Teaching Agile Management

The Fast-Paced, Iterative Project Management Style Used From Amazon to NASA

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WILLIAM & MARY

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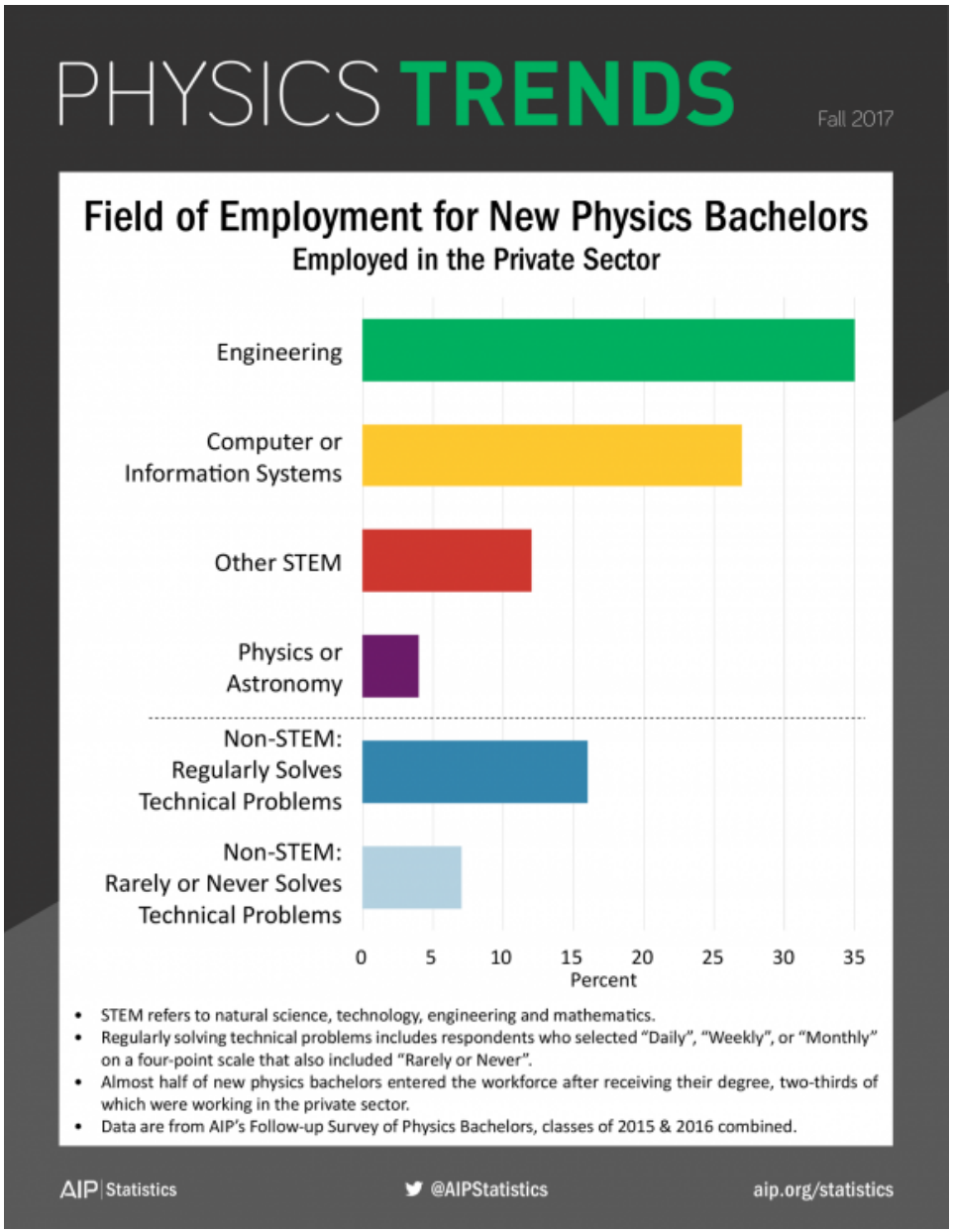
Physicists Find Careers Primarily Outside Academic Research



Physicists Find Careers Primarily Outside Academic Research

What skills are physicists missing?[1]

