Computer in Manufacturing Enterprises

Automation, Production Systems and CIM by M.P. Groover (Chapter 25)

Shop floor Control and Agile Manufacturing:

November 5, 2015

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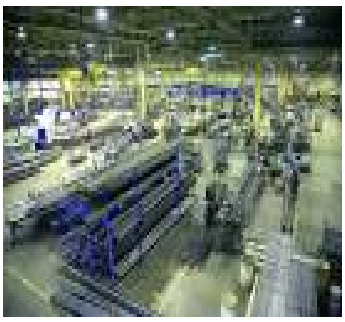
Shop Floor Control



http://blog.prodware.es/las-4-principales-tendencias-en-fabricacion-en-2012/

- 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 <- comes 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)

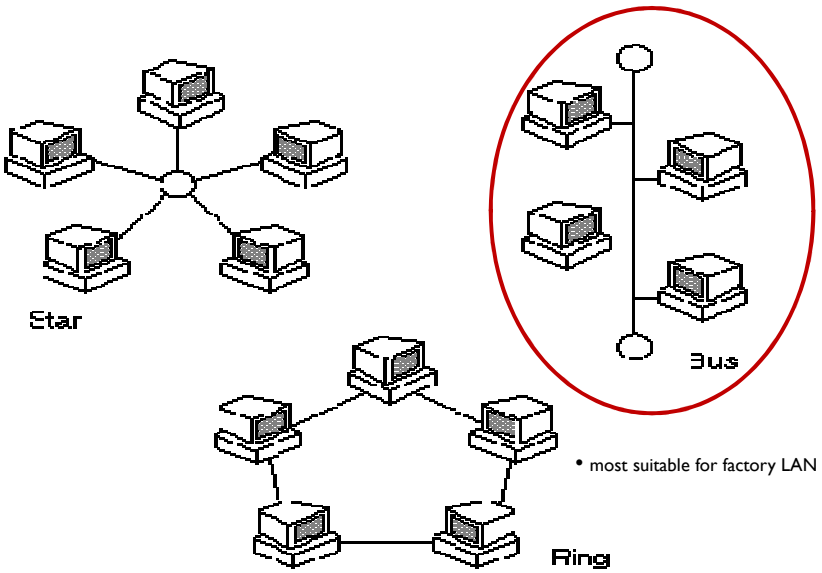
Hierarchy of Computers in Manufacturing

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



- 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 knows 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.awbinstitute.org/memberdata/files/14_Agile_manufV2.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

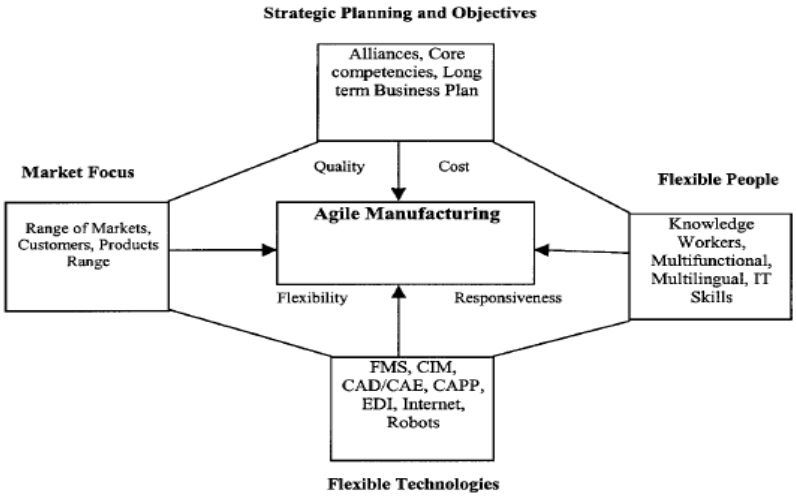


Figure 1. Agile manufacturing paradigm.

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

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

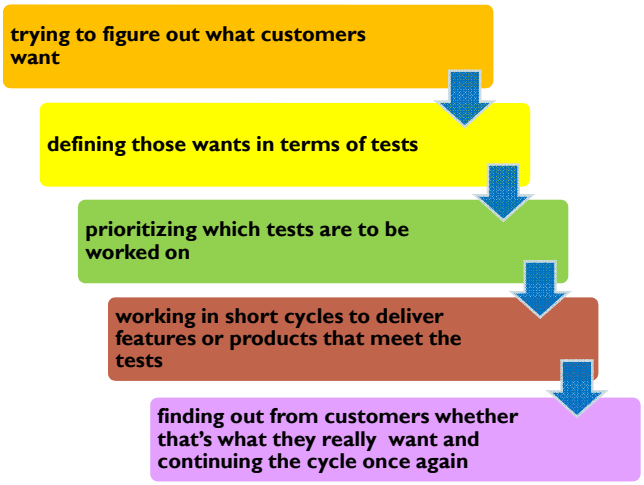
http://www.awbinstitute.org/memberdata/files/14_Agile_manufV2.pdf

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

http://www.forbes.com/sites/stevedenning/2012/08/01/transformational-leadership-in-agile-manufacturing-wikispeed/

Agile Manufacturing in *Wikispeed*



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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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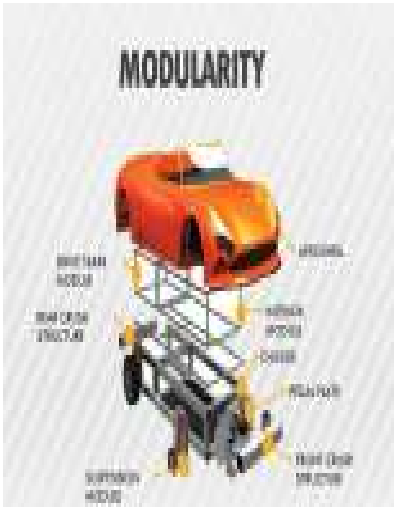
Agile Manufacturing in *Wikispeed*

- 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



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