



Earth Science Division Management Handbook

December 2023

Approved by:

Karen St. Germain
Director, Earth Science Division

Table of Contents

Purpose.....	2
References.....	2
The ESD Mission Management Team.....	2
The ESD Management Team’s Six Roles.....	4
Program Applications Lead (PAL):.....	5
Program Executive (PE):.....	5
Program Scientist (PS):.....	6
Data Systems Lead (DSL):.....	7
Technology Lead (TL):.....	8
Program Analyst (PA):.....	8
Authority Model.....	8
Resolution Process.....	9
Activities.....	10
RACI Process.....	10
Announcement of Opportunity.....	11
Project Initiation.....	12
Formulation: Mission Concept Review.....	14
Formulation: Standing Review Board.....	15
Formulation: Project Formulation Authorization Document.....	16
Formulation: Program-Level Requirements Appendix Development.....	16
Congressional Justification.....	17
Development.....	18
Operations.....	19
Mission Extension.....	19
Closeout.....	20
Appendix A: Project Applications Program Roles and Responsibilities.....	22
Appendix B: SMD Handbook Figures.....	24
Appendix C: Resource List.....	25
Appendix D: Acronyms.....	26

Purpose

The *Earth Science Division (ESD) Handbook* encompasses tasks related to Flight mission implementation and defines the roles and responsibilities of the ESD headquarters (HQ) team involved in Flight missions. It is designed to be a living document updated over time as practices and policies evolve.

The *ESD Handbook* is an electronic document available to all Science Mission Directorate (SMD) and Center personnel, including direct contractor support staff, on a NASA-internal website. Although it is primarily an ESD-internal document, it may be shared with Mission/Project leadership, Program Offices, and Center leadership personnel to aid in clarifying roles and responsibilities.

The *ESD Handbook* is aligned and consistent with the [SMD Management Handbook](#) and *ESD Program Executive Handbook*, providing elaboration where additional detail and content can reinforce the ESD Mission Management Team's integrated responsibilities. This handbook primarily describes ESD roles and required coordination between the various Division elements necessary to accomplish the tasks relevant to implementing missions.

As stated in the *SMD Management Handbook*, people are at the basis of everything we do – not only **what** we do, but **how** we do it. This handbook documents the ESD Mission Management Team's primary methods of collaboration and teamwork to achieve excellence by sharing the ideal approaches and standard interactions necessary to develop and support ESD flight projects. The focus of this handbook is on teamwork among ESD roles toward maximizing science return and societal impact within defined project and program constraints.

References

1. NASA Governing Documents (7120.5 *NASA Space Flight Program and Project Management Requirements*, 7123.1 *NASA Systems Engineering Processes and Requirements*)
2. *SMD Management Handbook*
3. *ESD Program Executive Handbook*
4. PAL Handbook (Appendix A of this document)

The ESD Mission Management Team

For each flight project, six headquarters-based positions comprise the ESD Mission Management Team (ESD MMT) that represents the interests of the division throughout all stages of mission development. MMTs include a Program Executive (PE), Program Scientist (PS), Program Applications Lead (PAL), Data Systems Lead (DSL), Technology Lead (TL), and Program Analyst (PA). At times, one individual may fulfill dual roles. Brief descriptions of the PE, PS, PAL, DSL, TL, and PA roles are provided on pages 4-8.

The underlying principle is that ESD MMT members work together with Program Offices and Implementing Centers in pursuit of a common goal: to make innovative and high-quality science

and applications within established resources while abiding by NASA standards. While each team member has specific roles and functions, it is the integrated and collaborative approach to supporting missions and projects that best enables NASA missions to maximize value in research, applications, and societal benefit. Each member of the ESD MMT serves as a principle within ESD for their area of expertise (mission science, applications, programmatic requirements, etc.), and contributes as an advisor to the Division Director in their area of expertise. Although these roles are often loosely referred to as “advocates” for the mission, and they are assigned responsibility for specific missions, their roles differ from the mission and project personnel implementing the mission, who exclusively advocate for the mission to which they are assigned. As leaders in the division, ESD MMT members are responsible for considering the mission to which they are assigned in the context of the broader ESD portfolio. ESD MMT members may encounter challenging trades within the portfolio and enterprise context and so need to provide objective assessments within their expertise that may not agree with the desires of mission or project implementation teams. The ESD MMT collectively is responsible for observing NASA rules, regulations, and standards applied to missions and projects, as authorized by the Authority Model (Figure 3). Additionally, the ESD MMT is also tasked with identifying cross-mission opportunities to broaden the individual project outcomes, with a particular focus in areas of Earth Action, as well as Research and Analysis.

The ESD MMT forms the basic HQ ESD managerial oversight unit for ESD flight projects. The ESD MMT strives to present a united interface to the assigned implementation organization and program office, including the respective project and program managers. ESD MMT members share project insights, concerns, and recommendations with each other to ensure the recommendations provided to project and program personnel, as well as to ESD leadership (Division leadership), are comprehensive. While the PE interfaces with program office personnel and the project managers on all programmatic issues concerning the project, other ESD MMT members may have similar engagement in areas of their expertise. PEs, PSs, PALs, DSLs, TLs, and PAs act on behalf of (or in coordination with) their respective elements to ensure mission success and the broadest overall benefit.

Team development is an extensive effort starting in pre-formulation and resulting in execution. This handbook attempts describe norms and standards used to accelerate ESD team development.

ESD MMT members are typically assigned by the leadership of the respective ESD elements and expected to oversee the mission activities as a team, starting from new mission concept development through mission execution and culminating in mission closeout. Backup for each ESD MMT member is managed by their respective ESD elements. Collaboration among several program elements is an established practice within NASA’s Science Mission Directorate for science mission and has been practiced by all SMD divisions. ESD missions and the ESD MMT involve more program elements, which is reflected in the ESD MMT composition. The ESD MMT coordinates with the mission project and program offices in support of ESD leadership decisions. It is expected that individuals assigned to each mission will use this handbook to move

more quickly through the well-known phases of team development (Figure 1). When the ESD MMT is collaborative, it provides the best decisions, advice, and consultations to the mission.

