Design of Goods and Services

5

PowerPoint presentation to accompany
Heizer, Render, Munson
Operations Management, Twelfth Edition, Global Edition
Principles of Operations Management, Tenth Edition, Global Edition

PowerPoint slides by Jeff Heyl

Outline

- Global Company Profile: Regal Marine
- Goods and Services Selection
- Generating New Products
- Product Development
- Issues for Product Design
- Product Development Continuum

Outline - Continued

- Defining a Product
- Documents for Production
- Service Design
- Application of Decision Trees to Product Design
- Transition to Production

Regal Marine

- Global market
- 3-dimensional CAD system
  - Reduced product development time
  - Reduced problems with tooling
  - Reduced problems in production
- Assembly line production
- JIT

Learning Objectives

When you complete this chapter you should be able to :

5.1 ***Define*** product life cycle

5.2 ***Describe*** a product development system

5.3 ***Build*** a house of quality

5.4 ***Explain*** how time-based competition is implemented by OM

Learning Objectives

When you complete this chapter you should be able to :

- **5.5** ***Describe*** how goods and services are defined by OM
- **5.6** ***Describe*** the documents needed for production
- **5.7** ***Explain*** how the customer participates in the design and delivery of services
- **5.8** ***Apply*** decision trees to product issues

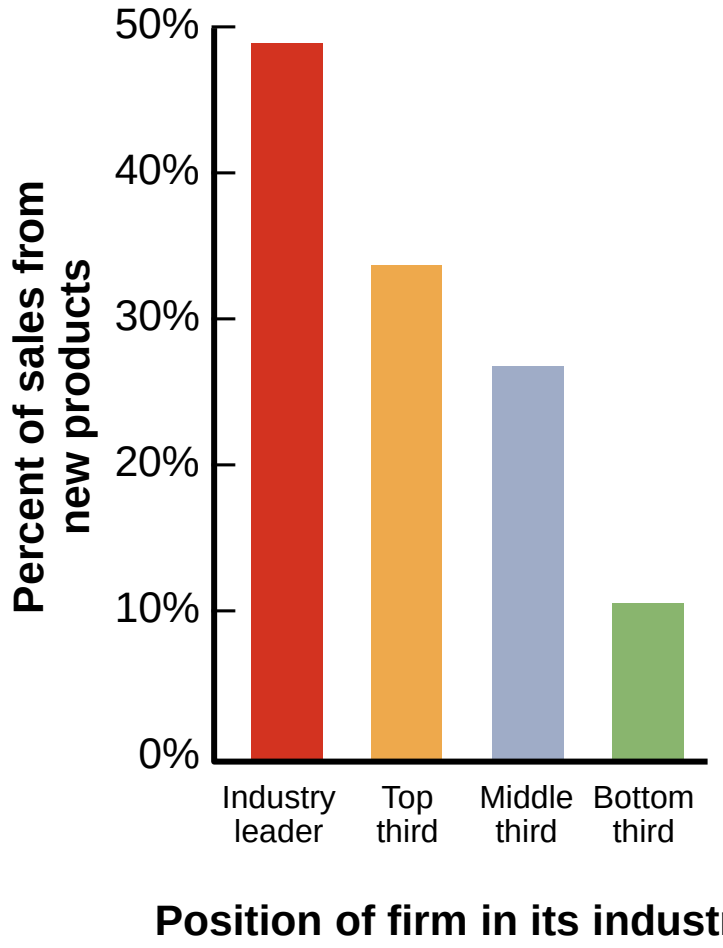
Goods and Services Selection

- Organizations exist to provide goods or services to society
- Great products are the key to success
- Top organizations typically focus on core products
- Customers buy satisfaction, not just a physical good or particular service
- Fundamental to an organization's strategy with implications throughout the operations function

Goods and Services Selection

- Limited and predicable life cycles requires constantly looking for, designing, and developing new products
- Utilize strong communication among customer, product, processes, and suppliers
- New products generate substantial revenue

Goods and Services Selection



The higher the percentage of sales from the last 5 years, the more likely the firm is to be a leader.

Figure 5.1

Product Decision

The objective of the* product decision *is to develop and implement a product strategy that meets the demands of the marketplace with a competitive advantage

Product Strategy Options

- Differentiation
  - Shouldice Hospital
- Low cost
  - Taco Bell
- Rapid response
  - Toyota

Product Life Cycles

- May be any length from a few days to decades
- The operations function must be able to introduce new products successfully

Product Life Cycle

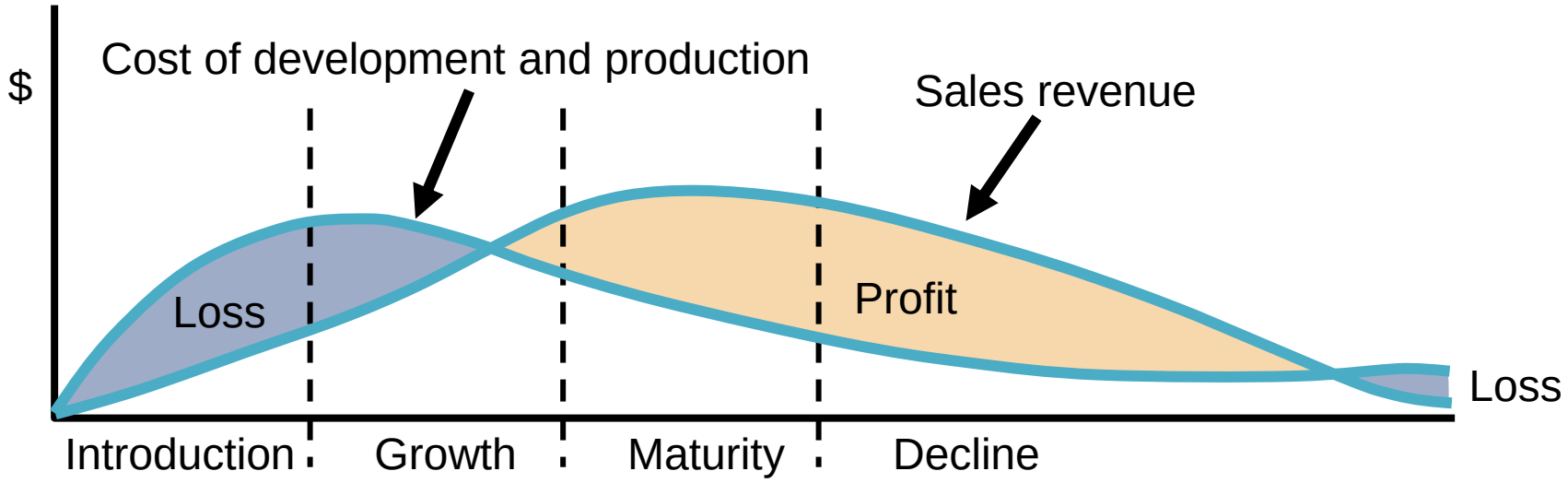


Figure 5.2

Life Cycle and Strategy

Introductory Phase

- Fine tuning may warrant unusual expenses for
  1) Research
  2) Product development
  3) Process modification and enhancement
  4) Supplier development

Product Life Cycle

Growth Phase

- Product design begins to stabilize
- Effective forecasting of capacity becomes necessary
- Adding or enhancing capacity may be necessary

Product Life Cycle

Maturity Phase

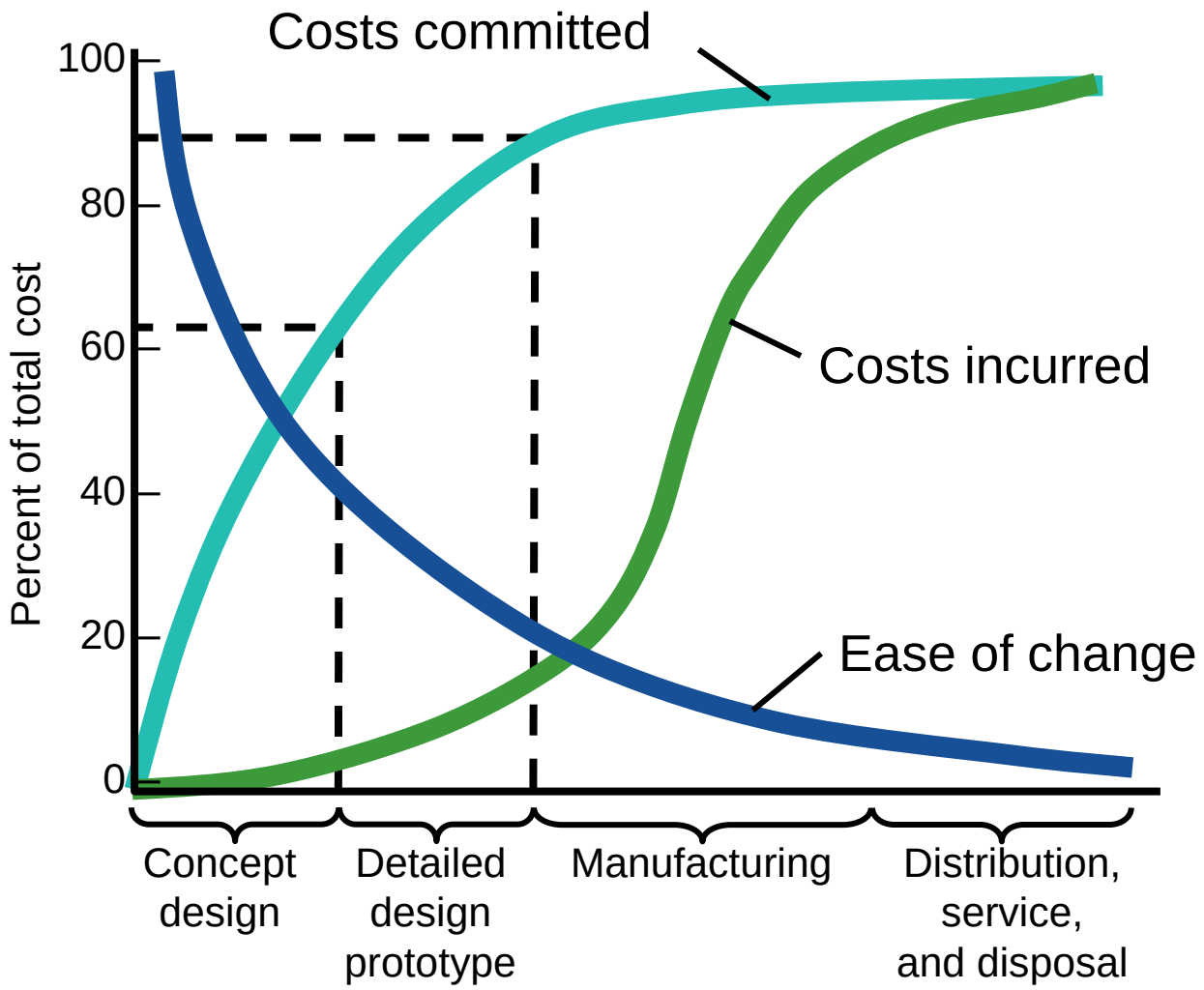
- Competitors now established
- High volume, innovative production may be needed
- Improved cost control, reduction in options, paring down of product line

Product Life Cycle

Decline Phase

- Unless product makes a special contribution to the organization, must plan to terminate offering

