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NEON: Chris McKay, Kathy Kirby, Verna Tomanek; Rick Farnsworth (former)

Defining Science Requirements, Managing Scope, and Ensuring Delivery

Lessons Learned During NEON Construction & Initial Operations

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Agenda

1. Context of NEON Project Management
2. Derivation of Science & CI Requirements
3. Perturbations to Scope, Schedule, Budget
4. How Integrated Product Teams Optimize Designs
5. How CI Development Plans are Adjusted
6. Lessons Learned

National Ecological Observatory Network

IS- Instrument Systems

Eddy Covariance

Fixed sensors; data transferred autonomously and continuously, processed in batches

Terrestrial & Aquatic

OS- Observation Systems

Terrestrial & Aquatic

Data are collected manually; samples sent to external facilities for analysis and/or archive

RS- Remote Sensing

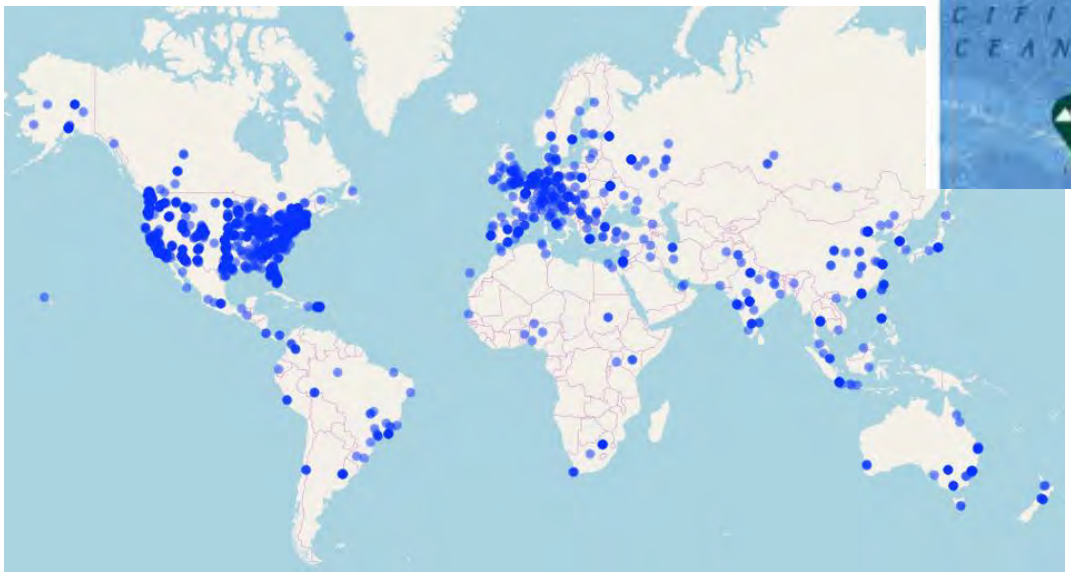
Airborne Platform

Mobile, airborne system; data are recorded electronically and downloaded at a later date

NEON Introduction

Sampling Locations

API Users



Project Management Targets

Schedule
Scope
Budget

PM Drivers

Schedule
Scope
Budget

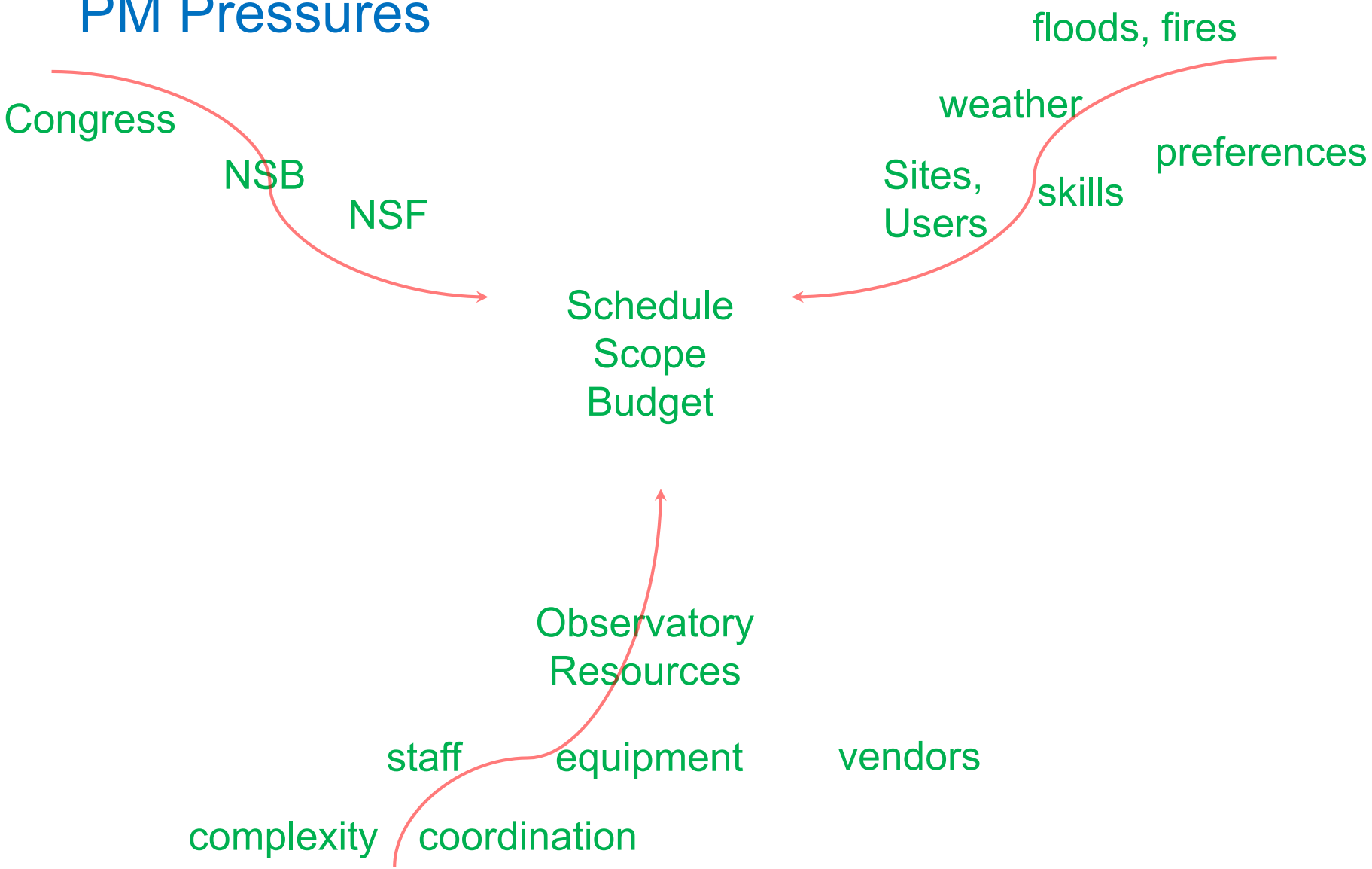
"…distributed but integrated…"

"…continual performance enhancement…"

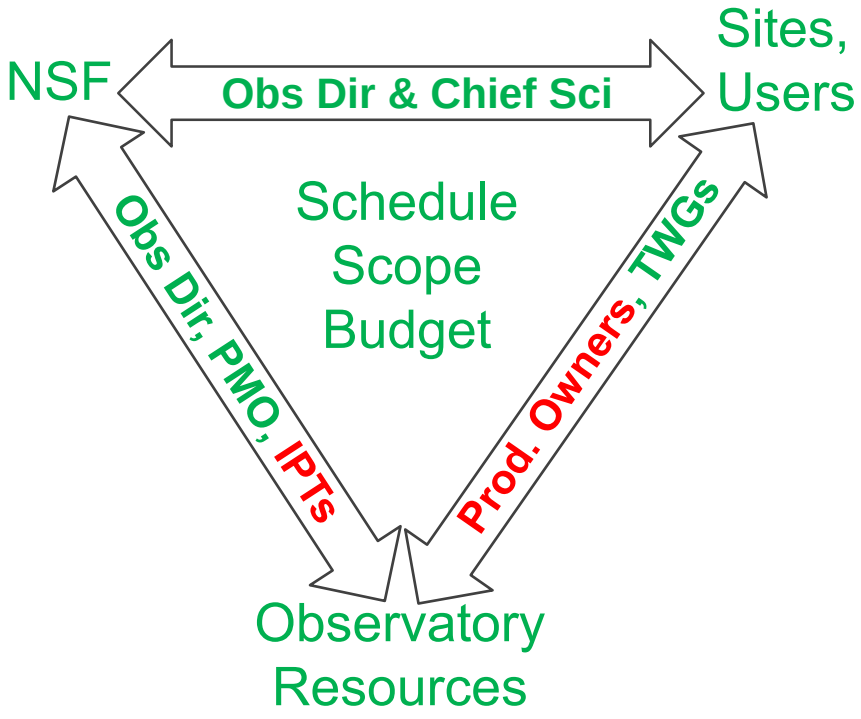
"…optimized pursuant to LFM's flexibility, with justification & substantiation…"

