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An Agile Systems Engineering Analysis of a University CubeSat Project Organization

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Objectives

- Present the Agile Decision Guidance Method
- Present Usage Findings On A CubeSat Project Led By The Norwegian University of Science and Technology

Fundamental Values

- Purpose is to assist teams in making directionally correct decisions
- Solution suitable to address wide range of development applications
- Products created - simple to use, quick to use
- Ensure integration with other learning within the agile SE WG community

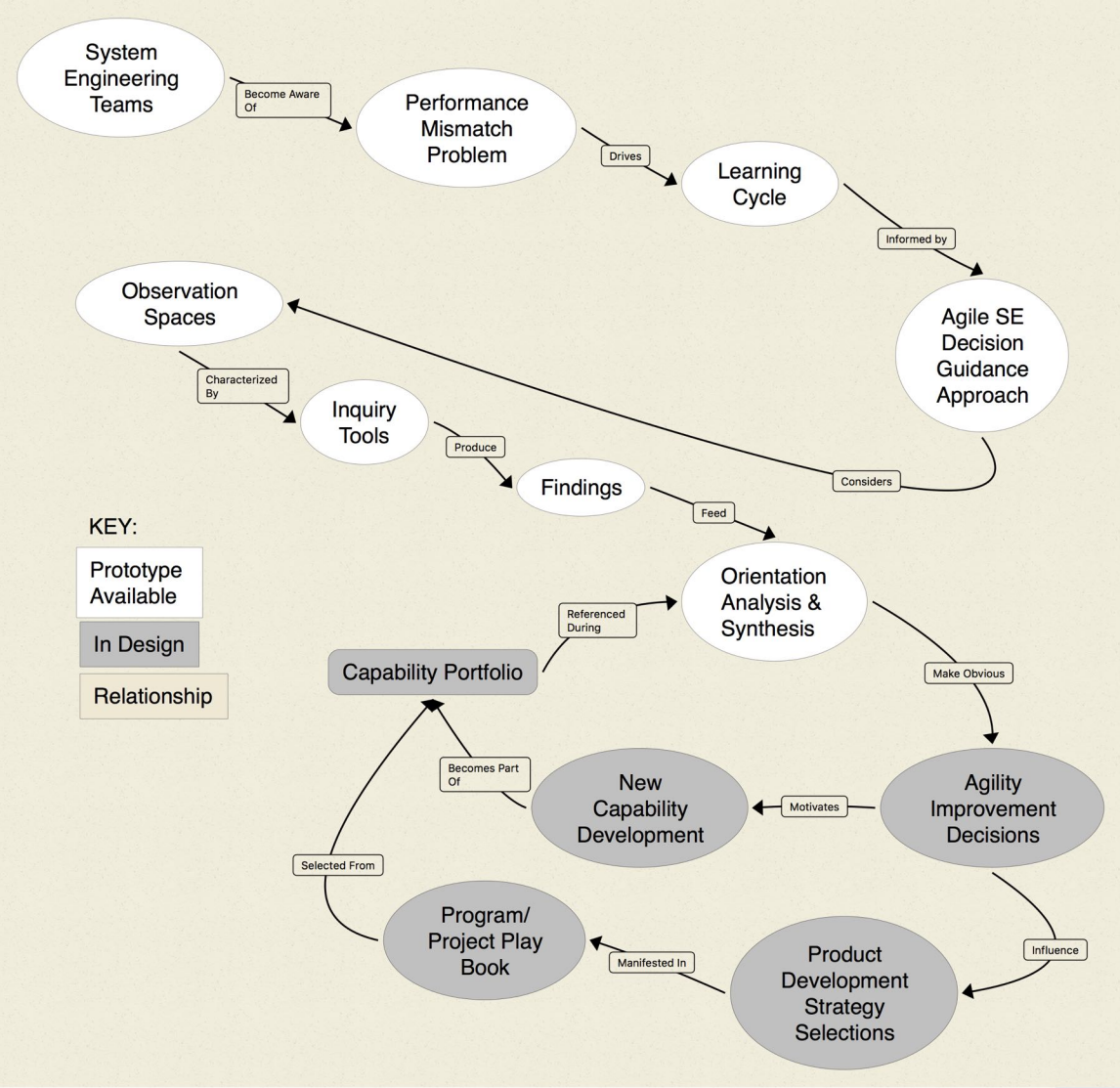
Decision Guidance Is Really A System

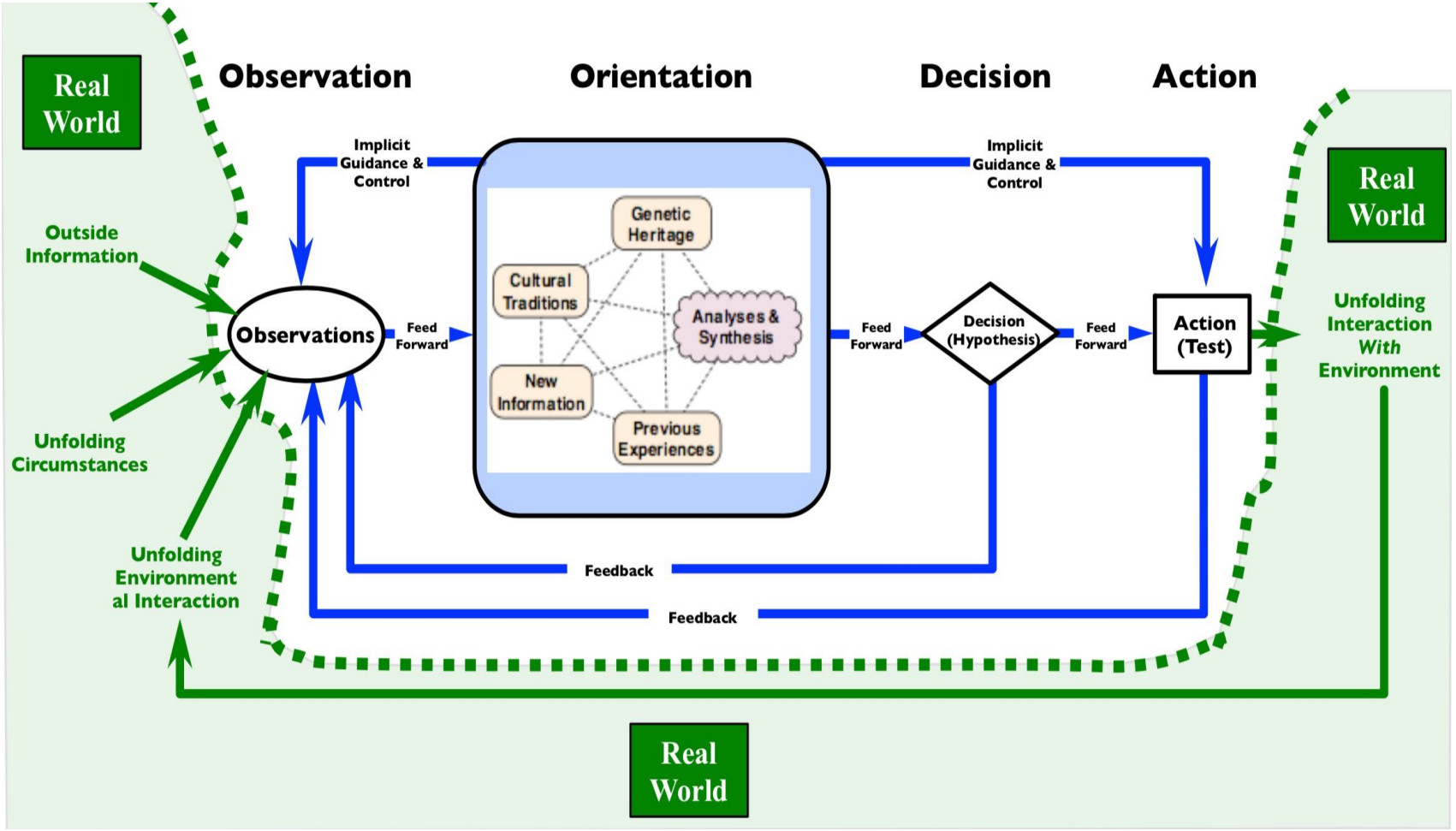
- Scope
- System Elements
- Relationships
- Organizing Framework

KEY:

Prototype Available

In Design

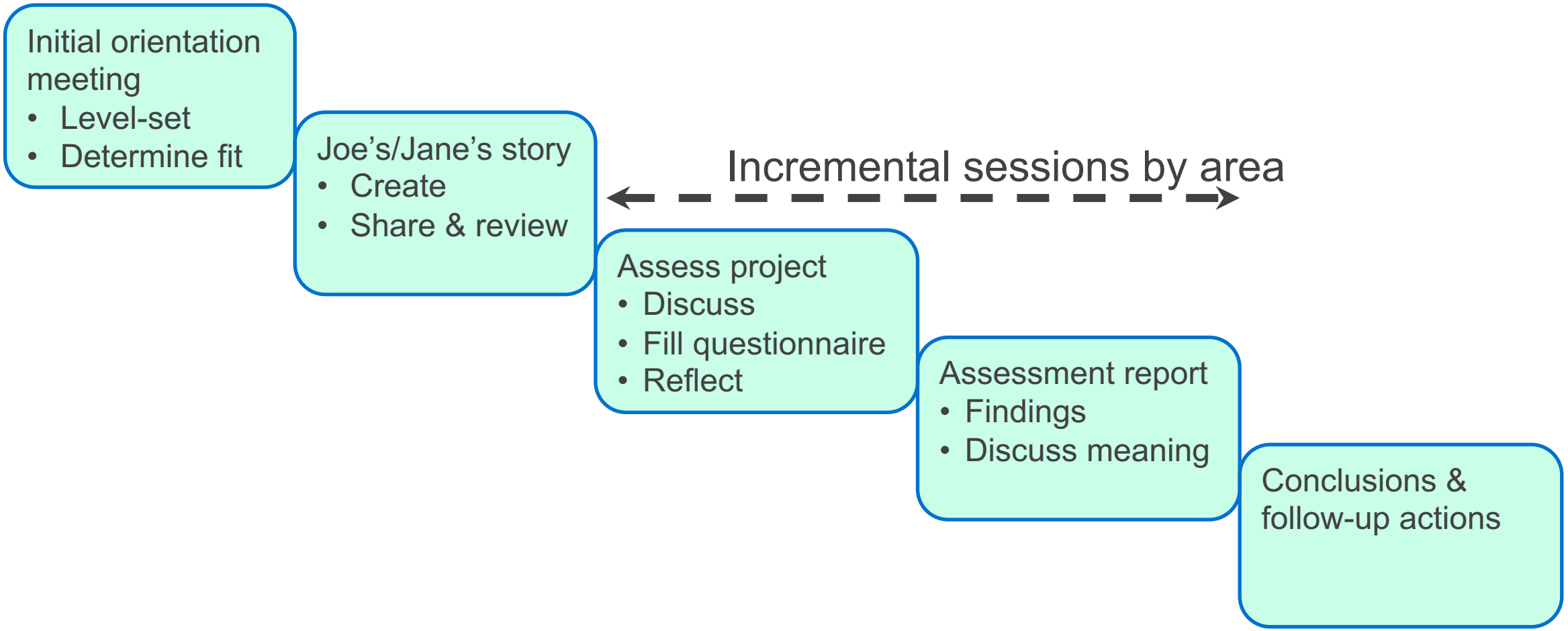




Choosing The OODA Loop For An Organizing Framework

Framework For An Information Processing System Whose Purpose Is To Provide A Guide For Action

