

# The Art and Science of Engineering Product Design



Gary Banta

1/14/08

# Agenda

- Part 1: The assigned topic: Introduction to Engineering Design
  - Engineers, companies, projects, products
- Part 2: Emphasis on the “art”
  - What to make? Ideas and Entrepreneurship

# Engineering is...

*“...the creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property.*”

**American Engineers' Council for Professional Development**

# Engineering is...

... the discipline of acquiring and applying scientific and technical knowledge to the design, analysis, and/or construction of works for practical purposes

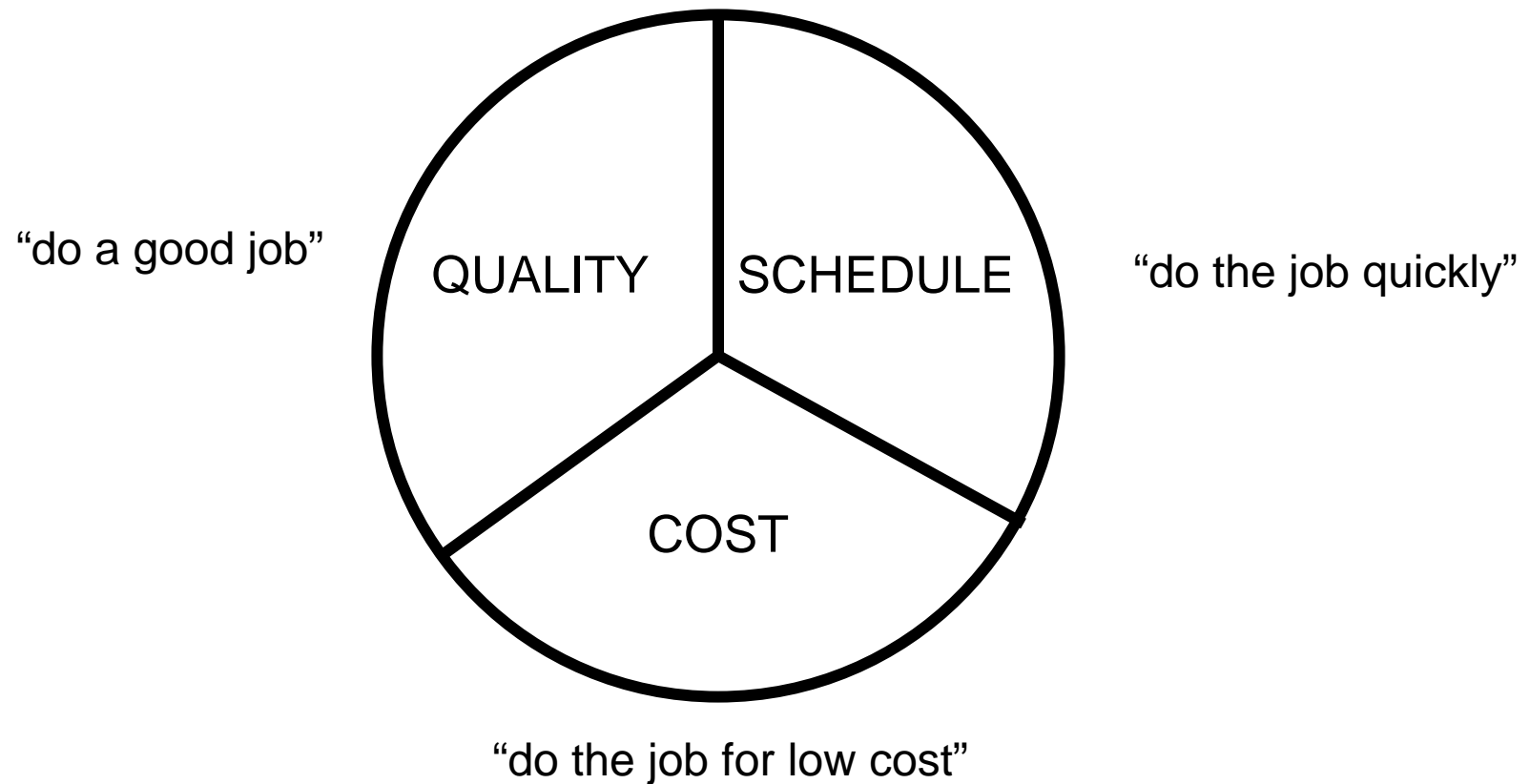
**Wikipedia**

# Engineering is...

... the art of informed compromise so as  
to best satisfy conflicting constraints