"…work authorization documents enable staff to charge WBSes…"

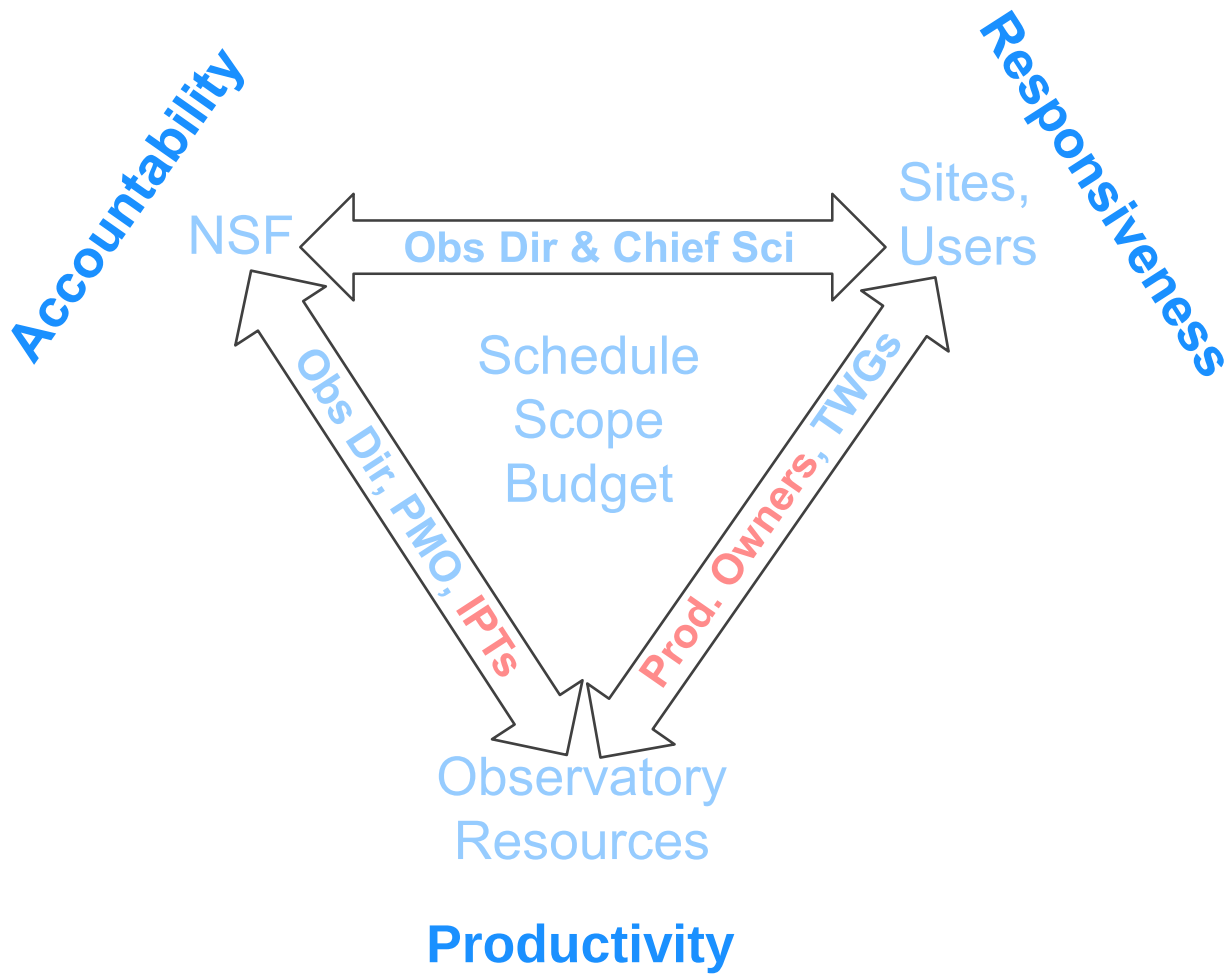
PM Pressures



PM Leaders

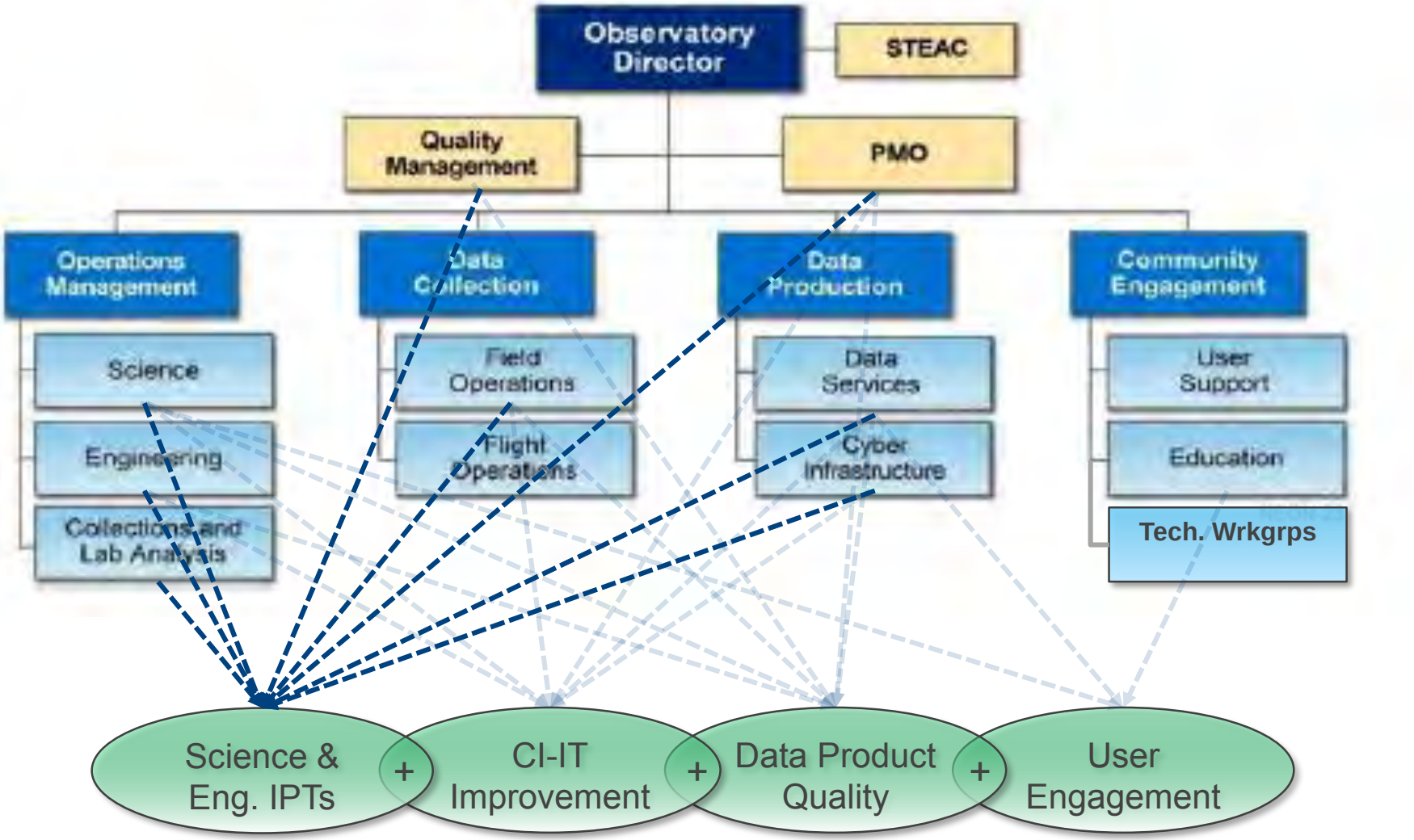

NSF
Obs Dir & Chief Sci
Sites,
Users
Schedule
Scope
Budget
Obs Dir, PMO, IPTs
Prod. Owners, TWGs
Observatory
Resources

