Personal Perspectives on Startups and Large Companies

Max Kelman
Stanford Energy Seminar
March 11, 2013
Personal Background

- Personal Training Systems
- AnimaTek
- Lawrence Berkeley National Lab (UC Berkeley)
- Advanced Micro Devices
- Stanford
- Intel
- Novellus
- InnovaLight
- DuPont
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Differences highlighted during transitions
Corporate Differences

Established Company

Consistent Profitability

Startup

Established companies have accomplished the goal of all startups--
Corporate Differences

Established companies have accomplished the goal of all startups--$
Software & Energy Startups

More time and resources needed for energy startups compared to software
Observations

Established Company:
- Maintain profit stream

Startup:
- Nothing to lose
Observations

Established Company
- Maintain profit stream
- Permanence

Startup
- Nothing to lose
- Transient existence
## Observations

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Observations

Established Company

- Maintain profit stream
- Permanence
- Consistency
- Established processes
- Many options
- Multiple locations
- Multiple products
- Sustaining & Growth

Startup

- Nothing to lose
- Transient existence
- Speed
- Clean slate
- Focus & Prioritization
- Single location
- Single product
- Growth
Job Stability
- All or none for startup
- Targeted resource optimization for large company
- Job description likely to evolve in startup

Flexibility & Speed
- Key requirements for startup
- Consistency & processes key for large company
Focus
• Key for limited resources of a startup
• Multiple options need evaluation for large company

Geographical Diversity
• Hard to manage for small company
• Key to address markets for large company
Focus & Visibility
Teamwork & Clarity of Vision
Compensation & Career Growth

- Salary & Negotiations
  - More flexibility for startups
  - Main source of income

- Options
  - Unlikely to be life changing

- Career growth
  - Depends on company success
## Personality Compatibility

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<td>Structured environment</td>
<td>Ambiguity</td>
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<td>Hierarchy</td>
<td>Initiative</td>
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<tr>
<td>Consensus building</td>
<td>Decision making</td>
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<tr>
<td>Tap into capabilities</td>
<td>Scrappy</td>
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<td>Existing expertise</td>
<td>Confidence</td>
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Bottom Line

- Vastly different environments driven by risk
- Flexibility and patience needed in transitions
- Detailed career planning is hard

- Flexibility and understanding key to satisfaction
Stanford Energy Seminar
Entrepreneurship Mini-Series, part II
Recent Stanford Graduates in Energy Start-Ups
March 11, 2013
Jacob Woodruff, Ph.D.

Solar Upstart
Outline

- Stanford to Startup
- Nanosolar Primer
- Research at a Startup
- Highlights
- Transitions
- Conclusion
While at Stanford I decided that I wanted to pursue a career in solar energy. How to start this career in solar was unknown. Absorbed all of the information about solar that I could find:

- Attended seminars
  - Energy Seminar, Materials Science Seminar, SPRC Seminar
- Attended Conferences
  - GCEP and MRS
- Hosted speakers through Student Hosted Chemistry Colloquium
  - Michael Graetzel and Nate Lewis
- Took classes
  - MATSCI 302 Solar Cells (McGehee), Renewable Energy Policies and Markets (Komor)
- Interviews with professors
  - Discussions with Advisor Chris Chidsey
  - Breakfast with Mike McGehee
- Read literature
Stanford to Startup
Choices of Solar Research

Postdoc

Established Company

Startup

SUNPOWER

innovaLIGHT

nanosys

Miasolé

SPECTROLAB

Jacob H. Woodruff
Stanford to Startup
Why I Ended Up at Nanosolar

Why a startup:
- Thought I wanted to work in industry
- At this time a lot of funding was being channeled into to try new ways of making solar cells
- A nice trade off between long term fundamental research and tweaking
- I thought that startups would be where the next advances would come
- Originally, I thought I would need to do a postdoc to get experience in solar research before a solar company would hire me, but startups wanted to hire me for my chemistry and materials science experience.

How Nanosolar:
- Heard talks on Nanosolar by Chris Eberspacher (VP of Engineering) and Jayna Sheats (Associate CTO)
- Informational interview with employee (Dave Jackrel)
- Resumes from multiple directions
  - Stanford Job Fair
  - Online
  - Handed to employees
  - Solicitation from Prof. Mike McGehee
- Typical interview process (but more colorful)
Nanosolar Primer
Company Facts

- Founded in 2002 as a nano-organic solar cell company, switched to CIGS in 2003/04
- Founders Martin Roscheisen and Brian Sager are both doctoral alumni of Stanford
- Raised ~$540M, including $35M DOE and $10.5M DARPA research grants
  - Angel Investors included Google founders Serge Brin and Larry Page
- Cell factory in San Jose, CA and module factory in Luckenwalde, Germany
- ~20MW installed
- >300 Employees by 2009
- Laid off >75% of workforce Feb 15th, 2013
- Currently looking for a buyer
Nanosolar Primer Technology
Nanosolar Primer
The Nanosolar Way

- Challenge conventional wisdom and just try it
- Flat structure
- Secrecy about everything
- Develop everything in-house
- Ownership
  - Nanosolar was your company
  - You could make a difference
  - Your contribution was valued
- Focused on the technology
  - CEO would come sit at your desk to ask what the next cool idea in R&D was.
  - Parties for record efficiencies
- Ikea desks → “all the toys for the scientists”
- Lunch onsite together
- T-shirts and jeans

Nanosolar Team, 2005
Research at a Startup Nanosolar Model

“We want to continue to be a powerhouse of lab innovation in the style that’s proven to work best for us: Mostly driven by smart kids straight out of school who we give all the tools and toys to try crazy new things; plus just a thin dose of managers who know how to earn their respect.”

