Jet Propulsion Laboratory
California Institute of Technology

iSAT Activity 2a Telecon:

Experiential ~~Subjective~~ Cost and Risk Assessment Team

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Today’s Agenda

1. **Review the changes to the 2a process (as recommended by the group last week so we’re all on the same page)**

2. **Review the list of Parameters**
   - Are the ones listed appropriate?
   - Can any be consolidated?
   - Any new ones?

3. **Start generating Claims for each of the Parameters** (this will be a valuable exercise in assigning the impact arrows at the next telecon)

4. **Face-to-face meeting set for 2/26-27 at JPL**

Changes Since Last Telecon

The Experiential Cost and Risk Assessment Team

#	Name	Organization
1	Sharon Jeffries	NASA LaRC
2	Scott Knight	Ball Aerospace
3	John Grunsfeld	NASA retired
4	Gordon Roesler	Robots in Space
5	Dave Miller	The Aerospace Corporation
6	Joe Pitman	Heliospace Corporation
7	Keith Warfield	NASA JPL
8	Keith Belvin	NASA LaRC
9	Kim Aaron	NASA JPL
10	Ben Reed	NASA GSFC
11	Bill Vincent	NRL
12	Phil Stahl	NASA MSFC
13	David Van Buren	NASA JPL
14	Ron Polidan	PSST Consulting
15	Jeff Hoffman	MIT
16	Brad Peterson	Ohio State University
17	Marshall Perrin	STScI
18	Bob Shishko	NASA JPL

… and Nick, Harley, and Rudra; Lee Feinberg consulting

Step 3: Create a table that shows the impact of these parameters, in isolation, on the iSAT mission in terms of relative science value, relative risk reduction, and relative cost savings.

- Show the impact through subjective metrics (i.e arrows up or down).
- Up arrows means “positive impact”; down arrows mean “negative impact”.
- One arrow means “low impact”, two means “medium impact”, and three means “high impact”.
- A dash means “none-to-little expected impact”; a question mark means “we don’t yet know”.

Parameter	Relative Science Value	Relative Cost Savings	Relative Risk Reduction
Parameter 1	↑	↑↑↑	↓↓
Parameter 2	-	↓	↑↑
Parameter 3	-	↓↓↓	↓↓

Note: Relative impacts are with respect to the current paradigm.

Arrows and Dollars

Option 1

Option 2

telescope aperture (m)	estimated Phase A-E cost with single LV deployment ($B)		Notional definitions			Notional definitions			Notional definitions			Rudra's notional definitions		
			Assuming 15 m telescope	Negative Impact	Positive Impact	Assuming 10 m telescope	Negative Impact	Positive Impact	Assuming 5 m telescope	Negative Impact	Positive Impact	For all telescopes	Negative Impact	Positive Impact
20	N/A													
15	20	5%	> $1B	↓↓↓	↑↑↑	> $750M	↓↓↓	↑↑↑	> $350M	↓↓↓	↑↑↑	> $350M	↓↓↓	↑↑↑
10	15			↓↓	↑↑		↓↓	↑↑		↓↓	↑↑		↓↓	↑↑
5	7	0.5%	< $100M	↓	↑	< $75M	↓	↑	< $35M	↓	↑	< $50M	↓	↑

Step 4: Create the correlation diagram to capture the “coupled” impact of these parameters on the iSAT mission (i.e. correlation).

Fill only the upper area as diagram will be symmetric

	Parameter 1	Parameter 2	Parameter 3
Parameter 1		↓↓	↓
Parameter 2			↑
Parameter 3			

E.g. Mass margin, multiple launches, standing army and schedule interplay to have a net low positive impact on cost

Fill one out each for for relative science value, one for relative cost savings, and one for relative risk reductions.

Step 5: Create "Claim Sheets" to capture the impact of the coupled parameters

- **These claim sheets are the outputs of this activity**
  - They will be summarized to get an overall idea of the total impacts on cost and risk.
  - **This will inform us qualitatively whether iSAT could be competitive with traditional single LV integrated system deployments (i.e. "enhancing") regarding science value, cost and risk.**

- **Each Claim Sheet will be in reference to the iSAT mission concept identified in Activity 1b.**

Claim Sheet

Cognizant Person/Lead:

Claim: Write the claim from the relationship diagram: e.g. Mass margin correlates with multiple launches, standing army, and schedule to have a net low positive impact on cost.