Product Life Cycle Costs



Product-by-Value Analysis

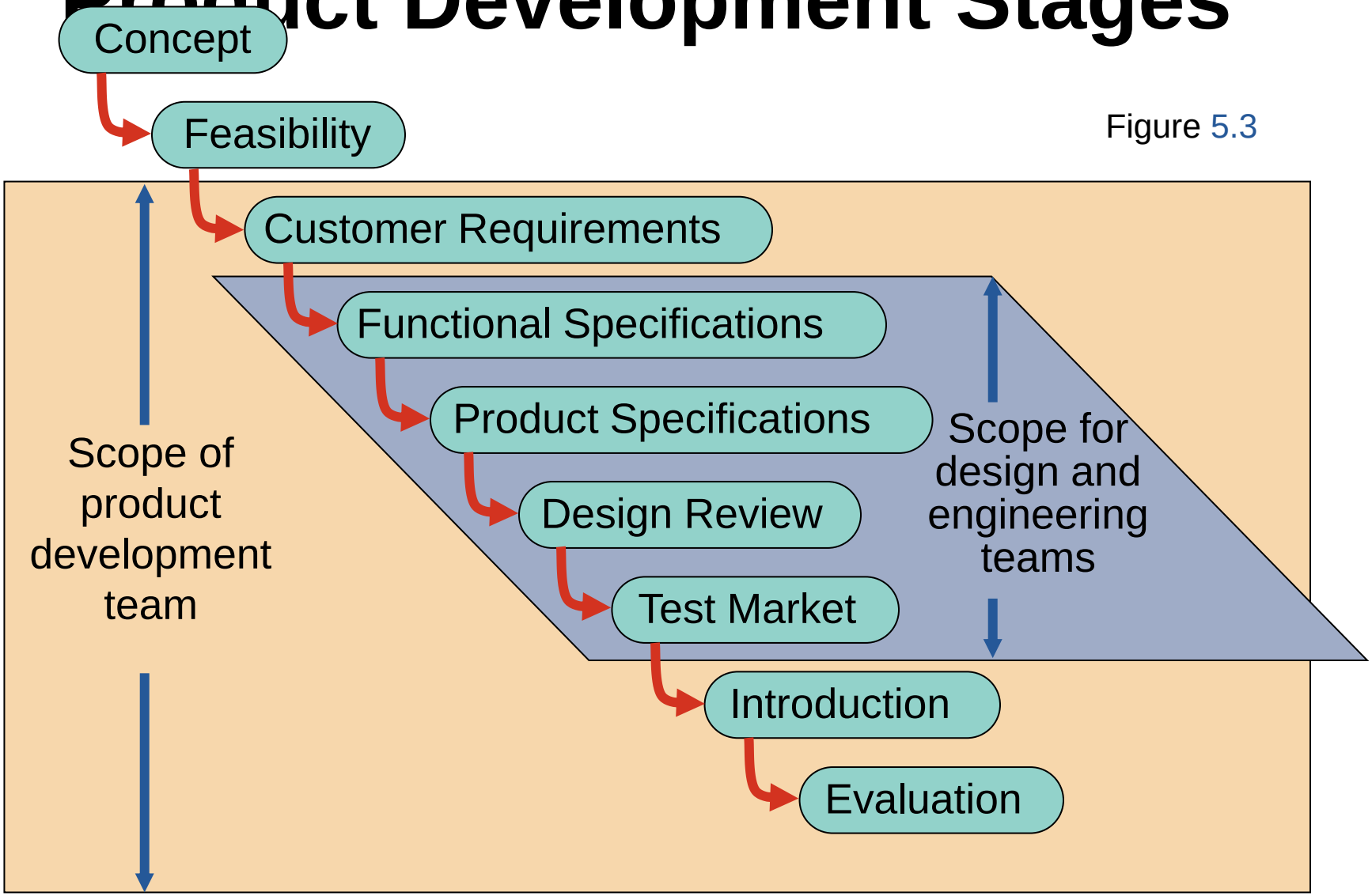
- Lists products in descending order of their individual dollar contribution to the firm
- Lists the total annual dollar contribution of the product
- Helps management evaluate alternative strategies

Generating New Products

1. Understanding the customer
2. Economic change
3. Sociological and demographic change
4. Technological change
5. Political and legal change
6. Market practice, professional standards, suppliers, distributors

Product Development Stages

Figure 5.3



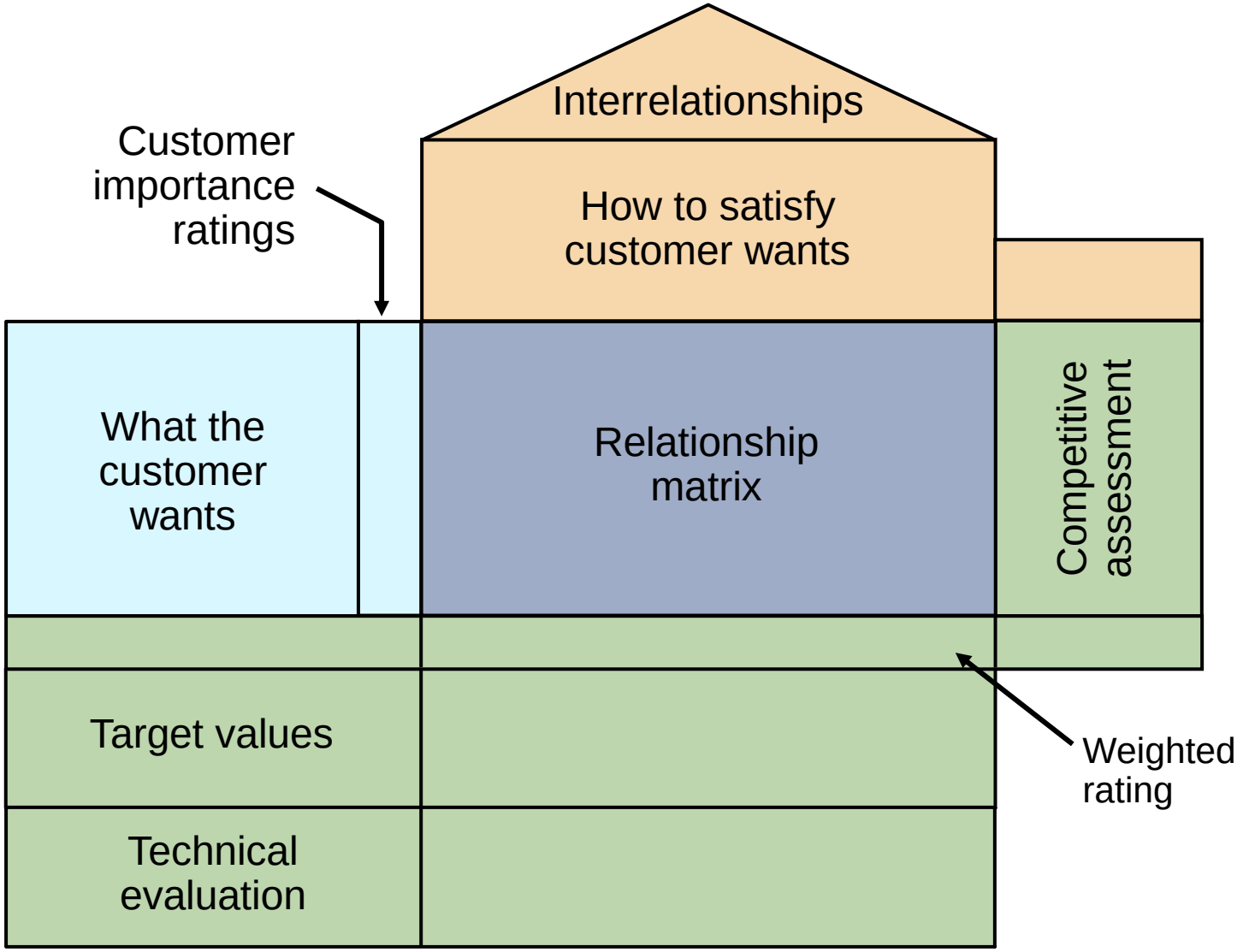
Quality Function Deployment

- **Quality function deployment (QFD)**
  - Determine what will satisfy the customer
  - Translate those customer desires into the target design
- **House of quality**
  - Utilize a planning matrix to relate customer *wants* to *how* the firm is going to meet those *wants*

Quality Function Deployment

1. Identify customer *wants*
2. Identify *how* the good/service will satisfy customer wants
3. Relate customer wants to product *hows*
4. Identify relationships between the firm's *hows*
5. Develop *our* importance ratings
6. Evaluate competing products
7. Compare performance to desirable technical attributes

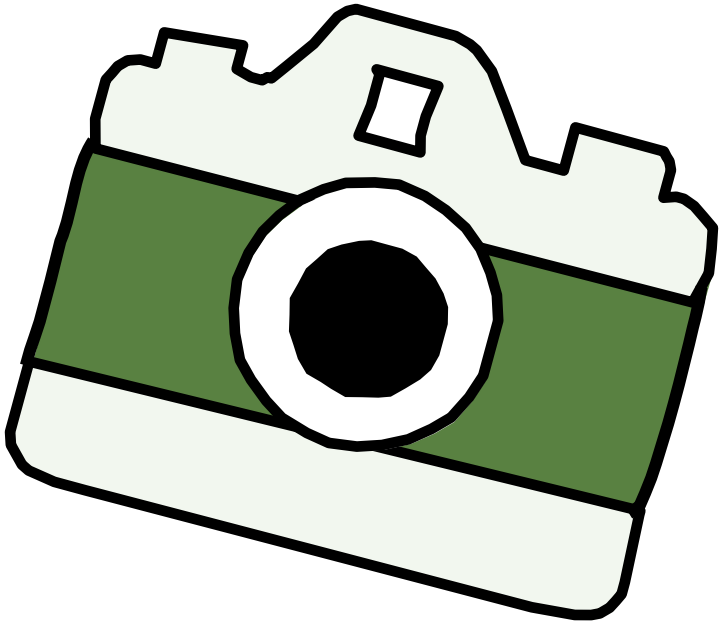
QFD House of Quality



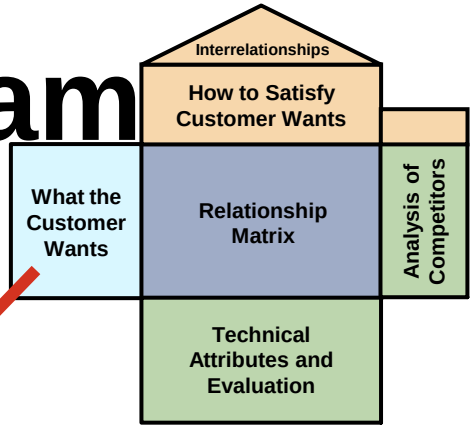
House of Quality Example

Your team has been charged with designing a new camera for Great Cameras, Inc.

