ARINC 838

Creating a reference implementation of the specification

The Players - Team IO2

Agenda

- Problem Statement
- Solution Demonstration
- Plan Recap
- Team Dynamics
- Execution Recap
- Hurdles and Conclusions

Mike Deats

Scott Griffin

Customer

Chris Ellison
(Boeing)

Ryan Neal

Liron Yahdav

Brandon Sutherlin

The Problem: Software

ARINC 838 Specification

- A specification for loadable software module
  - Creates files in both XML and Binary
  - Specific constraints on class and feature structure (DO-178B)
- Goal: to provide industry-wide accepted standard for data loading
- Create a reference implementation of the spec
- Analyze for problems and inconsistencies (gap analysis)

The Problem: Process

Agile Methodologies

- Agile not commonly used in aerospace
- One of our deliverables was an agile assessment document
  - Evaluate if required rigor can be achieved through Agile
- Adhere to the constraints of DO-178B standard

The Problem: Industry

DO-178B

- Defines guidelines for aviation software
- 5 certification levels: A (catastrophic), B (hazardous-severe), C (major), D (minor), E (no-effect)
- Customer requirements
  - Code coverage
  - Traceability of code to requirements
  - Verification/validation code needs to be certified, thus separate

"In aviation, safety is our highest priority. [The ARINC 838] standard will help ensure the integrity and traceability of our critical software components. Having a reference implementation is extremely important to ensure everyone in the supply chain is on the same page as we manage these complex and software-heavy systems." - Chris Ellison

DEMO!

The Plan

Organize

- Define the practices
- Define the technologies
  - Java, Eclipse, GIT, etc.
- Define the metrics and risks
- Work with the customer to plan releases, priorities, and deliverables

Code

- Keep to the practices
- Demonstrate progress at the end of the iterations
- Engage with the customer as soon as problems were encountered

Wrap-up

- Create customer deliverables
  - Source, Agile writeup, and Gap analysis
- Create school deliverables

The Plan: Agile

Extreme Programming (XP)

- No compelling reason *not* to use it
- Works well with remote teams
- Attempted to use all tenets

Tailoring

- Odd-number meant couldn't do 100% pair programming
- Didn't use pairs for easy problems

The Plan: Iterations

Six Iterations

- Begin and end with planning and reflection meetings
- "Iteration 0" for environment and logistics
  - Define the metrics and risks
  - Estimate the first group of stories

Two Releases

- Rigid dates, fluid features
  - Artifact of the school deadlines

Iterative Estimation

- Estimate the stories as we have sufficient knowledge
  - Otherwise numbers are totally off
- Done as a team using planning poker

The Plan: Risk

Risk Analysis

- "5 Whys" to identify core risks
- Wideband Delphi to assess risk factor
  - Probability X Impact = Risk Factor
- Two biggest risks manifested:
  - DO-178B constraints
  - Real-life events

Risk Mitigation

- For each risk, identified mitigation strategies

The Plan: Metrics

Metrics Plan

- Used the "Goal, Question, Metric" approach
- Settled on five metrics:
  - Average Velocity
  - Total effort logged
  - Effort logged per story
  - Code coverage
  - Time spent coding

The Plan: Open Source-ness

Open source project

- Not standard in industry
- Released under MIT License
- Opens up toolset options
  - TeamCity
  - Pivotal Tracker

Implications for DO-178B

- At certain levels, tools must also be "certified"
- Better tools = better product

Free stuff if your project is open source!

How'd We Do?

