

# Forecasting with confidence

# Brett Ansley

Interim  
Delivery Director

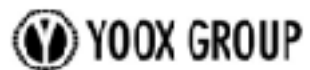


VictoriaPlum.com



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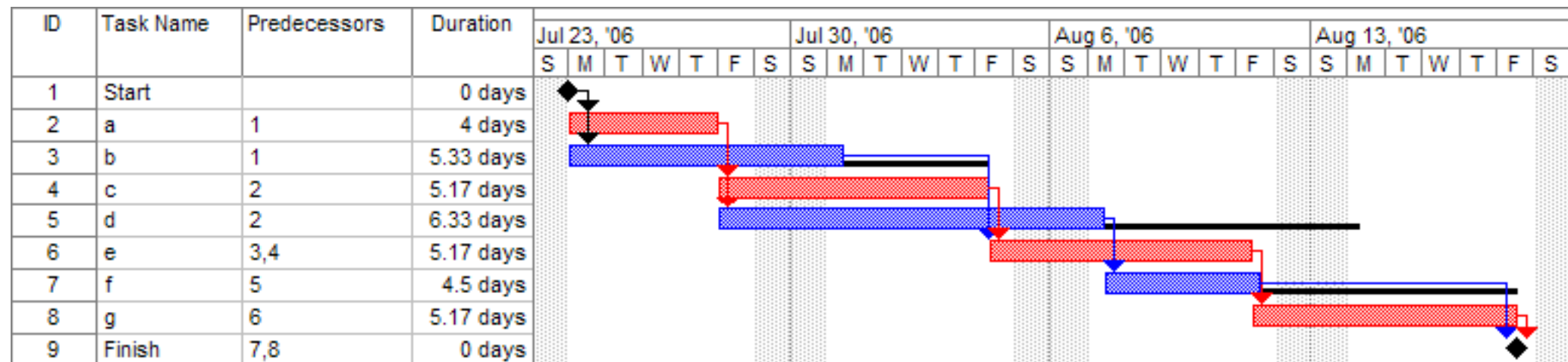
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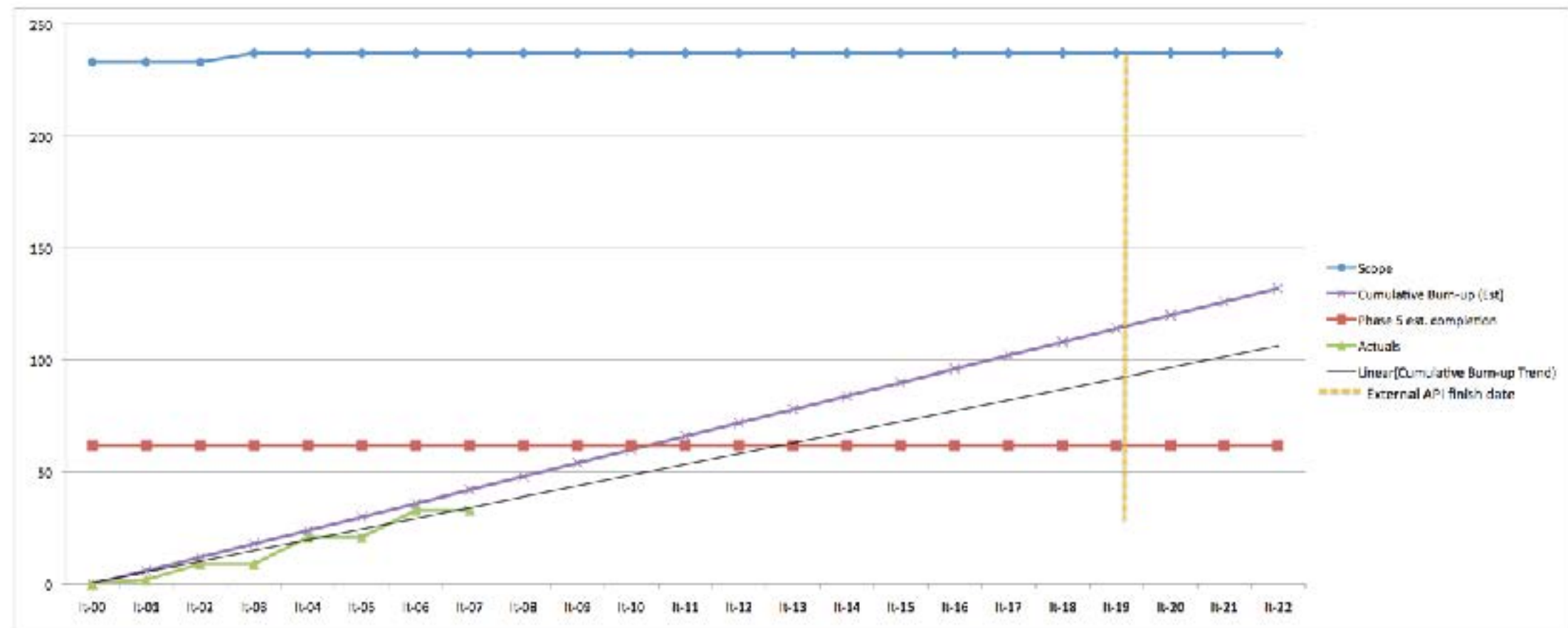
# How I got here