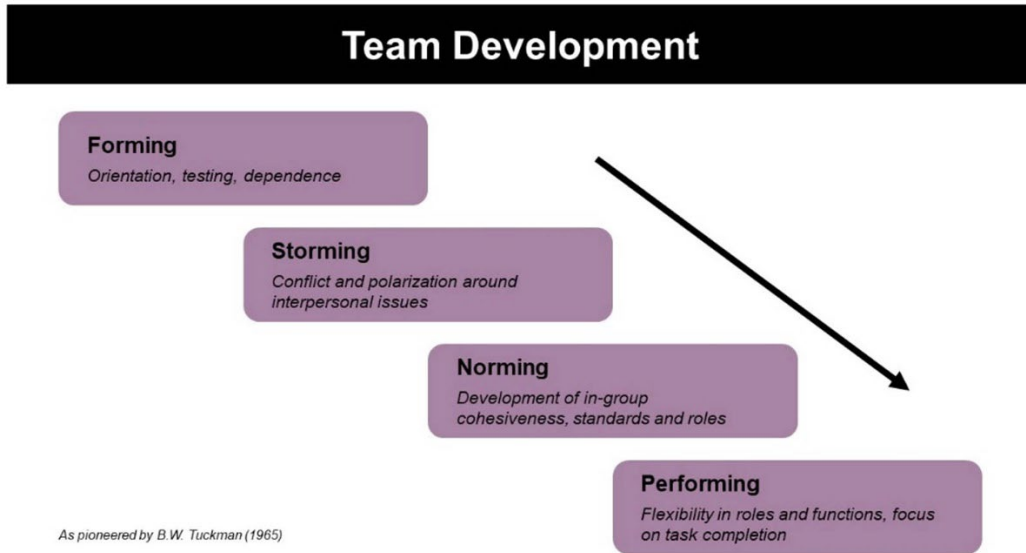


Figure 1. Tuckman's Phases of Team Development

Figure 2 show the expected behavior of high-performing NASA teams, representing ideal norms of high-functioning teams. These behaviors align with NASA Core Values of Safety, Integrity, Teamwork, Excellence, and Inclusion.



Figure 2. Lenioni's Behaviors of Cohesive Teams

The ESD Management Team's Six Roles

ESD MMT members have the common requirement to work together to ensure high quality science and applications impact. The way each team member contributes depends on their role. Each role is described, including a list of key responsibilities.

Program Applications Lead (PAL): The PAL champions and facilitates the use of NASA Earth Science data for societal benefit, including applied science, applications, decision support tools, and interagency uses of mission data. The PAL is an expert on the Directive on Project Applications Program document (Appendix C: Resources List), that provides guidance to missions/projects on application requirements.

The PAL works with the Mission Application Lead or project-assigned lead, who engages with communities that might benefit from mission applications efforts and manages and oversees these efforts for selected Earth science missions. Since 2015, all ESD missions have had applications as a funded and integral part of development based on their proposal or Mission Concept Review (MCR). Because of the unique role of applications in Earth science, many *SMD Handbook* references to the PS apply to the PS and PAL. The PAL is typically a member of the ESD Earth Action element; however, in some cases, the PS/PAL may be designated as a single role matrixed to Research and Analysis (R&A) and Earth Action.

The PAL:

- Works closely with the Mission Applications Lead (MAL) to explore application opportunities and considerations;
- Provides expertise, guidance, and advice on applications plans and activities;
- Participates in Announcement of Opportunity (AO) development, review, and selection;
- Participates in discussion/development of the Science and Applications Traceability Matrix;
- Maintains awareness of mission/project planned applications;
- Solicits and manages the competed science and applications team, in coordination with the PS;
- Ensures any mission change (design, schedule, science, etc.) includes discussion of impact(s) to planned or potential applications;
- Provides input to and signs all agreement documents that specify science and/or application requirements (e.g., PLRA, Project Plan);
- Initiates and monitors applied science research grants, cooperative agreements, and contracts (depending on the scope of the mission/project);
- Represents mission-relevant applications to NASA senior management;
- Represents flight project applications in outreach and education;
- Serves as program officer for one or more Research Opportunities in Space and Earth Sciences (ROSES) program elements related to mission applications (depending on the scope of the mission/project); and
- Participates in project lifecycle reviews (LCRs) and key decision point (KDPs) reviews and is prepared to provide concurrence or dissent on applications plans/activities/progress.

Program Executive (PE): The PE is responsible for maintaining awareness of the day-to-day aspects of mission and program implementation (per the *SMD Handbook*). The PE serves as the Division's lead responsible person for tracking technical and programmatic activities and the primary interface at HQ for an ESD flight project. To ensure projects are initiated and executed

according to approved NASA Procedural Requirements (NPRs), the PE interfaces with the appropriate personnel at HQ, programs, projects, and implementing Centers for technical, schedule, cost, and other programmatic activities. The PE is typically a member of the Flight element.

The PE:

- Oversees and manages activities to initialize programs and projects, documents Formulation, monitors Implementation, and evaluates performance;
- Develops, in coordination with the ESD MMT, the Program Level Requirements Appendix (PLRA), or Level 1 (L1), requirements;
- Works with the ESD MMT to coordinate activities over the project lifecycle;
- Works with the PA on budgets and budget issues;
- Supports development of AOs and the subsequent selection process;
- Coordinates all activities associated with Key Decision Point (KDP) reviews;
- Performs analyses of a project's ability to meet its technical, schedule, cost, and other programmatic commitments by working with program and project managers at implementing Centers and other implementing organizations to maintain current knowledge of project status, issues, potential corrections, and impacts of activities (internal and external);
- Reports to ESD and SMD management in a routine and timely manner;
- Represents SMD and ESD to the program, project, and mission partners, such as interagency and international partners; and
- Coordinates all HQ activities associated with launch campaigns.

Program Scientist (PS): The PS is the main steward of R&A programs and the science activities of missions and other programs (per the *SMD Handbook*). Due to the unique role of applications in Earth science, many references to the PS in the *SMD Handbook* apply to the PS and to the PAL. The PS is typically a senior NASA scientist responsible for ensuring the project's science content carries out NASA's science goals for the mission. The PS monitors science management and program execution and ensures the mission's science remains viable and true to strategic objectives during mission development. The PS is a member of the ESD R&A element; however, in some cases, the PS/PAL may be designated as a single role matrixed to R&A and Earth Action.

The PS:

- Leads AO development, review, and selection for competed missions and comparable activities for directed missions;
- Participates in discussion/development of the Science and Applications Traceability Matrix;
- Maintains awareness of mission/project planned science and ensures any mission changes (design, schedule, science, etc.) include discussion of impact(s) to planned science;
- Provides input to and signs all agreement documents that specify research requirements (e.g., PLRA, Project Plan);
- Participates in project LCRs and KDP reviews and is prepared to provide concurrence or dissent on research plans/activities/progress;

- Solicits and manages the competed science and applications team, in coordination with the PAL;
- Initiates and monitors scientific research grants, cooperative agreements, and contracts;
- Represents mission-relevant scientific disciplines to NASA senior management;
- Represents flight project science in outreach and education; and
- Serves as program officer for one or more ROSES program elements related to mission science.

Data Systems Lead (DSL): The DSL is a role on the ESD MMT specific to flight mission responsibilities and interactions with the Earth Science Data Systems (ESDS) program. The DSL role is typically filled by a member of the Earth Data Office element but may also be filled by another senior member of the ESDS Program team. A DSL is assigned to each flight mission, and multiple missions may have the same individual as their representative DSL.

