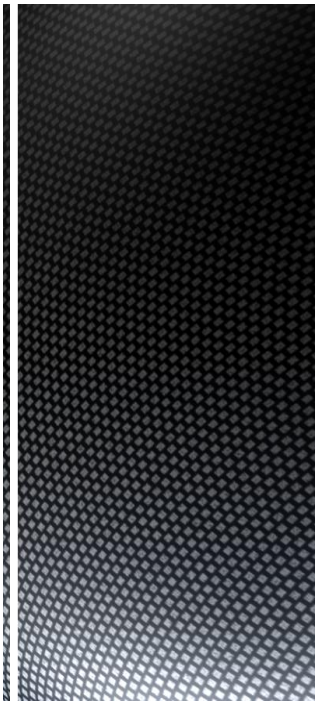


Product Planning & Development (21-423)

Advanced Manufacturing Laboratory
Department of Industrial Engineering
Sharif University of Technology

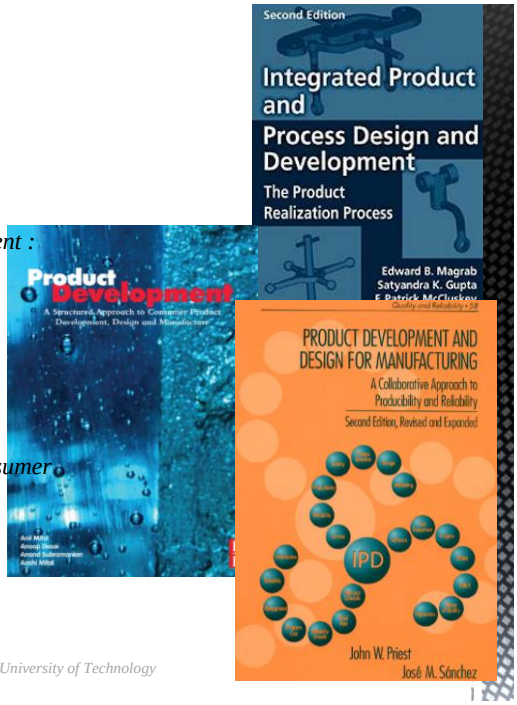
Session #17

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*
- *Recommended prerequisite*
  - *Manufacturing process I (21-418)*
- *Class time*
  - *Sunday-Tuesday 18:00-19:30*
- *Course evaluation*
  - *Mid-term (25%)*
  - *Final exam (40%)*
  - *Quiz (5%)*
  - *Exercise (Manufacturing Lab.) (30%)*

Session reference

- *Reference:*
  - *Edward B., "Integrated product and process design and development : the product realization process", CRC Press, 2010*
  - *John Priest, Jose Sanchez; "Product Development and Design for Manufacturing: A Collaborative Approach to Producibility and Reliability, Second Edition", CRC Press, 2001*
  - *Mital et al. , "Product Development A Structured Approach to Consumer Product Development, Design, and Manufacture", Butterworth-Heinemann, 2008*

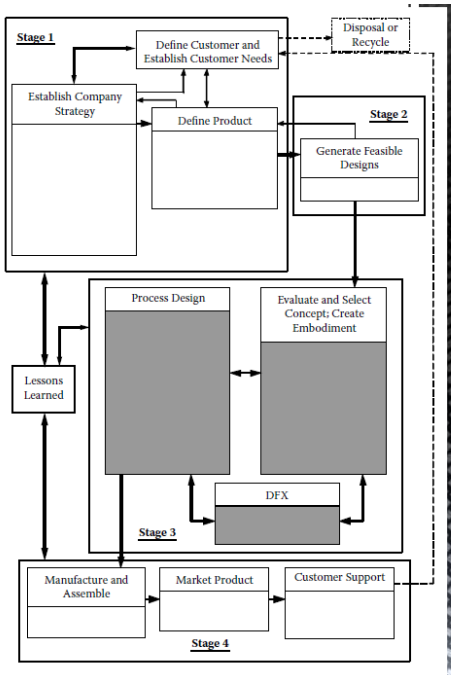


Course Description (Continued..)

- ***Contents:***
- *Product development in the changing Global world*
- *Stages of Product Development*
- *The Structure of the Product Design Process*
- *Early design: Requirement definition and conceptual Design*
- *Trade-off analyses: Optimization using cost and utility Metrics*
- *Detailed design: Analysis and Modeling*
- *Design Review: Designing to Ensure Quality*
- *Production System; Strategies, planning, and methodologies*
- *Production System Development*
- *Planning and Preparation for Efficient Development*
- *Supply chain: Logistics, packaging, supply chain, and the environment*

Design Review: Designing to Ensure Quality

- *Designing for Assembly and Disassembly*



Design Review: Designing to Ensure Quality

- *Designing for Assembly and Disassembly*
- *A consumer product often is an assemblage of several individual components.*
- *Each component has been planned, designed, and manufactured separately. Only after they are assembled into the final product can they effectively perform their intended function*
- *Assembly of a product is a function of design parameters that are both*
  - *Intensive (material properties) and extensive (physical attributes) in nature*
  - *such design parameters includes shape, size, material compatibility, flexibility, and thermal conductivity*

Design Review: Designing to Ensure Quality

- *Designing for Assembly and Disassembly*
- *In an engineering context, disassembly is the organized process of taking apart a systematically assembled product (assembly of components).*
- *Products may be disassembled to enable maintenance, enhance serviceability and/or to affect end of life objectives, such as product reuse, remanufacture, and recycling*

