SMD Mission Development: Controlling Costs for the Future

Presentation to the PI Forum

July 29, 2011

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SMD Principles

SMD operates with a set of proven basic principles:

- **A commitment to progress on national science goals in all four Science areas guided by National Academy of Sciences decadal surveys**
- **Investment choices based on scientific merit via peer review and open competition**
- **Active participation by the research community outside NASA**
- **Effective international and interagency partnerships to leverage NASA resources and extend the reach of results**
- **A balanced portfolio of space missions, suborbital missions, supporting research and technology development, information systems, and applications partnerships**
- **Optimal mix of small, medium, large, and flagship missions**
- **The NASA mandate includes broad public communication**

Astrophysics
Earth Science
Heliophysics
Planetary Science

Total Missions / Spacecraft
82 / 95

4/5/11

Formulation
7 / 7

	GSFC 4	MSFC 1
	ICESat-2	NF-3
SMAP	GEMS	
EMTGO	*Solar Orbiter*	
	Solar Probe +	

Implementation
20 / 23

ARC 1	JPL 7	GSFC 10/14	DFRC 1/0	MSFC 1
LADEE	NuSTAR	JWST	SOFIA(1/0)	*Strofio*
	ST-7	*Astro H*		
	Aquarius	LDCM		
	OCO-2	GPM		
	MSL	NPP		
	Juno	MAVEN		
	GRAIL	SET-1		
		RBSP (2)		
		MMS (4)		
		IRIS		

Primary Ops
11 / 11

ARC 1	JPL 5	GSFC 3	MSFC 2
Kepler	*Herschel*	Fermi	MESSENGER
	Planck	SDO	New Horizons
	Rosetta	LRO	
	DAWN		
	OSTM/Jason 2~		

Extended Ops
44 / 54

LaRC 1	JPL 13/16	GSFC 28/35	C
CALIPSO	GALEX	HST	Chandra
	Spitzer	*Suzaku*	*Hinode*
	Cloudsat	*Integral*	
	ACRIMsat	RXTE	
	GRACE (2)	XMM	
	Jason-1	SWIFT	
	Voyager (2)	Aqua	
	Mars Express	Aura	
	Mars Odyssey	SORCE	
	MER (2)	EO-1	
	Cassini	Terra	
	MRO	TRMM	
	Deep Impact	Landsat 7~	
		ARTEMIS* (2)	
		THEMIS (3)	
		STEREO (2)	
		AIM	
		Cluster-2 (4)	

SOFIA is a mission project but does not add spacecraft

Italics = US instruments on foreign mission

X / Y = # of missions / # of spacecraft

* New missions two of the THEMIS spacecraft, respectively

~ Operated by another agency

Being reassessed per new Decadal Survey

In concept development/pre-formulation:

Mars 2018#, OPF#, Discovery 12, CLARREO, DESDynI, GRACE FO, SAGE III, SWOT, ASCENDS, PACE, EV-2

NOAA Reimbursable:

GOES-R series, Jason-3, JPSS-1&2

RHESSI SOHO TIMED
WIND ACE
GEOTAIL
TWINS-A CINDI
TWINS-B IBEX

The SMD Portfolio

- 82 Missions (95 spacecraft) in formulation, development or operations
- 27 missions in formulation or development
  - Life Cycle Cost (LCC) range ~$100M to $5B
  - Directed and AO selected
  - LEO, GEO, highly elliptical and interplanetary
  - In-house, industry and mixed developments
  - NASA controlled and partner developments
    - Domestic and international partnerships

SMD Mission Development

- Objective: Continuously improve SMD's ability to define, commit and execute the technical, risk and resource requirements of our space flight mission developments while optimizing science output.
- Motivation:
  - A stable and efficiently run portfolio that maximizes science output within available budget
  - Improves credibility with our sponsors and stakeholders

Agency Guidelines on Programmatic Risk

- NM 7120-81, *Policy for NASA Acquisition*, Section 2.1.8.5, has the following requirements regarding the 70% joint confidence level:

- **Section 2.1.8.5(a)** Programs are baselined or rebaselined and budgeted at a confidence level of 70 percent or the level approved by the decision authority.

