

# High-Tech Design as Modern Engineering Entrepreneurship

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**Prof. Bruce Jacob**

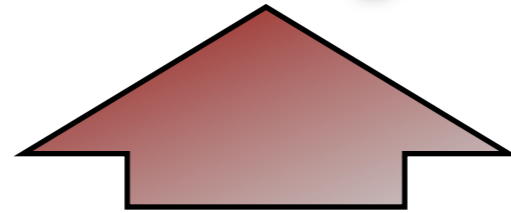
Keystone Professor & Director of Computer Engineering Program  
Electrical & Computer Engineering  
University of Maryland at College Park



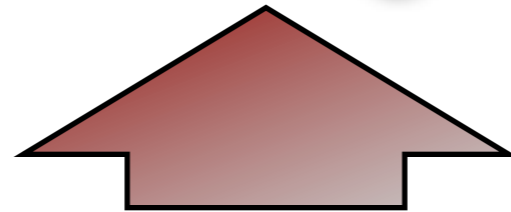
# The Point

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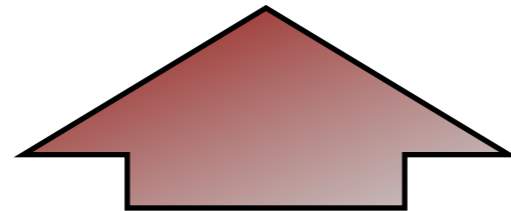
**all individuals in society become wealthier**



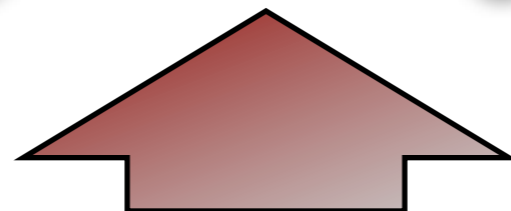
**economic growth**



**innovation**



**good design**



**???**

# It's All About Innovation ...

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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.”

—Progressive Policy Institute: *The Innovation Economy*, Oct 2003

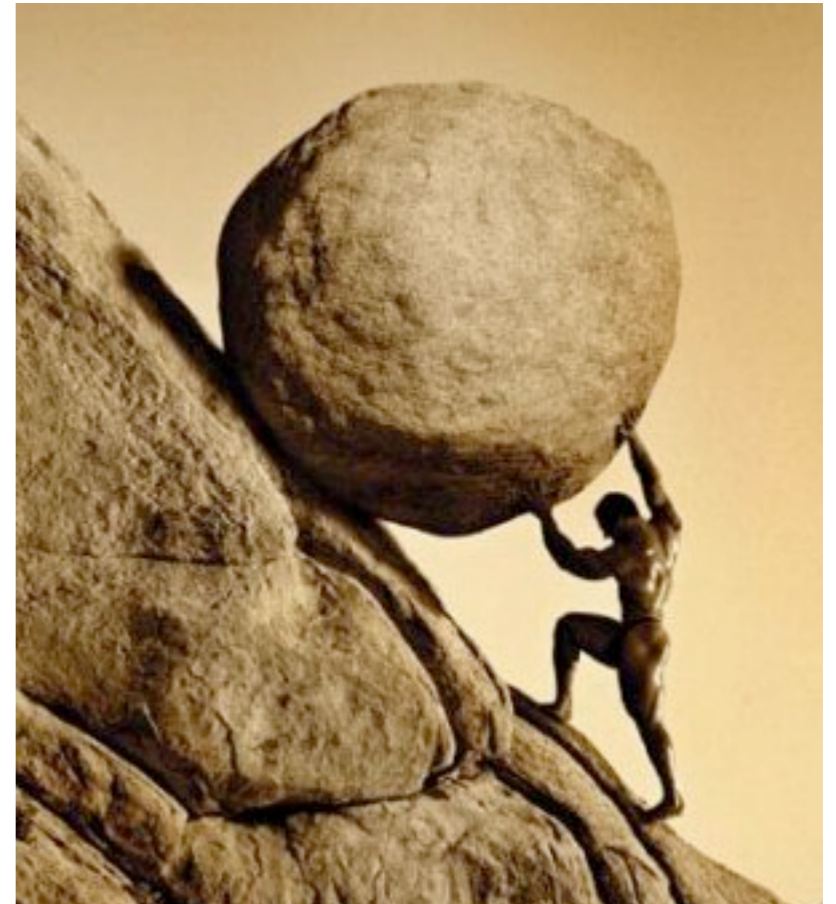
“Innovation is the heart of economic recovery & future prosperity.”