Agile SE Assessment Process



Where To Begin - Joe's Story

Think Short Story
- There are settings
- There is a hero
- There is a conflict
- There is a strategy in play
- There are other actors

- ✓ Captures the problem space
- ✓ One author but many can weigh in to ensure accuracy
- ✓ Used as reference for assessment

"Easy reading is damn hard writing" Nathaniel Hawthorne

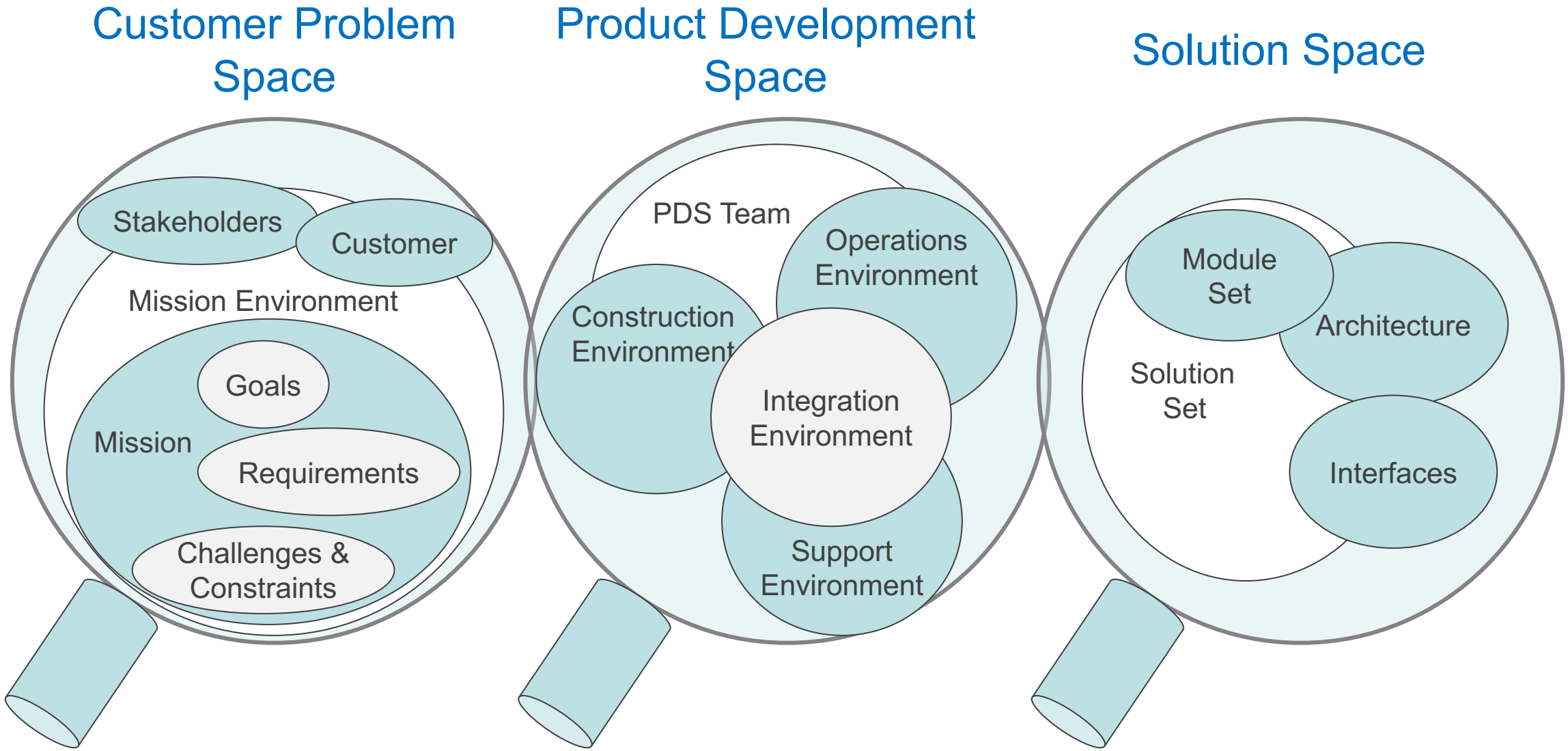
About Creating The Story

Creating Joe's/Jane's story for a project is a valuable activity

- Author must reflect about what is really going on with the project
- It crystalizes thinking for the author and other team members
- It provides a common ground for thinking about the project
- The story is about *why* things are done as they are
- The story can/will be enhanced during the assessment
- It is an asset to the project for communicating with new team members, stakeholders, and others

Assessment design

Observation spaces – where to look



Observation spaces – what to look for

Situational Awareness: Agility Factors

What drives the project's need for agility?

- Dynamics: Stability and predictability
  - Affects types of agile response needed
- Variety: Quantity and uniqueness of instances
  - Affects impact and capacity required to respond
- Visibility: Change rate vs. Lead time
  - Affects when changes can be known
- Missed detection rate:
  - measures effectiveness of the project's observation system

Agile Response Capability

How robust is the PDS Team's agile response?

