Design of Products/Services

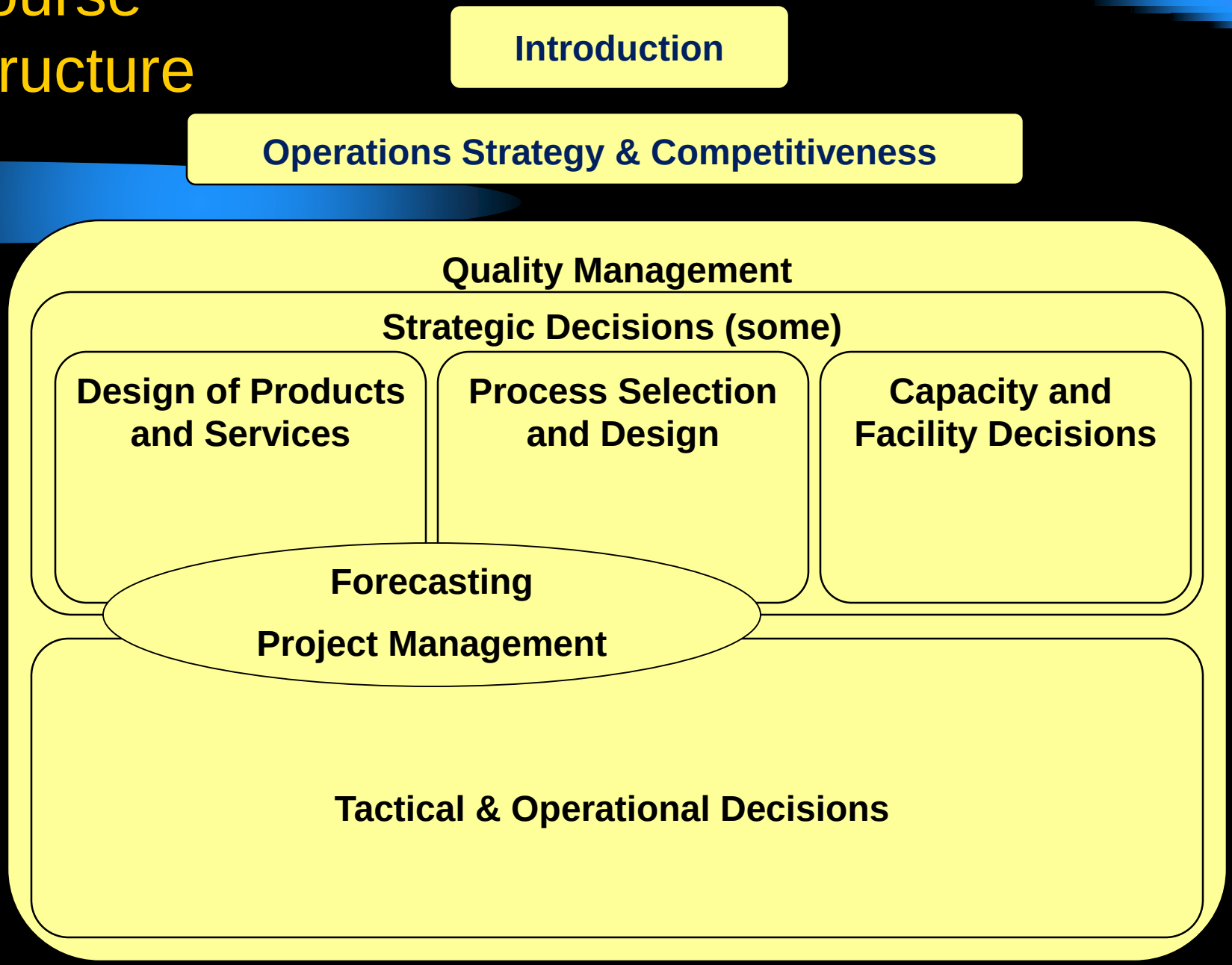
Module 3

July 14, 2014

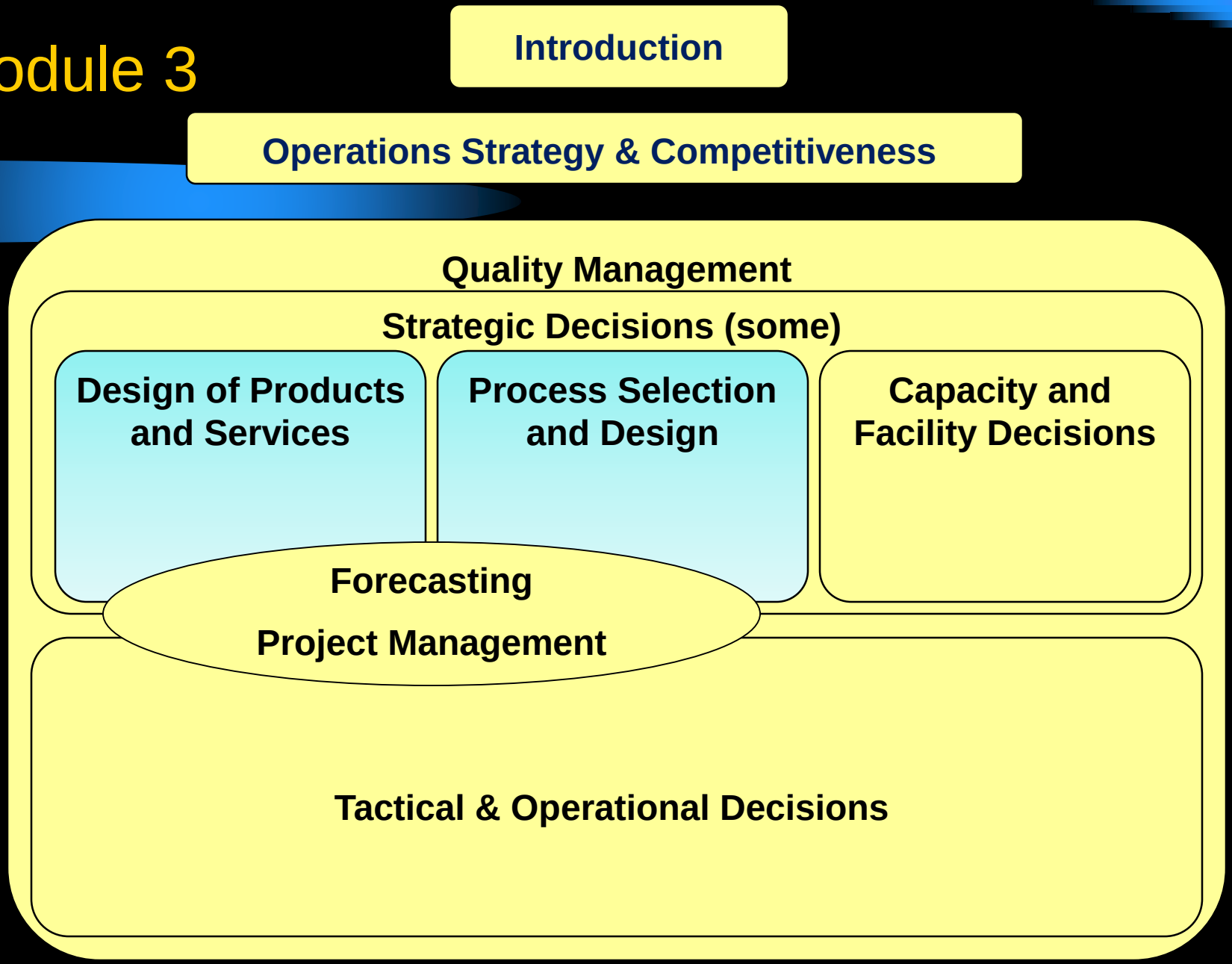
Learning Objectives

- Origin of ideas for new products/services
- Components of new products/services design
- Role of reliability
- Differences in design

Course Structure



Module 3


Introduction
Operations Strategy & Competitiveness
Quality Management
Strategic Decisions (some)
Design of Products and Services
Process Selection and Design
Capacity and Facility Decisions
Forecasting
Project Management
Tactical & Operational Decisions

The first rule of business:

"You have to have products that sell"

Product Design is a *Business Issue*

Why Firms Develop New Products

1. Competitive Advantage
2. Market Share Gain
3. Higher Profitability
4. Enhancement of Brand
5. Faster Competitive Response
6. Improved Operating Cost & Resource Utilization

Competitive Advantage

- Firms innovate and develop new products for unique opportunities for competitive advantages.