Support: Rationalize your claim (use $ impact whenever possible)

Traceability: Show how your claim and support map to activities in Life Cycle Phases A-E

Scalability: Discuss how the claim holds over the different sizes of telescope (5,10, 15, ~~and 20 m~~)

Advancing the Parameters

(go to Excel)

Plans moving forward

Moving Forward

- **Weekly recurring meetings to advance the work – Thursdays at 11:30 am EST**

- **Face-to-face – February 26-27**
  - JPL (Pasadena)

Additional Slides

Tentative Schedule

#	Week Of	Objective
1	Dec 10	Kickoff meeting
4	Jan 21	Start list of parameters
5	Jan 28	Start writing claims on parameter
6	Feb 4	Continue writing claims on parameter
7	Feb 11	Complete writing claims on parameters
8	Feb 18	**Face to face meeting: Draw relational diagram, advance all tasks together**
9	Feb 25	Start claim-sheets telecon – discuss multiple claims
10	Mar 4	Claim-sheets telecon – discuss multiple claims
11	Mar 11	Claim-sheets telecon – discuss multiple claims
12	Mar 18	Claim-sheets telecon – discuss multiple claims
13	Mar 25	Claim-sheets telecon – discuss multiple claims
14	Apr 1	Create Risk Diagram
15	Apr 8	Finalize Risk Diagram

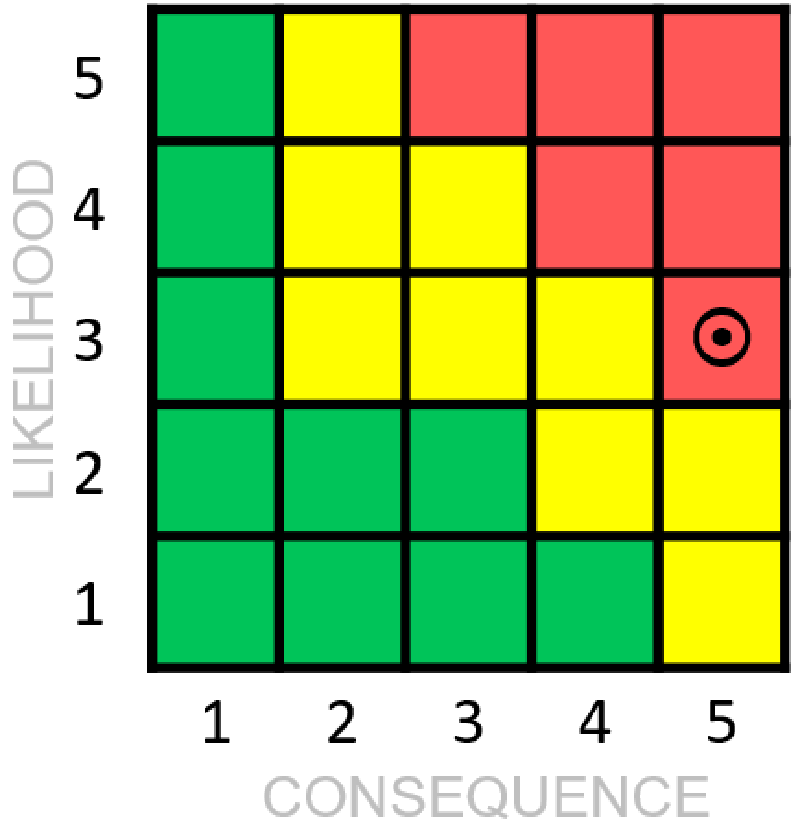
Step 1: Create a list of parameters that characterize the iSAT mission. This includes traditional mission parameters as well as unique aspects of iSA.

- A parameter is anything that impacts the mission cost or risk or that is potentially impacted by another parameter. A parameter can be increased or decreased.
- They’re more like a set of design or concept features that impact the overall mission for which a subset will have important different cost and risk impacts when compared between iSAT and the current paradigm.
- Examples: mass margin, number and capacity of launch vehicles, AI&T, V&V, workforce, adjustability and control authority, system complexity, critical path, facilitization, etc.

Step 2: Based on your experiences or on these parameters, hypothesize "claims" that you believe iSAT will impact (positively or negatively) mission cost or risk.

