

Product Planning & Development

(21-423)

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

Session #6



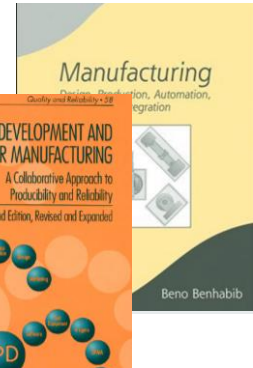
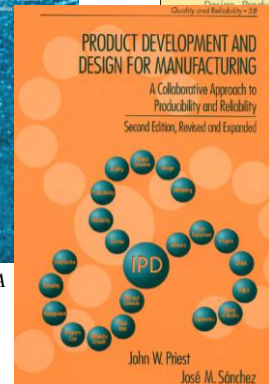
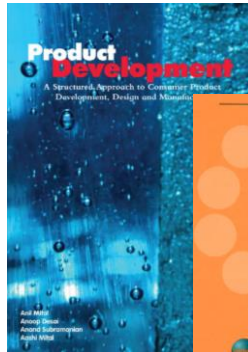
Course Description

- ***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%)*

Course Description (Continued ...)

- **Mid-term session:**
 - Wednesday: 9th Ordibehesht 1394, 16:30 ~ 18:30
- **Final Exam:**
 - Monday: 1st Tir 1394, 09:00 ~ 11:30
- **Reference:**
 - 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
 - Benhabib, Beno; "Manufacturing: Design, Production, Automation, and Integration", 2003, Marcel Dekker Inc, New York
 - Abouel Nasr, Emad; Kamrani, Ali K.; "Computer-Based Design and Manufacturing: An Information-Based Approach", 2007, Springer, New York

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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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The Structure of the Product Design Process

▪ *Early Design:*

▪ *Customer Needs Analysis*

Defining the customer's needs can be an extremely complex process resulting in many different and conflicting types of information.

There are several approaches for knowledge acquisition of customer needs.

The design team should use several of these methods to insure that the final requirements are representative of the customer.

The Structure of the Product Design Process

▪ *Early Design:*

▪ *Customer Needs Analysis*

▪ *Methods for capturing and documenting customer needs:*

- *Interviews of customers including techniques such as surveys*
- *Design partnerships or alliances*
- *Computer databases and data mining*
- *Consultants or experts*
- *Brainstorming sessions*
- *Personal and company experience*
- *Published information such as magazines, patents, etc.*
- *Technology capability forecasting*
- *Market and competitor benchmark analysis*
- *Prototyping and virtual reality*
- *House of quality or Quality Function Deployment*

The Structure of the Product Design Process

- **Early Design:**
 - *Customer Needs Analysis*
 - *Methods for capturing and documenting customer needs:*
 - **QFD**
 - *QFD constitutes “A system for translating customer requirements into appropriate company requirements at every stage, from research through production design and development, to manufacture, distribution, installation and marketing, sales and services”*

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The Structure of the Product Design Process

- **Early Design:**
 - *Customer Needs Analysis*
 - *Methods for capturing and documenting customer needs:*
 - **QFD**

QFD PLANNING STRUCTURE

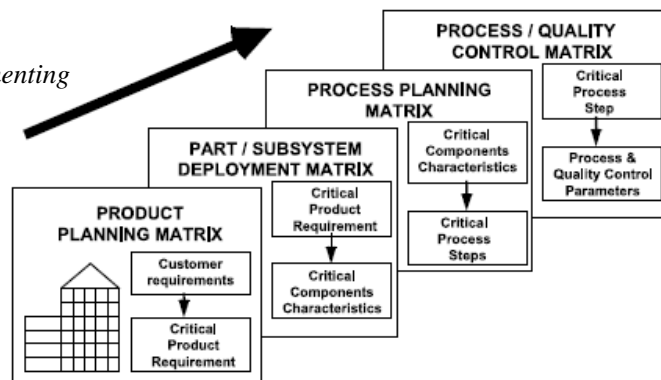
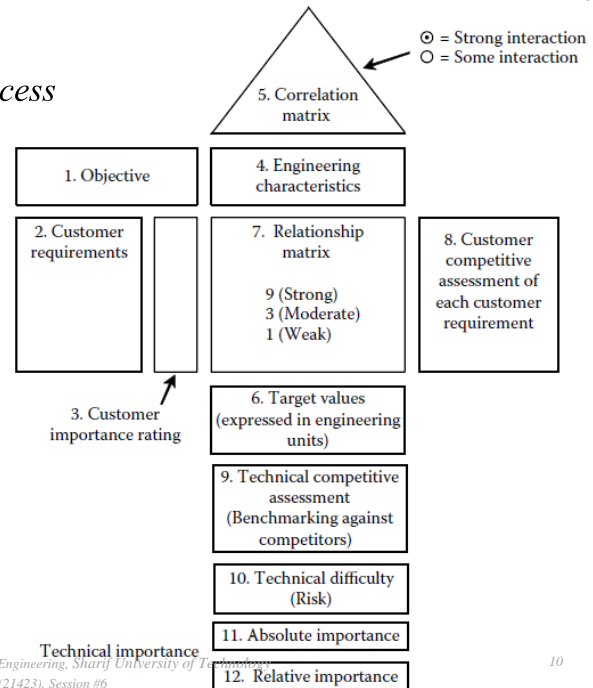