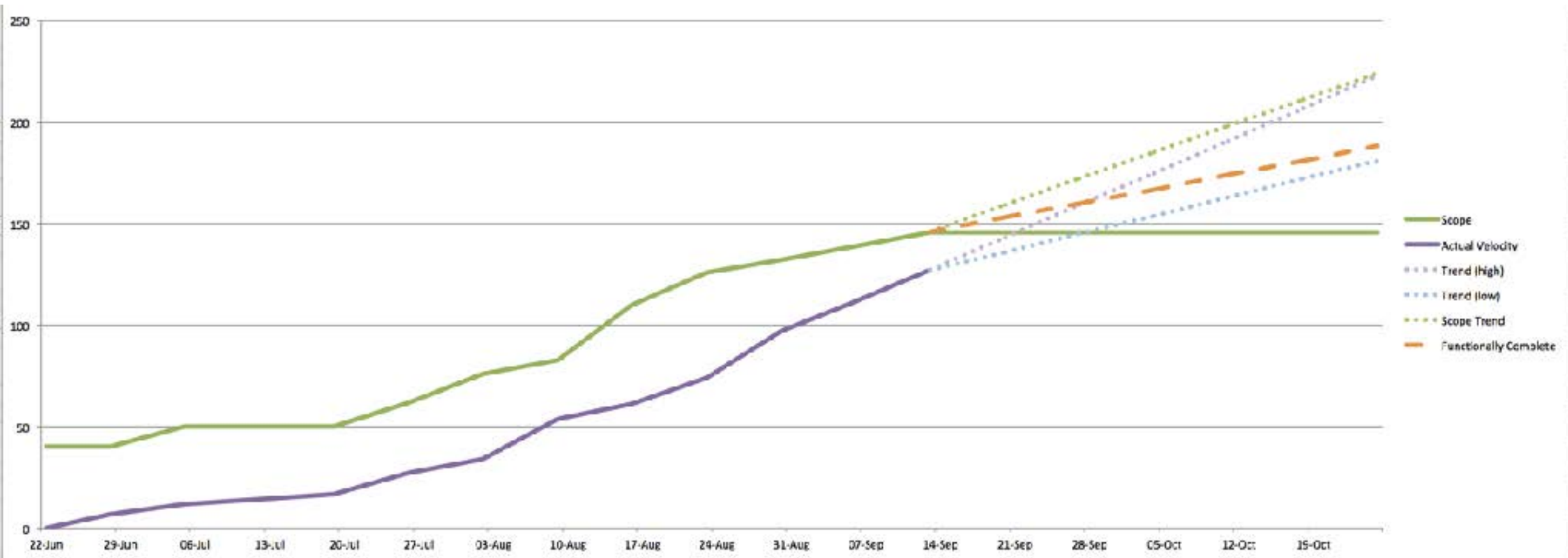
# How I got here

## Burn Up

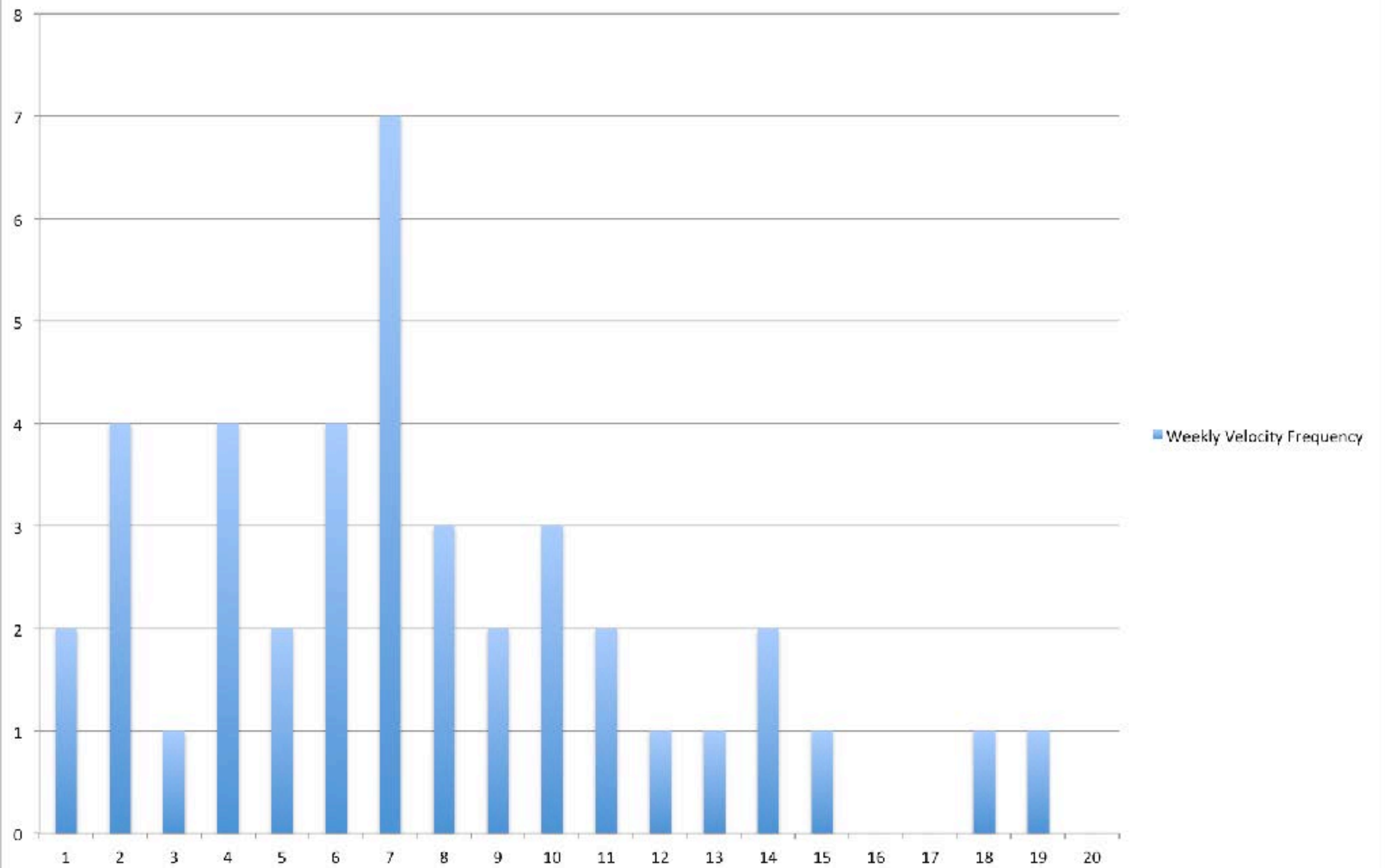
| Phase / Release           | Sprint 0 | Dev    |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|---------------------------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Start Date                | 05-Jul   | 12-Jul | 19-Jul | 26-Jul | 02-Aug | 09-Aug | 16-Aug | 23-Aug | 30-Aug | 06-Sep | 13-Sep | 20-Sep | 27-Sep | 04-Oct | 11-Oct | 18-Oct | 25-Oct | 01-Nov | 08-Nov | 15-Nov | 22-Nov | 29-Nov |
| End Date                  | 11-Jul   | 18-Jul | 25-Jul | 01-Aug | 08-Aug | 15-Aug | 22-Aug | 29-Aug | 05-Sep | 12-Sep | 19-Sep | 26-Sep | 03-Oct | 10-Oct | 17-Oct | 24-Oct | 31-Oct | 07-Nov | 14-Nov | 21-Nov | 28-Nov | 05-Dec |
| Iteration #               | It-00    | It-01  | It-02  | It-03  | It-04  | It-05  | It-06  | It-07  | It-08  | It-09  | It-10  | It-11  | It-12  | It-13  | It-14  | It-15  | It-16  | It-17  | It-18  | It-19  | It-20  | It-21  |
| Scope                     | 233      | 233    | 233    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    | 237    |
| Phase # est. completion   | 82       | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     | 82     |
| Weekly Burn (Est)         | 0        | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      |
| Weekly Burn Actual        | 0        | 2      | 7      | 0      | 12     | 0      | 12     | 0      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Cumulative Burn-up (Est)  | 0        | 6      | 12     | 18     | 24     | 30     | 36     | 42     | 48     | 54     | 60     | 66     | 72     | 78     | 84     | 90     | 96     | 102    | 108    | 114    | 120    | 126    |
| Cumulative Burn-up Actual | 0        | 2      | 9      | 9      | 21     | 21     | 33     | 33     |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Cumulative Burn-up Trend  |          |        |        |        | 21     | 21     | 33     | 33     |        |        |        |        |        |        |        |        |        |        |        |        |        |        |



