ASTROPHYSICS
DECADAL SURVEY 2020

Management Plan For
Large Mission Concept Studies – Rev D

February 26, 2018

http://science.nasa.gov/astrophysics/2020-decadal-survey-planning/

This is a living document and will evolve over time

Change Log

Date	Change	Pages	Rev
12/28/15	Initial Release		
03/15/16	Replaced “STDT Chair” with “STDT Community Chairs”	P20, 22	A
03/15/16	Removed references to “co-chair” from “Center Study Scientist”	P20, 23	A
03/15/16	Expanded list of points-of-contact for STDT questions	P21	A
3/15/16	Added Program Chief Scientists to the DSMT	P32	A
3/15/16	Replaced “Voting Members” with “Members”, and “Non Voting Members” with “Ex Officio Non Voting Members”	P17, 20, 23, 25	A
3/15/16	Updated the M1 milestone to be Friday 4/29, consistent throughout document	p42	A
3/15/16	Replaced co-chair language with “discipline lead” within the STDT	P22	A
6/15/16	Updated contents to reflect current order	2	B
6/15/16	Definition of term “Study Team”: Updated to graphically reflect same depiction of study team that is provided on page 24	9	B
6/15/16	Inserted new slide showing study team leadership	10	B
6/15/16	Guiding Principles (2/4): Added ‘Lifecycle’ to cost estimating principles	12	B
6/15/16	Removed the chart titled ‘APD Predicted Budget Profile’	n/a	B
6/15/16	Guiding Principles (¾): Added ‘technologies’ to first sub bullet	13	B

Change Log

Date	Change	Pages	Rev
6/15/16	Relocated CML chart from Success criteria section to Guiding Principles section. Renumbered to 4/4. First statement and 2nd bullet: Added clarification language on use and tailoring.	14	B
6/15/16	Updated Study Success Criteria to reflect more detail for M7	15	B
6/15/16	Guidelines for International Agency Engagement: This chart relocated from the back of the package to here	16	B
6/15/16	Study Drivers Important to Study Deliverables: Removed 'and resource requirements' from 2nd bullet	18	B
6/15/16	Study Deliverables: Removed study deliverables M2 & M3, and changed M5 to O3. Updated description of M4, M6, & M7	19	
6/15/16	Pause and Learn Meetings: Added chart to list the newly added Pause and Learn meetings	20	B
6/15/16	Changed title of slide to 'Expected Reporting from the Teams'	21	B
6/15/16	Roles and Responsibilities: A Team and Customer View: Added line to show study direction from the DSMT and added a line to show engagement of the science community	23	B
6/15/16	Relocated Integrated Review Team chart to after the Program Chief Scientist, Now chart 34. Added the Integrated Review Team and members	34	B
6/15/16	Study Team Detail: Under Ex-Officio Non-voting members, added 'Program' to the APD Scientist line	24	B
6/15/16	Roles and Responsibilities Overview (1 of 2): Updated to provide clarification to roles and responsibilities for the STDT Community Chairs, Ex-Officio non-voting members, Program Manger, Program Chief Technologist, Program Chief Engineer. Removed Study Program Level Program Executive (APD)	25	B
6/15/16	Roles and Responsibilities Overview (2 of 2): Updated to provide clarification on Funding Authority, Management Direction and When STDT members have questions	26	B

Change Log

Date	Change	Pages	Rev
6/15/16	Center Study Scientist (CSS): 2nd bullet – Added ' to the engineering team' for clarification. Added 5th bullet to clarify to whom the CSS is accountable to. Added 6th bullet "Does not act autonomously from the STDT chairs	28	B
6/15/16	Center Study Manger (CSM): 3rd bullet, 2nd sub-bullet – Removed 'The DSMT (programmatic, cost, schedule)'. 7th bullet – removed 'Provides periodic updates to Program Office and APD'. Removed 9th bullet – 'Responsible for Study Office'. Added last bullet – 'Does not act autonomously from the STDT chairs'. Updated with minor edits	29	B
6/15/16	ApD Program Scientist: Removed 'DOES' and 'DOES NOT' to match format of previous R&R charts. Added first bullet – 'Serves as a single point of contact for the STDT' . Added 6th bullet – 'Prepares and reports on STDT progress to DSMT regularly including a formal monthly progress reporting'. Modified 7th bullet – 'Does not direct the Study Team on how or what science case to include/exclude'. Added last bullet - 'Does not act autonomously from the STDT chairs'.	30	B
6/15/16	ApD Program Executive: Removed 'DOES' and 'DOES NOT' to match format of previous R&R charts. Added first bullet –' Serves as a member of the DSMT'. Added 2nd bullet – 'Carries a programmatic responsibility for respective APD program area in relation to STDTs (e.g., PCOS: X-ray Surveyor, COR: LUVOIR and Far-IR, Exoplanet: HabEx) scientific classification'	31	B
6/15/16	Program Office (PO) Manager: Added 'Manager' to title. Removed 'DOES' and 'DOES NOT' to match format of previous R&R charts. Added first bullet – 'Advises DSMT on study execution and associated programmatic issues'. Added 2nd bullet – 'Supports study execution as necessary by implementing ApD direction'. 3rd bullet – removed 'representatives of' and added 'directed by'. 7th bullet – Added 'At the direction of the DSMT, may provide', removed 'to APD'. 7th bullet, removed 1st sub-bullet – 'CML completeness at transition points/gates'. 8th bullet – Removed 'APD' added 'DSMT', removed 'conducting' added 'facilitating'. 9th bullet – Reworded to read 'Coordinates with other Program Offices'. Added last bullet - 'Does not act autonomously from the STDT chairs'	32	B
6/15/16	Program Chief Scientist: Removed 4th bullet 'May serve as member with the approval of APD DD. Added last bullet - 'Does not act autonomously from the STDT chairs'	33	B
6/15	Removed Exoplanet Standards definition Team Chart	n/a	B

Change Log

Date	Change	Pages	Rev
6/15/16	DSMT Governance: Updated to reflect current approach. Removed 'Key Elements' from title. Removed 3rd bullet under Objectives. Insight and Oversight Tools, Mechanisms Section: Removed 2nd, 3rd, 4th, 5th bullets from. Added bullet – 'APD PS will provide monthly report on STDT's progress to the ApD DD'. Removed 'TBC' 7th bullet. Added 8th bullet - 'Awareness of each STDT key events'. Removed 'Governance Guidance provided on these timescales by these Governance Bodies' and all associated sub-bullets. Now page 40 in rev B	37	B
6/15/16	Title Changed to 'Overall Study Coordinators'. Modified 1st bullet to read 'Provide overarching coordination of the policies and practices of the individual study teams and the communications between the DSMT, PS's and the study teams'. Changed 2nd bullet to read 'Represents ApD Director/Deputy Director'. Modified 3erd bullet to read 'Objectives: 1. ApD coordination with the study Program Scientists through the DSMT; 2. Stay informed about Study Teams' progress towards milestones established in this Management Plan; 3. Assist and represent the ApD Management as needed'. Specific tasks Section: Removed 1st sub-bullet. Modified 2nd sub bullet to read: 'Receive and review the monthly, reports from the APD PS's and summarize for the ApD Management'.	38	B
6/15/16	ApD Staff Involvement: Removed 'Governance of Decadal Studies' from title and replaced with ApD Staff Involvement. Removed Center Program Office column, Changed Study Center column title to 'Center Study Office Location', combined Mission Concept Coordinator and Overall Study Coordination Columns.	39	B
6/15/16	Implementation of Decadal Studies: Removed Program Office Column, Changed Center Program Office column title to 'Center Study Location'	40	B
6/15/16	Program Office Involvement: Removed 'Implementation of Decadal Studies from Title and replaced with Program Office Involvement. Updated with correct names.	41	B
6/15/16	Deleted e-mail contact chart	n/a	B
6/15/16	Removed Governance Structure Lines of Authority, Communication chart	n/a	B

