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 Decision

- The good or service the organization provides society
- 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
**Product Strategy Options**

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

**Product Life Cycles**

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

**Product Life Cycles**

![Figure 5.1](image-url)
Product Life Cycle

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**

<table>
<thead>
<tr>
<th>Costs incurred</th>
<th>Costs committed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of change</td>
<td>Percent of total cost</td>
</tr>
<tr>
<td>Concept design</td>
<td>100 – 80</td>
</tr>
<tr>
<td>Detailed design prototype</td>
<td>80 – 60</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>60 – 40</td>
</tr>
<tr>
<td>Distribution, service, and disposal</td>
<td>40 – 20</td>
</tr>
<tr>
<td>prototype</td>
<td>20 – 0</td>
</tr>
<tr>
<td>and disposal</td>
<td>0 – 0</td>
</tr>
</tbody>
</table>

**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
### Product-by-Value Analysis

Sam’s Furniture Factory

<table>
<thead>
<tr>
<th></th>
<th>Individual Contribution ($)</th>
<th>Total Annual Contribution ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Love Seat</td>
<td>$102</td>
<td>$36,720</td>
</tr>
<tr>
<td>Arm Chair</td>
<td>$87</td>
<td>$51,765</td>
</tr>
<tr>
<td>Foot Stool</td>
<td>$12</td>
<td>$6,240</td>
</tr>
<tr>
<td>Recliner</td>
<td>$136</td>
<td>$51,000</td>
</tr>
</tbody>
</table>

### New Product Opportunities

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

### Product Development System

Figure 5.3
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 importance ratings
6. Evaluate competing products
7. Compare performance to desirable technical attributes

Manufacturability and Value Engineering

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

Issues for Product Development

- Robust design
- Modular design
- Computer-aided design (CAD)
- Computer-aided manufacturing (CAM)
- Virtual reality technology
- Value analysis
- Environmentally friendly design
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

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

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

**Ethics, Environmentally Friendly Designs, and Sustainability**

- It is possible to enhance productivity and deliver goods and services in an environmentally and ethically responsible manner
- In OM, sustainability means ecological stability
- Conservation and renewal of resources through the entire product life cycle
Ethics, Environmentally Friendly Designs, and Sustainability

- Design
  - Polyester film and shoes
- Production
  - Prevention in production and packaging
- Destruction
  - Recycling in automobiles

The Ethical Approach

- View product design from a systems perspective
  - Inputs, processes, outputs
  - Costs to the firm/costs to society
- Consider the entire life cycle of the product

The Ethical Approach

- Goals
  1. Developing safe and environmentally sound practices
  2. Minimizing waste of resources
  3. Reducing environmental liabilities
  4. Increasing cost-effectiveness of complying with environmental regulations
  5. Begin recognized as a good corporate citizen
Guidelines for Environmentally Friendly Designs

1. Make products recyclable
2. Use recycled materials
3. Use less harmful ingredients
4. Use lighter components
5. Use less energy
6. Use less material

Time-Based Competition

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

Acquiring Technology

- By Purchasing a Firm
  - Speeds development
  - Issues concern the fit between the acquired organization and product and the host
- Through Joint Ventures
  - Both organizations learn
  - Risks are shared
- Through Alliances
  - Cooperative agreements between independent organizations
Defining The 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

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 Panel Weldment

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

Figure 5.9 (a)

## 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

(a) Ungrouped Parts | (b) Grouped Cylindrical Parts (families of parts)
| Grooved | Slotted | Threaded | Drilled | Machined |

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.

Route Sheet

Lists the operations and times required to produce a component.

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

Work Order

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Start Date</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>157C</td>
<td>125</td>
<td>5/2/08</td>
<td>5/4/08</td>
</tr>
<tr>
<td>Production Dept</td>
<td>Delivery Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F32</td>
<td>Dept K11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 and 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
  - Assembly
  - Environmental
Service Design

- Service typically includes direct interaction with the customer
  - Increased opportunity for customization
  - Reduced productivity
- Cost and quality are still determined at the design stage
  - Delay customization
  - Modularization
  - Reduce customer interaction, often through automation

Figure 5.12

Service Design

(a) Customer participation in design

![Diagram of design process](image)

(b) Customer participation in delivery

![Diagram of delivery process](image)

Figure 5.12

Service Design

(c) Customer participation in design and delivery

![Diagram of design and delivery process](image)
Application of Decision Trees to Product Design

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

Procedures

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

- Purchase CAD
- High sales: (4)
- Low sales: (-8)
- Hire and train engineers
- High sales: (4)
- Low sales: (-8)
- Do nothing

Figure 5.14
Decision Tree Example

EMV (purchase CAD system) = \(0.4 \times (\$1,000,000) + 0.6 \times (\$20,000)\)

EMV (purchase CAD system) = \$388,000

Figure 5.14

Decision Tree Example

EMV (purchase CAD system) = \(0.4 \times (\$1,000,000) + 0.6 \times (\$20,000)\)

EMV (purchase CAD system) = \$388,000

Figure 5.14

Decision Tree Example

EMV (purchase CAD system) = \(0.4 \times (\$1,000,000) + 0.6 \times (\$20,000)\)

EMV (purchase CAD system) = \$388,000

Figure 5.14
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 ensure producibility
  - Develop tooling, quality control, training
  - Ensures successful 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