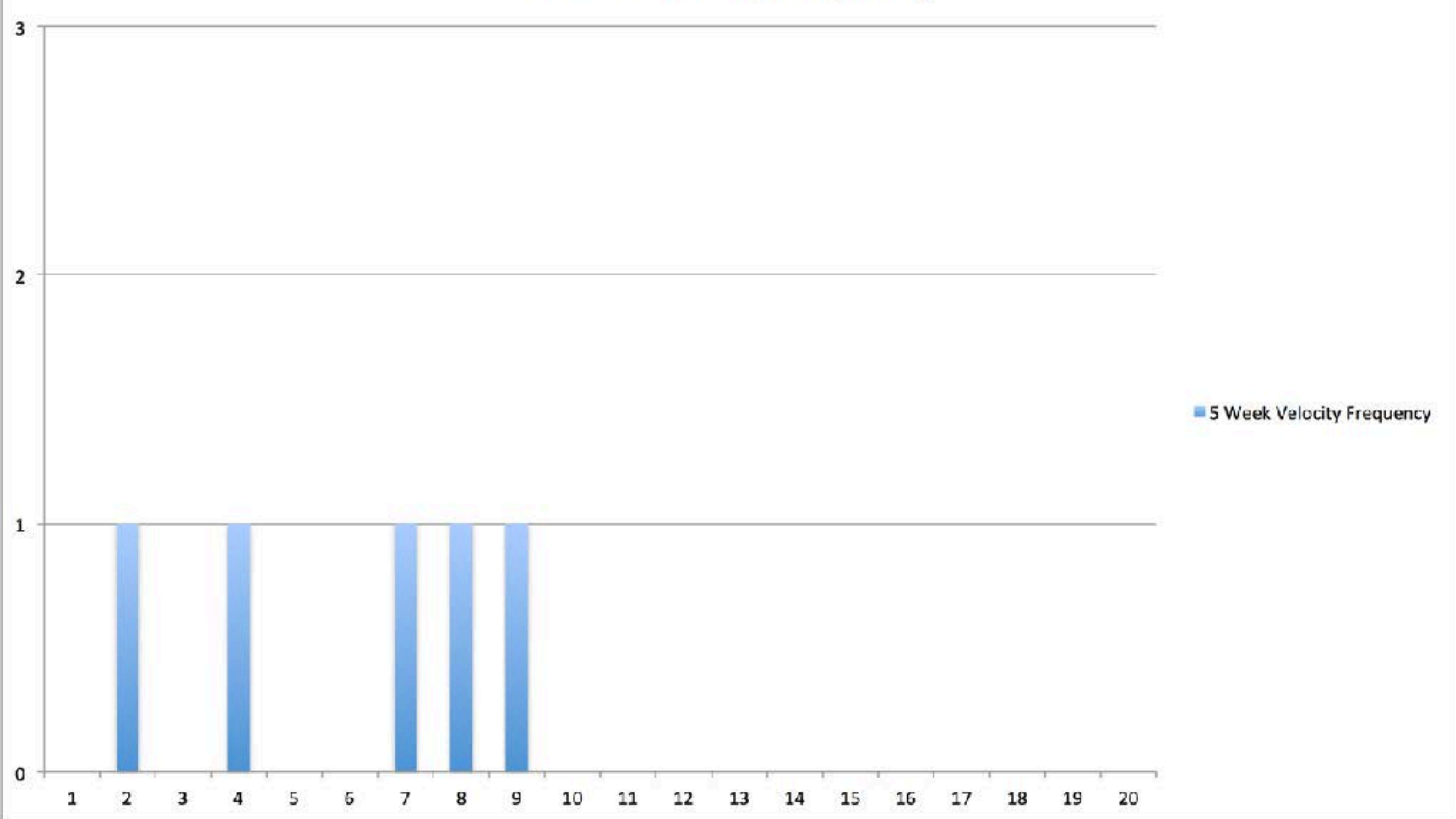
# How I got here



## Weekly Velocity Frequency



## 5 Week Velocity Frequency



# Little's $L\lambda w$

$$L = \lambda W$$



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No. of Customers in system = Arrival Rate \* Time spent in system

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Cycle Time = WIP / Throughput

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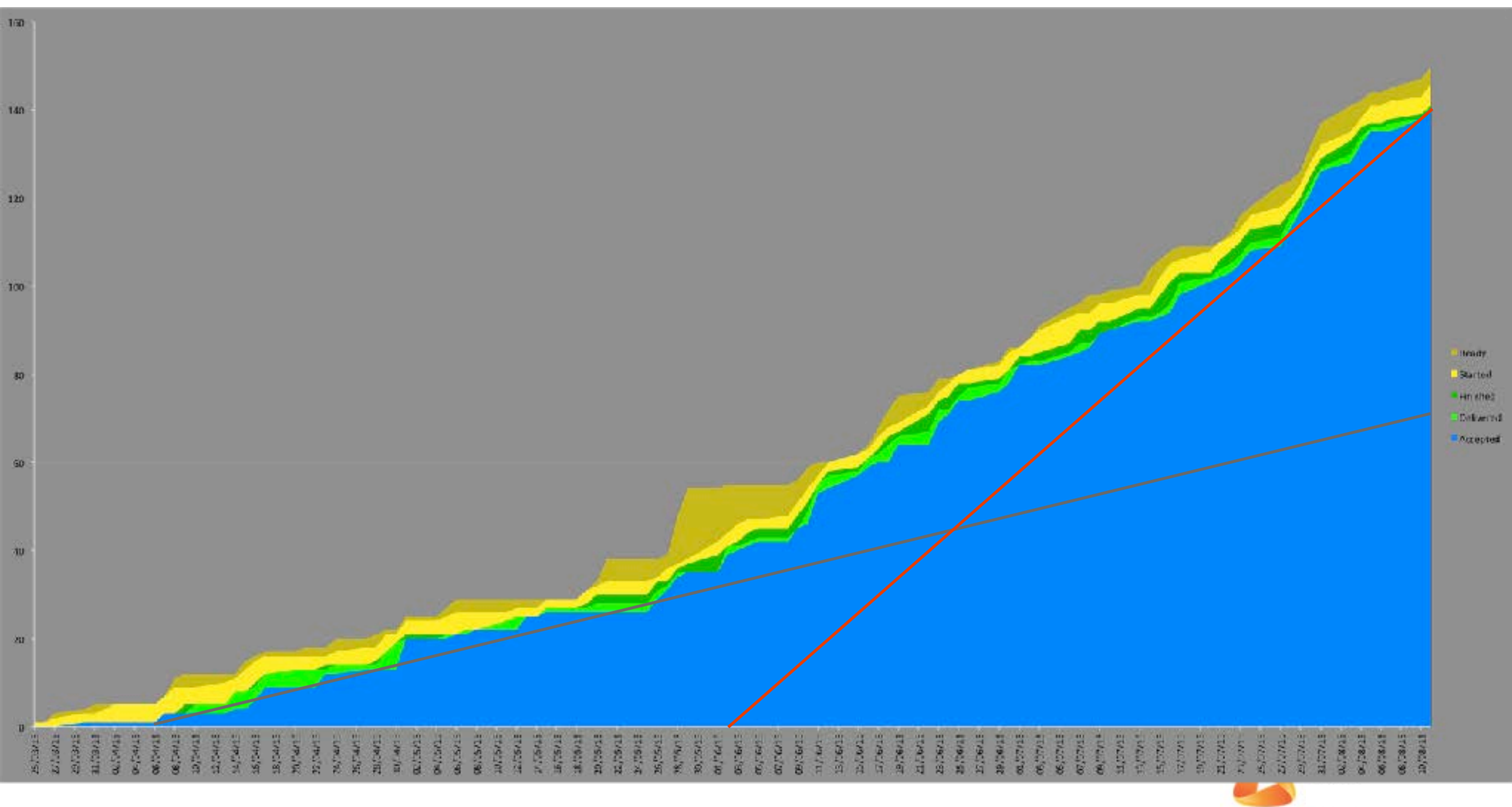
## ASSUMPTIONS

