WELCOME to IPPD/TE

• Joint course on
  – Integrated Product and Process Design
  – Technology Entrepreneurship
• IPPD taught from MIT
  – Anna Thornton
• TE taught from Univ. Maryland College Park
  – Scott Shane

Lecture outline

• Motivation for joint class
• Administration
• Project
• Introduction to IPPD
Purpose of the class

• We want to jointly teach you the process of
  – Developing a good product
  – Developing a good business
• Assignments and lectures are coordinated

Entrepreneurship and IPPD

• Entrepreneurship
  – ..seeks to understand how opportunities to bring into existence “future” goods and services are discovered, created, and exploited by whom and with what consequences
    Venkataraman “The distinctive domain of entrepreneurship research”
• IPPD
  – seeks to discover, create, and exploit future goods and services
Goal of the class

• These are both *theory courses* not how-to classes
• We assume you have the basics of finance and product development
  – General rule: *no undergraduates*
• If you want a “how-to” take Eppinger’s class and the E-lab courses

FAQ

• Can I take just the Entrepreneurship course?
  – No. There are several other classes that are similar.
• Can I take just the IPPD course?
  – Yes, but we encourage you to take both. The assignments last year were significantly better for those taking both classes
Should I be in this class?

- I haven’t had a business class.
  – Yes, if you are struggling with some of the business concepts, we can get you additional readings
- I’m an MBA student and have never taken an engineering class
  – Yes, we can get you additional readings and help
- I’m an undergraduate
  – No, you should take Eppinger’s class

Tone of the class

- We will not teach you
  – how to write a business plan
  – the steps in product development
- We will teach you
  – how to evaluate business and understand their feasibility
  – how to integrate multiple functional constraints (mfg, design, finance, customer, etc) to develop the best product
Administration

• As of Feb 8th
  – TE taught **TUES 5-7**
  – IPPD taught **THURS 5-7**
• Web sites
  – http://web.mit.edu/2.742
  – http://www.rhsmith.umd.edu/bmgt798a
• Lecture notes
  – Available the night before

Administration Continued.

• TAs
  – MIT: Erik Nelson (nelsone@mit.edu)
  – UM: Saquib Chowdhur
    (schowdhu@wam.umd.edu)
• Office hours
  – Prof. Thornton Tues 2 - 3
  – phone: 617 253 7677
  – office: 3-449
  – Email: acthornt@mit.edu
Lecture format

• Combination of
  – Traditional lectures
  – Case studies
  – In class exercises
• Expect everyone to participate
  – 15% of grade
  – You need to make intelligent commentary on the discussion

Participation

• Because of the remote teaching we need to create a structure
• 7 people at each site designated to participate
  – Random selection at the start of class
  – You have to participate in two classes in a row
• Please state your name before speaking.
• We need to use a “request/acknowledge” system to help cameras
Problems with remote systems

- Potential problems
  - Delay
  - Movement
  - Background noise
  - Screen switching
- Please email Scott or me with comments/problems after class or speak with us during break
- If there is a major breakdown, we will make up class on one of our visits

Project

- One semester project
- Team based (4-6 people)
- $500 budget (details to be given later)
- Choice of working within site or across sites
Scenario

- You are a new startup or group within a larger company
- You are proposing to a seed fund or budget team a business concept for a product family

Assignments

- Proposal will include
  - The preliminary design and production plan for a product family
  - The preliminary business case
  - The key product risks and proof that they can be overcome
    - Prototypes, analysis etc.
  - The key business risks and proof that they can be overcome
    - Comparisons to other product, financial analysis etc.
Three assignments

- Assignment 0: The idea proposal
- Assignment 1: The embodiment design and customer evaluation
- Assignment 2: The final design and business case
- Assignment 1 and 2 are handed in twice
  - *First time* is written. Profs. Shane and Thornton will evaluate and give comments
  - *Second time* is written and presented and will address the comments

Structure of the assignments

- Three parts for each assignment
  - What have you *proposed*
  - What are the key *risks* associated with your proposal
  - Provide *analysis* to evaluate the key risks
- Example
  - Proposing a new bike seat
  - May break
  - FEA analysis to calculate max stresses
## Deliverables

- The product concept
- Engineering and Business analysis
- Relevant prototypes that evaluate key risks
  - FEA
  - User prototypes tested with customers
  - Technology demonstration
  - Packaging prototypes

## Introduce people

- Name
- Degree program
- Industry experience
Lecture format

• Each lecture will start with
  – Basic introduction to the area
  – How this will apply to your project
• Each lecture will finish with
  – The key points from the lecture
  – What we expect in the assignments
80% of the final cost of the product is set in the first 20% of the design process.

