

SUCCESS OF MARS ORBITER MISSION



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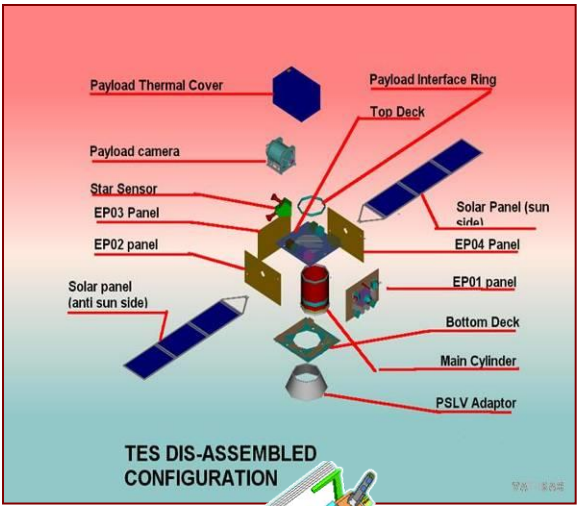
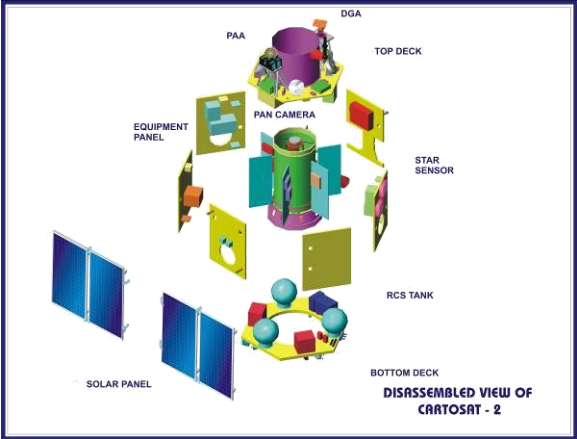
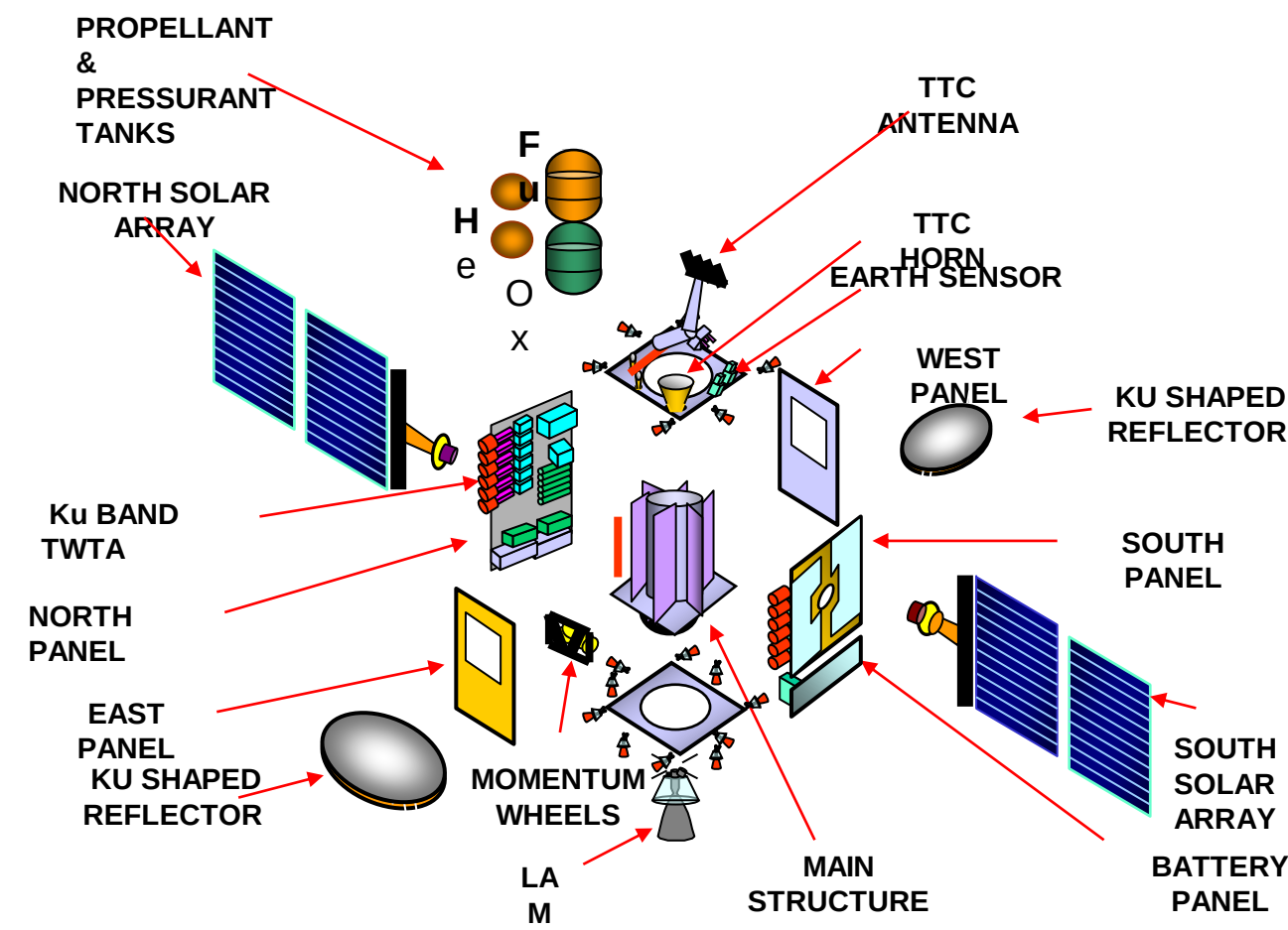
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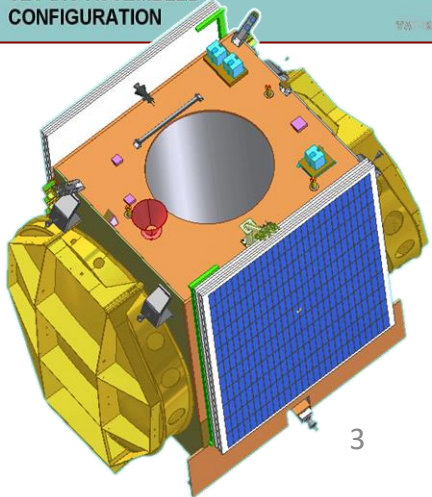
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Satellite In Deployed Configuration