The DSL:

- Ensures AOs are compliant with NASA Earth Science Data Policies and Requirements (such as ESDS program open-source science data and software requirements that implement [SPD-41a](#)), that reasonable information needed to assess cost for data systems support is part of the solicitation, and that the AO addresses data and software rights and other necessary information needed to determine merit of the approach;
- Approves the PLRA from a Data Systems perspective;
- Attends KDP reviews and provides ESDS concurrence with approach and deliverables;
- Directs and leads the process for the assignment of missions, projects, and datasets to archives in the ESDS Program, including but not limited to Distributed Active Archive Centers (DAACs) and Science Investigator-led Processing Systems (SIPS) or other data processing entities managed by the ESDS program;
- Develops solicitations and evaluates proposals to utilize and transform datasets for broader community use;
- Serves as the primary interface to the integrated Mission Data Processing pipeline;
- Ensures interface coordination between the mission or project and ESDS elements required in the data production, archive, or distribution of project data products. This may include interfaces documented between the mission or project with the Earth Science Data and Information Systems (ESDIS) project, such as an Inter Project Agreement (IPA) or an Interface Control Document (ICD) with a designated data repository or data processing entity utilized for a mission (e.g., SIPS);
- Ensures provision of the first line of support for accessing and utilizing open data, open software, open documentation, and open algorithms for NASA-funded researchers and the public;
- Ensures that PI-led missions are aware of and use available open software in mission systems and data systems, where appropriate and cost-effective;
- Primary ESD interface for the mission or project to the SMD Core Services (see References) that will be available to all SMD divisions; and
- Ensures data preservation [requirements](#) are met for transition from Operations in Phase E to Phase F Closeout.

Technology Lead (TL): The TL is an *ad hoc* member of the ESD MMT invoked in certain portions of the lifecycle where advancing technology is an important component of successful mission development. The TL role is typically filled by a member of the Earth Science Technology Office.

The TL:

- Recommends technology infusions and/or demonstrations (if viable) during AO formulation;
- Advises, as needed, on current technology investments, emerging capabilities, and technology readiness, particularly in cases where Earth Science Technology Office (ESTO) investments are being proposed; and
- Provides recommendations for alternative strategies for missions (advisory role).

Program Analyst (PA): The PA is a member of the Resources Management Division (RMD) embedded in the Earth Science Division (ESD) to provide budget support and advice. A team of PAs, led by a Lead Analyst, support ESD. PAs work closely with PEs, PSs, and POs to analyze program and project requirements, develop budget recommendations, and execute funding decisions.

The PA:

- Provides expertise, guidance, and advice to the PE, PS, and Program Office on budget matters associated with the mission/project;
- Manages the execution of the mission/project budget within the ESD budget, providing advice to ESD technical managers as well as SMD Front Office management;
- Coordinates with ESD Program Offices in all budget-related areas associated with the mission/project;
- Formulates project funds release, commitment, obligation, and cost plans and monitors variance throughout the Fiscal Year (FY);
- Prepares Selection and KDP datasheets and provides input to KDP decisions memos; and
- Prepares and submits quarterly cost and schedule reports for applicable ESD projects, as well as other internal, external, and *ad hoc* budget-related reports.

Authority Model

Lines of authority and coordination are shown in Figure 3. The figure does not supersede supervisor or institutional lines of authority, such as Technical Authorities, but is meant to delineate the ESD MMT at NASA HQ that support and guide the project.

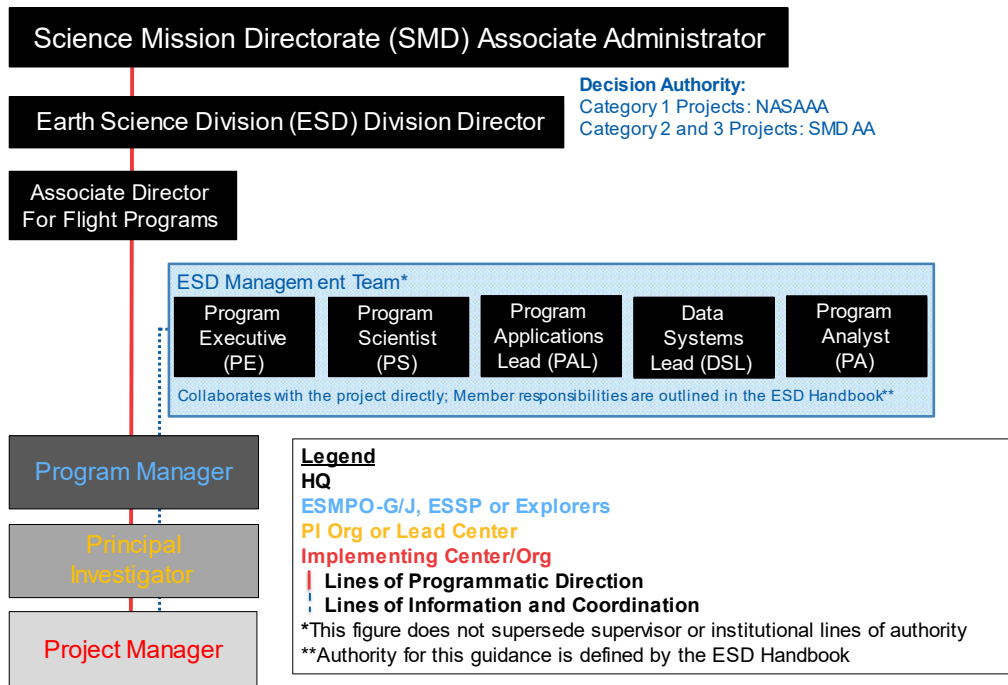


Figure 3. SMD Authority Model

The SMD Authority Model (Figure 3) represents the lines of authority and coordination from the perspective of the project. Some lines of supervision and coordination have been removed for clarity.

Resolution Process

When there is a difference or conflict **between two or more ESD MMT members**, the expectation is that, as experienced leaders, they will seek to resolve it swiftly and at the lowest level possible. If a solution is negotiated between ESD MMT members in conflict, the opinions, discussions, and solution will be documented (including context, rationale, and impacts) and shared with other members of the team to ensure the solution does not negatively impact another area. If the conflict cannot be resolved between the initial team members, the escalation process is as follows, with each step only elevating the issue if differences cannot be resolved.

1. Resolution by the entire ESD MMT.
2. Resolution by the ESD Associate Directors or element leads that supervise the roles and the ESD RMD lead if there is a cost impact.
3. The ESD Director, through the Decision Forum Process, including the participation of those listed in steps 1 and 2. Where the differences affect a KDP milestone or cost cap, and the decision authority has not been delegated to the ESD Director, differing opinions will be documented and elevated to accompany the final decision at the SMD Directorate Program Management Council (DPMC).

The ESD MMT may also need to resolve differences with **implementation organization personnel**, including Mission/Project personnel, Program Office leadership, Center leadership, Principal Investigator (PI), and SMD management. Differences are expected and valued; when they detract from moving forward collaboratively, they need to be addressed and resolved. The expectation is these differences will be resolved at the lowest possible level. One of the purposes for the ESD MMT is to support each other in approaching such challenges, allowing expression of diverse opinions, and working with the Center teams to find resolution or elevate an issue to the next level when needed, for example in cases where a PS or PAL disagrees with a Project Scientist or when a PE assessment disagrees with a Program Office position. If a solution is negotiated between an ESD MMT member and an implementation role, the opinions, discussion, and solution will be documented (including context, rationale, and impacts) and shared with the ESD MMT and Mission/Project Team Leadership and Program Office Leadership to ensure the solution does not negatively impact another area. If conflict cannot be resolved between the parties, the escalation process is as follows, recognizing there may be unique needs depending on the nature of the differences and roles of the parties that disagree.

