Reinventing Research: Agile in the Academic Laboratory

An Agile2018 Experience Report
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This presentation will cover four main sections:

- Setting the scene: Where is this work happening? What makes this place unique?
- My Story: Who am I? Why is this important to me? How have my experiences brought me to explore Agile in Academia?
- Agile Challenges in the academic setting: What challenges have Broad Institute laboratories faced during their Agile explorations?
- An agile manifesto for the academic lab: Exactly how could the Agile values evolve to better fit/represent the academic world?
Section I: Set the scene
I want to start my story by first setting the scene. I have work at the Broad Institute of MIT & Harvard, an international non-profit genome research institution. This Institute aims to improve human health by using genomics to advance our understanding of the biology and treatment of human disease, and to help lay the groundwork for a new generation of therapies.

Founded in 2004 by Eric Lander and philanthropists Eli and Edythe L. Broad, the Broad Institute includes over 4000 faculty, professional staff, and students from throughout the MIT and Harvard biomedical research communities and beyond, with collaborations spanning more than 100 private and public institutions in more than 40 countries worldwide.

To date, Broad Institute scientists have published over 8,715 publications, or just under 2 papers per day for over 14 years.

Source:
- When I truly reflect on my personal Agile “education and development” I really think the Broad’s values were what first opened my eyes to the power of collaboration, transparency, openness, continuous improvement; common themes we see in our own Agile experiences. Their values are Agile unto themselves, and I think that’s one of the biggest reasons that the Broad sets the scene so well for this Agile journey.

- I want to emphasize “collaborating deeply” as I believe this collaborative nature is largely what helps to drive our scientific process.
- The Broad has a diverse array of research specialties which helps to foster interdisciplinary ideas and collaborations.
- Some of these groups are established as larger, production type platforms, but many groups within these research specializations are set up as academic laboratories.
- In order to best follow the presentation, it’s crucial to understand how an academic laboratory operates.
  - This information is not Broad Institute specific.
- Academic laboratories are non-profit, knowledge-driven centers of learning such as colleges, research institutes, and teaching hospitals, among others.
- These areas are highly knowledge driven- first in the form of educating students and training strong scientists, and second in the publication of knowledge in scientific research journals.
- These centers are non-profit, and grant based, at times with research grants designated to specific projects happening within the laboratory.
- There are several different roles within the academic laboratory. Labs can vary in size from 3-30+ people.
- First, the Principal Investigator. The PI directs the research and vision of the laboratory, and generally hold PhD’s with extensive experience in their field of research. PI’s decide which students join their lab, have the final say on all laboratory projects, mentor individuals on their growth within the laboratory, and foster relationships with other groups in search of new projects.
- Next, are the students (both undergraduate and graduate) and the Post-Doctoral researchers. These individuals stay with the group on a shorter timescale, be it a six month rotation experience, or for a multi-year stay in pursuit of a bachelors, masters, or Doctoral degree. Post-Docs are individuals seeking additional research experience after the completion of their PhD. Students & Post-Docs tend to have individual projects of their own design. These folks work around the clock and are generally paid on a graduate stipend for their efforts.
- The final tier of individuals in a lab are the staff scientists, research technicians, and professional support staff. These individuals work with the laboratory full time, and fill many roles in enhancing the research process. (Assistance with lab work, Technical Development research, grant administration, lab management, etc.)
I wanted to find a way to share how the academic laboratory process works on a higher level, so I thought I’d compare it to the scrum cycle which we all know and love.
In the “Scientific Scrum Cycle”, we can observe the process:

1) A scientific plan is written around an experimental hypothesis
2) The work of writing a paper naturally falls into phases: Experimental, Analysis, and Writing.
3) In each phase, a work cycle occurs, at which point it’s useful for the scientists to solicit feedback on their results, ideas, and work.
4) From there, that feedback is incorporated into the scientific process. Feedback can affect the immediate work cycle, the phase of the research, or the overarching scientific plan.

This is a generalized process, and none of these phases have a specified amount of time.

Research projects can last anywhere from 6 months to 6 years.
Next up is a little more about my story, and how Broad laboratories came to start using Agile.
I've been a Broadie for five years.
- I'm presently a Scrum Master with the Data Sciences Platform.
- Completing a Masters in Engineering Management at Tufts University,
- I kind of fell into Agile software development.
And then...