Typical Spacecraft Configuration



Configuration Definition

Important Parameters of Spacecraft

- Mass
- Power
- Payload

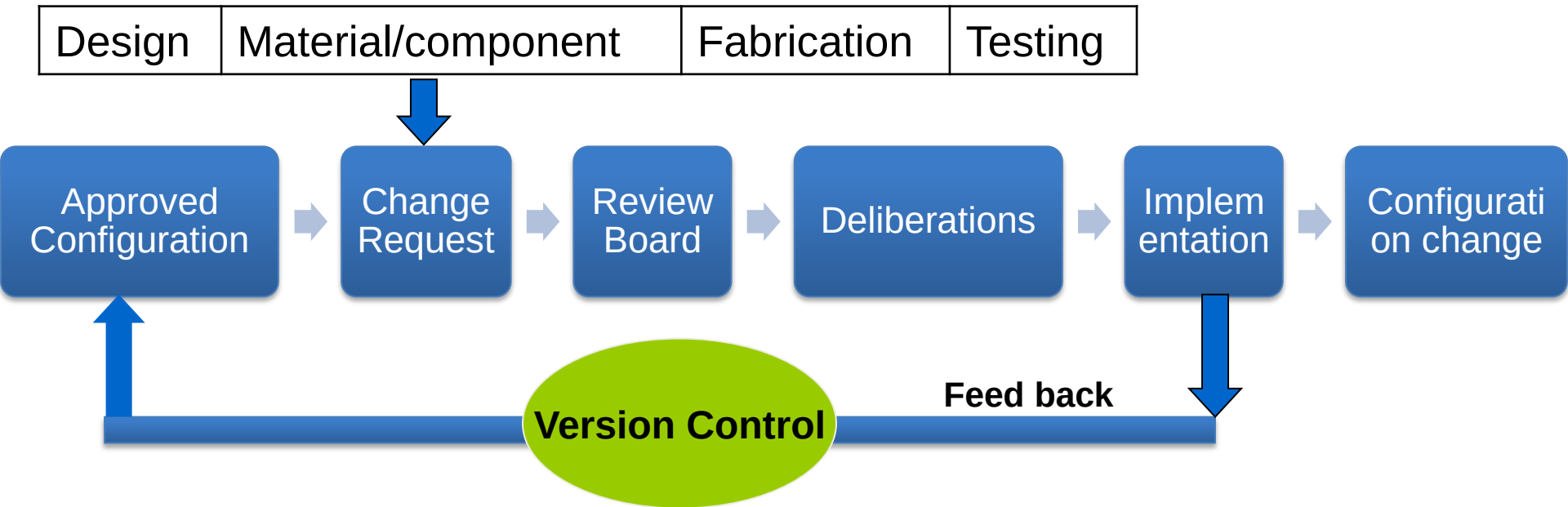
Satellite Design Drivers:

