Innovation & Design
and Modern Engineering Entrepreneurship

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The Point

all individuals in society become wealthier

economic growth

innovation

good design

???
The Point

Innovation creates Wealth

For you
For others (beneficiaries of your innovations)
For the economy

Wealth is not like energy;
it obeys no laws of conservation
The Point

Wealth

Not Wealth
The Point

Wealth  Not Wealth
The Point

Wealth

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???
“Innovation and trade: the ultimate engines of growth.”
—Economist, Oct 3, 2009

“We have to choose to do what past generations have done: shape a brighter future through hard work and innovation.”
—Barack Obama, Sep 22, 2009
(ASEE’s “Obama Touts Innovation Agenda At New York Community College”)

“In the new knowledge economy, innovation and knowledge are the most important factors driving economic growth.”

“Innovation is the heart of economic recovery & future prosperity.”
—Roll Call, Nov 20, 2008
… But, Boy, Is Innovation Hard

• “In an era when most technology outfits have tightened their belts to adapt to a slower-growing market, one company stands out for forging ahead on innovation: Apple Computer.” (BusinessWeek)

• “Big companies are losing their ‘A’ players, and they’re struggling to attract ‘B’ players. In an industry where everything is about people, large tech companies are in trouble because they are losing the talent war. And keep in mind, an ‘A’ player in an organization can usually produce the same results as three ‘B’ players.” (VentureBeat)

• “Lots of companies have tons of great engineers and smart people. But ultimately, there needs to be some gravitational force that pulls it all together. Otherwise, you can get great pieces of technology all floating around the universe. But it doesn’t add up to much.” (Steve Jobs, on innovation)
Some Issues I Would Like to Address Today

1. Despite what we may think, we don’t really teach it here

2. How can you instill it in your business partners/employees?

3. Why #2 matters to you (yes, you)
Talk 1: Thoughts on Teaching Design
What is Design? What is Innovation?

• Can’t define it, but you know it when you see it … 😊

• Close interaction with burnout phenomenon in start-ups

• An inability to eat, think, sleep, care for one’s self while technical problem remains

• Requires staring at one problem for extended period (much like Ph.D. in that regard)
Let’s Look More Closely at that Last Bit

- **Innovation and design requires staring at one problem for extended period**

- Contrast that with academia (undergrad in particular):
  - Attention flits from topic to topic in a scheduled, often frenetic pace
  - Semester concept is both arbitrary and contrived/artificial (innovation recognizes no schedule)

Is it any wonder that **SO MANY** successful entrepreneurs/innovators dropped out of school?
Teach Innovation Despite Scheduled Frenzy?

Necessary Elements:

- Look at one problem for extended period (years?)
- Personal investment in outcome (reward, pride, etc.)
- Time commitment need not be large on per-week basis
- Need to see real examples of both success and failure
- Must be guided by innovators (not academicians, not MBAs)
- Failure is acceptable (grades)
More on Grades

Students calculate the effort needed to get the desired (or lowest acceptable) grade. They do the minimum work required. We (unconsciously) train them to do this.

Needless to say, this doesn’t fly for design. In design, anything less than full attention = failure.
What Are We Doing?

- Electric Guitar Design Class
- MIPS: sponsored R&D
- Innovative engineering designs
- Coil LLC: Commercial venture involving students
What Are We Doing? (You know, besides PR ...)

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The Physics of Sound
What Are We Doing?

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The Physics of Sound
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Iron in a Magnetic Field

Flux Lines

Soft Iron

Glass

Iron in a Magnetic Field
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How a Pickup Works
What Are We Doing?

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Basic Electric Guitar Circuit
What Are We Doing?

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Basic Switching Circuit
(Fender-Style and Gibson-Style)
What Are We Doing?

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Preamp Design for Active Cables
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Switching Patent (one type)
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How do you make them care enough to do it right?
Talk 2: Innovation and the Lion’s Share of Reward
The Problem

Innovation.

Specifically, How to Do It in a Business Setting

... and, you know, like, regularly ...
Some Perspective

Big companies cannot innovate, whereas startups must.

Startups are engineer-dominated; founders (engineers) are rewarded for company’s success.

Upon maturity, startups become management-dominated; executives (non-engineers) are rewarded for company’s success.

(thus #1, above)

Goal: break this cycle
Some More Perspective

Middle managers believe themselves innovators.

“Intrapreneurship” (also termed “corporate entrepreneurship” or “corporate venturing”) tries to foster creativity within corporate environment.

Most studies empower middle management. None investigate rewarding engineers. WTF?

The term *managerial creativity*, a common term in the research literature, probably says it all.
The Problem, Again … and a Solution of Sorts

Either you do everything yourself, or you have partners/employees.

Assuming the latter, how do you instill in others the desire to do good design? How do you ensure that your company innovates? How to get partners/employees to go above & beyond on a regular basis? How do you convince the exceptionally talented that it is worth their while to work for you instead of for themselves?

Arrange it so that they are working for themselves.
Reward: Become a *De Facto* Startup

**Novel concept:**
Pay your engineers as if they are in a startup

Good managers, scarce though they may be, are no scarcer than good designers. Great designers and great managers are both very rare. Most organizations spend considerable effort in finding and cultivating the management prospects; I know of none that spends equal effort in finding and developing the great designers upon whom the technical excellence of the products will ultimately depend.

Fred Brooks (*The Mythical Man-Month*)
If You Are a Startup

**Not-so-novel concept:**
Have every partner buy in
Bottom Line

• Existing trend is to study innovative exceptions (Apple, Google, Fiat, etc.) and try to emulate them.

• Why not emulate an entire industry instead? In particular, the one industry known for innovating regularly.

• What do startups do? They recognize that engineers are their primary innovators, and they PAY them.

Innovation = Wealth
Talk 3: Design and Modern Entrepreneurship
Important development in last decade:

Manufacturing as a Service
The Basic Idea

You → Design Blueprint → Factory → Manufactured Device
The Basic Idea

Design Blueprints

Factories

Manufactured Device

Assembly
Some Blueprints
Some (other) Blueprints
Pros & Cons

<table>
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<tr>
<th>Cons</th>
<th>Pros</th>
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<tbody>
<tr>
<td>Can’t Possibly compete with big companies</td>
<td>Idea already proven in marketplace (shareware, boutique electronics)</td>
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<tr>
<td>Might fail</td>
<td>Win/win situation (even company failure is good résumé material)</td>
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<tr>
<td>Can’t afford it</td>
<td>Low risk/reward ratio</td>
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<tr>
<td>Window of opportunity?</td>
<td>Start soon</td>
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**Bottom line: a path well worth exploring**
Questions?
(thank you for your attention)

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