Research or development work?
Understanding technologists time allocation and career progressions in the federal laboratory context

Isabel Bignon
PhD Student

Zoe Szajnfarber, PhD
Assistant Professor

Engineering Management and Systems Engineering
The George Washington University

Industrial Studies Association Conference: May 29th 2013
Agenda

1. Motivation
2. Research Context
3. Problem Framing
4. Research Objectives
5. Method
6. Preliminary Results
7. Insights
8. Next questions
Motivation

- A study at NASA explored how innovation happens.

- As long as scientists and technologists have as much task discretion as they seem to, centralized/structural management schemes will be ineffective.

- We are exploring ways to exert control at a lower level of the organization by developing an incentive system that make sense. To be able to do that, we have to understand how people allocate their time and the nature of their preference structures.
Research Context

• NASA's vision: To reach for new heights and reveal the unknown so that what we do and learn will benefit all humankind.

  – Aeronautics (air transportation system)
  – Human Exploration and Operations (ISS operations and human exploration)
  – Science (explores the Earth, solar system and universe)
  – Space Technology (develops, demonstrates, and infuses revolutionary, technologies)
Mission: to achieve the expansion of knowledge on the Earth and its environment, the solar system, and the universe through observations from space.

Scientists and engineers build spacecraft, instruments, and new technology to study:

- The Earth (Earth science)
- The sun (Heliophysics)
- Our solar system (Solar system)
- The universe (Astrophysics)
Goddard employees

- Employees are mainly engineers and scientists (60% of the civil servants) and 20% of the civil servants hold PhDs. PhDs are underrepresented because many of them finish their degrees after being employed at Goddard.
- This extremely trained workforce has plenty of discretion with regards to time allocation.
Research Context

- NASA makes science (answer questions about space) by building new technology that is used in space missions to bring better data.

R&D (exploration)

Projects (exploitation)

www.nasa.gov
Problem framing

Notional S-shaped improvement in performance

- Exploration
  - Experimentation
  - Flexibility
  - Long-term view
  - High risk

- Exploitation
  - Refinement
  - Efficiency
  - Short-term view
  - Low risk

Technical performance vs. Time

- Current technology
- New technology

Explore
Exploit
**Problem framing**

### Ambidexterity
*(Tushman & O’Reilly 2007)*

- **E.g.: DoD**

<table>
<thead>
<tr>
<th>R&amp;D</th>
<th>Product unit</th>
<th>Senior team</th>
</tr>
</thead>
</table>

- Structurally separated units (ambidexterity) with strong linking mechanisms. E.g.: production unit and research unit coexist in different structures.

### Punctuated equilibrium
*(Brown & Eisenhardt, 1998)*

- **E.g.: NASA**

<table>
<thead>
<tr>
<th>R&amp;D</th>
<th>Projects</th>
</tr>
</thead>
</table>

- Sequencing periods of exploration and exploitation (punctuated equilibrium). E.g.: teams go through periods of exploration followed by periods of exploitation and so on.
**Exploration and exploitation at NASA**

- **R&D (Research)**
  - Research
  - Component level
  - **Exploratory with respect to technology (create new technology)**

- **Flight projects (Projects)**
  - Project formulation and development
  - System level
  - **Exploitative with respect to technology (use mature technology)**

**Future needs**

**Maturity capabilities**
Research question and objectives

• The broad question is: What happens at the individual level? When people have sufficient task discretion, the system is harder to control and collective behaviors are less predictable. How can we design better incentives?

• Research question: How do scientists and engineers allocate their time between research and projects instantaneously but also over their careers?

• Objectives
  – Document how people spend their time
  – Understand personal preferences
  – Identify different career progressions
  – Define staff archetypes
Method

• We are trying to understand this phenomena by following a process of theory building, description, abstraction, and conceptual categorization (Glaser & Strauss, 1967).

• This method is usually adopted by scholars when the research topic has not been widely studied in the literature (Goulding, 2002).

• The face-to-face, semi-structured type of interview is a commonly used data collection method when using grounded theory (Goulding, 2002).

• Our data collection methods:
  – Observation
  – Semi-structured interviews:
    • Personal experience at NASA
    • Work activities
    • Time allocation preferences
    • Career decisions
    • Network
Preliminary results: Archetypes

- **Exploiters**
  - Exploiting bridgers
  - Engineers who want to just fly projects and scientists who only care about getting data from missions.

- **Bridgers**
  - Exploring bridgers
  - Engineers or scientists who like to network, solve problems and advocate for new technology developments.

- **Explorers**
  - Engineers who like to work on new instruments -- no matter its application -- and scientists who want better instruments that give them better data.
Scientists who started working on a mission: “When I was starting out here, establishing myself was a big goal so the only way you can do that is as an independent researcher, someone who’s coming up with ideas and technologies... really spend time trying to generate the technology idea... So in the first few years that I was here I worked on [a technology development] and I got... funding. But that was a very deliberate thing that did because I wanted to get something that was mine.”