- Example: The iPod was instrumental in the survival and emergence of a *stronger* and more *competitive* Apple Inc., resulting in market share gain and higher profitability.

Market Share Gain

- New products introduced in the marketplace provide additional “first mover advantages” to the company.
- By developing new products, a company can quickly capture a big share of the market before competitive products are introduced.
- Example: Toyota’s successful introduction of the Prius hybrid car prior to its competitors’ development of such a car has allowed the company to establish a dominant position in the emerging market segment of fuel-efficient and environmentally friendly automobiles.
- Who else is in this ‘green’ automotive marketplace?

Higher Profitability

- During the early stages, a new product faces less competition than a product in a mature market; therefore, its profitability tends to be higher.
- As the market becomes saturated with several competitive products, prices start falling, and profit margins decrease.

Enhancement of Corporate Image and Brand Name

- The developments of innovative and creative new products is a very powerful source of goodwill and creates a positive corporate image.
- Brand equity measures used in marketing show that firms with more successful new product development efforts command higher respect from customers and profitability.
  - **brand equity**: the monetary or relative value of a brand perceived in the marketplace by its customers.

Faster Competitive Response

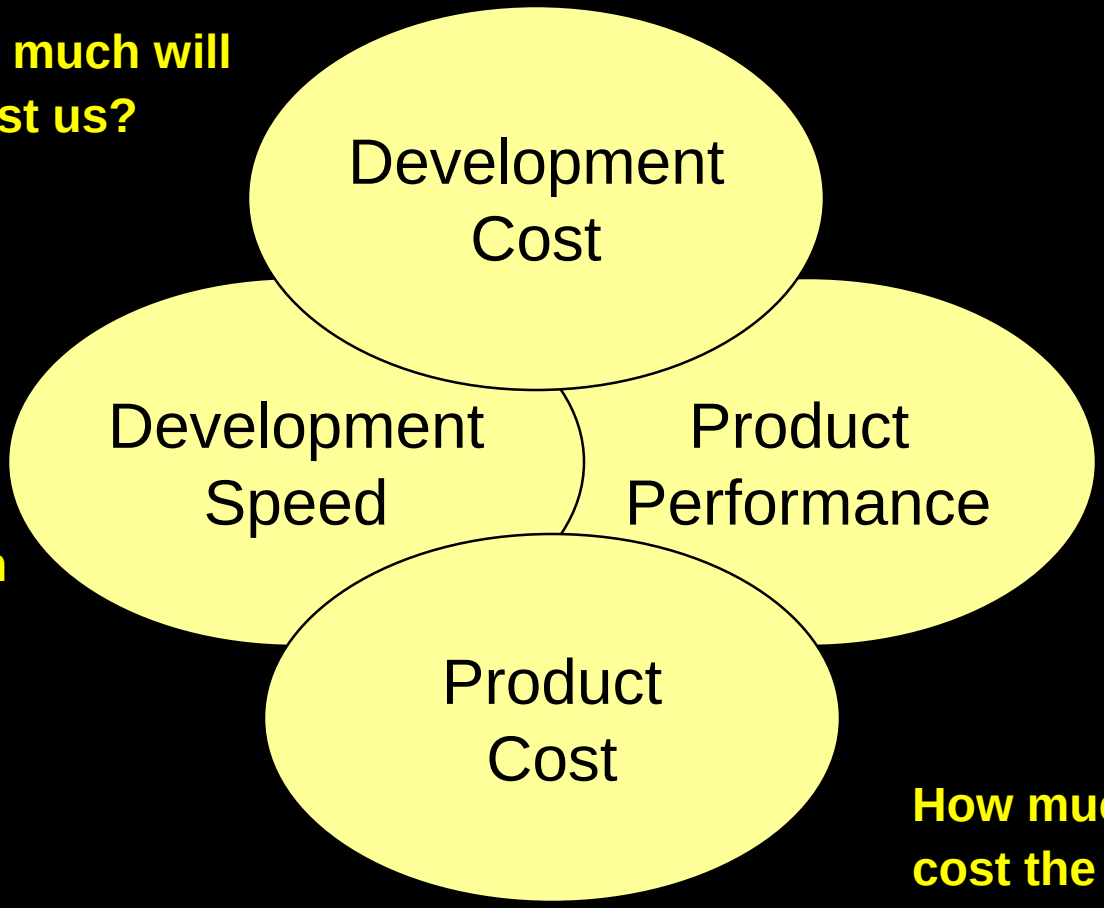
- Having a systematic process for new product development in place can introduce new products quickly after a competitor's product is launched.
- Sony's Playstation, Microsoft's X-Box, and Nintendo's Wii compete fiercely in the video game industry. Each company tries to quickly introduce new products to compete with others.

Operating Cost and Capacity Utilization

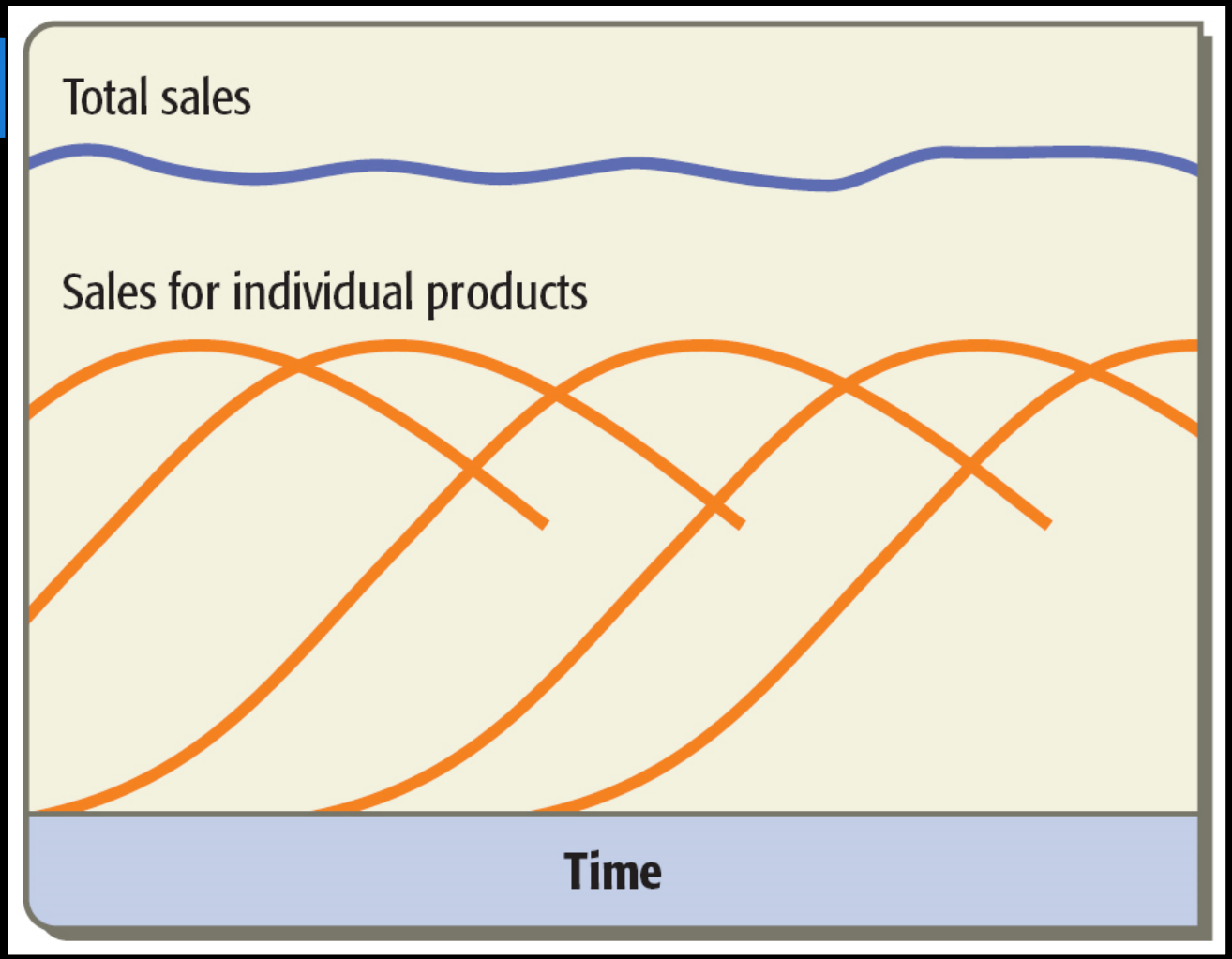
- The product development effort is often closely linked with process development.
- New products provide the opportunity for enhanced sales as the demand for older products decreases over time.