To do up-front analysis

- Must understand the downstream impact of decisions
- Must understand the constraints, cost models and requirements of other functional groups
- Need to design for
  - Product customers
  - The customers for your work (manufacturing, sales, marketing, field service)
Definitions of IPPD

- Definitions
  - Integrated Product and Process: The tradeoffs and coupling between functional needs (i.e., product and process)
  - Development: The tools and methods used throughout the development cycle to enable to identify IPP tradeoffs and make the “best” decisions.

What does IPPD gain you

- Reduced cycle time
  - Move from a sequential process to a simultaneous process
  - Reduced time to integrate the product
- Improved quality
  - Fewer adjustments
  - More manufacturable
  - Less inspection
- Reduced costs
  - Reduced rework, scrap and repair
  - Appropriate selection of manufacturing processes
  - Optimization of the entire product, not individual functions
Goal

- Understand principles of IPPD
- When a decision needs to be made, you should be able to understand
  - who to go to talk with
  - what are the key issues
  - what tools to use to make tradeoffs and decisions
  - what are the implications and effects of your decision
  - what are the risks

Course focus

- Course starts at the point when a product development project gets going
- Assumes that you understand how
  - Marketing and customer requirements are elicited
  - Ideas are generated, and
  - Product specification have been set
- We will talk about the implication/context but not cover the theories
Assumptions

• Product development is a process of tradeoffs
  – Every decision made will effect the ability of another member of the PD team to achieve their goals
  – There are tools that can highlight tradeoffs

• Cost is the ultimate metric
• Decisions are made in an environment of uncertainty, the uncertainty results in risk
• Decisions are impacted by
  – technical issues
  – cost impact
  – organizational structure

Products and platforms not parts

• Multiple product
• New technologies
• Pushing the edge of process capability
• Systems integration is hard
  – Many intended interactions
  – Many unintended interactions
• Many people and significant time to develop
Benefit of rapid PD

- Cost of delay
  - Automotive: $10M per week
  - Copiers: $1M per week
- Other costs
  - Loss of customers (competitiveness)
  - Loss of market share

Break Even vs. Discounted cash flow

Time

$
Reduced development time

IPPD as risk management

- Risk is the probability that the outcome you want won’t happen
- Risk mitigation strategies
  - Risk avoidance
  - Risk reduction through
    - information gathering
    - better practice
  - Risk dispersion through
    - avoiding “all of the eggs in one basket”
    - transfer risks to other players
PD is a resource intensive process

Product realization process

Design > Process Design > Ramp > Production > Delivery > Use

Human resources
Time
Interest costs
Opportunity costs

Tradeoffs

Equipment costs
Reuse
Material cost/performance

Ergonomics

Platform design

Design for repair
Design Time

Part costs

Safety

Performance

Manufacturing Cycle time

Supplier costs

Robustness

Prototypes

Ramp time

Assembly

Logistics

R&D/ New Technology

Risk

Market Share

Quality/inspection

Profit

Continual improvement

Rework/repair

Continual improvement
Key tradeoffs

Goal is to find creative ways to create *synergies* instead of *tradeoffs*

Conundrum

- **Production**
  - “It is just as easy to build a bad product as it is to build a good product” *Deming*
  - Most press on product improvement in production
    - TQM, 6Sigma
  - Benefits immediately seen

- **Design**
  - It is *much* harder to design a good product than a bad product
  - Don’t see the results for years
  - Never know if it was worth the effort
Lectures

- Product architecture and variety
- Product Development Process/IPTs and other organizational structures
- The impact of new technology on product development
- The role of prototyping and scheduling
- Make buy decisions, supplier relations
- DFX
- Variation risk management, the role of quality
- Manufacturing Strategy and the impact of design decisions
- Success Stories
- Methods for managing customer needs
- Target costing, pricing and techniques for managing cost

What you should have learned

- If you should be in this class
- How the class will be run and what the goals are
- A basic introduction to the issues of IPPD and an understanding of the course content
- Questions?
Assignment

• You will need to articulate the key tradeoffs between design, production, functionality, cost, quality, etc.
• You will need to articulate the key risks, assess their probability and describe how you are going to mitigate the risks.

Thursday’s lecture

• Ulrich, “The role of product architecture in the manufacturing firm”

• What are the types of product variety?
• What drives the selection of product variety?

• What other elements can be included in product architecture to create product variety (i.e., service, software)?
• Bring to class a picture or other material for a product that you consider to have an interesting/good way of developing product variety