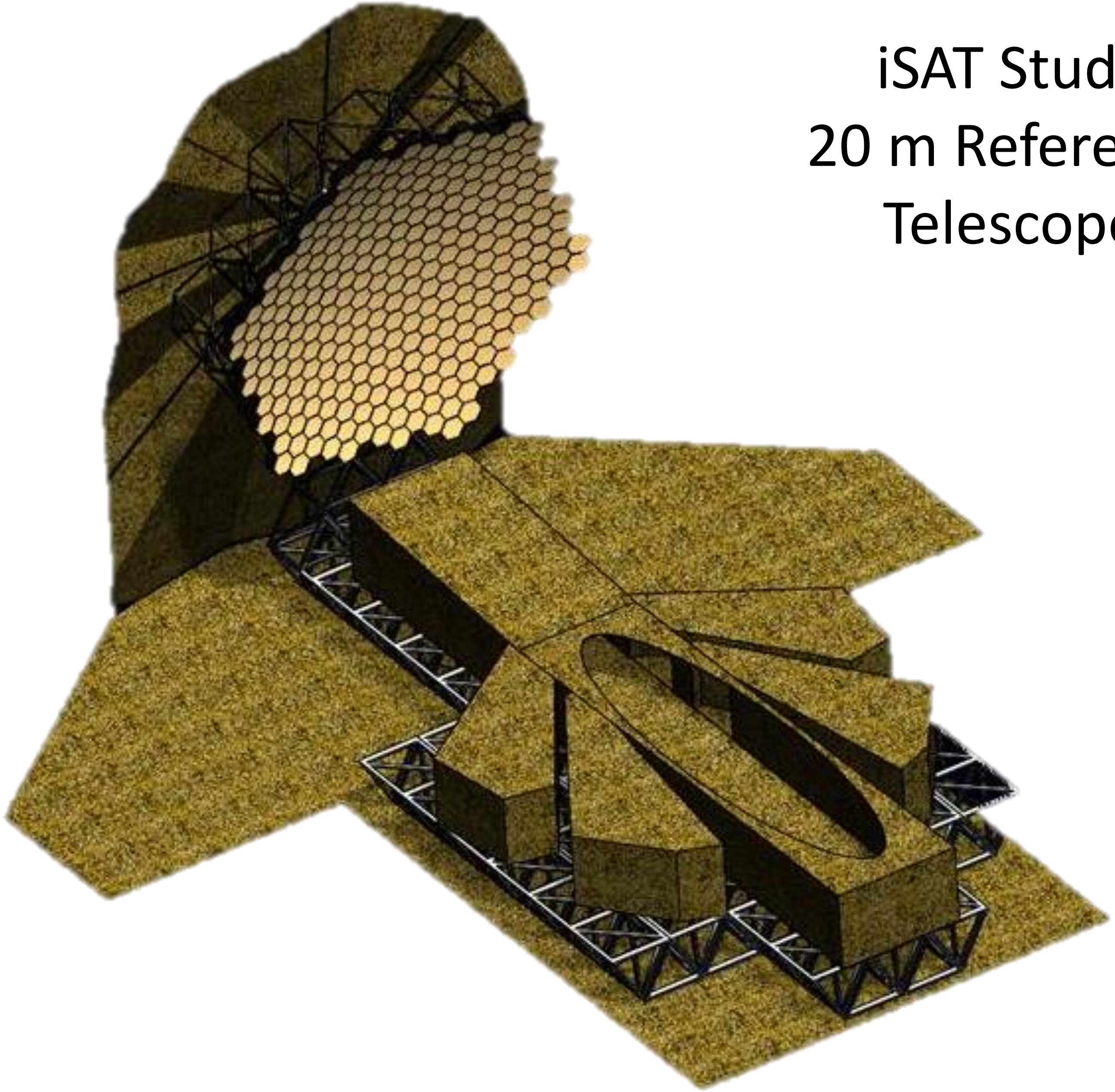
- **Examples:**
  - Increased mass margin will not require extreme light-weighing and complex modeling
  - iSA will not require ruggedization of system to survive launch loads
  - Modularization will simplify assembly and I&T (work force)
  - Modularization will reduce standing army (work force)
  - Modularization will preempt need for new test facilities
  - Increased adjustability and control authority will reduce assembly, I&T, and V&V time, but result in more actuators throughout the observatory.
  - Robotic assembly is a new cost upper for iSAT.
  - Medium-lift launch vehicles and iSA will not require an SLS (opportunity – cost and risk)
  - Launch failure is not a mission failure (opportunity – risk)

Step 6: Completely decoupled, create the traditional "risk" diagram (probability vs consequence) for the iSAT mission concept.



