Overview of HyspIRI Mission Characteristics

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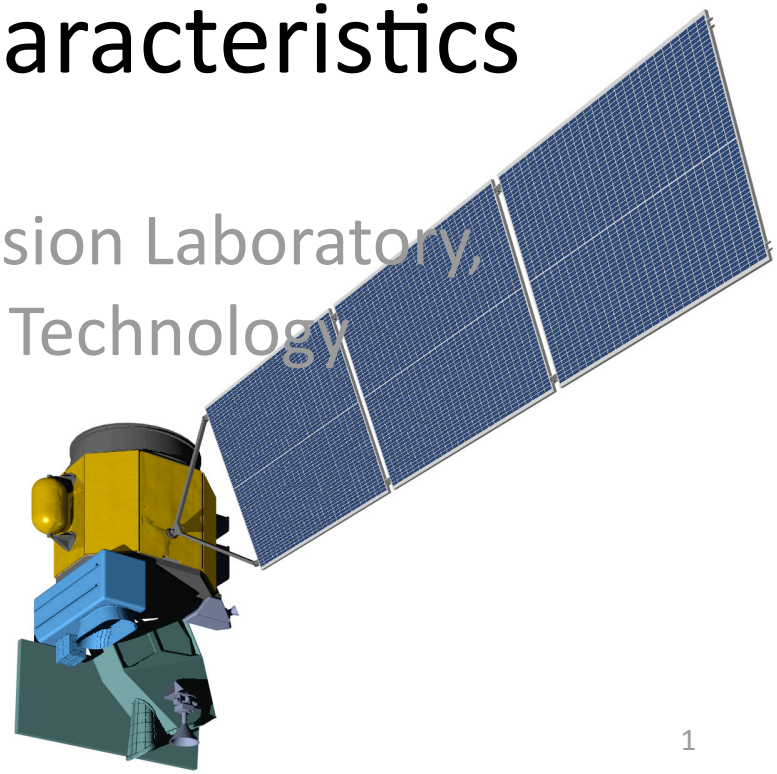
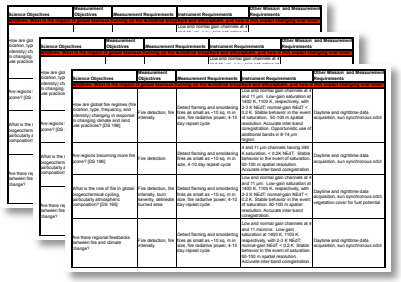


Goal of the Mission Concept Study

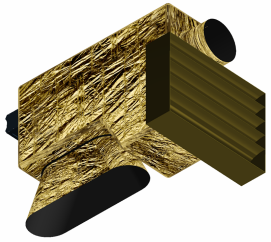
- To assess the feasibility of a mission that meets the science objectives by:
  - Including a high level description of a particular implementation,
  - Indentifying major risks,
  - Estimating the cost to develop and execute the mission.
- To provide a baseline:
  - For comparison of alternate implementations,
  - For evaluating the impact of different science requirements.

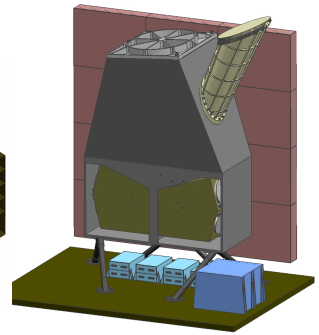
Second iteration for HyspIRI, but will be further refined in preparation for a Mission Concept Review

Inputs

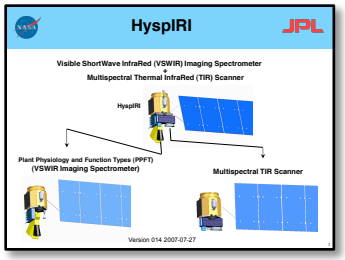


- Science Traceability Matrix
  - Mission requirements





- Instrument accommodation requirements
- Programmatic approach to Decadal Survey Missions
- Context
  - Existing or completed missions with similar characteristics
  - Previous studies



Overall approach: use demonstrated solutions wherever possible to decrease technical and schedule risk.

