

Pennsylvania Convention Center  
October 20 – 23, 2019

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Educate • Lead • Collaborate



# Justin Smith

Agile approach to assuring software for NASA's Orion spacecraft



# NASA's IV&V Program

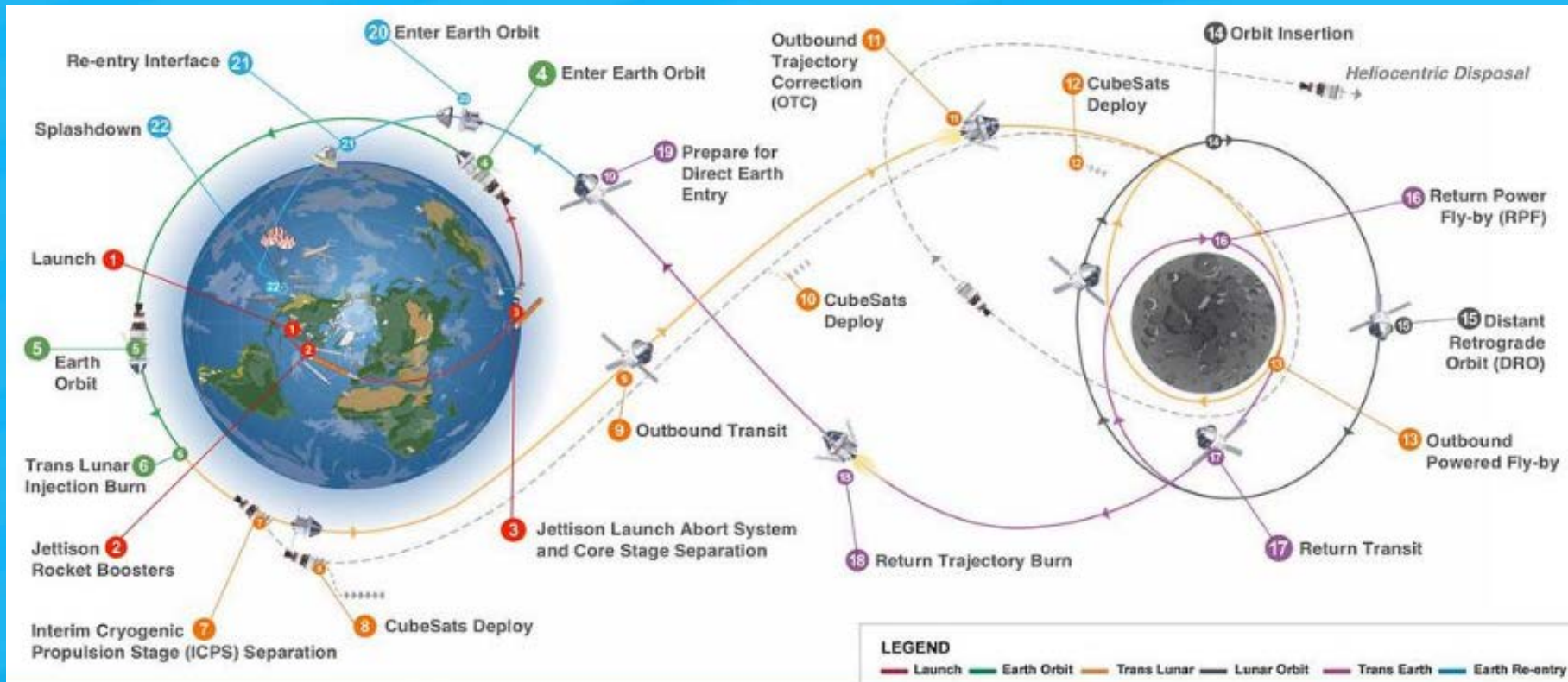
- NASA's Independent Verification & Validation (IV&V) Program reports to the Office of Safety and Mission Assurance (OSMA)
  - Technically, Managerially, and Financially Independent
- Located in Fairmont, West Virginia
  - Approximately 250 employees
- IV&V analyzes software for NASA's critical missions with the following perspectives:
  - Does the software do what it is supposed to do
  - Does the software not do what it is not supposed to do
  - Does the software respond appropriately under adverse conditions
- IV&V's goal across all projects is to add assurance and mitigate risk with respect to software

# Orion Multi-Purpose Crew Vehicle





# Orion Artemis 1 Mission Overview



Total distance traveled: 1.3 million miles – Mission duration: 25.5 days – Re-entry speed: 24,500 mph (Mach 32) – 13 CubeSats deployed

# Challenges

- Orion development environment is very dynamic – utilized a Scaled Agile Framework (SAFe) Agile approach to software development
- Team members could not perform the previous analysis without frustration
- In many cases IV&V provided inputs months out of phase with the developer
- Approach required IV&V to adapt much more than usual to perform effective analysis

# Agile IV&V

- To help with some of these challenges, IV&V approached Mr. Will Hayes with the Software Engineering Institute at Carnegie Mellon University
- Will was tasked to help IV&V understand the Agile approach used by the Orion flight software developer
- Will helped IV&V adopt Agile and Lean concepts that integrated logically with some of the ways we were trying to perform analysis
- Agile IV&V is the application of those relevant Agile and Lean principles in the planning, management and performance of IV&V – not an orchestrated adoption of some branded framework or tool



# Implementing the Principles

- 3 Main areas of change to address:
- Changing the way the team was structured
- Changing how the team communicates
- Changing how the work was being approached

# New Team Structure

- Small self-organizing teams
- Started with 2 Scrum teams
  - Teams were broken up into technical areas
- Established Assurance Releases / Sprints
- Transitioned to Scrumban after 6 months – team provided valuable rationale at retrospectives to make the change
- Now have 3 – 4 teams with rotating Scrum Leads every 2 Assurance Releases
  - Teams are designed from skill set / organizational fit

# Increased Communication

- Retrospectives

- Take time to stop work and talk about what went well, what didn't go well, and what to do differently
- Orion IV&V Retrospectives occur at the “entire team” level every 4 months and at the “scrum team” level every month or when needed

- Stand-ups

- Scrum teams meet 3-4 times a week to discuss what work has finished, what work is planned, and any help the team needs from leadership
- Leadership meets with scrum leads twice a week to discuss progress of analysis activities



# Increased Communication

- *Fast integrated learning cycles*
  - The team structure and frequent retrospectives help facilitate this key principle to implement plan, do, check, adjust cycles
- *Backlogs*
  - Backlogs are the work that you have to do
  - Added Kanban boards to display the backlog when the team transitioned to a Scrumban approach
  - Provides great insight to leadership into who is working on what and helps facilitate dialog around progress

# Changing the Work

- *Small batch sizes of assurance work*
  - Previously analysts would receive documents or code and work for months doing analysis
  - Now assurance work is broken down into specific mission critical capabilities that IV&V wants to add assurance for
  - Broken down to the analysis activity level
- *Frequent delivery*
  - Deliver findings and results when they are ready, not needing to wait for release reviews or major milestones

# Results

- Communication has improved in many areas
- Orion IV&V changed delivery cadence from months to weeks
- Stakeholders were happy with the changes
- The team embraced the continuous improvement mindset
- Team is getting comfortable with feeling uncomfortable



# Questions?