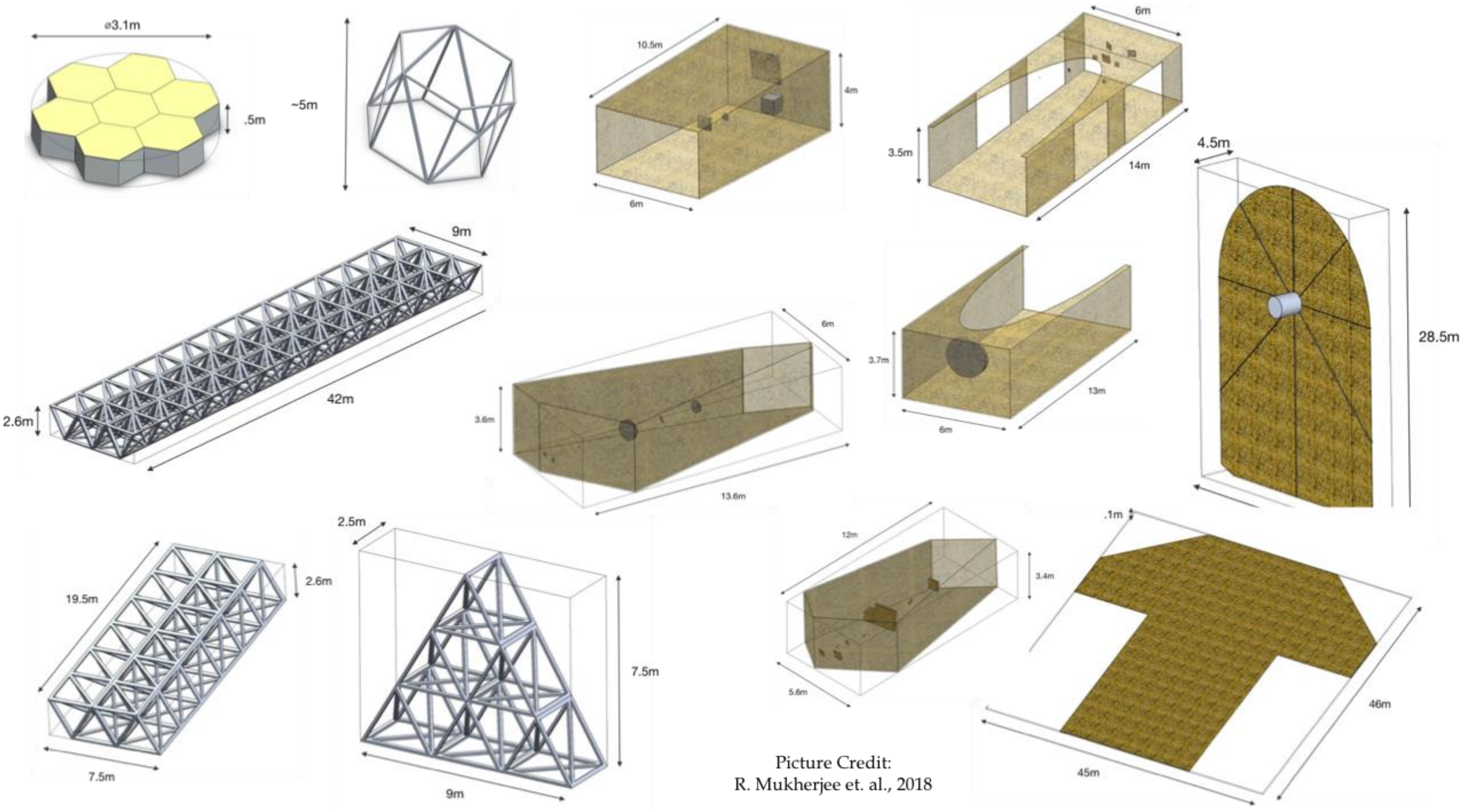
Example:

- Autonomous robotic assembly may falter causing important damage. (5,3)