- Communications: How well does information spread across the PDS Team?
- Culture: How ready is the PDS team to recognize and act on new information?
- Decision-making: How effective is the PDS team in reaching decisions to act?
- Actions: How effective is the PDS Team to take actions and observe their results

Direction of Thought Process

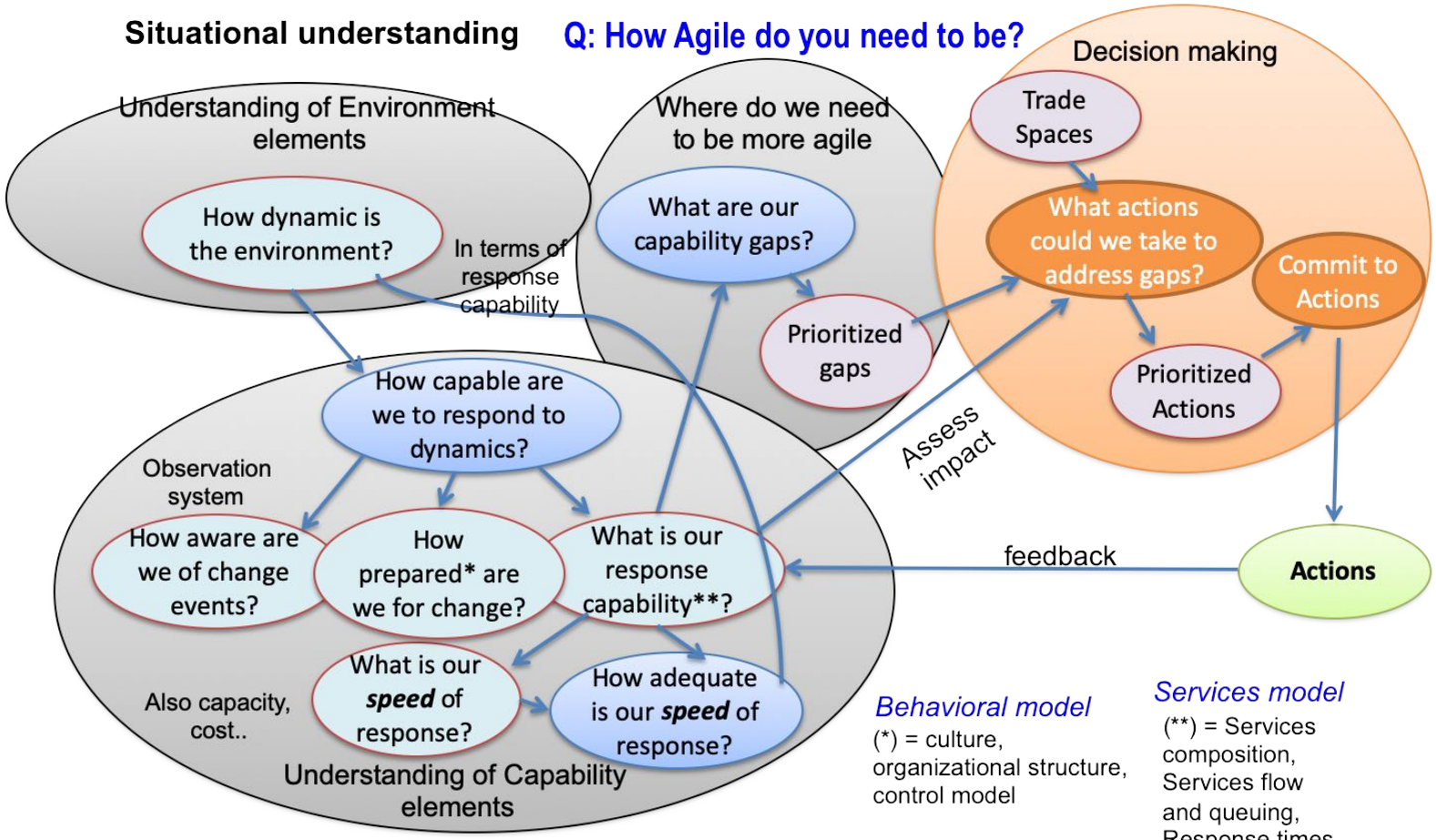
How agile do we need to be?

- Do we have situational understanding?
  - How capable are we to respond to environmental dynamics?
    - How aware are we of change events?
    - How prepared are we for change?
    - How effective is our response?
      - How adequate is our speed of response?
      - What is the cost to respond?
      - What is the scope of our response?
      - What is the quality of our response?
- What changes can we make?
  - Observation spaces: improve sensing, interpretation, …
  - Improve the team's agile response capability

Key Question Map

Re-look at the questions in the questionnaire: re: Guidance

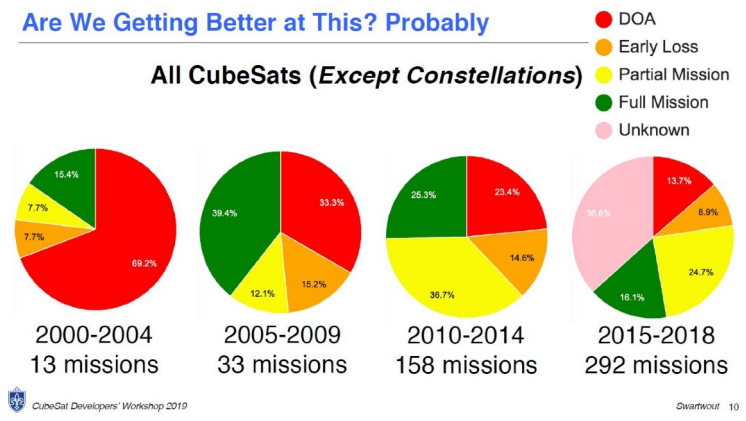
1. How do we get situational understanding?
2. What decisions/actions do they lead to?

