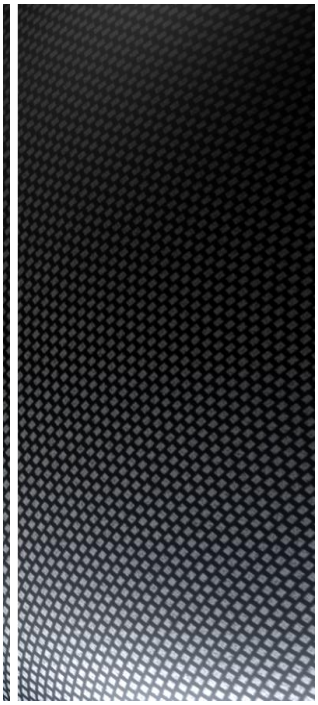


Product Planning & Development (21-423)

Advanced Manufacturing Laboratory
Department of Industrial Engineering
Sharif University of Technology

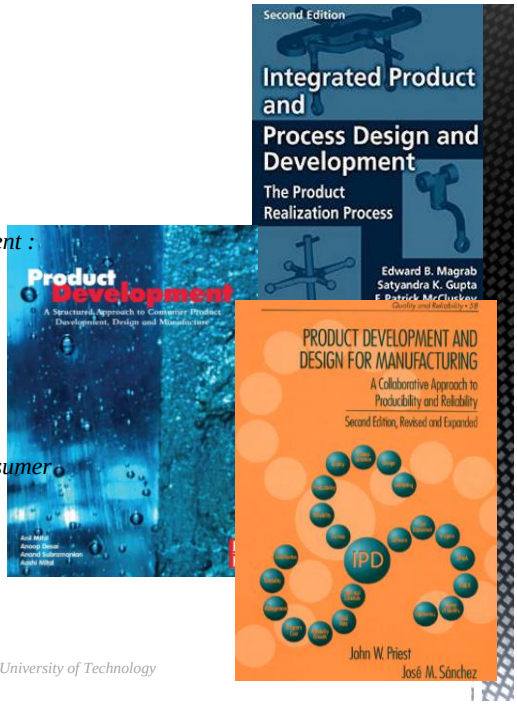
Session #9

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*

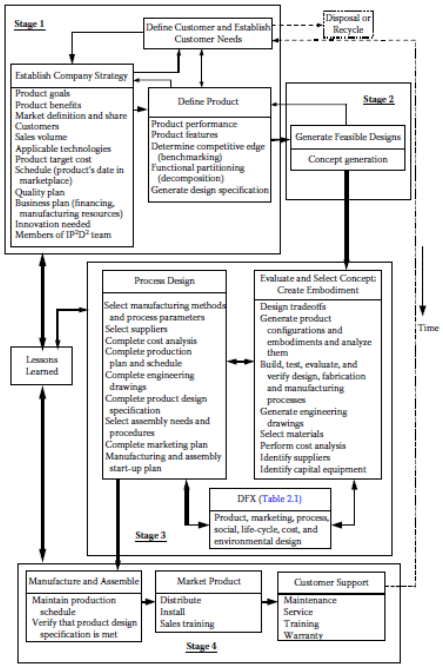


Course Description (Continued..)

- ***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*

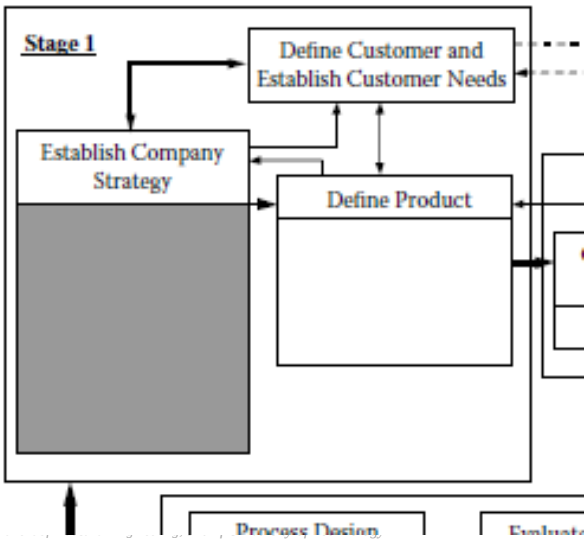
Trade-off analyses: Optimization using cost and

- *Early Design:*



Trade-off analyses: Optimization using cost and utility Metrics

- *Product Cost Analysis*



Trade-off analyses: Optimization using cost and utility Metrics

- *Trade-off analyses*
  - *Trade-off analysis is an important method for developing information to help the design team in making design decisions.*
  - *Almost any design or service parameter can be converted to a currency-based measure.*
    - *This allows the development team to perform analyses of different parameters based on a single performance metric.*
  - *Two commonly used methodologies are design to cost (DTC), which minimizes unit production costs and life cycle cost (LCC), which minimizes the cost of the product over its entire life.*

Trade-off analyses: Optimization using cost and utility Metrics

- *Trade-off analyses*
  - *Design to cost (DTC) is a cost analysis technique aimed at reducing or minimizing a product's price or cost, which results in increased sales volume.*
  - *Life cycle cost (LCC), is a cost analysis discipline that develops a model of the total cost for development, operation, maintenance and disposal of a product over its full life to be used in design trade-off studies.*
    - *The model is used to optimize product costs and predicting future costs of maintenance, logistics, and warranties.*

Trade-off analyses: Optimization using cost and utility Metrics

- *Trade-off analyses models*
  - *Models provide information to the design team.*
  - *The quality of the model and its parameters determines the quality of the information provided.*
  - *A cost model is used for estimating the manufacturing cost of a bearing by the bearing's configuration, material, length, diameter, and tolerance on diameter (AD) as modeled by (Tandon and Seireg, 1989).*

$$C_m = \gamma(k_0 + k_1/\Delta_D^{a})(k_2 + k_3 L D^2)$$

Where

γ = Machining cost factor based on the material hardness
ko through k_3 = cost coefficients (see article)
a = 1/3
Δ_D = Tolerance diameter
L = Length
D = Diameter

Trade-off analyses: Optimization using cost and utility Metrics

- *Trade-off analyses models*
  - *Models provide information to the design team.*
  - *The quality of the model and its parameters determines the quality of the information provided.*
  - *Large and colleagues (1975) developed a series of parametric equations for estimating the overall aspects of aircraft airframe costs based on performance. Their estimate for the total cost of aircraft airframes based on a sample of 25 military aircraft with first flight dates after 1951*

$$C_{100} = 4.29 W^{0.73} S^{0.74}$$

Where:

C_{100} = total cost for 100 airframes (Thousands of $)
W = airframe unit weight (lb.)
S = maximum speed (knots)

With the

R^2 = 0.88 and F = 79.

Both parameter coefficients were significant at the 1% level.