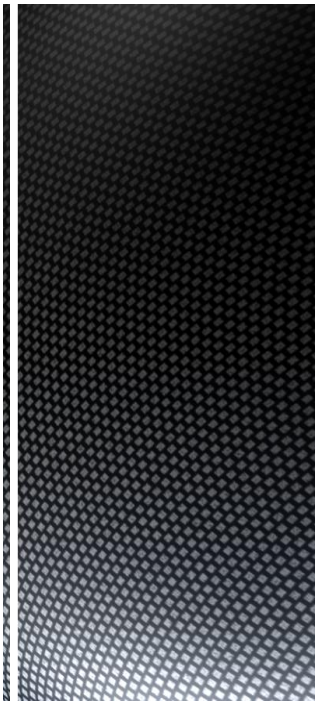


CIM (21-548)

Advanced Manufacturing Laboratory
Department of Industrial Engineering
Sharif University of Technology

Session # 5

Course Description

- *Instructor*
  - *Omid Fatahi Valilai, Ph.D. Industrial Engineering Department, Sharif University of Technology*
  - *Email: FValilai@sharif.edu , Tel: 6616-5706*
  - *Website: Sharif.edu/~fvalilai*
- *Class time*
  - *Sunday-Tuesday* *09:00-10:30*
- *Course evaluation*
  - *Mid-term* *(30%)*
  - *Final exam* *(50%)*
  - *Quiz* *(5%)*
  - *Exercise* *(15%)*

Course Description *(Continued ...)*

- *Mid-term session:*
  - *Sunday: 16th Azar 1393, 09:00 ~ 10:30*
- *Final Exam:*
  - *Tuesday: 30th Dey 1393, 15:00 ~ 17:30*
- *Reference:*
  - *Schaefer, D., Cloud-based Design and Manufacturing (CBDM): A Service-Oriented Product Development Paradigm for the 21st Century, . London: Springer, 2014*
  - *Koren, Y., "The Global Manufacturing Revolution", Wiley, 2010*
  - *Nasr, A., "Computer-Based Design and Manufacturing An Information-Based Approach",Springer, 2007*
  - *Mitchell, F.H., "CIM Systems: An Introduction to Computer-Integrated Manufacturing", Prentice Hall College Div; 1St Edition edition (January 1991), ISBN: 978-0131332997*

Course Description *(Continued..)*

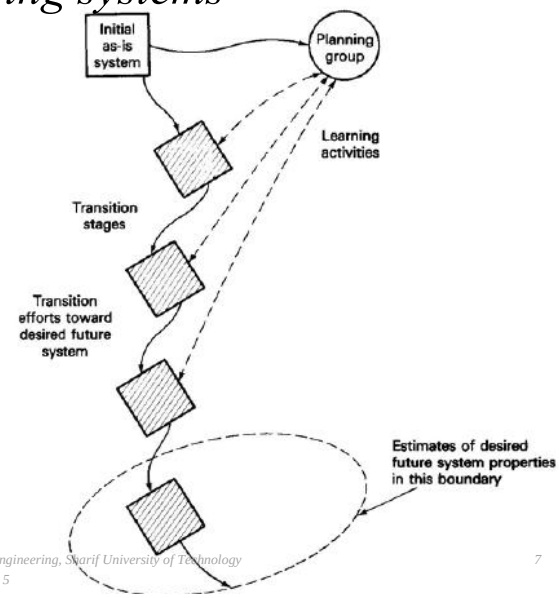
- *Contents:*
  - *Globalization and Manufacturing Paradigms* *(8 sessions)*
  - *System Concepts* *(3 sessions)*
  - *Evolution of Manufacturing systems* *(2 sessions)*
  - *Manufacturing System Design* *(4 sessions)*
  - *Manufacturing Equipment Design* *(3 sessions)*
  - *Information flow in Manufacturing Systems* *(4 sessions)*
  - *Product design and Manufacturing System* *(3 sessions)*
  - *Manufacturing System Implementation* *(5 sessions)*

Course Description *(Continued..)*

- *Contents:*
  - *System Concepts* *(3 sessions)*
    - *Open System Concepts*
    - *Application to the manufacturing systems*
    - *Developing models of manufacturing systems*

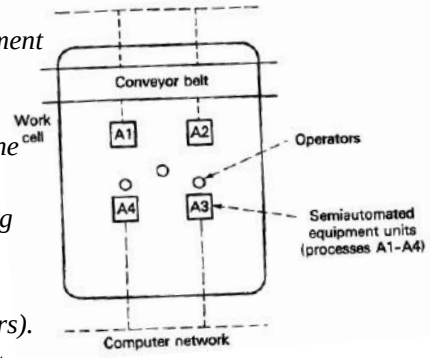
Application to the manufacturing systems