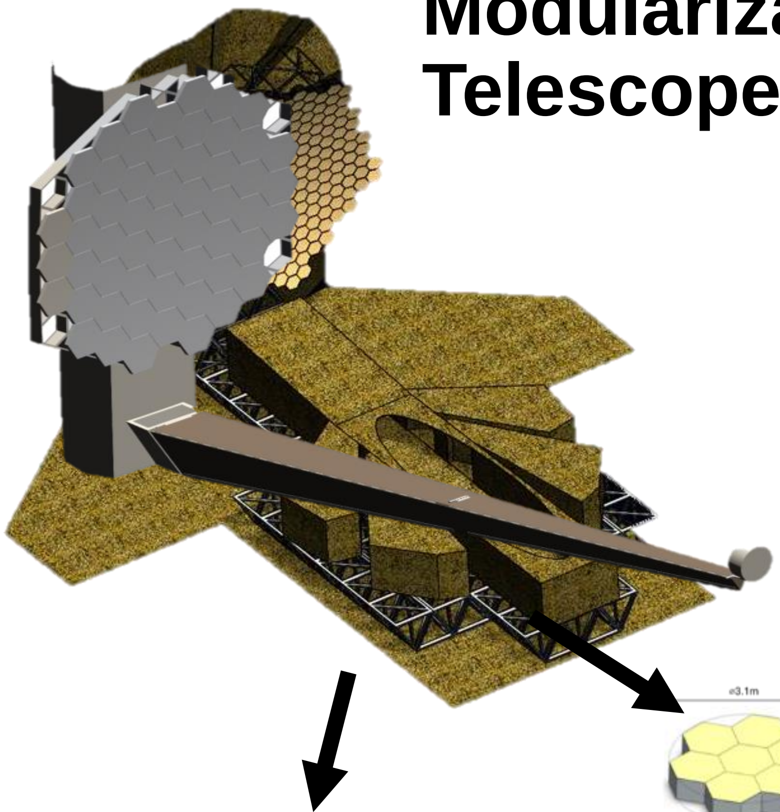
iSAT Study
20 m Reference
Telescope

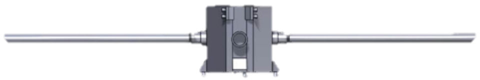
The Notional Modularized Components