Change Log

Date	Change	Pages	Rev
6/15/16	Funding Guidelines: deleted all bullets, added 'The funding profile for each team will be provided individually to each team by summer 2016'	42	B
6/15/16	Removed near term schedule chart	n/a	B
6/15/16	Applicable Metrics (all charts): Added 'and can be further tailored by the study teams based on their approach' to asterisk at top of chart	48-52	B
6/15/16	Added chart titled 'Working Version of Consensus'	53	B
6/15/16	Added chart titled 'How are CML assessed at M3,M4, M6	54	B
12/18/17	X-ray Surveyor - Center Study Manager name corrected	10, 40	C
12/18/17	Schedule drivers chart deleted	n/a	C
12/18/17	Study deliverables schedule updated	18	C
12/18/17	Added Final report review process and schedule	19	C
12/18/17	Additional Pause and Learn dates added	20	C
12/18/17	Added Large Mission Concept Studies Report Team Description	34	C
12/18/17	Overall study coordinator name updated	36, 39	C
02/26/18	Replaced CATE with Independent Cost Assessment (ICA)	18, 19	D

Contents

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- **Study Deliverables**
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  - Lines of Authority, Communications
  - Oversight/Insight Mechanisms
- **Study Phase Funding Process**

Plan Objectives: Defining the Why, What, When, and How

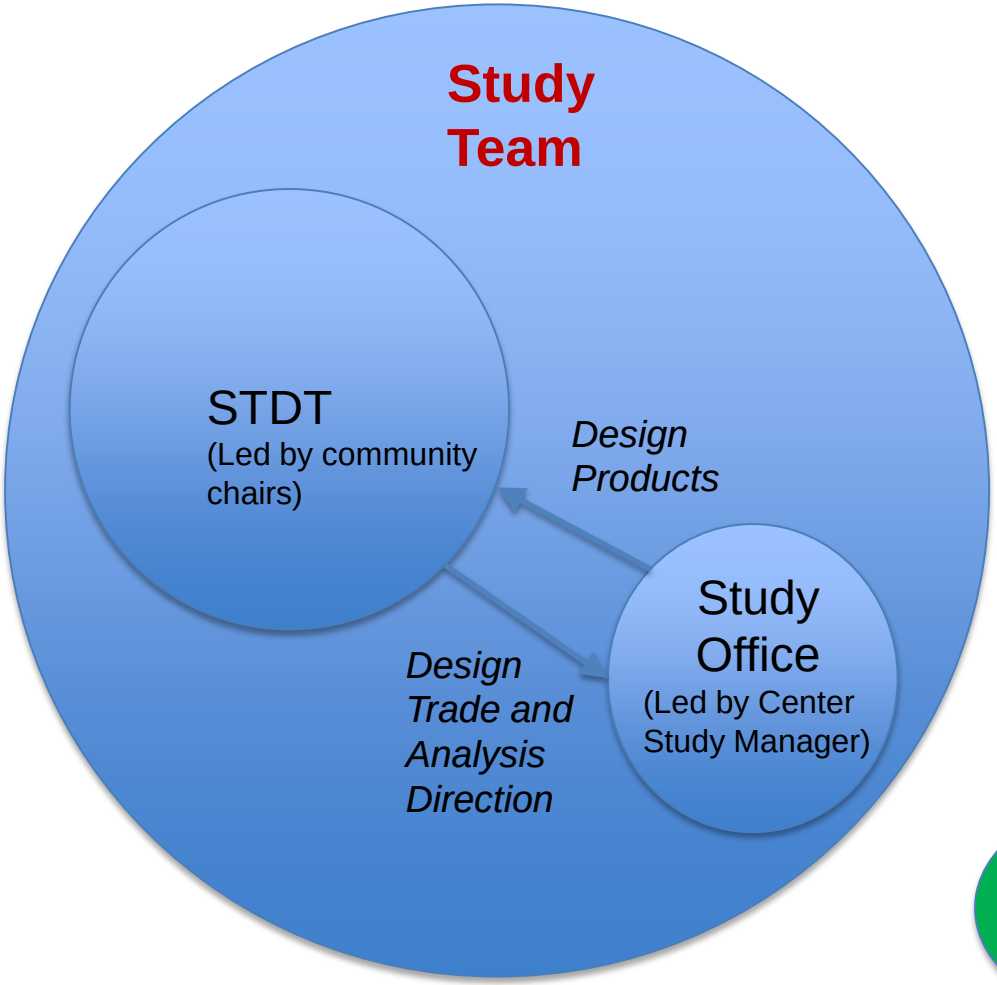
1. **WHY: Establish specific and measurable requirements so that**
   a) The Study Teams can
      1. Establish concept status at starting point
      2. Understand the success criteria for each milestone
      3. Produce the appropriate products for the Decadal Survey Committee
   b) APD / Program Offices can
      1. Assess and negotiate the resource requirements
      2. Monitor the study progress against specific metrics
      3. Guide the Study Teams in the depth & breadth of the study

2. **WHAT: Define final & interim deliverables that**
   a) Are clear, reasonable and valuable to stakeholders and Study Teams
   b) Provide quantitative measure of progress
   c) Meet the programmatic needs of APD
   d) Set community expectations

3. **WHEN: Define due dates for study deliverables that**
   a) Are consistent with programmatic needs
   b) Provide the necessary time for the Study Teams to achieve the objectives
   c) Are enabled by the near-term schedule

4. **HOW:**
   a. Establish the governance guidelines and approach so that
      1. Lines of authority, roles, responsibilities, and customer relationships, are clearly defined
      2. Lines of communications are clear
   b. Agree on the study funding approach that
      1. Is consistent with the current budget set aside for these activities
      2. Allocates resources according to the individual study plans
   c. Plan the execution of the study and determine resources for each milestone

Definition of term: “Study Team”



Study Team

- Union of STDT and Study Office
- STDT and Study Office work together as one team for success of Study
- Each has distinct and complementary roles within the Study Team

Observers

- Welcome and not part of Study Team per se
- Attendance is optional or on-call

Study Team Leadership

	Community STDT Chairs	Center Study Team	Study Lead Center
Far IR Surveyor	Asantha Cooray Margaret Meixner	David Leisawitz Ruth Carter	GSFC
Habitable Exoplanet Imaging Mission	Scott Gaudi Sara Seager	Bertrand Mennesson Keith Warfield	JPL
Large UV/Optical/IR Surveyor	Debra Fischer Bradley Peterson	Aki Roberge Julie Crooke	GSFC
X-ray Surveyor	Feryal Ozel Alexey Vikhlinin	Jessica Gaskin Karen Gelmis	MSFC

Guiding Principles (1/4)

- **APD Decadal Success Criteria:**
  - APD defines "full success" as delivery to the Decadal Survey Committee of compelling and executable concepts for all four large missions so that science can be adequately prioritized by the Decadal Committee.
  - Executable is defined as *feasible* with respect to technical, cost, and risk resources outlined in the Study Report
- **Study Teams are not in competition with one another**
  - Study Teams are making the best case – within fuzziness of boundary conditions – for science and mission concepts that enable science
  - Study Teams (especially leadership) are encouraged to create a collaborative environment that allows for each team to promote their concept and to acknowledge (and not undermine) the other concepts
  - Study Teams are encouraged to share or combine technical areas or observing strategies
- **This is not an Announcement of Opportunity**
  - Do not expect AO-like, crisp rules and guidelines
  - A goal of the Study Team should be to define a reference mission that accomplishes a certain level of scientific discovery

Guiding Principles (2/4)

- **Cost Estimating Principles**
  - Perform costing as necessary to drive design trades that inform science capabilities, priorities
  - Perform engineering as necessary for parametric costing, not solely for the purpose of more accurate costing
  - Explore a range of architectures to understand the relative relationship of cost, risk and science for the concepts
  - Present implementation strategies as "reference missions" – credible hardware configurations that can achieve the science goals and are sufficiently defined for a reasonable cost evaluation
  - Recognize that any actual mission is likely to vary from the study concept

- **There isn't a cost cap on mission costs**
  - Study Teams should address the "mission cost vs. science capability"
  - Consider the sweet spot factoring in science, technology, cost, and risk
  - Parametric results for key scientific performance are highly desirable
  - Teams may consider other budget profiles to explore additional opportunities
- **Study teams should engage industry in such a manner that it preserves mission study participants' ability to respond to potential future solicitations related to mission development work**

Guiding Principles (3/4)