PM Outcomes

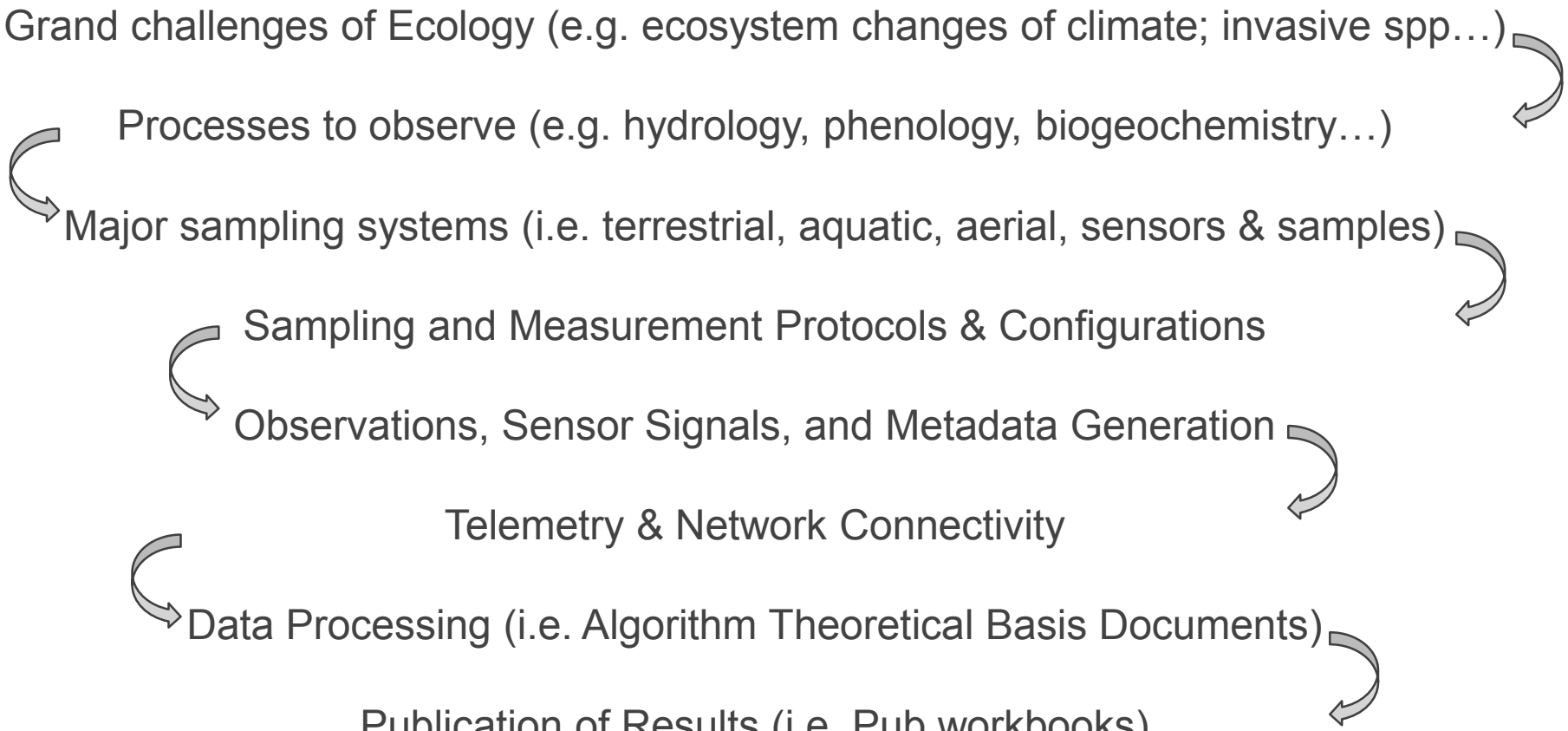

Accountability
Responsiveness
NSF
Obs Dir & Chief Sci
Sites, Users
Schedule
Scope
Budget
Obs Dir, PMO, IPTs
Prod. Owners, TWGs
Observatory Resources
Productivity

PM Leadership Landscape in AWP 2016-2018

PM Governance in PEP via Integrated Product Teams



Requirements of Science Mission Fulfillment



Perturbations to Science Mission Requirements

Grand challenges of Ecology (e.g. ecosystem changes of climate; invasive spp…)

Processes to observe (e.g. hydrology, phenology, biogeochemistry…)

Major sampling systems (i.e. terrestrial, aquatic, aerial, sensors & samples)

Sampling and Measurement Protocols & Configurations

Observations, Sensor Signals, and Metadata Generation

Telemetry & Network Connectivity

Data Processing (i.e. Algorithm Theoretical Basis Documents)

Publication of Results (i.e. Pub workbooks)

+ New User Preferences; + Force Majeures; + Sample Archival

Example1: Cumulative Species Richness Optimization

Do the results support NEON science mission?

Which facets of sampling cannot change?

- Consistency in plot sizes across sites

Which facets of sampling could we change?

- Subplots & frequency

How would changes impact scope, schedule, budget?

- In hours & dollars

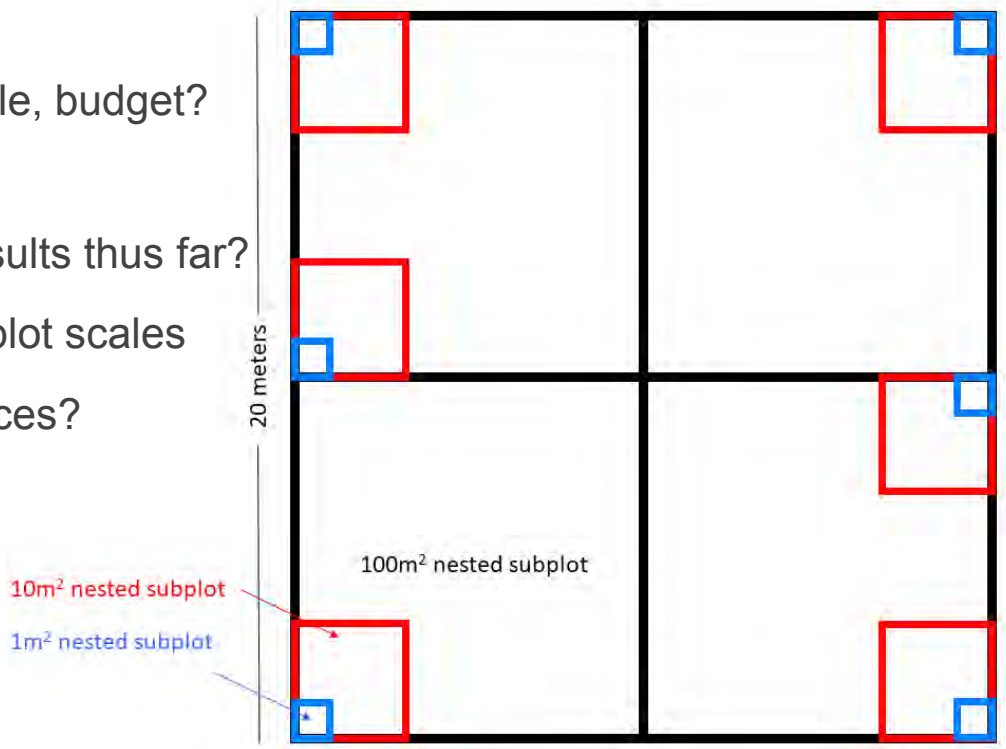
Can we examine these options with the results thus far?