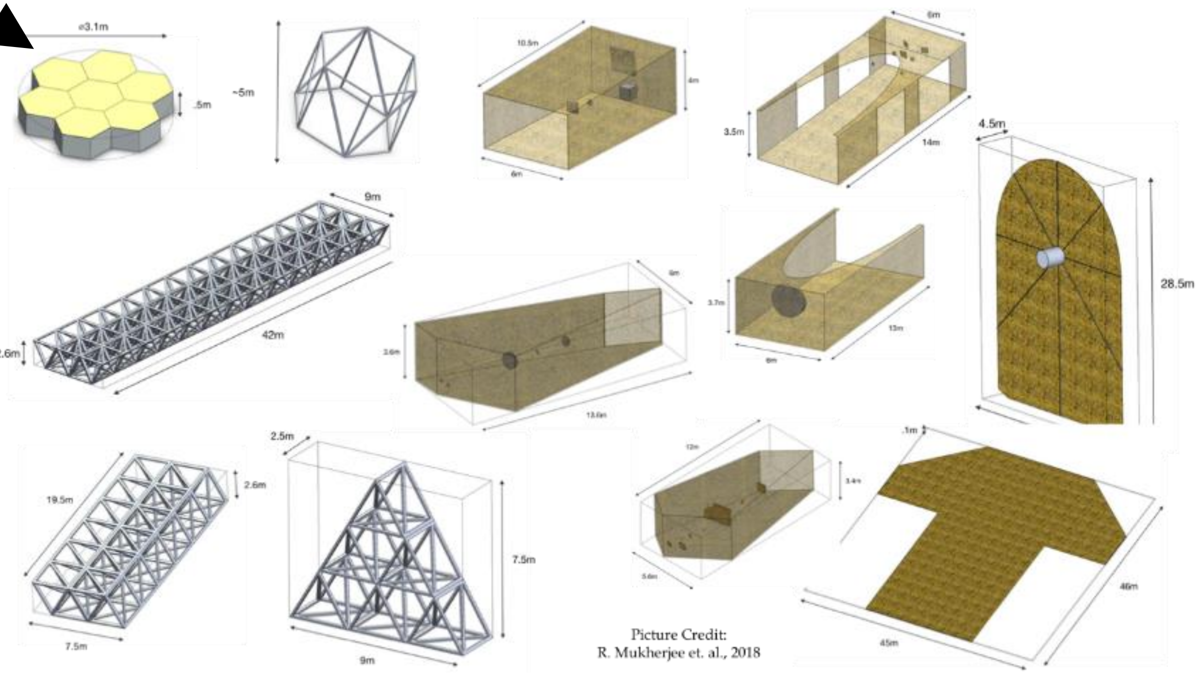


Picture Credit:
R. Mukherjee et. al., 2018

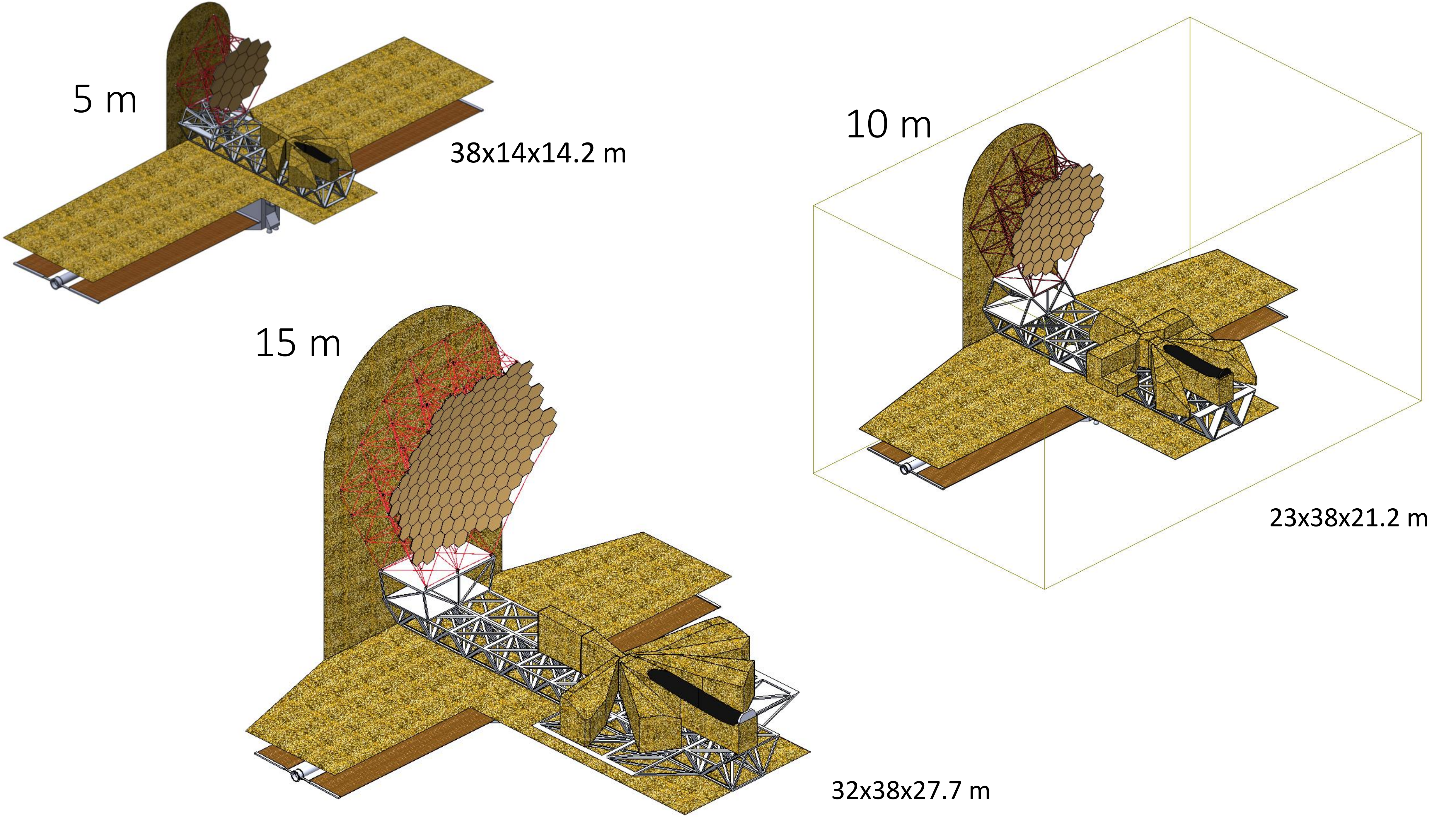
Modularization of a 20 m Space Telescope