- *Developing Models of Manufacturing Systems*
  - *Modeling based on heuristic basis:*
    - *It is often helpful to develop simple, intuitive models that describe the subsystem elements and the relationships among the elements.*
    - *This approach to visualizing problems has become a commonly applied method for gaining an understanding of complex systems.*
    - *A heuristic understanding "sets the stage" for exploration of the system to discover further information and insights.*



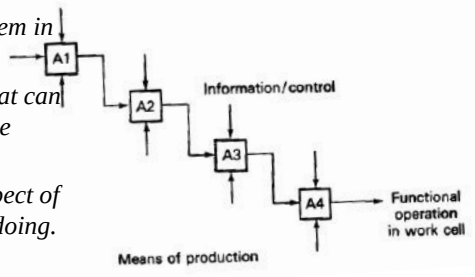
Application to the manufacturing systems

- *Developing Models of Manufacturing Systems*
  - *Efforts have also been made to formalize the development of more detailed system models to improve communication:*
    - *Physical models: describing the visible aspects of the manufacturing enterprise*
      - *Material transformation (including manufacturing equipment and operators)*
      - *Involving the hardware for information flow and system control (including computers and operators).*
      - *Subsystems are defined in terms of hard ware units and the movement of material through the system*



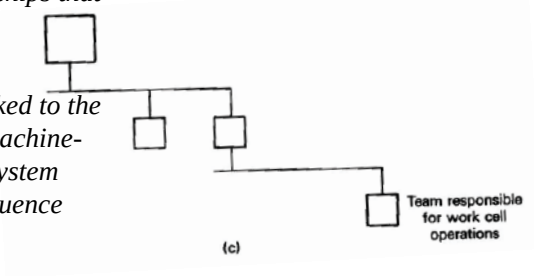
Application to the manufacturing systems

- *Developing Models of Manufacturing Systems*
  - *Efforts have also been made to formalize the development of more detailed system models to improve communication:*
    - *Functional models: describing the manufacturing system in terms of the functions it performs.*
      - *The emphasis is on defining sub system functions that can be well understood individually and then relating the functions to one another.*
      - *This type of model does not represent the visible aspect of the system, but rather describes what the system is doing.*
      - *Functional models can be grouped into those that describe the material trans formation processes achieved by the product equipment and those that describe the information flow throughout the system.*



Application to the manufacturing systems

- *Developing Models of Manufacturing Systems*
  - *Efforts have also been made to formalize the development of more detailed system models to improve communication:*
    - *Organizational models: describing the manufacturing system in terms of the organizational relationships that exist among the people in the system.*
      - *The organizational relationships can be linked to the physical models to determine if workable machine-human interfaces exist, and to the desired system functions to determine if a functional congruence exists.*



Exercise: CM:I:03

- *Developing Models of Manufacturing Systems*

ELSEVIER
Computers & Industrial Engineering
Volume 64, Issue 4, April 2013, Pages 895–901

A heuristic approach for U-shaped assembly line balancing to improve labor productivity ☆

Shwetank Avikal[a], Rajeev Jain[b], P.K. Mishra[a], H.C. Yadav[a]

DOI: 10.1016/j.cie.2013.01.001

Application to the manufacturing systems

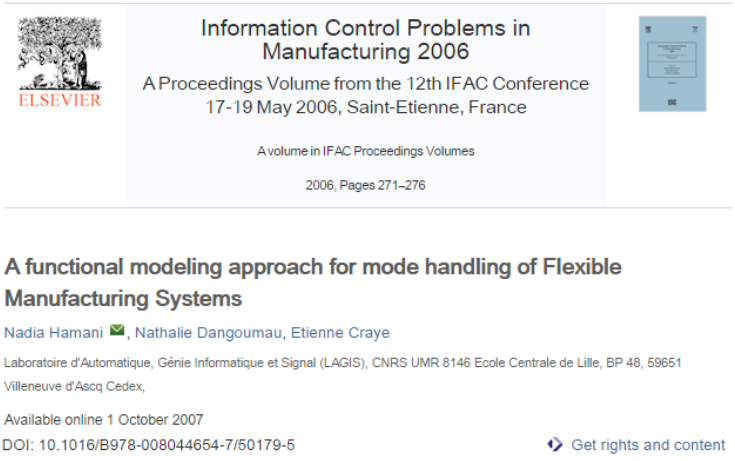
- *Developing Models of Manufacturing Systems*
  - *Models of manufacturing systems generally fall into one of these three categories.*
    - *Physical models are used to decide mechanical design issues and describe hardware performance, thus creating the physically observable manufacturing system.*
    - *Functional models are used to de scribe how the physical equipment will operate to achieve production objectives, indicating how the observable aspects of the system are functionally related to one another, and thus prescribe the knowledge that is required to operate the system.*
    - *Organizational models describe how people relate to one another to achieve system operations and how people function in the overall system setting.*

