## WELCOME to IPPD/TE

- Joint course on
  - Integrated Product and Process Design
  - Technology Entreprenurship
- 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



## Enterprenurship and IPPD

- Entreprenurship
  - ..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 Entreprenurship 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.edu8001/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

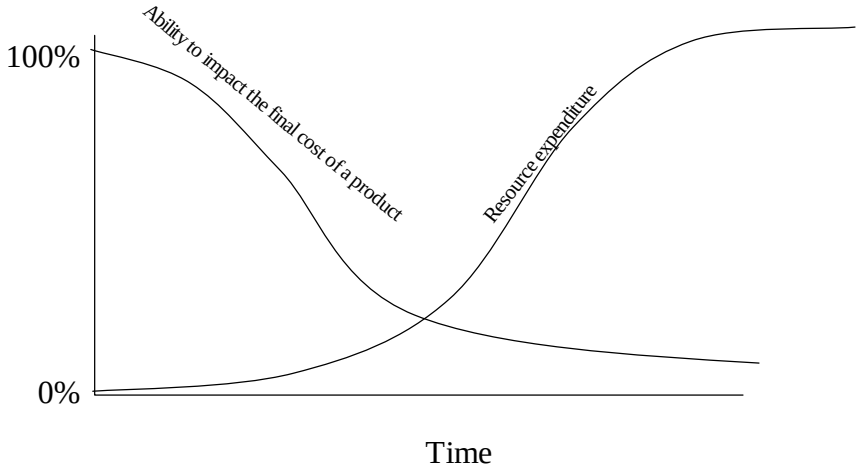
- Each lecture will start with
  - Basic introduction to the area
  - How this will apply to your project
- Each lecture will finish with
  - The key points from the lecture
  - What we expect in the assignments



## IPPD

- Course introduction

## Motivation for up-front design




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

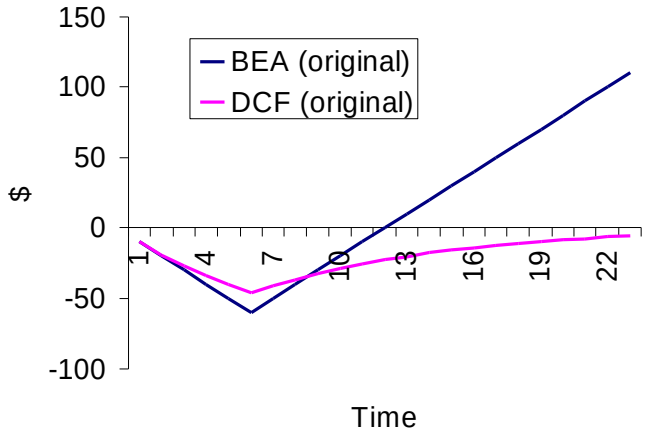
- Multiple product
- New technologies
- Pushing the edge of process capability
- Systems integration is hard
  - Many intended interactions
  - Many unintended interactions
- Many people and significant time to develop

# Benefit of rapid PD

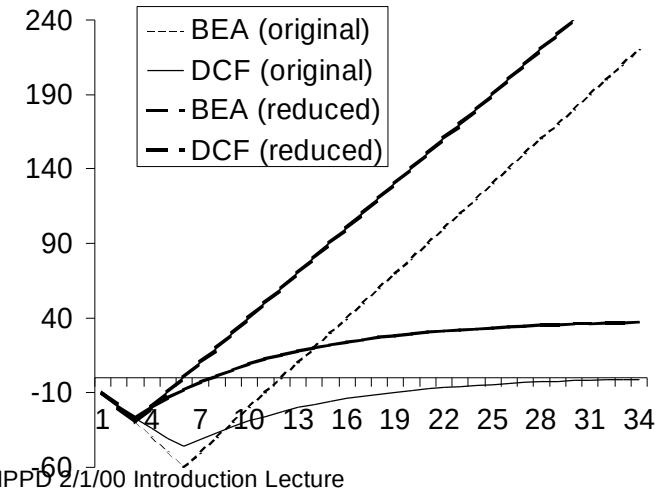
- Cost of delay
  - Automotive : $10M per week
  - Copiers: $1M per week
- Other costs
  - Loss of customers (competitiveness)
  - Loss of market share



