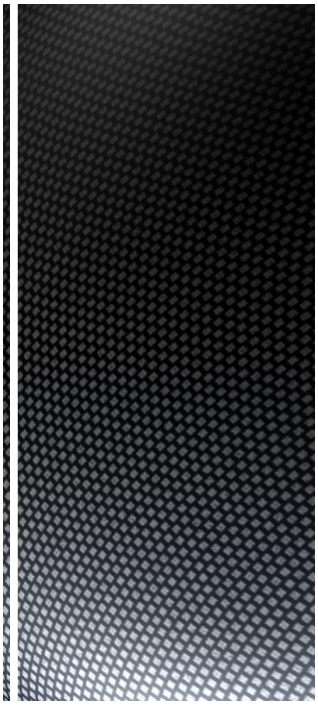

Automation (21-541)

Advanced Manufacturing Laboratory
Department of Industrial Engineering
Sharif University of Technology

Session # 2

Session Schedule

- *Automation & CIM relation with enterprise information systems (ERP, Accounting, Inventory, marketing…)*
  - *Automation and CIM development history*

Introduction to manufacturing automation and CIM (Computer Integrated Manufacturing)

- *Automation:*
  - *set of all measures aiming at replacing human work through machines (e.g. automation is applied science)*
  - *the technology used for this purpose (e.g. this company has an automation department)*
- *Automation:*
  - *replacement of human work through machines (e.g. the automatisation of the textile factory caused uproar of the workers)*
  - *replacement of conscious activity by reflexes (e.g. drill of the sailors allows the automatisation of ship handling)*
- *Automation:*
  - *The use of computers and machines instead of people to do a job*

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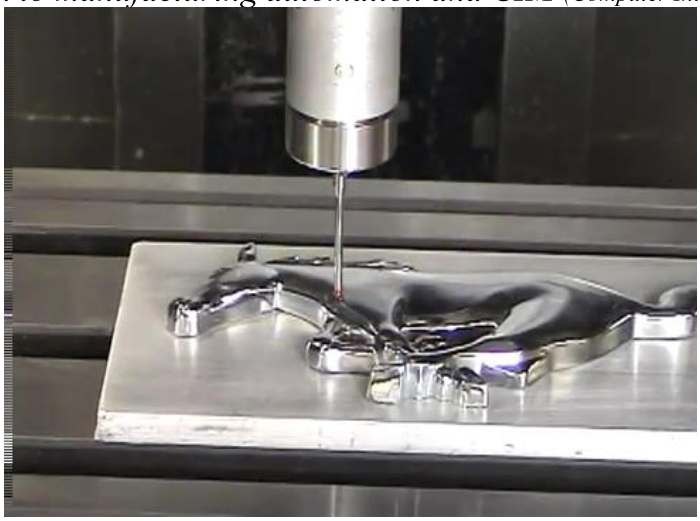
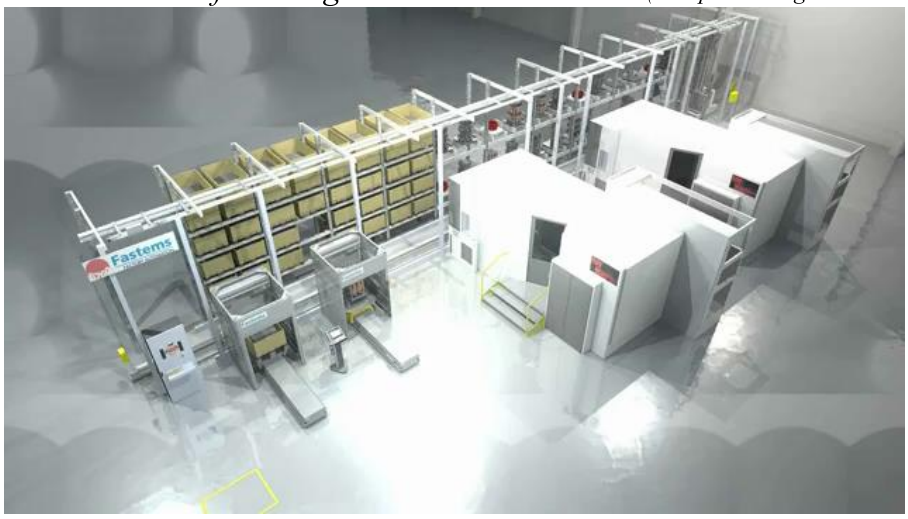


