

International Academy of Astronautics

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Minutes of Meeting IAA Commission IV Space Systems Operations and Utilization

October 1, 2006
Location : La Nau University, Valencia, Spain

1. Welcome and general information

1.1 List of Participants

See Attachment 1

1.2 Minutes of March meeting

Minutes of the meeting held on March 21, 2006 in Paris have been approved.

1.3 General information

R. Sandau informs that the status of the Commission 4 activities (Study groups) was not properly reflected in IAA management documents. This has been corrected following the meeting held on September 30, 2006.

Any information regarding the Commission 4 (minutes of meetings, study group reports, ...) shall be conveyed to IAA Webmaster (F. Dennemont). It is not possible to make direct uploads on the Commission 4 reserved domain.

2. Study Groups activities

2.1 Overview

Study Group SG 4.2 Quality of Space Programs has been cancelled as decided during the previous meeting of Commission 4. Study Groups SG 4.3 and 4.4 are considered completed, thanks to the publication of the report "Cost effective Earth Observation missions".

The idea of starting a new Study Group about Earth Observation activities linked to GEOSS and GMES is not yet mature, and is still missing well identified leaders. The decision is therefore postponed.

As a consequence, Commission 4 has two on-going Study Groups : Knowledge Management, Hitch-hiking to the Moon.

2.2 Knowledge Management (SG 4.1)

J. Holm delivered the study group status report (Attachment 2). Main points are :

- *Managing Knowledge for Successful Mission Operations* conference has been held in Houston, Texas on 2-3 March 2006

- A session on “*Collaboration and Knowledge Management in a Global Space Environment*” has been organised during the *Space Mission Conference on Information Technologies* in Pasadena, California on July 18.
- Several face to face meeting between NASA and US aerospace industry.
- The first *International Conference on Knowledge Management for Aerospace* is planned to be organised in Pasadena, California in March 2007
- Best papers from IAC 2005 and other discussions were featured in *Journal of Knowledge Management, Special Issue: Knowledge Management In the Space Industry*, vol. 10, no. 2, 2006

Work is going on for the next position paper, a draft being target for 2007.

2.3 Hitch-hiking to the Moon (SG 4.5)

The study group is getting momentum, as illustrated by a presentation given by L. Alkalai during the ILEWG meeting last July 2006 in Beijing (Attachment 3).

R. Sandau is taking the action to get together with L. Lakalai, L. Wu and B. Foing in order to freeze the process and milestones :

- Define the outline of the report (L. Alkalai, B. Foing)
- 1st meeting end of January 2007 in Taiwan, to start work on the first Draft
- 2nd meeting April 2007 in Berlin, to continue work on the first Draft
- First Draft finished by October 2007 for discussion at IAC
- Conclusion of the Study for IAC 2008

It is recommended to clean up the present list of participants, and to identify those who are ready to be real contributors, from those who are only interested to get information.

It could be interesting to establish contact with Commission 6, to develop the chapter on outreach and education which is particularly relevant for this study.

2.4 Proposal for a new Study Group on Quality

Following a discussion started last year in Fukuoka, M. Hernandez is presenting a proposal to start again a study group dealing with Quality (Attachment 4). It is proposed to follow the classical phasing of a space project from pre-phase A up to phase E, as a guideline to review past weaknesses or failures, analyse common root causes, and make recommendations for future projects.

Discussion emphasized the potential difficulties to get data on past failures, companies and agencies being generally not keen to share this kind of information. It was felt to be easier for missions technical failures, enquiry board reports being generally public, while programmatic failures are not always subject to enquiries.

It was also recognized that the added value of the study group will be to deliver a comprehensive report about the most frequent issues which have been encountered during past space activities, acting as a “warning” for the generation of young engineers entering the space business.

It is agreed that the study group will start focusing on technical issues, but keeping as an objective to address also the programmatic issues.

In order to keep some flexibility on the content, the proposed name for the study group is : “Quality considerations for space programmes”.