Source: © Image Source/Corbis

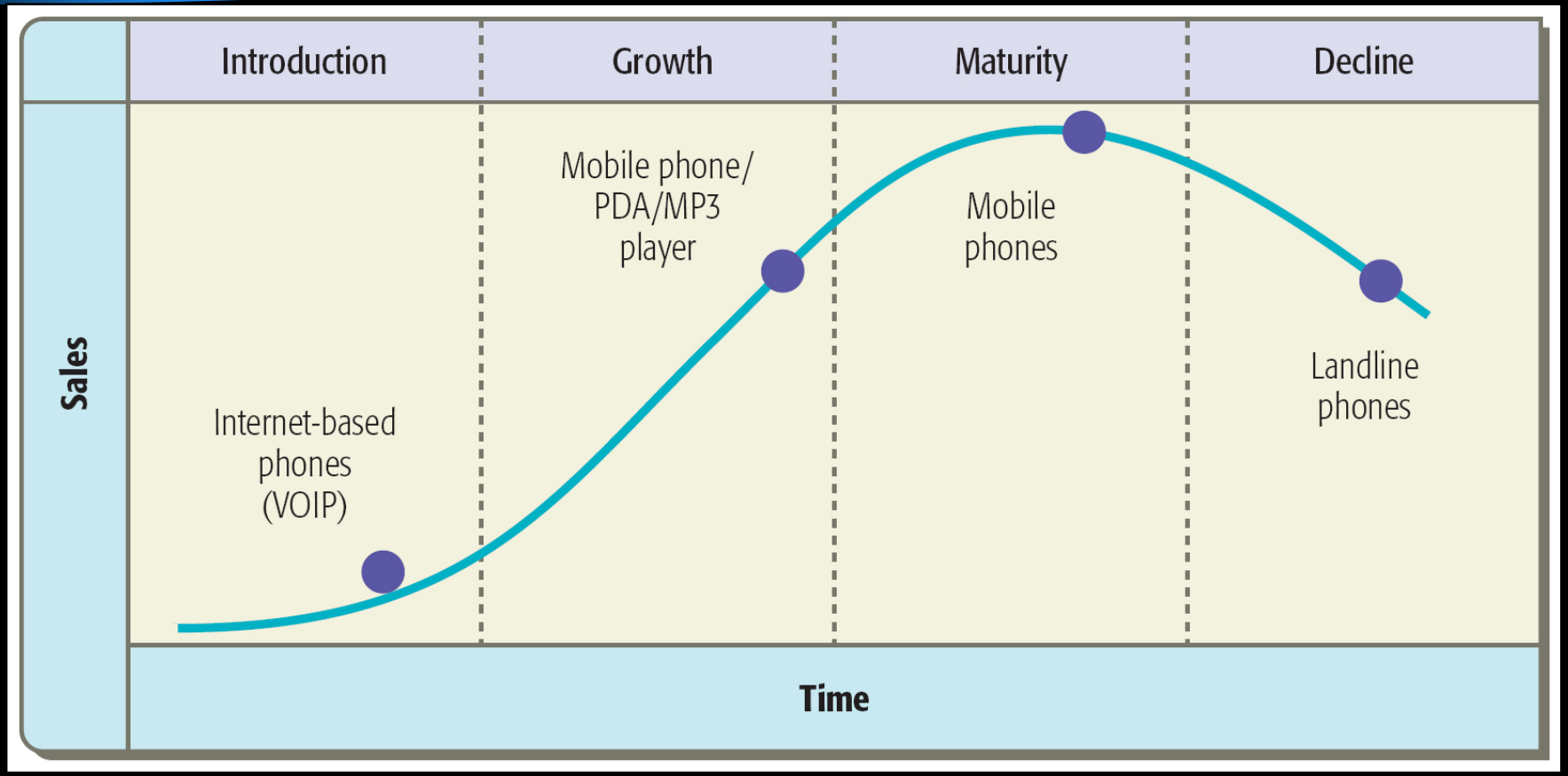
Product Development Tradeoffs



Multiple Product Life Cycles



Single Item (Industry) Product Life Cycle



Radical and Disruptive Innovation

- **Radical Innovation**: a new product, generally containing new technologies, that significantly changes behaviors and consumption patterns in the marketplace
- **Disruptive Innovation**: a new product that is initially introduced at a lower quality level along some established criteria but a much superior quality level along a new dimension