The first action is to construct a House of Quality



House of Quality Exam

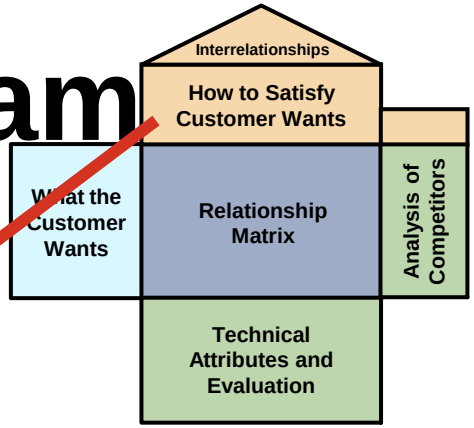


What the customer wants

Customer importance rating (5 = highest)

Lightweight	3
Easy to use	4
Reliable	5
Easy to hold steady	2
High resolution	1

House of Quality Exam



Low electricity requirements

Aluminum components

Auto focus

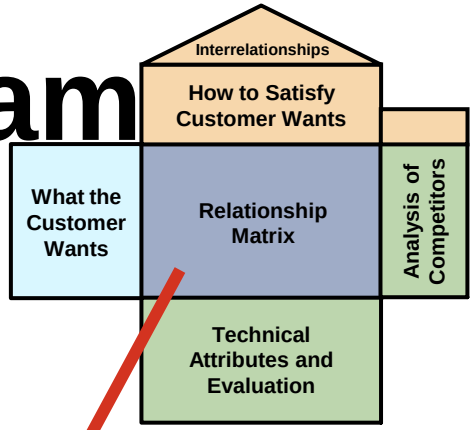
Auto exposure

High number of pixels

Ergonomic design

How to Satisfy Customer Wants

House of Quality Exam

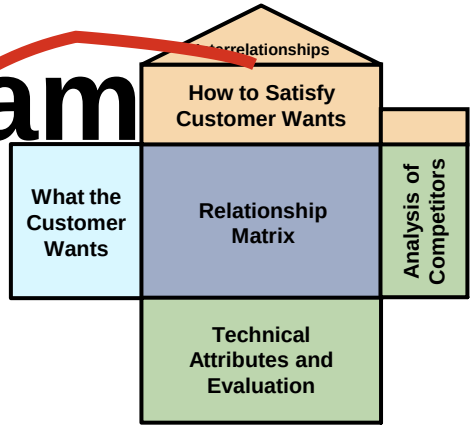


- High relationship
- Medium relationship
- Low relationship

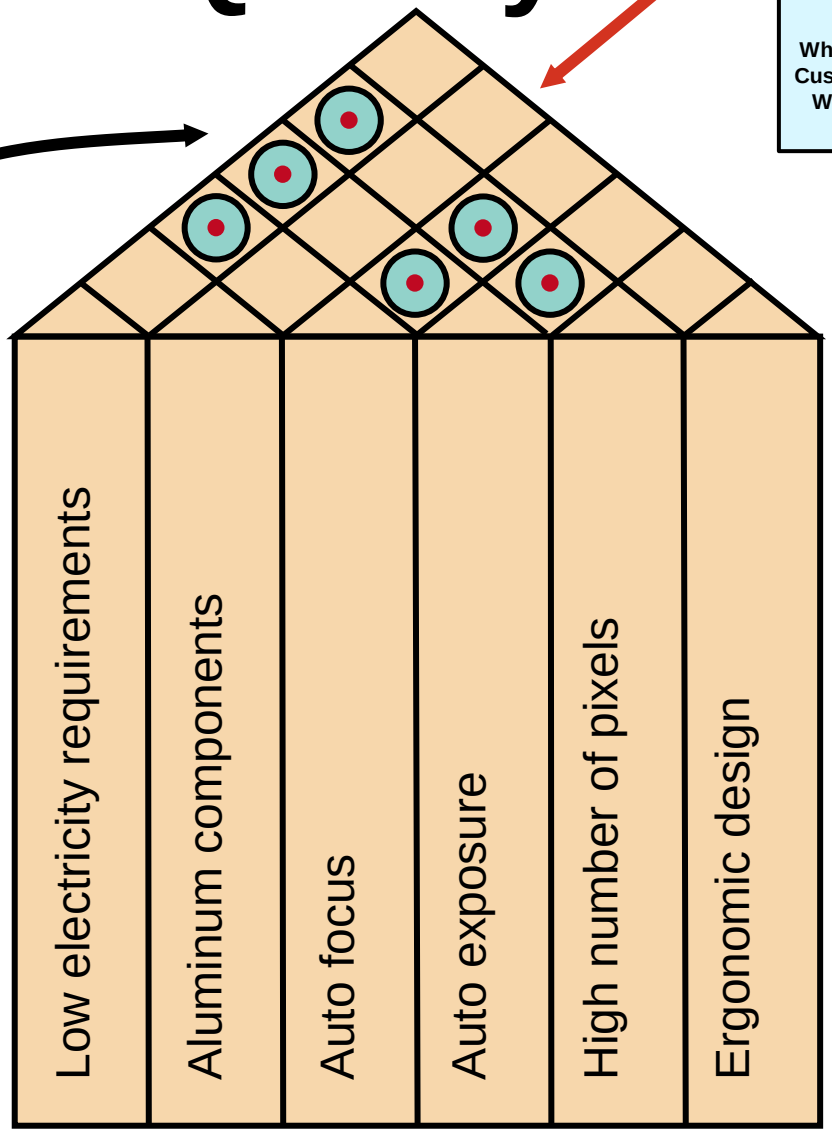
Lightweight	3	•	○				•
Easy to use	4	•		○	○	○	○
Reliable	5	○		○	○	○	
Easy to hold steady	2						◎
High resolution	1					◎	

Relationship matrix

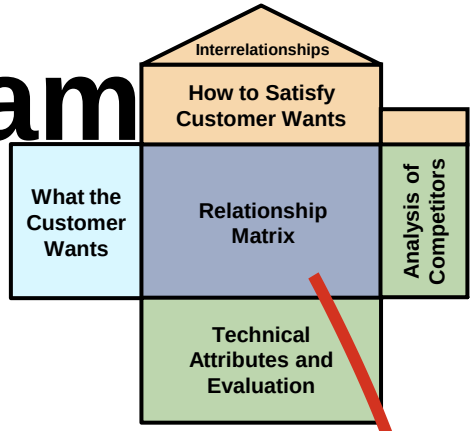
House of Quality Exam



Relationships between the things we can do



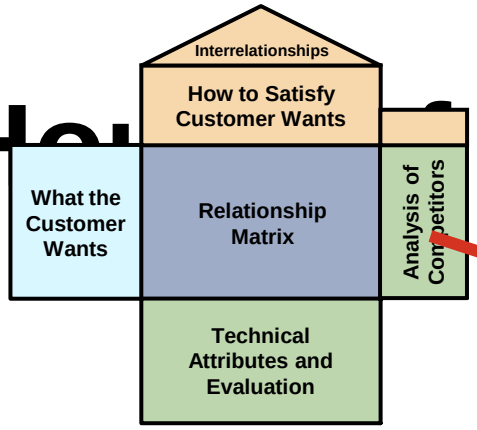
House of Quality Exam



Lightweight	3	●	○				●
Easy to use	4	●		○	○	○	○
Reliable	5	○		○	○	○	
Easy to hold steady	2						◎
High resolution	1					◎	
Our importance ratings		22	9	27	27	32	25

Weighted rating

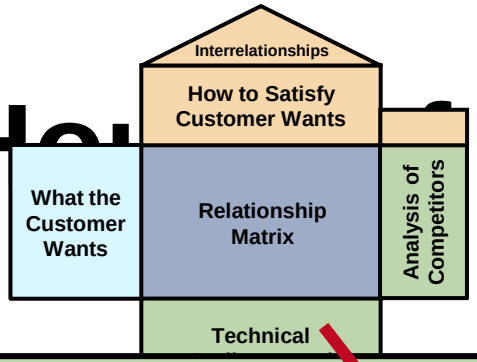
House of Quality Example



How well do competing products meet customer wants

				Company A	Company B
Lightweight	3	●	●	G	P
Easy to use	4	●	○	G	P
Reliable	5	○		F	G
Easy to hold steady	2			G	P
High resolution	1			P	P
Our importance ratings		22	5		

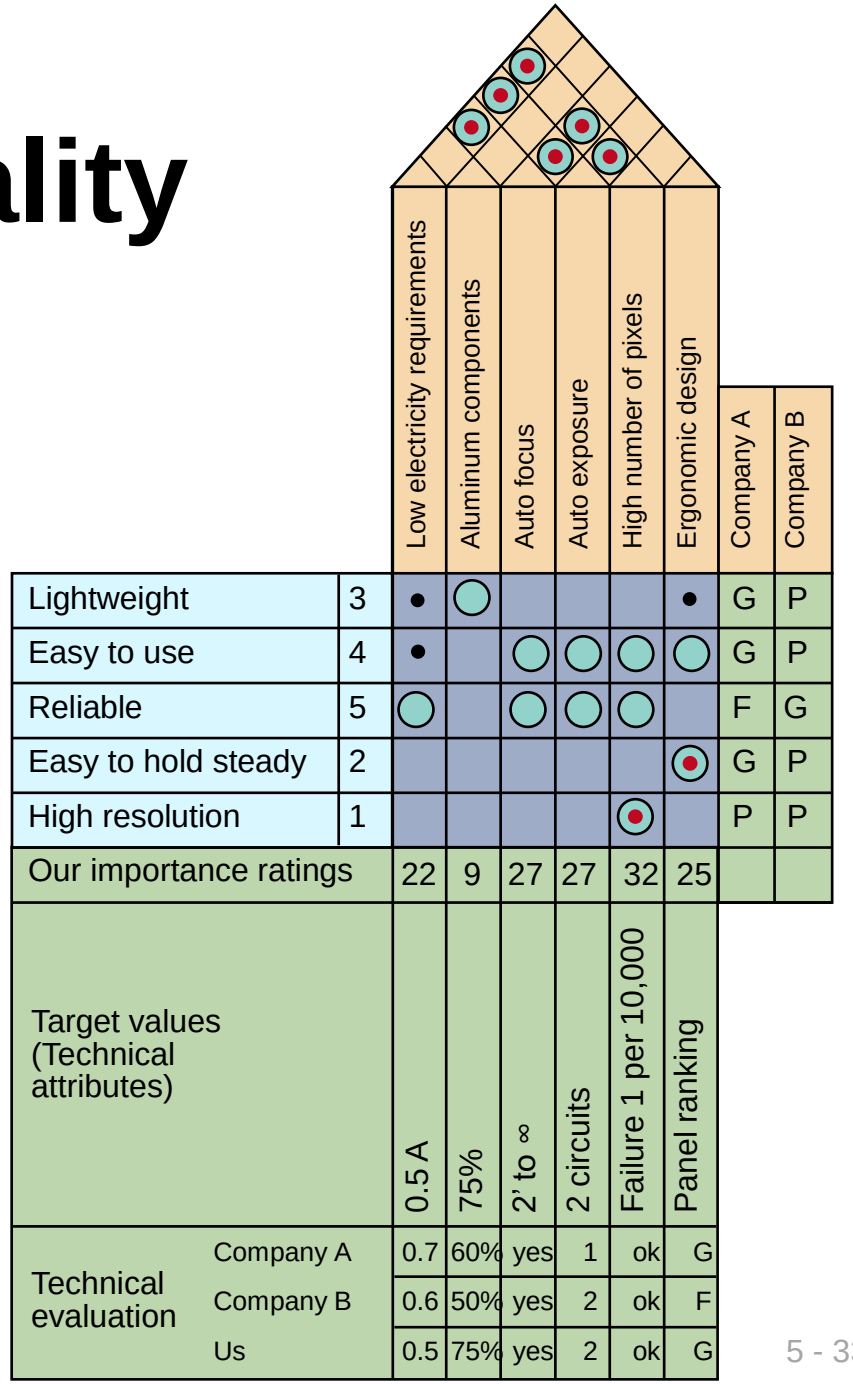
House of Quality Example



		0.5 A	75%	2’ to ∞	2 circuits	Failure 1 per 10,000	Panel ranking
Target values (Technical attributes)							
Technical evaluation	Company A	0.7	60%	yes	1	ok	G
	Company B	0.6	50%	yes	2	ok	F
	Us	0.5	75%	yes	2	ok	G