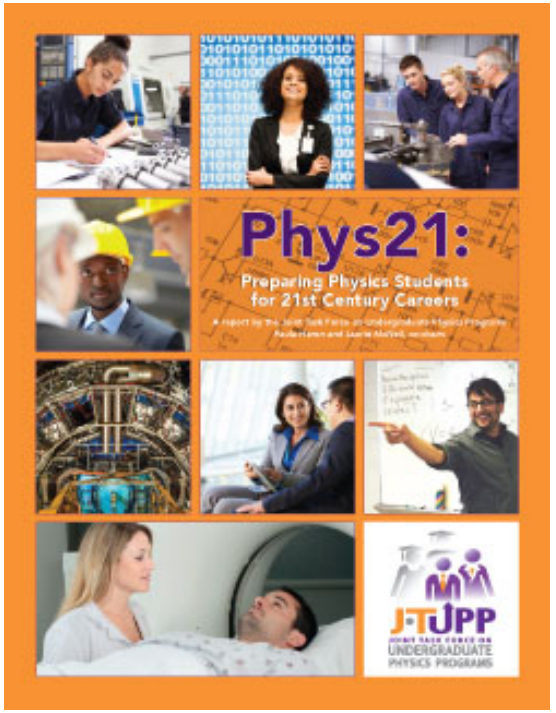
- Ability to design a system, component or process to meet a specific need
- Ability to function on multi-disciplinary teams
- Ability to recognize value of diverse relationships (customers, supervisors, etc)
- Leadership skills
- Familiarity with basic business concepts (i.e. cost-benefit analysis, funding sources, IP, project management)
- Communication skills (oral and written), esp. how to tailor message to audience
- Real-world experience in companies before graduation
- Awareness of career paths outside of academia

[1] *Sources: ABET Survey of Applied and Engineering Physics Graduates, Kettering University; APS Workshop on National Issues in Industrial Physics, Industrial Physics Lunches.*

Joint Task Force on Undergraduate Physics Programs

Findings

- "The overwhelming majority of physics bachelor's recipients are employed outside academia for all or part of their careers."
- "Since only about one-third of physics Ph.D. recipients end up in academic careers, even students who plan to obtain graduate degrees will benefit from developing skills and knowledge that are valued outside the academic community."



Promote career readiness: Scientific and technical skills

- "Competencies in instrumentation, software, coding, and data analytics."
- "Introduce students to industry-standard tools and software packages."

Initiatives in Team-Based Physics Design Courses I

Context at W&M

- Liberal-arts, no eng/med, subset of depts have graduate programs
- Physics department is largest STEM graduate research department
- Regional partners: NASA Langley, Jefferson Lab, Virginia Institute of Marine Science

Robo-Ops: Design and development of tele-robotic rover (2016)

- Semester-long class of 15 students (50% physics majors), 3 sub-teams
- Single project, agile project management (with many lessons learned)
- Co-supervisor: flight engineer at NASA Langley
- Outcome: third place on competition at Johnson Space Center

Initiatives in Team-Based Physics Design Courses II

Agile Innovation: NASA's Lab77 technology incubator (2017)

- Semester-long class of 15 students (30% physics majors)
- Problem finding, ideation, prototyping into minimum viable product
- Outcomes: mental health startup and novel drone-borne bacterial sampling system

Agile Project Management Senior Design Course (2018-19)

- Year-long senior project with 5 graduating physics majors
- Project entirely outside area of expertise of adviser
- Co-supervisors: mission engineer at NASA Langley, agile consultant
- Outcome: MVP of ejectable data recorder for NASA mission

Project Management: Waterfall vs. Agile

Waterfall model

- DOE/DOD/NASA: WBSes, gantt charts
- Large projects, extensive planning
- Reqts drive cost and schedule

Agile model

- Start-ups and collections of small teams, changing reqts
- Current cost and schedule drive features/priority iteratively