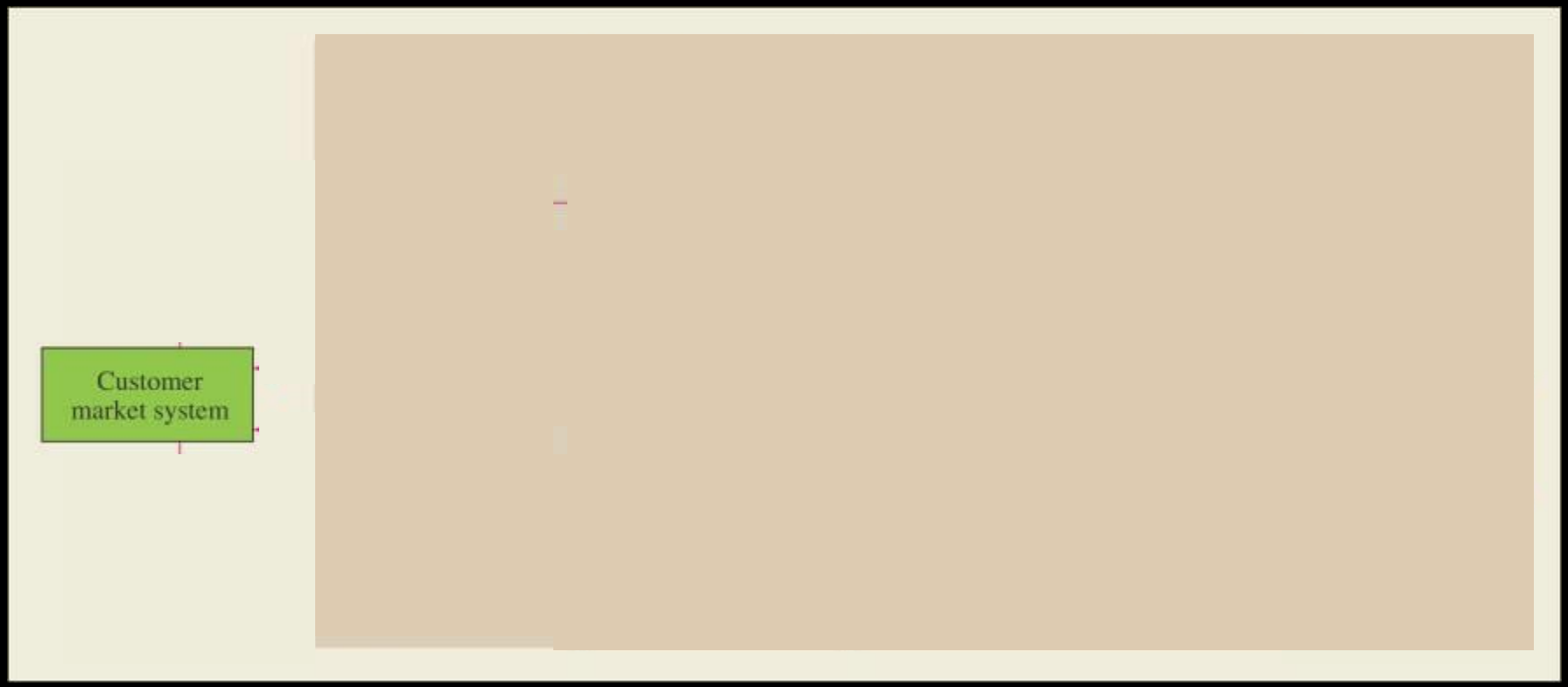
Examples of Disruptive New Products

TABLE 3.1 Some Examples of Disruptive New Products

Industry	Existing Product	Disruptive Product
Transportation	Horse-driven carriages	Automobiles based on gasoline-powered engines
Transportation	Automobiles based on gasoline-powered engines	Automobiles based on hybrid (gasoline + electric battery) engines
Computers	Mainframe computers	Laptop computers
Computers	Laptop computers	Palm-top computers
Retailing	Shopping center	Internet retailer
Hotels	Large convention and standard hotels	Boutique hotels
Restaurants	Traditional quick-service (or fast-food) establishments	Gourmet, organic, and health food–based restaurants
Communication	Landline phones	Mobile phones
Communication	Mobile phones	Internet-based phones (VoIP)
Photography	Camera using film	Digital cameras
Music	Audio cassettes	Compact disk players
Music	Compact disk players	MP3 players

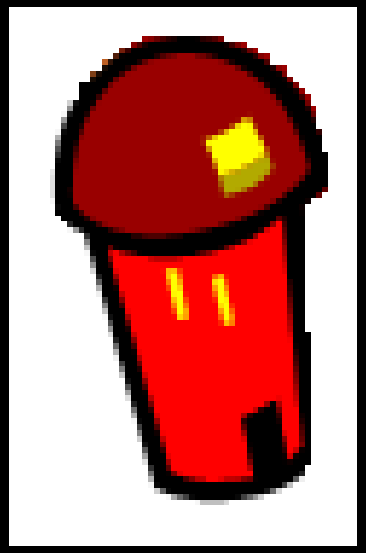
Product/Service Design

- *Major Business Functions Involved*

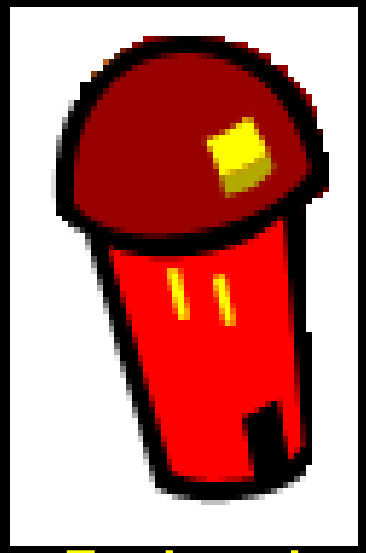


Historically…

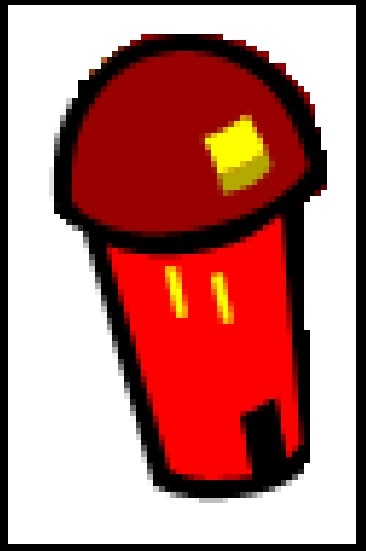
Functional "Silos"



Operations



Engineering

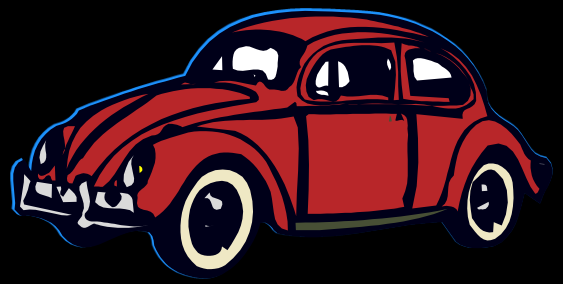


Marketing

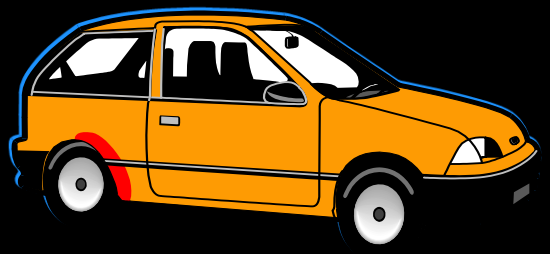
Historically…

As the customer wanted it.

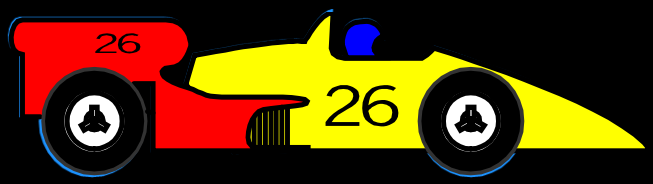
As Marketing interpreted it.



As Operations made it.



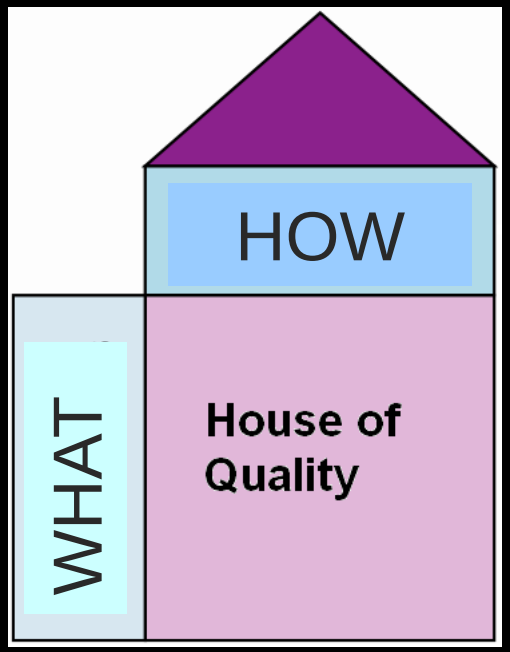
As Engineering designed it.



Quality Function Deployment

- House of quality
  - **Helps the cross functional team to focus on building a product that satisfies customers**
  - **Graphical technique to relate customer needs (WHATs)**