1. Resolution by the ESD MMT in consultation with the relevant Mission/Program/Project leadership and the PI.
2. Resolution by the ESD Associate Directors or element leads (including the RMD lead if there is a cost impact) that supervise the HQ roles and the Program Office leadership.
3. Elevation to the ESD Director in a decision meeting with the participation of those listed in steps 1 and 2, with appropriate Center leadership. For Competed missions, the PI is also included at this level, as appropriate.
4. Elevation to SMD DPMC in cases where authority has not been delegated to the Division Director (DD), such as when a KDP milestone or cost cap will be exceeded.

Activities

This section provides high level information about the roles and responsibilities of each ESD MMT member by phase and activity throughout the mission lifecycle. Activities covered are not exhaustive; instead, they have been selected to show the variety of ways the ESD MMT works together. Detailed/specific team member responsibilities are documented in reference documents (PE, PS, PA) or in an Appendix (PAL).

RACI Process

A RACI matrix is a format for documenting responsibilities assigned among collaborators for a given activity. It lists all stakeholders in a process element and their level of involvement on each task, with designations of “R” for Responsible (in this case standing for “Reliable contributor” to align with the *SMD Management Handbook* definition of ‘Responsible’), “A” for Accountable, “C” for Consulted, and “I” for Informed.

A RACI matrix is helpful when there are only a few people making the decisions, so this activity assumes a typical ESD MMT of five core members. Other stakeholders across the mission lifecycle are beyond the scope of this activity. A RACI matrix is a guide to collaboration but not the definitive source of authority in conflict resolution. Additionally, if the responsible individual varies across a process, best practice is to break the process into multiple pieces and create one

RACI matrix per piece, including a defined delineation where one part of the process stops before the beginning of the next to best capture the changes in authority and roles.

RACI Responsibility Definitions	
<u>R</u>eliable contributor	Does the work to complete the task or create the deliverable. Cannot be exempted from contributing to the process or product.
<u>A</u>ccountable	Solely and chiefly responsible for communication and reviews related to the completion of the work and in the leadership or management role for the task. <i>Amended for compliance with the definition for responsibility in the SMD Handbook.</i>
<u>C</u>onsulted	Provides inputs and feedback on deliverables and have a stake in the outcomes. Consulted on needs and requirements for outcomes.
<u>I</u>nformed	Stays informed about progress but is not consulted or provided all details of a task. Not a decision-maker.
* Not every ESD MMT role may be involved in every step of a RACI process.	

Announcement of Opportunity

The Announcement of Opportunity (AO) development process is documented in *SMD Management Handbook* Section 5.3.6.1. Per this guidance, the PS identifies Subject Matter Experts (SMEs), typically PEs, to assist with the AO; however, the PS has ultimate accountability for the document. Before the AO process, the PAL, DSL, TL, and PA will be identified by ESD leadership. The PE assists the PS in developing the draft AO and time is provided for broadly soliciting feedback internally until the AO’s release. During this time, the PAL and DSL should be providing content and reviewing for policy compliance per the responsibility designated by this document. The PS is responsible for revisions based on the internal comments, and then for releasing the AO to the public for feedback from the community. After this period of public comment, the PS is responsible for incorporating public comments and responding to public comments in the Q&A document on the AO’s acquisition homepage, which are considered procurement sensitive. The PS shares feedback from the public with the other members of the ESD MMT who concur with the responses before responses are formally released to the public, as permissible. The PS prepares the AO for final release and obtains the necessary approval from the SMD AA for the formal release through NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES). The NASA AA is the Decision Authority for all SMD flight programs. The NASA AA delegates the role of Decision Authority down to the SMD AA for specific missions.

The TL provides input on high-level characteristics of the opportunity, particularly if maturing technology investments are likely to factor into proposal development, and recommends appropriate reviewers as needed.

For the AO process, the PE, PS, PAL, DSL, TL, and PA are assigned roles, as in the RACI **ESD Coordination Matrix**.

ESD Coordination Matrix	PE	PS	PAL	DSL	PA	TL
Develop high level characteristics of the AO	R	A	R	R	C	R
Develop a Community Announcement	R	A	I	I	I	-
Internal review and response to comments received from Community Announcement	C	A	C	C	C	-
Write Draft AO using AO template	R	A	R	R	I	-
Adjudication and response to comments received	C	A	R	R	R	-
Final AO release	R	A	I	I	I	-
Proposal reviews (TMC/Science Panel)	I	A	R	R	I	R
SMD formal review panels (Steering Committee, Categorization Committee and Risk)	I	A	R	R	I	C
Selection coordination (ESD Briefings)	R	A	R	C	I	-
Science Management Council(s)	R	A	I	I	I	-
Out-briefs to proposers	R	A	C	C	I	-
<i>R = Reliable contributor, A = Accountable, C = Consulted, I = Informed</i>						

Project Initiation

Project Initiation is the first set of activities for a mission. For a Directed mission, this begins in pre-Phase A; Competed missions are selected into Phase A. The activities for the two types of missions are similar, but not identical. These activities include bringing on project team members and defining their respective responsibilities. These activities begin with “authority to proceed,” which is initiated through a contract or task for Competed missions and a Project Authorization Letter for Directed missions.

The project lifecycle phases and their corresponding Key Decision Points (KDP) and reviews are a good resource for the ESD Management Team (Figure 4). The formal NASA project lifecycle begins at KDP-A. Figure 5 shows typical ESD MMT members during the lifecycle phases.