House of Quality Example

Completed House of Quality



		Low electricity requirements	Aluminum components	Auto focus	Auto exposure	High number of pixels	Ergonomic design	Company A	Company B
Lightweight	3	•	◯				•	G	P
Easy to use	4	•		◯	◯	◯	◯	G	P
Reliable	5	◯		◯	◯	◯		F	G
Easy to hold steady	2						◉	G	P
High resolution	1					◉		P	P
Our importance ratings		22	9	27	27	32	25		
Target values (Technical attributes)		0.5 A	75%	2' to ∞	2 circuits	Failure 1 per 10,000	Panel ranking		
Technical evaluation	Company A	0.7	60%	yes	1	ok	G		
	Company B	0.6	50%	yes	2	ok	F		
	Us	0.5	75%	yes	2	ok	G		

House of Quality Sequence

Deploying resources through the organization in response to customer requirements

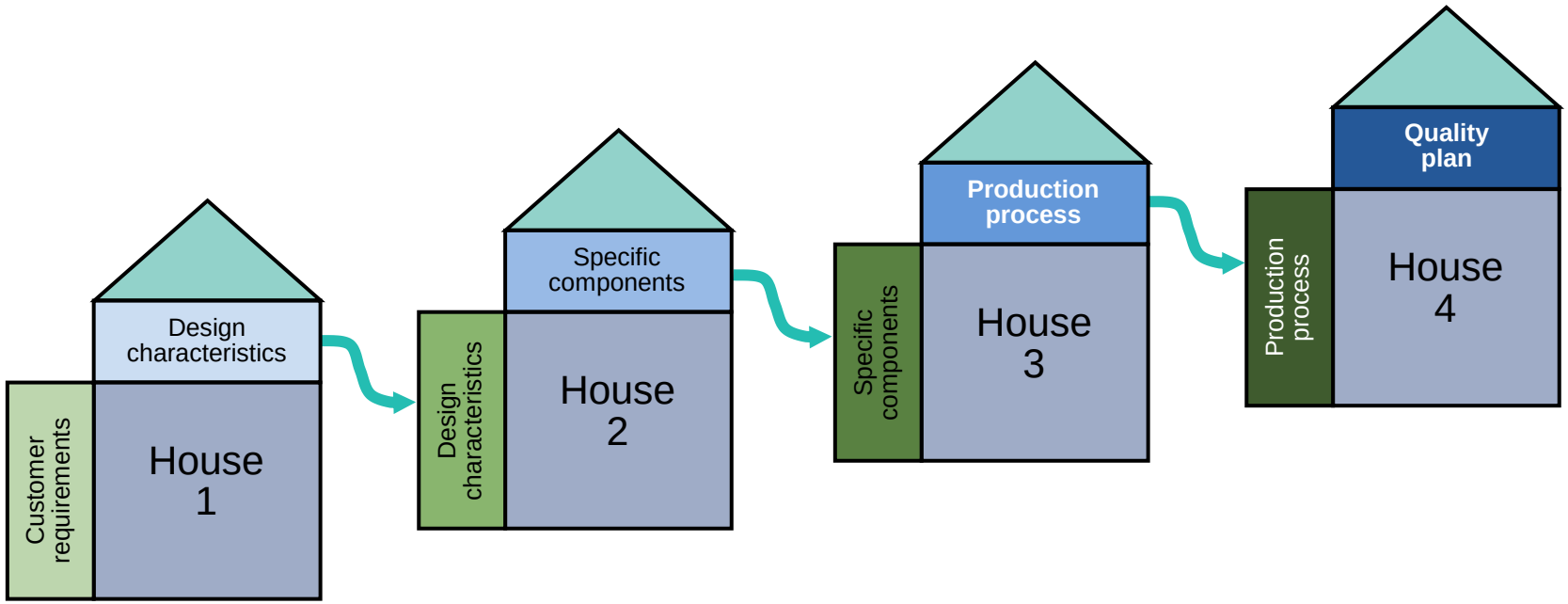


Figure 5.4

Organizing for Product Development

- Traditionally – distinct departments
  - Duties and responsibilities are defined
  - Difficult to foster forward thinking
- A Champion
  - Product manager drives the product through the product development system and related organizations

Organizing for Product Development

- Team approach
  - Cross functional – representatives from all disciplines or functions
  - Product development teams, design for manufacturability teams, value engineering teams
- Japanese “whole organization” approach
  - No organizational divisions

Organizing for Product Development

- Product development teams
  - Market requirements to product success
  - Cross functional teams often involving vendors
  - Open, highly participative environment
- Concurrent engineering
  - Simultaneous performance of product development stages

Manufacturability and Value Engineering

- Benefits:
  1. Reduced complexity of the product
  2. Reduction of environmental impact
  3. Additional standardization of components
  4. Improvement of functional aspects of the product
  5. Improved job design and job safety
  6. Improved maintainability (serviceability) of the product
  7. Robust design

Cost Reduction of a Bracket via Value Engineering

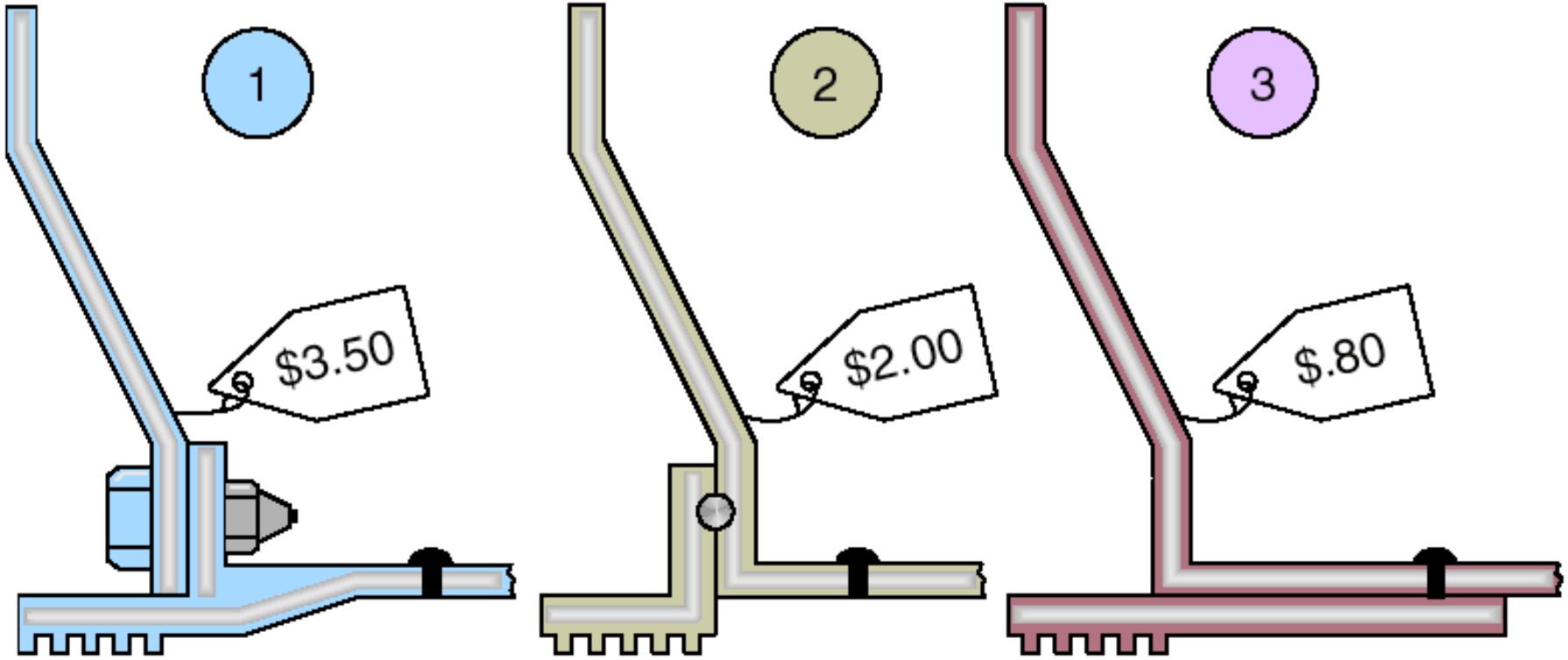


Figure 5.5

Issues for Product Design

- Robust design
- Modular design
- Computer-aided design (CAD)
- Computer-aided manufacturing (CAM)
- Virtual reality technology
- Value analysis
- Sustainability and Life Cycle Assessment (LCA)

Robust Design

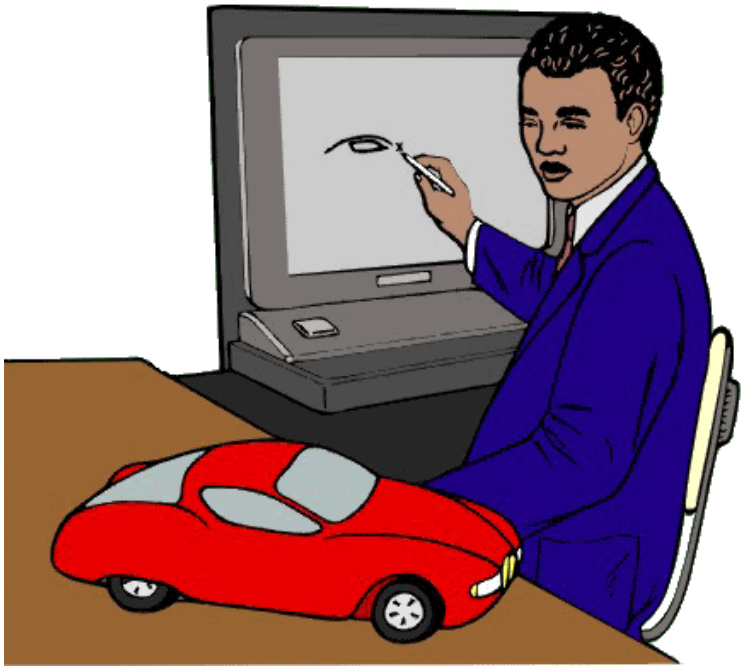
- Product is designed so that small variations in production or assembly do not adversely affect the product
- Typically results in lower cost and higher quality

Modular Design

- Products designed in easily segmented components
- Adds flexibility to both production and marketing
- Improved ability to satisfy customer requirements

Computer Aided Design (CAD)

- Using computers to design products and prepare engineering documentation
- Shorter development cycles, improved accuracy, lower cost
- Information and designs can be deployed worldwide



Extensions of CAD

- 3-D Object Modeling
  - Small prototype development
- Design for Manufacturing and Assembly (DFMA)
  - Solve manufacturing problems during the design stage
- CAD through the internet
- International data exchange through STEP
- 3-D printing