3. Programme Committees

3.1 D5 Safety and Quality (M. Grimard)

Status for IAC 2006 is very good : session 1 has 7 uploaded papers, and 1 withdrawn; session 2 has 7 uploaded papers, and 1 missing.

For IAC 2007, two sessions have been proposed as properly reflected in the Call for papers : session 1 deals about Quality and Knowledge Management, Session 2 is about Space Environment

3.2 B4 Small Satellite Missions (R. Hornstein)

Status for IAC 2006 is very good :

Session 1 : 5 papers uploaded, paper n° 6 withdrawn

Session 2 : 9 papers uploaded, paper n° 3 withdrawn

Session 3 : all 8 papers uploaded

Session 4 : 9 papers uploaded, paper n° 2 withdrawn

Session 5 : 11 papers uploaded, paper n°4 missing, paper n° 2 withdrawn

Session 6 : 15 papers uploaded, paper n°1, 17 missing, paper n° 11 withdrawn

Session 7 : 8 papers uploaded, paper n° 6 withdrawn

For IAC 2007 all 7 proposed sessions have been accepted as shown in the Call for Papers.

The meeting of the Small Satellites Committee will be held on October 4th, between 15:15 and 17:15.

3.3 Small Satellite Symposium, Berlin

Next stand alone symposium on Small Satellites Missions will be organised April 23-26, 2007 in Berlin.

A student conference will be included, for which R. Sandau is welcoming any support (proposals and selection, resources for the prize).

4. Organisation

In order to reflect some evolutions during the past few years, regarding the activities effectively managed by the Commission 4, it is agreed to slightly change the terms of Commission scope. The new terms to be proposed to the SAC will be :

- Space activities and new concepts that directly relate to space operations and utilization
- Communications, remote sensing, and navigation satellites
- Small satellites for developing nations, Earth observation, and Moon exploration and utilisation
- Quality, safety and rescue
- Utilization of space facilities and associated services

5. Report to the Scientific Activities Committee

Main topics of the Commission 4 report will be the changes on the scope (§ 4), and the proposal to start a new Study Group 4.6 : Quality Considerations for Space Programmes (§ 2.4).

6. Next meeting

Next meeting of Commission 4 will take place during the IAC IPC meeting in March 2007 in Paris.

Attachment 1 : Participants list

Name	Organisation	Email
Rainer Sandau	DLR (Germany)	rainer.sandau@dlr.de
Max Grimard	Astrium (France)	max.grimard@eads.net
Rhoda Hornstein	NASA Headquarters	rhoda.hornstein@hq.nasa.gov
Jeanne Holm	NASA JPL (USA)	jholm@jpl.nasa.gov
Lance Wu	National Space Organisation (NSPO) (Taiwan)	lancewu@nspo.org.tw
Jeng Shing Chern	National Space Organisation (NSPO) (Taiwan)	ischern@nspo.org.tw
Ajax B. Melo	Squitter Electronic (Brazil)	ajaxmelo@squitter.com.br
Pierre Bescond	Ex-PROSPACE IRDQ (Institut de Techerche et Développement de la Qualité) (France)	pierre.bescond@laposte.net
Miguel A. Hernandez	Hernandez Engineering (USA)	mhernandez@hernandez.engineering.com
Michael Ovchinnikov	Keldysh Institute of applied Mathematics (Russia)	ovchinni@keldysh.ru
Luigi C. Bussolino	Ex Alenia Space (Italy)	luigi.bussolino@virgilio.it
G. Madhavan Nair	ISRO	chairman@isro.gov.in
D.R. Suma	ISRO	suma@isro.gov.in
M.Y.S. Prasad	ISRO	mys@sac.isro.gov.in

Attachment 2 : Study Group report
SG.4.1. Knowledge Management of Space Systems

Responsible Commission:

- **IAA Commission 4: Space Systems Operations and Utilization**

Study Number and Title:

- **S.4.1. Knowledge Management of Space Systems**

Short Study Description

- Define the organizational and inter-organizational issues that support or inhibit knowledge sharing amongst aerospace organizations (including capturing knowledge of our key experts and aging workforce)
- Identify and recommend standards for knowledge management activities and initiatives to promote interoperability of key systems (such as lessons learned or publications)
- Create, through consensus, a position on the recommended approaches for an aerospace organization to investigate to excel at knowledge management

Website Study Information up to date?