- All measurement units are consistent
- Conservation of Flow which assumes
  - \*Average Arrival Rate == Average Departure Rate
  - \*All work that enters the system flows through to completion and exits
- System is “stable”
  - \*The average age of WIP is neither increasing or decreasing
  - \*The total amount of WIP is roughly the same at the beginning and at the end

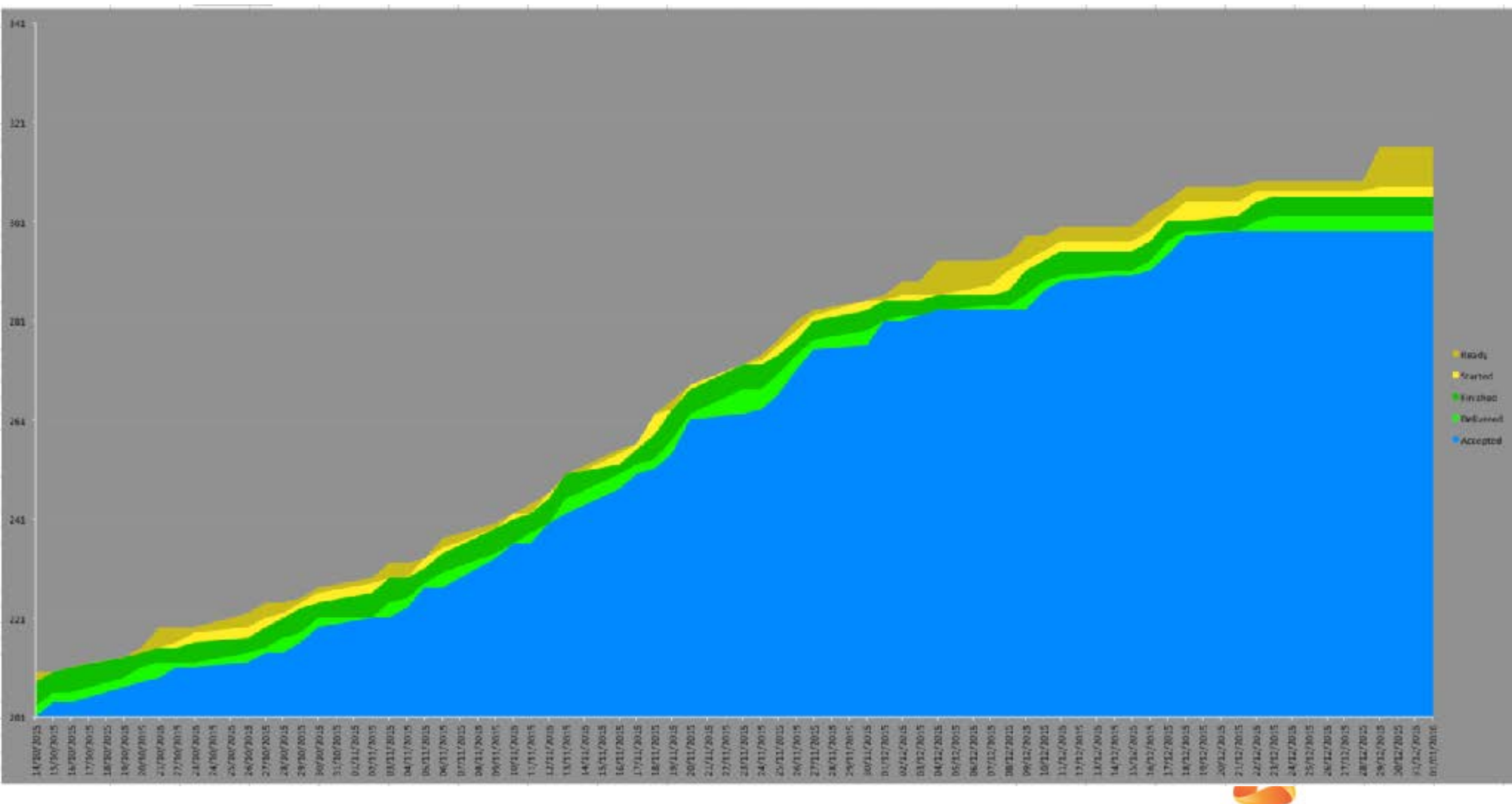
# Little's Law

- Explicitly Record:
  - Cycle time
  - WIP
  - Throughput

# Cumulative Flow 1



# Cumulative Flow 2



# Heuristic forecasting

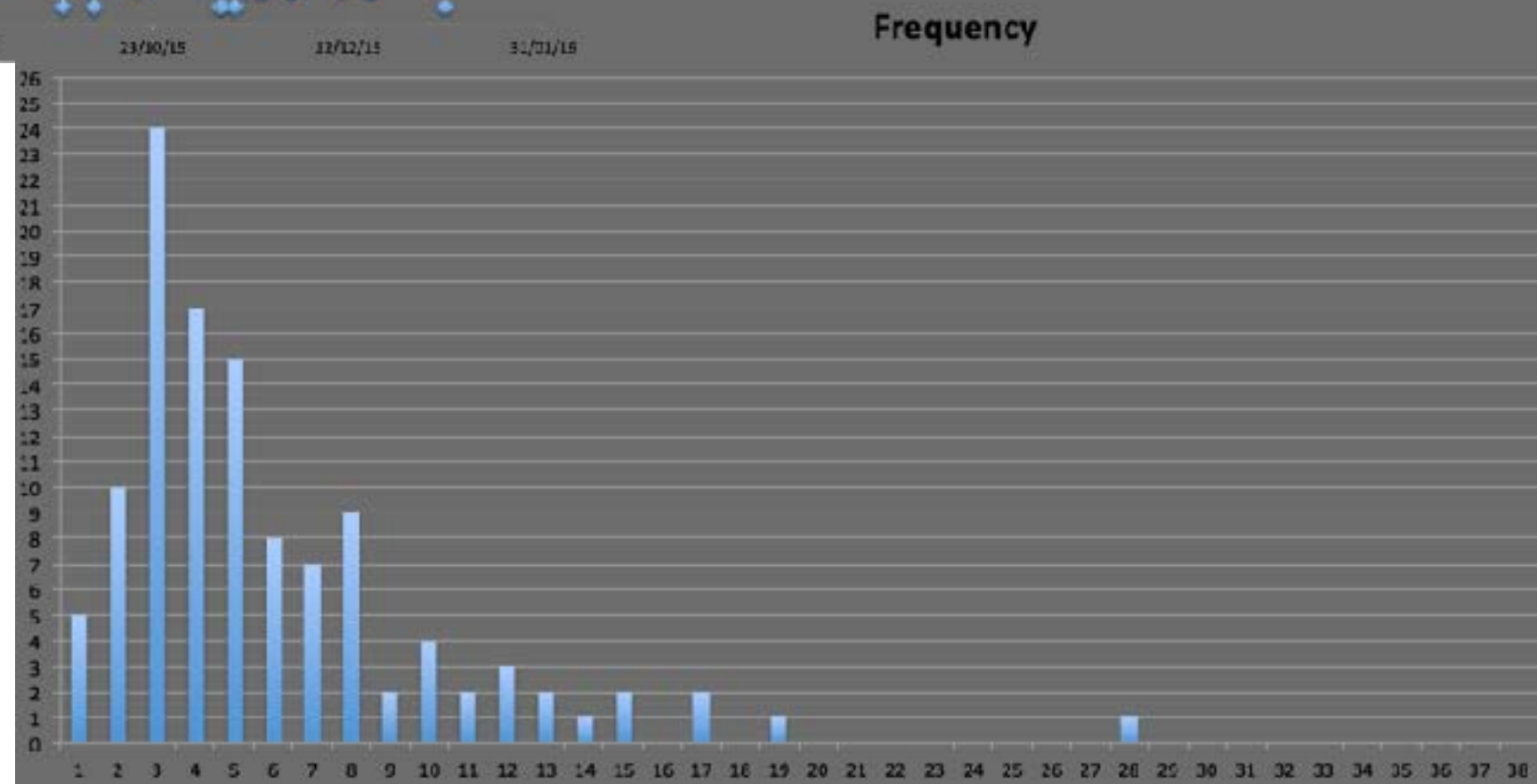
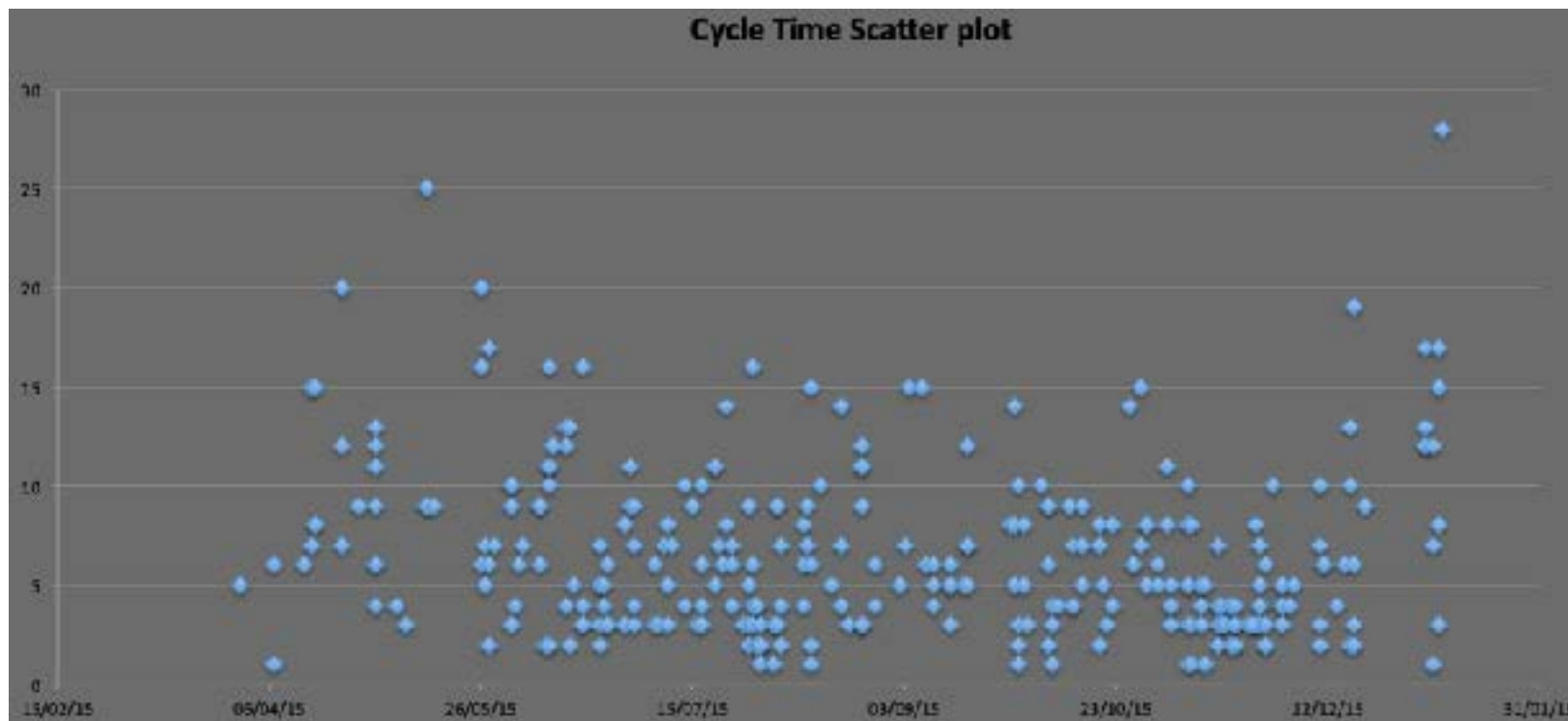
- Traditional “Agile” forecasting is heuristic
  - Points
  - Burn-up / burn-down
  - “Planning games”