- **Technology Development Principles**
  - The Technology Readiness Levels (TRL) of enabling technologies at the time of Decadal submittal will be one factor important to the Decadal Survey Committee and independent cost/risk assessment
  - Of equal or greater importance will be the credibility of the technology roadmap that shows
    - How TRL5 will be achieved by KDP-B (SMD Handbook[1])
    - How TRL6 will be achieved by PDR (NASA policy[2])
    - Description of technology funding and timeline required to achieve TRL5
  - Reference to TRL Definitions used for the Large Decadal Mission Studies: http://nodis3.gsfc.nasa.gov/npg_img/N_PR_7123_001B_/N_PR_7123_001B_.pdf

[1]Defined in NPR 7123.1B, NASA Systems Engineering Processes and Requirements

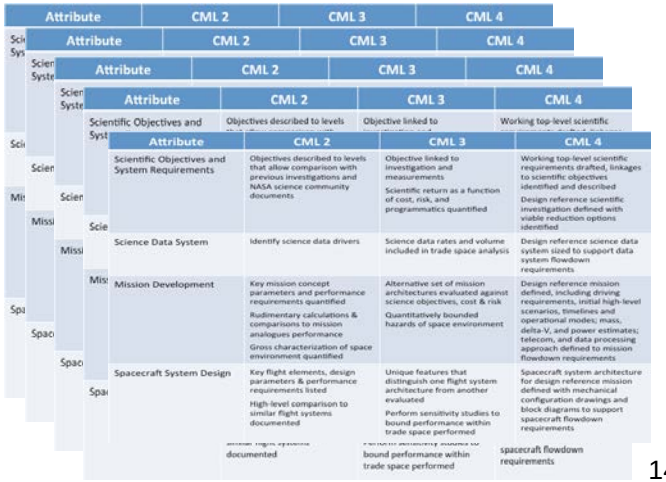
[2]According to NPR 7120.5e

Guiding Principles (4/4)

Concept Maturity Level (CML) can be used by the teams to guide their mission concept development.

What is Concept Maturity Level (CML)*:

- CML is a classification scheme for characterizing the various levels of a concept's maturity. The key strength of CML is the ability to evolve mission concepts guided by an incremental set of assessment needs. This process gauges a study conduction through measurable and deliverable milestones which helps to evaluate and manage the products during a given time line.
- Defined in the detailed table in backup charts. The study teams are encouraged to further tailor the CML 4 requirements to best fit their final design reference mission (DRM) and available resources.



** Space Mission Concept Development using Concept Maturity Levels, Randii Wessen, Chester S. Borden, John K. Ziemer, Robert C. Moeller, Joan Ervin, and Jared Lang, AIAA SPACE 2013 Conference and Exposition. September*

http://arc.aiaa.org/doi/abs/10.2514/6.2013-5454

Study Success Criteria

- **The final study deliverable shall include:**
  - *Science case for the mission*
  - *Mission and observatory performance requirements that deliver these science capabilities*
  - *Design reference mission, including straw-man payload trade studies conducted to arrive at the final mission concept*
  - *Technology assessment:*
    - *Current status, at the time of submittal of the final report*
    - *Roadmap for maturation to both TRL-5 by the start of Phase-A and*
    - *TRL-6 by the mission PDR*
    - *Phased resources needed to achieve the required technology maturity levels by the start of Phase A and by mission PDR*
  - *Cost assessment, major technical, and risk burn-down plans as a function of science capability.*
  - *Top-level schedule for major phases of development including a notional launch date (assuming entering phase-A as a post-WFIRST budget wedge opens) and top schedule risks.*

Guidelines for International Agency Engagement

- NASA welcomes international participation in the upcoming Decadal Studies as well as in the implementation of the mission(s) prioritized by the Decadal.
- NASA (APD DD) invites representatives from international agencies to engage in the decadal study teams
- Study teams are encouraged to engage with their international counterparts to inform them of this opportunity
- To be a member of the Study Team, the international member needs to be formally endorsed by their respective government agency
  - International partners will be subject to the International Traffic in Arms Regulations (ITAR)
- Interested international individuals are free to attend all open meetings of the study teams, as an observer, in accordance with export regulations
- NASA does not provide funding for any international participants; instead, this funding comes through the home institution

What, When:

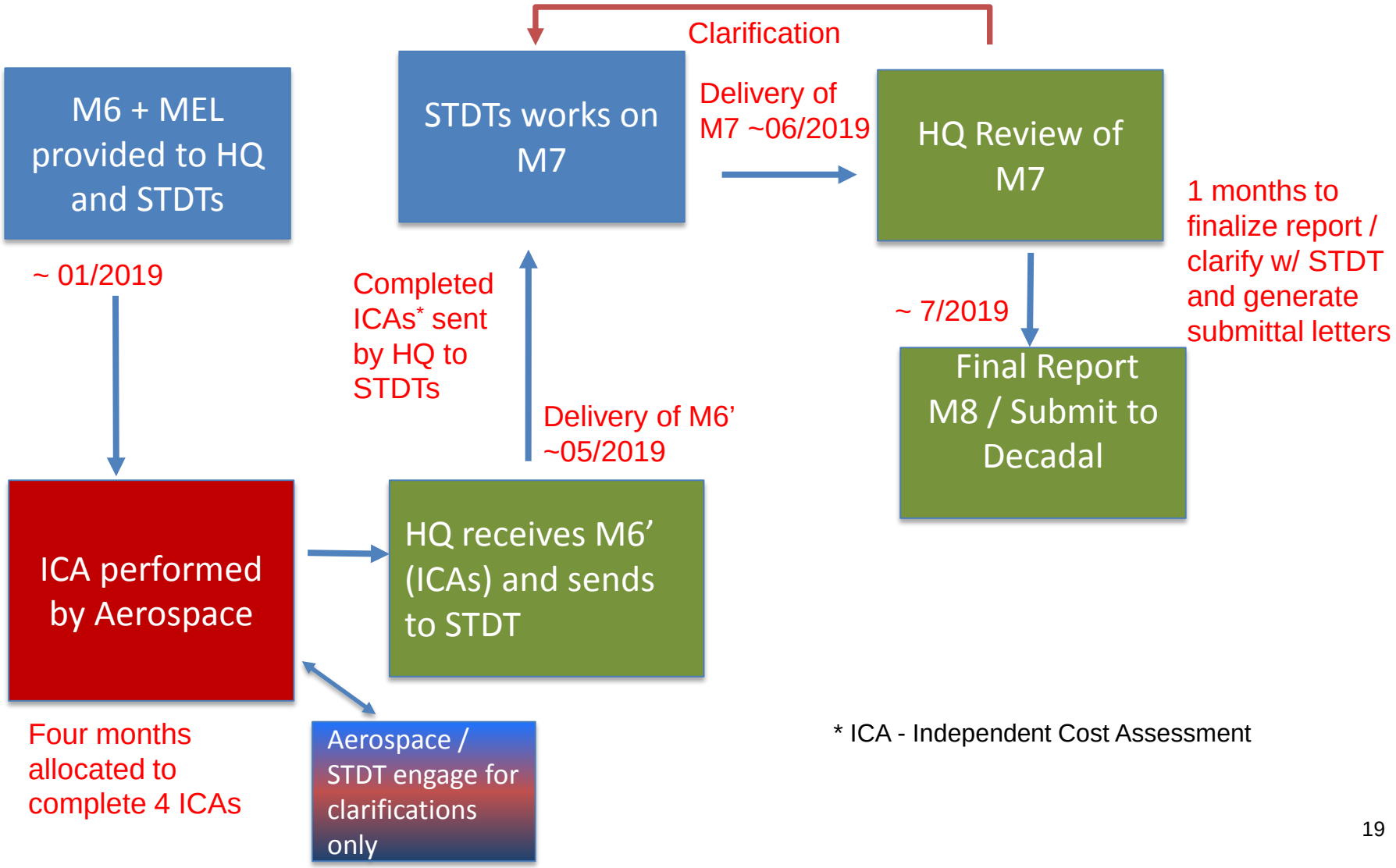
Deliverables and Schedule

Study Deliverables

M1	**Comments on Study Requirements and Deliverables** – Accept the study requirements/deliverables and submit plan--- or – Provide rationale for modifying requirements/deliverables	**April 29 2016**
O1	***Optional: Initial Technology Gap Assessment*** – *To impact PCOS/COR/ExEP 2016 technology cycle*	**June 30 2016**
O2	***Optional: Update Technology Gap Assessments***	**June 2017**
M4	**Interim Report** – Provide science case and mission concept (use CML 3 as a guide) – Deliver initial technology roadmaps; estimate technology development cost/schedule – CML 4 tailored approach (optional)	**March 2018**
O3	**Update Technology Gap Assessments**	**June 2018**
M6	**Draft Final Report at Concept Maturity Level 4 Audit / Freeze Point Design** – Provide science case and mission concept (use CML4 as a guide) – Support independent cost estimation/validation process – Submit to HQ for Independent Cost Assessment (ICA)	**Jan 2019**
M6'	**ICA report returned by HQ to STDTs for incorporation into M7**	**May 2019**
M7	**Final Report / incorporate ICA report + final changes** – As described in study success criteria chart 15	**June 2019**
M8	**HQ Submits final report to Decadal**	**July 2019**