—*Roll Call*, Nov 20, 2008

# ... But, Boy, Is Innovation Hard

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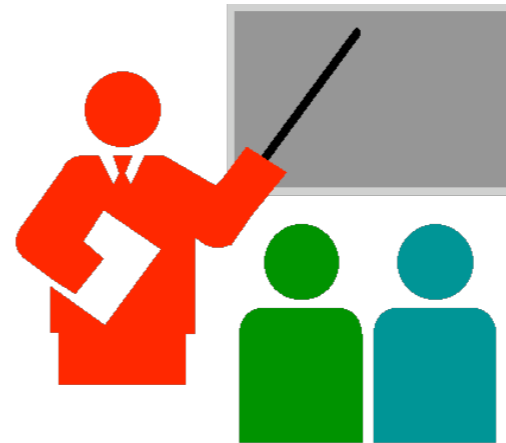
- “In an era when most technology outfits have tightened their belts to adapt to a slower-growing market, one company stands out for forging ahead on innovation: Apple Computer.” (*BusinessWeek*)
- “Big companies are losing their ‘A’ players, and they’re struggling to attract ‘B’ players. In an industry 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*)



# Today's Talk

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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?

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- 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

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- *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)



Larry Ellison



Bill Gates



Stephen Spielberg



Richard Branson



Michael Dell



Steve Jobs

**Is it any wonder that SO MANY successful entrepreneurs/innovators dropped out of school?**



## More on Grades

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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?

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- Electric Guitar Design Class
- MIPS: sponsored R&D
- Innovative engineering designs
- **Coil LLC: Commercial venture involving students**



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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

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**Innovation.**

Specifically, *How to Do It in a Business Setting*

... and, you know, like, *regularly* ...

# Some Perspective

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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**

*"Paul Graham's prose is brimming with contrarian insight and practical wisdom."*

*—Andy Hertzfeld, co-creator of the Macintosh computer*

**PAUL GRAHAM**

## **HACKERS & PAINTERS**

**BIG IDEAS FROM THE COMPUTER AGE**



# Some More Perspective

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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.

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What is the Goal, Again? (the point of innovation)

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## Create Wealth

For you

For others (beneficiaries of your innovations)

For the economy

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



# What is the Goal, Again?

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## Create Wealth



Wealth



Not Wealth

# What is the Goal, Again?

---

## Create Wealth



Wealth



Not Wealth

# What is the Goal, Again?

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## Create Wealth



Wealth



Not Wealth

# The Problem, Again ... and a Solution of Sorts

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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

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## **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

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**Not-so-novel concept:**

Make all participants partners;  
make all partners buy in



# Bottom Line

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- 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

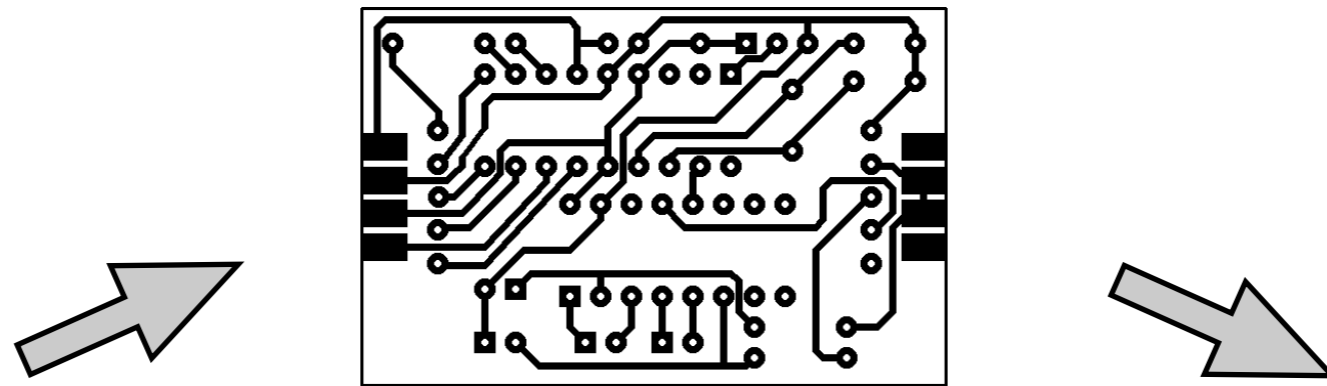


Important development in last decade:

# **Manufacturing as a Service**

# The Basic Idea

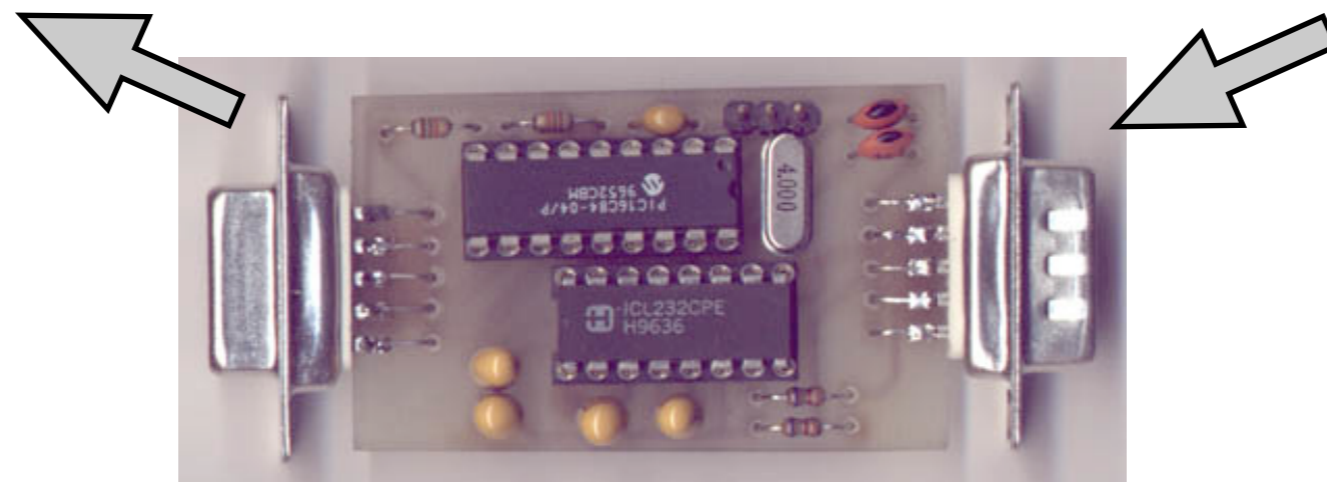
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**Design Blueprint**