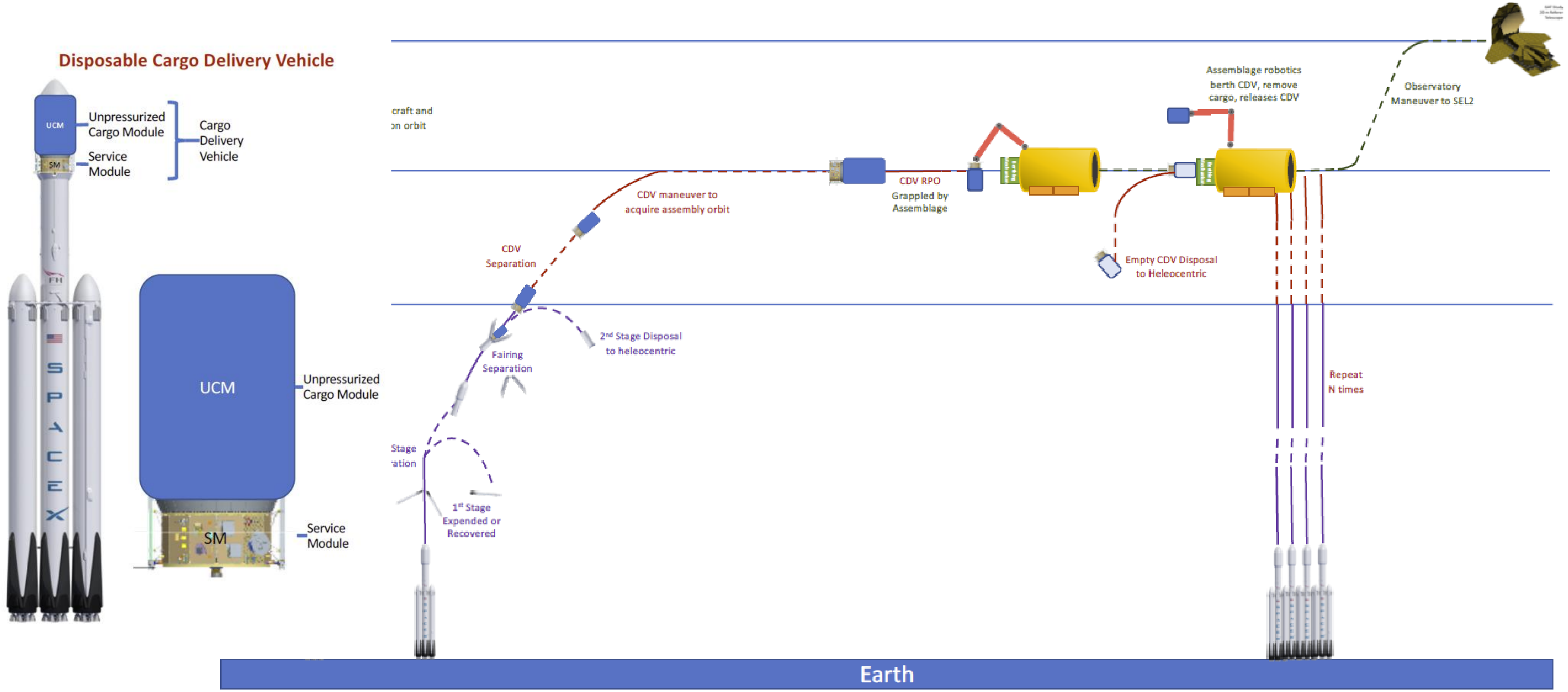


Picture Credit:
R. Mukherjee et. al., 2018


5 m
38x14x14.2 m
10 m
23x38x21.2 m
15 m
32x38x27.7 m

Delivery Via Disposable Cargo Delivery Vehicle

Preliminary Concept



Credit: Bo Naasz (NASA GSFC)