# Heuristic forecasting

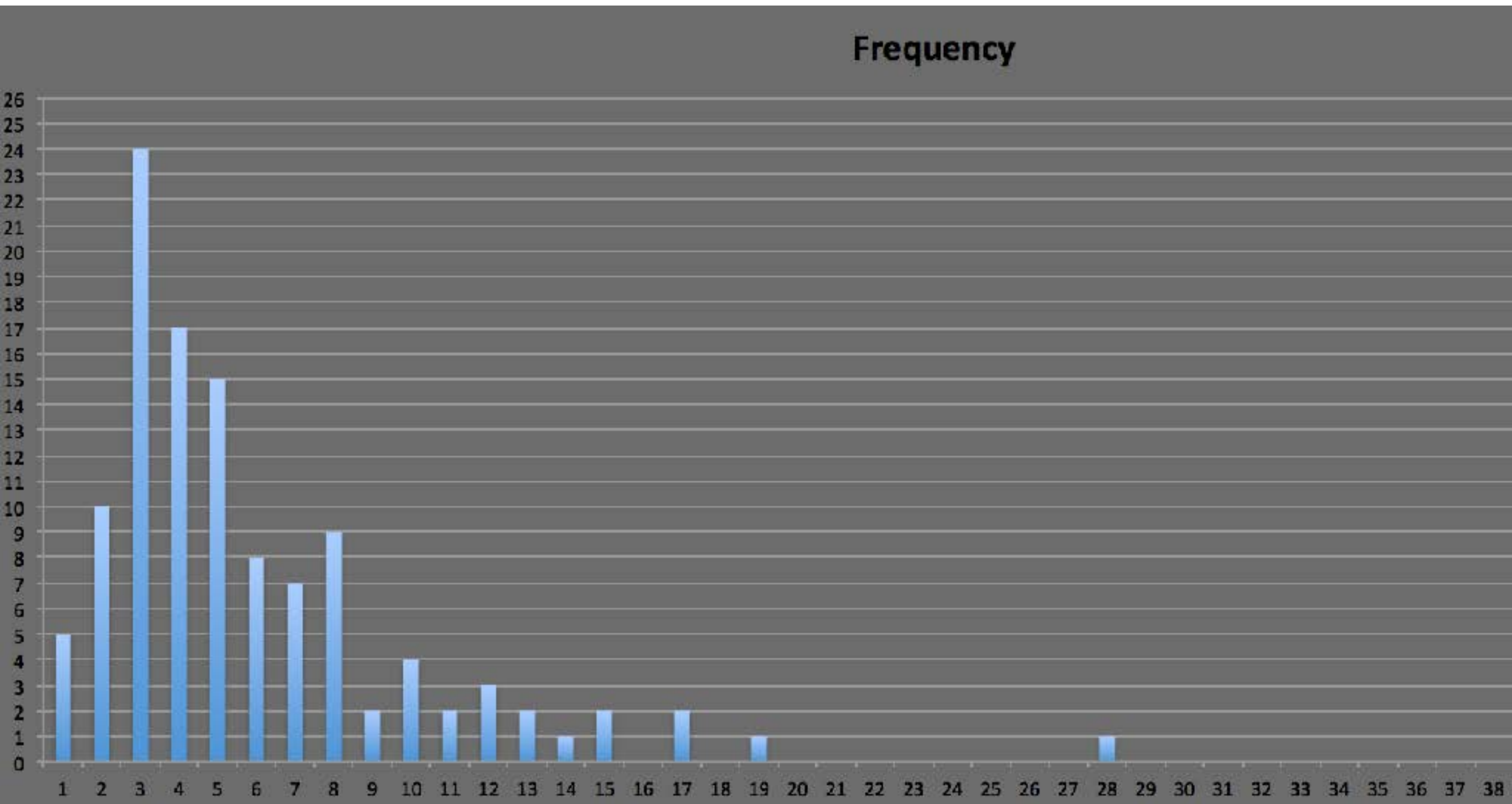
- Fall foul of cognitive biases
  - Confirmation bias
  - Optimism bias
  - Familiarity bias
- Miss small events that don't happen often but cumulatively have a big impact



# Looking at the data



# Looking at the data



# Stochastic forecasting

- Using a statistical model to forecast project delivery
- Model based on historic data

# Factors

- WIP
- Cycle time
- Bug rate
- Rate of change of scope
- Team size
- Rate of change of average age of stories

# Complicated forecasting

- Needs a stochastic model
- Uses Monte Carlo simulations based on the model

# Building a model

- Need less data points than you think
- Start simple
- Layer complexity
- Use history to refine

# Building a model

```
9 <!-- Staffing numbers for each skillset with some ranges to test -->
10 <?parameter name="FrontEnd" value="4" type="number" lowest="1" highest="5" step="1" ?>
11 <?parameter name="BackEnd" value="8" type="number" lowest="3" highest="11" step="1" ?>
12 <?parameter name="Testers" value="2" type="number" lowest="1" highest="4" step="1" ?>
13
14 <!-- This allows us to model risk - we predict that a certain percentage of work will -->
15 <!-- require us to do more work to correct issues that arise -->
16 <?parameter name="PerformanceRiskPercentage" value="30" type="number" lowest="0" highest="100" step="1" ?>
17
18 <!-- cost per day used to calculate running project staff cost -->
19 <?parameter name="CostPerDayPerPerson" value="$185" type="currency" lowest="105" highest="245" step="10" ?>
20 <?parameter name="RevenuePerMonth" value="$10000" type="currency" ?>
21
22 <!-- How many stories do we need to deliver? -->
23 <?parameter name="StoryCount" value="100" lowest="50" highest="150" step="10" ?>
24
25 <setup>
26
27 <forecastDate startDate="@StartDate"
28 costPerDay="@CostPerDayPerPerson * (@FrontEnd + @BackEnd + @Testers)"
29 revenue="@RevenuePerMonth" revenueUnit="month" />
30
31 <backlog type="custom" nameFormat="{1}" shuffle="true">
32
33 <!-- features that need to be delivered - all MUST HAVES -->
34 <deliverable name="Features">
35 <custom name="Stories" count="@StoryCount"/>
36 </deliverable>
37
38 <!-- % chance that there will be memory and performance issues that need to be remedied -->
39 <deliverable name="RISK: P1 Issues" skipPercentage="100.0-(@PerformanceRiskPercentage * 1.0)">
40 <custom name="P1 Issue {0}" count="5" />
41 </deliverable>
42
43 </backlog>
44
45 <columns>
46 <column id="1" buffer="true" wipLimit="3">Dev Ready</column>
47 <column id="2" estimateDistribution="DevelopmentDistribution" wipLimit="=(@FrontEnd+@BackEnd)-3" displayWidth="2">Development</column>
48 <column id="3" buffer="true" wipLimit="3">Test Ready</column>
49 <column id="4" estimateDistribution="TestDistribution" wipLimit="@Testers*2">Test</column>
50 </columns>
51
52 <distributions>
53 <distribution name="DevelopmentDistribution" shape="custom" parameters="2,0.1853,3,0.0526,4,0.1579,5,0.1579,7,0.2105,8,0.0526,9,0.1053,10,0.0526,12,0.0526,13,0.0526"
54 numberType="integer" />
55 <distribution name="TestDistribution" shape="custom" parameters="1,0.5,2,0.1075,3,0.125,4,0.125,7,0.0625" numberType="integer" />
56 </distributions>
57
58 <!-- BlockingEvents; Add any number of events that inhibit progress of a card -->
59 <!-- Cards that are blocked will not move to the next column until the block time expires. -->
60 <!--
61 <blockingEvents>
62 <blockingEvent columnId="2" occurrenceLowBound="4" occurrenceHighBound="10"
63 estimateLowBound="1" estimateHighBound="3">
64 Block dev (missing requirement)
65 </blockingEvent>
66
67 <blockingEvent columnId="4" occurrenceType="percentage" occurrenceLowBound="10" occurrenceHighBound="25"
68 estimateLowBound="1" estimateHighBound="2">
69 Block testing (no environment)
70 </blockingEvent>
71 </blockingEvents>
72
73 <defects>
74 <defect columnId="2" startsInColumnId="2"
75 occurrenceLowBound="1" occurrenceHighBound="3">
76 Bug found in Testing ({0})
77 </defect>
78
```



```
1 <simulation name="Forecasting" locale="en-US">
2
3   <execute intervalUnit="days">
4     <visual />
5   </execute>
6
7   <setup>
8
9     <forecastDate startDate="01/07/2016" />
10
11    <!-- start by putting 30 items into the backlog -->
12    <backlog type="simple" simpleCount="30" />
13
14    <columns>
15      <column id="1" buffer="true" wipLimit="3">Dev Ready</column>
16      <column id="2" estimateDistribution="DevelopmentDistribution"
17        wipLimit="5" displayWidth="2">Development</column>
18    </columns>
19
20    <distributions>
21      <distribution name="DevelopmentDistribution" shape="custom"
22        parameters="2,0.1053,3,0.0526,4,0.1579,5,0.1579,7,0.2105,8,
23        0.0526,9,0.1053,10,0.0526,12,0.0526,13,0.0526"
24        numberType="integer" />
25    </distributions>
26
27  </setup>
28
29 </simulation>
```



```

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20     <blockingEvents>
21       <blockingEvent columnId="2" occurrenceLowBound="4" occurrenceHighBound="10"
22         estimateLowBound="1" estimateHighBound="3">
23         Block dev (missing requirement)
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26
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28       <distribution name="DevelopmentDistribution" shape="custom"
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31         numberType="integer" />
32     </distributions>
33
34   </setup>
35
36 </simulation>
37