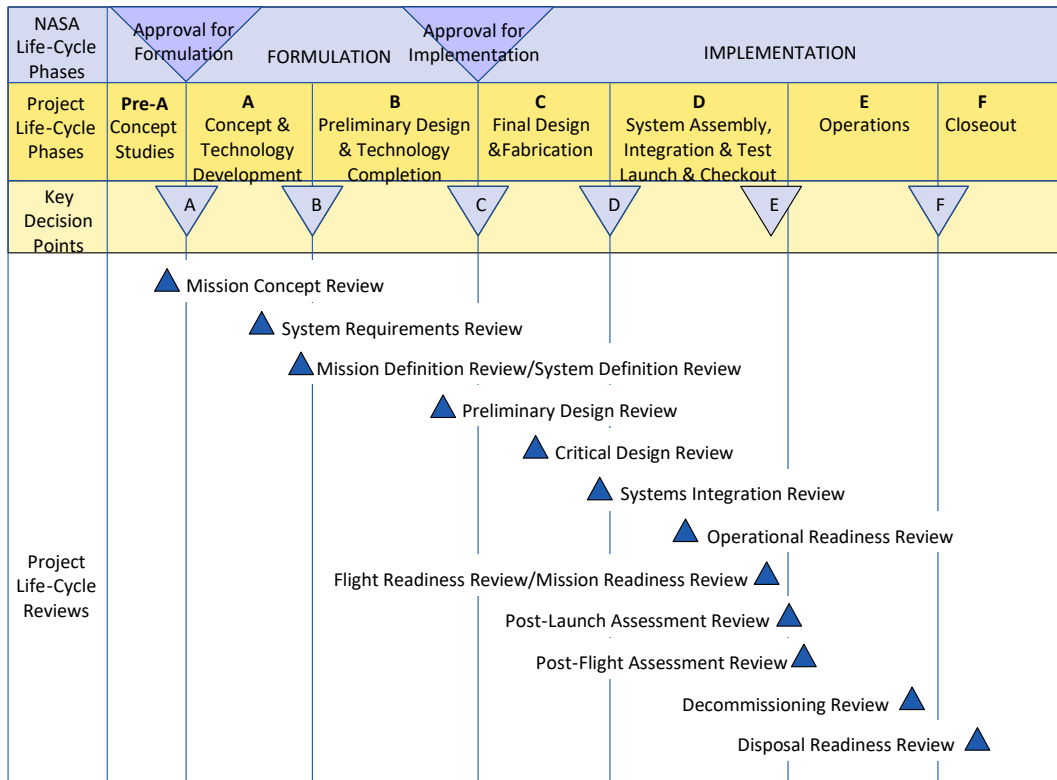


Figure 4. NASA Lifecycle Phases, Project Lifecycle Phases, Key Decision Points, and Project Lifecycle Reviews [figure is a copy of *SMD Handbook* Figure 7.1].

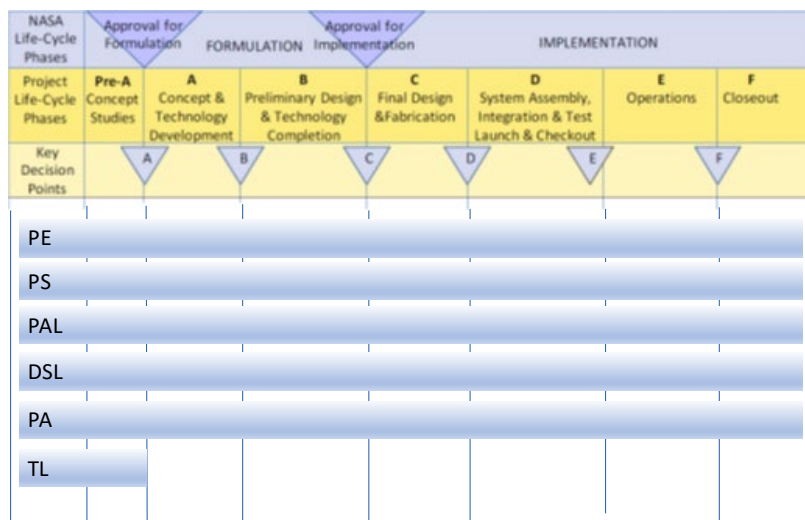


Figure 5. ESD MMT Participation in NASA Lifecycle Phases

The ESD MMT is involved in a variety of activities and assessments throughout the mission lifecycle, as documented in the *SMD Handbook* (Figures 7.2 and 7.3). *SMD Handbook* Figure 7.4 is the Directed Document tree and differentiates HQ vs Project documentation. These figures are included in Appendix B of this document for quick reference; consult the *SMD Handbook* for

the official versions. ESD MMT roles and responsibilities are documented in the **Directed Mission Project Initiation RACI** and **Competed Mission Project Initiation RACI** tables.

Directed Mission Project Initiation RACI	PE	PS	PAL	DSL	PA
Mission architecture studies kick-off	R	A	R	R	I
HQ review of Center Study Plan	R	A	R	R	I
Science Workshops	C	A	R	R	I
Applications Community Workshops	C	R	A	R	I
Community Assessment Report (CAR)	C	R	A	R	I
Study Oversight and Reporting	R	A	R	R	I
End of study (ESD and SMD) (see MCR RACI Matrix)	R	A	R	R	I
CAR report briefing (ESD and SMD) (see MCR RACI Matrix)	R	R	A	R	I
Proposal for directed mission to HQ management and HQ mission decision authority	R	A	R	R	I
Develop content for Project Authorization Letter (PAL)	A	R	R	R	I
R = Reliable contributor, A = Accountable, C = Consulted, I = Informed					

Competed Mission Project Initiation RACI	PE	PS	PAL	DSL	PA
Review selected mission proposal	R	A	R	R	I
Support designated Program office with getting mission team on contract (if necessary)	A	I	I	I	I
Prepare content for Project Kickoff meeting	A	R	R	R	I
Attend Project Kickoff meeting	A	R	R	R	I
Present roles and responsibilities (and preferred engagement frequency) during Project Kickoff	A	R	R	R	I
R = Reliable contributor, A = Accountable, C = Consulted, I = Informed					

Formulation: Mission Concept Review

The Mission Concept Review (MCR) is the first mission lifecycle review and precedes a KDP-A decision to enter Phase A and mission formulation. As such, it brings together material from the pre-formulation concept definition phase of mission design, including the case for mission science and applications, as well as preliminary design, cost, and schedule information. Mission KDP-A typically follows the MCR by two to three months. Thus, the MCR is a comprehensive review of what is known about a potential mission as a result of concept studies and other pre-Phase A activities. It demonstrates NASA’s readiness to begin the mission lifecycle in earnest through mission formulation. ESD Management Team roles are documented in the **MCR RACI Matrix** table.

MCR RACI Matrix	PE	PS	PAL	DSL	PA
Plans and schedules meetings and pre-briefings leading up to MCR	A	C	C	C	I
Supports the MCR	A	C	C	C	I
Prepares, reviews, and disseminates KDP-A documentation	A	C	C	C	I
Conducts/participates in the KDP-A at the dPMC, DPMC, or APMC levels	A	R	R	R	R
Responsible for the Preliminary Acquisition Strategy/Pre-ASM and Baseline FAD	A	C	C	C	C
Finalizes the Decision Memorandum (DM)	A	C	C	C	R
Follows up on any actions and archives documents after the KDP-A	A	C	C	C	C
Documents preliminary partnerships and interagency and international agreements	A	R	R	R	C
R = Reliable contributor, A = Accountable, C = Consulted, I = Informed					

Formulation: Standing Review Board

Mission lifecycle reviews (LCRs) are held to demonstrate mission progress to a Standing Review Board (SRB). The SRB is independent of the mission, and members are nominated and approved. Once approved, SRB members generally retain their role for the entire mission. The charter of the SRB is to evaluate mission progress against the Terms of Reference, a set of review criteria that changes based upon the maturity of the mission. The SRB will rate the mission against each criterion and provide a written report.

The SMD process for establishing, managing, and conducting SRBs is detailed in the *NASA Standing Review Board Handbook*, NASA/SP-201-3706. ESD Management Team roles are documented in the **SRB RACI Matrix** table.