**Factory**



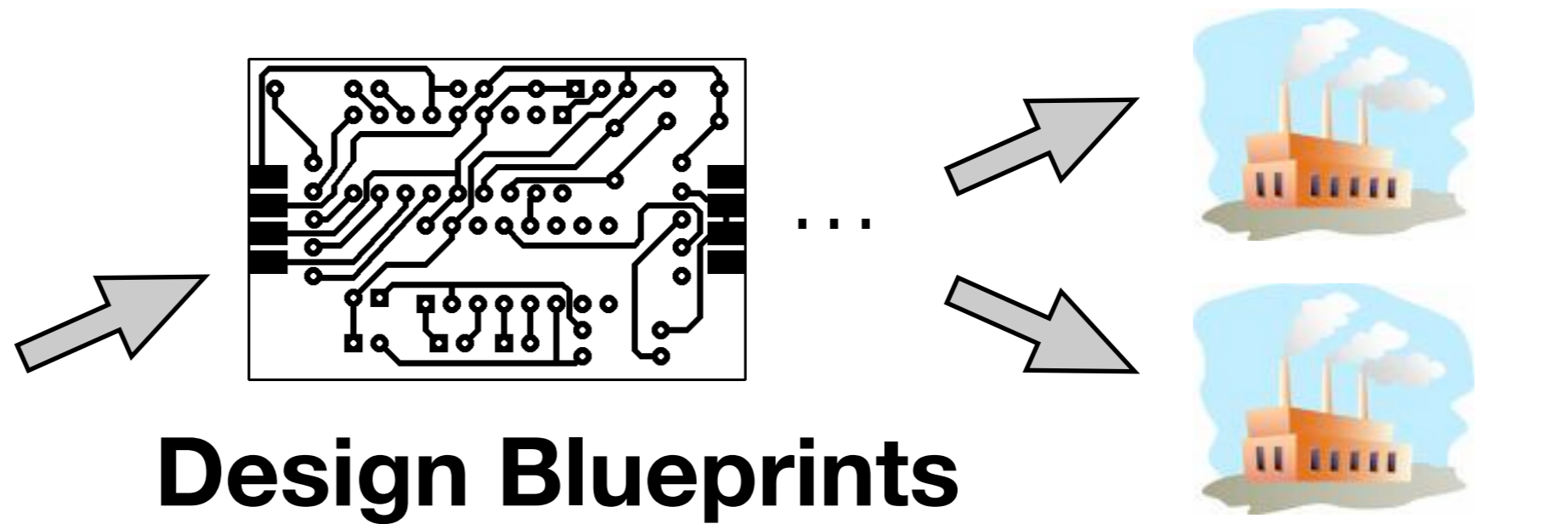
**Manufactured Device**



**You**

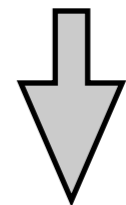
# The Basic Idea