- variance /site, /year, /bout, /plot, /subplot scales

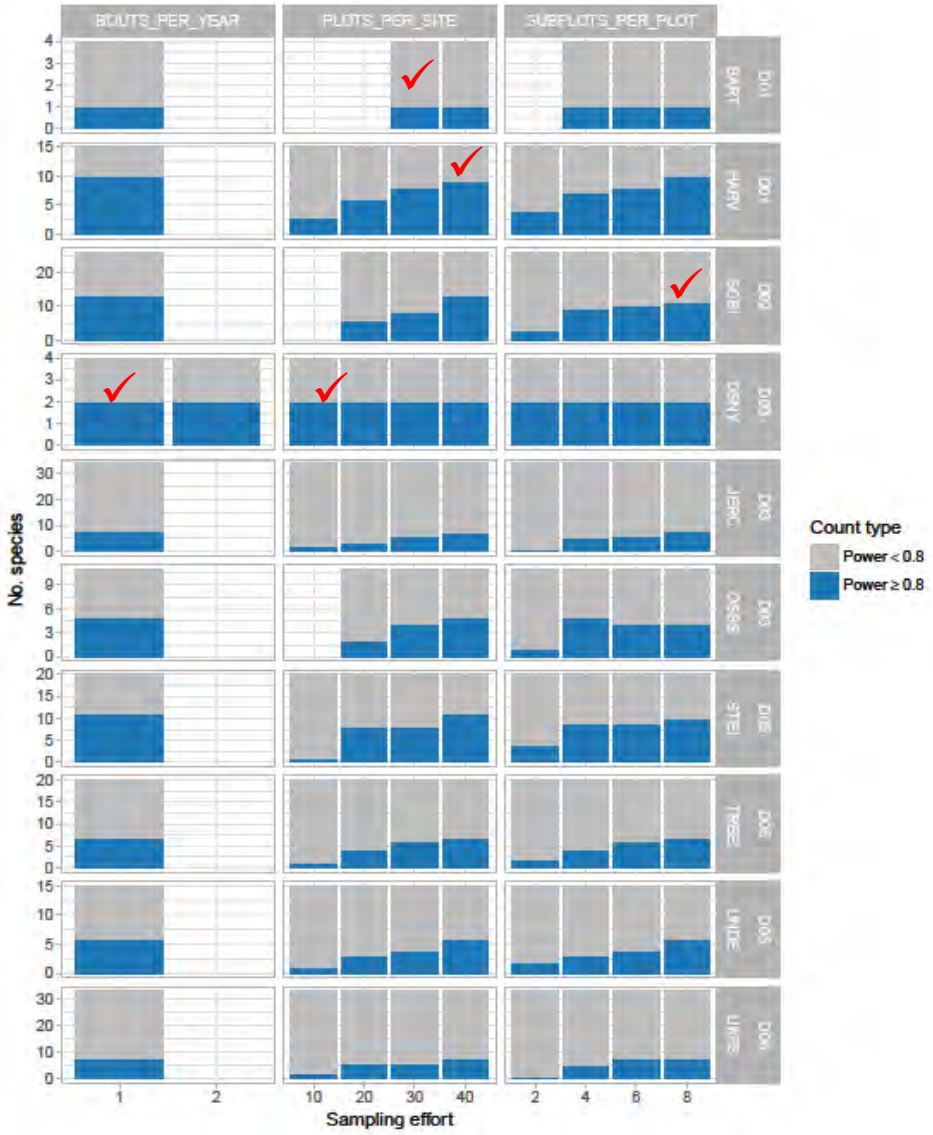
Who should be engaged to deliberate choices?

- OS IPT, TWG, Ops-IPT, NSF

Observational System IPT

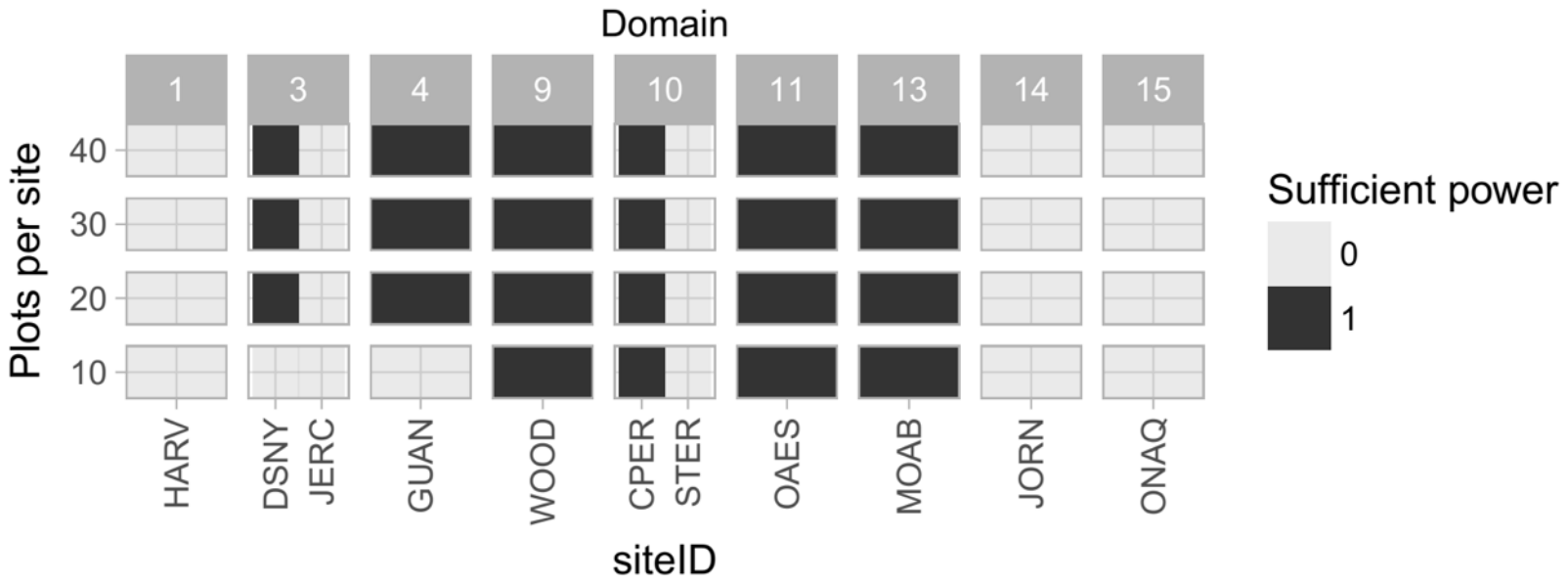


Cumulative Species Richness Optimization



Example2: Plant Diversity Optimization

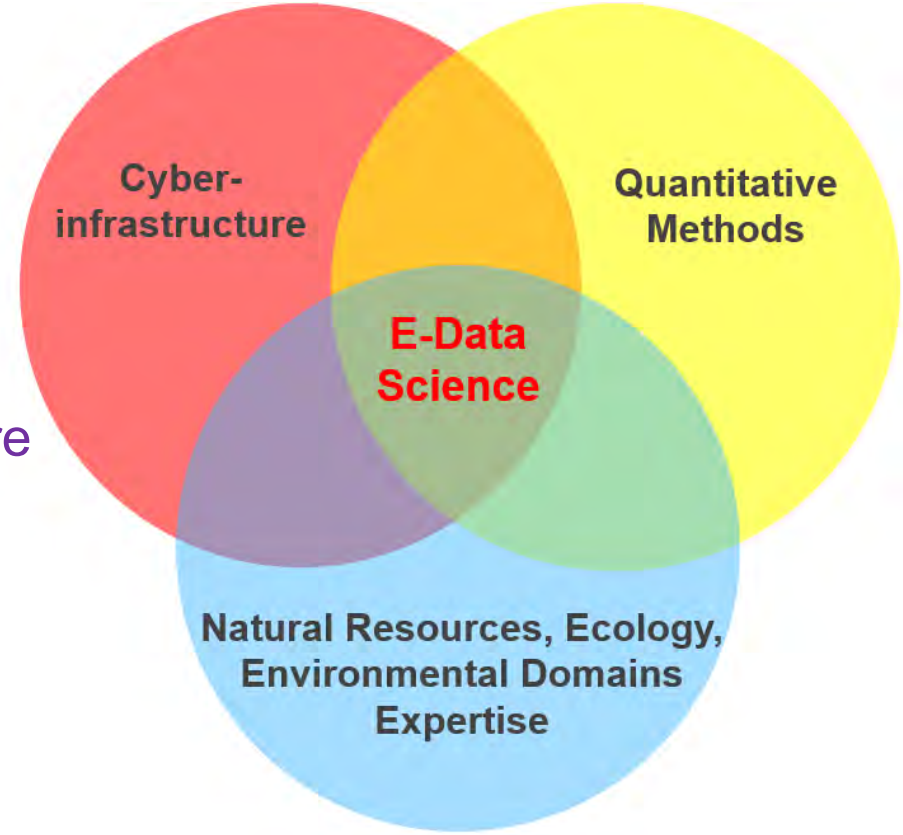
Data-driven Optimization of Herbaceous Biomass Sampling Design