SRB RACI Matrix	PE	PS	PAL	DSL	PA
SRB Formation: Chair and Deputy	A	C	C	C	C
SRB Formation: Team	A	R	R	R	R
SRB Terms of Reference (ToR)	A	R	R	R	R
Conduct Lifecycle Review (LCR) Readiness Assessment	A	-	-	I	-
Ensure data availability for SRB Review (in coordination with Program Office)	A	-	-	I	-
Coordinate SRB Funding (in coordination with Program Office)	A	-	-		R-
Attend LCRs	A	C	C	C	C
Brief ESD Management of LCR outcome	A	I	I	I	I
Post LCR, Schedule SRB Snapshot Report debrief	A	I	I	I	I
Brief DA	A	I	I	I	I

Provide Deputy Associate Administrator for Programs (DAAP) list of Snapshot Report debrief attendees	A	I	I	I	I
SRB Snapshot Report Debrief	A	R	R	R	R
R = Reliable contributor, A = Accountable, C = Consulted, I = Informed					

Formulation: Project Formulation Authorization Document

The Project Formulation Authorization Document (FAD) is the governing document authorizing initial planning of a new project. It captures requirements, schedules, and project funding as documented in the *SMD Handbook* (Section 5.3.5.1) and NPR 7120.5F (Section 2.2.3.4). Per guidance, the PE works to identify SMEs (including the ESD MMT) to assist with the FAD, but the PE has ultimate accountability for the document. The FAD template is provided in [\(Appendix E\)](#). The FAD is approved by the NASA Associate Administrator (AA) or SMD AA, depending on project categorization.

The FAD provides direction to the project, whereas the Formulation Agreement is prepared by the project in response to the FAD to establish the technical and acquisition work that needs to be conducted during Formulation and define the schedule and funding requirements during Phases A and B for that work.

FAD Process RACI Matrix	PE	PS	PAL	DSL	PA
Develop the mission purpose, project goals/objective, and key formulation activities	A	R	R	R	I
Identify participants (external and internal)	A	R	R	R	C
Develop the budget and cost estimate for formulation	A	I	I	I	R
Develop the schedule for formulation	A	I	C	I	I
Coordinate SMD review and signatories' approval consistent with SPD-46	A	I	I	I	I
R = Reliable contributor, A = Accountable, C = Consulted, I = Informed					

Formulation: Program-Level Requirements Appendix Development

The Program-Level Requirements Appendix (PLRA), often referred to as the Level 1 Requirements document, is the project-specific appendix to a mission project Program Plan. It is one of the most important project documents, and includes: mission definition, Program-level requirements and constraints, HQ-controlled requirements and constraints, and management structure, approach, and processes. The PLRA is a necessary communication tool for requirements that should be well-coordinated by the involved parties. The PLRA is intended to be the authoritative document for mission data requirements and is therefore subject to update prior to KDP-C.

The PLRA is a NASA HQ-controlled document with responsibility assigned to the PE for the Level 1 technical requirements and the document as a whole and to the project PS for the Level 1 science requirements and the Mission Success Criteria (MSC). The PE may be assisted in

drafting this document by the program and project staff as well as other members of the ESD MMT.

The most important technical criteria established on a project are the science requirements, which are often referred to as Level 1 requirements or program-level requirements. SMD differentiates baseline science requirements and threshold science requirements, which are documented in the PLRA (*SMD Handbook*, Section 7.6.3). MSC are also documented in the PLRA. MSC are the criteria by which a mission is evaluated after launch.

The PLRA template is available in the *SMD Handbook* (Appendix G-7). For ESD, signatories should include all members of the ESD Management Team, at the “concurrence” level at a minimum.

Flight Mission PLRA RACI Matrix	PE	PS	PAL	DSL	PA
Develop content for mission definition and project objectives	A	R	R	R	I
Develop content for mission payload and program level requirements and constraints	A	R	R	R	I
Develop content for science requirements (Threshold and Baseline)	C	A	R	R	I
Develop content for Mission Success Criteria (MSC)	C	A	R	R	I
Develop content for applications requirements	C	R	A	R	I
Develop content for mission data system requirements	C	R	R	A	I
Include management structure and process (see SMD template)	A	R	R	R	I
Coordinate document review with the mission Project staff	A	R	R	R	I
Coordinate SMD review and signatories’ approval consistent with SPD-46 timeline	A	R	R	R	I
Review and update following each Senior Review (as needed)	R	A	R	R	I
R = Reliable contributor, A = Accountable, C = Consulted, I = Informed					

Congressional Justification

The Congressional Justification (CJ) is NASA’s official funding request to the U.S. Office of Management and Budget (OMB) and is the basis for the President’s Budget Request to Congress. Although statutory and recurring, the requirements for format and content may be modified by OMB prior to submission to Congress.

Annually, beginning in the fall, the PA will request edits to existing justification language from the PE. Each PE is responsible for writing the justification for their projects. Justification includes 1) project description (including the development phase), 2) broad technical status (accomplishments of the prior Fiscal Year (FY), plans for the current FY, and projections for the next FY), 3) broad financial status (developed by PAs), and 4) changes to the Agency Baseline Commitment (ABC), as needed, due to launch delays, technical issues, etc. Given the Earth

Science to Action Strategy, inclusion of science, applications and data systems recent achievements and planned future achievements as applicable may improve communication to budgetary stakeholders of the total value of the mission. The **Congressional Justification RACI Matrix** defines the CJ process.

Congressional Justification RACI Matrix	PE	PS	PAL	DSL	PA
Define the required content and timeline	I	I	I	I	A
Drafting process	R	R	R	C	A
Execute the review cycle amongst leadership, OLIA, policy branch, etc.	-	-	-	-	A
Revision process (as required)	C	C	C	C	A
Formal submission	I			I	A
Revision process post-passback (as required)	C	C	C	C	A
Revised submission	I	-	-	I	A

R = Reliable contributor, A = Accountable, C = Consulted, I = Informed

Development

Mission development occurs over three lifecycle phases: pre-formulation, formulation, and implementation). During pre-formation (for directed missions only), the mission focuses on concept studies. During formulation, the mission focuses on concept development, technology development, and formalizing a preliminary design. During implementation, the mission focuses on finalizing the design, fabrication, and system integration and test. During each phase, the mission has requirements for reporting and conducting reviews.

Development expectations are defined in detail in NPR 7120.5, where the ESD MMT roles and responsibilities are defined, as in the **Development RACI Matrix**.

Development RACI Matrix	PE	PS	PAL	DSL	PA
Participate in Mission Monthly progress report discussions	A	R	R	I	I
Assess and report on monthly progress (in area of expertise)	A	R	R	I	I
Summarize and report monthly progress to ESD/SMD leadership	A	R	R	I	I
Participate in LCRs meetings	A	C	C	C	C
Participate in Key Decision Point meetings	A	R	R	R	R
Identify risks, based on plans and progress (in area of expertise)	A	R	R	R	I
Identify opportunities, based on plans and progress (in areas of expertise)	A	R	R	R	I

R = Reliable contributor, A = Accountable, C = Consulted, I = Informed

Operations

The purpose of Phase E is to conduct the mission science investigation (prime and extended). Delivered science products are evaluated against the requirements identified in the PLRA. During Phase E, the project updates the Project Plan and all relevant control plans referenced in the Project Plan (*SMD Handbook*, Section 7.1.2.4.6 Phase E: Operations). The ESD MMT roles and responsibilities during operations are defined in the **Operations RACI Matrix**.

