Agile: From Software to Mission System

Jay Trimble, Mark Shirley, Sarah Hobart
NASA Ames Research Center

SMC-IT 2017
MOS & GDS

- Mission Operations System (MOS)
  - People, Team(s), Products, Processes
- Ground Data System (GDS)
  - Software, hardware, facilities
- Mission System = MOS + GDS
Waterfall to Agile for Software

- We began the journey to agile design and development with software
In the Beginning (Software)

- Delivery every 6 months
- The 6 month delivery cycle created too much time for customer expectations to diverge from what we were building
  - Customers needed to see the product more frequently
- Progress difficult to measure
- Long and formal design specs
  - Too much time talking, not enough time doing

Subsystem1 | Subsystem2 | Subsystem3 | Subsystem4
6 Months    | 6 Months  | 6 Months  | 6 Months
Time for Changes

• Fix the problems iteratively, without a broad proclamation of methodology, i.e. “we are going to be agile” or “we are going to be “lean”
Agile Sprint

- Agile Tailored for our team
- Deliver to customer every 3 weeks
- Nightly build
- Release every 3 months
- Emphasis on constant interaction and use

jay.p.trimble@nasa.gov
Key attributes of our tailored agile process for software

• The measure of progress is working code

• Rank issues, always focus on the highest priorities

• Demonstrations, not presentations

• Customer interaction over extensive requirements meetings (some meetings still required)

• Visible progress - nightly or continuous builds

• Ship on time, features that are not ready go into the next sprint or release

• Verification using both QA and customer use in context
Agile for MOS

• NASA “standard” process definition is waterfall
  • It’s proven, it works

• Why change a proven process?
  • Potential gains in effectiveness, efficiency
  • Team engagement, culture of doing
  • Cost reductions
Tailored Agile

- For MOS
  - Simulation for Design
  - Assessment of capability through demonstration
  - Early and frequent builds and tests
  - Risk reduction through targeted experiments
  - Maturation of tools and processes through frequent use

- For Software
  - The measure of progress is working code
  - Rank issues, always focus on the highest priorities
  - Demonstrations, not presentations
  - Customer interaction over extensive requirements meetings (some meetings still required)
  - Visible progress - nightly or continuous builds
  - Ship on time, features that are not ready go into the next sprint or release
  - Verification using both QA and customer use in context
Agile Applied: Resource Prospector MOS

- The Mission
  - Lunar Rover
  - Search for volatiles at a polar region
  - Launch 2021?
  - For now, using agile methods on
    - New design
    - Where it increases effectiveness
Resource Prospector Ops

- Lunar surface operations, round trip light time + comm latency = 6 - 30 seconds
- Short duration surface mission 5 - 7 days
- Fully distributed operations, including core teams, everyone operates from home institution
- Lighting, power constraints
- Operation in shadowed regions, no light for a billion years, rover is solar powered
- Continuous comm requirement
- Class D Mission
Agile Applied on RP

• 2015 Distributed Operations Test (DOT)

• Traditional design approach
  • Write a document (s)
  • Present, discuss, review
  • Train the team and test the design in simulations, late in the mission development flow

• Agile approach
  • Write a simple document
  • Conduct a series of simulations, for design, not training (though the team was trained in processes and procedures), early in the flow
  • Test and iteratively improve the concept of operations by trying it
Distributed Operations Test

- Simulation for Design
- Assessment of capability through demonstration
- Maturation of tools and processes through use
- Early and frequent builds and tests
DOT

- Test/ Validate
  - Distributed decision making
  - Distributed command and data flow
  - Integrated situational awareness tools/integration into flight and ground system processes
  - Integrated ground/flight system test procedures
  - Team composition and roles
  - Waypoint driving

- What we did
  - Multiple simulations culminating in the Distributed Operations Test (DOT)
    - Three day DOT
    - Iterative refinement to procedures and processes
    - Mission operations teams using prototype tools
    - Distributed teams
      - Mission Team, science, rover drivers in California, rover hardware, rover systems in Texas, payload in Florida, drill in Southern California
What was Agile about DOT?

✓ Simulation for Design
✓ Assessment of capability through demonstration
✓ Early and frequent builds and tests
✓ Risk reduction through targeted experiments
✓ Maturation of tools and processes through frequent use

• How we used the information
  • GDS architecture improvements for robustness and reliability
  • Updates to team composition and roles
  • Updated requirements
  • Update software designs
Agile Example: Procedures

- “Say it then sim it”
- We wrote procedures, conducted a brief review then tried them
- Develop procedures by trying them out
- User paper simulations to fill in what’s not there yet
Procedures Sim/Walk Through

- Procedure Sim
- Google Hangouts to connect NASA centers
- Mix of paper and prototype software
An Agile MOS requires an Agile GDS

- DevOps
  - Medium to high fidelity simulations require parts of the GDS
  - Updating GDS across multiple locations
  - Prototype system for near-continuous integration, testing and deployment
    - Kickstart, Ansible, Docker
  - Rapid deployments, containers
Challenges

• Are low fidelity simulations beneficial?

• High fidelity simulations may be complex and labor intensive to set up
  
  • Focus on flight forward work, don’t put extensive effort into simulation work that is not flight forward

• Difficult to sim frequently
Conclusions

• Ideal - fly early and often

• If we can’t fly as often as we want
  • Focus on doing
  • Say it, then sim it

• After an issue is articulated in a meeting, instead of ongoing meetings, say it, then sim it
Conclusion

- Team culture can be shifted from a culture of meetings and documents to a culture of doing