- Reduction in Mass
- Reduction in Cost
- Increase in Reliability
- Increase in System Integration
- Increase in Capabilities For Equivalent Mass
- Reduction in Power Requirements

Subsystem Design Drivers :

- Mission Profile (Maneuvers, Mission Duration, Distances, Angles)
- Payload Requests (Mass, Volume, Pointing, Data Handling, Thermal needs, Power, Cleanliness)
- Launch requirements (Mass, Volume, Mechanical Loads & Frequency)
- Ground Segment Constraints
- Technical Complexity

Configuration Control



Review Boards

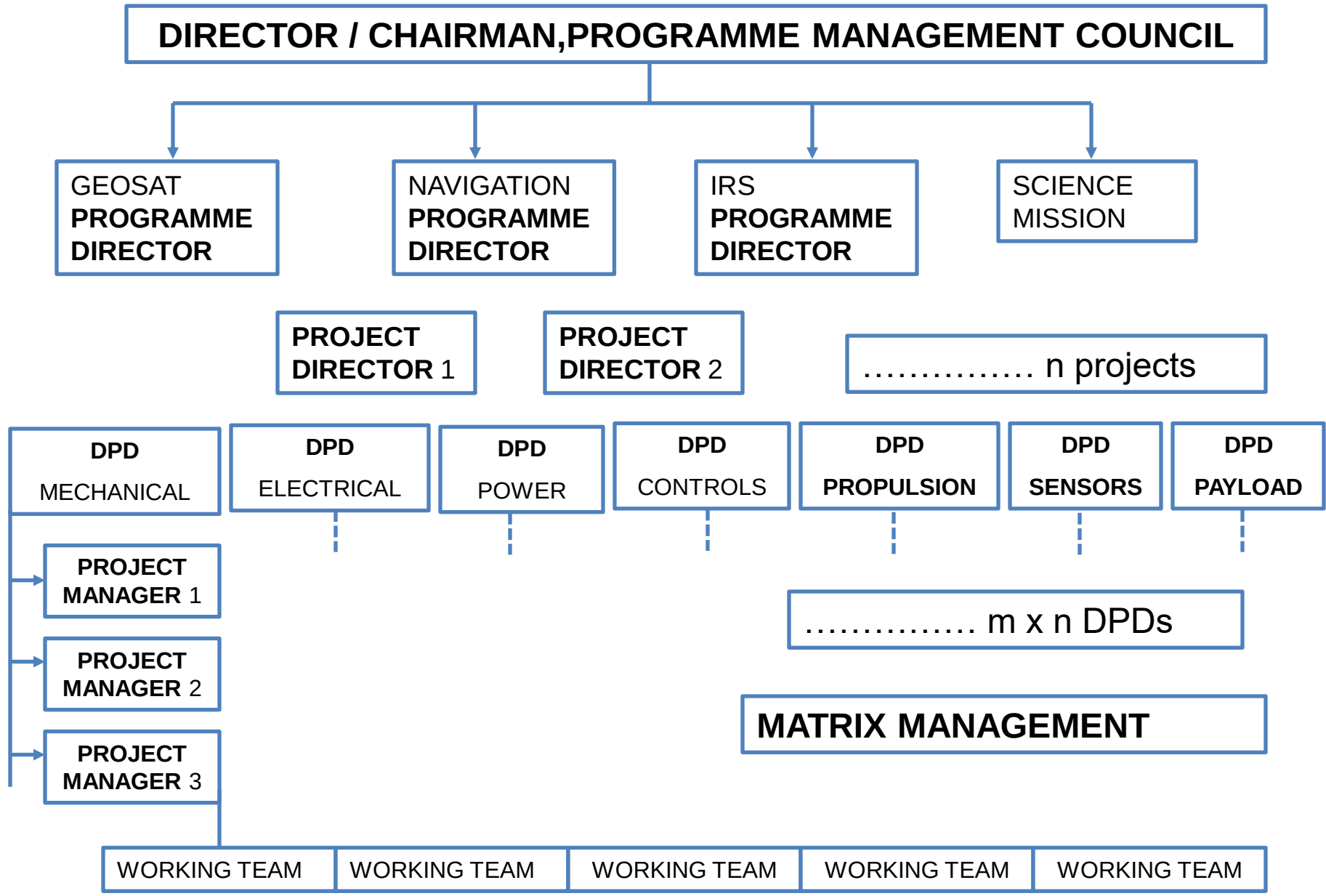
PRB: Parts Review Board

MRB: Materials Review Board

CMRB: Configuration Management Review Board

SRC: Standing Review Committee

Project Organization Structure