```



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23         Block dev (missing requirement)
24       </blockingEvent>
25
26       <addedScopes>
27         <addedScope occurrenceLowBound="2" occurrenceHighBound="4" />
28       </addedScopes>
29
30     <distributions>
31       <distribution name="DevelopmentDistribution" shape="custom"
32         parameters="2,0.1053,3,0.0526,4,0.1579,5,0.1579,7,0.2105,8,
33         0.0526,9,0.1053,10,0.0526,12,0.0526,13,0.0526"
34         numberType="integer" />
35     </distributions>
36
37   </setup>
38
39 </simulation>
40
```



```

1 <simulation name="Forecasting" locale="en-US">
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23         Block dev (missing requirement)
24       </blockingEvent>
25
26       <addedScopes>
27         <addedScope occurrenceLowBound="2" occurrenceHighBound="4" />
28       </addedScopes>
29
30       <defects>
31         <defect columnId="2" startsInColumnId="2"
32           occurrenceLowBound="10" occurrenceHighBound="20">
33           Bug found in Testing ({0})
34         </defect>
35
36       <distributions>
37         <distribution name="DevelopmentDistribution" shape="custom"
38           parameters="2,0.1053,3,0.0526,4,0.1579,5,0.1579,7,0.2105,8,
39           0.0526,9,0.1053,10,0.0526,12,0.0526,13,0.0526"
40           numberType="integer" />
41       </distributions>
42
43     </setup>
44
45 </simulation>
46

```



