

# *Product Planning & Development*

## *(21-423)*

*Advanced Manufacturing Laboratory  
Department of Industrial Engineering  
Sharif University of Technology*

*Session #10*



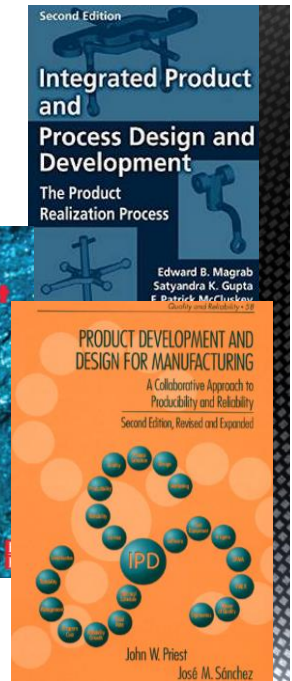
## *Course Description*

- ***Instructor***
  - *Omid Fatahi Valilai, Ph.D. Industrial Engineering Department, Sharif University of Technology*
  - *Email: [FValilai@sharif.edu](mailto:FValilai@sharif.edu), Tel: 6616-5706*
  - *Website: [Sharif.edu/~fvalilai](http://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



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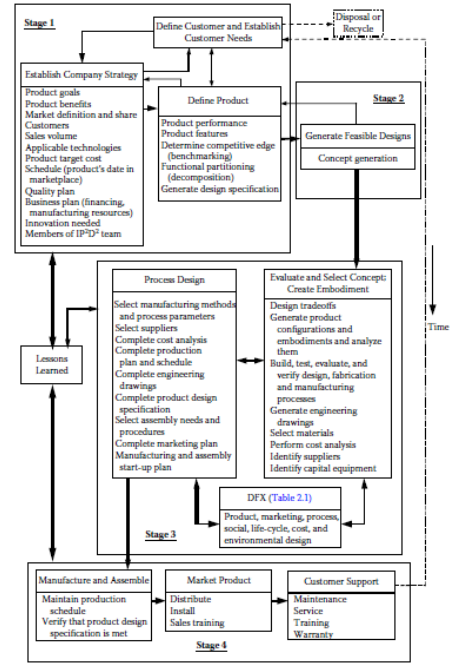
## Course Description (Continued..)

- **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

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Trade-off analyses: Optimization using cost and

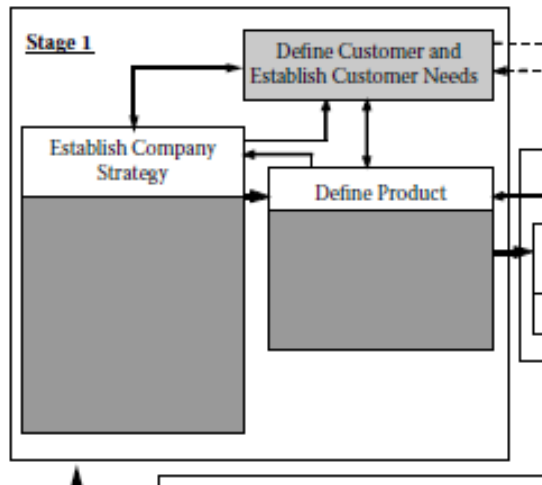
Early Design:



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Product Functional Requirements and Functional Decomposition

Functional modeling



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## *Product Functional Requirements and Functional Decomposition*

- *Functional modeling*
  - *The generation of a product's or a system's functional requirements (FRs) is done in the context of the overall goals for that product, which are directly related to the customer requirements.*

*a Function Requirement specifies a mandatory action of a product or system.*

- *Accompanying the product's goals are constraints that the functions must satisfy.*

## *Product Functional Requirements and Functional Decomposition*

- *Functional Requirement headings*
  - *Function*
    - *How will it be used?*
    - *Usability*
  - *Performance characteristics*
  - *Documentation/engineering drawings*
  - *Human factors/ergonomics*
  - *Appearance and style (aesthetics)*
  - *Configuration*
  - *Responsiveness*
    - *Delivery date to customers*
    - *Packaging and shipping*
    - *Adaptability to variability in materials and process conditions*
  - *.*
  - *.*