Models of Manufacturing Systems

- *Graphical Modeling of Manufacturing Systems*
  - *Graph theory can provide insight into the properties of large, complex systems.*
  - *Broad use is made of the Project Evaluation and Review Technique (PERT) and Critical Path Method (CPM) project management techniques, both examples of applied graph theory.*
  - *For these techniques,*
    - *connecting lines represent tasks, and nodes represent completed tasks;*
    - *A path through such a network is any set of successive activities leading from the beginning to the end of the network.*
  - *The critical path is the one with activity times that are longer than any other path and that places the maximum time constraint on the project completion.*

Exercise: CM:I:02

- *Developing Models of Manufacturing Systems*



ELSEVIER

Information Control Problems in Manufacturing 2006

A Proceedings Volume from the 12th IFAC Conference 17-19 May 2006, Saint-Etienne, France

A volume in IFAC Proceedings Volumes

2006, Pages 271–276

A functional modeling approach for mode handling of Flexible Manufacturing Systems

Nadia Hamani, Nathalie Dangoumau, Etienne Craye

Laboratoire d'Automatique, Génie Informatique et Signal (LAGIS), CNRS UMR 8146 Ecole Centrale de Lille, BP 48, 59651 Villeneuve d'Ascq Cedex,

Available online 1 October 2007

DOI: 10.1016/B978-008044654-7/50179-5

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Models of Manufacturing Systems

- *Graphical Modeling of Manufacturing Systems*
  - *Another graphical application involves Petri nets, which can be used to model complex systems.*
    - *The nodes of such a network are used to represent system states;*
    - *Linking arrows describe the necessary transitions that must take place to move among system states.*
  - *Petri nets are studied by considering the circumstances under which particular transitions will occur to allow specific states to be reached.*
  - *Petri nets can be used to model information flow and decision making in a system.*

Models of Manufacturing Systems

- *Graphical Modeling of Manufacturing Systems*
  - *One of the most ambitious modeling effects for manufacturing Aided Manufacturing (ICAM) program in 1981.*
  - *The objective of the ICAM program was to*

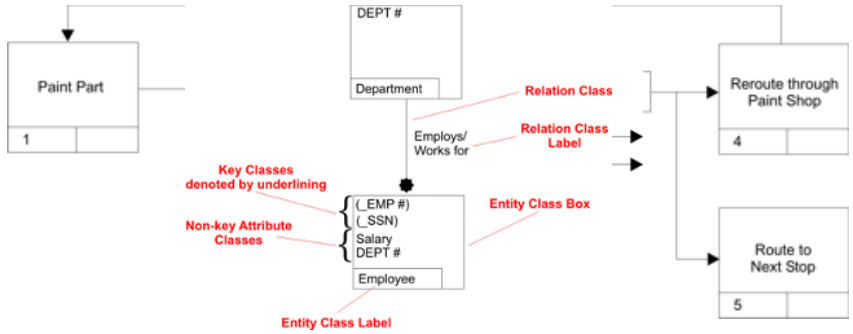
"Develop structured methods for applying computer technology to manufacturing and to use those methods to better understand how best to improve manufacturing productivity."

Models of Manufacturing Systems

- *Graphical Modeling of Manufacturing Systems*
  - *The ICAM program developed three well-documented modeling methodologies around the ICAM Definition (IDEF) approach to system study:*
  - *(I) A functional model of a manufacturing system and environment (called the IDEF0 model);*
  - *(II) An information model of the system and environment (called the IDEF1 model); and*
  - *(III) A dynamics model to describe time-varying system behavior (called the IDEF2 model).*

Models of Manufacturing Systems

- *Graphical Modeling of Manufacturing Systems*
  - *The ICAM program developed three well-documented modeling methodologies around the ICAM Definition (IDEF) approach to system study:*



Models of Manufacturing Systems

- *IDEF based Modeling of Manufacturing Systems*
  - *The IDEF methodology can be applied as*
    - *A descriptive tool*
      - *can be readily understood as an extension of the heuristic study of systems*
    - *An analysis tool.*
      - *calls for a more careful evaluation.*

Models of Manufacturing Systems

- *IDEF based Modeling of Manufacturing Systems*
  - *The IDEF methodology can be applied as*