***Note: Schedule relaxed from original by ~4 months due to decadal committee schedule delay**

Delivery Schedule for Final Report



* ICA - Independent Cost Assessment

Pause and Learn Meetings

- **Periodic Pause and Learn activities will be held for all teams to participate**
  - Teams will provide status updates and opportunities for information exchange across the teams
  - Participants will be the Study Team Leadership (Chairs, Center Study Manager, and Center Study Scientist), the DSMT and the APD Division Director.
  - Schedule:
    - October 2016
    - April 2017
    - October 2017
    - June 2018
    - December 2018
    - June 2019

Reporting from the Teams

- STDT Community Chairs will present at each Winter meeting of the American Astronomical Society (2017, 2018, 2019)
  - Either special session or at PAG meeting
- STDT Community Chairs should assume periodic presentations to National Committee Meetings at the request of Committee Chairs (e.g. APS, CAA, AAAC). An estimate of ~4 per year can be used for planning purposes
- STDT Community Chairs will present to the Decadal Survey Committee and be prepared for follow-up questions (as needed) during 2019. The schedule for 2019 will be further clarified when the Decadal Survey Committee is chartered in early 2018
- Study Team Leadership to meet semi-annually to cross-coordinate studies with APD, through Pause & Learn sessions
- Interim and Final reports include a briefing to APD before public release
- Study Deliverables listed on page 19 are briefed to APD Decadal Studies Management Team (defined on page 36) with the Integrated Review Team (defined on page 34) present to provide technical and programmatic analysis
- HQ Program Scientists (PS's) will be included in routine Study team meetings, therefore regular formal reporting is not required.
  - The PS's will provide a status report to the APD DD on a monthly basis.

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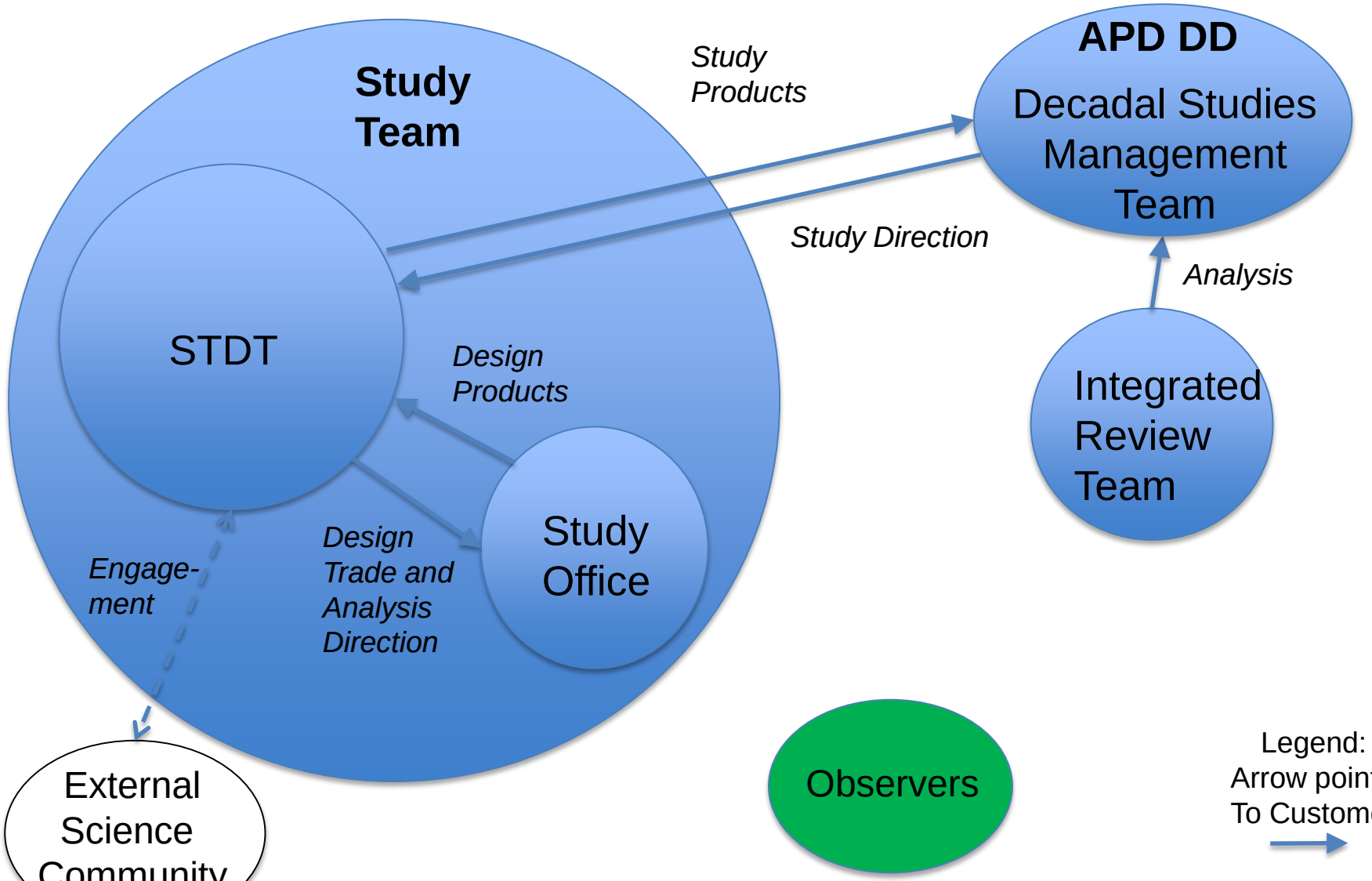
How:

Roles and Responsibilities

Lines of Communication

Governance Approach

Roles and Responsibilities: A Team and Customer View



Study Team: Detail

Members

- Appointed from community by ApD DD
- Appointed from Centers and PO by ApD DD

Examples

- Members of community and NASA Centers
- Center Study Scientists

Ex-Officio Non-voting Members

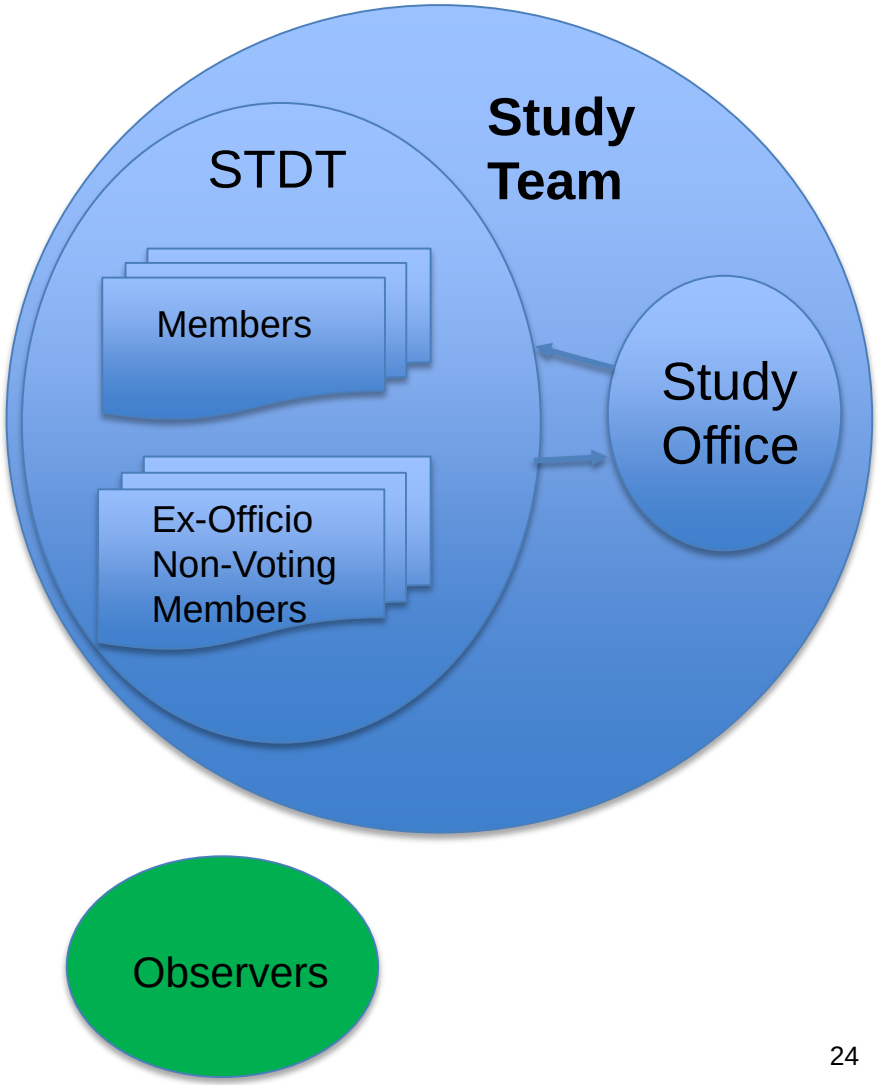
- Appointed by ApD DD virtue of office
- Not participate in deliberations

- ApD Program Scientists
- Program Office Chief Scientists
- Representatives of International Partners

Observers

- Welcome and not part of Study Team per se

- Mission Concept Coordinator (ApD)
- Program Office Manager
- Program Office Chief Technologist
- Program Office Chief Engineer



Roles and Responsibilities Overview

(1 of 2, detail pages follow)

STDT

- **STDT Community Chairs**
  - Members of the non-NASA science community
  - Lead the STDT
  - Provide design trade and analysis direction, in consultation with the STDT, to the Study Office
  - Ultimate responsibility for interim and final products
  - Responsible for progress briefings to ApD, national committees
  - ApD DD and Community Chairs may appoint discipline leads as needed (co-chairs will have an area of responsibility within the overall study)
- **STDT Members**
  - Appointed by ApD DD
  - Include members of community and of NASA Centers
  - **Center Study Scientist (CSS)**
    - Interfaces to Study Office and Center engineering teams
- **STDT Ex-Officio non-voting members**
  - **ApD Program Scientist (APD PS)**
    - Supports and liaises "up-and-out" with emphasis on science objectives to APD, NASA stakeholders and Reports to DSMT on study progress
    - Represents ApD at the Study Team meetings
    - More detail page 30
  - **Program Office Chief Scientist (PCS)**
    - Represents PM in insight/oversight of the study progress

STUDY OFFICE

- **Center Study Manager (of Study Office)**
  - Supports STDT. The STDT is the customer of the Study Office
  - Leads the engineering team
  - Responsible for developing an implementable DRM meeting the science objectives

OBSERVERS

- **Program Office (PO) Manager**
  - Supports ApD technical insight/oversight of the Study Teams
  - Provides input/advice on study team management; implements HQ actions as directed
  - More detail page 32
- **Program Office Chief Technologist**
  - Represents Agency technology plans and progress to STDT and Study Office
  - Performs STDT technology oversight
  - Represents study technology needs to Agency
  - Integrates technology requirements into the SAT process
- **Program Office Chief Engineer**
  - Performs STDT engineering oversight
  - Available as PO engineering resource to Study Teams
  - Represents study cost estimates to ApD
  - Assess CML fidelity and readiness for Integrated Review Team

Roles and Responsibilities Overview
(2 of 2)

- **Technical direction**
  - To Study Office comes from STDT Community Chair
- **Trade decisions**
  - Options assessed and recommended by Study Office
  - Choice made by STDT Community Chair
- **Funding authority**
  - Provided to Study Offices by the NASA HQ Astrophysics Division (ApD)
- **Management direction**
  - Provided by the Decadal Survey Management Team (DSMT)
  - Implemented by Program Offices upon direction from ApD.
- **When STDT members have questions:**
  - First point of contact will be the STDT Community Chairs
  - Next POC will be the Center Study Scientist and the Center Study Manager
  - After that, questions should go to ApD Program Scientist who will bring the question to the DSMT for guidance and consistency of direction.
  - *Note: Programmatic questions (cost, schedule, governance per this Management Plan) should be directed to the DSMT via the Program Scientist*

STDT Community Chairs

- Leads the STDT in defining the science case
- Members of science community
- Ensures that the science case is a community driven process
- Are the community advocates for this reference mission
- May appoint discipline leads from within the STDT as needed
- May utilize the Program Analysis Group (PAG) infrastructure to obtain community input and provide status to the community
  - Science Analysis Groups (SAGs)
  - Science Interest Groups (SIGs)

Center Study Scientist (CSS)

- Appointed member of STDT
- Represents STDT to the engineering team in its day to day activities
  - Engineering and science tradeoffs, etc.
- Provides guidance to the STDT regarding NASA processes
- Provides guidance to the STDT regarding the practicality of implementing science objectives
- Accountable to:
  - The STDT chair (technical direction)
  - Center Study Manager
- Does not act autonomously from the STDT chairs

Center Study Manager (CSM)

- Leads the Study Office (engineering team)
- Supports the STDT; the STDT is the customer of the Study Office.
- Accountable to the STDT chair (technical direction)
- Responsible for developing an implementable Design Reference Mission (DRM) meeting the science objectives
- Obtains the necessary technical & administrative resources from the NASA Center
- Obtains Center approval/reviews of the deliverable milestones prior to delivery
- Responsible for cost estimates and inputs to independent cost estimates
- Through Study Office staff, is responsible for Study Team logistics: websites, document postings, mailing lists, processing affiliate travel, contracts, export compliance guidelines, budget, schedule, etc.
- Does not act autonomously from the STDT chairs

ApD Program Scientist

Represent ApD science interests at the STDT meetings

- Serves as a single point of contact for the STDT
- Serves as a resource to the STDT in providing clarification of STDT charter
- Provide “big picture guidance” to the STDT
- Serves as conduit of information exchange between STDT, APD, DSMT and science community
- Serves as appointed ex-officio non-voting members of STDT
- Prepares and reports on STDT progress to DSMT regularly, including a formal monthly progress reporting
- Does not direct the Study Team on how or what science case to include/exclude
- Does not act autonomously from the DSMT in managing the study teams or the conduct of the studies.

ApD Program Executive

- Serves as a member of the DSMT
- Carries a programmatic responsibility for respective ApD program area in relation to STDTs (e.g., PCOS: X-ray Surveyor, COR: LUVOIR and Far-IR, Exoplanet: HabEx) scientific classification
- Represents ApD programmatic interests at the Study Team meetings
- Supports the Study Teams in developing international partnerships, as needed
- Serves as Observer/Resource to Study Team
- Does not direct the engineering team on how or what architectures to develop

Program Office (PO) Manager

- Advises DSMT on study execution and associated programmatic issues
- Supports study execution as necessary by implementing ApD direction
- Provides programmatic (cost, approach) guidance to Study Teams as directed by ApD
- Facilitates synergy between all mission studies
- Provides progress/status of Strategic Astrophysics Technology (SAT) driven technologies to the Study Teams
- Supports the Study Teams in developing industrial partnerships
- At the direction of the DSMT, may provide independent assessment of all study deliverables
  - Thoroughness of the technology roadmap
  - Thoroughness of the systems engineering and trades
  - Study resource requirements
- Supports DSMT in facilitating independent cost estimates of mission concepts
- Coordinates with other program offices
- Does not direct the engineering team on how or what architectures to develop
- Does not act autonomously from the DSMT in managing the study teams or the conduct of the studies.