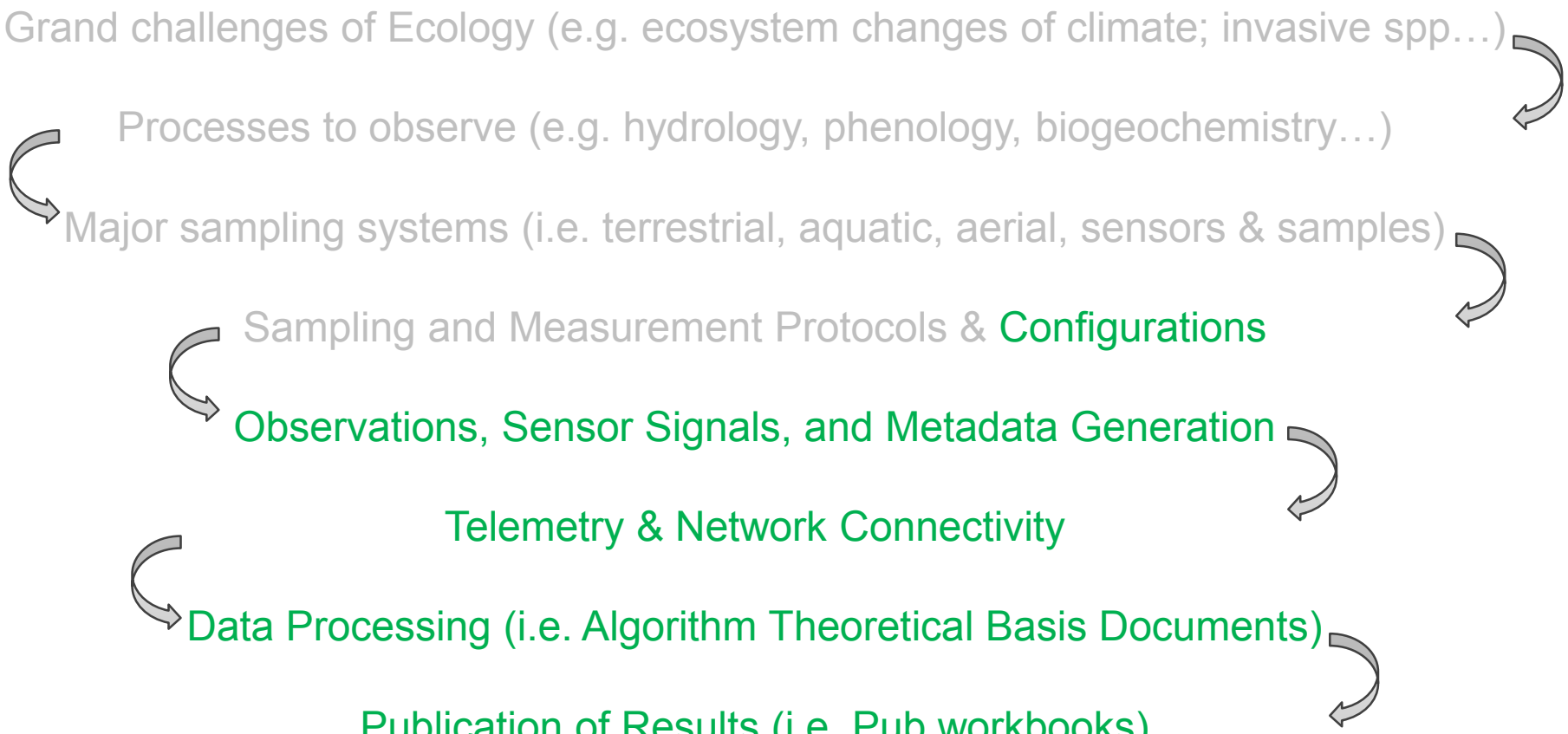
Black cells indicate sampling efforts (number of plots, y-axis) at each site (x-axis) that have sufficient power to detect a 20% change in standing biomass between years.

Scope Control of Sampling & Data Products by Unicorns

- Balance science mission scope, schedule and budget via a blend of skills
- Overlaps are most powerful combinations of core expertise:
  - Smarter models & tools
  - Defensible conclusions
  - Faster, lower cost data capture
  - Unified team solutions



Requirements of Cyberinfrastructure Performance



Perturbations to Cyberinfrastructure Requirements

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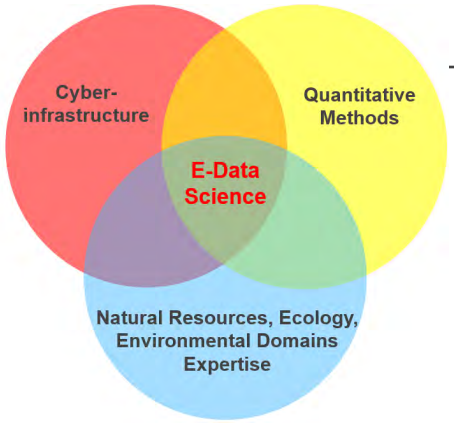
Publication of Results (i.e. Pub workbooks)

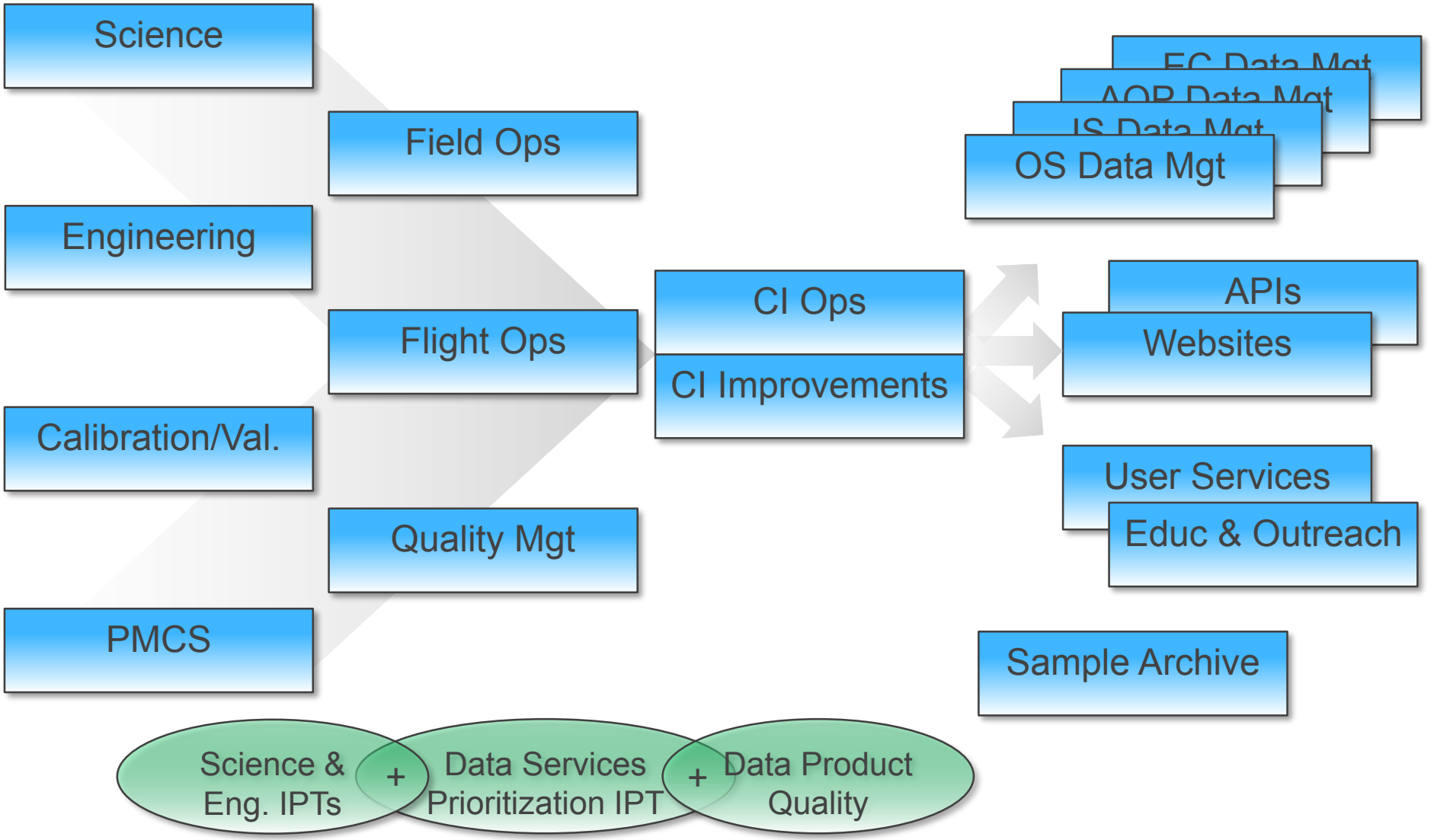
Perturbations to Cyberinfrastructure Requirements