JPL

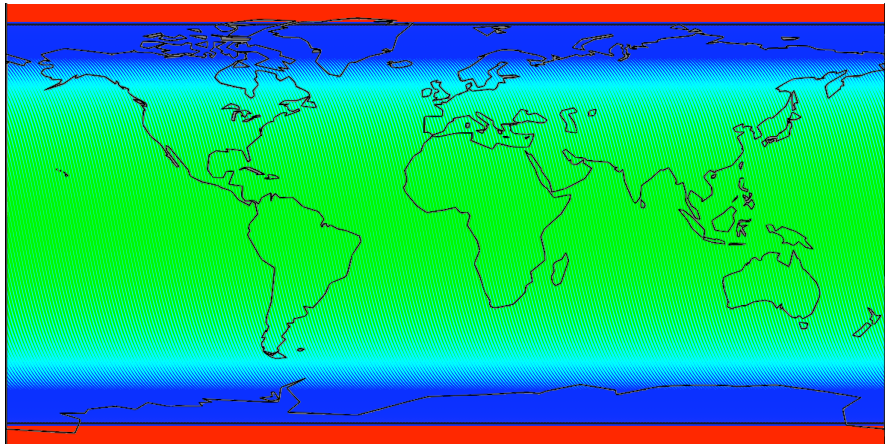
Orbit Design

- Local time of observations
  - Sun-synchronous, 11:00 +/- 30 minutes.
- Altitude
  - Low Earth Orbit, frozen.
- Global coverage in a minimum number of days given the swath-width of each instrument.
  - VSWIR: 19 days revisit at the equator
  - TIR: 5 day revisit at the equator (1 day + 1 night)
  - Combined solution: 626 km altitude at equator

There is a suitable orbit that matches the characteristics of both instruments.

Geometrical Access in 19 days

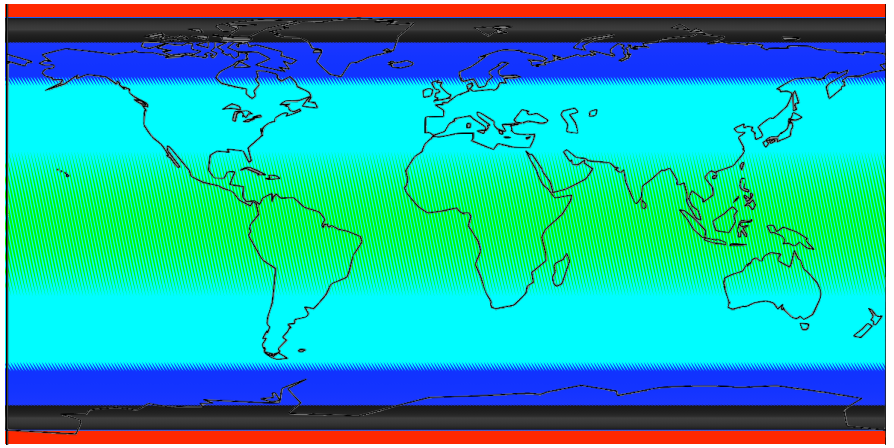
Number of daytime VSWIR access (no nighttime)



0
1
2
>2 and <19
>=19

The above plots show the average gap between access to each location.
Effects of Sun illumination and clouds are not included.

Number of daytime TIR access (nighttime is identical)