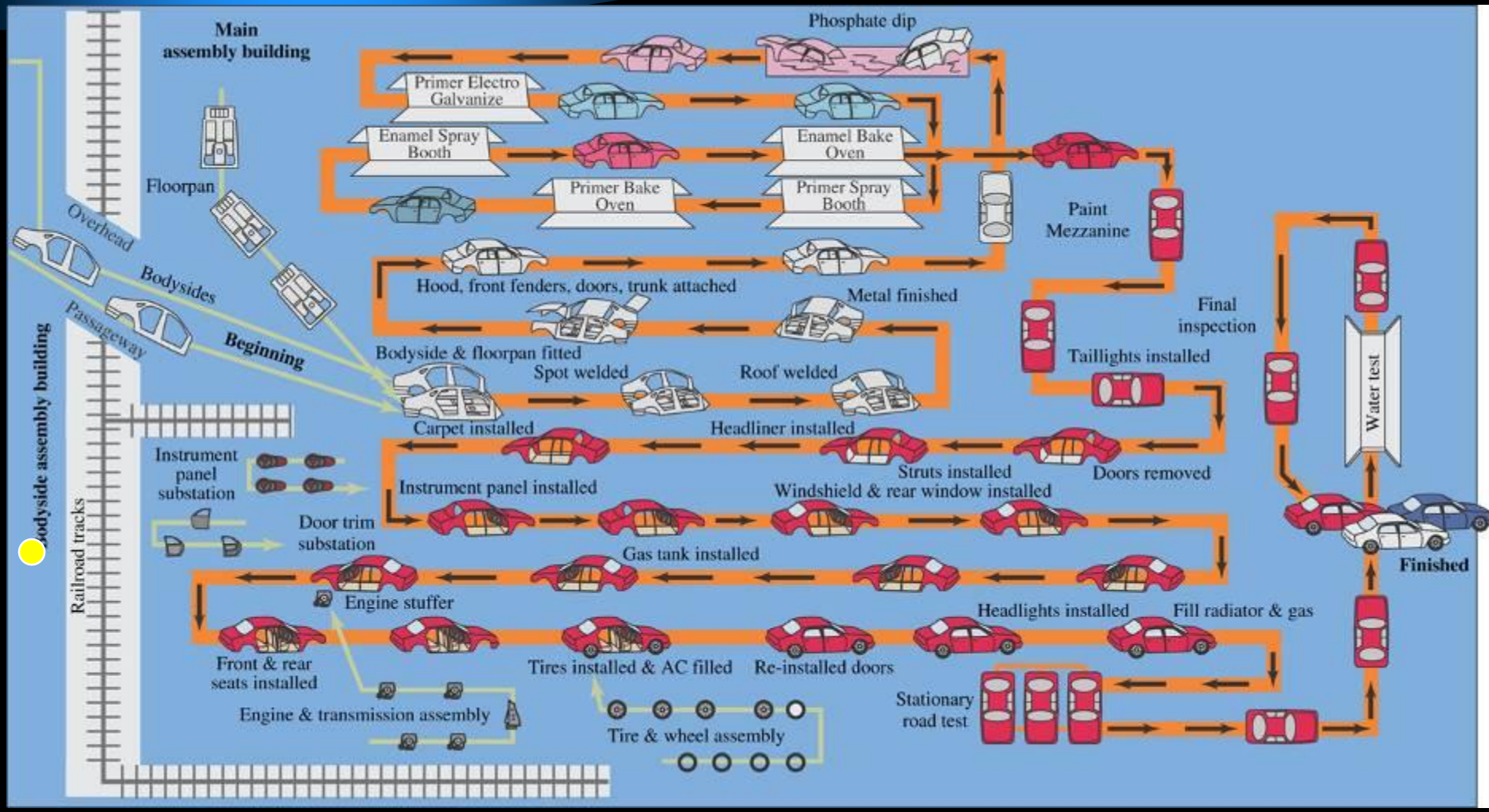
    to product design characteristics (HOWs)



Process Choice

- Selection of inputs, operations, workflows, and methods for producing goods and services

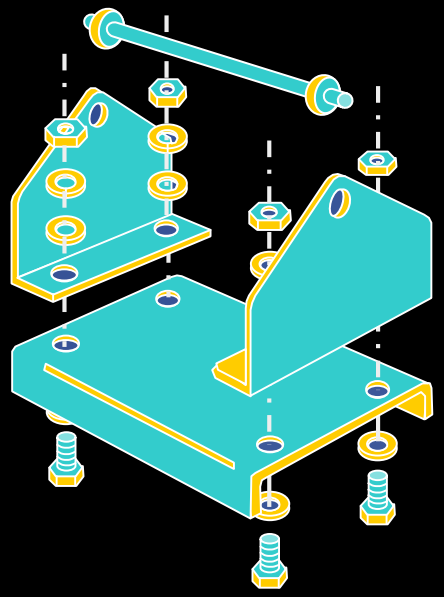
Process Example 1: How to Make a Car



Process Example 2: How to Make a Burger

Elements of Product Design: Design Simplification

(a) The original design

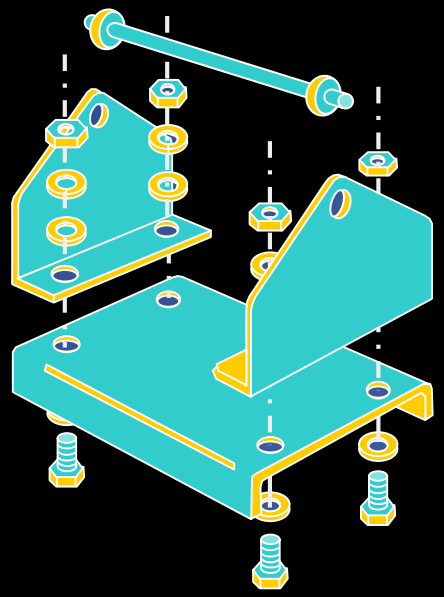


Assembly using common fasteners

Figure 3.3

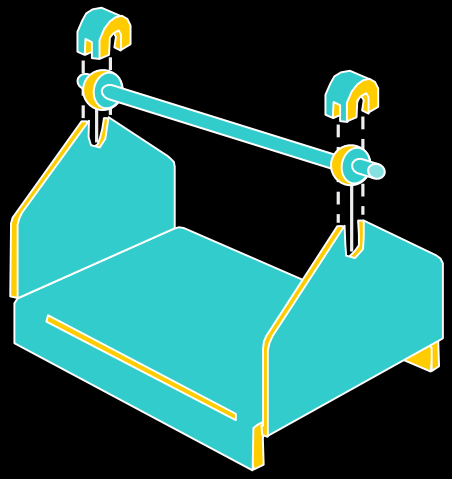
Design Simplification

(a) The original design



Assembly using common fasteners

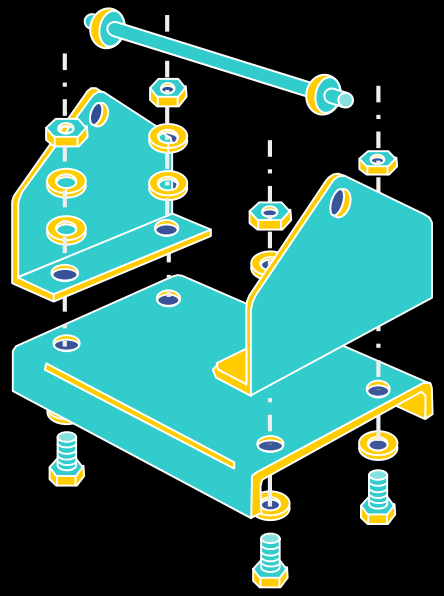
(b) Revised design



One-piece base & elimination of fasteners

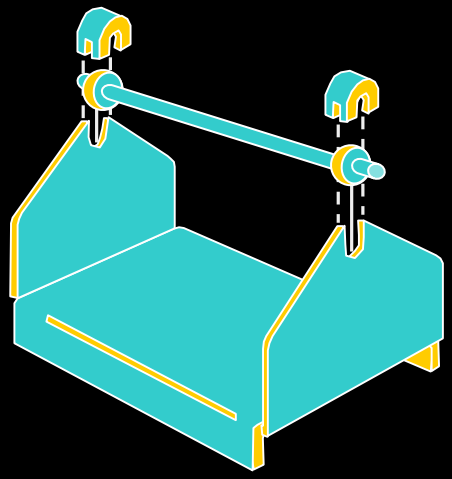
Design Simplification

(a) The original design



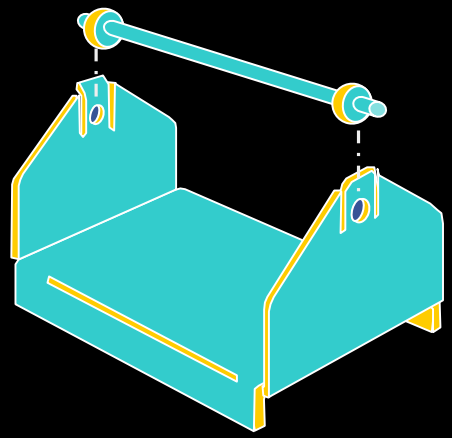
Assembly using common fasteners

(b) Revised design



One-piece base & elimination of fasteners

(c) Final design



Design for push-and-snap assembly

Standardizing
parts among different products at Ford

Product	# before	# after	Savings/veh
Air filters	18	5	$0.45
Carpet	9	3	$1.25
Trunk carpet	7	1	$1.16

