Engineers as Entrepreneurs
(Class 11.1 – April 2, 2013)

CSE 3316 – Professional Practices
Spring 2013
Instructor – Bill Carroll, Professor of CSE
Where Are We?

✓ Contemporary issues (1/15 – 1/31)
✓ Professional ethics (2/5 – 3/5)
✓ Mid-term exam (3/7)
✓ Spring break
✓ Communications (3/19 – 3/28)
  • Entrepreneurship (4/2 – 4/11)
  • Career planning (4/16 – 4/23)
  • Student presentations (4/25, 4/30, 5/2)
  • Final exam (5/7)
  • Guest lecturers throughout the semester
Reading Material (S&E Library reserve)

✓ Communications module


- Entrepreneurship module


- Career Planning module

Part 1: Technology Entrepreneurship for Scientists and Engineers

Chapter 1: Scientists and Engineers as Entrepreneurs
Chapter Overview

• The role of innovation and entrepreneurship

• The commercialization process
The Transition to Entrepreneurship

• What translates
  – Engineers conceive, design, build, and operate useful objects or processes
  – Engineering education is a logical foundation for entrepreneurial concepts

• What does not easily translate
  – Linear thinking
  – Formulas
  – Solutions in search of a problem
  – Understanding the way entrepreneurs think
From Bench to Market

Technology

BUSINESS MODEL
Create & Capture Value

Commercial Product

Valley of Death
Why technologies don’t make it to market
Why Study Entrepreneurship?

• The most commonly held expertise of S&P 500 CEOs is finance, operations, and marketing
• Scientists and engineers who want to lead companies need to know how to back up ideas with numbers
• You will learn the complex business processes involved in commercialization
• You learn how to make trade-offs among features, benefits, price, markets, and operations
• You learn how to adapt to uncertainty and change
• You learn techniques for managing people
The Role of Innovation and Entrepreneurship

- Technological change and entrepreneurship are critical components of growth models based on market incentives.
- The new economy is characterized by:
  - Knowledge workers
  - Globalization
  - Innovation
- Time-to-market is a key competitive advantage
What is Innovation?

- Producing something new
- Commercializing or extracting value from ideas
- Schumpeter’s five types of innovation
  - New product or substantial change in existing product
  - New process
  - New market
  - New sources of supply
  - Changes in industrial organization
- Incremental innovation = improvements on existing products
- Disruptive innovation = game changers
Dispelling Innovation Myths

• The myth of the great idea
• The myth of the replicable process
• The myth of doing what’s expected
• The myth of the solo inventor
• The myth of the first mover
The Commercialization Process

1. Discovery
   - Invention
   - Innovation

2. Opportunity Recognition
   - Invention Disclosure
   - Concept Development

3. Feasibility
   - Technology Feasibility
   - Market Feasibility
   - Initial Financials

4. Intellectual Property & Regulatory Requirements
   - Provisional patent decision
   - Non-provisional patent filing
   - Other intellectual property
   - Regulatory Requirements

5. Prototype Development
   - Platform
   - Applications
   - Testing
   - Pre-clinicals

6. Market/Customer Test
   - Field test
   - Applications
   - Testing
   - Clinical Trials

7. Launch Strategy
   - License
   - Start a Business
   - Sell or joint venture

8. Business Plan
   - Execution Strategy
   - Develop operations plan
   - Develop marketing plan
   - Secure needed management
   - Identify funding needs & sources

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Part 1: Technology Entrepreneurship for Scientists and Engineers

Chapter 2: Recognizing and Screening Technology Opportunities
Chapter Overview

- Opportunity recognition and creation
- Sources of opportunity
- Screening technology opportunities
How Opportunity Happens

• When entrepreneurs are involved in an active search for opportunities

• When entrepreneurs have the skills to spot an opportunity in the market

• When they have experience in an industry or field of endeavor
Employing Creative Problem-Solving Skills

• Divergent thinking
  – Pulls you away from a central point to explore different directions
  – Used to generate many ideas quickly

• Convergent thinking
  – Brings you back to focused thought
  – Evaluate ideas and devise solutions

• Simplistic problems: only one answer
• Deterministic problems: a formula produces one answer
• Random problems: different answers are possible
• Indeterminate problems: many different answers are possible, but you need all the information or the right formula
Restating the Problem

- Initial problem statement: We don’t have enough lab space.

- Restatement: There are too many people for the space we have.

- Restatement: How can we reduce the number of people we have?

- Restatement: How can we use the space we have more effectively?
Engineering Approach to Creative Problem Solving – Clegg & Birch

• Surveying
  – Gather information to solve the problem and set a goal for the end of the process using divergent and convergent thinking.