We're (still) Awesome

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DEFENDER OF THE UNIVERSE
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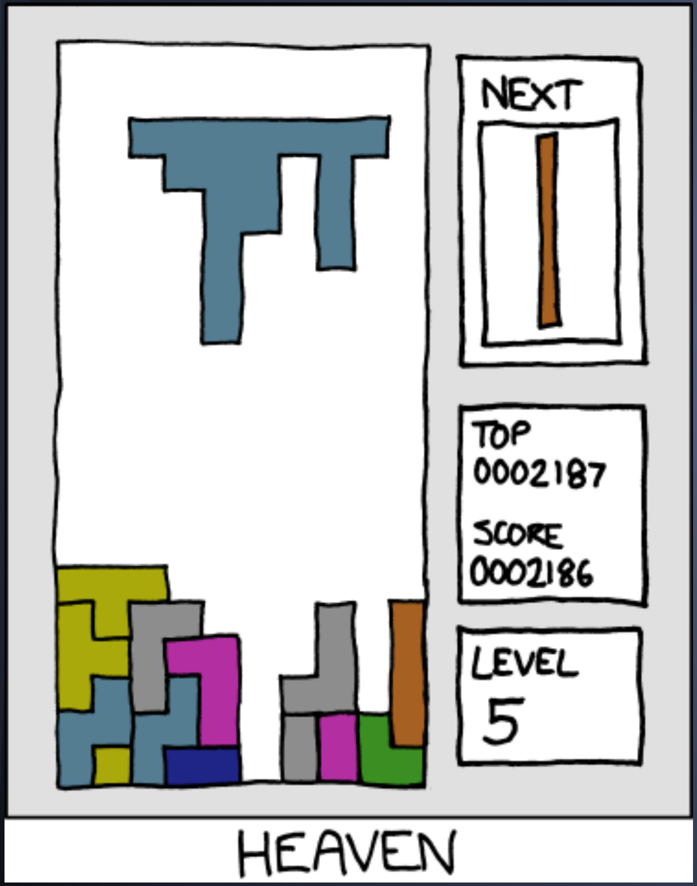
No. Really. We are.

The Team Dynamics



Each strong individually

- Inspired teammates

Established trust and rhythm

- Helped deal with real life event
- Actively sought out work
- Self organized

Maintained team motivation

Amazing customer

- More on this...

The Customer: "Plastics!"

Chris Ellison

- Responsive
    - Github member
    - Involved in Pivotal Tracker
- Involved
    - Scheduled extra informative meetings
    - Responded to bugs and gaps
    - Made Agile processes possible
- Prepared
    - Stories before the semester started

The Execution: Iterations

5.5 Iteration

- At each demonstrated feature we'd completed
- Outlined the goals going forward at end
  - Kept an eye on the customer's satisfaction
  - Checked for shifting priorities
- Demonstrated completeness to customer
- Cut final iteration short to focus on school deliverables
  - Worked with the customer to make sure his needs were met

Estimated when it made sense

- As we gained knowledge and needed the estimations
- Relayed information to customer for feedback

Adhered to Agile practices

- Pair programming, TDD, CI
- In-line with customer, and team, desires

The Execution: Releases

Release 1

- Right before the break
- Created the ability to read and write the Binary and XML version
    - No validation, just parsing the data into the right shape
- Defined the infrastructure for code
    - Designed with some thought to the future
- Simple UI
    - Intended for testing
- Extensive Code Coverage

Release 2

- At end of class
- Added all the validation
    - Separate according to DO-178B
    - Required extensive refactor
- Enhanced UI
    - Only capability demos
- High code coverage
- Final deliverables
    - Source code
    - Agile Writeup
    - Gap Analysis
- School deliverables

The Execution: Results

Code base

- Great starting place for future teams
  - Make fully qualified for DO-178B
- Able to create and verify both binary and XML versions of the spec
  - Simple UI for developer
- Demonstrated value to customer
- Thorough test set
  - Useful for future changes to the spec

Process

- Demonstrated a rigorous Agile process
- Worked closely with the customer
  - He knows more than a writeup can explain

Analysis

- Identified many gaps in the spec
- Provided valuable information through implementation