+ schedule -	Budget Threats	Budget Neutral	Budget Opportunity
	• Workflow Automation • New Ticketing System	• Agile Teams	• Agile Product Owners • Data Science MVPs
	• Agile Coach Governance • Vol/Capacity Growth • Cybersecurity	• SW Development QA	• Data Science Code • External Data Hosts • NSF CI CoE
	• CI-science silos • Data/Metadata Gaps • COTS obsolescence	• CI Documentation	• Document-driven generic ETL

Data Services Prioritization IPT



Data Lifecycle Dependencies Converge at CI



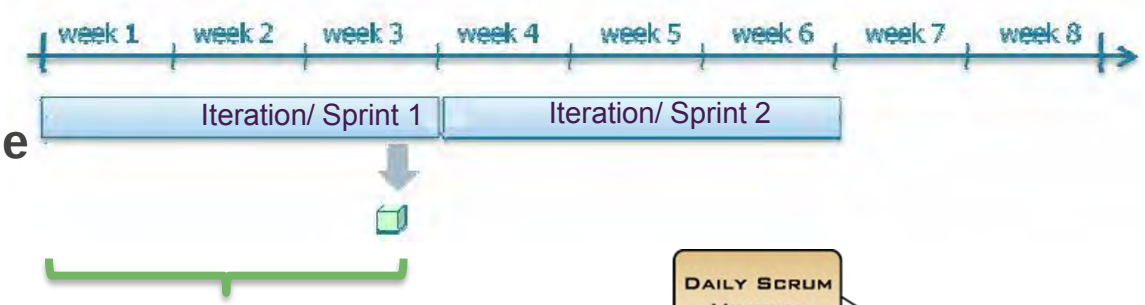
Agile Methods to Balance Science Req. & Schedule Within Budget

Sprints

Sizing **Velocity**

Roles **Backlog**

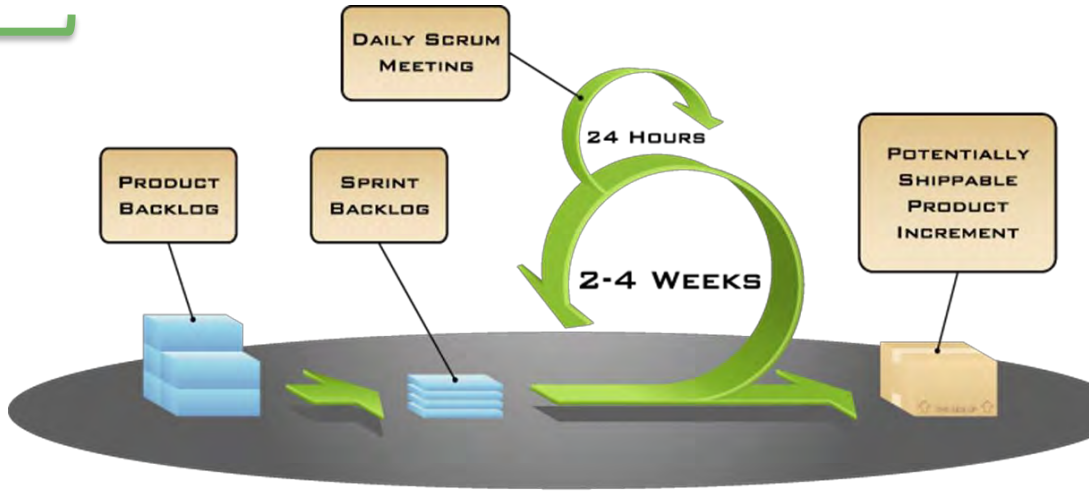
Iteration: Stories
Assumptions
Definitions of Done



MVP

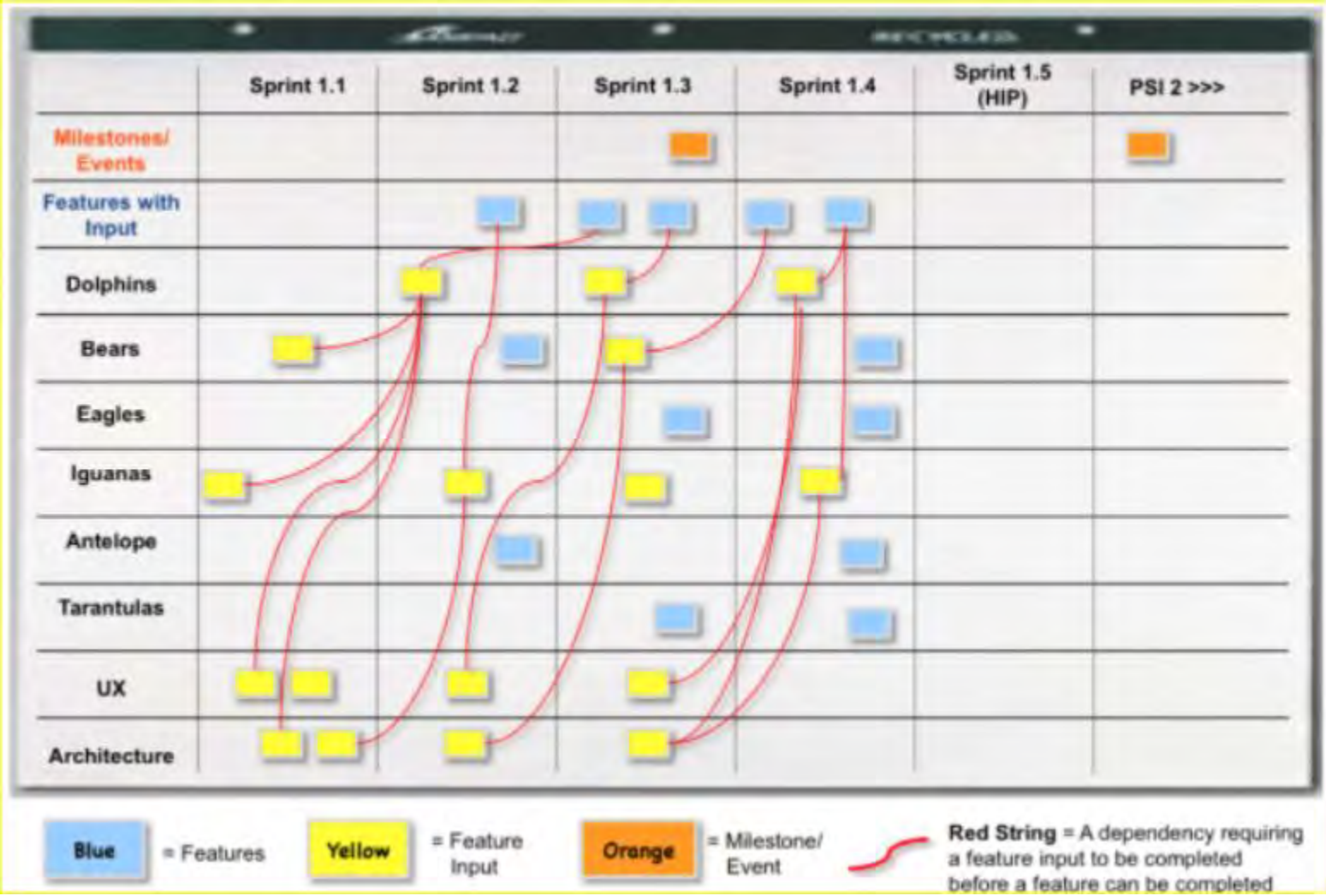
Data Scientist Product Owner

Scrum Teams



Scrum Master

Agile Methods to Pursue Science Req. Near-term Within Budget



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Agile Features to Fulfill Science Req. Near-term Within Budget