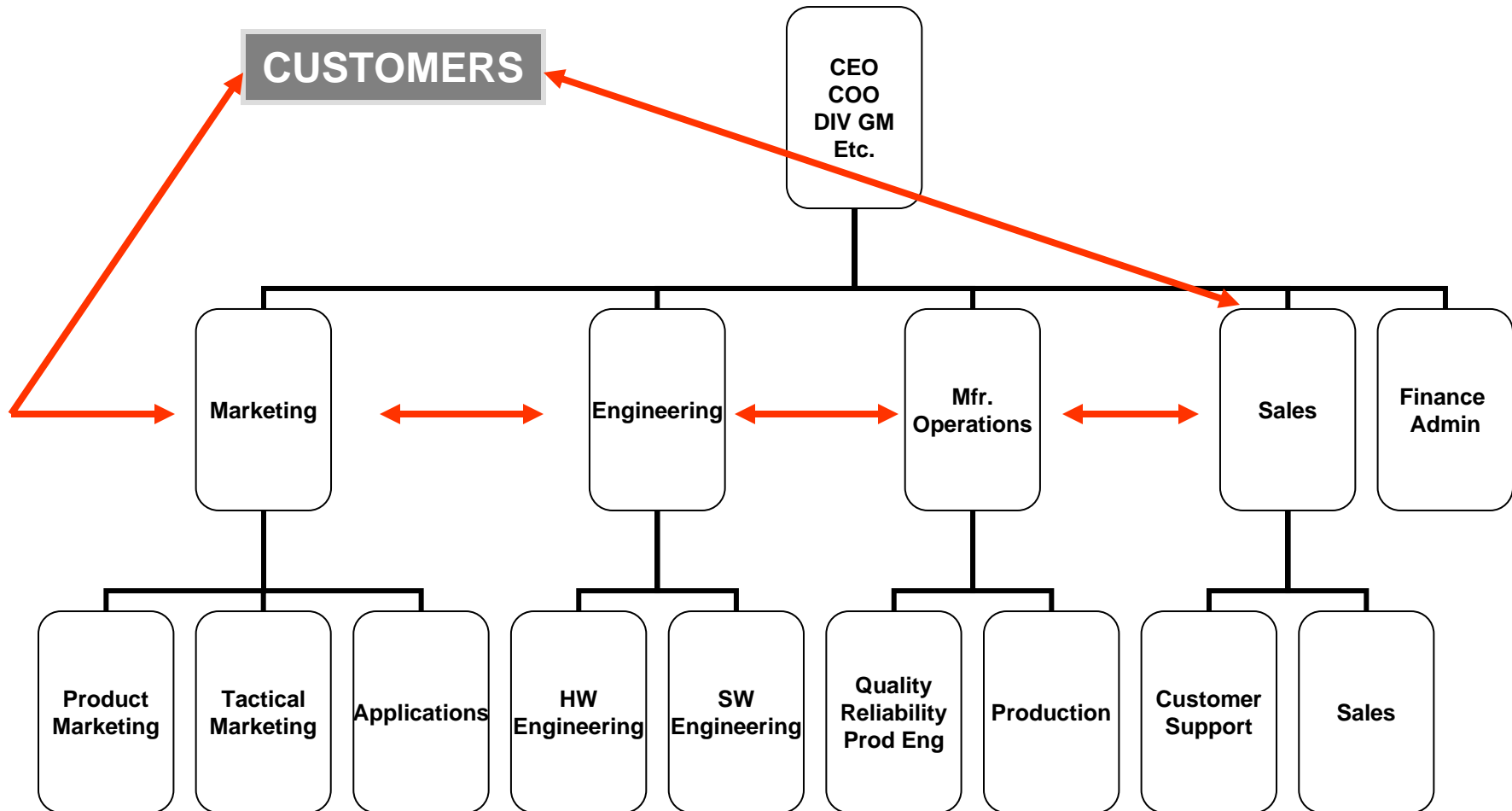
Gary

# Example: Project