NASA Project Life Cycle

NPR7120.5E

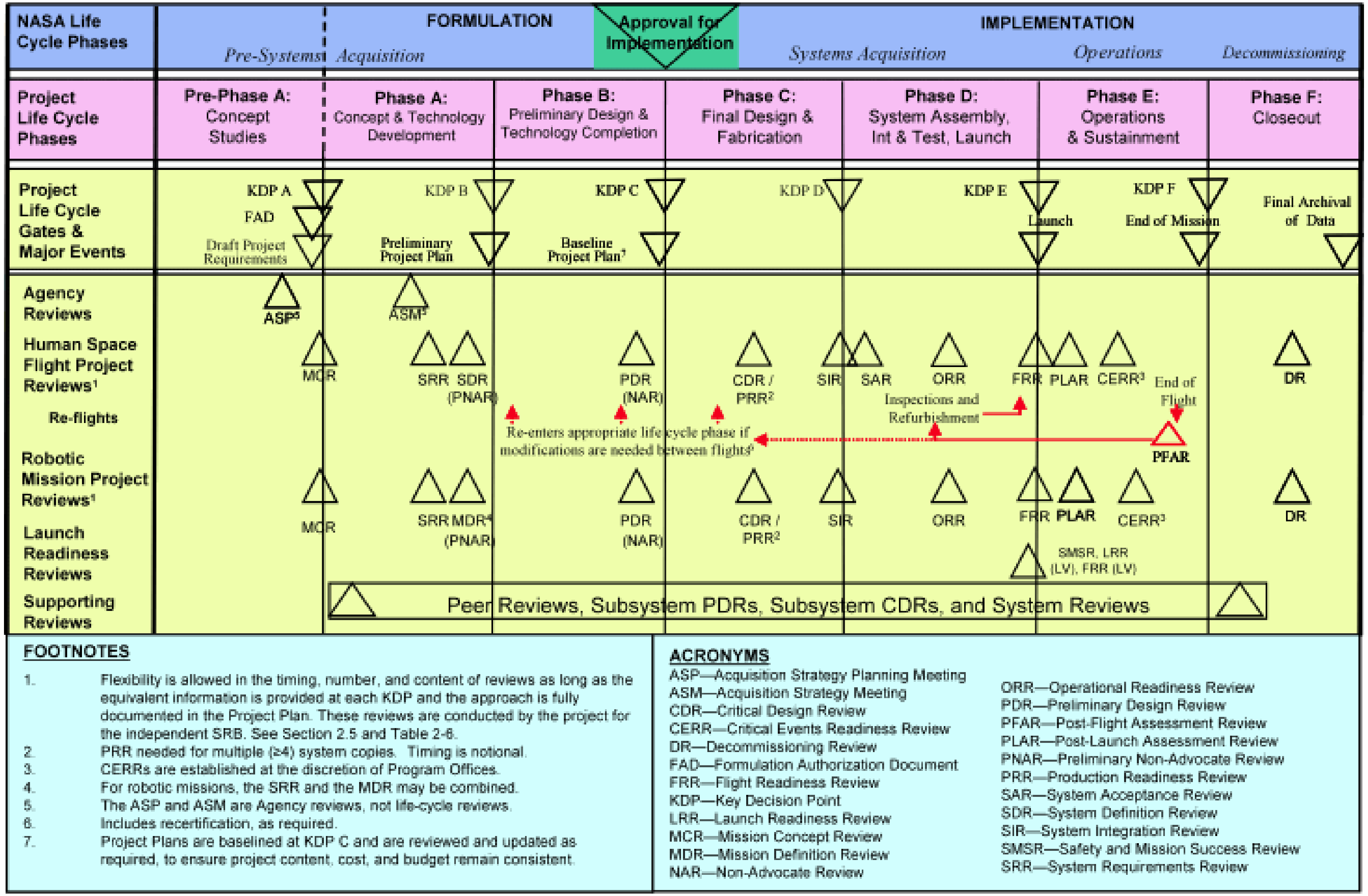


Figure 5-2 – The NASA Project Life Cycle

Writing Schedule

#	Week Of	Objective
1	Apr 15	Start Draft: PPTX and Doc of team findings
2	Apr 22	Deliverable: Above, end of week
3	Apr 29	Start first “Formal” draft of DSP – based on continual absorption draft
4	May 6	WIP
5	May 13	**Deliverable:** First formal draft of DSP at week’s end
6	May 20	Reviews, Edits and Iterations
7	May 27	**Deliverable:** First draft to Sponsor at Week’s end
8	Jun 3	Inputs and Iterations
9	Jun 10	Inputs and Iterations: **Deliverable:** Submission to Decadal Survey

The Subjective Cost and Risk Assessment Effort

iSAT Activity 2a

Objective:

- To identify the key parameters of iSAT and qualitatively assess their impact on the Phase A-E costs and risks with respect to a traditional space telescope.
- We will use the results as a qualitative indicator whether iSAT may be advantageous to the traditional paradigm of space telescope missions and a sanity check when compared to the detailed cost assessment of iSATs.
- We expect the results of this subjective effort (Activity 2a) and the detailed effort (Activity 2b) to be consistent.

Approach:

Using the team's experiential insights and lessons learned from past space telescope missions we will identify these key parameters and examine their relations and interactions with each other to understand where the benefits of iSAT, if any, may lie.