Computer-Aided Manufacturing (CAM)

- Utilizing specialized computers and program to control manufacturing equipment
- Often driven by the CAD system (CAD/CAM)

Benefits of CAD/CAM

1. Product quality
2. Shorter design time
3. Production cost reductions
4. Database availability
5. New range of capabilities

Virtual Reality Technology

- Computer technology used to develop an interactive, 3-D model of a product from the basic CAD data
- Allows people to ‘see’ the finished design before a physical model is built
- Very effective in large-scale designs such as plant layout

Value Analysis

- Focuses on design improvement during production
- Seeks improvements leading either to a better product or a product which can be produced more economically with less environmental impact

Sustainability and Life Cycle Assessment (LCA)

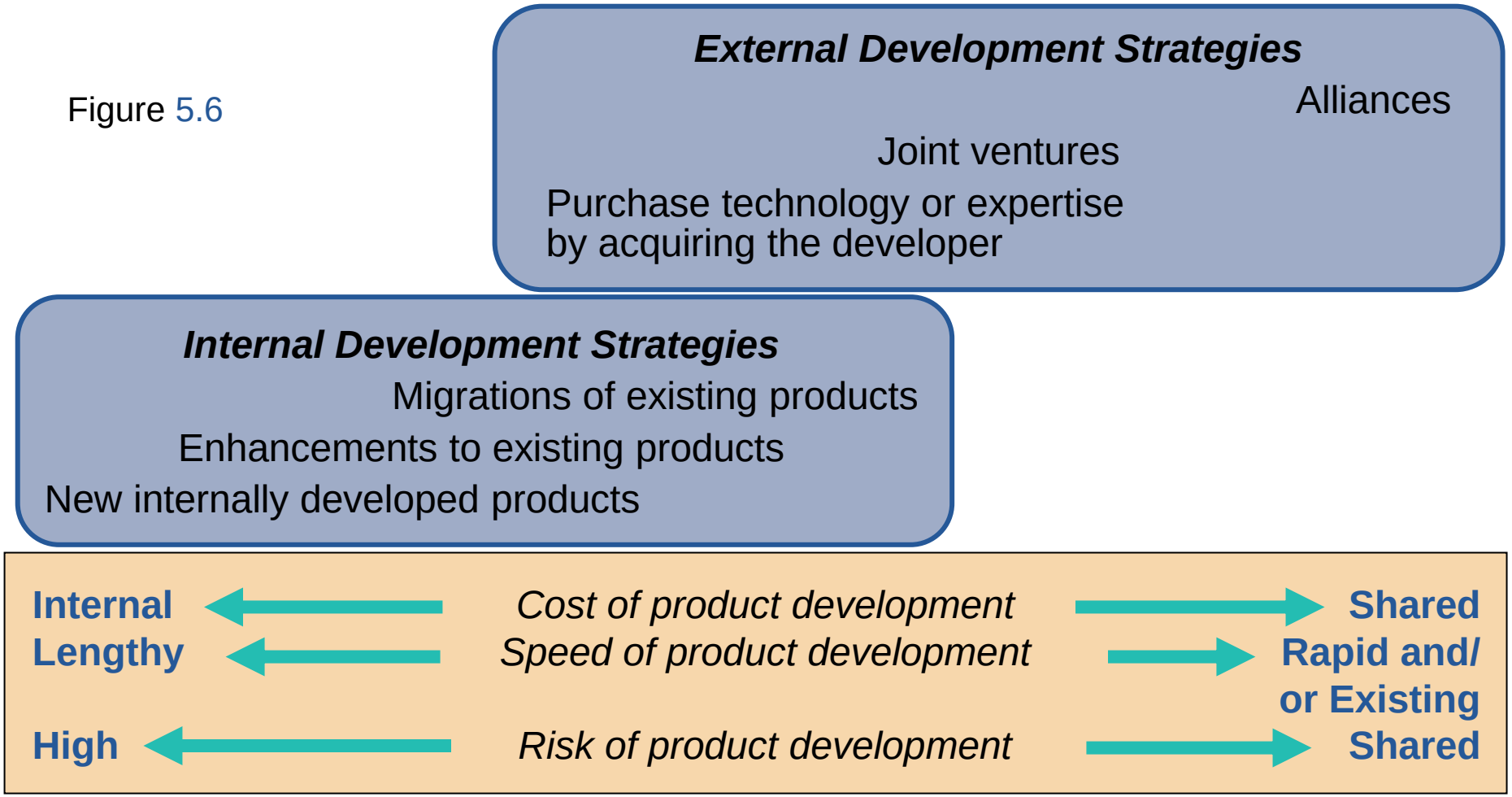
- *Sustainability* means meeting the needs of the present without compromising the ability of future generations to meet their needs
- LCA is a formal evaluation of the environmental impact of a product

Product Development Continuum

- Product life cycles are becoming shorter and the rate of technological change is increasing
- Developing new products faster can result in a competitive advantage
- **Time-based competition**

Product Development Continuum

Figure 5.6



Product Development Continuum

- Purchasing technology by acquiring a firm
  - Speeds development
  - Issues concern the fit between the acquired organization and product and the host
- Joint Ventures
  - Both organizations learn
  - Risks are shared

Product Development Continuum

- Alliances
  - Cooperative agreements between independent organizations
  - Useful when technology is developing
  - Reduces risks

Defining a Product

- First definition is in terms of *functions*
- Rigorous specifications are developed during the design phase
- Manufactured products will have an **engineering drawing**
- **Bill of material (BOM)** lists the components of a product

Monterey Jack Cheese

(a) *U.S. grade AA*. Monterey cheese shall conform to the following requirements:

(1) *Flavor*. Is fine and highly pleasing, free from undesirable flavors and odors. May possess a very slight acid or feed flavor.

(2) Body and texture. A plug drawn from the cheese shall be reasonably firm. It shall have numerous small mechanical openings evenly distributed throughout the plug. It shall not possess sweet holes, yeast holes, or other gas holes.

(3) *Color*. Shall have a natural, uniform, bright and attractive appearance.

(4) *Finish and appearance—bandaged and paraffin-dipped*. The rind shall be sound, firm, and smooth providing a good protection to the cheese.

Code of Federal Regulation, Parts 53 to 109, General Service Administration

Product Documents

- Engineering drawing
  - Shows dimensions, tolerances, and materials
  - Shows codes for Group Technology
- Bill of Material
  - Lists components, quantities and where used
  - Shows product structure

Engineering Drawings

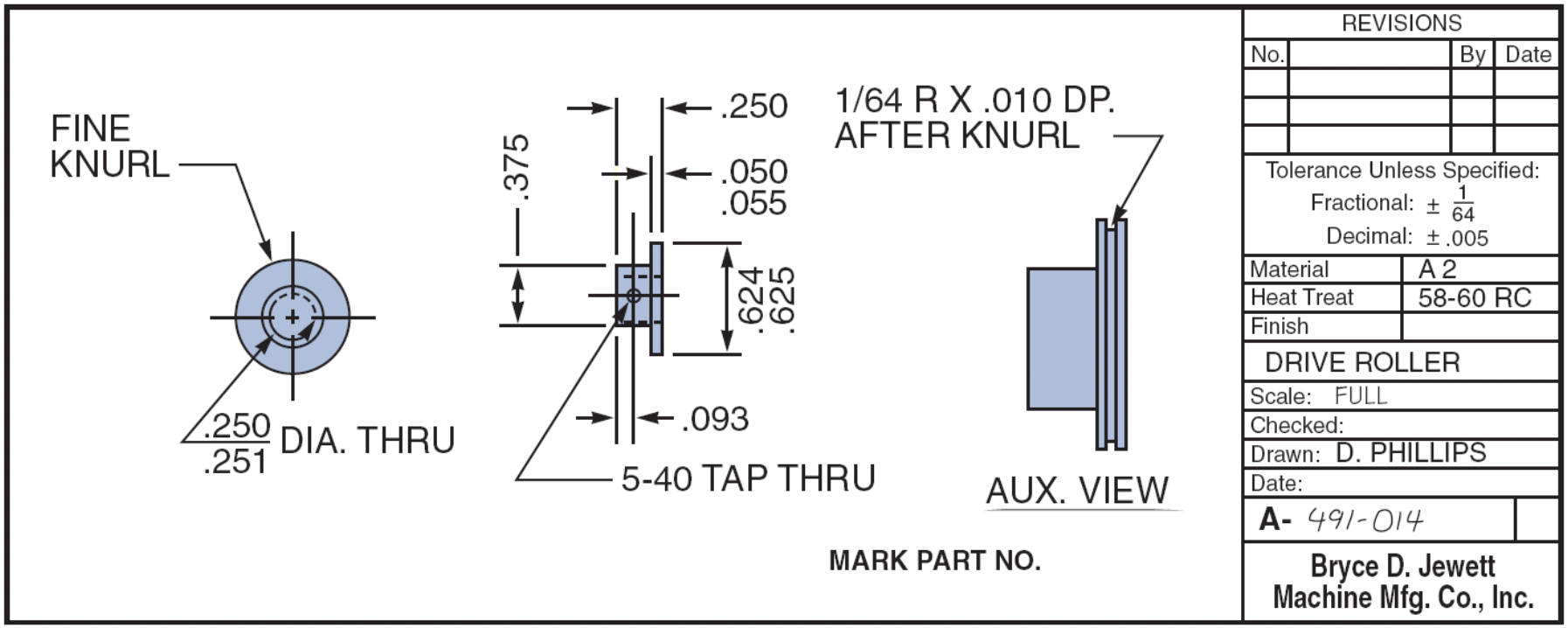


Figure 5.8

Bills of Material

BOM for a Panel Weldment

NUMBER	DESCRIPTION	QTY
A 60-71	PANEL WELDM'T	1
A 60-7	LOWER ROLLER ASSM.	1
R 60-17	ROLLER	1
R 60-428	PIN	1
P 60-2	LOCKNUT	1
A 60-72	GUIDE ASSM. REAR	1
R 60-57-1	SUPPORT ANGLE	1
A 60-4	ROLLER ASSM.	1
02-50-1150	BOLT	1
A 60-73	GUIDE ASSM. FRONT	1
A 60-74	SUPPORT WELDM'T	1
R 60-99	WEAR PLATE	1
02-50-1150	BOLT	1

Figure 5.9 (a)

Bills of Material

Hard Rock Cafe's Hickory BBQ Bacon Cheeseburger

DESCRIPTION	QTY
Bun	1
Hamburger patty	8 oz.
Cheddar cheese	2 slices
Bacon	2 strips
BBQ onions	1/2 cup
Hickory BBQ sauce	1 oz.
Burger set	
Lettuce	1 leaf
Tomato	1 slice
Red onion	4 rings
Pickle	1 slice
French fries	5 oz.
Seasoned salt	1 tsp.
11-inch plate	1
HRC flag	1

Figure 5.9 (b)

Make-or-Buy Decisions

- Produce components themselves or buy from an outside source
- Variations in
  - Quality
  - Cost
  - Delivery schedules
- Critical to product definition

Group Technology

- Parts grouped into families with similar characteristics
- Coding system describes processing and physical characteristics
- Part families can be produced in dedicated manufacturing cells