- Information has been updated on group collaboration site, but not the IAA site.

Issues requiring resolution?

- None.

Progress and Product Deliveries on Schedule?

- **Plan:** Support a better understanding among member and aerospace organizations of the ways in which they can share knowledge
 - **Action (new):** Co-led “Collaboration and Knowledge Management in a Global Space Environment” track at *Space Mission Conference on Information Technologies* in Pasadena, California on July 18. Attendees represented 21 organizations, including JAXA, Canadian Space Agency, Netherlands, NASA, science fiction writers, industry, and academia. Talks were focused around a sample future space mission (Europa Submersible in 2015) and looked at all issues surrounding knowledge management and collaboration on international missions. Topics included “A Vision for Space Missions of the Future: Using Collaboration and Web Technology in 2015,” “Virtual Humans—Pushing the Frontiers of Robotic Exploration,” “Current Knowledge Management Best Practices and Gap Analysis for Our Future Space Mission Needs,” and best practice presentations on knowledge management, collaboration, and knowledge capture. Break out meetings for key topics led to further meetings and collaborations.
 - **Action (new):** Organizing first *International Conference on Knowledge Management for Aerospace* in Pasadena, California in March 2007. Call for participation initiated last week, with call for papers expected in November. Based on the conference in Houston in March, expect ~150 attendees.

- **Action (ongoing):** Help to co-lead an consortium of US aerospace industry and NASA meetings on knowledge management. Team meets face-to-face 4-6 times a year (meetings this year on March 14, June 2, June 20, September 27, and December 13 to come). Participants include Northrop Grumman, The Aerospace Corporation, Boeing, Pratt Whitney Rocketdyne, Lockheed Martin, University of California at Irvine, Pepperdine University, California State University at Northridge, and NASA.
- **Action (previous):** *Managing Knowledge for Successful Mission Operations* conference held in Houston, Texas on 2-3 March 2006. Attendees from North America: aerospace industry, NASA, and Canadian Space Agency. Will hold international conference next year based on interest this year. 25 presentations, 2 panel discussions, and 19 organizations represented by 95 attendees. 75 of the attendees expressed interest in being part of discussions on KM in the international aerospace sector.
- **Plan:** Ensure that there is a set of related papers from workshop participants at the 2006 IAF conference that exemplifies excellent knowledge management practices at aerospace organizations.
 - **Action:** Best papers from IAC 2005 and other discussions were featured in *Journal of Knowledge Management, Special Issue: Knowledge Management In the Space Industry*, vol. 10, no. 2, 2006. This special edition was edited by Philip Olla and Jeanne Holm.
 - **Action:** Seven papers selected from 12 papers submitted for the KM track for the Valencia conference:
 - “Journey from Space Projects to Portfolio and Knowledge Management,” Serge Garon, Canadian Space Agency.
 - “Integrating Knowledge Management at ESOC,” Roberta Dow, ESA/ESOC.
 - “Knowledge Management Activity in JAXA,” Shinichi Sobue, JAXA.
 - “Developing a Knowledge-Based View Across an Aerospace Organization: InsideNASA,” Douglas Hughes, JPL, Caltech.
 - “Hardware/Software Facilities for Product Assurance, Control, and Management at Krunichev State Research and Production Space Center,” Yury Mirosh, Krunichev State Research and Production Space Center.
 - “Emerging Applications of Knowledge Management and Innovation in Space Activities,” Gabriela Prelicean, Stefan cel Mare University of Suceava, Romania.
 - “IAA Knowledge Management Working Group Update,” Jeanne Holm, NASA JPL.
- **Plan:** Meetings outside of the conference would be held virtually to minimize travel and increase participation. Information will be posted on a web site for each of communication and status reference.
 - **Action:** Group has an online collaboration workspace and has held face-to-face meetings as well.

