Introduction

Teaching materials to accompany:

Product Design and Development
Chapter 1

Karl T. Ulrich and Steven D. Eppinger
Research and Development

R • Structured methods • Planned timing • Predictable outcome • Short term

T • Loosely structured • Difficult to plan • Less predictable • Medium term

D • Structured methods • Planned timing • Predictable outcome • Short term

Basic Research • Discovery process • No set timing • Unpredictable returns • Long term

Technology Development

Product Development
Changing Dimensions of Competition

Competitiveness today is more than ever based on product development capability.
Creating Value through Product Development:

*It’s all about the product.*
Apple: Simply Better Products
Black & Decker Snake Light
Target Prescription Pill Bottle

Target Guest

AMOXICILLIN 500MG

Take: One capsule by mouth three times daily.

qty: 30
refills: No
Dr. Smith
disp: 02/27/05 REL
mfr: GENEVA NDC: 00781-2613-05
(877) 795-2743 Rx: 1234567-0000
TARGET PHARMACY
900 Niccol Mall Minneapolis, MN 55401
Bodum Pavina Glasses
iRobot Roomba
Textbook

Product Design and Development
Karl T. Ulrich and Steven D. Eppinger

1. Introduction
2. Development Processes and Organizations
3. Opportunity Identification
4. Product Planning
5. Identifying Customer Needs
6. Product Specifications
7. Concept Generation
8. Concept Selection
9. Concept Testing
10. Product Architecture
11. Industrial Design
12. Design for Environment
13. Design for Manufacturing
14. Prototyping
15. Robust Design
16. Patents and Intellectual Property
17. Product Development Economics
18. Managing Projects
Development Processes and Organizations

Teaching materials to accompany:

Product Design and Development
Chapter 2

Karl T. Ulrich and Steven D. Eppinger
Concept Development Process

Mission Statement

1. Identify Customer Needs
2. Establish Target Specifications
3. Generate Product Concepts
4. Select Product Concept(s)
5. Test Product Concept(s)
6. Set Final Specifications
7. Plan Downstream Development
8. Development Plan

- Perform Economic Analysis
- Benchmark Competitive Products
- Build and Test Models and Prototypes
Generic Product Development Process
Rapid Iteration PD Process

Planning

Concept Development

Mission Approval

Concept Review

System-Level Design

Cycle Plan Review

Many Iteration Cycles

Design

Build

Test

Production Ramp-Up

Cycle Review
Complex System PD Process

1. Planning
   - Mission Approval
2. Concept Development
   - Concept Review
3. System-Level Design
4. System Review
5. Design
6. Test
7. Integrate and Test
8. Production Approval
9. Validation and Ramp-Up
• Front-end of PD need not be a fuzzy process.
• Structured methods exist for each process step (see text chapters 4 to 8).
• This is not strictly sequential -- generally a parallel and iterative process.
Tyco Product Development Process
## Tyco Product Development Process