Group Technology Scheme

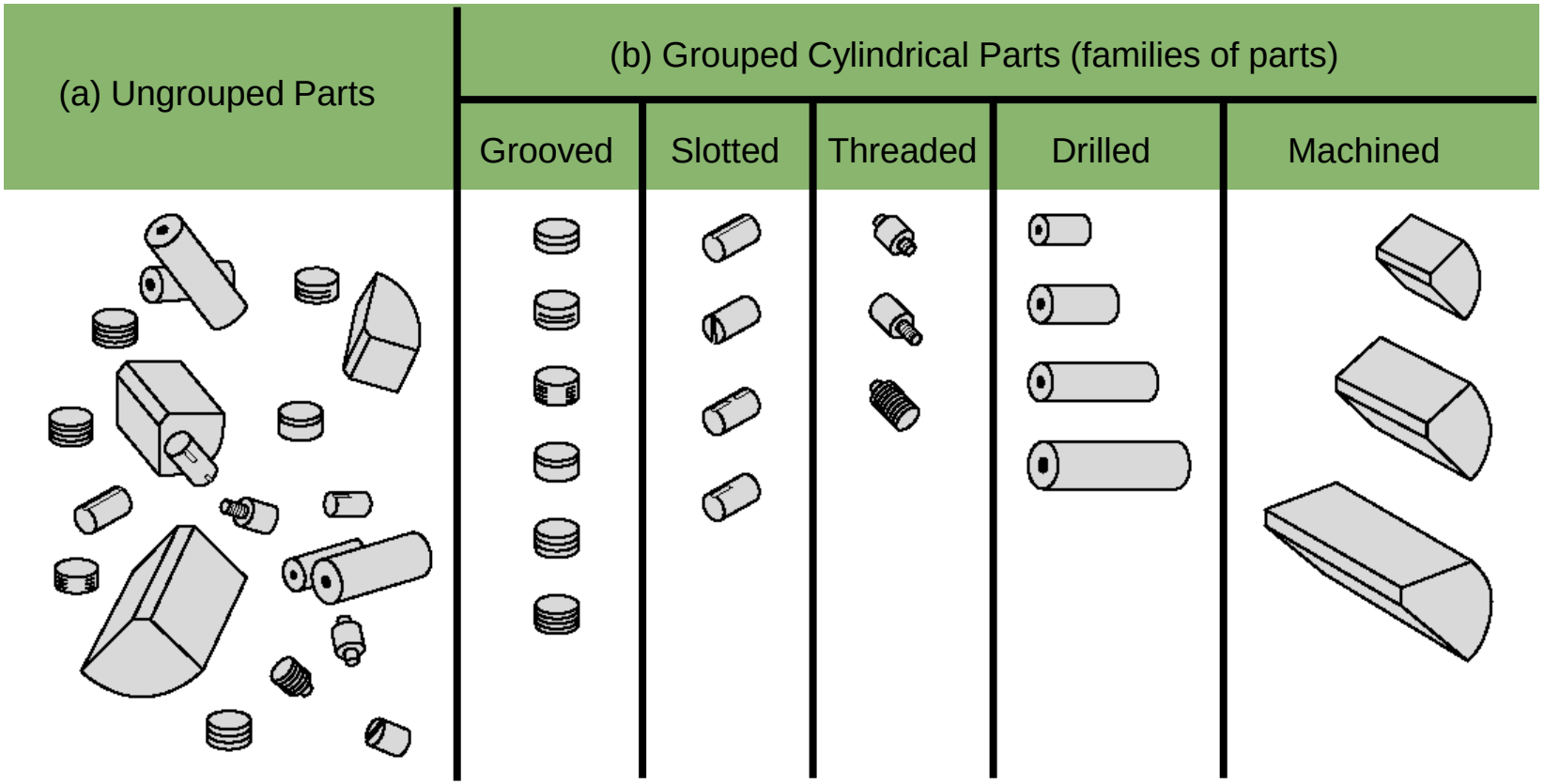


Figure 5.10

Group Technology Benefits

1. Improved design
2. Reduced raw material and purchases
3. Simplified production planning and control
4. Improved layout, routing, and machine loading
5. Reduced tooling setup time, work-in-process, and production time

Documents for Production

- Assembly drawing
- Assembly chart
- Route sheet
- Work order
- Engineering change notices (ECNs)

Assembly Drawing

- Shows exploded view of product
- Details relative locations to show how to assemble the product

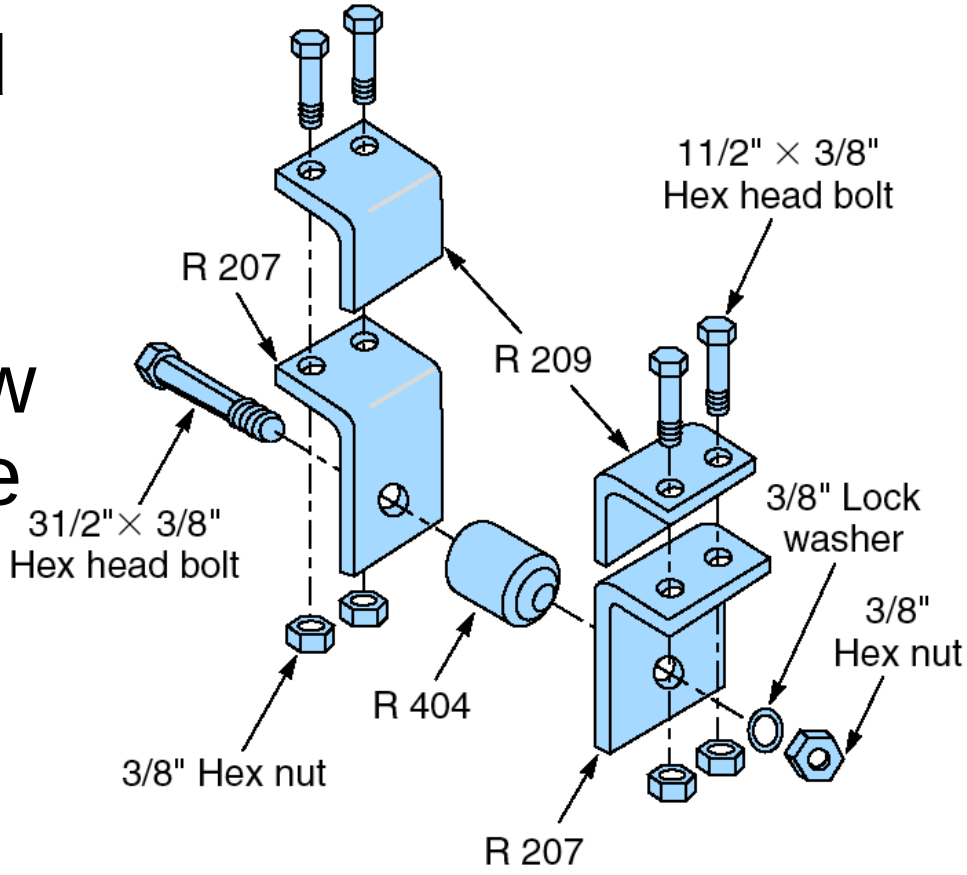
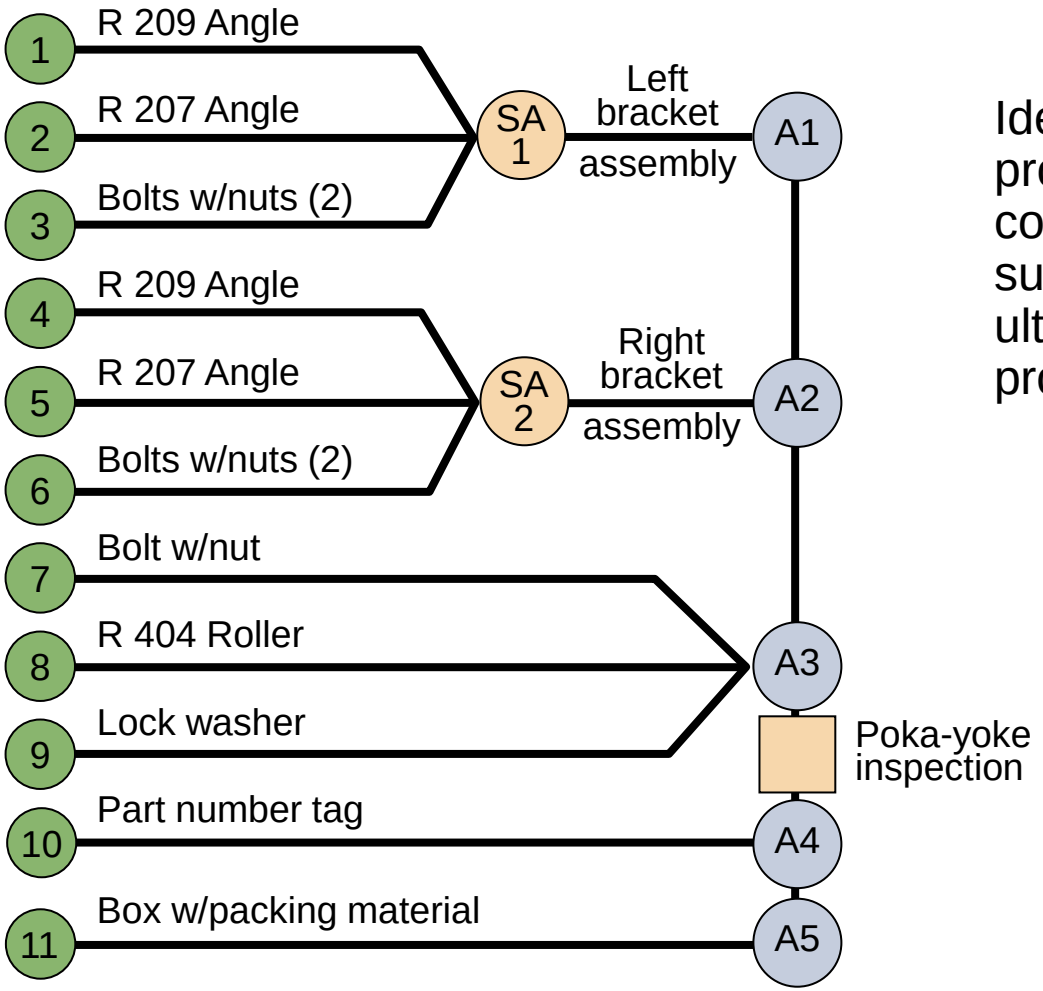


Figure 5.11 (a)

Assembly Chart



Identifies the point of production where components flow into subassemblies and ultimately into the final product

Figure 5.11 (b)

Route Sheet

Lists the operations and times required to produce a component

Process	Machine	Operations	Setup Time	Operation Time/Unit
1	Auto Insert 2	Insert Component Set 56	1.5	.4
2	Manual Insert 1	Insert Component Set 12C	.5	2.3
3	Wave Solder	Solder all components to board	1.5	4.1
4	Test 4	Circuit integrity test 4GY	.25	.5

Work Order

Instructions to produce a given quantity of a particular item, usually to a schedule

Work Order			
Item	Quantity	Start Date	Due Date
157C	125	5/2/16	5/4/16
Production Dept		Delivery Location	
F32		Dept K11	

Engineering Change Notice (ECN)

- A correction or modification to a product's definition or documentation
  - Engineering drawings
  - Bill of material

Quite common with long product life cycles, long manufacturing lead times, or rapidly changing technologies