- **Plan:** Coordination with other key working groups such as the OMG standards committee for knowledge-based engineering and the W3C committees for interoperability.
 - **Action:** Study Group Chair was appointed to governing board and co-chair of U.S. Federal Knowledge Management Working Group, which focuses on identifying emerging standards in the KM area and best practices in the field. These will be brought up as part of the IAA group discussions for any potential applicability.
 - **Action:** Successfully got a task funded by JPL to work with Tim Berners-Lee (MIT) and Eric Miller (W3C) to look at standards in this area. Work will be presented at March 2007 conference.
 - **Action:** Support given to IAF President on Web Portal site management and vendor selection to ensure KM works within our own organization.

- **Plan:** A position paper on the recommended approaches for an aerospace organization to follow in knowledge management that would promote knowledge sharing and interoperability with other organizations
 - **Action:** Discussions have begun, paper has been outlined for draft review. Draft paper to be published for March 2007 conference discussions and finalization.

Study Team Member Changes?

- No formal additions since March.
- Many additional collaborators and community members.

Name of Person Providing Study Group Status

- Jeanne Holm, Chief Knowledge Architect, NASA, Jet Propulsion Laboratory.

Status Report Date

- 1 October 2006

Attachment 3 SG.4.5. Hitch hiking to the Moon



Hitch-hiking to the Moon A Concept and a Proposal for International Collaboration

Leon Alkalai
Jet Propulsion Laboratory
July 27st, 2006
leon.alkalai@jpl.nasa.gov
ILEWG - 2006
Beijing, China

July 27st, 2006

ILEWG 2006, Beijing, China

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Background

- April 2005 - IAA Symp. on Small Satellites for Earth Observation, Berlin:
 - ◆ Proposal to symposium for small-sat community to consider lunar exploration.

- Sept. 2005 – ILC 2005/ILEWG 2005, Toronto, Canada:
 - ◆ Proposal to lunar-community to consider small-sats for lunar exploration:
 - Lunar gravity mapping using cube-sats; 5-kg micro-sats for vehicle inspection; penetrators, etc.
 - ◆ Vision: international lunar project to carry many micro-sats to the moon.
 - ◆ Toronto Moon Declaration: “ ... *and the deployment of micro systems as secondary payloads.*”

- Oct. 2005 – IAC Fukuoka, Japan:
 - ◆ IAA Commission IV on Space Systems Operations and Utilization approved study:
 - “Hitch-hiking to the Moon: Access and Opportunities for Small Satellite Missions.”

July 27st, 2006

ILEWG 2006, Beijing, China

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Hitch-hiking to the Moon Study Current Participants

- ◆ L. Alkalai (chair, JPL)
- ◆ L. Wu (Co-Chair, NSPO)
- ◆ A. Spear
- ◆ J. Wertz (Microcosm)
- ◆ C. Underwood (Surrey SSC)
- ◆ P. Willekens (ESA)
- ◆ M. Yarymovych (IAA)
- ◆ T. Obata (Mitsubishi)
- ◆ H. P. Roeser (U. Stuttgart)
- ◆ R. Sandau (DLR)
- ◆ L. Paxton (APL)
- ◆ O. Yoshiwo (Chiba)
- ◆ S. Mostert (Sun Space)
- ◆ R. Laufer (DLR)
- ◆ K. Hermann (U. Berlin)
- ◆ R. Hornstein (NASA HQ)
- ◆ H. Tomonao (Chiba)
- ◆ J.-M. Contant (IAA)
- ◆ J.-S. Chern (NSPO)
- ◆ G. F. Bignami (IFCTR)
- ◆ M. Angulo (INTA)
- ◆ J. Esper (GSFC)
- ◆ H. Flemming (Danish NSC)
- ◆ A. Valenzuela (Media Lario)
- ◆ M. Grimard (EADS)
- ◆ A. B. Melo (Brazil)
- ◆ B. Foing (ESA/ILEWG).