FIGURE 3.4 The logical sequence of QFD forms. The first two modules (house of quality and part characteristics) refer to product planning; the second two refer to manufacturing process planning and quality control. (From Crow, K.A. [1992], Seminar on Concurrent Engineering, DRM Associates, Rome.)

Advanced Manufacturing I

The Structure of the Product Design Process

- **Early Design:**
 - *Customer Needs Analysis*
 - *Methods for capturing and documenting customer needs:*
 - *QFD*



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The Structure of the Product Design Process

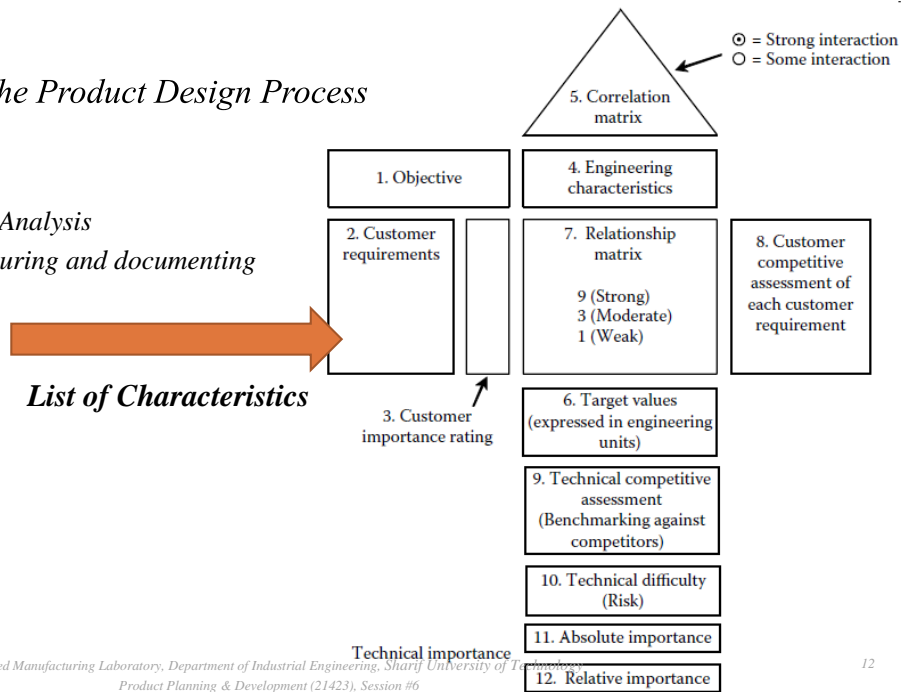
- **Early Design:**
 - *Customer Needs Analysis*
 - *Methods for capturing and documenting customer needs:*
 - *List of characteristics:*
 - *Obtaining a list of characteristics of the product as defined by the customers (CRs).*
 - *When possible, the customer requirements should be grouped at their highest level by arranging them according to the applicable dimensions of Garvin's eight dimensions of quality (Performance, Features, Reliability, Conformance, Durability, Serviceability, Aesthetics, perceived Quality)*

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The Structure of the Product Design Process

- Early Design:

- Customer Needs Analysis
- Methods for capturing and documenting customer needs:
 - QFD



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The Structure of the Product Design Process

- Early Design:

- Customer Needs Analysis
- Methods for capturing and documenting customer needs:
 - List of characteristics:

Quality Characteristic	Customer Requirements
Performance	Short time to make connection Strong connection Makes connection every time (repeatable)
Features	Lightweight Accessible to hard-to-reach places Overload protection Easy to undo connection
Conformance	Safe Quiet Easy to use Impact resistant Low vibrations (if applicable)
Ergonomics	Not fatiguing to use Controllable/maneuverable Comfortable to hold Compact/balanced
Serviceability	Little or no maintenance Components easy to replace Replacement components available
Aesthetics	Rugged-looking

