Flexible Manufacturing Systems (FMS)

A Closer Look
What Will Be Covered

- Flexible Manufacturing Defined
- How “you” can use FMS
- Nuts and Bolts
- How FMS works
- A real world example
- Summary
What Is A Flexible Manufacturing System?

Flexible Manufacturing System:

- “A system that consists of numerous programmable machine tools connected by an automated material handling system” (2)
History of FMS

- FMS first proposed in England in 1960’s
- “System 24” operates 24 hours a day
- Automation is main purpose in beginning
How You Can Use FMS

- To reduce set up and queue times
- Improve efficiency
- Reduce time for product completion
- Utilize human workers better
- Improve product routing
- Produce a variety of Items under one roof
- Improve product quality
- Serve a variety of vendors simultaneously
- Produce more product more quickly
Nuts and Bolts of FMS

FMS Layouts

• **Progressive Layout:**
  – Best for producing a variety of parts

• **Closed Loop Layout:**
  – Parts can skip stations for flexibility
  – Used for large part sizes
  – Best for long process times
FMS Layouts Continued

• Ladder Layout:
  – Parts can be sent to any machine in any sequence
  – Parts not limited to particular part families

• Open Field Layout:
  – Most complex FMS layout
  – Includes several support stations
Automated Material Handling

- Automated Guided Vehicle (AGV)
- Automated Storage and Retrieval System (ASRS)
- Conveyors
Components of Flexible Manufacturing Systems

- NC
- CNC
- DNC
- Robotics
- AGV
- ASRS

- Automated Inspection
- Cells and Centers
Flexible Automation

- Ability to adapt to engineering changes in parts
- Increase in number of similar parts produced on the system
- Ability to accommodate routing changes
- Ability to rapidly change production set up
FMS Nuts and Bolts

Robots
Robots

Robots: Programmable Manipulators

- Can tolerate hostile environments
- Can work much longer hours than humans
- Can perform redundant jobs more consistently (1)
Common Uses of Robots

- Loading and unloading
- Spray painting
- Welding
- Material handling
- Inspection
- Machine Assembly
Computer Integrated Manufacturing

- CIM: “The Integration of the total manufacturing enterprise through the use of integrated systems and data communications coupled with new managerial philosophies that improve organizational and personnel efficiency.” (4)
Components of CIM

- CAD  Computer Aided Design
- CAM  Computer Aided Manufacturing
- CAE  Computer Aided Engineering
Manufacturing Technology

• This part of FMS uses:
  – NC  Numerically Controlled Machine
  – CNC Computer Controlled Machine
  – DNC Direct Numerical Controlled
Challenges with FMS

- Determining if FMS the best production system for your company (economically and socially)
- Possible expansion costs associated with implementing FMS
- Day to day maintenance of FMS operations
Flexible Manufacturing

How Does It Work?
Integration of FMS

- Manufacturing Technology
- CIM
- Robotics
Making FMS Work

- By implementing the components of robotics, manufacturing technology and computer integrated manufacturing in a correct order one can achieve a successful Flexible Manufacturing System
A Real World Example

The Ford Motor Company
Ford’s Problem

- At Ford Powertrain they faced the following challenges
  - outdated cell controller
  - lack of flexibility because of it
  - causing loss of efficiency
Solution

- Implemented a cell control based on an open architecture, commonly available tools, and industry standard hardware, software, and protocols. (3)
Benefits

• Enabled Ford to mix and match machine tools from different vendors (3)
• Reduced the number of man-years required to implement the application (3)
Benefits Continued

- The budget for the fully automatic closed-loop controller was less than 1/10th the cost for a system built in language.

- No formal training was required for the floor shop operators.
References Used

(1) Class and lecture notes from Dr. Tom Fosters Ops. Mgmt. 345 class.

(2) Russell-Taylor text from Dr. Tom Fosters Ops. Mgmt 345 class. Pgs 263-264, 304.
References Used

(3) http://www.gensym.com/manufacturing/ss_ford.shtml

(4) http://www.howard. engr. siu. edu/staff2/spoerre/Roblec6.htm
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