July 27st, 2006

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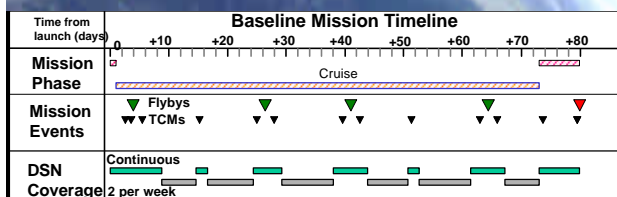
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Proposed (and not selected) Lunar Impactor Mission Design as Secondary Payload



- LI is dual-LV compatible
- LI separates from upper stage after LRO and becomes a free-flyer to the Moon
- Mission trajectory
 - ◆ 3-month baseline mission design developed for both Oct and Nov 2008 launch periods
 - ◆ 6-9 month duration mission also developed
- Impact Energy is > 10x better than LP:
 - ◆ Impact velocity of 2.5 – 3.2 km/sec
 - ◆ Incident angle 30 – 60 degrees
 - ◆ Impact energy 3.1 – 5.1 GJ
- Favorable timing for LRO S/C and instrument commissioning



LI features a flexible mission design that accommodates a variety of launch and high-velocity impact conditions.

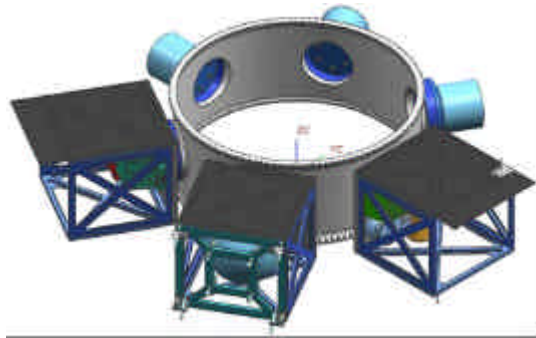
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Lunar Impactor Flight System Summary



- Flight System space heritage:
 - ◆ ESPA ring, built by CSA will fly in 9/06
 - ◆ Power: Deep Impact (DI)
 - ◆ Avionics: MER, MRO
 - ◆ Propulsion: Mars Observer, DI
- Modular flight system design enables parallel I&T activities
- Flight system applicable to other mission concepts:
 - ◆ Stacked, multiple impactors
 - ◆ Lunar orbiter
 - ◆ General purpose payload transfer stage to the Moon

Extensive flight heritage in the flight system and sub-systems enables LI to meet the tight development and implementation schedule

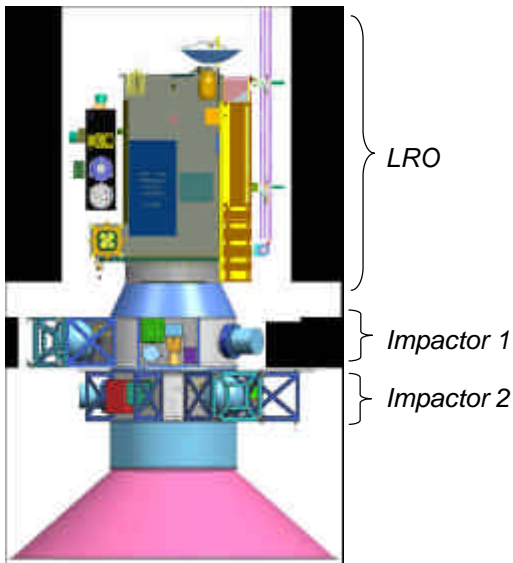


Leaving Behind a Legacy for Follow-on Missions





Examples of Mission Concepts



- Modular Flight System design using standard ESPA ring is adaptable to a variety of alternative missions
 - ◆ Multiple impactor flight systems could be accommodated on single EELV, to the extent that extra launch mass is available
 - ◆ Basic LI Flight System could serve without modification as host spacecraft for a variety of low Delta-V missions, depending on EELV host mission trajectory
 - LEO
 - GEO
 - Beyond
 - ◆ Could support dedicated science instrument suite or combination of science instruments and deployable payloads