Matrix Management- Satellite Perspective

- **Multi Project Environment:** To build various projects for Communication, Remote sensing, Navigation & Space science applications
- **Optimum Utilisation Of Resources**– Effective utilization of all Resources (Manpower expertise, Money & Material, & Machines)
- **Concurrent Engineering** – Geographically Distributed work centres
- **Improved Responsibility & Accountability**
- **Decision Making Process** – Review from component level to spacecraft level
- **Promotes Team Work & Team Building** – Health work environment and competition
- **Balancing Technology Growth And Project Load**

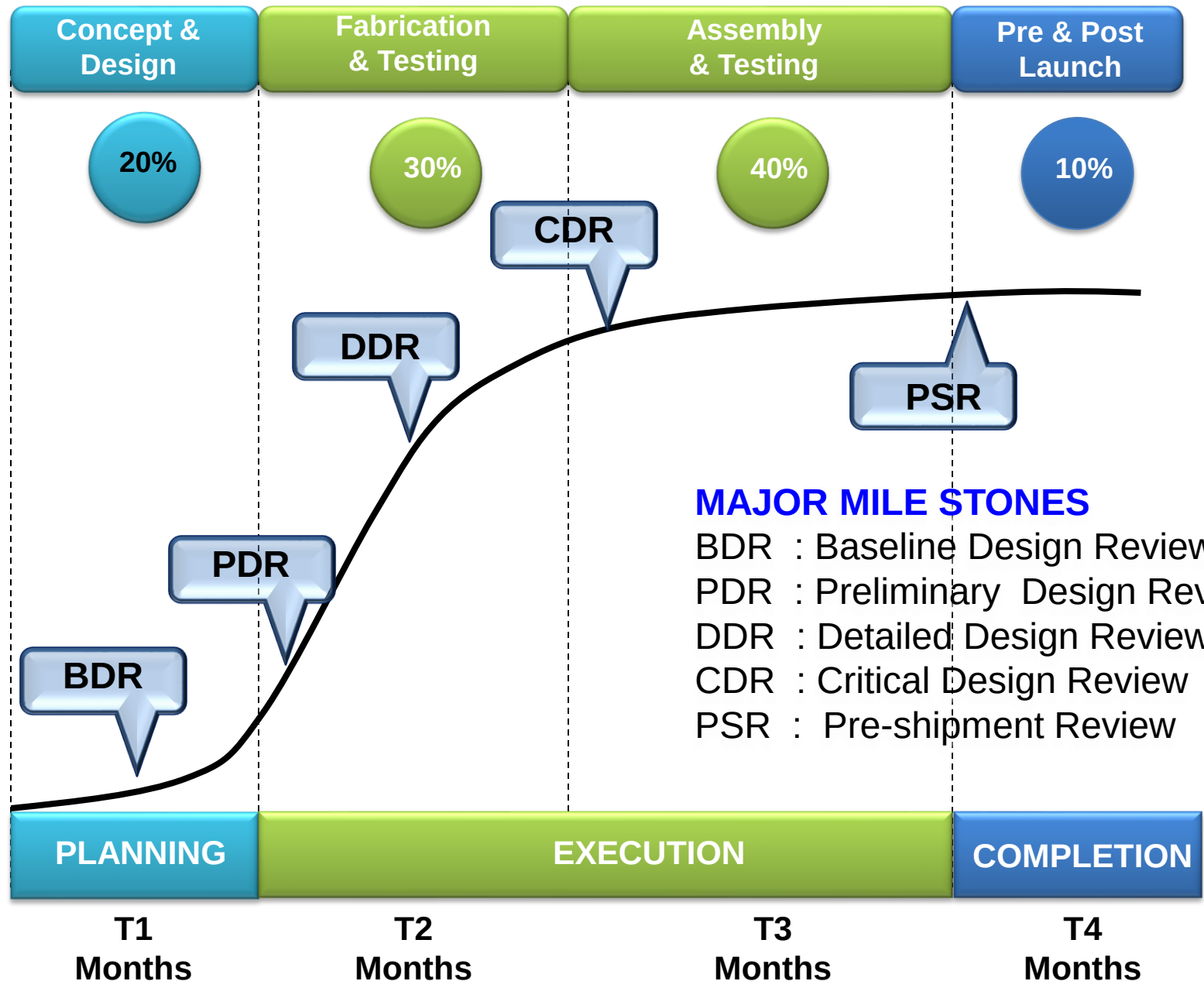
FUNCTIONAL ORGANISATION (TECHNOLOGY MANAGEMENT)