Annual savings = $3M + $9M + $5M

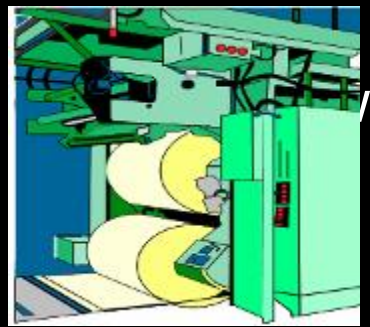
= $17M

Process Types

- Project
- Batch Production (job shop)
- Mass Production (assembly line)
- Continuous Production

Process Types

- **Project**
  - HI variety of products, low volume, flow not unique
- **Batch Production (job shop)**
  - Wide variety of products, med volume, jumbled flow
- **Mass Production (assembly line)**
  - Low variety of products, High volume, dominant flow
- **Continuous Production**
  - Commodity product, HIGHEST volume,



Process Type - Characteristics

	Project /Batch	Assembly /Continuous
Volume/Variety:	Low/high	High/low
Capacity Measured:	Inputs	Outputs
Competition:	Non-cost	Cost
Process Stages:	Separate	Linked
Equipment:	General	Specialized
Work In Process:	High	Low
Size:	Small	Large
Flexibility:	Very	Not at all
Labor Content:	High	Low

The Product-Process Matrix

Make to order vs.
Make to stock vs.
Assemble to order

Make to Order | Assemble to Order | Make to Stock

Process Focus vs. Product Focus

	Low Volume One of a Kind	**Low Volume** Multiple Products	**Higher Volume** Few Products	**Hi Volume** High Standard-ization
I. Project	**Making a movie** **German restaurant**			
II. Batch		**Hospital visit** **Coffee Shop**		
III. Assembly Line			**Automobile assembly** **Burger King**	
IV. Continuous Flow				**Sugar refinery**

Flexibility? - High
Unit Cost? - High

Flexibility? (Low)
Unit Cost? (Low)

Where Do New Product Ideas Come From?

Traditional sources:

- customer surveys
- analyzing warranty claims, customer complaints
- surveys of suppliers, distributors, and salespersons

Modern Sources – New Products

- Benchmarking
  - comparing product/service against best-in-class
- Reverse engineering
  - dismantling competitor's product to improve your own product
- Early Supplier Involvement (ESI)

Analysis Tools for New Product Development

- Customer Choice Analysis
- Product Reliability Analysis
- Product-Complexity Index
- Quality Function Deployment

Customer Choice Analysis

- **Customer choice analysis**: an experimental approach to identify the relative importance of various product features for customer choices
- **Willingness to pay:** define
- **Desirability:** define

Product Reliability Analysis

An approach for assessing the overall integrity of a product based on the configuration of its components

Product Reliability Analysis

- **Redundancy**: the use of backup components and systems to enhance the reliability of a product
- **Robust design**: a design approach that ensures that small variations in the production process do not adversely affect the quality of the product

Quantifying Reliability

- State Reliability in Terms of Probability
  - Ex: A Product that is 90% Reliable Has a Failure Probability of 1 – 0.9 = 0.1 (10%)
- What If a Product Has Multiple Components That Can Fail?
  - Component A: 90% Reliability
  - Component B: 80% Reliability
  - Under What Conditions Does the Product Fail?
  - If One or Both Components Fail → Product Fails

Quantifying Reliability

- In Other Words → Both Components Must NOT Fail
- Probability of Both Being Reliable is:
  - (0.9)(0.8) = 0.72 (72% Chance of Being Reliable)
  - 1 – 0.72 = 0.28 (28% Chance of Failure)
- Calculate System Reliability By Multiplying Reliabilities of Components

Quantifying Reliability

- What Is the Reliability of the Product Below? (Component Reliabilities Shown)

Reliability = (0.9)(0.95)(0.9) = 0.77 (77%)

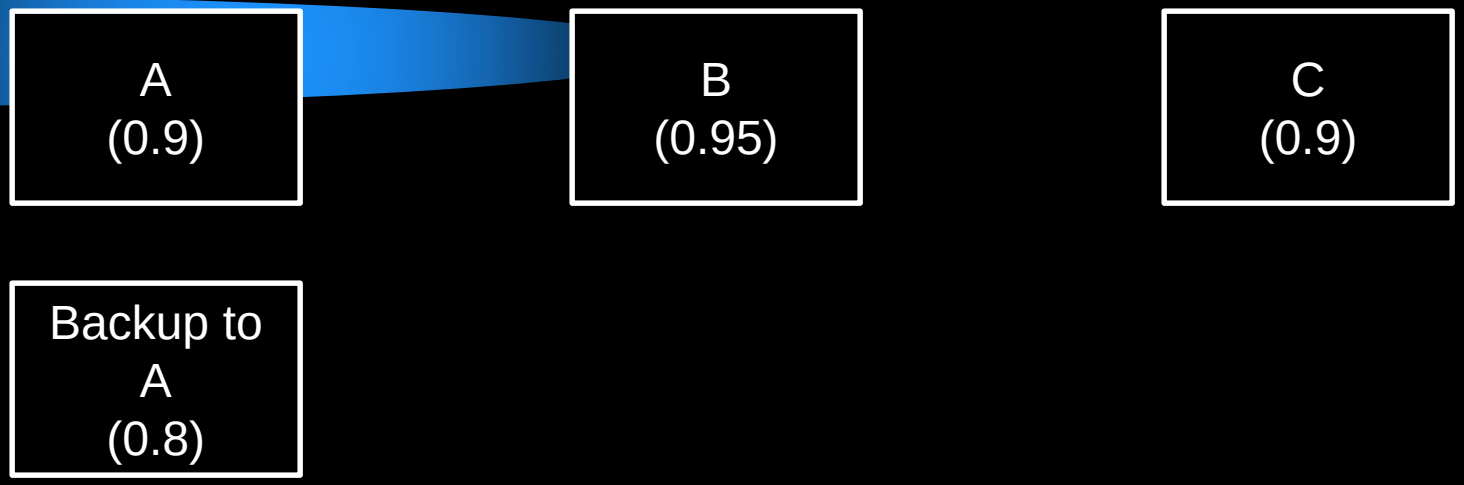
Quantifying Reliability

- How to Improve Reliability?
  - Add Redundancy!

Ex: Add a Backup Component to Component A

Under What Conditions Does This Product Fail?

Quantifying Reliability



Under What Conditions Does This Product Fail??
A & It's Backup Fail OR B Fails OR C Fails