–M. Roscheisen, GigaOM.com 2007

The Nanosolar “Lab” Research Team, 2007
Research at a Startup Compared to Academia

Similarities to Academia:
- Interesting science and engineering
- Responsible to startup methods, tools, and techniques to do research
- Teamwork (in my case)

Differences to Academia:
- Accelerated Timeline
- Experiments have a specific product related goal in mind, less to follow a curiosity or gain obscure understanding
  - More empirical experimentation instead of mechanistic study
- Results were coming faster
  - Felt like I was getting data that I could write a paper on every few weeks and a dissertation on in a year.
- Generally don’t publish (unless for PR and not process related)
- Read and write patents (unless trade-secret)
- Team mentality and responsibility
- Rewarded with more responsibility and stock options
Doing Research at a Startup Idea to Manufacturing

- Creative ideas
- Hero experiments
- Champion efficiencies

- Design for manufacturability
- Scale Process
- Statistics and DOEs
- Reliability testing

Nanosolar’s first major installation: 1.1MW outside of Luckenwalde, DE

Jacob H. Woodruff
Highlights
Breakthroughs

- Three new generations of CIGS technology with champion printed solar cell efficiencies
  - Gen 2: Lab 15.3% (16.4% active area), 0.5 cm² (April 2009)
  - Gen 3: Production 13.9%, 200cm² (April 2011)
  - Gen 4: Lab 17.1%, 0.5 cm² (Sept 2011)
- Lead team to transfer fundamental breakthroughs in a materials system to pilot and production (2X)
- Seeing fruit of labor make clean energy in the field.
- Developing proof-of-concept all-solution-printed solar cells: “Solar Paint”

15.3% lab solar cell

17.1% lab solar cell
Brown, G.; Stone, P.; Woodruff, J.; Cardozo, B.; Jackrel, D., "Device characteristics of a 17.1% efficient solar cell deposited by a non-vacuum printing method on flexible foil," Photovoltaic Specialists Conference (PVSC), 2012 38th IEEE
Highlights
Popularity

- Interactions with experts in academia and NREL
- Visits from politicians
- Company awards and features in popular media
- Featured on PBS NOVA television program shared with Secretary of Energy Steven Chu, the Governor, and Bill Nye the Science Guy

Popular Science Magazine Innovation of the Year 2007

Photo Credit: WGBH Educational Foundation
Highlights
The “Beehive” to Factory

- Labs in Palo Alto
  - DOE visitor mentioned it was like a “beehive”, very busy activity with people popping in and out of cavities.
  - Plastic curtains to separate reception and the XRD.
  - Staff meetings in a portable out back

- Cell Factory in San Jose
  - 200,000 ft²
  - Build out of state of the art lab and manufacturing line
  - Still used rows of Ikea desks for offices
Transitions
Nanosolar 2.0

- Transition of CEO in 2010 and changes in some management, due to missed promises to customers on production volumes.
- Blow to moral of many employees ➞ large exodus
- Change in culture:
  - More focused on customers and production than the next cool advancement of technology
  - More hierarchy and controls
  - Organized efforts, less hero experimentation
  - People dressed up more
- “Go For It” Plan: Leverage $X00M to build out additional lines in factory so that economy of scale would enable us to prove profitability
As more tools started to come online as part of “Go For It” plan, effects of overcrowded industry and oversupply were being felt.

**Transitions Solar Winter**

- **Bankability:** Unproven technology, Solyndra
- **Strategic Partnerships**
Transitions
Decision to Move On

- Culture of company had shifted
- Company growth and outlook had stalled
- At time of departure, refinancing made previous stock options irrelevant
  - “Stock is Gravy” – Prof. Chris Chidsey
  - Evaluation $2.1B → $0.05M precash, $70M round
- Final decision
  - Asked myself, what experience in the next couple of years would make me a better scientist and technical manager.
  - Chose SunPower
    - Learn a new technology from the high efficiency side
    - Well respected technology and company
    - Learn business processes of an established company
    - Dick Swanson
Conclusion
Why Work for an Energy Startup?

Yep
- Create something new to benefit society and try to bring it to market
- Gain broad experience quickly
- Like working on new things regularly
- Be part of a bright, dynamic team

Not so much
- Get Rich
- Job Security
- Expert in narrow field of study
- Publish
- Work-life balance
Thanks

- Thanks to the Nanosolar team

Note: If you are looking for great technical contributors to hire, contact me. I have many recommendations from the Nanosolar team.

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http://www.linkedin.com/in/jacobwoodruff