Computer in Manufacturing Enterprises

Automation, Production Systems and CIM by M.P. Groover (Chapter 25)
Shop floor Control and Agile Manufacturing:
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Shop Floor Control

- implementation techniques and technologies of production planning
- concerned with issuing production orders, controlling the progress of orders through different work centres, and getting current status of the orders
- deals with managing WIP

Shop Floor Control System - Phases

- input is collection of production plans (eg: results of process planning, MRP, capacity planning etc)

- typical system consists of 3 phases:
  - order release
  - order scheduling
  - order progress

- these phases are executed by a combination of computer and human resources

Phase 1: Order Release

- documentation needed to process a production order through the factory

  - collection of docs is sometimes called the “shop packet” which consists of:
    - route sheet
    - requisition for required materials
    - job cards / other means to track labor time needed for the order
    - part list (if required)
    - move tickets: to authorize material handling personnel to transport parts between work centres

  - paper documents are unnecessary in automated methods

- driven by 2 inputs”
  - authorization to produce <= from master schedule
  - engineering and manufacturing databases
Phase II: Order Scheduling

- deals with the allocation of production orders to different work centres and priorities for each job
- follows directly from order release module
- solves 2 problems in shop floor control:
  1. Machine loading problem: allocating the orders to the work centres
  2. Job sequencing problem:
     - when number of orders exceed the number of work centres, then each workcentre will have a queue of orders to be processed
     - job sequencing addresses this problem by prioritizing the jobs in the queue
- Priority Control denotes the function that maintains the priority levels for the different production orders
  - important input for order scheduling phase
  - some rules for determining order priority are:
    - earliest due date,
    - shorter processing time,
    - least slack time (difference between time remaining till due date and the remaining process time)
    - lower critical ratio (ratio of between time remaining till due date and the remaining process time)
- relative priorities of order may change over time due to equipment breakdown, change in demand, order cancellation, defective raw material etc

Phase III: Order Progress

- monitors the status of different orders in the plant, work-in-progress etc
- the order status report includes:
  - work order status: processing hours remaining, current work centre where each order is located, on-time or behind schedule, priority level etc
  - progress reports: shop performance (orders completed, how many orders are left to be completed) during a certain time period
  - exception reports: indicates non-conformity from production schedule
- reports are useful for production management for identifying problem areas
Dynamics AX 2012 R3 Shop Floor Control App – YouTube
(https://www.youtube.com/watch?v=r8EoCw3eqNU)

Factory Data Collection System

- consists of various paper documents, terminals, automated devices for collecting data from shop floor control operations
- also includes compilation and processing of data
- acts as input to order progress module in shop floor control
- example: number of pieces completed at a certain work centre, scrapped parts, parts requiring rework etc
- purpose is to supply data to “order progress module” and provide current info to concerned personnel
- can be online (real time data collection) or offline (temporary data storage in some device)
Automatic Identification Methods

- bar codes
- Radio frequency systems
- Magnetic stripe
- Optical character recognition
- Machine vision

Computer networks for Manufacturing

(Chapter 26)
Hierarchal Structure of a Manufacturing Plant

**Fourth Level**
- Corporate mainframe computer
- Compilation of plant data takes place at this level
- Communication with individual computers in the plant is done

**Third Level**
- Consist of central plant computer
- Operating data from different computers is compiled and reports prepared
- CAD/CAM can be used here

**Second Level**
- Consist of small computers, sending data to big computers at third level
- Coordinates and controls the activities of first level computers

**First Level**
- Consist of computers, directly connected to the processes to control or monitor
- Also includes the devices for factory data collection

**Benefits of Hierarchical Structure**

- **Gradual implementation**
  - Installation can be done gradually
  - Risk and expense can be spread

- **Redundancy**
  - In an event of a computer breakdown, other systems in the network are programmed to assume the task of broken down computer

- **Reduced software development problem**
  - Programming can be handled separately
  - Changes in the software can be done easily
Local Area Networks

- Etar
- Bus
- Ring

Most suitable for factory LAN.