Constraints

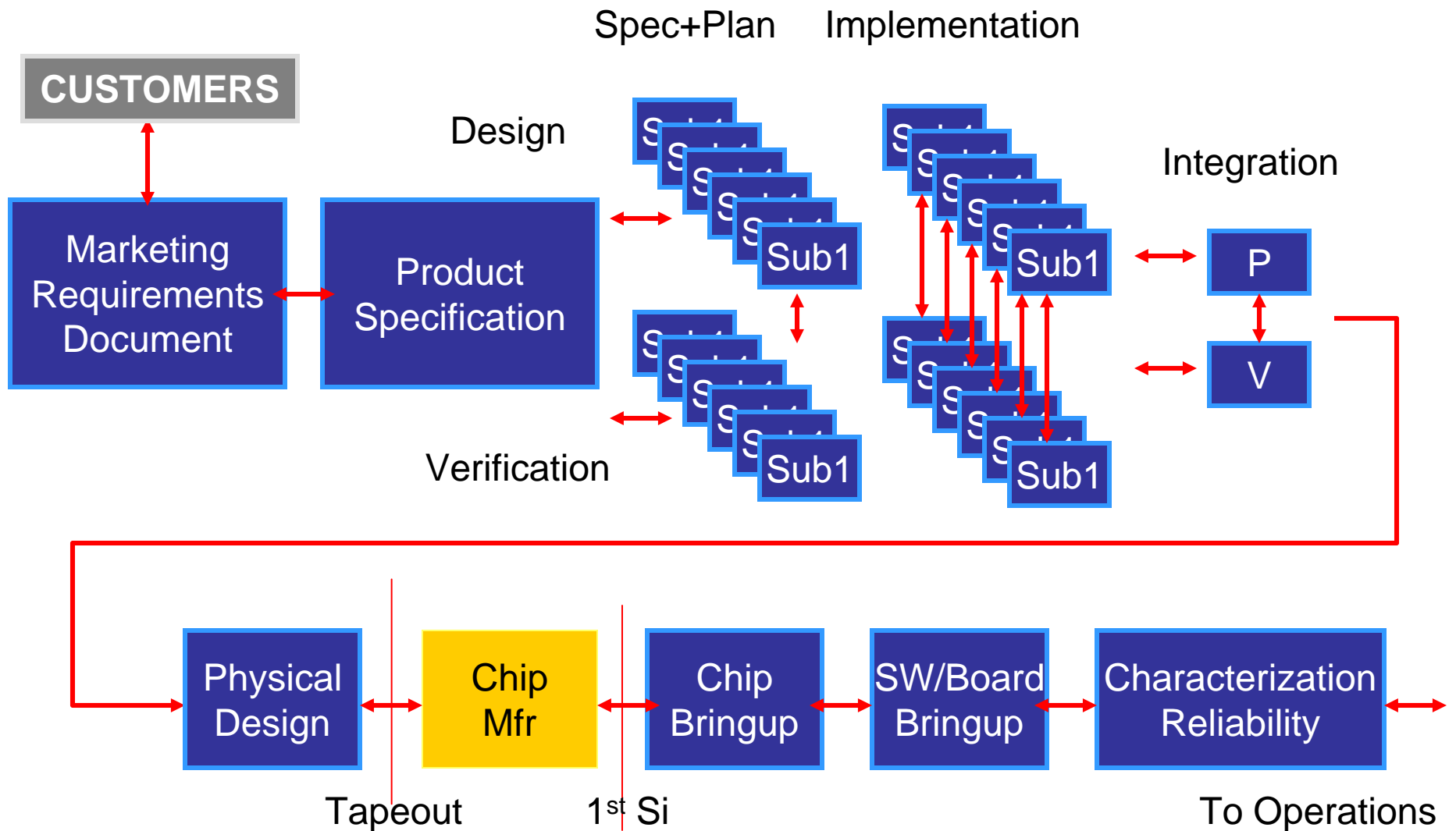


Pick any two...