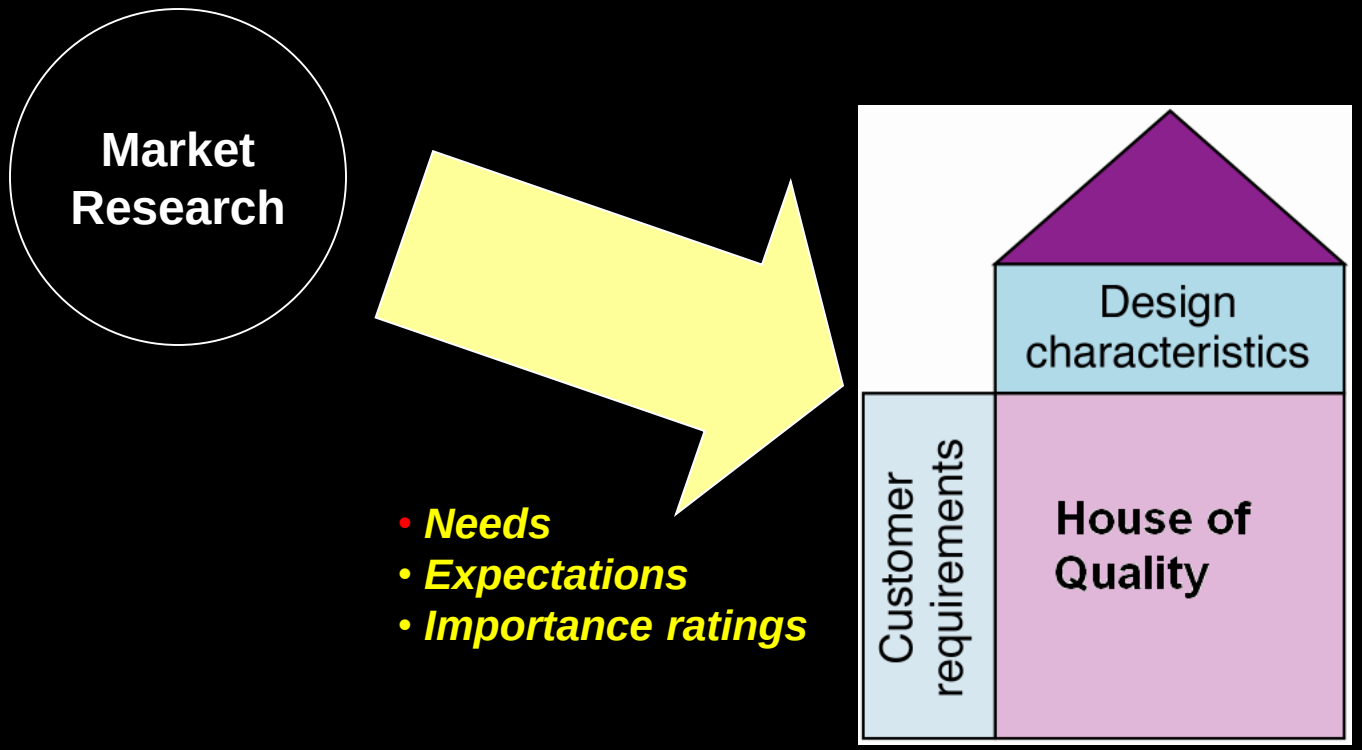
What Is Probability that BOTH A & Backup Fail?
(0.1)(0.2) = (0.02) (2%) (98% Reliable)
Reliability of Product? (0.98)(0.95)(0.9) = 0.84

Quality Function Deployment

A structured approach for systematically integrating customer requirements and quality standards into every aspect of product development from planning to the production floor

Quality Function Deployment

- *Integrates voice of the customer into product design*
- *Involves cross-functional teams*



Quality Function Deployment

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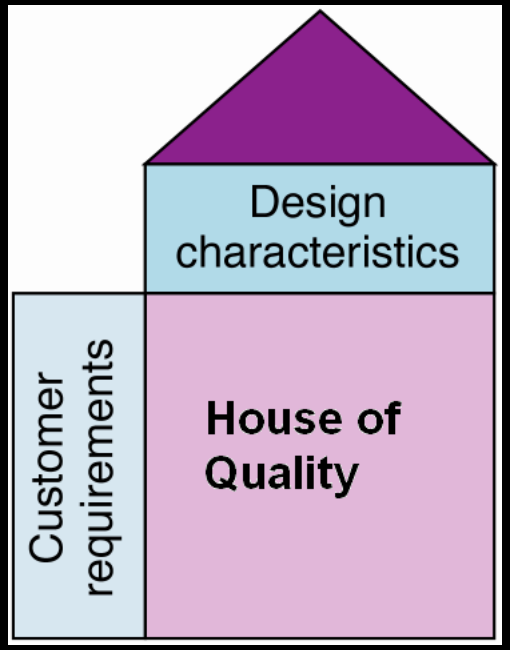


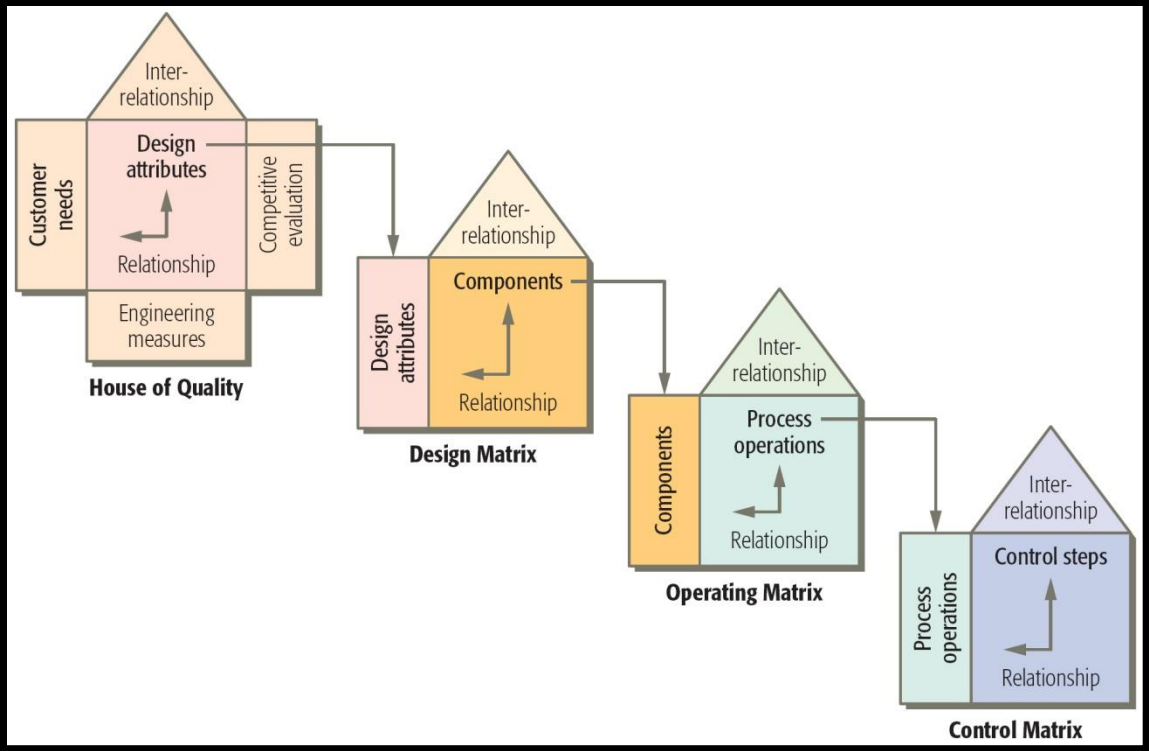
The Quality Function Deployment (QFD) Process