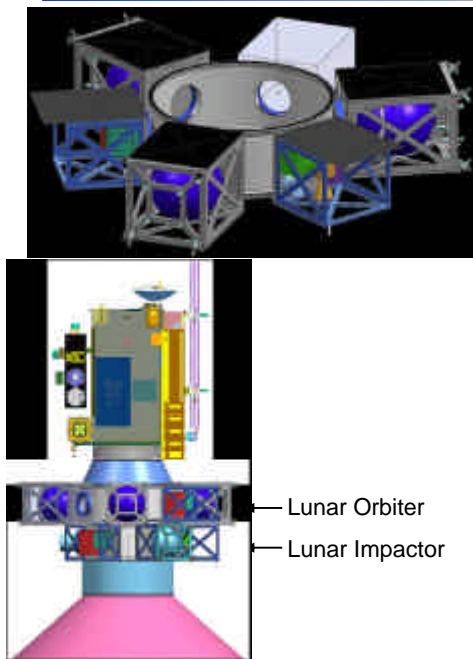
July 27th, 2006

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Lunar Orbiter Example



- Modification of Propulsion Module to enhance Delta-V capability enables low cost lunar orbiter missions
 - ◆ Incorporation of 113 kg capacity Deep Impact tank requires minimal changes to Propulsion Module
 - ◆ Use of three such Prop Modules provides up to 900 m/s Delta-V capability
 - Establishment of 100 km circular lunar orbit from drop-off on LRO-type trans-lunar injection trajectory requires ~700 m/s
 - ◆ Open ESPA attachment point can accommodate up to 180 kg of science payload or deploy a free flying satellite in lunar orbit
 - ◆ Incorporation of solar arrays on all modules could provide up to 1 kW of electrical power
- Dual launch with baseline Impactor S/C could provide self contained mission including impact with dedicated observation orbiter

July 27th, 2006

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International Lunar Exploration Project Proposal

- Propose to large national space organizations (NASA, ESA, CNSA, JAXA, ISRO) who have plans for lunar exploration to offer a ride to a broad-base international community:
 - ◆ Small businesses, universities, smaller space agencies, etc.
- Use international BAA (broad area announcement) to solicit mission concepts followed by full proposals:
 - ◆ For Orbiters: gravity mapping, probes, soft landers, hard landers, etc.
 - ◆ For Landers: nano-rovers, beacons, telescopes, seismic sensor networks, etc.
- Provide support for essential services:
 - ◆ Communications (DSN), mission design/NAV/Ops, project reviews, consulting, system integration and engineering advice.
 - ◆ Encourage industry participation and cost-sharing
 - ◆ Require broad public outreach and education
- Overall Objective:
 - ◆ Enable a broader international community to participate in the excitement and benefits of lunar exploration.

**Attachment 4
Proposal for a new Quality Study Group**

**IAA Commission IV
Quality in Space Programs
Position Paper Study Group**

October 1, 2006

M.A. Hernandez

Page: 1 of 7

Quality in Space Programs Study Group

STUDY GROUP OBJECTIVE

Primary Objective

- To develop/produce a Position Paper adequate for distribution by the IAA that addresses the subject of "Quality" in Space Program
- "Quality" in this content encompasses the disciplines of Safety, Reliability, Risk, and Quality as well as other elements that affect the probabilities of accomplishing mission success

Secondary Objective

- To establish a subject platform that will stimulate the generation/presentation of papers at future International Aeronautical Congresses sharing specific Program/Project experiences

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Quality in Space Programs Study Group

Organization

Chairs: Miguel A. Hernandez (USA)
TBD

Secretary: M. Grimard (France)

Other Members: Luigi Bussolino (Italy)
Hasson Elrada (USA)
Earl McNeil (USA)
Jerry Hammack (USA)
Others to be identified