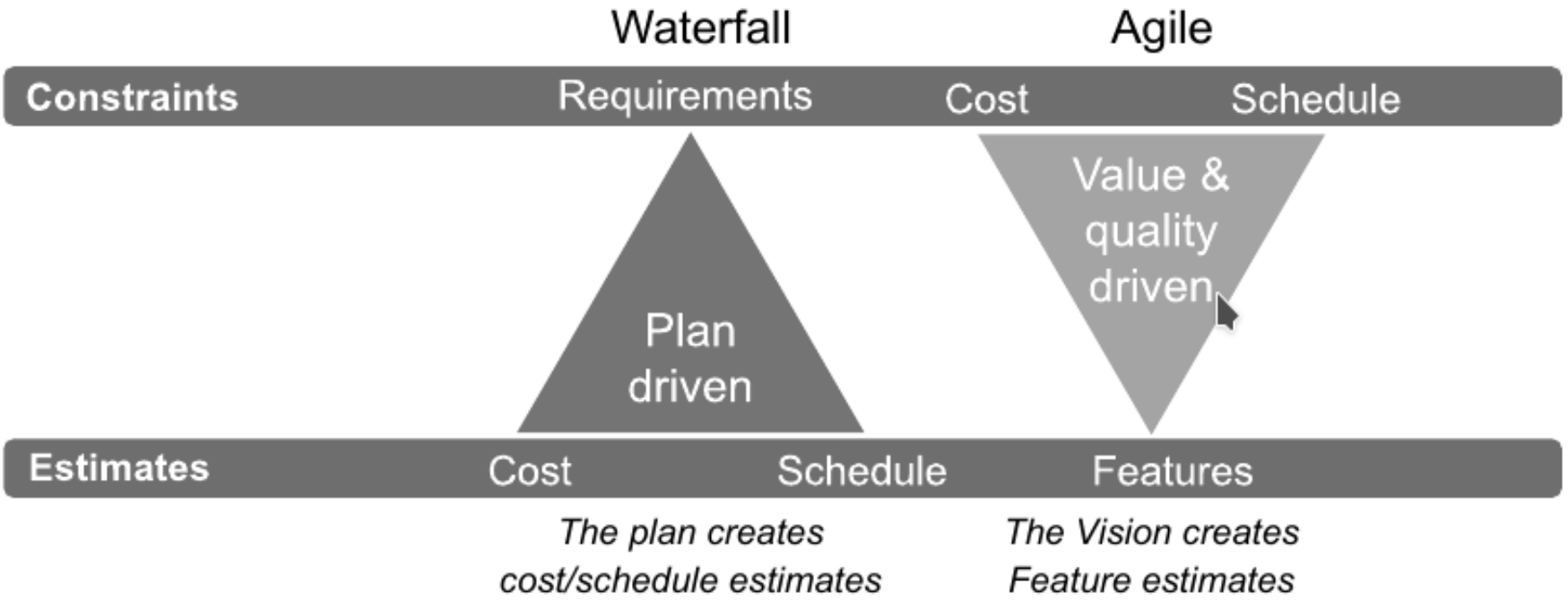