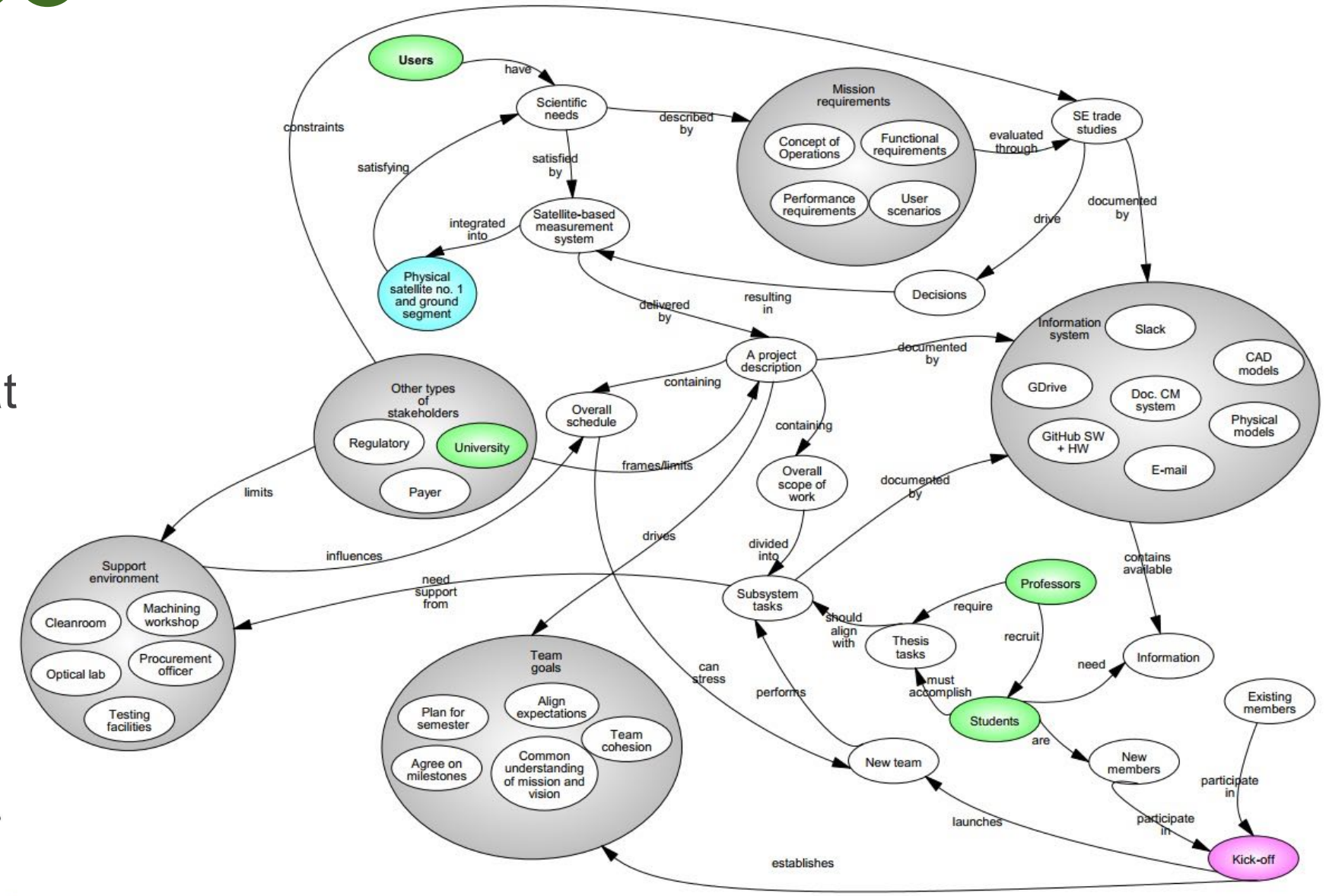


HYPSO CubeSat assessment findings

HYPSO

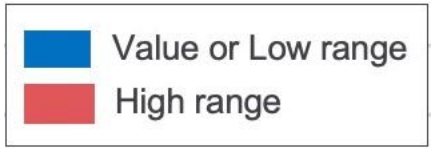
- 15-20 students
- 5-8 PhD/post.doc.
- Want to achieve both a successful CubeSat and thesis work

