COMPUTERS IN MANUFACTURING ENTERPRISES

AUTOMATION STRATEGIES

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Automation Strategy 2 – Combined Operations

- production is carried out as sequence of operations
- complex parts may require dozens / hundreds of processing steps
- strategy involves reducing the number of different production machines or workstations through which the part routes
- accomplished by performing more than one operation at a given machine
- saves set-up time required for individual machines, material handling effort and non-operation times are also reduced
- **effect: Reduce n_m, T_h, T_{no}**

Multi Spindle Head Riveting Machine

- perform riveting operation on multiple rivets (around 10) simultaneously
- minimum center distance can be 32 mm (this depend on size / material of rivet) and maximum center distance can be approx 120mm

http://www.riveting-machines-manufacturers.com/multi-spindle-head-riveting-machine.html

Automation Strategy 3 – Simultaneous Operations

- extension of combined operations
- strategy is to perform "combined operations" at the same time
- performing 2 or more processing (or assembly) operations on the same work part reduces processing time
- **effect: Reduce n_m, T_o ,T_h, T_{no}**

A hydraulic and pneumatic clamping system permits four simultaneous machining operations on Harley-Davidson motorcycle frames. The four-spindle operation reduces machining time from 11 min to about 3.

http://machinedesign.com/automotive/concurrent-machining-kickstarts-motorcycle-production

Automation Strategy 4 – Integration of Operations

- link several workstations into a single integrated mechanism using automated devices to transfer parts between stations
- number of separate machines through which the product must be scheduled is reduced
- several parts can be processed at the same time with more than one workstation -> increase in output of the system
- **effect: Reduce n_m, T_h, T_{no}**

Automation Strategy 5 – Increased flexibility

- use same equipment for a variety of products to achieve its maximum utilization for job shop and medium volume situations
- uses flexible automation concepts
- objective is to reduce set up / programming time -> decrease in MLT and WIP
- effect: Reduce T_{su} , MLT, WIP; increase U

Automation Strategy 6: Improved Material Handling and Storage

- using automated material handling and storage systems to reduce non-productive time
- effect: Reduce T_{no} , MLT, WIP

http://automatedmachinesystems.com/index.php/material-handling/detail/ams-pallet-conveying-systems/

Automation Strategy 7: On-line Inspection

- traditionally the quality of work is inspected after the product is manufactured
- strategy incorporates inspection into the manufacturing process -> corrections can be implemented in the process while the product is being made
- reduces scraps and increases conformity of the product to the specified quality
- effect: Reduce T_{no}, q

Part of the MetraSCAN 3D line-up, the robot-mounted MetraSCAN-R optical CMM 3D scanning systems are scanning solutions designed for **3D automated inspection** of parts on the production line and on the shop floor

http://www.creaform3d.com/en/metrology-solutions/robot-mounted-optical-cmm-scanners-metrascan-r

Automation Strategy 8: Process Control and Optimization

- control schemes aimed at efficient operation of individual processes and associated equipments
- strategy is devised to reduce the individual processing times and improve the product quality
- effect: Reduce T_o , q
- example:

Automation Strategy 9: Plant Operations Control

- attempts to control the average operations in the plant more efficiently
- implementation usually requires a high level of computer networking within the factory
- effect: Reduce T_{no} , MLT; increase U

Automation Strategy 10: Computer Integrated Manufacturing

- integration of factory operations with engineering design and many other business functions
- involves major use computer applications, data bases, and computer networking in the company
- effect: Reduce MLT, design time, production planning time; increase U

Group Technology

Automation, Production Systems & CIM by M.P. Groover

Group Technology: Introduction

batch production is estimated to be the most common form of production

growing need to make batch production more efficient and productive

desire to achieve a higher level of integration of the design and manufacturing

GROUP TECHNOLOGY

Group Technology: Introduction

- similar parts are identified and grouped together to take advantage of their similarities in manufacturing and design
- similar parts are grouped in one family
  - example: a plant producing 10,000 different part numbers may be able to group the vast majority of these parts into 50 – 60 distinct families
- each family of parts would have similar design and manufacturing characteristics => processing of each member of a given family would be similar => achieve efficiency in manufacturing
- production machines are arranged into machine groups, **or cells**, to facilitate work flow and achieve efficiency

Group Technology: Introduction

- in product design, the advantages of grouping parts into families lie in classification and coding of parts
  - concerned with identifying the similarities between parts and relating to a coding system
- part similarities
  - design attributes (shape and size)
  - manufacturing attributes (processing steps required to make a part)
- processing steps are usually correlated with the part's design attribute but NOT ALWAYS
- need for classification and coding system arises to take care of design and manufacturing difference
- some form of part classification and coding is usually required to implement GT