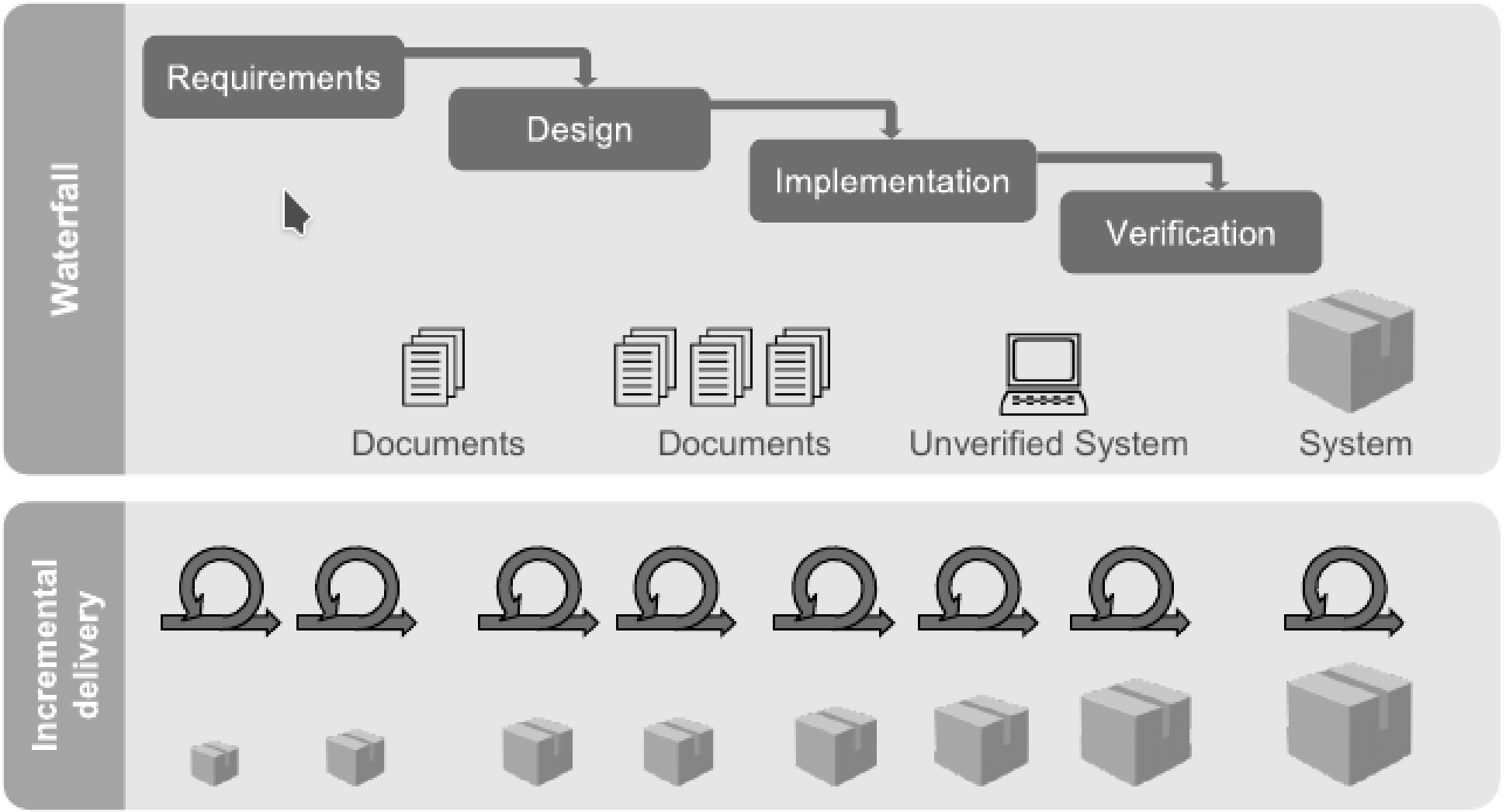