# Functional Organization

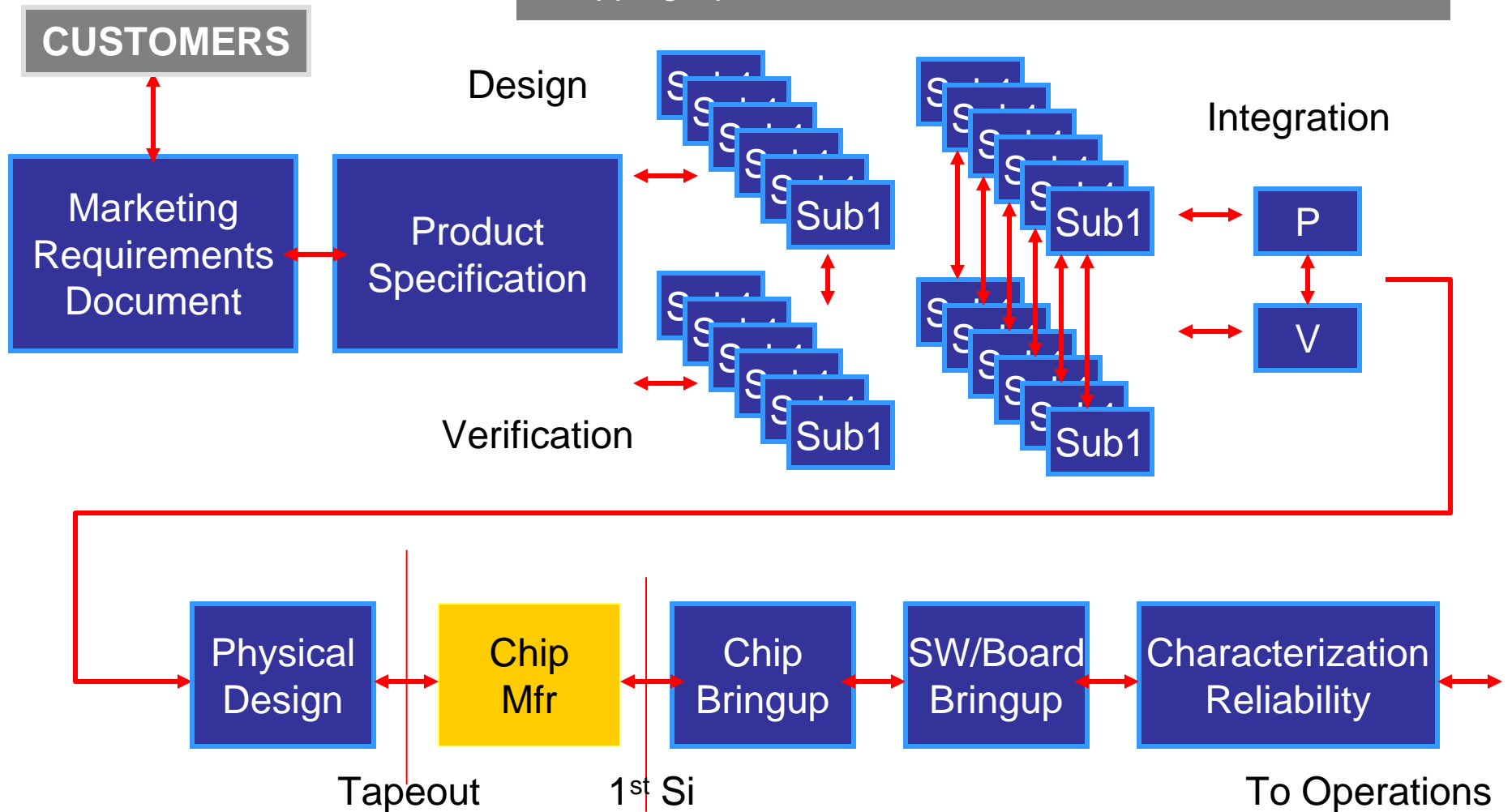


# Example Chip Project

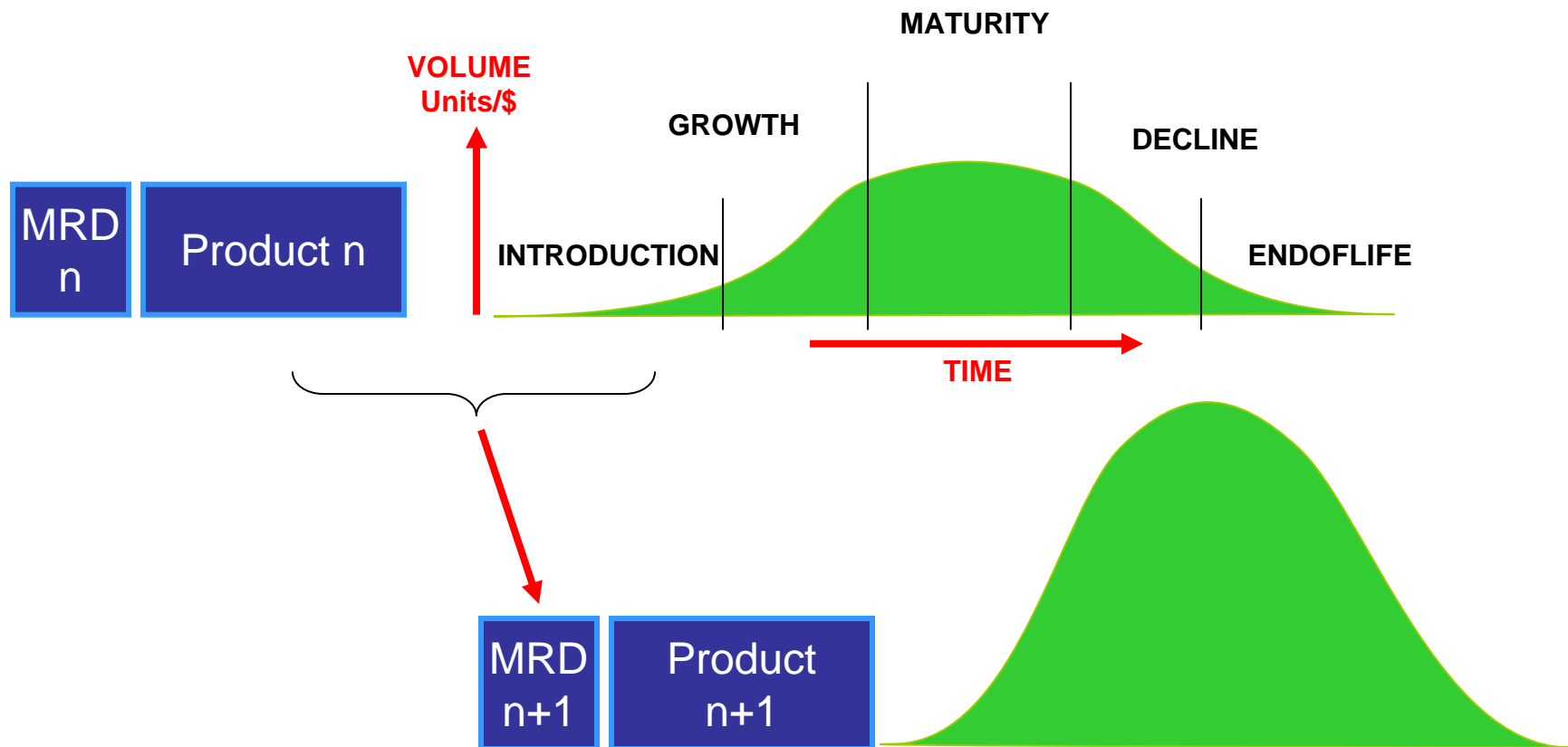


# Exam

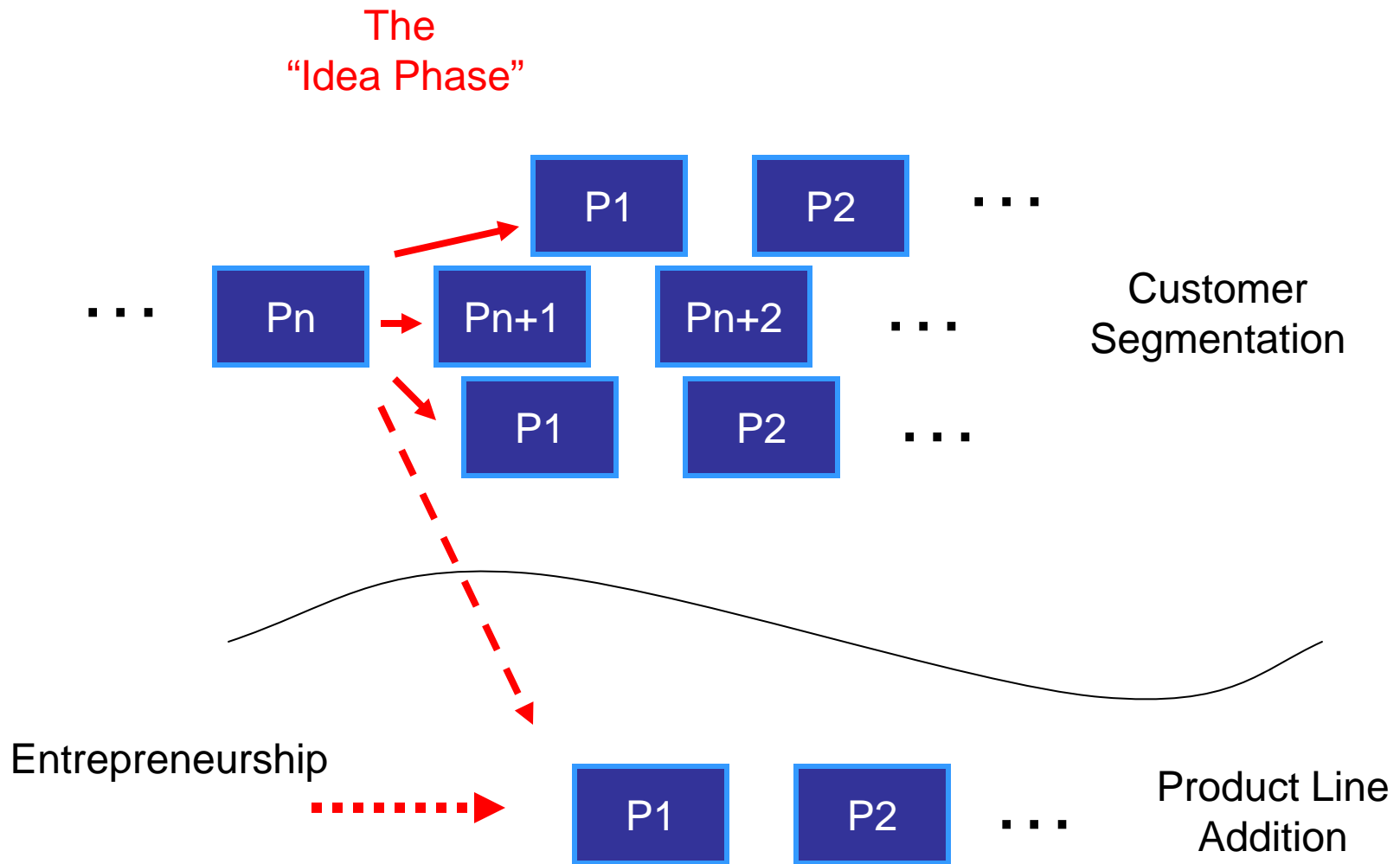
Introduction to Engineering Design– Gary Banta  
The Design Process - Jim Fruchterman  
Defining an Engineering Problem – Mark Ross  
Function and Specifications - Michael Farn  
Generating Design Ideas – Shanda Bahles  
Why Things Fail - Panel: Eve, Karin Meyer & Joseph Hei  
Wrapping Up - Vinu Sundaresan