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**Design Blueprints**

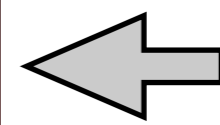
**Factories**



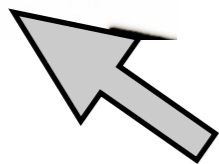
**Assembly**



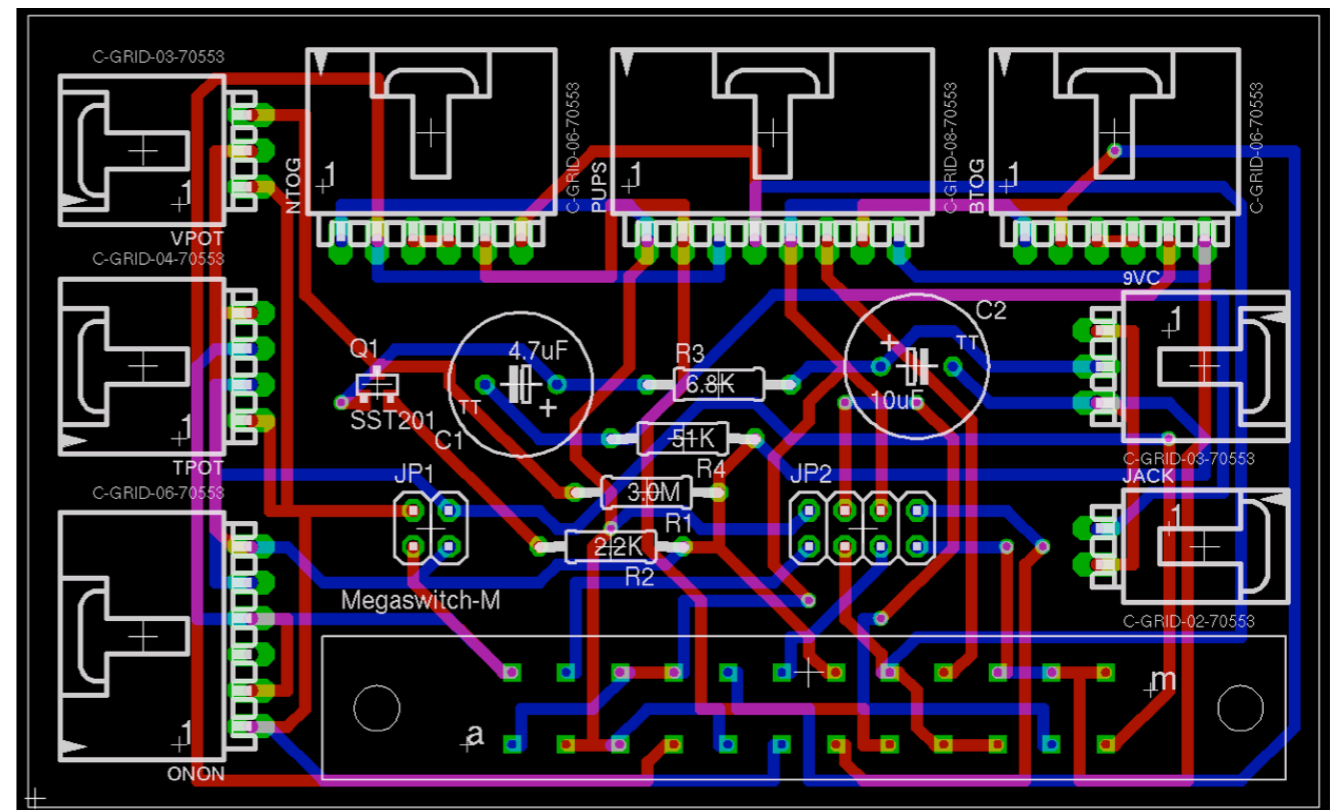
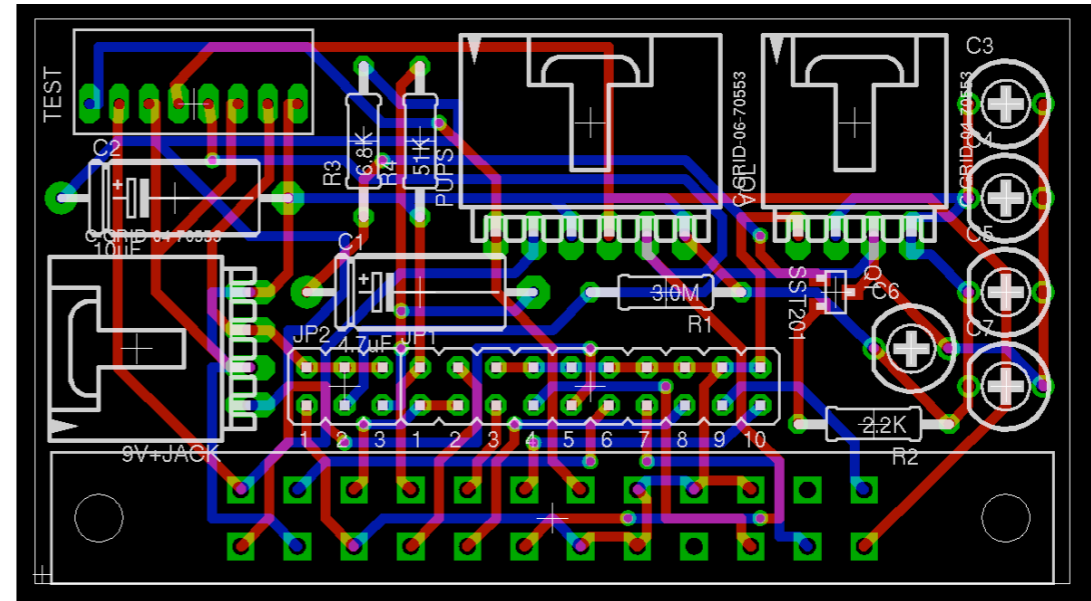
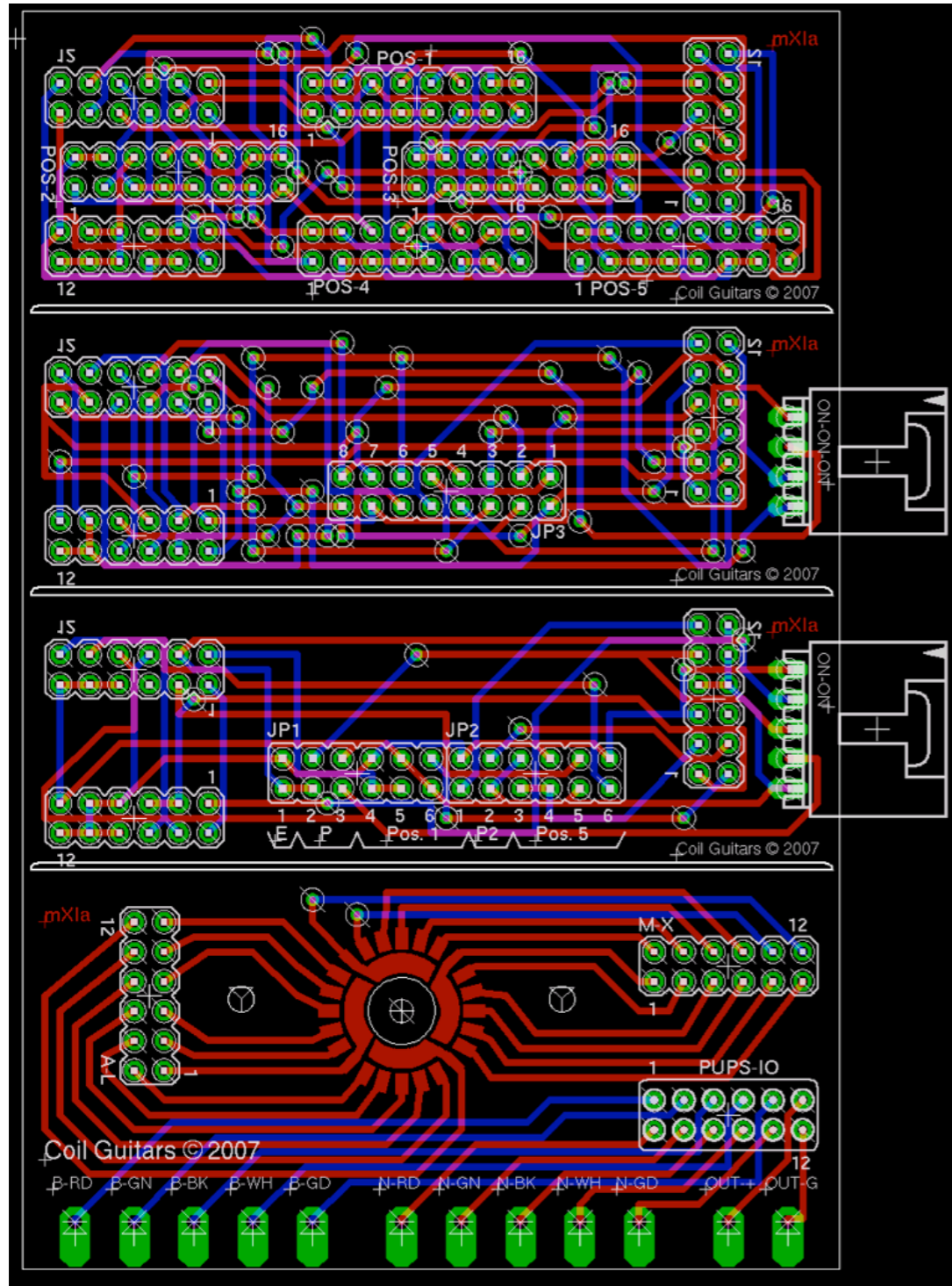
**Manufactured Device**