Introduction to manufacturing automation and CIM (Computer Integrated Manufacturing)



Automation engineer characteristics

- *Curiosity:* *I want to understand*
- *Learn-hungry:* *I learn fast – my knowledge is volatile*
- *Basic Physics:* *I can make a model of my world*
- *Mathematics* *I know how to calculate*
- *Programming:* *I can structure*
- *Systematic Work:* *I can plan …*
- *Initiative:* *I can try….*

Introduction to manufacturing automation and CIM (Computer Integrated Manufacturing)

Introduction to manufacturing automation and CIM (Computer Integrated Manufacturing)

Introduction to manufacturing automation and CIM (Computer Integrated Manufacturing)

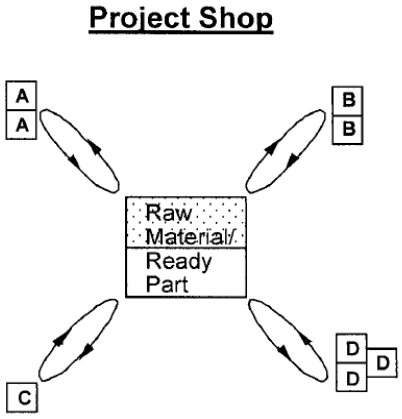
- *Computer Integrated Manufacturing (CIM) encompasses*
  - *The entire range of product development and manufacturing activities with all the functions being carried out*
  - *With the help of dedicated software packages.*
  - *The data required for various functions are passed from one application software to another in a seamless manner*
- *CIM considers*
  - *All activities from the design of the product to customer support in an integrated way,*
  - *Using various methods, means and techniques in order to achieve*
    - *Production improvement,*
    - *Cost reduction,*
    - *Fulfillment of scheduled delivery dates,*
    - *Quality improvement*
    - *Total flexibility in the manufacturing system.*

Introduction to manufacturing automation and CIM (Computer Integrated Manufacturing)

- *Types of manufacturing systems*
  - *Project shop*
  - *Job shop*
  - *Batch production system*
  - *Flow line*

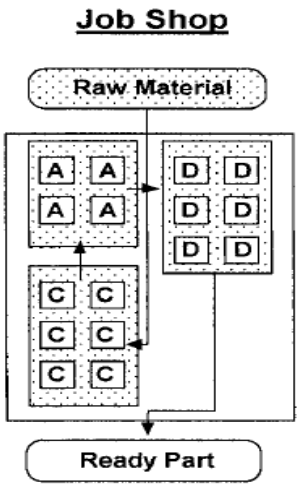
Project shop

- *Characteristics*
  - *product's position remains fixed during manufacturing because of its size and/or weight*
  - *Materials, people, and machines are brought to the product as needed.*



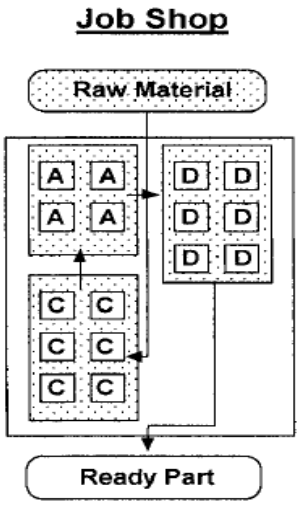
Job shop

- *Characteristics*
  - *Machines with the same or similar material processing capabilities are grouped together*
  - *The machines are usually general-purpose machines, which can accommodate a large variety of part types*
  - *Material handling is very flexible in order to accommodate many different part types*
  - *Within each work center, a number of machines can be used for a particular operation.*