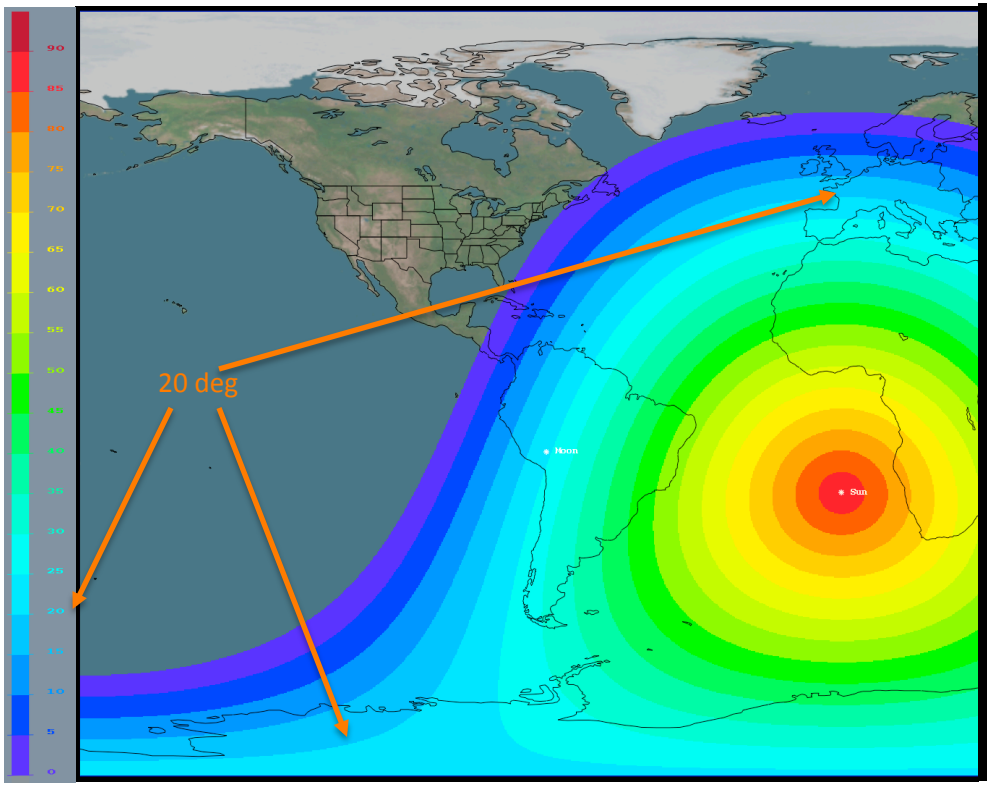
<4
4
>4 and <=8
>8 and <19
>=19

The 626 km orbit is one of the few that also minimize the maximum temporal gaps between acquisitions.

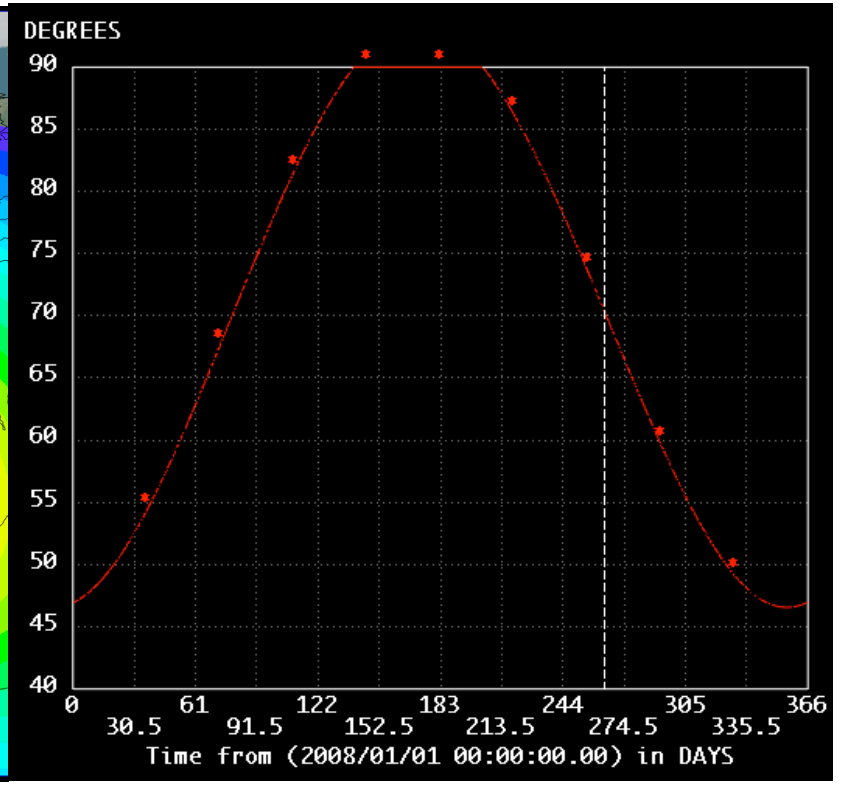
Sun Illumination (VSWIR)

- Impact of the latitude variations of the sub-solar point
  - Latitude extent of VSWIR coverage varies seasonally
- Variations of the Local Time of Ascending Node.
- Optimization of the VSWIR pointing.
- Small variation of the local time of observations with latitude.