- Agile Horizon Typically 2 Weeks and 3 Months
- T-shirt Sized Feature Planning. Does it all fit in the multi-year budget & timeframe?
- Tech Debt Accumulation ~25% vs. Buffer

Sprint Start	Sprint End	Dev #5 (AOP)	Dev #6 (LWS/MET)	Dev #7 (LWS/MET)	Dev #8 (LWS/MET)	Dev #9 (LWS/MET)
6/24/2016	7/14/2016	NIS Level 0=>1B	NEON.DOM.SITE.DP1.00040 - Soil Heat Flux Plate	NEON.DOM.SITE.DP1.20217 - Temp Groundwater	NEON.DOM.SITE.DP1.20016 - Elev Surf Water	
7/15/2016	8/4/2016	Automation Framework	NEON.DOM.SITE.DP1.00006 - Precip - Throughfall	NEON.DOM.SITE.DP1.00094 - Soil Water & Salinity	NEON.DOM.SITE.DP1.00094 - Soil Water & Salinity	Phenocam/Aeronet cleanup
8/5/2016	8/25/2016	Digital Camera L0=>L1	NEON.DOM.SITE.DP1.20053 - Surface Water Temperature	NEON.DOM.SITE.DP1.20100 - Elev Groundwater	NEON.DOM.SITE.DP1.00094 - Soil Water & Salinity	NEON.DOM.SITE.DP1.00017.001 - Dust & Particulate Size (IS/OS)
8/26/2016	9/15/2016	Automation Framework	NEON.DOM.SITE.DP1.20015 - Spec Cond Groundwater	NEON.DOM.SITE.DP1.20033 - Nitrate/Surf H2O	NEON.DOM.SITE.DP1.20033 - Nitrate/Surf H2O	NEON.DOM.SITE.DP1.00017.001 - Dust & Particulate Size (IS/OS)
9/16/2016	10/6/2016	Discrete Lidar	NEON.DOM.SITE.DP1.20100 - Elev Groundwater	NEON.DOM.SITE.DP1.00095 - Soil CO2	NEON.DOM.SITE.DP1.20264 - Temp/Specific Depths/Lakes	NEON.DOM.SITE.DP1.00017.001 - Dust & Particulate Size (IS/OS)
10/7/2016	10/27/2016	Automation Framework	NEON.DOM.SITE.DP1.00095 - Soil CO2	NEON.DOM.SITE.DP1.20264 - Temp/Specific Depths/Lakes	NEON.DOM.SITE.DP1.20264 - Temp/Specific Depths/Lakes	NEON.DOM.SITE.DP1.00038.001 - Stable Isotope Concentrations (IS/OS)
10/28/2016	11/17/2016	Waveform Lidar	NEON.DOM.SITE.DP1.00095 - Soil CO2	NEON.DOM.SITE.DP1.20004 - Barometric pressure at lakes on-buoy -	NEON.DOM.SITE.DP1.20264 - Temp/Specific Depths/Lakes	NEON.DOM.SITE.DP1.00013.001 - Wet Deposition (IS/OS)
11/18/2016	12/8/2016	Waveform Lidar	NEON.DOM.SITE.DP1.20004 - Barometric pressure at lakes on-buoy - BP/lake/buoy	NEON.DOM.SITE.DP1.20004 - Barometric pressure at lakes on-buoy - BP/lake/buoy	NEON.DOM.SITE.DP1.20004 - Barometric pressure at lakes on-buoy - BP/lake/buoy	NEON.DOM.SITE.DP1.00101.001 - Particulate Mass (IS/OS)
12/9/2016	12/29/2016	TECH DEBT				
12/30/2016	1/19/2017	Automation Framework	IS SOM	NEON.DOM.SITE.DP1.20004 - Barometric pressure at lakes on-buoy -	NEON.DOM.SITE.DP1.20261 - PAR Below Water	NEON.DOM.SITE.DP1.20042 - PAR/Water Surf (Buoy)
1/20/2017	2/9/2017	Data Catalog	NEON.DOM.SITE.DP1.20046 - SAAT/lake/bouy	NEON.DOM.SITE.DP1.20046 - SAAT/lake/bouy	NEON.DOM.SITE.DP1.20046 - SAAT/lake/bouy	NEON.DOM.SITE.DP1.20042 - PAR/Water Surf (Buoy)
2/10/2017	3/2/2017	Data Catalog	NEON.DOM.SITE.DP1.20046 - SAAT/lake/bouy	NEON.DOM.SITE.DP1.20046 - SAAT/lake/bouy	NEON.DOM.SITE.DP1.20271 - RH/air/above lake	NEON.DOM.SITE.DP1.20042 - PAR/Water Surf (Buoy)
3/3/2017	3/23/2017	Pipeline Database	NEON.DOM.SITE.DP1.20271 - RH/air/above lake	NEON.DOM.SITE.DP1.20271 - RH/air/above lake	NEON.DOM.SITE.DP1.20271 - RH/air/above lake	IS SOM

Agile Stories' %s Rolled Up to Features as EVMS Input

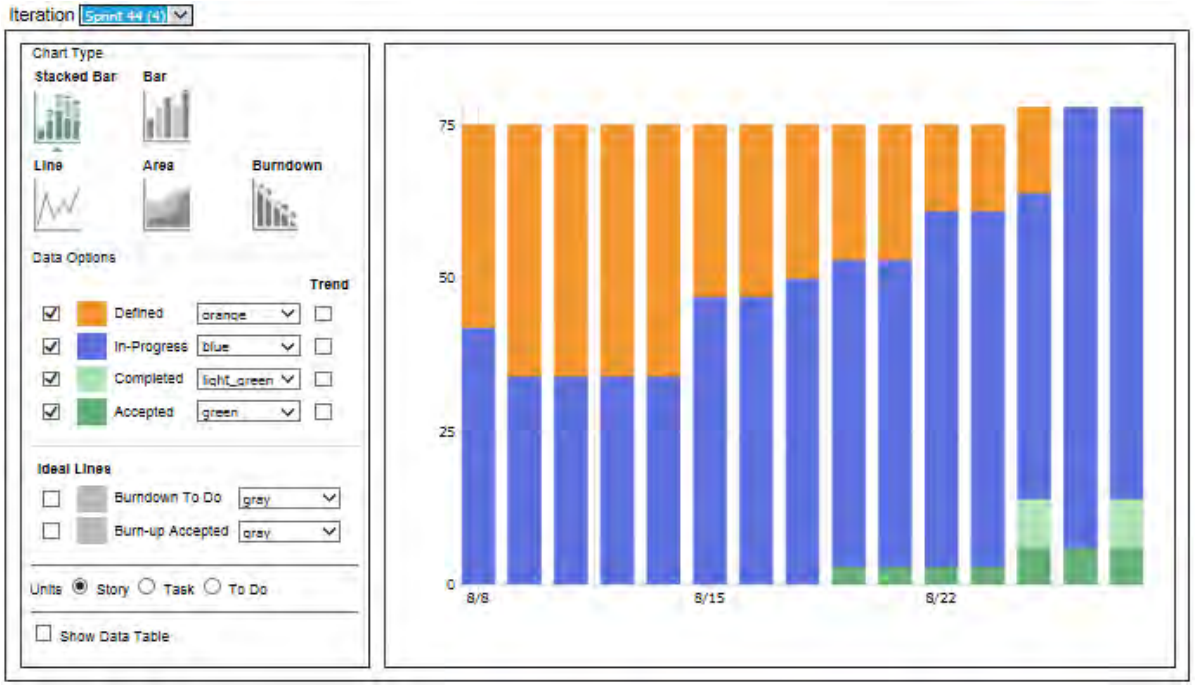
%Complete of Agile Tasks → Stories → Features → Epics → Project