```

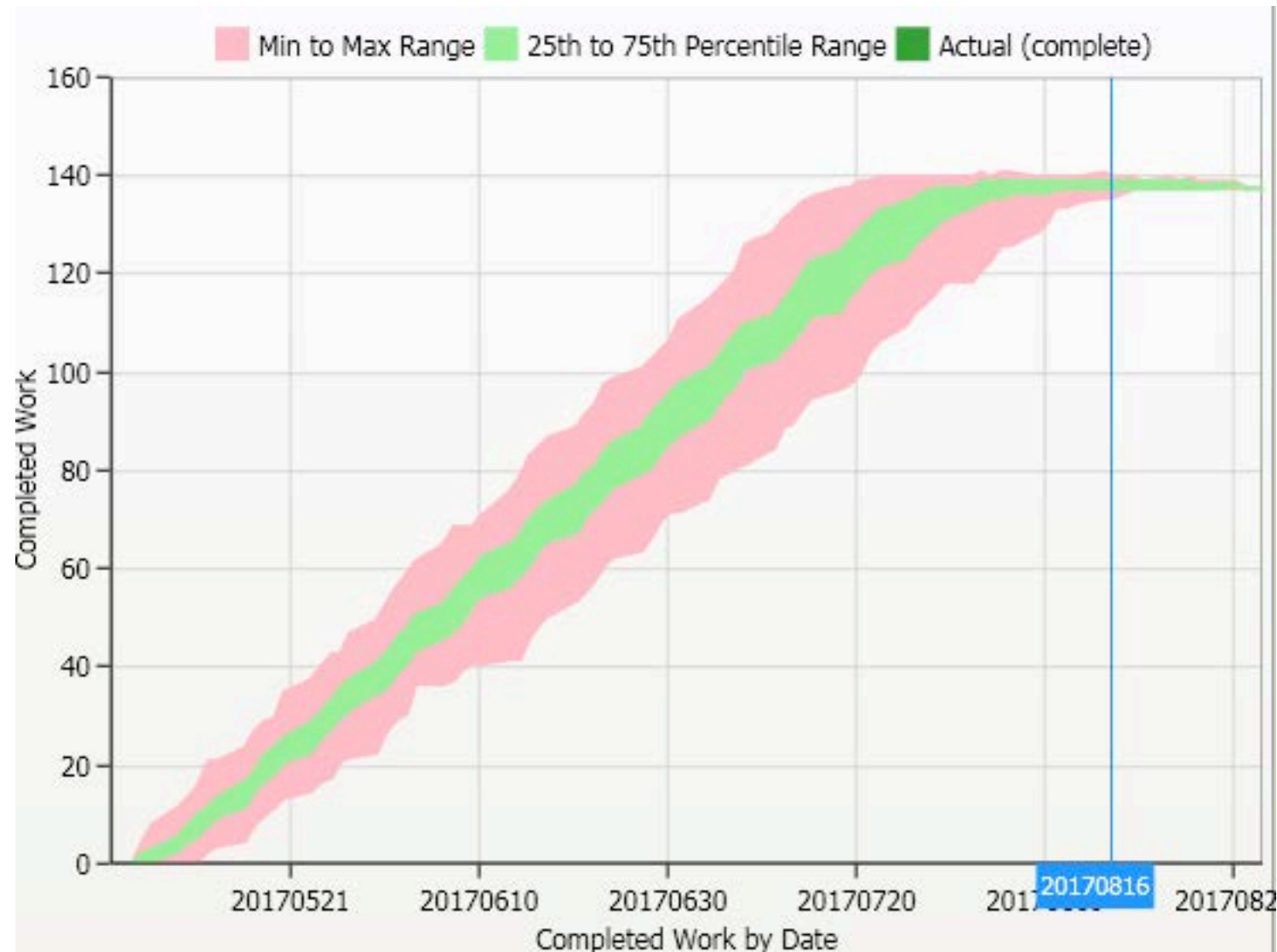
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41         0.0526,9,0.1053,10,0.0526,12,0.0526,13,0.0526"
42         numberType="integer" />
43       <distribution name="TestDistribution" shape="custom"
44         parameters="1,0.6,2,0.2,3,0.15,5,0.05" numberType="integer" />
45     </distributions>
46
47   </setup>
48
49 </simulation>
50

```

# Validating a model

- Test against historic data
- Run multiple tests
- Keep validating every time you use the model (in case something has changed)

# Forecasting with a model



# Forecasting with a model

- Monte Carlo simulation
- 85th percentile
- Quote as a range
- Reducing variance improves forecasts

# It's all about variance

## **ASSUMPTIONS**

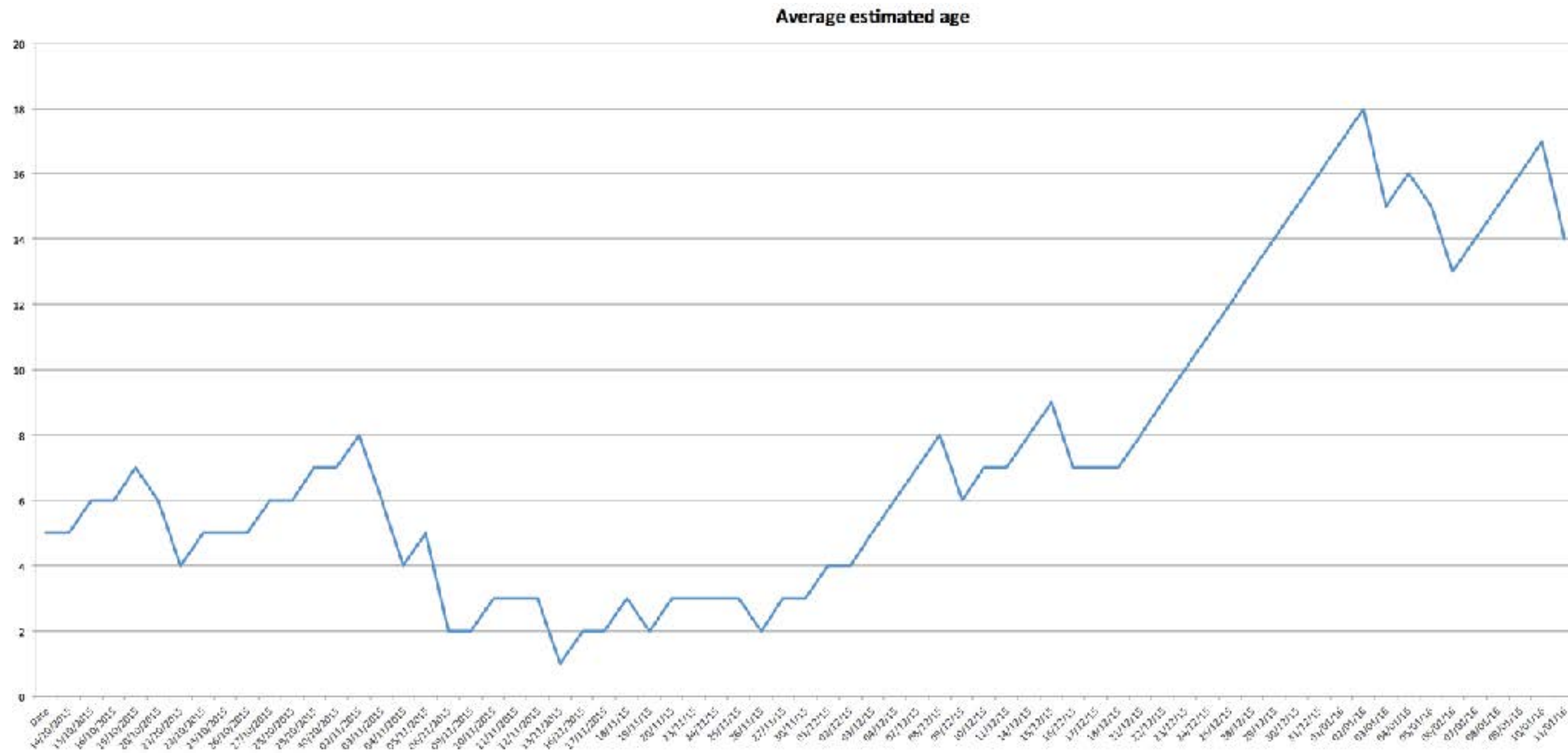
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# It's all about variance

- Make assumptions explicit
- 85th Percentile
- 85th to 50th percentile split (indicator of variance)
- Variance introduced by instability (changing average age)

# Example of moving to stochastic forecasting



# Dashboard

|                            | For Week 45 | Cumulative for<br>Week 36 to 45 |
|----------------------------|-------------|---------------------------------|
| Average Cycle Time         | 7.78        | 5.17                            |
| Median Cycle Time          | 6.00        | 4.00                            |
| Cycle Time Deviation       | 3.69        | 2.42                            |
| Min Cycle Time             | 2.00        | 1.00                            |
| Max Cycle Time             | 19.00       | 19.00                           |
| Cycle Time Mode            | 6.00        | 3.00                            |
| Cycle Time 5th percentile  | 2.00        | 2.00                            |
| Cycle Time 25th percentile | 3.00        | 3.00                            |
| Cycle Time 50th percentile | 6.00        | 4.00                            |
| Cycle Time 85th percentile | 12.40       | 8.00                            |
| Cycle Time 90th percentile | 14.20       | 9.00                            |
| Average Throughput         | 9.00        | 10.89                           |
| Median Throughput          |             | 8.00                            |
| Throughput Deviation       |             | 4.96                            |
| Min Throughput             |             | 2.00                            |
| Max Throughput             |             | 18.00                           |
| Throughput Mode            |             | 7.00                            |
| Throughput 5th percentile  |             | 3.80                            |
| Throughput 25th percentile |             | 7.00                            |
| Throughput 50th percentile |             | 8.00                            |
| Throughput 85th percentile |             | 14.65                           |
| Throughput 90th percentile |             | 15.30                           |

# Impacts on forecast accuracy

- Instability in the project team
- Excessively large work items
- Artificial ageing

# Brett Ansley

Interim  
Delivery Director



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