Program Office Chief Scientist (PCS)

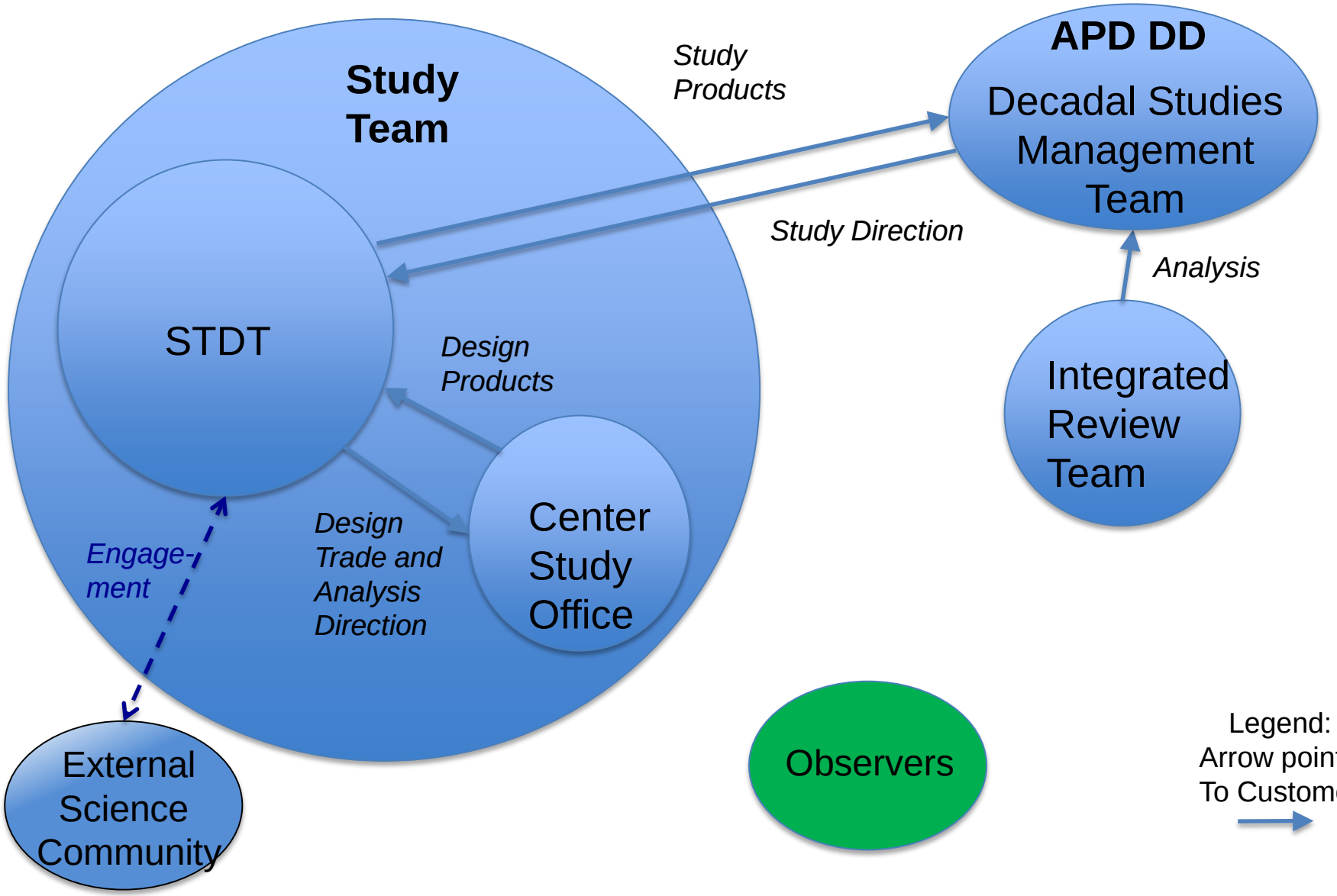
The Program Office Chief Scientist represents the Program Offices at the Study Team meetings

- Supports the program manager in the insight/oversight activities
- Supports the ApD scientists in communication with the community
- Facilitates interaction between STDT and PAGs, as needed
- Does not direct (impose upon) the STDT on how or what science case to include/exclude
- Does not act autonomously from the DSMT in managing the study teams or the conduct of the studies.

Large Mission Concept Studies Report Team (LRT)

- **A single team will review the M4 deliverable of all Study Teams**
- **The purposes are to assess:**
  A. Completeness with respect to the M4 deliverable scope
  B. Whether the STDTs are on the right track for delivering the final report
- **The charter of the LRT is documented here (https://science.nasa.gov/astrophysics/2020-decadal-survey-planning)**
- **The LRT will provide a short written report for each study, and provide an individual out-brief to each STDT and a common out-brief to all STDT leadership at a future Pause-and-Learn**
- **Makeup of the LRT (10-11 people) will be:**
  - Internal Subject Matter Experts, drawn from the Program Engineering Offices of PCOS/COR at GSFC and of ExEP at JPL;
  - External Subject Matter Experts, drawn from those in the community not directly involved in the studies or the program offices
  - The Aerospace Corporation

Roles and Responsibilities: A Team and Customer View



Decadal Studies Management Team (DSMT) Structure

Provided by standing leadership team reporting to ApD Deputy Division Director (14 members)

- Participating Principles:
  - Chair: Andrea Razzaghi
  - Overall Study Coordination: S.Habib (PE), R. Sambruna (PS)
  - ApD Program Executives: S. Habib (PCOS and COR), J. Gagosian (Exoplanet)
  - ApD Program Scientists: D. Evans (X-Ray Surveyor), K. Sheth (Far-IR), M. Perez (LUVOIR), M. Still (HabEx)
  - Program Office Managers: Mansoor Ahmed, G. Blackwood

Function:

- Provides agile, consistent, transparent guidance to the Study Teams; avenue of dissemination of this guidance (e.g. by PS, PO or DSMT) will be determined by the DSMT chair or delegate, as appropriate
- Recipient of STDT formal deliverables
- **For each study milestone deliverable, specific delivery instructions will be provided. At a minimum, all study milestone deliverables will be sent to the ApD Deputy Director, designated as the ApD Overall Study Lead, Andrea Razzaghi, andrea.i.razzaghi@nasa.gov.**

DSMT Governance

- **Objectives:**
  - Ensure the studies will produce the required deliverables on time
  - Ensure studies are adhering to the guidelines
  - Resolve questions in a consistent, transparent way
  - Provide synergy within the concepts to the extent practicable
    - Promote communications and coordination between studies
- **Insight & Oversight Tools, Mechanisms:**
  - Attendance at telecons and STDT meetings (as needed)
  - The ApD PS will provide monthly report on STDTs progress to ApD DD
  - Quarterly tag up telecon of all 4 study leadership with ApD Decadal Studies Management Team
  - Awareness of each STDT key events
  - Review of study milestone deliverables

Overall Study Coordinators

- Provide: overarching coordination of the policies and practices of the individual study teams and the communications between the DSMT, PS's and the study teams.
- Represents ApD Director/Deputy Director
- Objectives: 1. ApD coordination with the study Program Scientists through the DSMT; 2. Stay informed about Study Teams' progress towards milestones established in this Management Plan; 3. Assist and represent the ApD Management as needed
- Specific tasks:
  - Receive and review the monthly reports from the PS's and summarize for ApD Management
  - Remain cognizant of the science content of the STDTs and synergies across STDTs and summarize for ApD Management
  - Facilitate interactions between the STDTs, advisory committees, and with ApD Management
  - Assist the ApD Director with reporting to advisory committees and the community (slides preparation, written reports, etc.)
  - Document entire process & write Lessons-Learned and Best Practices report

ApD Staff Involvement

Overall Study Lead is the ApD Deputy Director, Andrea Razzaghi

Study	Center Study Office Location	Program Scientists	Program Executives	Overall Study Coordination
X-Ray Surveyor	MSFC	Dan Evans	Shahid Habib	Shahid Habib Rita Sambruna
Large UV Optical and IR Surveyor	GSFC	Mario Perez		
FAR IR Surveyor	GSFC	Kartik Sheth		
Habitable ExoPlanet Imaging Mission	JPL	Martin Still	John Gagosian	