Image credit: Scaled Agile Inc.

Project Management: Waterfall vs. Agile



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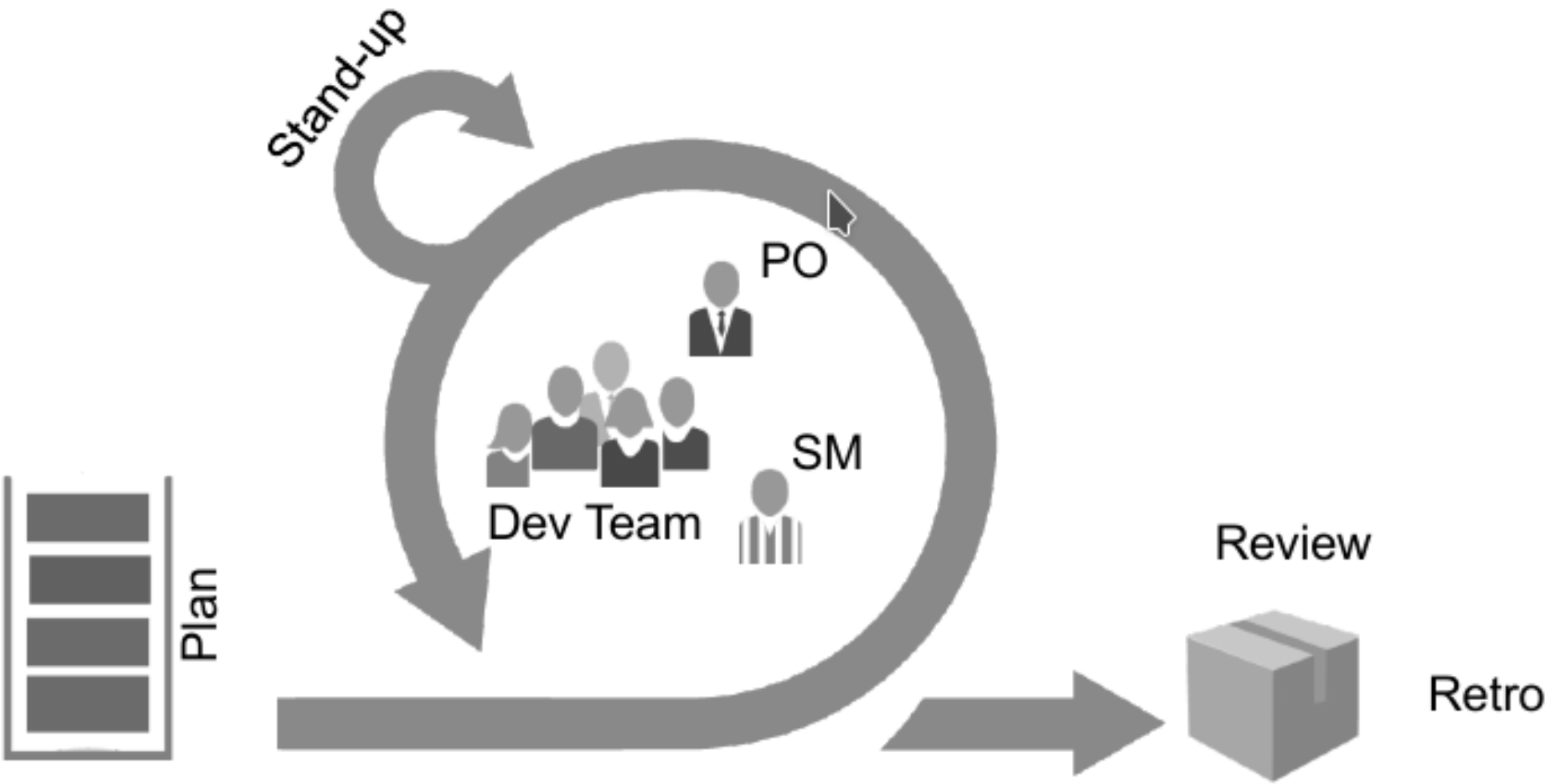

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Agile Values and Principles

Agile Manifesto

- Individuals and interactions over processes and tools
- Working products over comprehensive documentation[a]
- Customer collaboration over contract negotiation
- Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more.

[a] *Products: software, hardware,...*

Agile Senior Research Capstone Course

Implementation

- Assigned roles: SM, scribe, archivist, ambassador, devil's advocate
- Scrum, but students are part-time researchers so slower paced
- Stand-up meeting (15 mins) led by SM every 1-2 days, at university
- Sprint demonstration (1 hour) with PO every 1-3 weeks, on location
- Followed by retrospective (30 mins) and next sprint planning (1 hour)
- Physical support tools: shared office/workspace, whiteboards, post-its
- Online support tools: Trello (kanban board), Slack (virtual space), Zoom