Research Associate
Sabeti Laboratory
MS "I don’t quite know yet but I know I like people and science" 13

- Three years ago I was a research associate in an academic laboratory called the Sabeti Laboratory and I was pursuing a degree in “I don’t know but I know I like people and science”
- I had joined the laboratory because of its cool research focus, and to get a better understanding if I wanted to get an advanced degree in the life sciences.
- The Sabeti Laboratory is an infectious disease research laboratory focusing efforts around viral surveillance, evolution, and diagnostics development.
- The lab does incredible work with many terrible diseases, such as Mumps, Lassa virus, Zika virus, and Ebola.
What really connected me to the laboratory was the powerful mission.

Among the group’s efforts was a significant educational aspect. The Sabeti Lab team is working with the African Center for Excellence in Genomics and Infectious Disease to establish a viral surveillance network across the African continent. In the event of the next outbreak, samples can now be processed and analyzed right on African soil.

The lab works collaboratively with these types of partner institutions, and several papers from the group have been published in renowned scientific journals.
Cool. So how does all this relate to Agile?

So how does this all relate to Agile?
- It was around this point in the lab that I realized the advanced scientific path was not the one for me; what continued to drive my interest and career goals was the amazing people I worked with.
I began to search for ways I could help my colleagues through organization and process optimization.

- (clockwise) 1. A calendar chart used as a large workboard for the team during the Zika outbreak. 2. The lab’s first kanban board for laboratory-type organization tasks. 3. Using Lean ideas and 5S-ing shared laboratory spaces.

- It was in this process that someone suggested I talk to another department’s Agile coach about Agile.
- This is how I was introduced to Diolinda Vaz, the Broad Institute’s first Agile coach. After speaking with Didi I knew that these Agile ideas were something I needed to learn in order to continue helping my peers in the laboratory, and I opted to join Didi’s team with the Data Sciences Platform as a scrum master for two software development teams.
- But the laboratory was and is still close to my heart!
- In order to continue sharing these Agile ideas with my laboratory peers, Didi and I established a meetup called Agile Academia. In two years, this group of individuals has grown to nearly 100 individuals in over 20 departments. We meet once monthly for an Agile related discussion and to brainstorm how to incorporate Agile ideas into our teams and processes.

- It is in this space, that Agile-minded individuals (from management to the lab bench) share their experiences and ideas with Agile.
Section III: Agile challenges in the Academic setting

It hasn't all been easy!
Challenge 1: How to start
Challenge 2: Team Structure
Challenge 3: Work Structure
Challenge 4: Project Tracking
Challenge 1: “How do we start?”
"I know! We'll present a basic Introduction to the Agile Principles and Frameworks, and then highlight how these tools can be used in the lab!"

- Laboratories have started exploring Agile through different means, but often adoption of the ideas is pushed by a motivated individual within the laboratory.
- I had the pleasure of working with the Sabeti Lab through their Agile exploration, and I had a great idea on how to start.
I drafted a slide deck detailing the specifics of Agile software development to present to the laboratory team.
Feedback was generous!
- There was a lot of concern around the lack of examples in the laboratory field, and the software specifics in this Agile example.
I realized in this presentation that the question here to answer was not “How do we start” but “WHY do we start”
My colleagues and I also adopted tactics we called stealth scrum in order to make some of the Agile/scrum concepts more approachable to a new field.
- The final key in a successful intro to Agile was starting with an Agile retrospective.
- Because all of this was so new, Retros gave an opportunity for the laboratory to self-reveal the areas in which they were challenged the most. Establishing a forum for continuous improvement was key to many teams’ success.
Challenge 2:
Team Structure
The next challenge in the academic setting is the lack of obvious team structure. On a software team, all team members are working towards a common goal. In the laboratory that is not always the case because laboratories have multiple projects.
- In a lab setting, there can be many different projects happening within the main research focus.
- Due to the lab’s mentoring structure, the PI often mentors all lab members at once. This can be quite overwhelming and keeping track of so many projects is not an easy process.
- Many individualized projects mean some redundant experiments, or mistakes made multiple times due to individuals not sharing information between one another.
To combat some of these challenges, one lab established communities of practice for like roles within the lab; for students and staff scientists. These groups offer enhanced routes of communication, and opportunities for peer mentorship and support.
Challenge 3: Work Structure
- The scrum cycle has specific meetings, but work can occur in a fairly predictable and sustainable cadence.
The typical lab cycle: Preparing samples for DNA sequencing