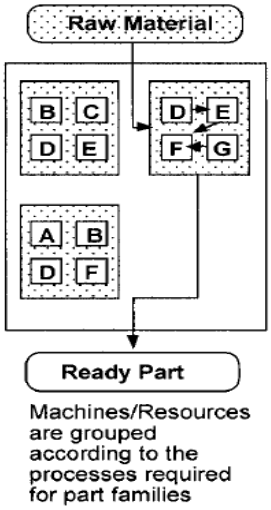
Job shop

- *Characteristics*
  - *Each operation can be assigned to a machine, which yields the best quality or the best production rate*
  - *Machines can be evenly loaded*
  - *Machine breakdowns can be accommodated easily.*
  - *Requires making and implementing complex decisions in real time.*
  - *Parts spending a long time on the job shop*



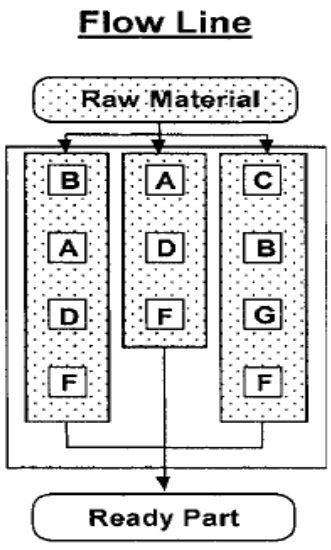
Batch production

- *Characteristics*
  - *The equipment or machinery is grouped according to the process combinations that occur in families of parts*
  - *Each cell contains machines that can produce a certain family of parts*
  - *Intra-cellular material flow can be performed either automatically or manually*

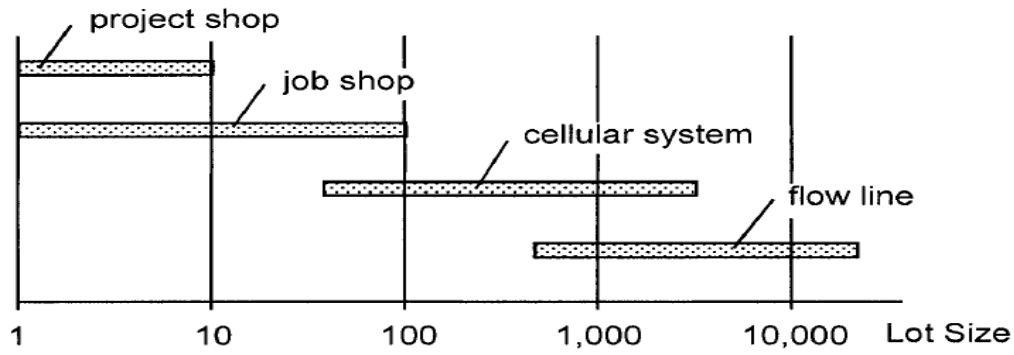


Flow line

- *Characteristics*
  - *machines and other equipment are ordered according to the process sequences of the parts to be manufactured*
  - *Only one part type is produced at a time*
  - *The machines are linked by automated material handling devices, such as conveyors.*
  - *lot size of each part is high enough to guarantee that the capacity of the equipment will be fully exploited and not wasted on the setups*



Manufacturing Systems



Manufacturing Systems

Type	*Job shop*	*Batch Production*	*Flow line*
Machine allocation	*same or similar material processing capabilities are grouped together*	*grouped according to the process combinations that occur in families of parts*	*ordered according to the process sequences of the parts to be manufactured*
Machine Types	*general-purpose machines*	*machines produce a certain family of parts*	
Material handling	*flexible*	*Intra-cellular material flow can be performed either automatically or manually*	*automated material handling devices,*
Product Variety	*High*	*Medium*	*Low*
Product Quantity	*Low*	*Medium*	*High*
WIP	*High*	*Medium*	*Low*
Material Flow	*Complicated*	*material flow within the cell may differ for different parts of a part family*	*Smooth*
Product type	*specialized and customized*	*Family Part*	*One type of product*
Labor	*highly skilled*	*Medium*	*Not skill*

Automation and CIM development history

- *Fixed automation*
  - *Uses mechanical, electrical, pneumatic and hydraulic systems*
  - *Is widely used in automobile manufacturing*
- *Fixed automation examples*
  - *Single spindle automatic lathe*
  - *Multi spindle automatic lathe*
  - *Transfer lines*
- *Fixed automation limitations*
  - *It is designed for a particular product*
  - *Any product change will require extensive modifications to the automation system.*

Automation and CIM development history (continue ...)

