Product and Service Design

- Major factors in design strategy
  - Cost
  - Quality
  - Time-to-market
  - Customer satisfaction
  - Competitive advantage

Product and service design – or redesign – should be closely tied to an organization's strategy.
<table>
<thead>
<tr>
<th><strong>Product or Service Design Activities</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Translate customer wants and needs into product and service requirements</td>
</tr>
<tr>
<td>• Refine existing products and services</td>
</tr>
<tr>
<td>• Develop new products and services</td>
</tr>
<tr>
<td>• Formulate quality goals</td>
</tr>
<tr>
<td>• Formulate cost targets</td>
</tr>
<tr>
<td>• Construct and test prototypes</td>
</tr>
<tr>
<td>• Document specifications</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Reasons for Product or Service Design</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Economic</td>
</tr>
<tr>
<td>• Social and demographic</td>
</tr>
<tr>
<td>• Political, liability, or legal</td>
</tr>
<tr>
<td>• Competitive</td>
</tr>
<tr>
<td>• Technological</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Objectives of Product and Service Design</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Main focus</td>
</tr>
<tr>
<td>• Customer satisfaction</td>
</tr>
<tr>
<td>• Secondary focus</td>
</tr>
<tr>
<td>• Function of product/service</td>
</tr>
<tr>
<td>• Cost/profit</td>
</tr>
<tr>
<td>• Quality</td>
</tr>
<tr>
<td>• Appearance</td>
</tr>
<tr>
<td>• Ease of production/assembly</td>
</tr>
<tr>
<td>• Ease of maintenance/service</td>
</tr>
</tbody>
</table>
### Designing For Operations

- Taking into account the capabilities of the organization in designing goods and services

### Legal, Ethical, and Environmental Issues

<table>
<thead>
<tr>
<th>Legal</th>
<th>FDA, OSHA, IRS</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Product liability</td>
</tr>
<tr>
<td></td>
<td>Uniform commercial code</td>
</tr>
<tr>
<td>Ethical</td>
<td>Releasing products with defects</td>
</tr>
<tr>
<td>Environmental</td>
<td>EPA</td>
</tr>
</tbody>
</table>

### Regulations & Legal Considerations

- **Product Liability** - A manufacturer is liable for any injuries or damages caused by a faulty product.

- **Uniform Commercial Code** - Products carry an implication of merchantability and fitness.
Designers Adhere to Guidelines

- Produce designs that are consistent with the goals of the company
- Give customers the value they expect
- Make health and safety a primary concern
- Consider potential harm to the environment

Other Issues in Product and Service Design

- Product/service life cycles
- How much standardization
- Product/service reliability
- Range of operating conditions

Life Cycles of Products or Services

![Life Cycle of Products or Services Diagram](image)

- Introduction
- Growth
- Maturity
- Saturation
- Decline
- Time
- Demand
Standardization

- Standardization
  - Extent to which there is an absence of variety in a product, service or process
  - Standardized products are immediately available to customers

Advantages of Standardization

- Fewer parts to deal with in inventory & manufacturing
- Design costs are generally lower
- Reduced training costs and time
- More routine purchasing, handling, and inspection procedures

Advantages of Standardization (Cont’d)

- Orders fillable from inventory
- Opportunities for long production runs and automation
- Need for fewer parts justifies increased expenditures on perfecting designs and improving quality control procedures.
Disadvantages of Standardization

- Designs may be frozen with too many imperfections remaining.
- High cost of design changes increases resistance to improvements.
- Decreased variety results in less consumer appeal.

Mass Customization

- Mass customization:
  - A strategy of producing standardized goods or services, but incorporating some degree of customization
  - Delayed differentiation
  - Modular design

Delayed Differentiation

- Delayed differentiation is a postponement tactic
  - Producing but not quite completing a product or service until customer preferences or specifications are known
**Modular Design**

*Modular design* is a form of standardization in which component parts are subdivided into modules that are easily replaced or interchanged. It allows:

- easier diagnosis and remedy of failures
- easier repair and replacement
- simplification of manufacturing and assembly

**Reliability**

- **Reliability**: The ability of a product, part, or system to perform its intended function under a prescribed set of conditions

- **Failure**: Situation in which a product, part, or system does not perform as intended

- **Normal operating conditions**: The set of conditions under which an item’s reliability is specified

**Improving Reliability**

- Component design
- Production/assembly techniques
- Testing
- Redundancy/backup
- Preventive maintenance procedures
- User education
- System design
**Product Design**

- Product Life Cycles
- Robust Design
- Concurrent Engineering
- Computer-Aided Design
- Modular Design

**Robust Design**

Robust Design: Design that results in products or services that can function over a broad range of conditions.