Implementation of Decadal Studies

NASA Center participation

Study	Center Study Office Location	Center Study Scientist	Study Office Manager	Center Line Management
X-Ray Surveyor	MSFC	Jessica Gaskin	Karen Gelmis	Martin Weisskopf
Large UV Optical and IR Surveyor	GSFC	Aki Roberge	Julie Crooke	Mark Clampin
FAR IR Surveyor	GSFC	Dave Leisawitz	Ruth Carter	Mark Clampin
Habitable ExoPlanet Imaging Mission	JPL	Bertrand Mennesson	Keith Warfield	Jeff Booth

Program Office Involvement

Program Office	Program Office Center	Program Manager / Deputy	Program Chief Scientist / Deputy	Program Chief Engineer	Program Chief Technologist
PCOS	GSFC	Mansoor Ahmed	Ann Hornschemeier / Peter Bertone	Gabe Karpati	Harley Thronson Bruce T. Pham
COR	GSFC		Susan Neff / Debbie Padgett		
ExEP	JPL	Gary Blackwood / Kendra Short	Karl Stapelfeldt / TBD	Kendra Short (acting for K. Warfield)	Nick Siegler

Funding Guidelines

- **The funding profile for each team will be provided individually to each team by summer 2016**

Backup

Acronyms

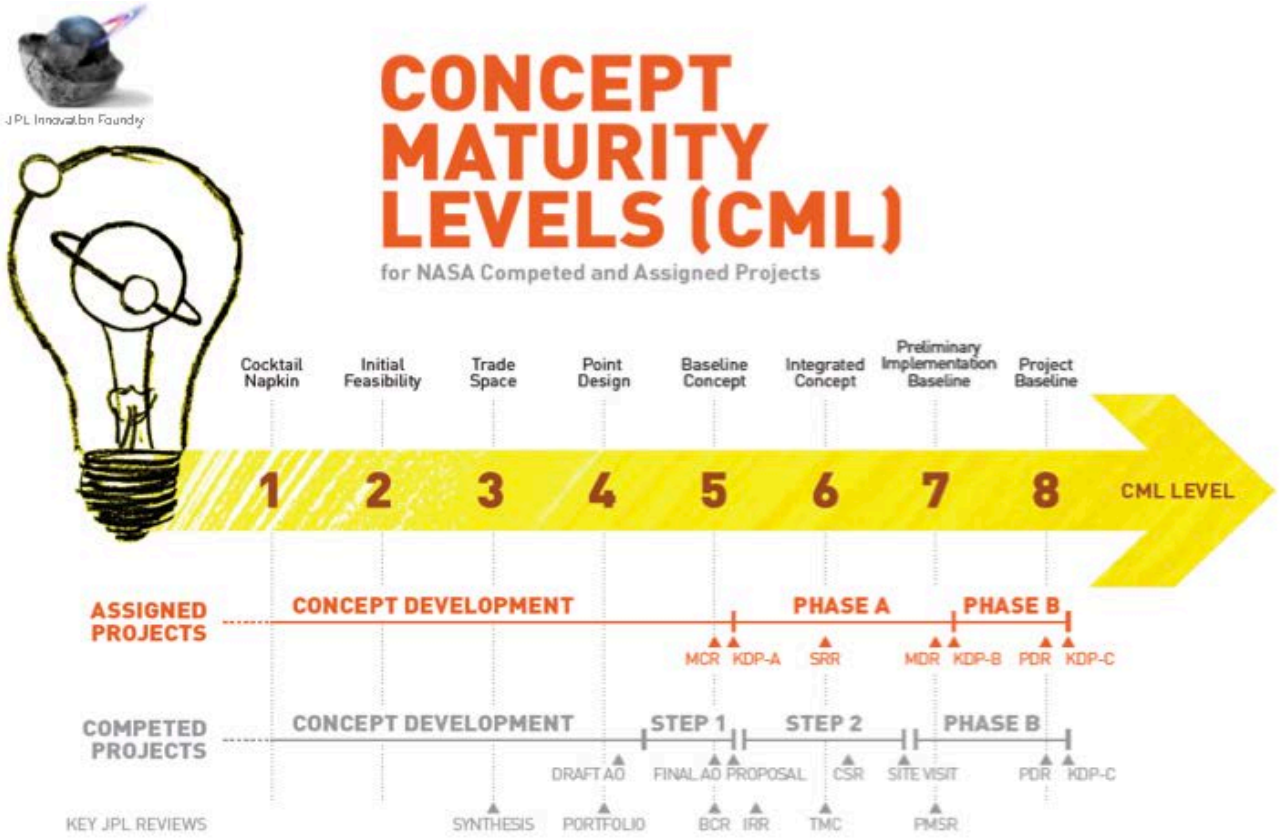
- APD Astrophysics Division
- CML Concept Maturity Level
- COR Cosmic Origins
- CSM Center Study Manager
- CSS Center Study Scientist
- DD Division Director
- DDD Deputy Division Director
- DRM Design Reference Mission
- DS Decadal Survey
- ExEP Exoplanet Exploration Program
- KDP Key Decision Point
- LCC Lifecycle Costs
- LL&BP Lessons Learned and Best Practices
- MCC Mission Concept Coordinator
- MEL Master Equipment List
- PAG Program Analysis Group
- PCS Program Chief Scientist
- PCOS Physics of the Cosmos
- PDR Preliminary Design Review
- PO Program Office
- RFI Request for Information
- RFP Request for Proposal
- SAG Science Analysis Group
- SAT Strategic Astrophysics Technology
- SIG Science Interest Group
- SMD Science Mission Directorate
- STDT Science and Technology Definition Team
- TBC To Be Confirmed
- TRL Technology Readiness Level

Document Change Log

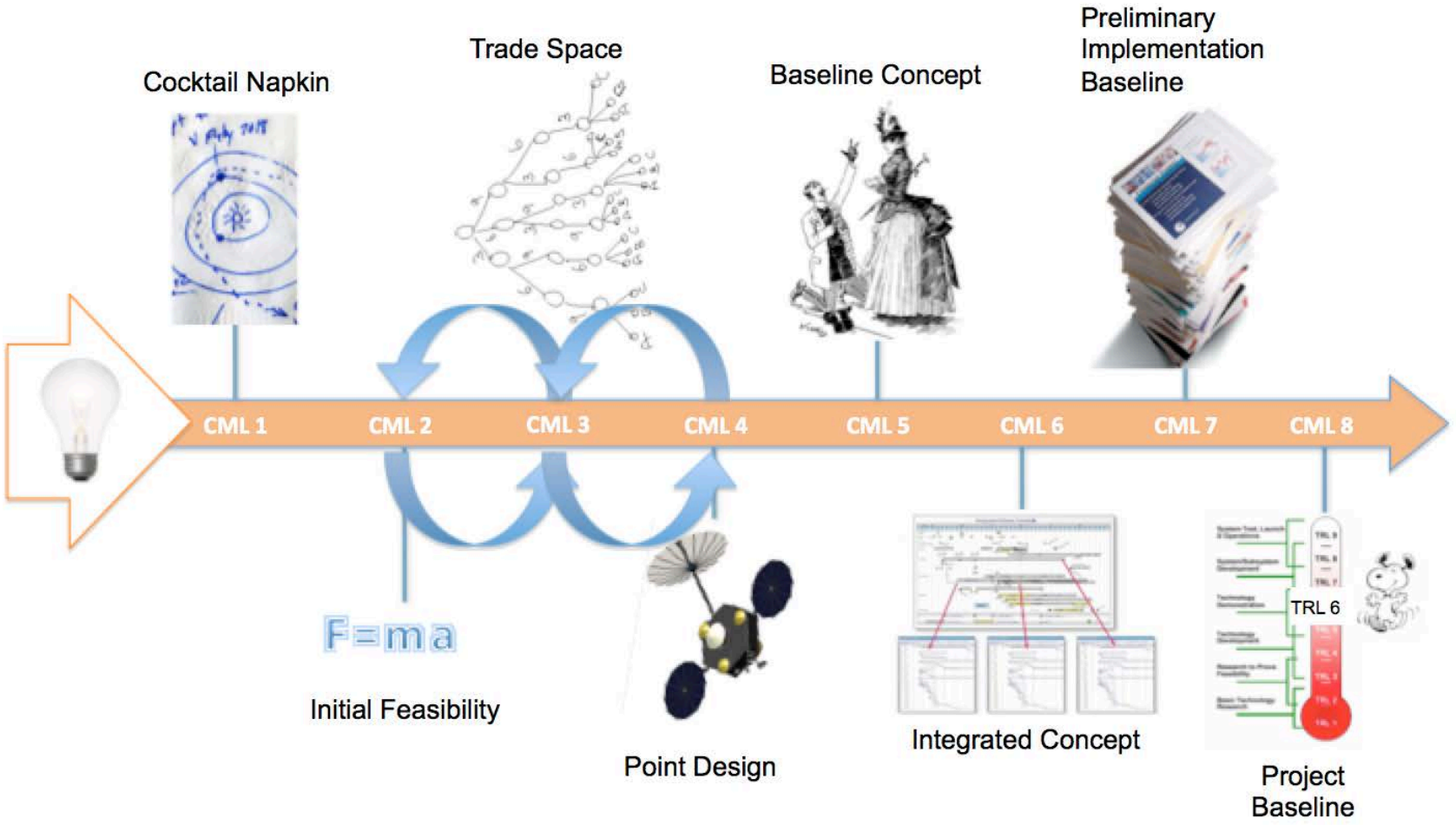
Cover Date	Change	Page
12/28/2015	Initial Release	