- *Programmable automation*
  - *Electrically controlled systems*
  - *Programs were stored in punched cards and punched tapes*
- *Programmable automation examples*
  - *Electrical programmed controlled milling machines*
  - *Hydraulically operated Automatic lathes with programmable control drum*
  - *Sequencing machines with punched card control /plug board control*

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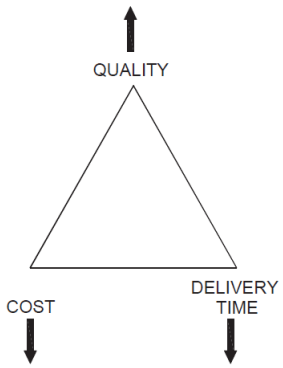
Automation & CIM

- *The advances in automation have enabled industries to develop*

  "Islands of automation"
- *Islands of automation examples are :*
  - *Flexible manufacturing cells*
  - *Robotized work cells*
  - *Flexible inspection cells*
- *CIM tries to achieve the consolidation and integration of these islands of automation.*

Automation & CIM (Continued…)

- *Consolidation and integration of "Islands of automation" requires:*
  - *Sharing of information among different applications or sections of a factory (Collaboration)*
  - *Accessing incompatible and heterogeneous data and devices (Interoperability)*



Automation & CIM (Continued…)

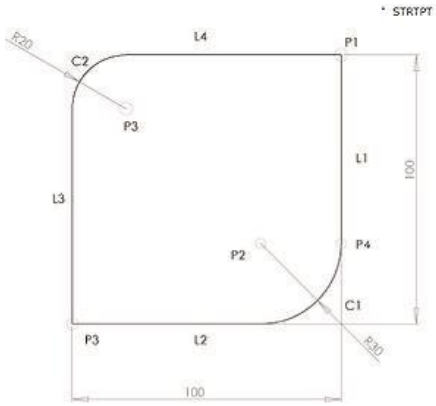
- *Advantages of Automated Manufacturing:*
  - *Improved work flow*
  - *Reduced handling*
  - *Simplification of production*
  - *Reduced lead time*
  - *Increased moral in workers (after a wise implementation)*
  - *More responsive to quality, and other problems*

CIM history

- *Computer-Aided Design (CAD) & Computer-Aided Manufacturing (CAM) were the first areas for "Automation islands integration"*
- *Massachusetts Institute of Technology (MIT, USA) is credited with pioneering the development in both CAD and CAM*
- *The need to meet the design and manufacturing requirements of aerospace industries after the Second World War necessitated the development CIM technologies.*
- *US Air Force approaches MIT to develop suitable control systems, drives and programming techniques for machine tools using electronic control*

CIM history (Continued…)

- *CAD in fact owes its development to the APT language project at MIT in early 50's.*
  - *APT (Automatically Programmed Tool)*



- *P1 = POINT / 50, 50, 0*
- *P2 = POINT / 20, -20, 0*
- *C1 = CIRCLE / CENTER, P2, RADIUS, 30*
- *P3 = POINT / -50, -50, 0*
- *…*
- *SPINDL / 3000, CW*
- *FEDRAT / 100, 0*
- *…*
- *GOFWD / C1, TANTO, L2*
- *GOFWD / L2, PAST, L3*

CIM history *(Continued…)*

- *By 80's, the automation in design was well progressed.*
- *In the case of manufacture, CNC machines, DNC systems, FMC, FMS … provide tightly controlled automation systems*
- *Also computer control has been implemented in several areas like*
  - *Manufacturing resource planning*
  - *Accounting*
  - *Sales*
  - *Marketing*
  - *Purchase*

CIM history *(Continued…)*

- *CIM scope within the enterprises:*
  - *Marketing*
  - *Product Design*
  - *Planning*
  - *Purchase*
  - *Manufacturing Engineering*
  - *Factory Automation Hardware*
  - *Warehousing*
  - *Logistics and Supply Chain Management*
  - *Finance*
  - *Information Management*

CIM history *(Continued…)*