- **Section 2.1.8.5(b)** Projects are baselined or rebaselined and budgeted at a confidence level consistent with the program's confidence level.

- **Section 2.1.8.5(c)** As a minimum, projects are funded at a level that is equivalent to a confidence level of 50 percent or as approved by the decision authority.

JCL: A risk based joint cost and schedule confidence level.

Project Commitment

- Project commitments are established at Key Decision Point (KDP)-C following the mission PDR and the development of a Joint Confidence Level (JCL) estimate of the cost and schedule for the mission
  - The SMD PMC assesses the mission status, risks, and cost and schedule estimates prior to deciding on a Management Baseline Commitment and an Agency Baseline Commitment
    - Cost, schedule, technical, and risk estimates from several sources are considered
      - Project JCL
      - Project grass roots
      - PI proposal cost commitment if AO selected → Management Commitment
      - Center independent assessment
      - Program Office independent assessment
      - SMD independent assessment
      - SRB independent assessment

Commitment Levels

- Management Commitment: Agreed to cost and LRD between the SMD and the implementing organization
- Agency Baseline Commitment: Agreed to cost and LRD between the Agency and stakeholders (OMB/OSTP and Congress)
  - May be identical to the Management Commitment or may have a greater cost and/or later LRD.
  - Additional budget held at HQ as Unallocated Future Expense (UFE). Only released to Project upon DPMC authority.
    - Project is considered to have overrun and breached their Management Commitment if UFE is released

Implementation Oversight Processes and Tools

- Standard processes:
  - Weekly written reports to HQ by the projects
  - Monthly/Quarterly Center reviews with SMD PEs and OCE embed
  - Monthly SMD Flight Program Reviews for the DAA Programs (3 hours per Division)
    - Special focused reviews as needed
  - Monthly Management Review for the SMD AA
  - KDP reviews by Governing Program Management Councils (PMC)
  - Monthly independent assessment by Agency team (OCE, SMA and IPCE)
  - Monthly Agency Baseline Performance (BPR) review for the Agency AA and BPR members (Mission Directorate and Mission Support Directorate AAs)
    - Quarterly focus on each Mission Directorate
  - Ad Hoc special reviews as needed

Implementation Oversight Processes and Tools

Tool Improvements:

- Expanded EVM reporting and analysis on contracts (over $50M)
- Pilot program to establish capability for EVM at NASA Centers for in-house work
- Increased emphasis on programmatic performance within the Directorate
    - SMD Council of Deputies (Review Directorate processes with Division deputies)
    - Expanded and improved FPR reporting (MPAR threshold reporting, EVM assessments, “window analysis”, etc.)
    - PE forums (Review/discuss Directorate processes with PEs)
    - PI forums (Set expectations with new project team membership)
    - Special emphasis on SRB Chair selection and working relationship

Continuous Improvements to SMD's Mission Selection and Commitment Processes

- Improvements to AO process
  - 2 step down selections
  - Removed development time limits
  - Making probabilistic cost estimates available to selection official
  - Encouraging carryover of TMCO membership to SRB membership
  - Providing for brief of TMCO weaknesses to responsible Division and Program Office for follow-up in formulation and implementation
- Improvements to independent cost estimate capabilities
  - Implemented as part of Decadal Survey process
  - Expanded Agency and SMD capability
  - Developing Program Office capability
  - Adding probabilistic cost range estimates at KDP-B
  - Improved AO evaluation/selection process
- Improvements to formulation process
  - Adding formal Formulation Plan response to FAD to document technical and cost required for successful KDP-C

How are we doing?