1. Domain expertise
2. Fostering innovation
3. Technology forecasting
4. Space quality and reliability
5. Knowledge management & documentation

PROJECT ORGANISATION (PROGRAMME MANAGEMENT)

1. Satellite bus standardisation & subsystems productionisation
2. Configuration management
3. Timely project execution
4. Lessons learnt data base
5. Seamless information flow
6. Documentation control

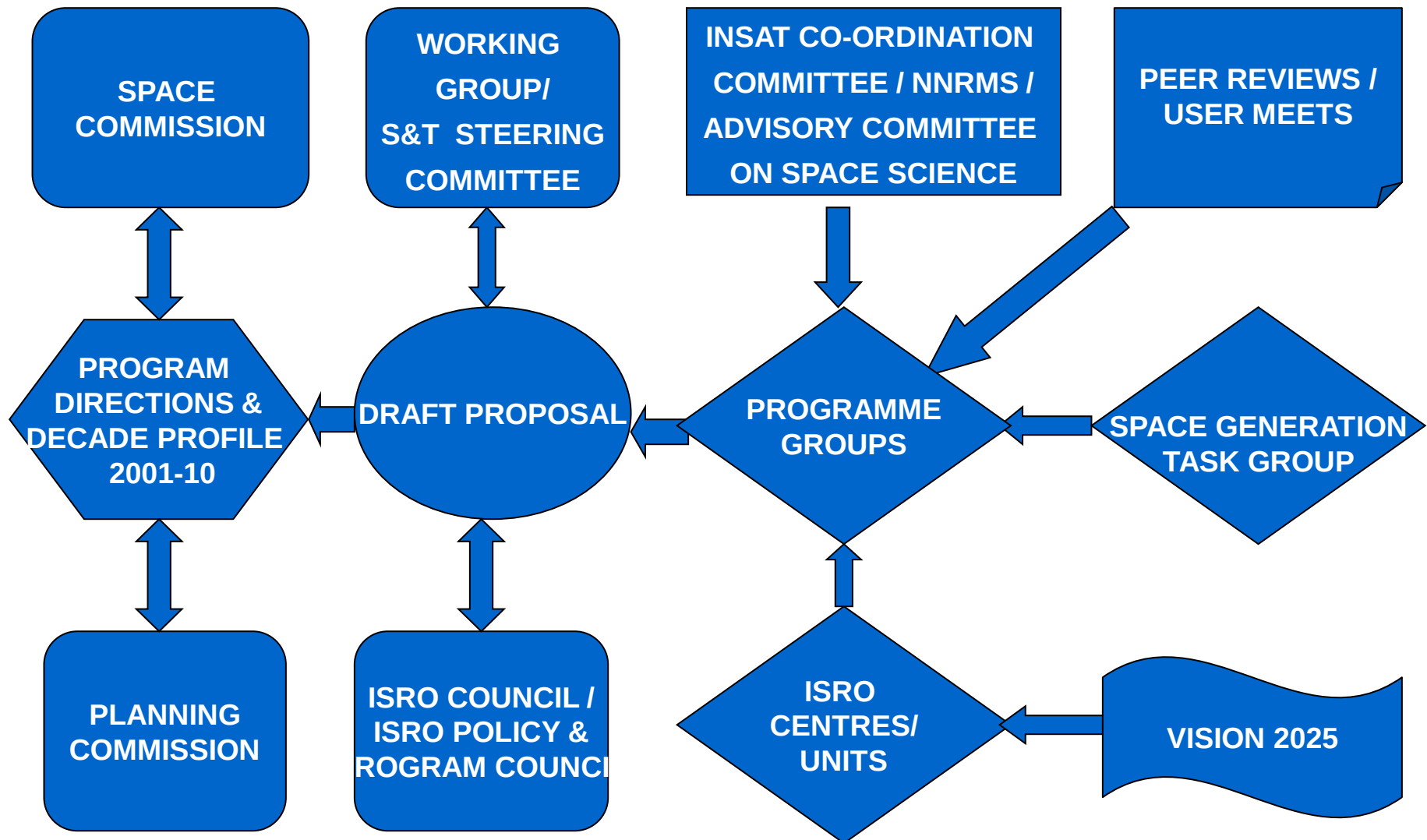
Project Life Cycle- A Typical View



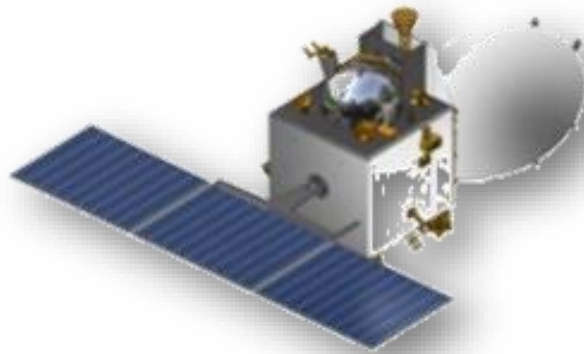
Strategic Management

25 year plan	1. socio-economic development of the nation using space technology 2. Self reliance in satellite technology 3. Establishment of space systems for operational services
Decade Plan	1. Continuity of INSAT system 2. Continuity of IRS system 3. Development and establishment of of Navigation systems 4. Research and development in space sciences and planetary exploration 5. Technology, infrastructure and manpower development
5 Year Plan	1. Programmatic targets- Communication, Earth observation, Navigation and Space sciences 2. Development of advanced technology 3. Infrastructure and Capacity Building
2.5 Year Plan	1. Programmatic targets – Detailed project schedules for the next 2.5 years 2. Development of Project related technologies 3. Extend of Productionization-Outsourcing
Annual Plan	1. Project milestone plan 2. Subsystem Delivery schedule 3. Resource planning 4. Workload Analysis 5. Facility Load Pattern
Monthly Plan	1. Project Work breakdown structure, 2. Gantt chart, Network diagram 3. Project Dashboard