Protocols

- rules for communication between systems (computers)
- On this networks either TCP/IP or specially designed manufacturing protocols like, MAP or TOP are used
- An initiative by GM has resulted in the selection of a set of protocols, all based on ISO standards, to achieve open system interconnection within an automated manufacturing plant. The resulting protocols are known as manufacturing automation protocols (MAPs)
- Boeing Corporation (USA) has resulted in the selection of a set of ISO standards to achieve open system interconnection in a technical and office environment. The selected protocols are known as technical and office protocols (TOPs)

http://www.slideshare.net/viswa375/ch9-computer-integrated-manufacturing
Syllabus of Major Exam

- Date / time: November 22, 2015 between 6:00 – 8:00 pm
- Venue: LH 316
- Expert Systems and their applications
- Concurrent Engineering
- Computer Integrated Manufacturing
- Agile Manufacturing / e-business
- Conceptual questions based on above topics
- Case studies / handouts given in class

Agile Manufacturing
Agile Manufacturing - Introduction

- Businesses are restructuring and re-engineering themselves to respond to challenges in 21st century

- 21st century business challenges to be addressed:
  - customers seeking high-quality, low-cost products
  - respond to customers’ specific unique and rapidly changing needs

- AM is an organization that has created the processes, tools, and training to enable it to respond quickly to customer needs and market changes while still controlling costs and quality

http://www.awbinstitute.org/memberdata/files/14_Agile_manufV2.pdf

Lean Manufacturing → Agile Manufacturing

- seen as the next step after Lean manufacturing

- lean manufacturing, stresses on:
  - elimination of waste
  - high productivity and quality
  - but not necessarily being responsive

- Agility should be based on:
  - responsiveness and flexibility
  - cost and quality of goods and service

- Agile manufacturing takes care of ‘total needs’ of the customer

http://www.awbinstitute.org/memberdata/files/14_Agile_manufV2.pdf
Agile Manufacturing Characteristics

- demands a manufacturing system that is:
  - able to produce effectively a large variety of products
  - reconfigurable to accommodate changes in the product mix and product designs

http://www.awtinstitute.org/memberdata/files/1_Agile_manuf2.pdf

Agile Manufacturing Strategies

- **Strategic Planning**
  - customer-integrated multidisciplinary teams, supply chain partners, flexible manufacturing,
    computer-integrated information systems
  - need of extended enterprises
  - type of the market and products, location, government policies and environmental
    regulations need to be considered in the strategic planning for the suitability of AM and
    its development
- **Product Design**
  - Virtual design environment,
  - Automated high level process planning
  - Online data gathering(such as E-Commerce) could be used to learn more about exact
    customer/market requirements
- **Virtual Enterprise**
  - Integration of core competencies,
  - Supply chain, Temporary alliances,
  - System integration
- **Automation and Information Technology**
  - Internet, EDI, E-Commerce, Information Technology, ERP, Multimedia, Robots, NC machines,
    CCD, Simulation
Agile Manufacturing Paradigm

Key Enablers of Agile Manufacturing

(i) virtual enterprise formation tools/metrics
(ii) physically distributed manufacturing architecture and teams
(iii) rapid partnership formation tools/metrics
(iv) concurrent engineering
(v) integrated product/production/business information system
(vi) rapid prototyping
(vii) electronic commerce
Agile Manufacturing in Wikispeed

- a Seattle WA Corporation developed a functional road-safety-legal prototype of a car to get 100 miles per gallon
- developed in three months, instead of the multi-year process that traditional manufacturing requires
- car can go from 0 to 60 mph in less than five seconds and weighs just 1,404 pounds
- has a top speed of 149 mph and its ground clearance can be adjusted anywhere from racing to sport utility
- seats 4 passengers and meets all legal safety standards


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Agile Manufacturing in Wikispeed

1. trying to figure out what customers want
2. defining those wants in terms of tests
3. prioritizing which tests are to be worked on
4. working in short cycles to deliver features or products that meet the tests
5. finding out from customers whether that's what they really want and continuing the cycle once again

**Agile Manufacturing in Wikispeed**

- Wikispeed works with customers to help prioritize what to work on next
- uses distributed collaborative teams that self-organize to get the work done
- work in short cycles and receive customer feedback at the end of each cycle
- each team pair focuses on meeting the test in the simplest, cheapest and quickest way -> reduction in the cost of making changes wherever possible
- team is able to make changes to any part of the car every seven days
- mostly uses tools that are free, like FreeConference.com, Dropbox, GoogleDocs, YouTube, Skydrive, Facebook and LinkedIn.


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**Agile Manufacturing in Wikispeed**

- design of the car is modular
- engine is able to be switched from a gasoline to an electric engine in about the time it takes to change a tire
- car body can be switched from a car body to a pickup truck
- accelerating response to problems
- transparency: everyone can see at any time what is going on, who is doing what, what the overall goals of the enterprise, can make suggestions about any issue