ECE520.427
Class #6
Concept Selection
and
Preliminary Costing
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

Perform Economic Analysis
Benchmark Competitive Products
Build and Test Models and Prototypes

Development Plan
Roadmap to a Product Concept

- Concept generation
- Concept screening
- Concept scoring
- Concept testing
Concept Selection Techniques

Subjective:
- External decision (pass the buck)
- Product champion (bully)
- Intuition (guess)

Objective
- Multivote
- Compare pros and cons
- Prototype and test
- Create decision matrices
Why Use a Formal Process?

The product concept largely determines the success and cost of the product.

A formal procedure ensures that:

- The selected concept is focused on customer needs.
- The selected concept compares favorably to competitors.
- The decision process is documented.
- Subjective feelings are minimized and objective criteria are maximized.
General strategy:
1. Choose selection criteria
2. Evaluate initial concepts relative to a common reference
3. Eliminate some alternatives, combine others into new alternatives
4. Evaluate new concepts relative to reference
5. Select 1-3 concepts for further investigation, testing, or development

Variants: concept screening vs. concept scoring

Note: this is also a scale-invariant process
Concept Screening (AKA Pugh Concept Selection)

Step 1: Choose selection criteria
- Consider use of primary needs
- Consider use of enterprise needs (price, manufacturability, etc.)
- Choose criteria that differentiate your concepts

Step 1.5: Choose reference concept
- Could be industry standard, best-in-class benchmark, or top seller, or a new concept
- Pick a reference that will allow you to differentiate your concepts
Concept Screening (AKA Pugh Concept Selection)

Step 1: Choose selection criteria

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Concept Screening (AKA *Pugh Concept Selection*)

- **Step 2: Rate concepts**

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## Concept Screening (AKA Pugh Concept Selection)

### Step 3: Rank concepts

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**CONCEPT VARIANTS**

- **A**
- **B**
- **C**
- **D**
- **E**
- **F**
- **G**
- **REF.**

**PLUSES**

- **SAMES**
- **MINUSES**

**NET**

**RANK**

**CONTINUE?**
## Concept Screening

(AKA *Pugh Concept Selection*)

### Step 4: Combine and Conquer

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</table>

- **Pluses** indicate a positive attribute.
- **Sames** indicate a neutral attribute.
- **Minuses** indicate a negative attribute.
Concept Screening (AKA Pugh Concept Selection)

**Step 5: Choose concepts**

- Based on concept screening, select the most promising product concepts for further testing, analysis, and review.
- Maintain 2-3 options in case testing of your “preferred” concept is poor or in case of intellectual property issues.
Concept Scoring

Concept scoring is a more quantitative version of concept screening

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Intermission

Let's all go to the Lobby
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**

- Identify Customer Needs
- Establish Target Specifications
- Generate Product Concepts
- Select Product Concept(s)
- Test Product Concept(s)
- Set Final Specifications
- Plan Downstream Development
Why Preliminary Costing?

At this stage, we just want to obtain general parameters of cost
- Can be “Go/No-Go” point
- Can help decide between two product concepts
- Can help with corporate finances, budgeting, etc.
Costing Overview

- Basic income/expense categories:
  - Development costs
  - Ramp-up costs
  - Marketing and support costs
  - Production costs
  - Sales revenues

- Alternate breakdown:
  - Fixed costs (aka “general and administrative expenses” or G&A)
  - Variable costs

- Another breakdown:
  - Indirect costs ~ fixed costs
  - Direct costs ~ variable costs
Cost Estimates

- Development costs: multiply person-hours by hourly rate
- Ramp-up costs: big-ticket manufacturing/tooling items plus labor to set up manufacturing line
- Unit cost: sum of costs of all major components
- Add overhead (depends on company)
  - Add roughly 40-80% of personnel costs
  - Add roughly 15-30% of material costs
- Rule of thumb:
  - Electronic products typically cost (unit cost × 4) per unit
- Final cost: \( N \times (\text{unit cost} \times 4) + C_{\text{devel}} + C_{\text{ramp}} \)
Caveat: NPV

NPV: Net present value

If we expect units to sell at $100/each in 3 years, how much is that actually worth in today’s dollars?

- \((1 + r) * C = V\)
  - \(r\) = interest rate
  - \(C\) = amount invested
  - \(V\) = value at maturity

- \(C = \frac{V}{1 + r}\)
  - \(r\) = interest rate (aka “discount rate”)
  - \(V\) = value received
  - \(C\) = equivalent value invested
Summary

- Preliminary costing: rough estimates of final cost to produce
- Output: cost estimates per unit + fixed costs
- Application: based on Product Testing, determine estimated number of sales, compute minimum sales price for profit (compare to sales price valuation)
Product Development Task #5: Concept Selection

- Preliminary costing: determine rough cost of key components and unit cost
- Patent review: find at least five patents that are related to your product concepts
  - Briefly summarize the relevant claims for each patent
  - Describe how each patent will affect your design, if at all
- Complete concept selection procedure
  - Complete concept screening matrix
  - Iterate as necessary
  - Choose one or two concepts to move forward with into the next phase of development

Remember: the better your front-end process, the better your product will be.