Plan Formulation process



MARS ORBITER MISSION SUCCESS STORY



Mars Orbiter Mission-Overview

ISRO's first interplanetary mission to Mars planet with an orbiter craft designed to orbit Mars in an elliptical orbit. The scientific payload instruments are intended to study surface features morphology, topology and mineralogy of Mars, Constituents of Martian atmosphere. The Earth-Mars trajectory comprises of three phases namely, Earth-centered phase, Heliocentric phase and Martian phase.

SALIENT FEATURES

Orbital Location : 370 X 80,000 Kms elliptical orbit

Voyage from : 300 Days

Earth's orbit

Mass : 1350 Kg

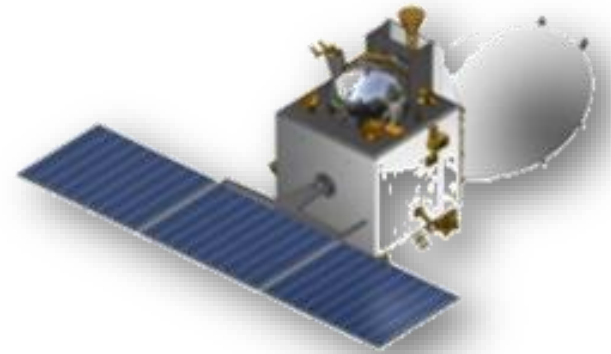
Power : 750 W

Mission Life : ~ 6 Months

Launcher : PSLV C 25

Payload : Lyman Alpha Photometer, Methane Sensor for MARS, Martian Exospheric Composition Explorer, MARS Color Camera and TIR Imaging Spectrometer

Launch Date : 5th November , 2013



Mars Orbiter Mission- Mission Objective

Technological objectives:

- Design and realisation of a Mars orbiter spacecraft with a capability to survive and perform Earth bound manoeuvres, cruise phase, Mars orbit insertion and capture, and on-orbit phase around Mars.
- Deep space communication, navigation, mission planning and management.
- Incorporate autonomous features to handle contingency situations

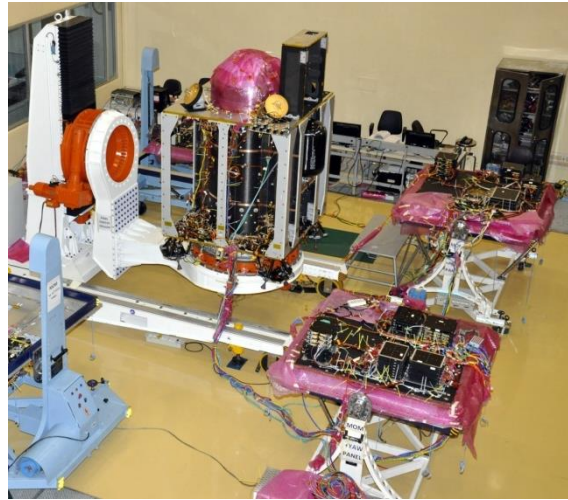
Scientific objectives:

- Exploration of Mars surface features, morphology, mineralogy and Martian atmosphere by indigenous scientific instruments.