“[Now] if an idea comes in mind, great. If not, I have plenty of other work to do. I’m not trying to generate work to do....I have gotten to the point where I wanted to get to when I started... I don’t necessarily see that I need to be somewhere else higher up in the future because, frankly, the only place higher up from where I am is [another position] and that’s not where I want to go... I like what I do...”
• Scientist “We are going to stick with the technology solution that we are most familiar with, that we have developed. We have developed it because we think is the best but that can’t go too far. You continue to insist in a technology solution that may not actually be the best but it’s what you know how to do...”
Perspectives about work (Explorer)

- Scientist: “I realized that, in the end, I want to build things that go find answers, and then the scientists can then go and determine what they mean... we’re also “scientists” because we are physicists but we’re not desk jockeys sitting behind computers. We build stuff in the lab.”

Always work on the next cutting-edge technology. Not interested in missions. Others would do the science.
• Scientist who started as a post doc: “I think in a place like this, there’s so much stuff going on that you can either say: "ok, I can’t possibly keep track of that stuff" and just... focus on what you do; or you can say: "some of it may be relevant to me so I better keep my ears open". And I certainly did the second. I was always listening and I had a pretty clear idea of almost anything on the center that was going on that had any significant overlap…”

• “I remember... thinking to myself, I said: ... “if I want to stay here and do something... you can’t do this... just by being smart and have good ideas.” There is a very... complex situation of figuring out how to use the resources that are here and how to get access to it. How to get people to do things is really “the" thing, that’s where all the leverage is in this…”

Being smart does not ensure success. You need to understand what others are doing and be strategic about it.
Perspectives about work (Manager)

• Ask about management going back to the technical work:

  “I could have gone back. Sometimes I think it would be good, but now I realize that young people like [you] are much smarter and capable. We have a lot of good people.”

  "The longer I am away of technical things the more that I think I’ve lost my technical skills. But sometimes I miss [it]... [I think] oh it would be so cool to be in the clean room…”

Management as a terminal state.
Perspectives about work (Bridger)

- Technical Manager who started as an engineer: “So I spent all these years getting a PhD in engineering, which is fine but I was never a hard-core researcher. I enjoyed the technology or seeing the applications but I also enjoy when people can work together. I like when organizations work well. I appreciate the detailed work, how much effort takes to get things to work and organizations to work. I appreciated the engineering culture and the science culture but also the tension between them is kind of entertaining. But I also know how hard it is. You got to have good teams to be successful.”
- “Through all this, my style has been always the same. I was freed from being a supervisor so my analogy is like I could flow like water. I could just go and talk to people and learn about what they were doing.”
- “I’m the middle child. I’m the peace maker... So that’s part personality.”

Enjoy technology, applications and people working together.
## Summary of some perspectives

<table>
<thead>
<tr>
<th>Perspectives about...</th>
<th>Explorer</th>
<th>Exploiter</th>
<th>Bridger/Manager</th>
<th>Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work</td>
<td>Revolutionary technology</td>
<td>Projects that actually fly and get science</td>
<td>Connect people and opportunities</td>
<td>Make the organization work well</td>
</tr>
<tr>
<td>Network</td>
<td>External network</td>
<td>Internal network</td>
<td>Internal and external network</td>
<td>----</td>
</tr>
<tr>
<td>Values</td>
<td>Interesting work</td>
<td>Successful missions</td>
<td>People working well together</td>
<td>Fund R&amp;D</td>
</tr>
<tr>
<td>People</td>
<td>Individual oriented</td>
<td>Team oriented</td>
<td>Team oriented (scientists and engineers)</td>
<td>---</td>
</tr>
</tbody>
</table>
• Archetype identification gives us information about preferred incentives and recognition, and about how they make tradeoffs among different types of job.
  – Exploiter: “What would make it [my work] more enjoyable would be to have the missions come along that would use the technology that we have already developed”.
  – Bridger: “Most of us want to work on exiting good projects and get recognition for it. If that’s recognized by each party then that recognition is successful. The best PI’s, I think, are the ones that give that recognition and they don’t assume that the engineers are just there to work for them no matter what. It is a partnership…” Recognition: team recognition.
Examples of individual career progressions

**Explorer-Bridger**

**Manager-Bridger**

**Exploiter**

**Manager**
Example of workforce over time

Time allocation of the workforce

Archetypes

Time allocation
Next questions

- Are exploration and exploitation two ends of a continuum or are they parallel spectrums?
- Are they core identities or do they change over time?

P(archetype, degree, age, experience, proposal writing, past success, team productivity)?

Proposal → R&D → P → M → Proposal

P(archetype, degree, age, experience, past success, available missions)?
Questions? Comments?

Thank you!