Sprint Planning

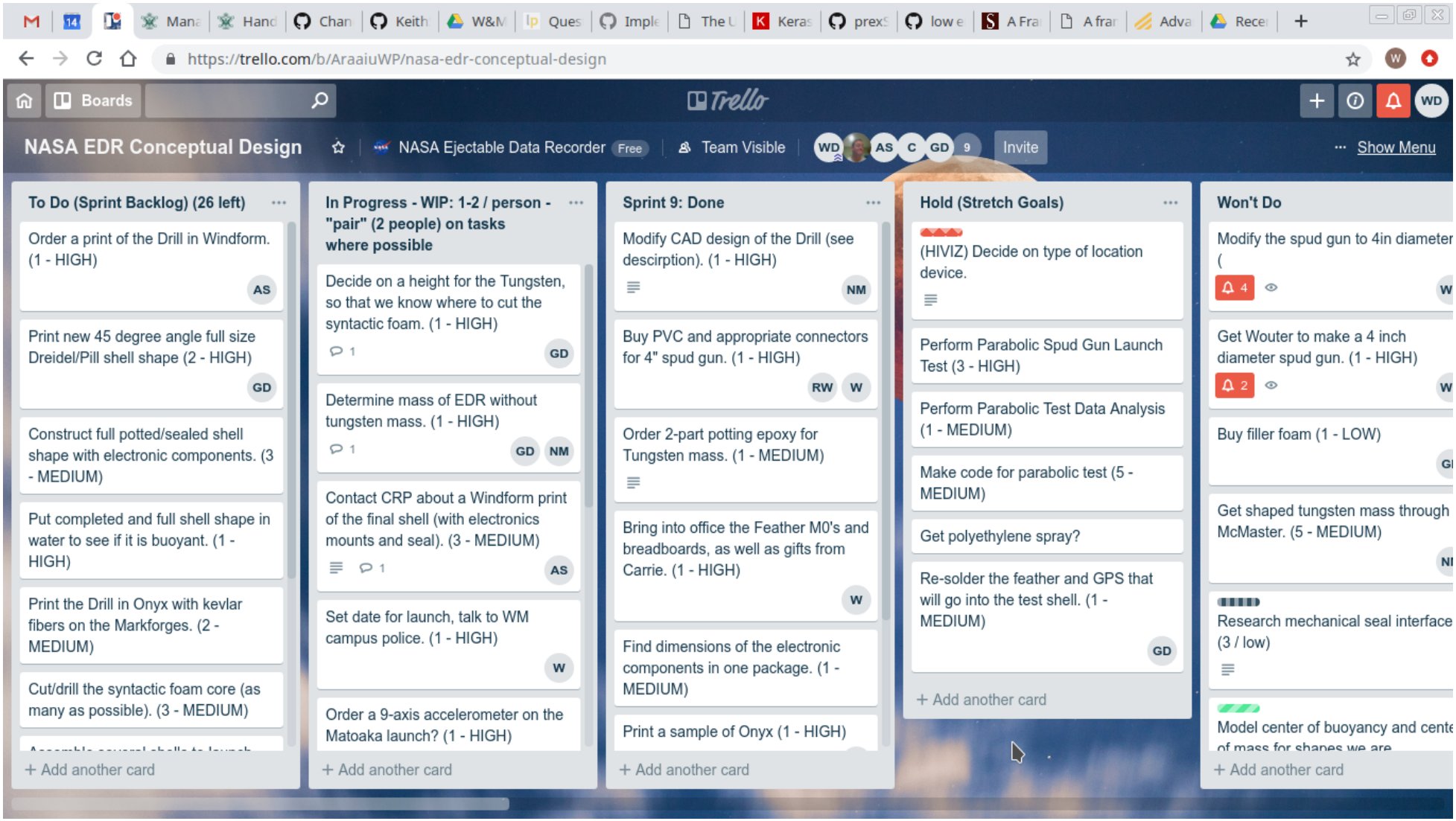
From Goals to Tasks

- Start with overall goals: "At the next demo, we would like to see functionality X" (largely driven by PO)
- Develop list of tasks that can be completed by single person in a single setting (by entire team)
- Three C's: Card, Conversation, Confirmation (or Criteria)

Tasks based on Card Template

- "As a <role>, I want <activity> so that <value>"
  - e.g. "As a NASA LOFTID mission planner, I want to recover the payload after reentry so that stored data can be analyzed."
- All cards assigned a Fibonacci score: 1, 2, 3, 5, 8 (a.u., equates roughly to hours), longer must be split up in parts

Agile Project Student Evaluation



Lessons Learned: Retrospective I

Based on feedback from students during the past year.

Participation of External Partners

- Strong motivator for students (even if not with name recognition and job prospects of NASA)

Consultants and Mentorship

- Benefited from industry partner (Adam Beck, Berkana Enterprise Consulting)
  - Agile coach, called in during half of the stand-ups, attended nearly all demos and team retrospectives (often virtually)
  - Provided optional parallel agile scrum master training for the teams (one current team member interviewed for agile project manager jobs based on this experience)
  - Opportunities for mentorship exist at many companies

Lessons Learned: Retrospective II

Additional Formal Training

- Agile workshop at start of year, may have been too early to be useful

Evaluation of Students

- Looking for tools beyond Trello that automatically determine velocity, burndown rate, individual contributions