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</thead>
<tbody>
<tr>
<td>Primary Goal</td>
<td>Define project and business unit needs</td>
<td>Develop project concept and charter</td>
<td>Create product description</td>
<td>Create preliminary detailed design</td>
<td>Detail and optimize design</td>
<td>Demonstrate product performance</td>
<td>Demonstrate process performance</td>
<td>Launch product</td>
<td>Identify lessons learned</td>
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<tr>
<td>Marketing and Sales</td>
<td>Identify customers and market size</td>
<td>Capture voice of the customer</td>
<td>Develop marketing and sales plans</td>
<td>Review concepts with customer</td>
<td>Initialize field trials</td>
<td>Complete field trials</td>
<td>Finalize pricing and sales forecasts</td>
<td>Solicit customer feedback and satisfaction ratings</td>
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<tr>
<td>Describe competitive features and benefits</td>
<td>Analyze customer needs</td>
<td>Create phase-in and phase-out plans</td>
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<tr>
<td>Identify target cost and price</td>
<td>Document customer needs</td>
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<td>Complete phase-in and phase-out</td>
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<tr>
<td>Engineering</td>
<td>Identify project risks</td>
<td>Identify critical-to-quality specs</td>
<td>Create functional specification and performance metrics</td>
<td>Conduct a preliminary design review</td>
<td>Freeze hardware and software design</td>
<td>Finalize design documentation</td>
<td>Obtain regulatory approvals</td>
<td>Finalize product metrics</td>
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<td></td>
<td>Develop and select concepts</td>
<td>Review concept selection</td>
<td>Build and test alpha prototypes</td>
<td>Complete engineering documentation</td>
<td>Complete beta prototype and field testing</td>
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<td></td>
<td>Update project risks</td>
<td>Define product architecture</td>
<td>Assess product failure modes</td>
<td>Draft technical documentation</td>
<td>Apply for regulatory approvals</td>
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<tr>
<td>Quality Assurance</td>
<td></td>
<td>Assess technical failures modes</td>
<td>Secure beta prototypes</td>
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<tr>
<td>Manufacturing</td>
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<td>Create preliminary test plan</td>
<td>Test beta prototypes for robustness</td>
<td>Complete quality assurance testing</td>
<td>Conduct process verification testing</td>
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<td>Register obsolete and scrap products</td>
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<tr>
<td>Purchasing</td>
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<td>Create a supplier participation matrix</td>
<td>Identify long lead-time items</td>
<td>Verify supply chain readiness</td>
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<td>Legal</td>
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<td>Financial</td>
<td>Prepare preliminary business case</td>
<td>Refine business case</td>
<td>Complete financial package</td>
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<td>Monitor return on investment</td>
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<tr>
<td>Project Management</td>
<td>Identify project timing, resources, and capital</td>
<td>Assess team capabilities/skills</td>
<td>Plan integrated product development schedule</td>
<td>Update RP1-2 deliverables</td>
<td>Update RP1-3 deliverables</td>
<td>Update RP1-4 deliverables</td>
<td>Update RP1-5 deliverables</td>
<td>Finalize all deliverables</td>
<td>Document best practices</td>
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<td>Prepare RP0 checklist &amp; submit for approval</td>
<td>Identify development team members</td>
<td>Assign a project manager</td>
<td>Prepare RP3 checklist &amp; submit for approval</td>
<td>Prepare RP4 checklist &amp; submit for approval</td>
<td>Prepare RP5 checklist &amp; submit for approval</td>
<td>Prepare RP6 checklist &amp; submit for approval</td>
<td>Prepare RP8 checklist &amp; submit for approval</td>
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From Product Design and Development by Karl Ulrich and Steven Eppinger (McGraw-Hill/Irwin)
Functional Organization

Functional Managers

General Manager

Lightweight Project Matrix Organization

Functional Managers

Lightweight Project Managers

General Manager

Heavyweight Project Matrix Organization

Functional Managers

Heavyweight Project Managers

From Product Design and Development by Karl Ulrich and Steven Eppinger (McGraw-Hill/Irwin)
Opportunity Identification

Teaching materials to accompany:

*Product Design and Development*

*Chapter 3*

Karl T. Ulrich and Steven D. Eppinger

Opportunities Begin the Product Planning and Product Development Processes
Pharmaceutical Drug Development

10,000 newly discovered compounds

8-12 years
$500 million - $1 billion

1 new drug
Hollywood Film Studios

500 “pitches”

3-5 years
$50-200 million

1 new feature film

Cars
Opportunity Identification Example
FroliCat Sway Opportunity Funnel

1 mission statement
1 PD process
1 product launch

3 explored

50 opportunities
7 selected
Automobile Concepts
# Product Naming Tournament

<table>
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<tr>
<th>Initial Ideas</th>
<th>Best Ten</th>
<th>Best Three</th>
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<td>AstroPong</td>
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<td>Hurricane</td>
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<td>Funpult</td>
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The Funnel in Various Industries

Selection Phases

Development Phases

Pharma

Movies

VC

Industrial

Consumer

All Values Normalized Relative to 1 Launch

Innovation Phase

(nomenclature varies by industry)

Launch

Profits
Where do opportunities come from?

- internally generated: 46%
- customer: 23%
- competitive product: 11%
- sales force: 5%
- university: 4%
- independent inventor: 4%
- distribution partner: 3%
- other partner company: 2%
- supplier: 2%

Source:
Terwiesch and Ulrich survey of 524 managers in diverse service and product industries, October 2006.
What drives the quality of the opportunities?

- Mean quality of the opportunity identification process.
- Variance in quality of the opportunity identification process.
- Number of “draws” from the opportunity identification process.
- Accuracy of discerning the best subset of opportunities generated.
Project Down selection: The PD Process Funnel