Configuration Management

- The need to manage ECNs has led to the development of configuration management systems
- A product's planned and changing components are accurately identified
- Control and accountability for change are identified and maintained

Product Life-Cycle Management (PLM)

- Integrated software that brings together most, if not all, elements of product design and manufacture
  - Product design
  - CAD/CAM
  - DFMA
  - Product routing
  - Materials
  - Layout
  - Assembly
  - Maintenance
  - Environmental

Service Design

- Service typically includes direct interaction with the customer
- **Process – chain – network (PCN)** analysis focuses on the ways in which processes can be designed to optimize interaction between firms and their customers

Process-Chain-Network (PCN) Analysis

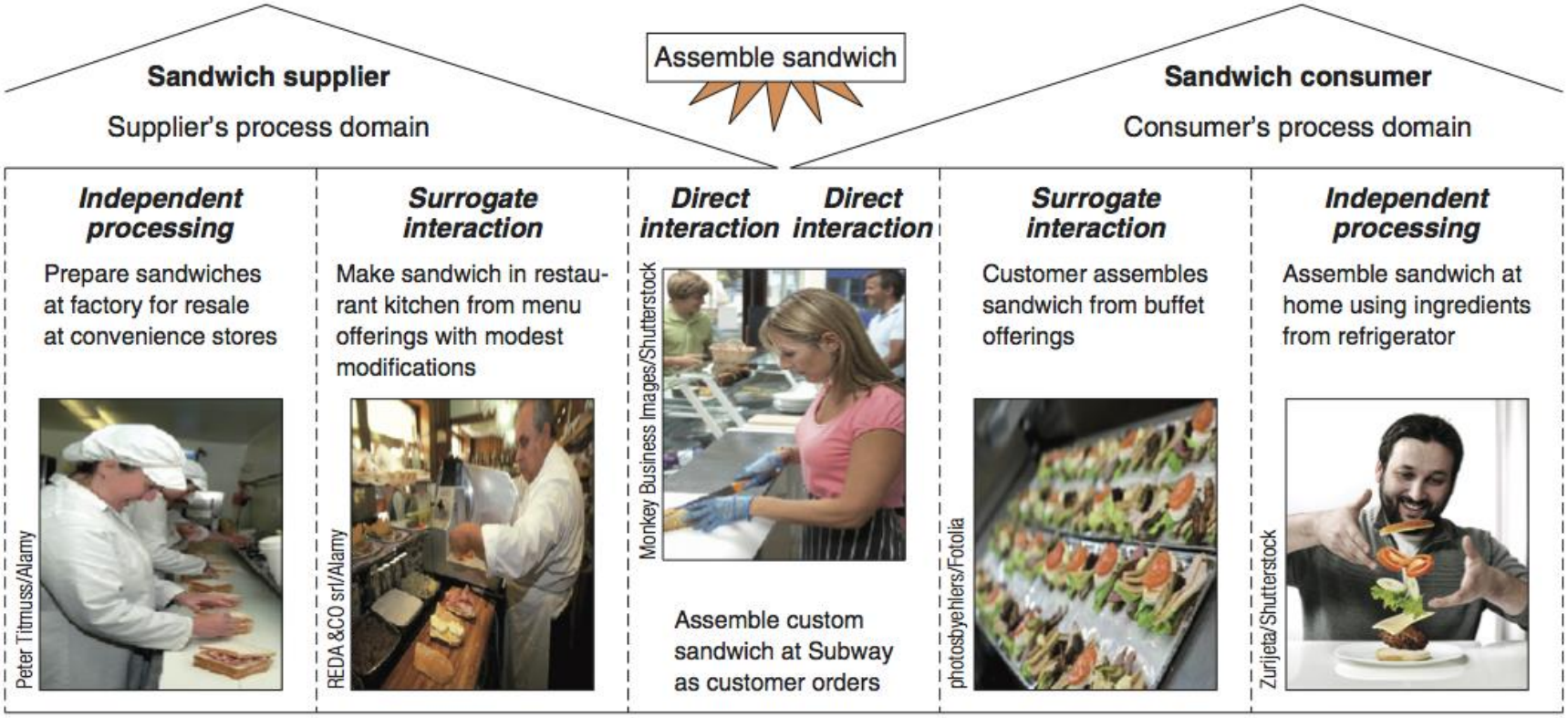


Figure 5.12

Process-Chain-Network (PCN) Analysis

1. *Direct interaction* region includes process steps that involve interaction between participants
2. The *surrogate (substitute) interaction* region includes process steps in which one participant is acting on another participant's resources
3. The *independent processing* region includes steps in which the supplier and/or the customer is acting on resources where each has maximum control

Process-Chain-Network (PCN) Analysis

- All three regions have similar operating issues but the appropriate way of handling the issues differs across regions – service operations exist only within the area of *direct* and *surrogate interaction*
- PCN analysis provides insight to aid in positioning and designing processes that can achieve strategic objectives

Adding Service Efficiency

- Service productivity is notoriously low partially because of customer involvement in the *design* or *delivery* of the service, or both
- Complicates product design

Adding Service Efficiency

- Limit the options
  - Improves efficiency and ability to meet customer expectations
- Delay customization
- Modularization
  - Eases customization of a service

Adding Service Efficiency

- Automation
  - Reduces cost, increases customer service
- Moment of truth
  - Critical moments between the customer and the organization that determine customer satisfaction

Documents for Services

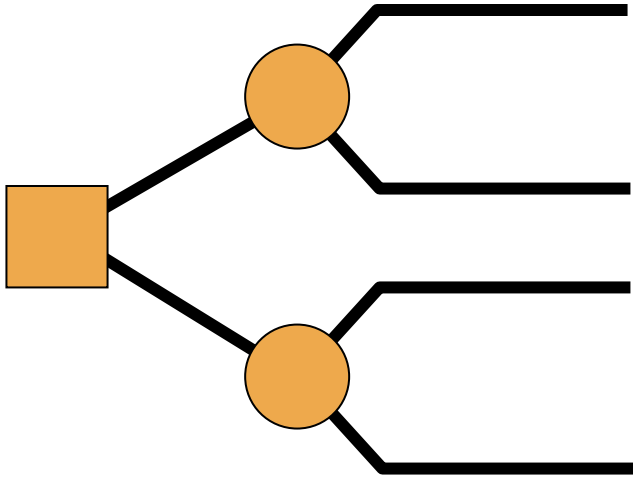
- High levels of customer interaction necessitates different documentation
- Often explicit job instructions
- Scripts and storyboards are other techniques

First Bank Corp. Drive-up Teller Service Guidelines

- Be especially discreet when talking to the customer through the microphone.
- Provide written instructions for customers who must fill out forms you provide.
- Mark lines to be completed or attach a note with instructions.
- Always say “please” and “thank you” when speaking through the microphone.
- Establish eye contact with the customer if the distance allows it.
- If a transaction requires that the customer park the car and come into the lobby, apologize for the inconvenience.

Application of Decision Trees to Product Design

- Particularly useful when there are a series of decisions and outcomes that lead to other decisions and outcomes



Application of Decision Trees to Product Design

Procedure

1. Include all possible alternatives and states of nature – including “doing nothing”
2. Enter payoffs at end of branch
3. Determine the expected value of each branch and “prune” the tree to find the alternative with the best expected value