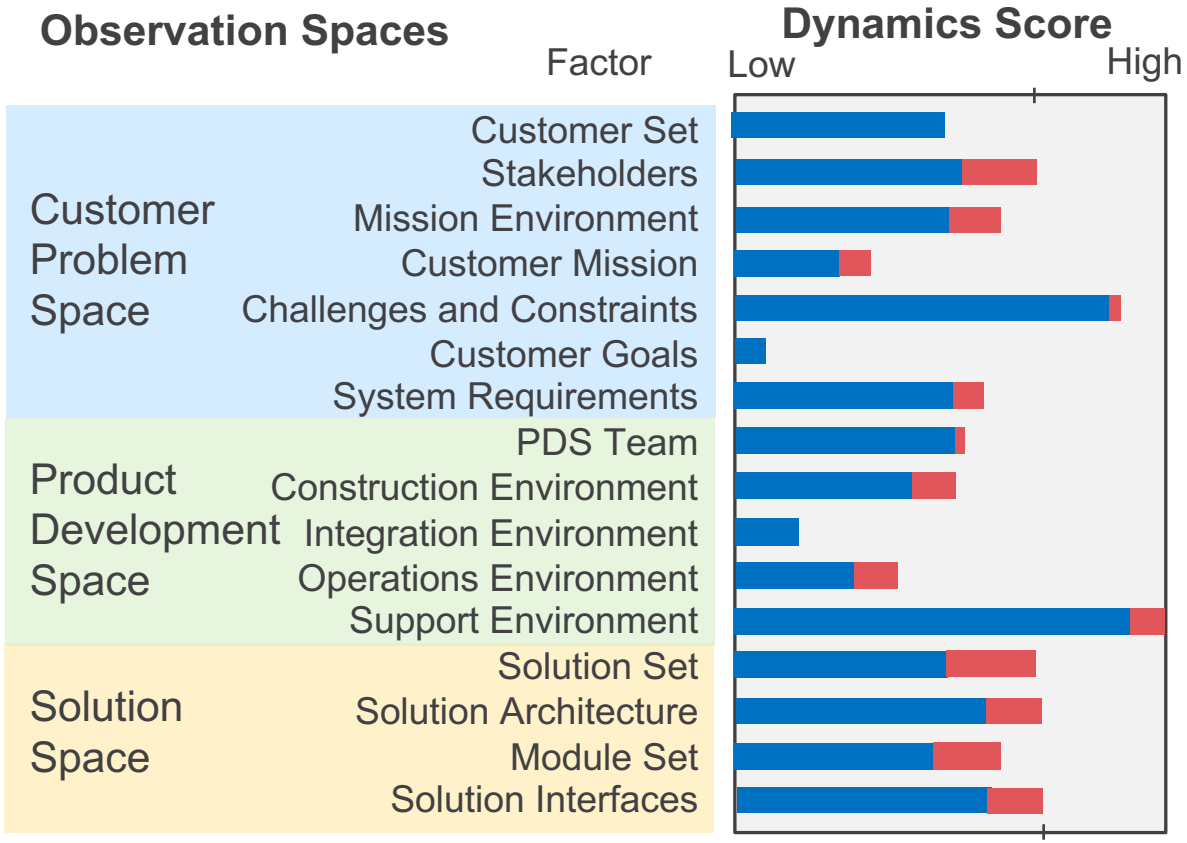




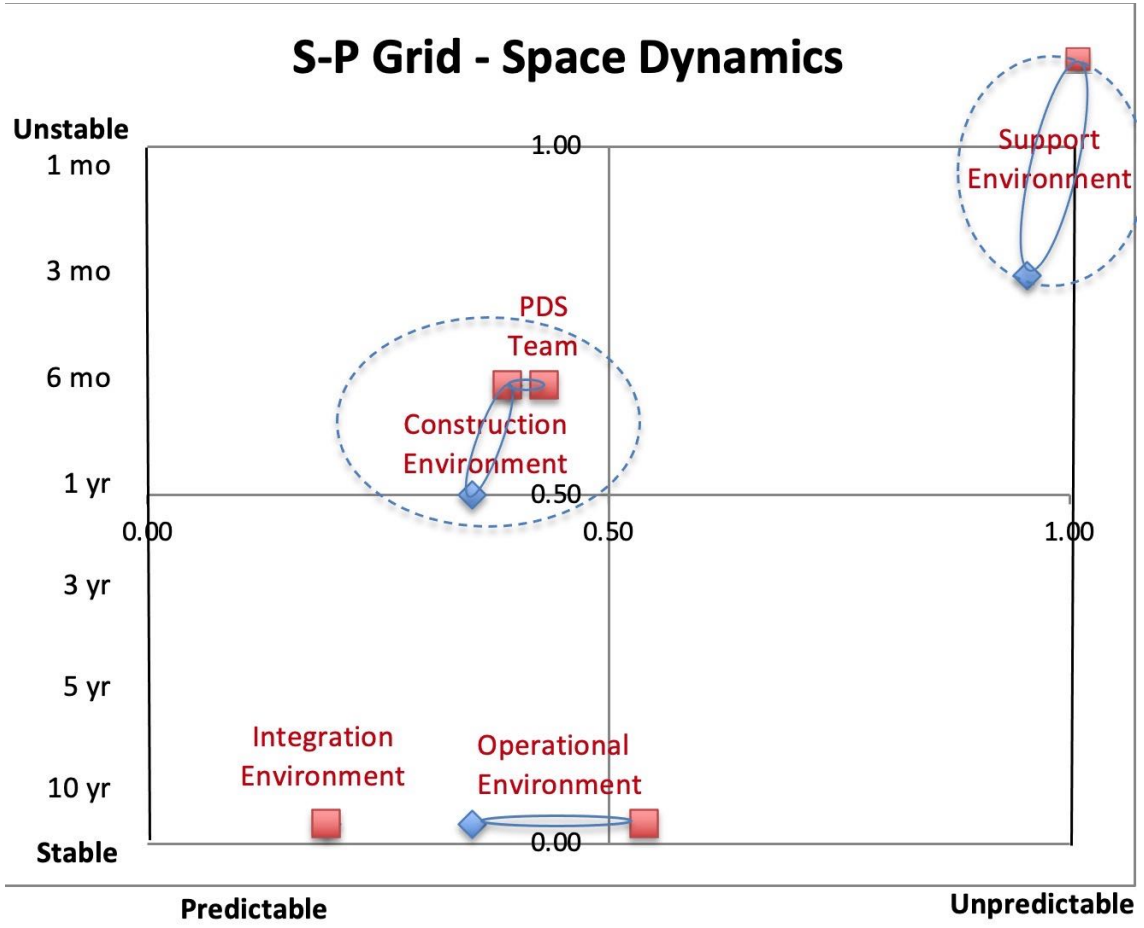
Results from assessment: dynamics

- Some factors have high dynamics
- Support environment: not under team control
- Solution space: changes depending on the team composition and goals
- Interfaces have been changing, part of development effort





Product development space



- Challenging to manage the support environment
  - No in-house test facilities
  - Lack of structured purchasing/procurement
- The team is unstable, but mostly follows the school-year
  - Requires off/on-boarding efforts

Response capabilities

- Mix of push and pull
  - Not very effective in assimilating information
    - Why?
    - Design decisions influencing different subsystems not “caught”
- Very collaborative
  - Good team spirit
  - People like building CubeSats