Mars Orbiter Mission-Making



**Structure
Delivery at
Clean Room
June 2012**



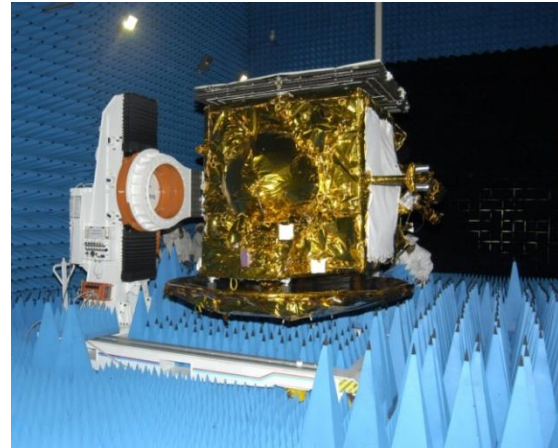
**Subsystem Integration
activities in Clean Room
March –Aug 2013**



**Loading to Thermovac Chamber
Aug 2013**



**Antenna Deployment Test
Sep 2013**



**EMI/EMC Test
Sep 2013**

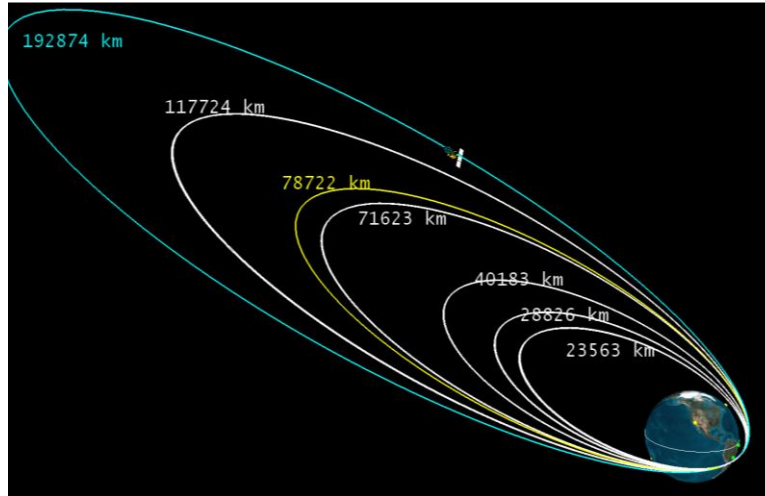


**Vibration Test
Sep 2013**

Mars Orbiter Mission- Sequence of Event



Launched onboard PSLV-C25 on November 5, 2013



Six orbit raising manoeuvres to raise the apogee



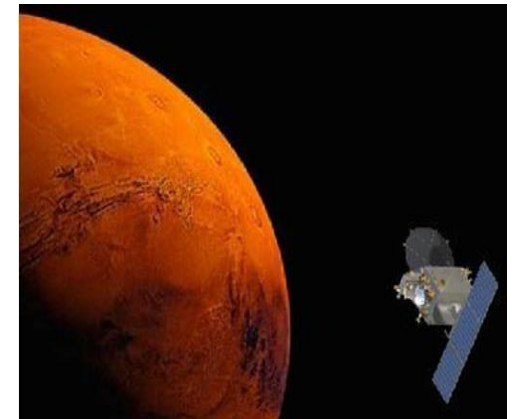
Trans Mars Injection on December 01, 2013



Main Liquid Engine Successfully restarted on September 22, 2014



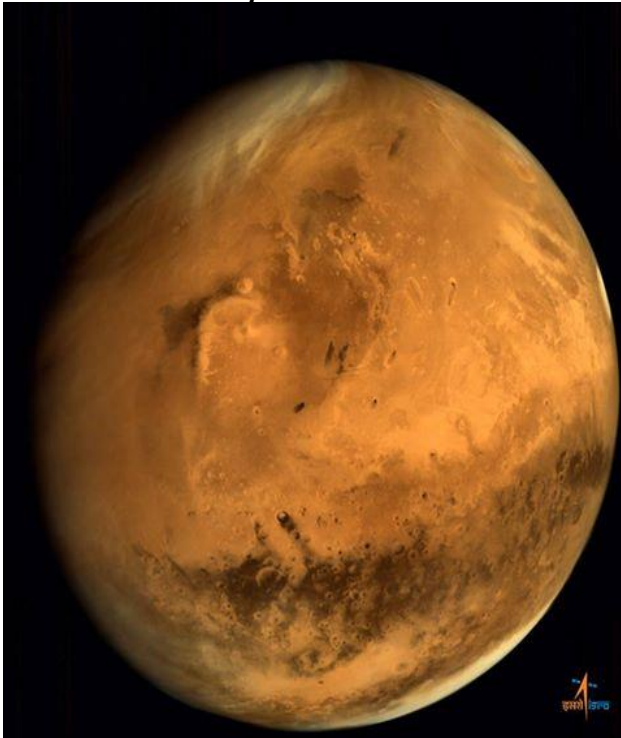
**MOI: September 24, 2014
Honourable Prime Minister of India, Mr Narendra Modi Witnessed the event**