Backup: "Decadal CML"

Decadal CML = Tailored CML4



CML Progression



Applicable Metrics (1 of 5)

*All columns tailored for Decadal, and can be further tailored by the study teams based on their approach

Attribute	CML 2*	CML 3*	CML 4*
Scientific Objectives and System Requirements	Objectives described to levels that allow comparison with previous investigations and NASA science community documents	Objective linked to investigation and measurements Scientific return as a function of cost, risk, and programmatics quantified	Working top-level scientific requirements drafted, linkages to scientific objectives identified and described Design reference scientific investigation defined with viable reduction options identified
Science Data System	Identify science data drivers	Science data rates and volume included in trade space analysis	Design reference science data system sized to support data system flowdown requirements
Mission Development	Key mission concept parameters and performance requirements quantified Rudimentary calculations & comparisons to mission analogues performance Gross characterization of space environment quantified	Alternate set of mission architectures evaluated against science objectives, cost & risk Quantitatively bounded hazards of space environment	Design reference mission defined, including driving requirements, initial high level scenarios, timelines and operational modes; mass, delta-V, and power estimates; telecom, and data processing approach defined to mission flowdown requirements
Spacecraft System Design	Key flight elements, design parameters & performance requirements listed High-level comparison to similar flight systems documented	Unique features that distinguish one flight system architecture from another evaluated Perform sensitivity studies to bound performance within trade space performed	Spacecraft system architecture for design reference mission defined with mechanical configuration drawings and block diagrams to support spacecraft flowdown requirements

Applicable Metrics (2 of 5)

*All columns tailored for Decadal, and can be further tailored by the study teams based on their approach

Attribute	CML 2*	CML 3*	CML 4*
Instrument System Design	One sentence description of potential measurement technique(s) Perform high-level comparison to similar measurement techniques(s)	Key instrument performance requirements, measurement techniques and instruments selected against science / mission objectives, cost & risk Sensitivity studies to bound performance within trade space performed	Instrument system architecture for design reference mission defined with mechanical configuration drawings and block diagrams to support instrument flowdown requirements and performance simulations Instrument performance requirements traced to scientific requirements
Ground System / Mission Operations System Design	Mission ops approaches defined	Mission ops drivers and sensitivities assessed Major flight / ground trades identified New ground system capabilities identified	Mission Operations System / Ground Data System architecture for design reference mission to support the ops scenarios described
Technical Risk Assessment & Management	Identify risks Identify areas of major concerns	Compare risks across the various architectures Identify mitigation strategies for key risks	Risk drivers listed 5x5 matrix provided with relevant risk drivers (include selected mitigation / development options)
Technology	Identify enabling technologies and / or significant engineering developments required to get to TRL 6 by PDR	Compare technologies and major developments required for design options across the trade space	Technology options described Baseline options selected and justified (technology roadmap) Rationale for TRL(s) explained Risk mitigations (including fallback options, if any) for all new technologies identified

Applicable Metrics (3 of 5)

*All columns tailored for Decadal, and can be further tailored by the study teams based on their approach

Attribute	CML 2*	CML 3*	CML 4*
Inheritance	Identify source of assumed inheritance	Early evaluation of inheritance options, benefits, and risks across trade space	Discuss all significant heritage assets used by the design reference mission
Master Equipment Lists	N/A	Mass of major elements quantified based on subsystem estimates	MEL documented for design reference mission to assembly level (e.g., antenna, propellant tank, star tracker, etc.)
Technical Margins	Identify high risk areas that need significant margin Assess uncertainty	Use institutional margins where applicable Analyze best and worst case scenarios	Critical performance margins estimated, resource margin estimated for design reference mission (AIAA S-120 margin policies followed)
System Engineering	Initial generation of trade space options	Capture the relative merits of performance, cost and technical risk over a broad range of architectures Subsystem dependencies identified	Selective, high-leverage science, spacecraft, and ground system trades completed
Launch Services	Launch approach and performance identified	Perform trades for candidate launch vehicles demonstrating compatibility with performance and fairing size	Preliminary launch vehicle(s) selection documented (NASA Launch Services used)

Applicable Metrics (4 of 5)

ASTROPHYSICS

*All columns tailored for Decadal, and can be further tailored by the study teams based on their approach

Attribute	CML 2*	CML 3*	CML 4*
Verification & Validation	N/A	Identify any major or unique V&V activities	Approach for verifying new and enabling functions of the design reference mission defined to support an acceptable risk assessment by independent reviewers System testbeds and prototype models identified where applicable
Acquisition & Surveillance	N/A	N/A	N/A
Project Organization, Implementation Mode & Partnering	N/A	N/A	N/A
Schedules	Potential launch opportunities identified Use Schedule & Cost Rules-of-Thumb to estimate lifecycle duration	Assess variations and risks to science, development schedule and impacts to mission duration	Top-level schedule (one page) developed for design reference mission to support (coarse) independent cost estimates

Applicable Metrics (5 of 5)

*All columns tailored for Decadal, and can be further tailored by the study teams based on their approach

Attribute	CML 2*	CML 3*	CML 4*
Work Breakdown Structure	N/A	NASA Standard WBS & Dictionary (down to level 2 and level 3 for spacecraft and payload) used	N/A
Cost Estimation and Cost Risk	Cost estimate range provided based on analogous missions Cost uncertainty quantified	Cost sensitivities explored across trade space as a function of major drivers Initial estimate down to level 2 and level 3 for spacecraft and payload Cost uncertainty quantified System cost risks identified	Cost estimate and basis of estimate provided for design reference mission Cost uncertainty quantified Cost risks identified at subsystem level, with emphasis on enabling technologies
NEPA Compliance	Identify any nuclear material or public safety issues	Explore options (e.g., non-nuclear options for nuclear power missions)	N/A
Export Compliance	N/A	N/A	N/A

Working version of Consensus (yes, NASA has a policy)

- **In general, consensus decisions can produce stronger and more durable decisions than those by votes or decree.**
- **However, convergence time can be a factor in consensus decisions – they take too long or do not converge.**
- **Instead, we suggest (but do not require) a Constrained Consensus method: defined as preferring and striving for consensus in the reasonable time available, else, the leaders make a decision, dissent (if any) is captured and the groups moves on with full support of the decision.**
- **Will follow 7120.5E, Ch 3.4, "Process for Handling Dissenting Opinion"**
  - Three options: (1) Agree, (2) Disagree but fully support the decision, (3) Disagree and raise a dissenting opinion
- **Treat (1) and (2) as consensus for STDT**
- **Dissents (3) will be documented and delivered to senior NASA management (APD DD) per 7120.5E**

How are CML Assessed at M3,4,6

- The program chief engineer, as a member of the program office, may provide, if requested by the study teams, the CML assessment and presents that first to the Integrated Review Team for concurrence, and then to the DSMT for acceptance.
- The CML assessment is essentially a compliance assessment, based on professional experience, of each row of the CML table.
- We expect a set of conversations between the chief engineer and the study team to inform the assessment. Update MP to add these words.