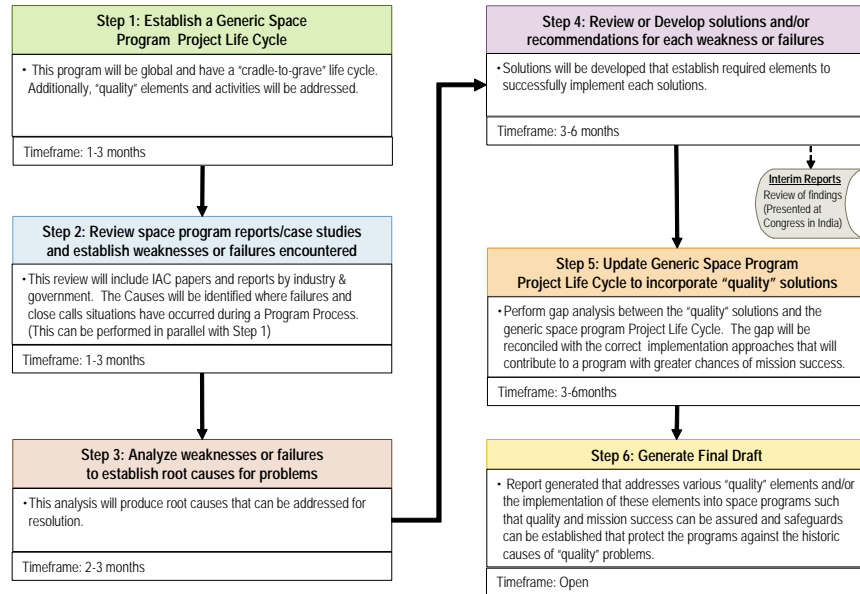
Quality in Space Programs Study Group

Proposed Schedule

- Study Group membership organization and development approach during IAC in October 2006
- Interim Report presented for discussion by study group during IAC October 2007
- Draft Paper presented mid 2008
- Final Paper presented TBD

Quality in Space Programs Study Group

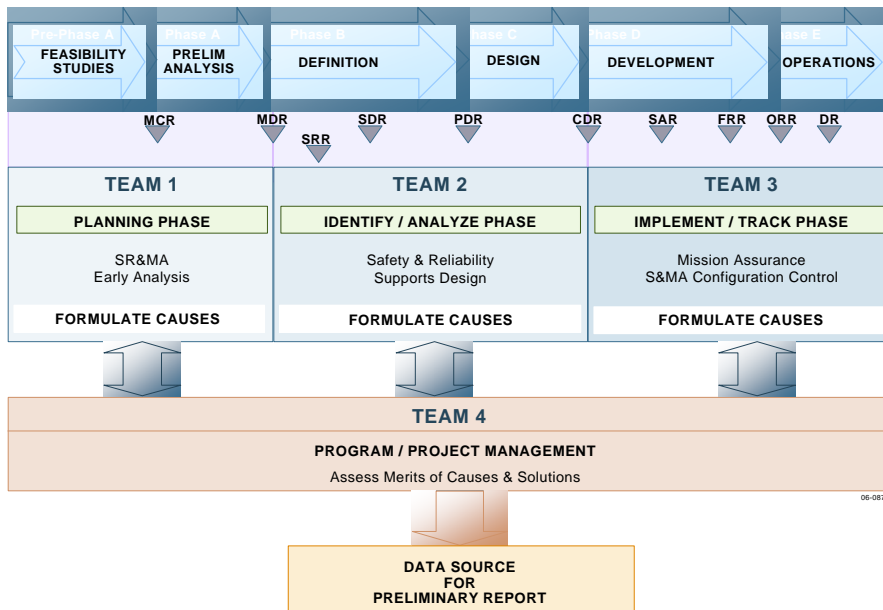
PROPOSED WORKFLOW



06-088

Quality in Space Programs Study Group

PROPOSED COMMITTEE TEAM ORGANIZATION



06-087