• Building
  – Based on the information gathered, devise a method for getting to the goals, identifying all potential obstacles

• Waymaking
  – Turn what is built into a solution. This is an iterative process that considers the views of all the stakeholders

• Navigating
  – Determine resources required to implement the solution and metrics to track progress and signal reaching the goal
TRIZ Approach – defining the real problem

• This approach focuses on the problem in the belief that the problem defined may not be the actual problem.

• Problems suitable for TRIZ
  – Technical conflict and physical contradiction
  – Inventive problem – involves a trade-off or invention a solution to resolve a conflict
  – Ideal machine – finding the simplest way to make the invention work – how to simplify the device
Sources of Opportunity

- Study an industry
- Search the patent literature
- Talk to customers
- Look into university opportunities
- Investigate government sources
- Find new value in existing technology
Screening Technology Opportunities

Gauge technology readiness

Determine intellectual property status or potential for IP

Identify potential market applications

Estimate resource requirements

Determine potential risks & challenges

Select technology opportunity
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Part 1: Technology Entrepreneurship for Scientists and Engineers

Chapter 3: Designing and Developing a Technology Start-up
Chapter Overview

• Developing a business concept

• Conducting a feasibility analysis

• Is this business feasible?
Developing a Business Concept

• Two-sentence statement:
  – Customer, benefit, product/service, distribution

  HeadBlade Co. LLC provides a state-of-the-art way for men to easily and safely shave their heads. Customers control the blade with their own hands, preventing unwanted cuts. HeadBlade is delivered direct to the consumer through the company’s Internet site.

• Features versus benefits
  – Features are attributes such as an ergonomically-designed handle
  – The benefit answers the question, “what’s in it for me?”
  – Here the benefit is convenience and safety
Feasibility Analysis – Key questions

• Are there enough customers to make the business work?

• Do the capital requirements to start the business make sense?

• Does the entrepreneur have the right team put together to execute the concept?
Components of Feasibility Analysis

- Industry analysis
- Market and first customer analysis
- Product/service analysis
- Founding team assessment
- Financial analysis
Analyzing the Industry Growth Cycle

Figure 3.1 Industry Growth Cycle

- **Domination of a few firms**
- **Demographic Shifts**
- **New Industry Emerges**
- **Changes in customer markets**
- **Intense product differentiation**
- **Uncertainty reduced/proprietary rights less exclusive**
- **Firms that can’t compete exit**
Key Industry Information

- Demographics: size, lifecycle stage, growth, rate, etc.
- Trends and patterns that predict change
- R&D expenditures
- Regulatory requirements
- Intellectual property acquisition
- Opinion leaders
- Threats
- Typical gross margins
Market Analysis – Key Questions

• Who is most likely to be the first customer for this product? In other words, who is in the most pain?

• What does this customer typically buy, how do they buy it, and how do they become aware of it?

• How often does this customer buy, and what is their buying pattern?

• How loyal is the customer to the current solution?

• What are the switching costs to the customer of moving to the new technology?

• How can this company meet the customer’s needs?
Market Research

• Evaluate information needs
• Conduct a customer test
  – Definition of the target market
  – Identification of first customer
  – Estimate of demand
  – Willingness of customer to purchase from the entrepreneur
• Create the customer profile
• Forecast demand
  – Triangulate from points of view of the entrepreneur’s knowledge and experience, analogous products, and industry experts
  – Experiment by going into limited production
Analyze the Competition

• Good competition: companies that serve their customers poorly

• Bad competition: companies that are doing a good job of serving customers

• Visit competitors’ physical sites
• Purchase their products
• Study public companies as benchmarks of excellence
• Talk to trade associations
Analyze Product/Service Feasibility

• Is the technology technically feasible?
• Can it be produced in quantity at a reasonable cost?
• What are the intellectual property requirements?
• Are there regulatory requirements?
• What is the plan for product development?
• How much money will be required?
• What is the timeline for completion?
Analyze the Management Team

• Relevant experience

• Ability to execute the plan

• Gaps in experience and how you will fill them

• Advisory board
Business Model and Capital Requirements

• Choices for commercialization
  – Licensing to third parties
  – Selling the technology outright
  – Partnering with a larger company and sharing the technology
  – Starting a new venture

• How can the venture create and capture value?

• How much cash is needed to start the business and operate to a positive cash flow from the revenues generated by the business?
Is the Business Feasible?

• Have the major challenges been identified and dealt with?

• Does the industry provide an environment conducive to success?

• Can the new venture enter and capture a market niche?

• Can the team make this happen?

• Can funding be raised to support the venture until revenues are sufficient.
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