**Taguchi Approach Robust Design**

- Design a robust product
  - Insensitive to environmental factors either in manufacturing or in use.
- Central feature is *Parameter Design*.
- Determines:
  - factors that are controllable and those not controllable
  - their optimal levels relative to major product advances
### Degree of Newness

1. Modification of an existing product/service
2. Expansion of an existing product/service
3. Clone of a competitor’s product/service
4. New product/service

### Degree of Design Change

<table>
<thead>
<tr>
<th>Type of Design Change</th>
<th>Newness of the organization</th>
<th>Newness to the market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modification</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Expansion</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Clone</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>New</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

### Phases in Product Development Process

1. Idea generation
2. Feasibility analysis
3. Product specifications
4. Process specifications
5. Prototype development
6. Design review
7. Market test
8. Product introduction
9. Follow-up evaluation
Idea Generation

- Supply chain based
- Competitor based
- Research based

Reverse Engineering

*Reverse engineering* is the dismantling and inspecting of a competitor’s product to discover product improvements.

Research & Development (R&D)

- Organized efforts to increase scientific knowledge or product innovation & may involve:
  - *Basic Research* advances knowledge about a subject without near-term expectations of commercial applications.
  - *Applied Research* achieves commercial applications.
  - *Development* converts results of applied research into commercial applications.
Manufacturability

- Manufacturability is the ease of fabrication and/or assembly which is important for:
  - Cost
  - Productivity
  - Quality

Designing for Manufacturing

Beyond the overall objective to achieve customer satisfaction while making a reasonable profit is:

Design for Manufacturing (DFM)

The designers’ consideration of the organization’s manufacturing capabilities when designing a product.

The more general term design for operations encompasses services as well as manufacturing.

Concurrent Engineering

Concurrent engineering is the bringing together of engineering design and manufacturing personnel early in the design phase.
Computer-Aided Design

- Computer-Aided Design (CAD) is product design using computer graphics.
- Increases productivity of designers, 3 to 10 times
- Creates a database for manufacturing information on product specifications
- Provides possibility of engineering and cost analysis on proposed designs

Product design

- Design for manufacturing (DFM)
- Design for assembly (DFA)
- Design for recycling (DFR)
- Remanufacturing
- Design for disassembly (DFD)
- Robust design

Recycling

- Recycling: recovering materials for future use
- Recycling reasons
  - Cost savings
  - Environment concerns
  - Environment regulations
<table>
<thead>
<tr>
<th>Service Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Service is an act</td>
</tr>
<tr>
<td>• Service delivery system</td>
</tr>
<tr>
<td>• Facilities</td>
</tr>
<tr>
<td>• Processes</td>
</tr>
<tr>
<td>• Skills</td>
</tr>
<tr>
<td>• Many services are bundled with products</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Service design involves</td>
</tr>
<tr>
<td>• The physical resources needed</td>
</tr>
<tr>
<td>• The goods that are purchased or consumed by the customer</td>
</tr>
<tr>
<td>• Explicit services</td>
</tr>
<tr>
<td>• Implicit services</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Service</td>
</tr>
<tr>
<td>• Something that is done to or for a customer</td>
</tr>
<tr>
<td>• Service delivery system</td>
</tr>
<tr>
<td>• The facilities, processes, and skills needed to provide a service</td>
</tr>
<tr>
<td>• Product bundle</td>
</tr>
<tr>
<td>• The combination of goods and services provided to a customer</td>
</tr>
<tr>
<td>• Service package</td>
</tr>
<tr>
<td>• The physical resources needed to perform the service</td>
</tr>
</tbody>
</table>
**Differences Between Product and Service Design**