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General

Purpose of product
 Target cost to customer
 Need for product
 Benefits to user
 Time for product to first reach customer (scheduling)
 Customers
 Size
 Weight
 Quantity
 Competition (benchmarking)
 Service life (planned obsolescence)
 Market evaluation: trends, growth, share
 Trademark, brand name, logo

Performance

Functions
 Features

Constraints

Shipping modes and costs
 Disposal and recycling
 Manufacturing facilities, processes, and capacities:
 in-house, in-country, out of country

Constraints (continued)

Political, social, and legal requirements
 Maintenance and service requirements
 Packaging (including ability to re-use and recycle)
 Reliability
 Shelf life
 Patents (search, apply for, obtain license)
 Environment: factory floor, packaged, stored, during transportation, and in-use
 Testing
 Safety: compliance issues
 Materials and components: recyclable, disposable, availability, suppliers
 Ergonomics
 Standards: U.S. and international
 Interfaces: electrical and mechanical connections
 Aesthetics (appearance)
 End user requirements: professional installation, preassembled, user-assembled
 Suppliers
 Energy consumption
 Product operational costs
 User training and learning requirements: documentation

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The Structure of the Product Design Process

- **Early Design:**
 - *Customer Needs Analysis*
 - *Product Use and User Profiles*
 - *Product use and user profiles document on a time scale, all the functions that a product and the user must perform, including the various environments that the system will encounter.*
 - *These profiles are often called scenarios, use cases, task analysis, network diagrams and environmental profiles.*

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The Structure of the Product Design Process

- *Early Design:*
 - *Product Use and User Profiles*
 - *They list and characterize each step in product use, its important parameters and how they relate to the environment.*
 - *Profiles provide the operational, maintenance, and environmental baseline for the definition of design requirements.*

The Structure of the Product Design Process

- *Early Design:*
 - *Product Use and User Profiles*
 - *Scenarios and Use Cases*
 - *Scenarios and use cases are step-by-step descriptions of how the product will be used for a particular application or task.*
 - *They are usually formatted as a list or a flow diagram. A product will have several scenarios depending on the number of product uses, features and different users.*
 - *Scenarios are elicited from users and experts in the domain, and validated by independent experts.*
 - *Scenario analysis identifies typical and atypical process flows within the system. Results are used to define task responsibilities and often involve time dependent sequencing.*

The Structure of the Product Design Process

- *Early Design:*
 - *Product Use and User Profiles*
 - *Scenarios and Use Cases*
 - *A storyboard for each scenario(s) is generated using*
 - *Group techniques*
 - *Interactive observation*
 - *Structured interviews*
 - *Demonstrations*
 - *Focus groups*

The Structure of the Product Design Process

- *Early Design:*
 - *Product Use and User Profiles*
 - *Task Analysis and User Profile*
 - *Task analysis (sometimes called task-equipment analysis) is a design technique that evaluates specific task requirements for an operator with respect to an operator's capabilities.*
 - *The level of detail for the task analysis is based on the design information required at each phase of the design and the importance of each task.*
 - *User profiles are descriptions of the users and support personnel's capabilities.*
 - *This includes descriptions of their physical, educational, training and motivational levels*

The Structure of the Product Design Process

- *Early Design:*
 - *Product Use and User Profiles*
 - *Network Diagram*
 - *Network diagrams are used to graphically show the interrelationships and sequential flow of how the product will be used and supported.*
 - *Traditional structured analyses may also be used to identify process flows, events and conditions, and entities in legacy system documentation.*
 - *Structure diagrams such as data flow, state transition, and entity relation diagrams may be used.*
 - *Early conceptual analyses elicit "as-is" user information for the definition of standard or common values, metrics, roles and responsibilities, and standard high-level abstract components with their capabilities and constraints.*

The Structure of the Product Design Process

- *Early Design:*
 - *Product Use and User Profiles*
 - *Product Use, Mission, or Environmental Profiles*
 - *These profiles should include both environmental and functional conditions.*
 - *Many products such as washing machines and notebook computers can experience harsher physical environments in moving and shipping than they experience in actual use.*
 - *An environmental profile shows on a time scale the significant environmental parameters, including their levels and duration that are expected to occur during the life of the product.*
 - *The functional mission profile emphasizes how a system must perform in every potential situation in the total envelope of environments.*

Project

- *Product profile and elements*