Design Review: Designing to Ensure Quality

- *Designing for Assembly and Disassembly*
- *In the present era of environmental awareness, end-of-life objectives, such as*
  - *component reuse (components from a retired product used without upgrading in a new product),*
  - *Remanufacture (components from a retired product used in a new product after a technological upgrade), and*
  - *Recycling (reuse at the material level, such as recycling of plastics), constitute some of the most important reasons for disassembling products.*

Design Review: Designing to Ensure Quality

- *Designing for Assembly and Disassembly*
- *In 1991, Carnegie Mellon University estimated that some 150 million obsolete PCs, none with readily recoverable materials, required more than 8 million cubic meters of landfill space at a cost of around $400 million*

Design Review: Designing to Ensure Quality

- *Designing for Assembly and Disassembly*
- *Depending on the extent of disassembly, nondestructive disassembly can be further classified into two categories:*
  - *Total disassembly:*

The entire product is disassembled into its constituent components. This may not be economically feasible due to the imposition of external constraints, such as time, economic factors, and presence of hazardous materials

  - *Selective disassembly*

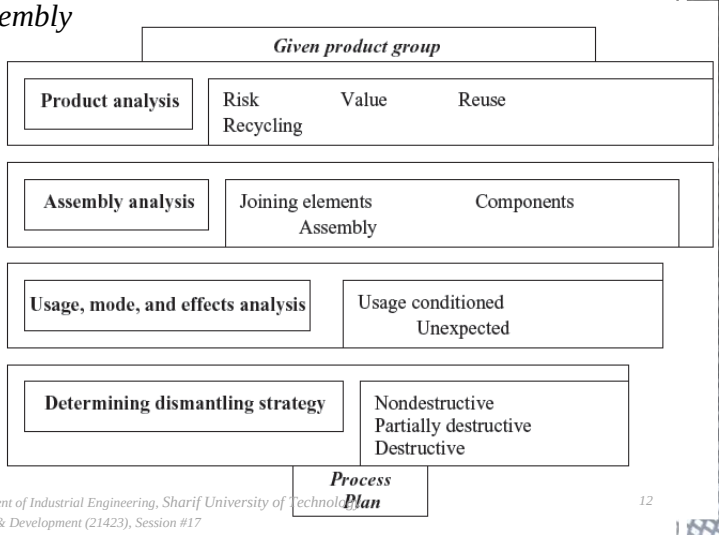
Selective disassembly is the reversible dismantling of complex products into less complex subassemblies or single parts. It involves the systematic removal of desirable constituent parts from an assembly while ensuring that there is no impairment of parts due to the process

Design Review: Designing to Ensure Quality

- *Designing for Assembly and Disassembly*
  - *Products are selectively disassembled to realize the following objectives:*
    - *Enabling maintenance and repair (serviceability).*
    - *Availability of subassemblies as service parts or for assembly in new products.*
    - *Removal of parts prior to setting free other desired parts.*
    - *Availability of parts intended for material reuse (recycling).*
    - *Increased purity of materials by removal of contaminants.*
    - *Complying with regulations that prescribe removal of definite parts, materials, and substances for environmental and safety reasons, like removal of working fluids such as engine oils and lubricants.*

Design Review: Designing to Ensure Quality

- *Designing for Assembly and Disassembly*
  - *Disassembly Process Planning*



Design Review: Designing to Ensure Quality

- *Designing for Assembly and Disassembly*
  - *Design for disassembly guidelines:*
    - *If possible, similar elements need to be combined in a group.*
    - *Material variability should be minimized to predict disassembly procedures with a degree of certainty.*
    - *As far as possible, compatible materials should be used to facilitate disassembly.*
    - *Any harmful materials, if functionally important, should be grouped together into subassemblies for fast disposal.*
    - *Any valuable, reusable, and harmful parts need to be easily accessible. This saves a lot of time and effort trying to reach the part in question.*

Design Review: Designing to Ensure Quality

- *Designing for Assembly and Disassembly*
  - *Design for disassembly guidelines:*
    - *Drainage points need to be easily accessible.*
    - *Fasteners need to be easy to remove or destroy.*
    - *The number of fasteners must be minimized to save time and effort.*
    - *Easy access to disjoining, fracture, and cutting points must be provided.*
    - *Generally speaking, the disassembly path needs to be a simple and straightforward route along which most components are removed. To that end, multiple directions and complex movements for disassembly need to be avoided.*
    - *Metal inserts in plastic parts should be avoided, since this increases material variety and part complexity and necessitates multiple directions and complex movements in disassembly.*

Design Review: Designing to Ensure Quality

- *Designing for Assembly and Disassembly*
  - *Product Recovery Approach*

Options for Product Recovery after Disassembly (Thierry et al., 1995)

Option	Objective	Level of Disassembly	Result
Repair	Restore to working condition	Product level (limited disassembly and fixing)	Some parts repaired
Refurbishing	Improve to quality level, though not like new	Module level (some technological upgrading)	Some modules repaired or replaced
Remanufacturing	Restore to quality level, as new	Part level	Used and new parts in new products
Cannibalization	Limited recovery	Selective disassembly and inspection of potentially reusable parts	Parts reused, recycled, or disposed of
Recycling	Reuse materials only	Material level	Materials used in new products

Project

- *Phase 8*
  - *Product DFD Analysis*