		Low	High
Communicate	Number of Ways to Collaborate	10	
	Information Push		75%
	Information Pull	50%	
	Collaboration Reach across Team	80%	
	Scope of Collaboration Information	95%	
	Speed of Information Flow	week	hour
Orient	Effectiveness of Information Assimilation		Effective
	Readiness to accept new insights	Very ready	
	Readiness to adjust to new situations	Prepared	
	Alignment of Values across Extended Team	Aligned	
	Firmness of Commits across Extended Team		Very firm
Decide	Collaborative Decision Making	Very col	
	Clear Org Responsibilities for Decisions		Somewhat clear
	Latitude to Make Changes	Sufficient	Latitude
	Ability to Renegotiate Commitments	Able	
	Speed of Consequential Decisions	year	3 mos
	Decisions Timely to Achieve Results	40%	
Act	Modular Response Capabilities	Somewhat mod.	
	Scope of Influence to Implement Actions	70%	
	Speed to Implement Consequential Actions	month	2 weeks
	Actions Timely Enough for Effective Results	75%	
Observe Results	Ability to Observe Actions	75%	
	Ability to Observe Results of Actions	80%	
	Lag between Actions and Observing Results	3 yrs	month

Score

Value or Low range

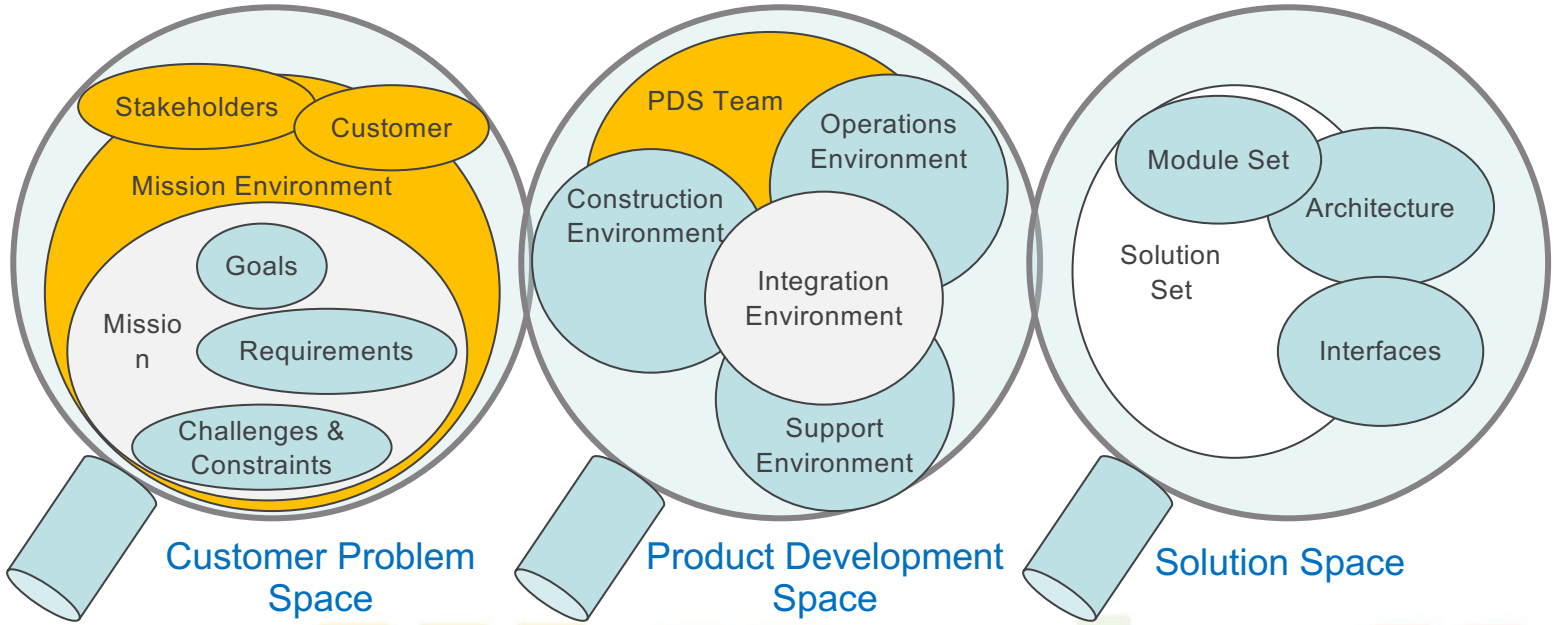
High range

What we learned about the process

Learning about assessment design

Our intent was to produce a generic assessment tool for SE agility

- Its authors started from a common background of large commercial projects
- The initial WG-HYPSO meeting revealed gaps in these models
  - Additional factors were needed to cover things important to HYPSO, especially complex of stakeholders & customers, PDS Team and its social considerations
  - Remember that people are an essential part of our complex technical systems



Learning about conducting the assessment..

