ECE520.427
Class #7

Concept Testing
and
Product Architecture
Front-End Process

Phase 0: Planning

Phase 1: Concept Development
- Perform Economic Analysis
- Benchmark Competitive Products
- Build and Test Models and Prototypes

Phase 2: System-Level Design

Phase 3: Detail Design

Phase 4: Testing and Refinement

Phase 5: Production Ramp-Up

Mission Statement
- Identify Customer Needs
- Establish Target Specifications
- Generate Product Concepts
- Select Product Concept(s)

Development Plan
- Set Final Specifications
- Plan Downstream Development
Concept Testing

What is concept testing?
- Process wherein feedback is solicited from potential customers on top design candidates
- Customer-based counterpart of concept selection

Why do concept testing?
- Helps decide which concept should be pursued
- “Last chance” for feedback to improve design concept
- Gauge potential sales
- Kill product?
Concept Testing Procedure

1. Choose who to survey
2. Choose how to survey
3. Create the survey
4. Survey
5. Analyze the survey
Step 1: Who to Survey

- (Re)Identify market segment(s) and target customers
- Choose sample size (10–1000)
  - Smaller sample size favored for gathering qualitative data
  - Smaller sample size favored for relatively small markets
- Reuse survey participants if possible
Step 2: How to Survey

Possible options:
- Face-to-face
- Telephone
- Snail mail
- Email
- Internet
Step 3: Create the Survey

- Start with screening questions
- Describe product concepts
- Include sketches or mock-ups if available
  - Videos, renderings, storyboards, simulations, or interactive media can be used if resources allow it
  - Models may backfire
- Ask which concepts they prefer
- Get price ranges, try not to bias them
- Gauge interest, try not to bias them
Step 4: Survey

- Just do it.
Step 5: Analyze the Survey

- Determine whether one concept is obviously superior to the others
- Determine whether components of different concepts can be combined for a better overall product
- Determine how many you’re likely to sell:

\[
Q = N \times A \times P
\]

\[
P = C_{\text{def}} F_{\text{def}} + C_{\text{prob}} F_{\text{prob}}
\]

\[
C_{\text{def}} = 0.4, \quad C_{\text{prob}} = 0.2
\]
Intermission
Front-End Process

Phase 0: Planning

Phase 1: Concept Development

Phase 2: System-Level Design

Phase 3: Detail Design

Phase 4: Testing and Refinement

Phase 5: Production Ramp-Up

Mission Statement

Identify Customer Needs

Establish Target Specifications

Generate Product Concepts

Select Product Concept(s)

Test Product Concept(s)

Set Final Specifications

Plan Downstream Development

Development Plan

Perform Economic Analysis

Benchmark Competitive Products

Build and Test Models and Prototypes
Generic Design Process

Phase 0: Planning
- Identify Customer Needs
  - Product Specifications
  - Concept Generation
  - Concept Selection
  - Concept Testing
- Product Architecture
  - Industrial Design

Phase 1: Concept Development
- Design for Manufacturing
  - Prototyping
  - Robust Design
  - Patents, IP, and Economics

Phase 2: System-Level Design

Phase 3: Detail Design

Phase 4: Testing and Refinement

Phase 5: Production Ramp-Up
“The architecture of a product is the scheme by which functional elements are arranged into physical chunks”

Different approaches to chunking the product will result in differences to:

- Ease of upgrade/design changes
- Design variety
- Reuse of components
- Performance
- Manufacturability
- Project management
Trailer Example: Modular Architecture

- **Box**: protect cargo from weather
- **Hitch**: connect to vehicle
- **Fairing**: minimize air drag
- **Bed**: support cargo loads
- **Springs**: suspend trailer structure
- **Wheels**: transfer loads to road

Diagram showing a trailer with a box, hitch, fairing, bed, springs, and wheels.
Trailer Example: Integral Architecture

- upper half
- lower half
- nose piece
- cargo hanging straps
- spring slot covers
- wheels

- protect cargo from weather
- connect to vehicle
- minimize air drag
- support cargo loads
- suspend trailer structure
- transfer loads to road

protect cargofrom weather
connect tovehicle
minimizeair drag
supportcargo loads
suspendtrailer structure
transfer loadsto road
Product Architecture Procedure

1. Create system schematic
2. Cluster elements in chunks
3. Identify incidental interactions
Step 1: Create System Schematic

System schematic can be a more specific version of the product decomposition.

- Enclose Printer
  - Provide Structural Support
- Print Cartridge
  - Position Cartridge In X-Axis
  - Position Paper In Y-Axis
- ‘Pick’ Paper
  - Store Output
  - Store Blank Paper
- Accept User Inputs
  - Control Printer
  - Communicate with Host
  - Display Status
  - Supply DC Power
  - Command Printer
  - Connect to Host

Functional or Physical Elements:
- Flow of forces or energy
- Flow of material
- Flow of signals or data
Step 2: Create Chunks

- Enclosure
  - Enclose Printer
  - Provide Structural Support

- Chassis
  - Store Output
  - Store Blank Paper

- Paper Tray
  - Print Cartridge

- Print Mechanism
  - Position Cartridge In X-Axis
  - Position Paper In Y-Axis

- User Interface Board
  - Accept User Inputs
  - Display Status

- Logic Board
  - Connect to Host
  - Communicate with Host

- Power Cord and "Brick"
  - Supply DC Power
  - Command Printer
  - Host Driver Software

- Chunks
  - Functional or Physical Elements
Step 3: Identify Incidental Interactions
Chunking Example
Software Chunks

Skella Architecture – BPM & Workflow Automation

Server Controls
- Process Reports
- Activity Monitor
- Activity List
- Process Designer

Workflow Engine
- .NET Server
- Workflow Services
- Task Scheduler Services
- Notification Services
- Workflow Proxy

Security & Directory Services
- Active Directory
- LDAP
- Any user Directory

External Web Services

3rd Party Apps
- ERP
- CRM
- HRIS
- Automated Activities
- Others

ASPI.NET
- .NET Framework
- OS

Client

Operational Data

Business Rules Engine
- BizTalk Rules
- Skelta Decision Tables
- 3rd Party Business Rules

Microsoft Integration
- Exchange
- SharePoint
- Word
- InfoPath
- SQL

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http://www.skella.com/products/workflow/architecture-diagram.html
Why Chunks

For your products, creating chunks can help determine what you will need to create for a core tech demo

- You will likely want to demo a complete chunk
- Other related chunks can be “stubs” or “mocks” – simple, minimally functional stand-in modules
  - Power supply instead of internal regulator
  - PC for data display instead of LCD

Each chunk should in turn be described by a detailed schematic or functional diagram
Product Development Task #6A: Concept Testing and Product Architecture

- **Concept testing:** interview at least five potential customers
  - Ask which concepts or solution fragments they prefer if you still need to eliminate some
  - Ask what they would pay
  - Inquire about likelihood of purchase
  - Estimate overall unit sales

- **Product architecture**
  - Create a product architecture based on your existing product decomposition
  - Generate a more detailed system schematic
  - Determine how the product will be chunked
  - Identify which chunks will be implemented for your core technology demo
Next class:
PowerPoint presentation of final concepts

- Introduction and motivation
- Brief summary of customer needs
- Product decomposition
- Description of key sub-problems and solutions
- Overview of integrated concept
- Product architecture (chunks)
- Prototyping plans for core technology