MOM orbiting Mars

Mars Orbiter Mission- Data Products

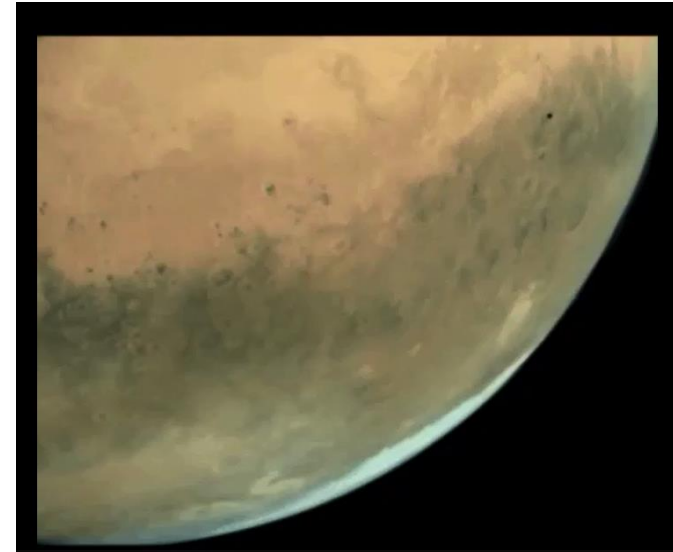
Full disc image of Mars, taken by the Mars Color Camera, from an altitude of 66,543 km.



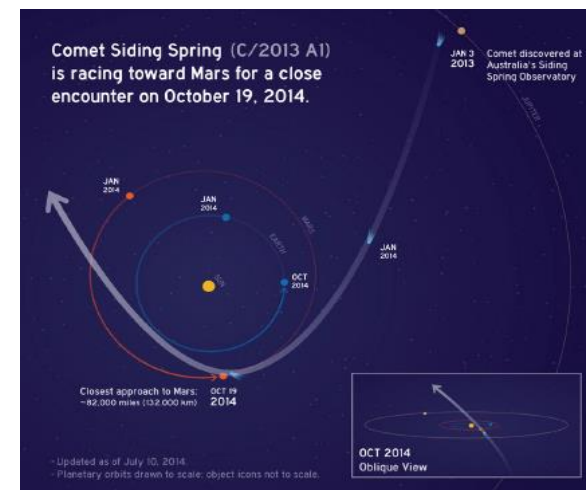
Google doodle- on 1 month completion of Mom



**Image of Phobos, the larger of the two
Martian moons taken by the MOM**



Mom encounter with the comet Siding Spring on October 19, 2014



Mission Objectives- Compliance

- Technological objectives met with still 80 days to go and 37 kg usable propellant left.
- Scientific objectives fully met with huge amount of planetary science data.
- Deep space mission management successfully executed.
- Time, quality, cost and scope met
- IDSN- 32/ 18 m were the prime antennae for MOM and 32 m antenna support continues

Space Segment

- Realised in a record time of 18 months winning over all the challenges in all the systems of spacecraft.
- The mission and operations requirements were fully met.
- The first satellite to cross Van Allen belt 39 times demanded by unique mission concept and did not encounter “lost in space” condition.
- The systems were put to their extreme limits in-orbit .
- The first Indian satellite being analyzed by space agencies and management schools for paving way for low cost access to deep space and frugal engineering aspects.

Zero to one : The success story of MOM!

- Analysis of failures of the other missions and risk mitigation at the start of the project.
- Realised and executed the mission with less muscle power and more brain.
- Innovative ways of making use of the natural galactic forces to conserve energy and to navigate.
- Using heritage modules and incorporating only mission specific requirements.
- Focused approach and lean thinking.
- An excellent mechanism to predict and observe internal and external disturbances.
- Stringent review mechanism.
- Meticulous Planning (schedule with a resolution of one hour).

Zero to one : The success story of MOM!

- Fully home grown technology and knowledge.
- Ground testing of systems and sub systems to the extremes of their capability .
- Extensive ground simulations for hardware and software.
- Brain storming and preparedness for managing contingency situations.
- Round the clock work.
- Dedicated and energetic young team.

International recognition for the “smartness” of MOM and her success in getting the planet mars in the maiden attempt.



Thank You!