RANK ▲	ID	NAME	% DONE BY STORY PLAN ESTIMATE
1	F91	Fulcrum HQ Interface	77%
2	F93	OS Schema Design	100%
3	F94	OS Data Service	42%
4	F97	OS L0 Parser	33%
5	F100	OS Transition System	67%
6	F102	Design SOM Portal for OS	100%
7	F103	OS Pipeline Testing Strategy	81%
8	F104	SOM Portal OS: Ingest Workbook Mgmt	86%
9	F110	Design Lab Ingest System	100%
10	F136	SOM Portal OS: Fulcrum HQ Controller	37%
11	F174	Taxon Manager (includes source references)	38%
12	F164	Auditing for named location and property value	0%
13	F175	LOV manager	0%

Agile Burndown Charts Depict Near-term Achievements

= SW Dev Planned
= Work in Progress
= In Review
= Owner Acceptance

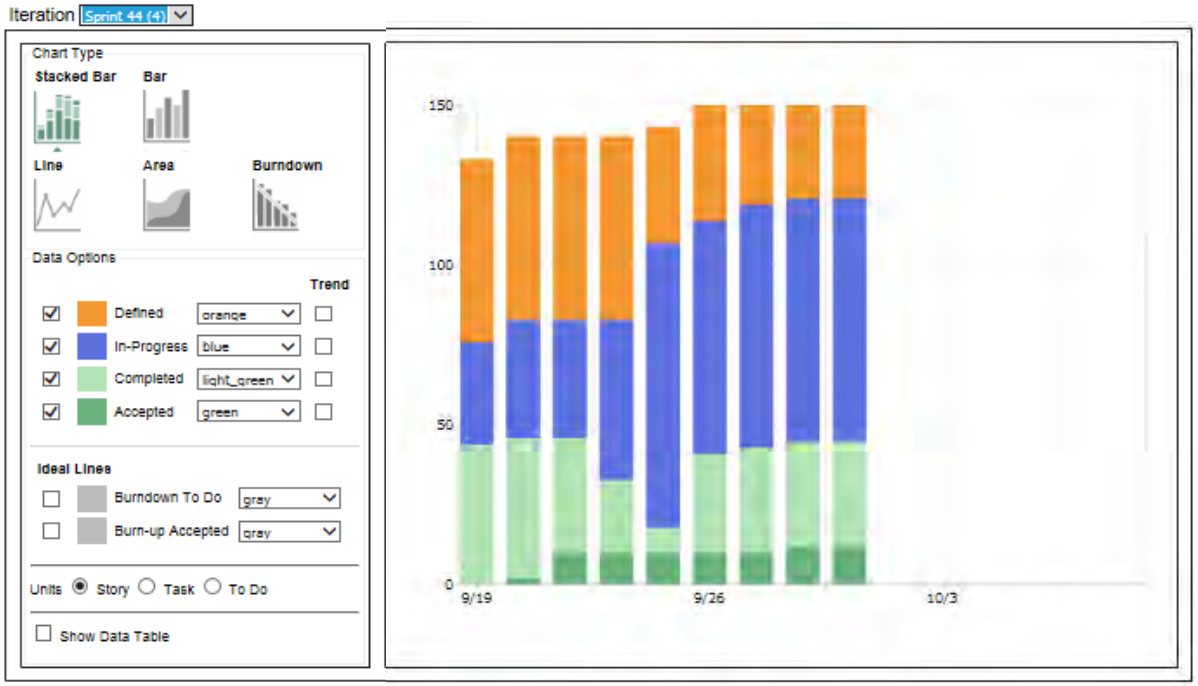
- Stories fit into sprint
- Should complete



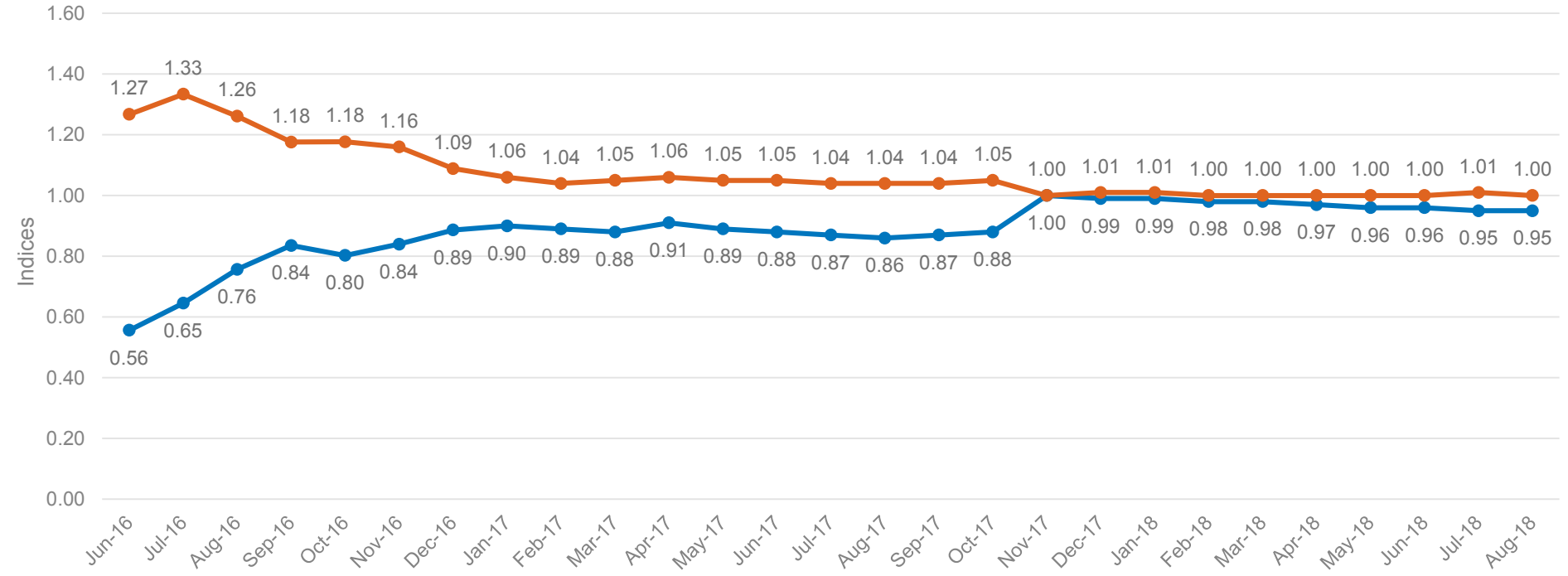
Agile Burndown Lessons Apart From EVMS

- Plan shouldn't grow
- WIP should be even

- Untouched plan
- Req review cycles
- Carryover WIP
- Snowplowing



EVMS Metrics to Depict Net Schedule & Cost Performance Indices



	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18
SPI	0.56	0.65	0.76	0.84	0.80	0.84	0.89	0.90	0.89	0.88	0.91	0.89	0.88	0.87	0.86	0.87	0.88	1.00	0.99	0.99	0.98	0.98	0.97	0.96	0.96	0.95	0.95
CPI	1.27	1.33	1.26	1.18	1.18	1.16	1.09	1.06	1.04	1.05	1.06	1.05	1.05	1.04	1.04	1.04	1.05	1.00	1.01	1.01	1.00	1.00	1.00	1.00	1.00	1.01	1.00

Defining Science Requirements, Managing Scope, and Ensuring Delivery – lessons during C and IO

- Unification of visions & options via Data Scientists
- Integrated Product Teams balance Observatory-wide needs
- Breakthroughs occurred as stakeholders viewed lifecycle
- Bottom-up solutions discovered as staff shared responsibilities
- Agile data patterns can reveal productivity of stable teams
- Agile Product Owners vital to early intervention toward MVPs
- Agile principles challenged by fixed schedules & budgets
- EVMS metrics functional when completion forecast viable

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