- Recent launches:
  - SDO: $783.4M commitment
    - $805M at launch ready (2.75% overrun)
    - $847M at launch (additional 5.2% growth due to launch manifest delay of 14 months)
  - WISE: $312.5M commitment vs. $319.5M at launch (2.2% overrun)
- JUNO is at KSC processing for an 8/5/11 LRD has over run the management commitment by $40M (~4%) but remains under the Congressional commitment.
- GRAIL is at KSC and processing for a 9/8/11 LRD and remains within their management commitment.
- NPP scheduled for launch in September breached its Congressional commitment as result of failure of our Air Force partner to deliver key instruments.
- MSL scheduled for launch in November has breached its Congressional commitment. It was confirmed prior to full implementation of current programmatic control processes.

How are we doing?

- NuStar (2/2012) is in observatory TV testing and, is planning to ship to launch processing in Dec. It remains within its management/congressional commitment.
- The RBSP LRD was recently slipped (8/2012) to align spacecraft development with launch vehicle manifest. Project is performing well. Current estimate is that the project management commitment will need to be increased by 1-2%, but will remain well under its Congressional commitment.
- LDCM (12/2012) has exceeded its management commitment by $17.4M (~ 2%), but remains well within its Congressional commitment.
- GPM (7/2013) is in re-planning phase with international partner JAXA as result of NASA development problems as well as impacts from earth quake/tsunami.
- MMS (8/2014) has exceeded its management commitment by $35M (~3.5%).

Backup

SMD's summary response to Aerospace's Explanation of Change (EoC) Study

As presented and discussed with the Management Operations Working Group on March 22-23, 2011

SMD current processes which address MOWG Recommendations

1. Funding Profile Adequacy.

SMD has implemented new requirements for the development of a KDP-B probabilistic cost range and a formal Formulation Plan to cover activities in Phases A and B.

2. Select lowest cost-risk step-2 proposals.

This has been a standard practice within SMD, but the development and execution of the Formulation Plan should assist in lowering mission development risk.

3. Project involvement in competed instrument selections.

This is executed by SMD to the extent possible within conflict of interest restrictions.

4. Cost and schedule threats incorporated into AO evaluations.

Cost and schedule risk are an integral part of the AO evaluation process.

5.Longer Phase A/B – Better Readiness.

The introduction of a Formulation Plan into the process will meet this intent.

SMD current processes which address MOWG Recommendations

6. Revisit technical margins.

Technical margins should be commensurate with the TRL level and design maturity of the system. The new 70% JCL development requirements provides an opportunity for a dialogue between the SRB and the Project on that topic.

7. Historical date capture.

The CADRE is currently a requirement for SMD projects.

8. Expectations communicated at Project initiation.

SMD has initiated a PI Forum (2 days – off site) for all newly selected PI Teams.

9. Focused, early technology/instrument funding.

Intent met by Formulation Plan.

10. Cost/schedule threats incorporated into Phase B plans.

Agency/SMD has initiated a new requirement to develop a cost/schedule probabilistic range at KDP-B.

SMD current processes which address MOWG Recommendations

11. IBR as a Phase B deliverable.

Recommendation being evaluated.

12. Better integrated technical reviews.

NASA's SRB processes are continual reviewed and updated as lessons are learned and applied.

13. Management on cost-to-go using EVM, liens and cost threats.

SMD has greatly enhanced its capability and capacity to truly analyze project performance data based on cost and EVM data. Results are routinely reviewed at monthly SMD Flight Program Reviews as well as routine and ad hoc reviews.

14. Contractor incentive to share project savings.

Neither the MOWG nor SMD are in agreement with this recommendation.

15. Contractor/Center funded re-baseline.

Neither the MOWG nor SMD are in agreement with this recommendation.

SMD current processes which address MOWG Recommendations

16. PM/DPM on-site presence during I&T.

MOWG and SMD agree with current SMD practice which is to rotate project staff and/or use staff level personnel for on-site coverage.

17. Project vs functional management assessment.

Insufficient information provided for the MOWG or SMD to assess this recommendation .

18. Develop reliable alternatives to EELVs .

NASA and SMD working closely with industry to reduce cost of access to space.