TABLE 3.3 The Quality Function Deployment (QFD) Process

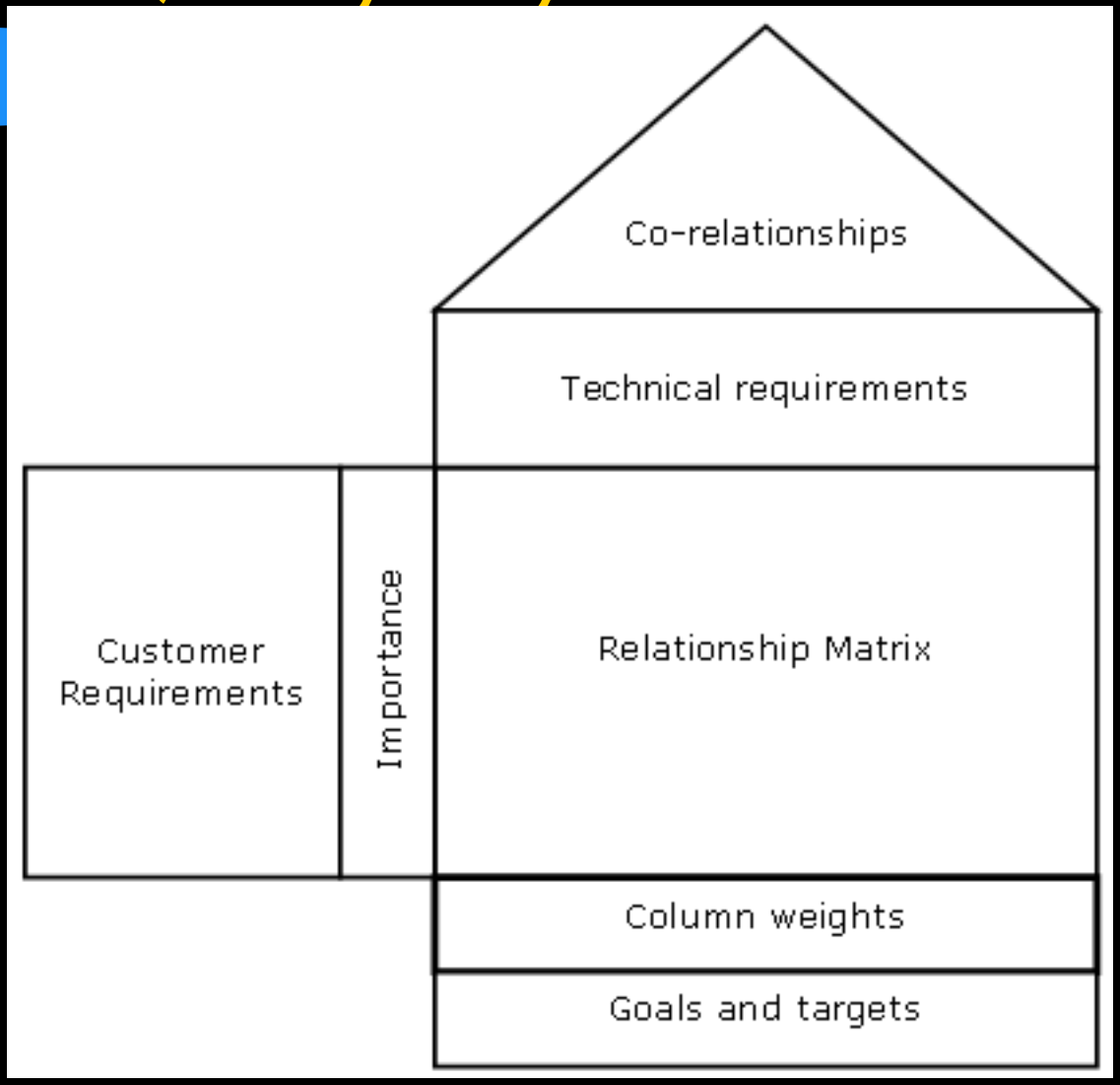
Step 1	Identification of customer needs and preferences
Step 2	Relationship between customer needs and engineering design characteristics
Step 3	Interrelationships among the engineering design characteristics
Step 4	Competitive evaluation of competing products and targets for design attributes
Step 5	Linking engineering design characteristics and component characteristics
Step 6	Linking component characteristics and the process operations
Step 7	Linking the process operations and control parameters
Step 8	Implementation and continuous improvement

The QFD Process

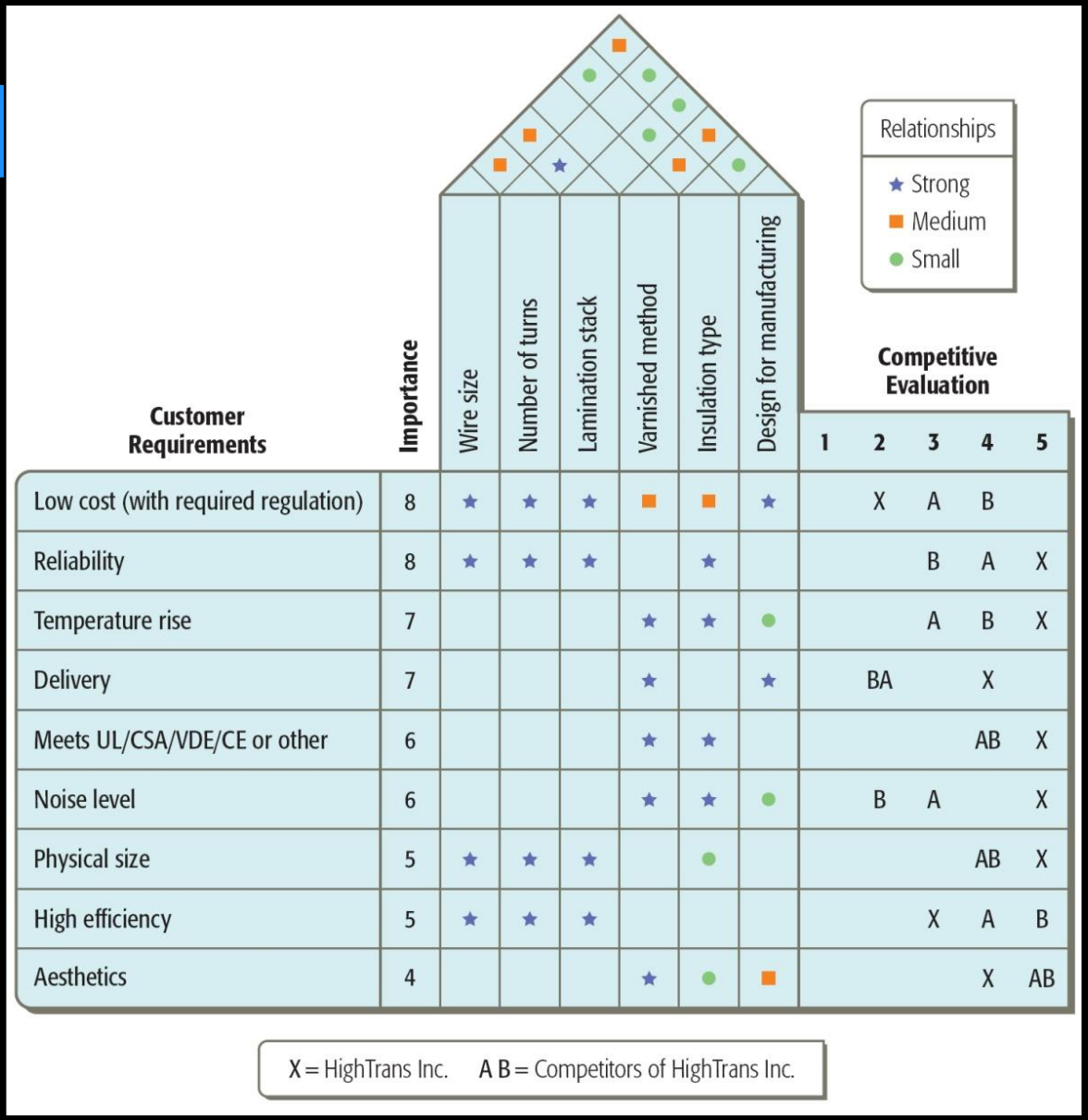
- The first QFD matrix, called the *House of Quality* links the voice of the customer to the product design attributes *(voice of the engineer).*



House of Quality Layout



The House of Quality



Relationships
★ Strong
■ Medium
● Small

Customer Requirements	Importance	Wire size	Number of turns	Lamination stack	Varnished method	Insulation type	Design for manufacturing	Competitive Evaluation 1	2	3	4	5
Low cost (with required regulation)	8	★	★	★	■	■	★		X	A	B	
Reliability	8	★	★	★		★				B	A	X
Temperature rise	7				★	★	●			A	B	X
Delivery	7				★		★		BA		X	
Meets UL/CSA/VDE/CE or other	6				★	★					AB	X
Noise level	6				★	★	●		B	A		X
Physical size	5	★	★	★		●					AB	X
High efficiency	5	★	★	★						X	A	B
Aesthetics	4				★	●	■				X	AB

X = HighTrans Inc. A B = Competitors of HighTrans Inc.

Summary

- Why is it important to develop new products?
- Radical versus disruptive innovation?
- What are the various process types and where is each best?
- What are sources of new products?
- Who do you quantify reliability?
- Quality deployment function?