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- The laboratory “cycle” is far more drawn-out, with experiments that can take up to two weeks to complete.
- This work does not change, some groups tried out daily standups and found they weren’t a valuable use of time because the processes tended to be long, predictable, and slow moving.
- Additionally, because processes are so long and cannot always be stopped part-ways through, adding in meetings to an already complex lab schedule means long hours for research scientists.
- What it comes down to is to do the right thing - listen to the research cadence of the team and adjust accordingly with what makes sense for the group.
- Lab members should feel empowered to suggest a change.
Challenge 4: Project Tracking
How do software teams visualize work?

- One tool used in software to simplify project tracking are visual workboards.
- The key for academic laboratory groups was to visualize work in the first place! Many teams did not use this tactic to better align what was going on. (Many trackers that were used had the FULL picture of what was going on versus the work that was actually happening day-to-day).
- Laboratories use boards in a variety of levels in the lab; from tracking individual samples to batches of samples within a process.
- These boards offer transparency between lab members (revealing new ways to collaborate) as well as transparency to management to any changes in schedule or areas of concern.
In summary, these strategies helped the academic laboratories to think in a more Agile way. While each lab tends to do things a bit differently, even thinking about how the group can change to embrace agility can spark a lot of conversations about how the group can continue to improve.
Section IV: An agile manifesto for the Academic Lab
- Here at Agile2018 I’m not going to ask if anyone’s not familiar with the Agile manifesto.
- These values are what drive our teams towards continuous improvement and collaborative success, but there are a few places in the laboratory where they don’t make sense.
- In the spirit of Agile Marketing or Agile HR, who have drafted manifestos which capture these agile values while better reflecting their field of work, I’ve considered how a laboratory manifesto might look.
The first line, Individuals and interactions over processes and tools, remains unchanged. It is still important to encourage face-to-face communication over relying on protocols or systems to get lab members through their challenges. This not only enhances communication within a group, but also fosters an environment of learning.
- The second line has been redrafted.
- In the lab, “working results” are not a requirement. Comprehensive documentation is required in order to know what steps of the experiment could have contributed to results, and a failure of an experiment is not a bad thing.
- Instead, here we focus on the continuous improvement aspect of Agile and set it in stone that a lab should focus on seeking improvements to their science or processes over sustaining the norm.
The third line of the Agile manifesto has also been changed. Instead of the specific “customer collaboration” aspect of this line, we’ve evolved to “collaboration over competition”. In a lab, collaborations can take place at many levels, between lab members or between laboratories themselves. While a healthy sense of competition is required in order to encourage a rapid pace of research and the drive to be the first to publish; sharing results will ultimately foster a more rapid pace of research to be realized by the scientific community. So much of science is iterating off of someone else’s experiment and bringing a new idea to an existing concept. With the early sharing of data and a shift to a collaborative mindset, we’ll begin to see research happening at a faster pace.
The final line of the Agile Laboratory manifesto also remains the same. This line, responding to change over following a plan, accurately reflects the true nature of academic research in which the “changes” in your results often lead to larger, more impactful discoveries. Responding to these changes can change the plan but ultimately lead to a stronger new concept or idea.
An Agile Manifesto for the Academic Lab

Individuals and interactions over processes and tools

Seeking improvements over sustaining practices

Collaboration over competition

Responding to change over following a plan
Agile ideas can evolve the way we do research. While at first it may not appear that these concepts are a perfect fit; embracing agility in any way can help to train stronger scientists to the value of communication and transparency in a laboratory environment. We’ve worked so hard in the software realm to enhance the way we build our products through the effective alignment of teams; with one another and with a common goal. Many of the most influential minds and discoveries come from the academic laboratory, but with so much effort focused on the science it’s not always realized that there are process changes which can enhance the space too. Ultimately, if these knowledge laboratories will embrace Agile it will lead to a more rapid pace of research and well-rounded, Agile scientists.
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