13 parts with similar manufacturing process requirements but different design attributes

Group Technology: Introduction

three types of activities are necessary in applying group technology :

- determination of critical part attributes that represent the criteria for part family membership
- allocation of parts to established families
- retrieval of part family members and related information

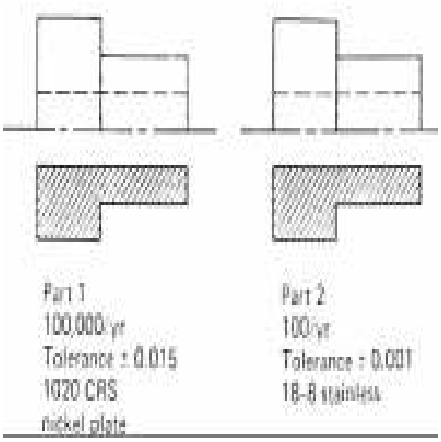
Group Technology: Part Families

- a collection of parts which are similar either because of shape and size or because similarity in their processing steps
- parts within a family are different but their similarities are very close

Group Technology: Part Families

13 parts with similar manufacturing process but different design

2 parts of identical shape and size but different manufacturing requirement



Process type VS Group Technology Type Layout

Process – type Layout

- batch production in a machine shop
- various machine tools are arranged by function
  - L: lathe section
  - M: milling section
  - D: drilling
  - G: Grinding
  - A: assembly
- during machining, the work piece must be moved between sections

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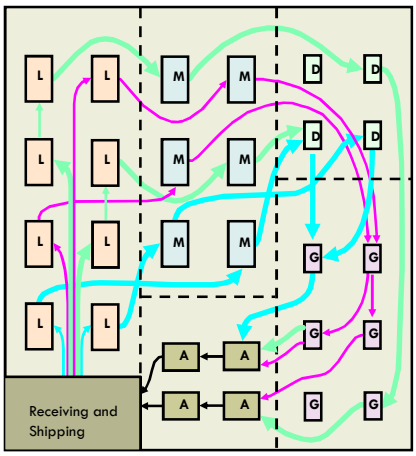
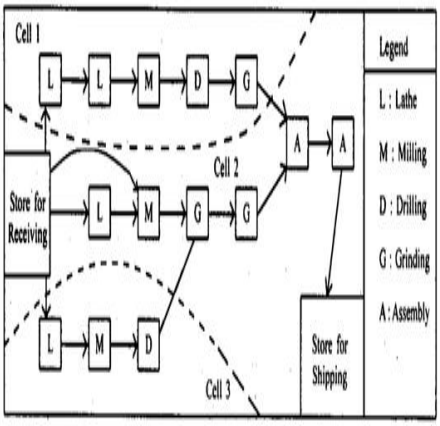
  the same section might being visited several times



Process type VS Group Technology Type Layout

Group Technology Layout

- machines are arranged into cells
- each cell specializes in the manufacturing of a particular part family



http://www.transtutors.com/homework-help/industrial-management/plant-layout/cellular-layout.aspx

Process type VS Group Technology Type Layout

- process- type layout
  - significant amount of material handling
  - a large in-process inventory
  - more set-ups than necessary
  - long manufacturing lead-times
  - high cost
- group technology layout
  - reduced work piece handling
  - lower set up times
  - less in-process inventory
  - shorter lead times

Group Technology: Problems

- to identify part families among the huge number of components produced
  - if the company makes 10,000 parts, reviewing all of the part drawing to group them into appropriate family is a substantial and time consuming task
- cost of parts classification and coding
- arrangement of machines into the appropriate machine cells
  - costly and time consuming to plan
  - machines are non-productive during changeover
- changing to a new system

ME 445_GROOVER_Ch18_CELLULAR MANUFACTURING.pdf

Part Grouping into Family

- 3 methods for grouping parts into family:

Visual Inspection	• least sophisticated and expensive method • classification is done by looking at either the physical parts or their photographs • generally considered to be the least accurate method
classification and coding by examination of design and production data	• examining the individual design and/or attributes of each part • results in a code number that is unique to part attributes • can be done on the entire list of active parts of firm or on a sample • sample may not be a representative of the entire population • most commonly used method
Production flow analysis (PFA)	• uses information contained on route sheets rather than part drawings • work parts with identical or similar routings are kept in one family