Break Even
vs.
Discounted cash flow



## Reduced development time

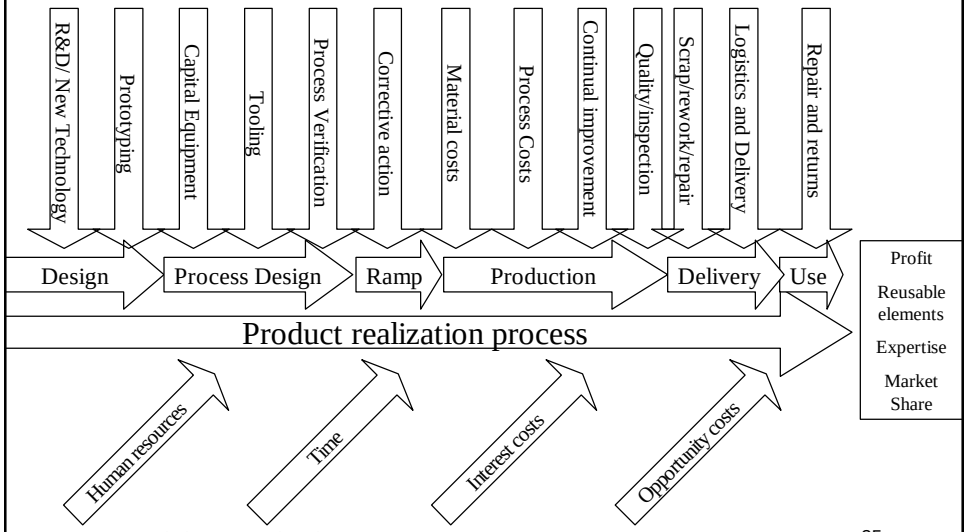





## IPPD as risk management

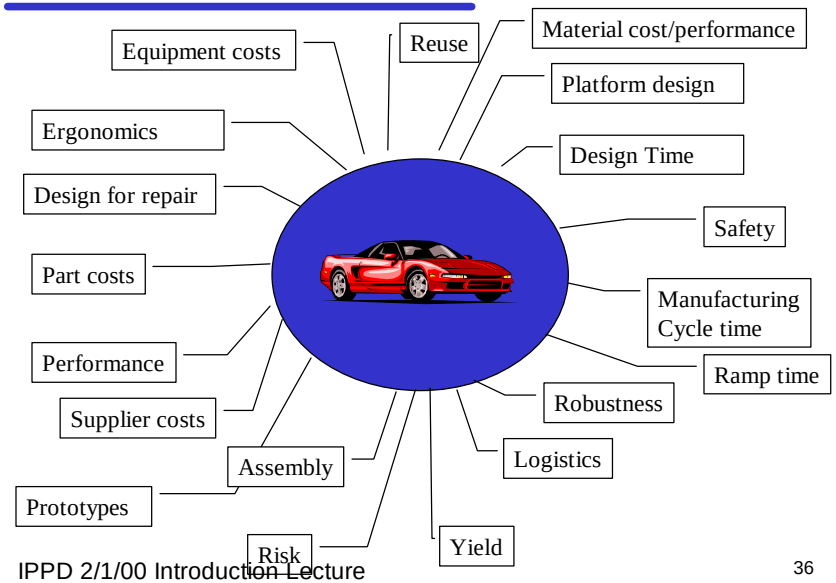
- Risk is the probability that the outcome you want won't happen
- Risk mitigation strategies
  - Risk avoidance
  - Risk reduction through
    - information gathering
    - better practice
  - Risk dispersion through
    - avoiding "all of the eggs in one basket"
    - transfer risks to other players

# PD is a resource intensive process

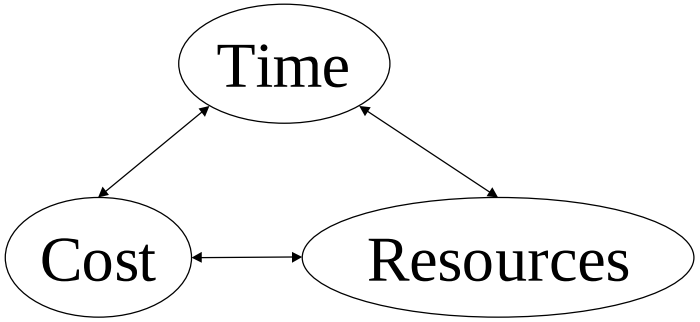





# Tradeoffs



## 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

- Meyer, M. H. and A. P. Lehnerd *The Power of Product Platforms.*
- 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