of design attributes, manufacturing features and functions leads to improved productivity in various functional areas of an organization.

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Group Technology (GT): Concept and Definition

- In product design, parts are classified and coded on the basis of their geometric similarities.
- To use GT principles, formal classification and coding systems are incorporated into a computerized design retrieval system.
- This results in reduced time and cost of product development. Thus GT principles need to be adopted in product development process.

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In product design, parts are classified and coded on the basis of their geometric similarities. To implement GT, formal classification and coding systems are incorporated into a computerized design retrieval system. This results in reduced time and cost of product development.

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Group Technology (GT): Concept and Definition

- In a manufacturing system, the goal of improved productivity and reduced cost may be achieved by exploiting similarities in machining operations, tooling, setup procedures, and material handling.
- Parts and components with similar manufacturing requirements can be processed together/in groups with dedicated work or machine cells, leading to reduced setups, tooling, and material handling.
- Cellular manufacturing, which is an application of GT principles in manufacturing, provides a strategy for obtaining economic advantages in an environment of high-variety, low-demand production that are normally associated with high-volume repetitive flow production.



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In manufacturing , productivity and cost savings are realized by exploiting similarities in machining operations, tooling, setup procedures, and material handling. Parts having similar manufacturing requirements can be processed together in dedicated work cells, leading to reduced setups, tooling, and material handling. Cellular manufacturing, which is an applications of GT in manufacturing, provides a strategy for obtaining economic advantages in an environment of high-variety, low-demand production that are normally associated with high-volume repetitive flow production.

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Design Attributes and Manufacturing Features

- Typical design attributes include part configuration (round or prismatic), dimensional envelope (length/diameter ratios), surface integrity (e.g., surface roughness, dimensional tolerances), material type, raw material state (e.g., casting, forging, bar stock), and so forth.
- Part manufacturing features/functions include operations (such as turning, drilling, milling, and grinding) and their sequences, batch sizes, machine tools and cutting tools needed to perform operations, processing times, and so forth.



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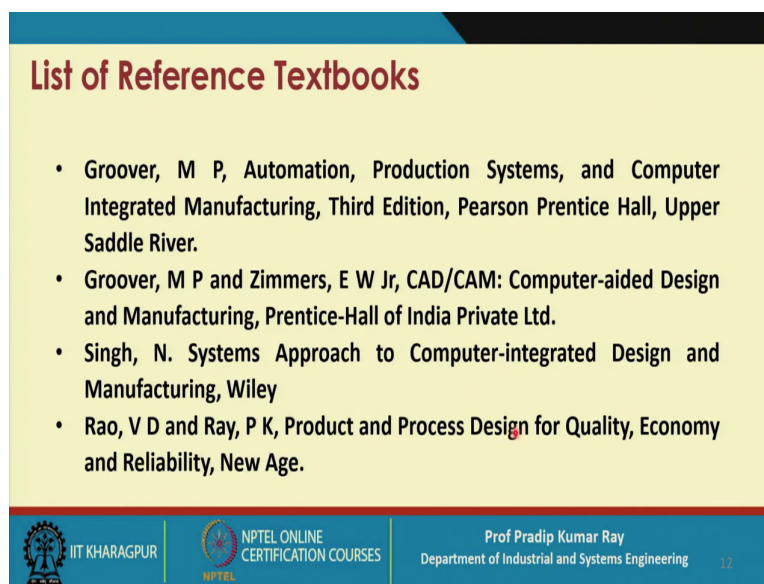


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List of Reference Textbooks

- Groover, M P, Automation, Production Systems, and Computer Integrated Manufacturing, Third Edition, Pearson Prentice Hall, Upper Saddle River.
- Groover, M P and Zimmers, E W Jr, CAD/CAM: Computer-aided Design and Manufacturing, Prentice-Hall of India Private Ltd.
- Singh, N. Systems Approach to Computer-integrated Design and Manufacturing, Wiley
- Rao, V D and Ray, P K, Product and Process Design for Quality, Economy and Reliability, New Age.

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I have given the textbooks the references, please refer to these text book and there are many numerical problems.