The Execution: Metrics

Collected Metrics

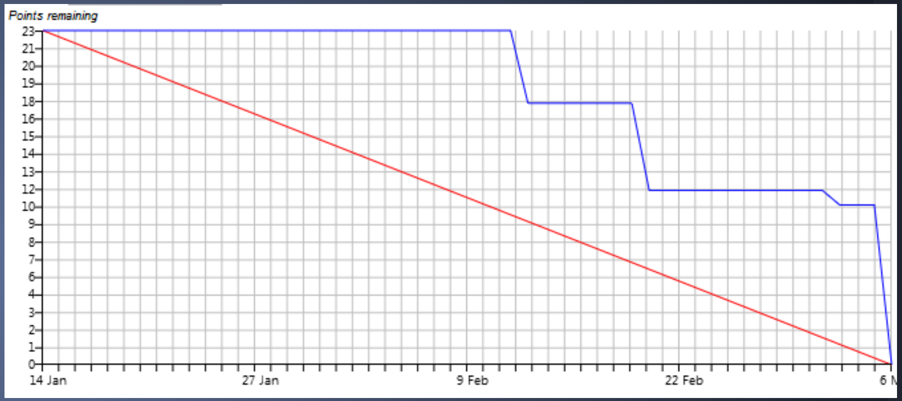
- Velocity
  - Provided by Pivotal
- Neglected many 'planned' metrics
  - Didn't see the value

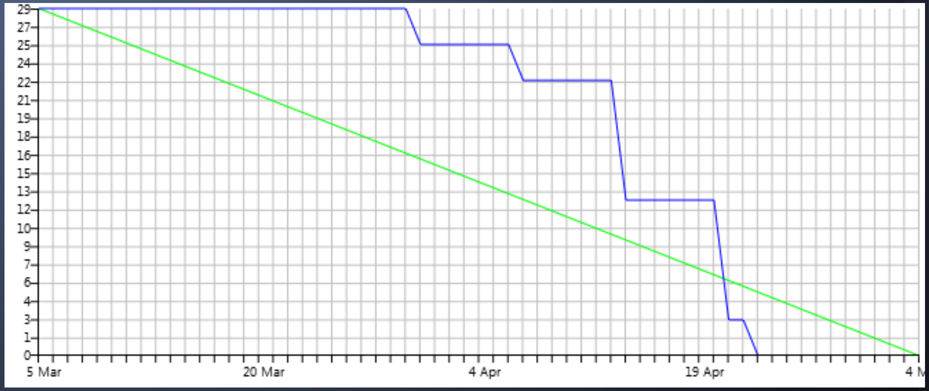
Soft Metrics

- Customer satisfaction
- Team Morale

Story Points

- Bursty acceptance
  - Weak acceptance criteria
- Commonly accepted at the end of the iteration





The Stumbling Blocks

The Stumbling Blocks: Metrics & Process

Metrics

- Collected only some of those intended
  - Didn't see value
  - Used Pivotal and customer feedback
  - Make explicit decisions

Process

- Did not tailor as intended
- Over reliance on team dynamics and talent

The Stumbling Blocks: Team Size and Just Enough

Team size

- Odd number made tasking complicated
- Team adapted and found balance

Just Enough

- How much is enough?
- Ran into major refactor
  - Cost slightly over a week of schedule slippage
  - Didn't have the experience when decisions were needed
- Just Enough != None

The Stumbling Blocks: Brandon's Flat

- There was no spare tire
- Brandon's a bit of a princess with dirt
- If this makes it to the list...

Conclusions

Project was successful

- Customer is happy
- Goals achieved
- Team increased skills, knowledge and experience

Agile can add value in Aerospace

- Refine Just Enough
- Leverage diversity and tacit knowledge of the team
- Goal is to improve software development
- Infuse XP practice where value will be added

Questions?

Pivotal

- https://www.pivotaltracker.com/projects/457281

GitHub

- https://github.com/squirrely/arinc_838

Photo credits

- Tetris
  - http://xkcd.com/888/
- Voltron
  - http://aramedia.com/voltronparadise.htm
- Fallout
  - http://midlifegamer.wordpress.com/
- Stumbling Blocks
  - https://encrypted-tbn3.google.com/images?q=tbn:ANd9GcTE5apk2v3F4SRyKMbROS0uF14Wu4Heg5YXCEI0DmiBqhUDjS344w
- Flat Tire
  - https://encrypted-tbn1.google.com/images?q=tbn:ANd9GcSkyxlZWHZXyu-4K25xyQWUCawF67qjd4nqYPMYpwTg2NRSoKmf