## *Product Functional Requirements and Functional Decomposition*

- *Functional Decomposition*
  - *A product's overall function may be divided into a hierarchical set of sub functions by decomposition.*
  - *Functional Decomposition is the process of dividing a system's functions into smaller, coherent, self-contained functional elements.*
  - *The interrelationships among these functional elements will dictate the decisions by which a solution is obtained.*

## *Product Functional Requirements and Functional Decomposition*

- *Functional Decomposition*
  - *Advantages*
    - *It provides a means of transforming the overall complexity of the product into functional units that have lower complexity.*
    - *It forces the design team to focus initially on what the product should do before determining how to do it.*
    - *It can provide the design team with a basis for organizing itself and the tasks that need to be accomplished.*
    - *If one or more of the functional units is independent of all other functional units, then tasks with respect to these units may be performed in parallel with the tasks for the other functional units.*

## *Product Functional Requirements and Functional Decomposition*

- *Functional Decomposition and the Axiomatic Approach*
  - *AD gives a means of clarifying and focusing both the product's functions and the objectives that the design should meet.*
  - *the axiomatic approach provides a compact visual way of expressing the design intent and the overall design objective.*
  - *Functional requirements are defined as the minimum no unique set of independent mandatory requirements that completely characterize the design objectives for a specific need.*
    - *If possible, they must be independent of each other at every level in the design hierarchy.*



## *Product Functional Requirements and Functional Decomposition*

- *Functional Decomposition and the Axiomatic Approach*
  - *AD gives a means of clarifying and focusing both the product's functions and the objectives that the design should meet.*
  - *The axiomatic approach provides a compact visual way of expressing the design intent and the overall design objective.*
  - *(FRs) Functional Requirements are defined as the minimum no unique set of independent mandatory requirements that completely characterize the design objectives for a specific need.*
    - *If possible, they must be independent of each other at every level in the design hierarchy.*

## *Product Functional Requirements and Functional Decomposition*

- *Functional Decomposition and the Axiomatic Approach*
  - *Design parameters (DPs) denote the physical entities that will be created by the design process to fulfill the FRs.*
    - *In other words, the functional requirement describes what action or series of actions is required to satisfy the customer needs, and the design parameter is the physical entity (component/module/unit) that has to be created to satisfy its functional requirement.*
  - *The creation of the DP requires that a concept (specific principle, method, or means) be selected.*

## *Product Functional Requirements and Functional Decomposition*

- *Functional Decomposition and the Axiomatic Approach*
  - *The FRs reside in the function domain and are presented in a solution-neutral manner.*
  - *It enables it for the avoidance of any preconceived ideas of what would work best.*
  - *The functional requirements should have a noun and a verb, not use jargon, be stated in the affirmative rather than the negative, and be quantifiable.*
  - *Each specific measurable attribute, or characteristic, of each FR is called an engineering characteristic (EC).*

## Product Functional Requirements and Functional Decomposition

- *Functional Decomposition and the Axiomatic Approach*
  - *The common two-knob water faucet*



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## Product Functional Requirements and Functional Decomposition

- *Functional Decomposition and the Axiomatic Approach*
  - *The common two-knob water faucet*
  - *The design objective for this water faucet is to provide water continuously at a desired flow rate and at a desired temperature when the flow rate of the hot and the cold water is controlled separately*
  - *In terms of the axiomatic design procedure, this system is modeled as follows:*
    - (FR)<sub>1</sub> = Obtain water flow rate*
    - (FR)<sub>2</sub> = Obtain water temperature*



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## Product Functional Requirements and Functional Decomposition

- *Functional Decomposition and the Axiomatic Approach*
  - *The common two-knob water faucet*
  - *The design objective for this water faucet is to provide water continuously at a desired flow rate and at a desired temperature when the flow rate of the hot and the cold water is controlled separately*
  - *The design parameters are dictated by the fact that we are to control the flow rates of the hot and cold water separately.*
  - *(DP)<sub>1</sub> = Means to adjust cold water flow*
  - *(DP)<sub>2</sub> = Means to adjust hot water flow*



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## Project

- *Product Functional Decomposition*