# Product Lifecycle



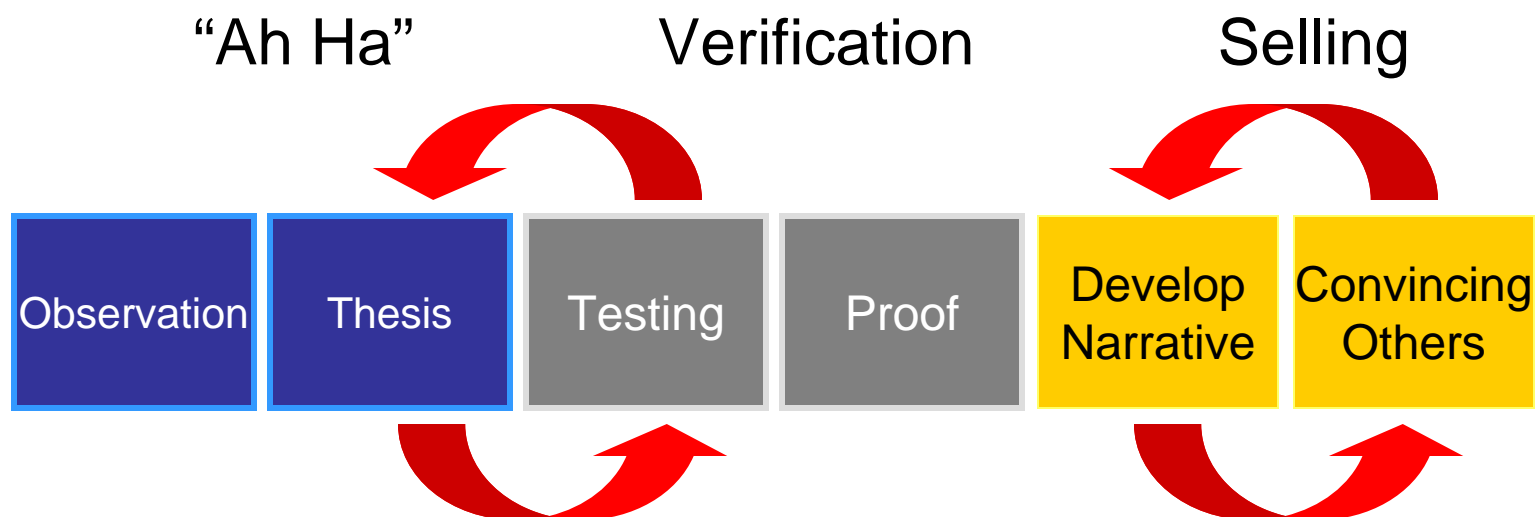
# Product/Project Proliferation



# Moving To The Driver's Seat

Creating Ideas  
and Leading Others

# Where Do Ideas Come From?



- Incremental innovations
    - Easier to develop, prove and sell (internally and externally) – but less differentiating
  - Major (Disruptive?) Innovations
    - Vastly harder to develop, etc (especially sell) but highly differentiating
- iPod => Video iPod
- TIVO

# TIVO Realities

- Founded in 1997– before first mp3 player
- Observation – hard drive capacity growth enabled digital video storage in a consumer device – better than VCR
- Technical execution very straight forward (black-box a Linux machine)
- Marketing problem
  - Creating a true consumer product
  - Explaining the product to consumers
  - When most consumer's VCR flashed 12:00

# Entrepreneurship Realities

Someone is going to  
win the lottery...