- Tangible – intangible
- Services created and delivered at the same time
- Services cannot be inventoried
- Services highly visible to customers
- Services have low barrier to entry
- Location important to service

**Phases in Service Design**

1. Conceptualize
2. Identify service package components
3. Determine performance specifications
4. Translate performance specifications into design specifications
5. Translate design specifications into delivery specifications

**Service Blueprinting**

- Service blueprinting
  - A method used in service design to describe and analyze a proposed service
  - A useful tool for conceptualizing a service delivery system
Major Steps in Service Blueprinting

1. Establish boundaries
2. Identify steps involved
3. Prepare a flowchart
4. Identify potential failure points
5. Establish a time frame
6. Analyze profitability

Characteristics of Well Designed Service Systems

1. Consistent with the organization mission
2. User friendly
3. Robust
4. Easy to sustain
5. Cost effective
6. Value to customers
7. Effective linkages between back operations
8. Single unifying theme
9. Ensure reliability and high quality

Challenges of Service Design

- Variable requirements
- Difficult to describe
- High customer contact
- Service – customer encounter
Quality Function Deployment

- Quality Function Deployment
- Voice of the customer
- House of quality

QFD: An approach that integrates the "voice of the customer" into the product and service development process.

The House of Quality

![Diagram of the House of Quality]

- Correlation matrix
- Design requirements
- Customer requirements
- Relationship matrix
- Competitive assessment
- Specifications or target values

Customer Requirements

<table>
<thead>
<tr>
<th>Importance to Customer</th>
<th>Easy to close</th>
<th>Stays open on a hill</th>
<th>Easy to open</th>
<th>Doesn't leak in rain</th>
<th>No road noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importance weighting</td>
<td>10</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>2</td>
</tr>
</tbody>
</table>

Engineering Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Energy needed to close door</th>
<th>Check force on level ground</th>
<th>Energy needed to open door</th>
<th>Water resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation:</td>
<td>Strong positive</td>
<td>Positive</td>
<td>Negative</td>
<td>Strong negative</td>
</tr>
</tbody>
</table>

Competitive Evaluation

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>A</th>
<th>B</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>X A B</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationship:</td>
<td>Strong = 9</td>
<td>Medium = 3</td>
<td>Small = 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Target Values

- Reduce energy level to 7.5 ft/lb
- Reduce force to 9 lb.
- Reduce energy to 7.5 ft/lb.
- Maintain current level

Technical Evaluation

- Door seal resistance: Maintain current level
- Acoust. Trans. Window: Maintain current level

House of Quality Example

![Diagram of the House of Quality Example]
The Kano Model

Operations Strategy
1. Increase emphasis on component commonality
2. Package products and services
3. Use multiple-use platforms
4. Consider tactics for mass customization
5. Look for continual improvement
6. Shorten time to market

Shorten Time to Market
1. Use standardized components
2. Use technology
3. Use concurrent engineering
Additional PowerPoint slides contributed by Geoff Willis, University of Central Oklahoma.

### Product Life Cycle

- Introduction
- Growth
- Maturity
- Decline

### Product Development

- Dis-integrated design processes
- Standardization
- Modular design
- R&D versus benchmarking

![Graph showing the product development process with stages: Proposed, Prototype, Mkt. Test, Produced.](image)
### Actors & the Arena

<table>
<thead>
<tr>
<th>Physical Evidence</th>
<th>Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onstage Service</td>
<td>Line of Interaction</td>
</tr>
<tr>
<td>Backstage Service</td>
<td>Line of Visibility</td>
</tr>
<tr>
<td>Support</td>
<td></td>
</tr>
</tbody>
</table>

### Quality Function Deployment

A structured and disciplined process that provides a means to identify and carry the voice of the customer through each stage of product or service development and implementation.

QFD is:
- Communication
- Documentation
- Analysis
- Prioritization $\rightarrow$ breakthroughs

### Japanese QFD Results

- Design time reduced by $\frac{1}{4}$ to $\frac{1}{2}$
- Problems with initial quality decreased
- Comparison and analysis of competitive products became possible
- Communication between divisions improved