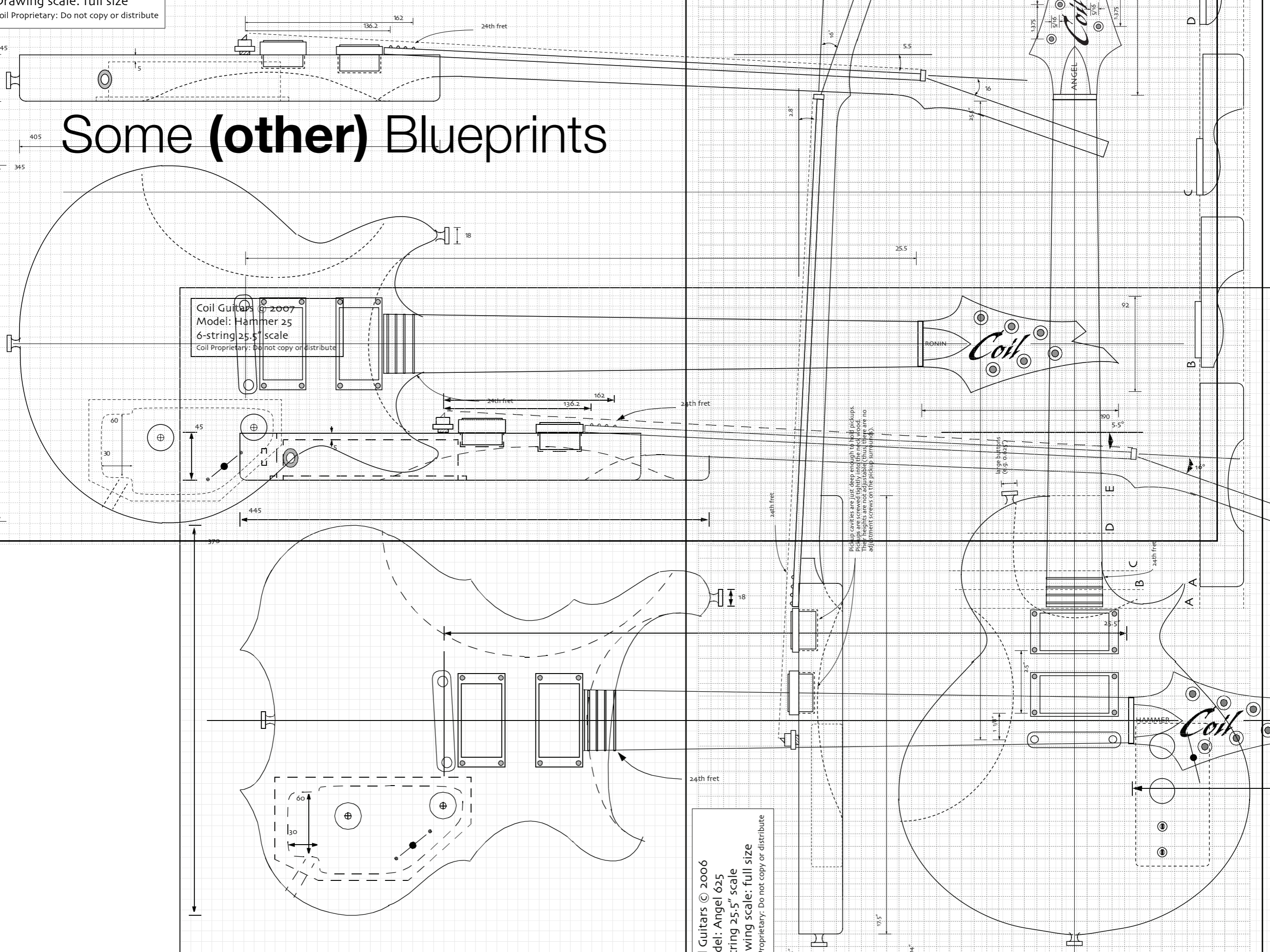
**You**



# Some Blueprints



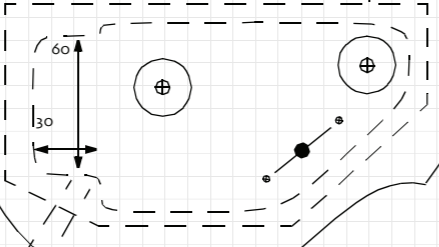
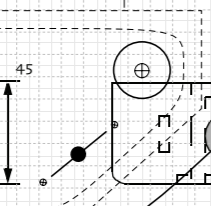
# Some (other) Blueprints



Coil Guitars © 2007  
Model: Hammer 25  
6-string 25.5" scale  
Coil Proprietary: Do not copy or distribute

Coil Guitars © 2006  
Model: Angel 625  
6-string 25.5" scale  
Drawing scale: full size  
Proprietary: Do not copy or distribute

Pickup cavities are just deep enough to hold pickups.  
Pickups are screwed tightly into the neck wood.  
All heights are non-adjustable (thus there are no  
adjustment screws on the pickup bumpers).



large bumpers  
(1.5" x 0.625")

190

5.5°

16°

24th fret

25.5

17.5

1.1/8"

25.5

24th fret

18

16

5.5

16°

13.75

5/16

5/16

13.75

16

25.5

16

16

16

16

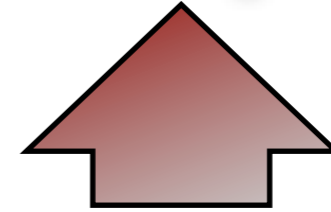
# Pros & Cons

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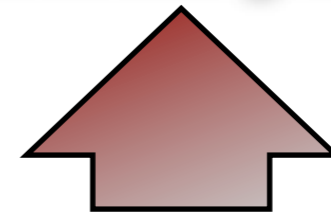
- Can't Possibly compete with big companies
- Might fail
- Can't afford it
- Window of opportunity?
- Idea already proven in marketplace (shareware, boutique electronics)
- Win/win situation (even company failure is good résumé material)
- Low risk/reward ratio
- Start soon

*Bottom line: a path well worth exploring*

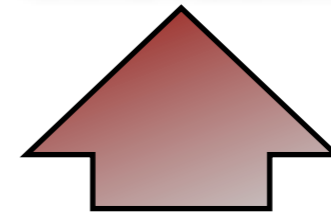
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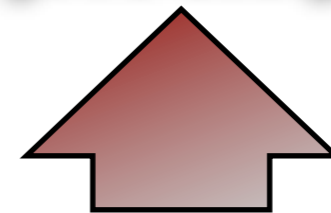
**economic growth**



**innovation**



**good design**



**???**

# Questions?

(thank you for your attention)

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... or just Google "bruce jacob"