...just not you

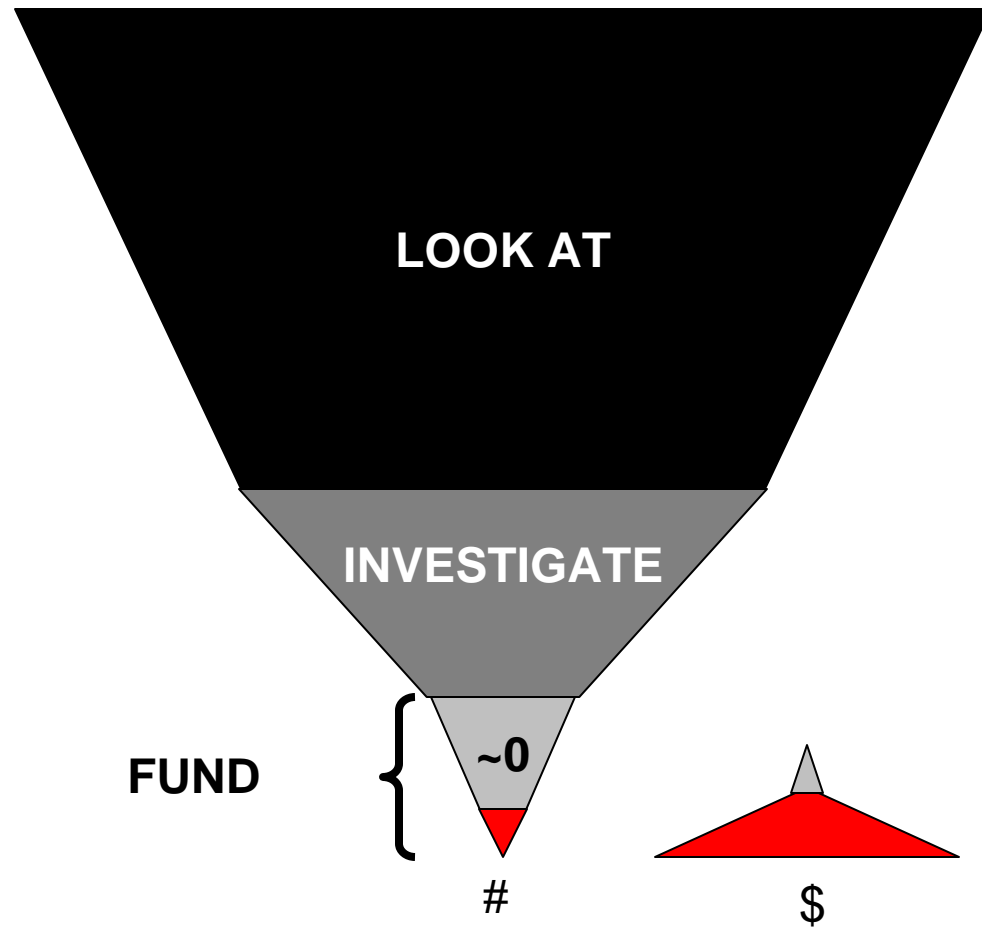
# Realistic Timeframes

- Expect 5 to 7 years before you know if the venture will be successful
  - What were you doing 5 to 7 years ago?
  - Starting company A means you are not starting company B (opportunity cost)

# Role of Market Timing

- You can be right and too early
  - Making HD chips before the HD market
  - Was Tivo too early?
- The whole world can believe in a market that doesn't exist or can't work economically
  - Dot com bust/Networking bust/VOIP bust
- The role of luck!

# VC Realities – Deal Funnel



A few deals “make the fund”

# The Biggest Challenge: People

- People – not technology or market problems, are the biggest company killers
  - The team is a long-term commitment
  - Team and culture determine outcome
- 18x7 has unintended consequences
- Experience matters especially earliest stages

# Types of Entrepreneurship

- Classic Venture funded startup (OPM)
  - You ARE an employee
  - Goal is “capital appreciation” through acquisition or public offering
- Start and run your own business
  - You own it. Goal is or should be income
- Internal entrepreneurship within existing company (OPM)
- Invest OPM (VC, banker)

# Managing Your Career

- (Unsolicited advice) Stay in a technical role as long as possible
  - Most engineers eventually move up, out or on
  - Take a seat up front
  - But become an engineer first!
  
- ... the discipline of acquiring and applying scientific and technical knowledge to the design, analysis, and/or construction of works for practical purposes