Operations RACI Matrix	PE	PS	PAL	DSL	PA
Sign off on the SDS and data repository readiness to function as defined in the PLRA and L2 requirements below in the IPA/ICDs	I	I	I	A	-
Solicit competitive science teams	I	A	R	I	I
Draft Mission success Confirmation Memo	C	A	R	C	I
Review Mission Success Confirmation Memo	R	A	R	R	-
Schedule End of Prime Review	A	C	C	C	I
Develop End of Prime Review agenda	R	A	C	C	-
Coordinate out-of-cycle mission extension request (if end of Prime mission does not align with triennial Senior Review schedule)	A	I	I	I	C
R = Reliable contributor, A = Accountable, C = Consulted, I = Informed					

Mission Extension

Missions that have completed their baseline mission and continue to operate are invited to participate in the Senior Review to determine the scientific value, applications, and priority of a continued mission operations. The Senior Review is a formal review led by the PE for Operating Missions that solicits input from a Science Panel, a Cost Panel, and a National Interest Panel. This input allows the PE and PS to make Mission Extension recommendations to the ESD Division Director that align with the available budget.

The Senior Review process is discussed in greater detail in the *SMD Handbook* (Section 5.8.1). The roles of the ESD MMT in the Senior Review process are documented here in the **Mission Extension RACI Matrix**.

Mission Extension RACI Matrix	PE	PS	PAL	DSL	PA
Initiate Mission Extension	A	-	-	I	-
Coordinate and hold Steering Committee Meeting (kickoff)	A	-	-	I	-
Recommend projects for Senior Review Invitations	A	R	I	I	I
Establish Review Process	A	-	-	I	-
Provide input on ToR to Steering Committee	A	R	R	C	-
Get ToR endorsement from SMD Science Management Council (SMaC)	A	-	-	I	-

Draft invitation letter with project specific questions/items	A	I	I	I	I
Recommend Senior Review Program Officer (SMD Handbook)	A	R	-	I	-
Hold Kickoff meeting (with projects/missions)	A	R	I	I	I
Revise “call letter” and release final version to missions	A	R	C	I	I
Identify science reviewers (Senior Review Panel)	R	A	C	I	-
Identify National Interests Panel (NIP) reviewers	I	I	A	I	-
Perform Review by Review Panels	A	R	R	C	R
Assemble NIP Report and report out to Senior Review Panel	I	I	A	I	-
Assemble Science Report	R	A	-	C	-
Assemble Decision Package	A	R	-	C	-
Provide Recommendations to ESD Director	A	R	-	C	C-
Work with the DD to accept, modify, or reject the proposal	A	R	-	I	-
Work with the DD to establish needed budget authority for extended phase	A	-	-	I	C
Upon approval, the PE takes steps to update international or interagency agreements	A	-	-	C	-
Notify projects of mission extension approval	A	I	I	I	I
If not approved, develops a termination recommendation letter for SMD AA review and approval	A	R	-	I	-
If not approved, review/update baseline termination plan	A	R	-	I	-
R = Reliable contributor, A = Accountable, C = Consulted, I = Informed					

Closeout

After the completion of mission operations (including any mission extensions resulting from the Senior Review process), NASA has standard procedures for closing out missions. These procedures ensure the archival of all science/applications data and engineering telemetry resulting from the mission and the complete decommissioning and disposition of all mission elements. NASA also documents lessons learned for the mission. Ultimately, all research and applications activities are completed, and results documented in appropriate reports to PSs and PALs. The KDP-F review and associated decision memorandum documents mission closeout, as in the **Closeout RACI Matrix**.

Closeout RACI Matrix	PE	PS	PAL	DSL	PA
Ensure project science/applications data are dropped to an appropriate data archive	C	R	R	A	I
Verify full implementation of Decommissioning Plan/Disposal Plan	A	C	C	C	I
Disposition all flight and ground hardware and ground systems and ensure engineering telemetry is appropriately archived	A	C	C	C	I
Document key lessons learned in a Final Mission Report and ensure submission to the SMD Programmatic Information archive	A	C	C	C	I
Process final research (PS) and applications (PAL) reports	I	A	R	I	I
Draft and distribute KDP-F Decision Memorandum (DM)	A	C	C	C	I
R = Reliable contributor, A = Accountable, C = Consulted, I = Informed					

Appendix A: Project Applications Program Roles and Responsibilities

Project Applications Program (PAL) roles and responsibilities are documented by project phase. Each activity is completed by working with members of the mission and/or in coordination with other members of the ESD MMT. This appendix serves as the first Project Applications Program Handbook.

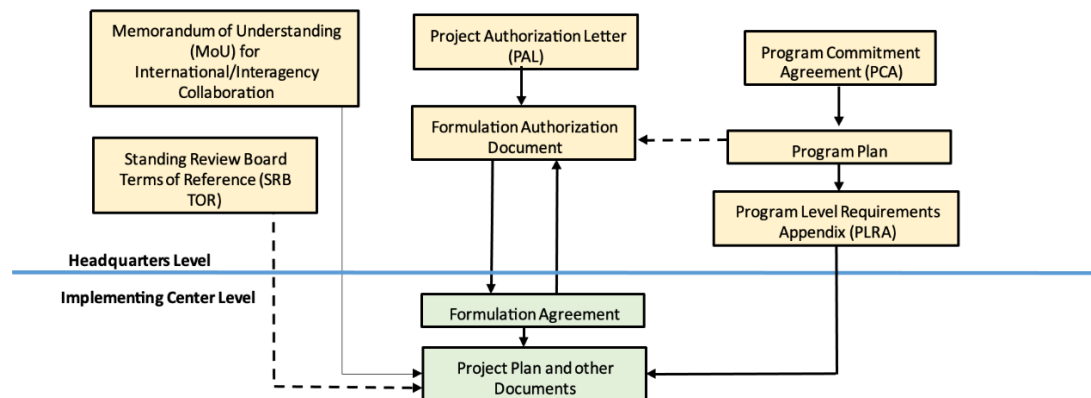
1. Overall
 - a. Be the resident expert on the Directive on Project Applications Program.
 - b. Be the resident expert on the *Early Adopter Handbook*.
 - c. Be familiar with the *SMD Handbook*, *PE Handbook*, and *ESD Handbook*.
 - d. Engage with other ESD Management Team members in accordance with the *SMD Handbook*, *PE Handbook*, and *ESD Handbook*.
 - e. Provide missions with application guidance, mentoring, and expectations.
 - f. Work closely with Mission Application Leads, who are responsible for execution, to:
 - i. Help the mission team identify items that would increase or diminish the applications value of the mission.
 - ii. Ensure teams consider the use of data products and measurements by end users other than the research science community during satellite mission planning and requirements development.
 - iii. Work with mission teams to examine applications-oriented concerns and opportunities for each mission.
 - iv. Examine applications-oriented concerns and opportunities for each mission.
 - g. Document application successes and submit them to the Earth Action weekly report and Program Manager for Mission Engagement. Success is defined as use of mission data for external decision-making to benefit society.
 - h. Consult the Program Manager for Mission Engagement with questions or for additional guidance.
2. Directed Missions MCR Preparation
 - a. Ensure applications are included in MCR briefings and coordinate a pre-review of Applications content with the Earth Action director, Program Manager for Mission Engagement, and the mission.
3. Competed Mission Proposal Review
 - a. In panel reviews, sign off on proposed applications.
4. Formulation
 - a. Participate in Science Definition Team and Science Team meetings
 - b. Provide input to the draft Program-level Requirements Appendix (PLRA) to ensure applications are addressed. Suggest including language requiring compliance with the Directive on Project Applications Program. Suggest documenting the requirement for at least one annual applications-focused workshop.
 - c. Sign PLRA (mandatory signee).
 - d. Help the mission define potential application users and metrics to enable measuring success.