Regular joint meetings were effective

- They provide a place, time, and means to have a focused conversation
- Tempo is important: reflection time was needed between (weekly) sessions
- Video meetings made cross-team communications more effective

The assessment was reasonable successful in meeting its usability goals

- A common mindset with consistent questions produced a systematic review
- The total set of questions (111 multiple-choice) was not burdensome
- The assessment tool successfully grew in planned areas, in parallel with using it

Conducting the assessment: information capture

The discussions about each question, captured in comments, were of great value

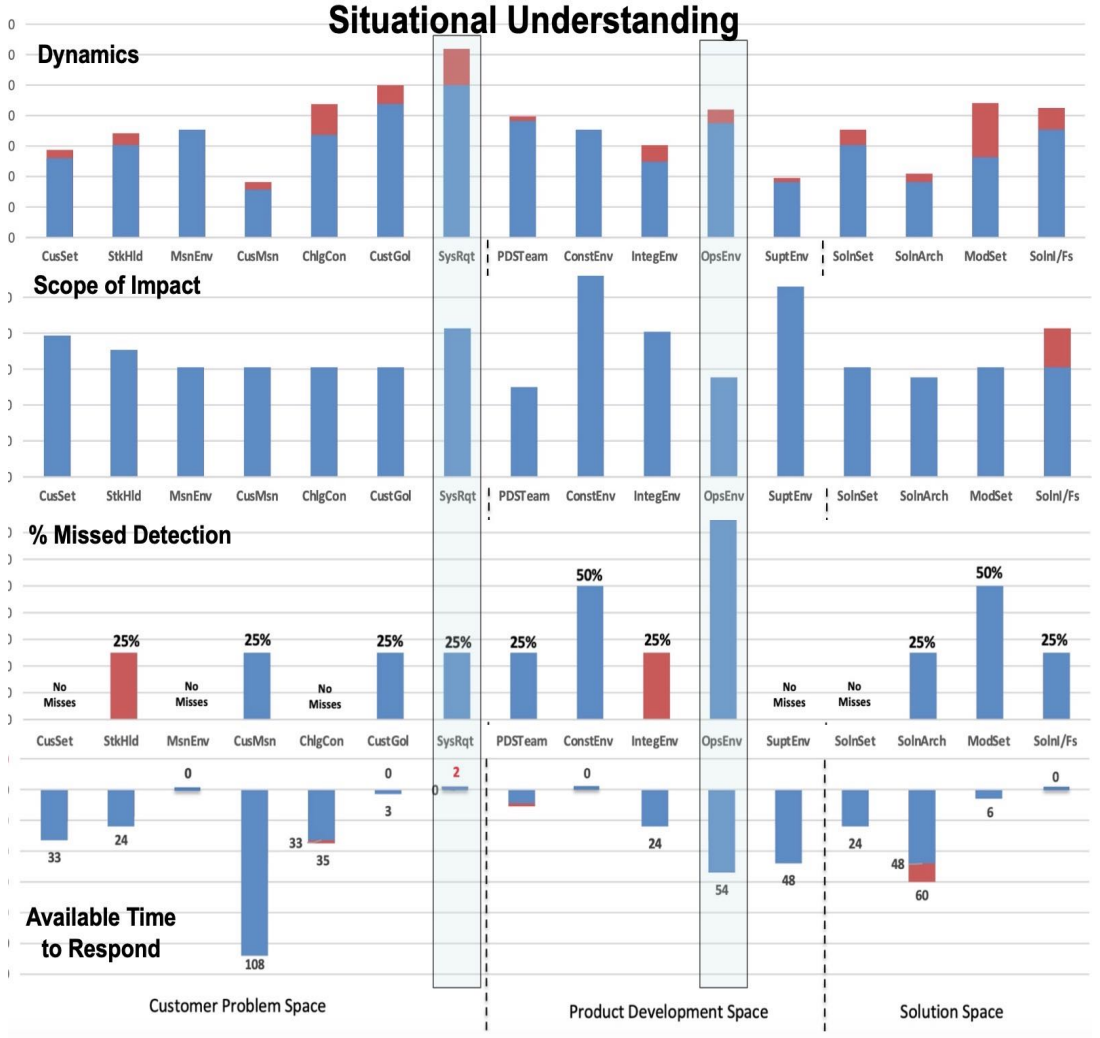
- Explanations and clarifying questions produced a common understanding
- This is where most of the “aha” moments came
- Later, captured comments help in finding solutions to weak areas

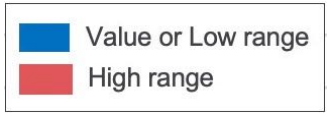
C-SH. Stakeholders			*Consider the groups that have direct interest i*		
Variability		**Answer**	**Comments**	**Score**	
CSH1	How many stakeholder groups are there?	10 or more	PhD researchers and their professors Science Board gives advice, and are potential users of the data Production users of successful projects 3rd-party suppliers launch organization regulatory agencies	10	
CSH2	How diverse are the stakeholder groups?	highly varied		4	
Predictability					
CSH3	How predictable are stakeholder group changes?	predictable to somewhat predictable	a new stakeholder popped up: space law new suppliers and launch providers come up all the time	2	3
CSH4	How far in advance can stakeholder group changes be known?	3 to 6 months for suppliers & launch orgs some are immediate	some of the others are static	5	6

Assessment report: situational understanding

The assessment report helped visualize the issues

- WG produced a report incrementally after each session, as new information and models were added
- The report generally confirmed what we knew from the discussions, in a way that could be quickly communicated:
  - Summary bar graphs showed relative magnitudes of factors for each issue (heat map)
  - They made connections visible between issues and across factors, which led to additional “aha” moments
  - Bar graphs are the starting point, with drill-down into grids where needed





Learning about using the assessment

How can the assessment results be used?

- Assessment of *observation space* factors relate to *situational awareness*
- Assessment of the agile *response capability* relates to *agility*
- They show where capability is strong, good enough, or could be improved.
- HYPSO is applying assessment results to the next phase of the project

Where can the assessment be applied?

- It is not domain-specific
- It could be applied to projects, and to broader levels such as product development systems, programs, and organizations

What are the assessment's limitations?

- Would not use for short term projects. A year or two of project life is needed to benefit
- Assessment of situational awareness does not address emerging or hidden factors

Invitation and Future Work

- Do you want to be an early adopter?
  - Create a story, use the assessment, map answers to the S-P grid
  - Use as basis for team/group discussion
  - Support a debrief to the team
  - Make improvement recommendations

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