Decision Tree Example

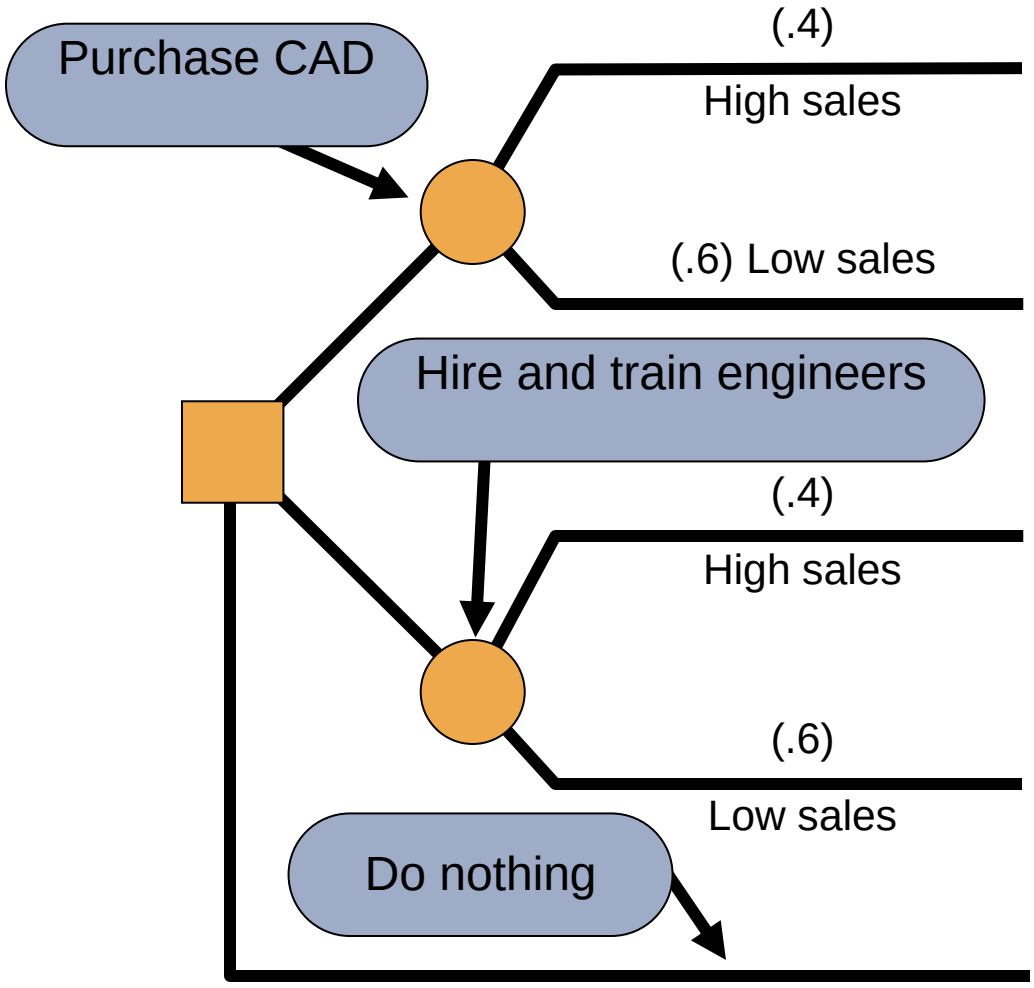


Figure 5.13

Decision Tree Example

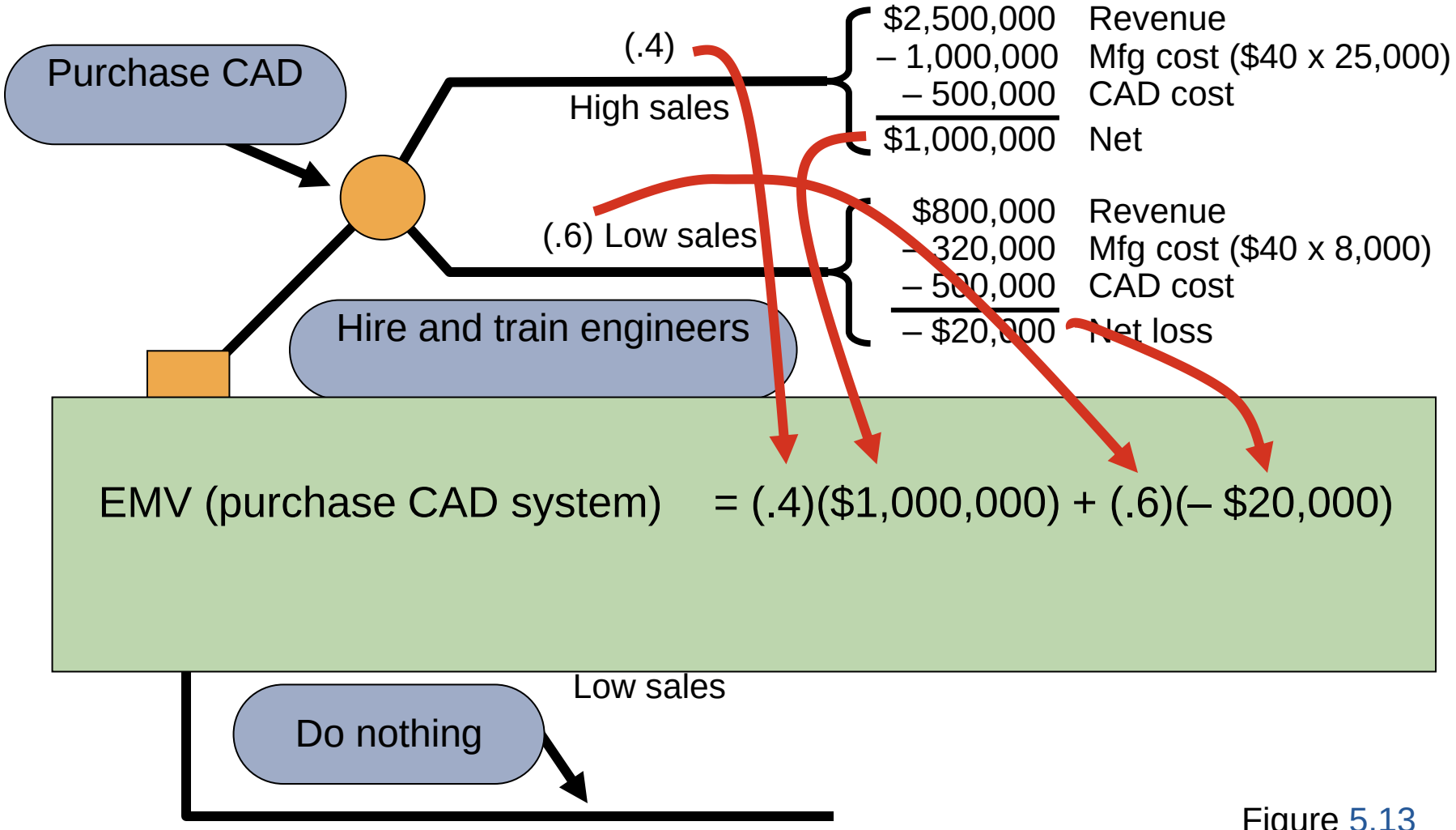


Figure 5.13

Decision Tree Example

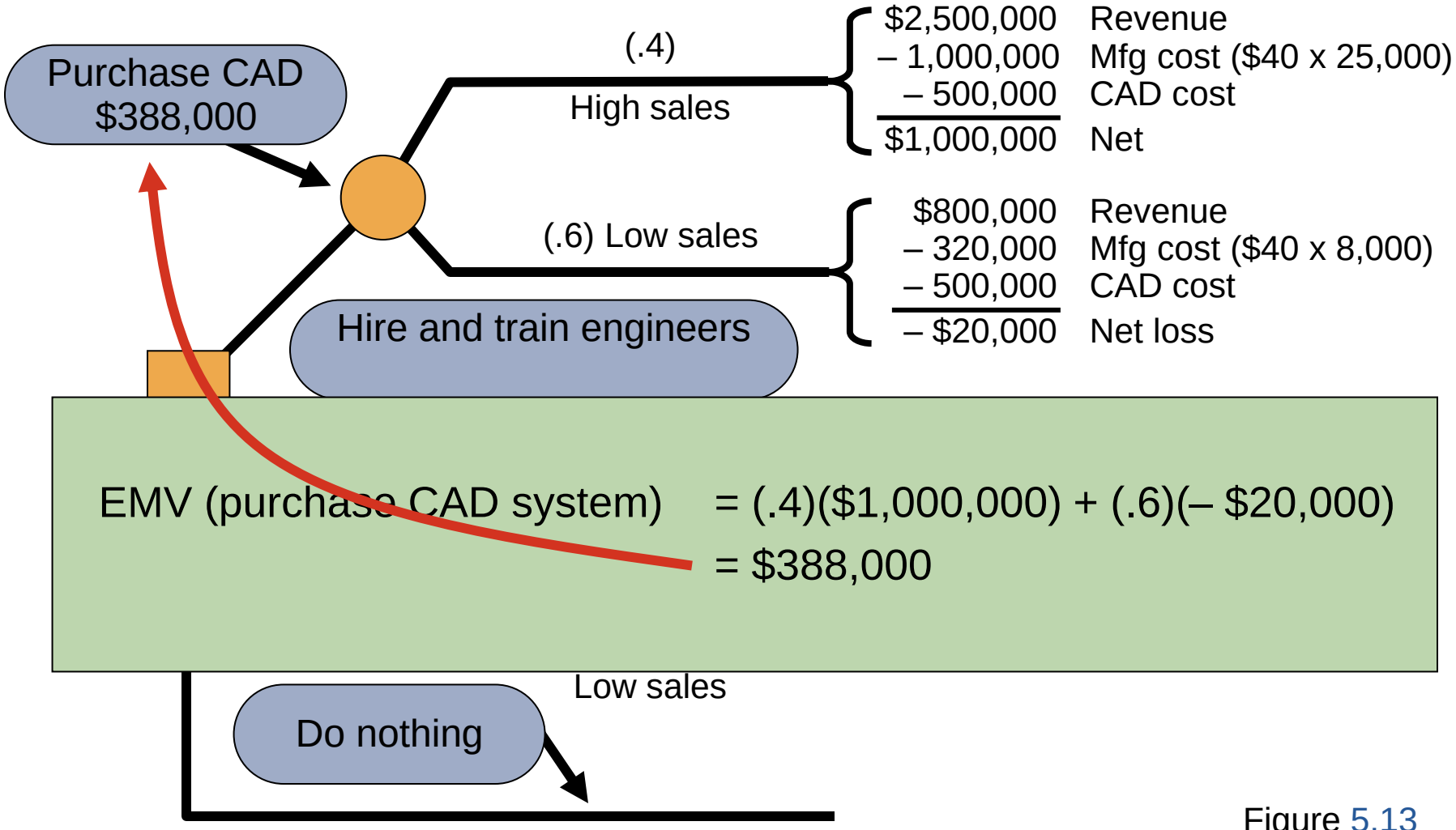


Figure 5.13

Decision Tree Example

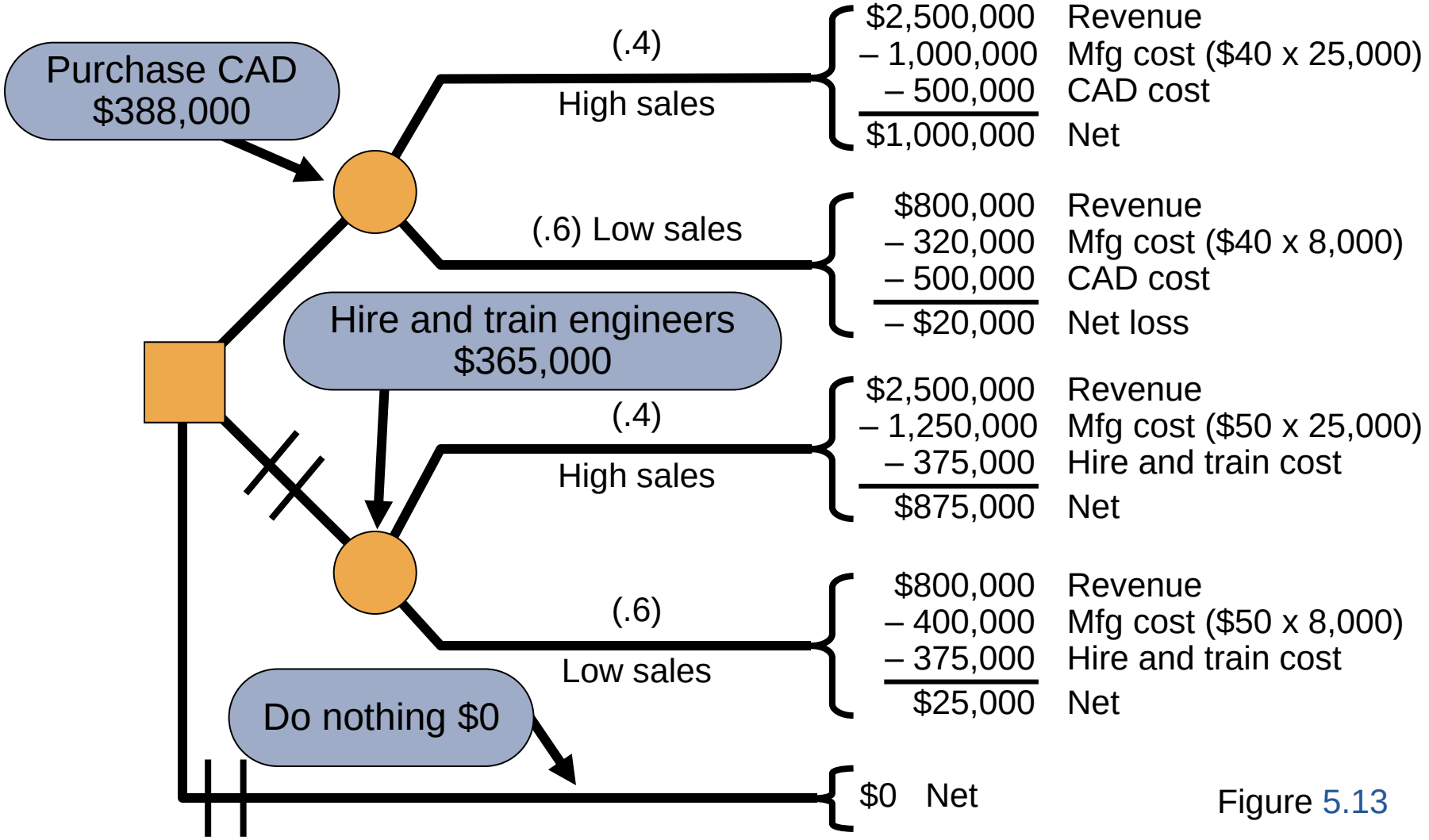


Figure 5.13

Transition to Production

- Know when to move to production
  - Product development can be viewed as evolutionary and never complete
  - Product must move from design to production in a timely manner
- Most products have a trial production period to insure producibility
  - Develop tooling, quality control, training
  - Ensures successful production

Transition to Production

- Responsibility must also transition as the product moves through its life cycle
  - Line management takes over from design
- Three common approaches to managing transition
  - Project managers
  - Product development teams
  - Integrate product development and manufacturing organizations