- e. Guide the mission in understanding and complying with the Directive on Project Applications Program (including Community Assessment Reports and Project Application Plans).
5. Formulation/Implementation
- a. Monitor/manage outcomes. Application Risks and opportunities should be included in the mission risk matrix. Should have proactive mission discussion of design changes and resulting risk to applications.
 - b. Engage Program Manager for Mission Engagement to work with the review management to ensure Application requirements are in review criteria (look at 7120.5 entry/exit criteria and work with the review manager to add applications requirements. This may be as simple as changing any requirement with the word “science” to “science and applications”).
 - c. Monitor and evaluate application criteria to propose modifications for 7120.5 (review entry/exit criteria).
 - d. Leverage knowledge of other projects to suggest/support cross mission coordination in applications (cross-mission early adopters, multi-mission workshops, synergistic engagement with DAAC/Data System Leads, etc.).
 - e. Evaluate impact of schedule changes on applications (if the schedule change impacts alignment with other missions and therefore the planned applications).
 - f. Participate in project status reviews (minimally monthly status report meetings, lifecycle reviews, and Key Decision Point reviews) to assess risks to planned and potential applications and ensure this is part of the review discussion.
 - g. Ensure Senior Review submissions document applications activities and impacts.
6. Operations
- a. Collaborate with PSs to co-write solicitations (ROSES).
 - b. Collaborate with PSs to engage with the science team.
 - i. Co-write solicitations.
 - ii. Participate on review panels.
 - iii. Sign-off on selections.

Appendix B: SMD Handbook Figures

Project Pre-Formulation	Project Formulation	
Pre-Phase A Concept Studies	Phase A Concept & Technology Development	Phase B Preliminary Design & Technology Completion
Key SMD Activities: - Pre-ASM - AOs - Reporting Key Documents: - FAD - FA - KDP A DM Assessments: - MCR LCR - KDP A	Key SMD Activities: - ASM - Agreements - Tailoring - SRB Formation - Requirements Development - JCL (if applicable) - Reporting Key Documents: - FAD (update) - Preliminary Project Plan - Draft PLRA - SRB ToR - Agreements - ASM DM - KDP B DM Assessments: - SRR, MDR/SDR LCRs - KDP B	Key SMD Activities: - JCL (if applicable) - Launch Vehicle Request - Reporting Key Documents: - Project Plan - PLRA - Preliminary MPCP - KDP C DM Assessments: - PDR LCR - KDP C

Project Implementation and Operations			
Phase C Final Design & Fabrications	Phase D System Assembly, Integration & Test, Launch & Checkout	Phase E Operations	Phase F Closeout
Key SMD Activities: - JCL (if applicable) - Reporting Key Documents: - KDP D DM Assessments: - CDR, SIR LCRs - KDP D	Key SMD Activities: - Launch and In-Orbit Checkout - Launch Book - Reporting Key Documents: - Baseline MPCP - Mission Operations Plan - KDP E DM Assessments: - ORR, FRR/MRR, PLAR LCRs - KDP E	Key SMD Activities: - Mission Termination - End-of-Mission Notification - Reporting Key Documents: - KDP F DM Assessments: - Senior Review - PFAR, DR LCRs - KDP F	Key SMD Activities: - Closeout - Reporting Key Documents: - N/A Assessments: - DRR LCR



Appendix C: Resource List

AO Template	https://soma.larc.nasa.gov/StandardAO/pdf_files/StandardAOTemplate181023f.pdf
Data Preservation Requirements	https://www.earthdata.nasa.gov/s3fs-public/2022-06/NASA_ESD_Preservation_Spec_C.pdf?VersionId=nLDSU6awu0KGWq6o.YzEhLvK0tG.816
Earth Science to Action	https://nasa.sharepoint.com/:p:/r/sites/earth/_layouts/15/Doc.aspx?sourcedoc=%7B260BC263-F5F0-4224-BCF9-B630364142E0%7D&file=Earth%20Science%20to%20Action_Animated%20Arrows.pptx&action=edit&mobileredirect=true
NPR 7120.5F	https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=7120&s=5E
PLRA Mission Data Requirements	https://wiki.earthdata.nasa.gov/download/attachments/118138197/ESDIS05090_HQ_ESD_S%20PLRA%20template.pdf?version=4&modificationDate=1612286234561&api=v2
ScienceWorks	https://scienceworks.hq.nasa.gov/group/scienceworks-users/home
SMD Core Data Services	Core Data and Computing Services Program - NASA Science
SMD Management Handbook	https://scienceworks.hq.nasa.gov/documents/10543/1779832/SMD%20Management%20Handbook/e229e62a-cbef-4589-81d4-f2a0c9d5b9c5
SPD-41a	SMD-information-policy-SPD-41a.pdf
SPD-46	https://scienceworks.hq.nasa.gov/documents/10165/1963800/54738_SPD-46_SMD_PMC_Operations_Directive_2022_rev2.pdf

Appendix D: Acronyms

AA	Associate Administrator
ABC	Agency Baseline Commitment
AO	Announcements of Opportunity
CAR	Community Assessment Report
CDR	Critical Design Review
CJ	Congressional Justification
DA	Decision Authority
DAAP	Deputy Associate Administrator for Programs
DAAC	Distributed Active Archive Center
DD	Division Director
DSL	Data Systems Lead
DM	Decision Memorandum
ESD	Earth Science Division
ESDS	Earth Science Data Systems
ESTO	Earth Science Technology Office
FAD	Formulation Authorization Document
FY	Fiscal Year
HQ	Headquarters
IPA	Inter Project Agreement
ICD	Interface Control Document
KDP	Key Decision Point
L1	Level 1
LCR	Life Cycle Review
MAL	Mission Applications Lead
MCR	Mission Concept Review
MSC	Mission Success Criteria
NPR	NASA Procedural Requirements
NSPIRES	NASA Solicitation and Proposal Integrated Review and Evaluation System
OLIA	Office of Legislative and Intergovernmental Affairs
OMB	Office of Management and Budget
PA	Program Analyst
PAL	Program Applications Lead
PAL	Project Authorization Letter
PE	Program Executive
PLRA	Program-Level Requirements Appendix
PS	Program Scientist
Q&A	Question and Answer
RACI	Responsible, Accountable, Consulted, Informed
RAPTOR	Research and Analysis Program Tracking of Resources

RMD	Resources Management Division
ROSES	Research Opportunities in Space and Earth Science
SDS	Science Data System
SMaC	Science Management Council
SMD	Science Mission Directorate
SPD	SMD Policy Directive
SRB	Standing Review Board
TL	Technology Lead
TMC	Technical, Management, and Cost
ToR	Terms of Reference