Daily Maximum Sun Elevation



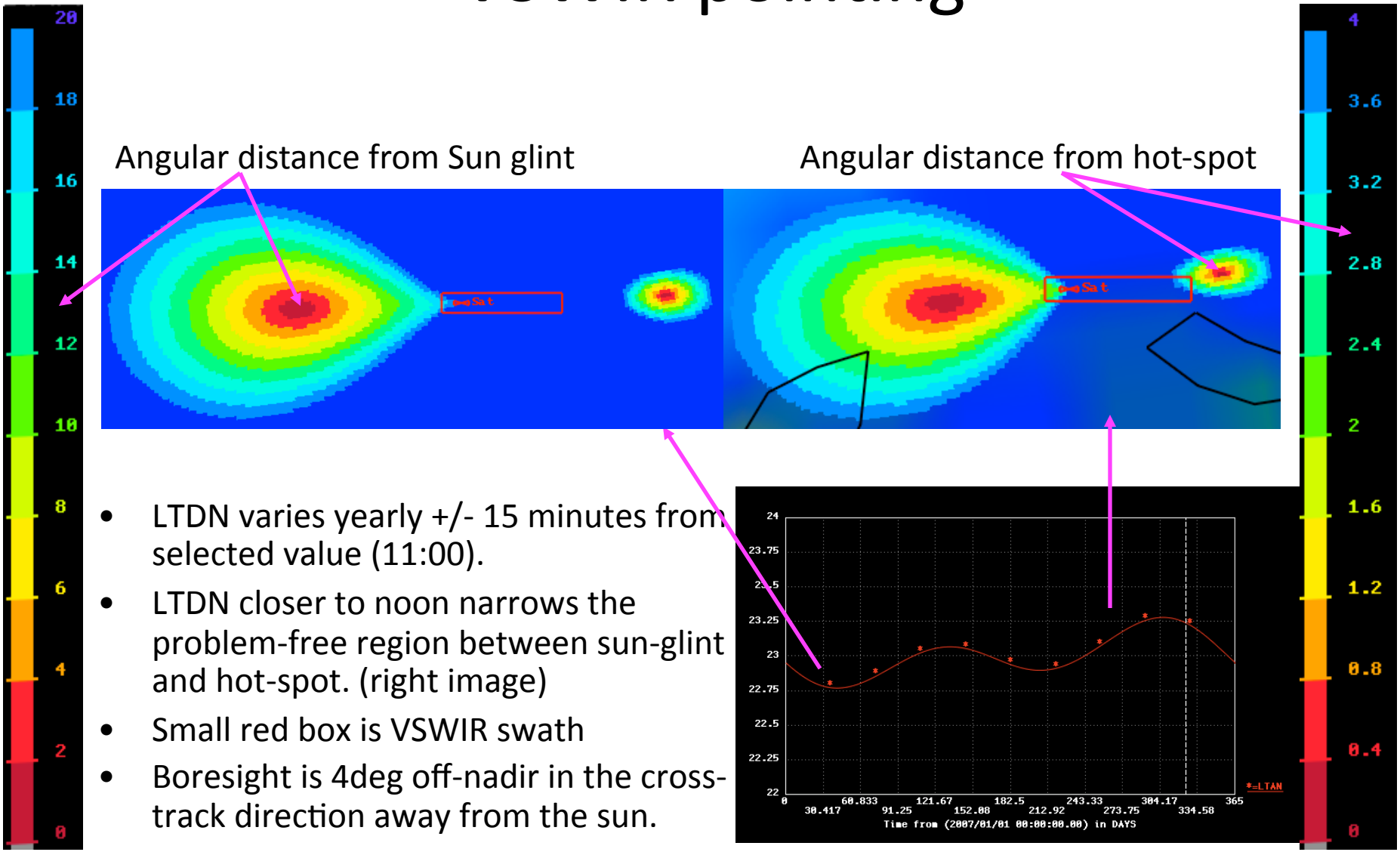
December solstice: worst case Sun illumination in the Northern hemisphere.



Equinox: sun elevation greater than 20 degrees between +/- 70 deg latitude.

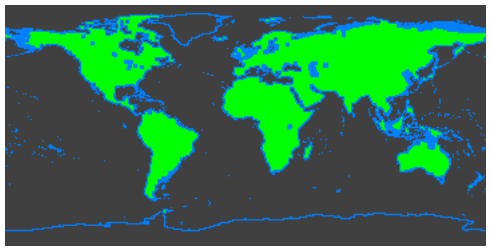
Sun illumination constraints reduces VSWIR coverage during local winter.

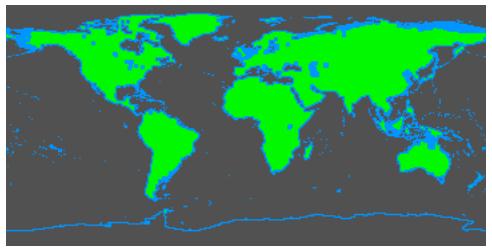
VSWIR pointing



- LTDN varies yearly +/- 15 minutes from selected value (11:00).
- LTDN closer to noon narrows the problem-free region between sun-glint and hot-spot. (right image)
- Small red box is VSWIR swath
- Boresight is 4deg off-nadir in the cross-track direction away from the sun.

Data Acquisition Scenario & Mission Operations





- Target maps driven
  - No need for uploading acquisition sequences
- Low resolution mode
  - Ocean & Ice coverage, little impact
- Direct broadcast option
  - To demonstrate real-time use of data
- Systematic mapping vs. pointing capability
- Downlink scheduling

Systematic mapping maximizes science return and minimizes complexity of Mission Operations

Data Volume

- Duty-cycle and data rates:
  - Duty cycle based on target masks
    - Full swath width acquisition baselined
    - Partial swath acquisition could reduce data volume
  - Includes illumination constraints (VSWIR)
  - Includes compression (TIR: 2x, VSWIR: 3x)
  - Includes overhead
  - Continuous averaged data-rate: 65 Mbps
- Data volume:
  - 372 Gb / orbit
  - 5.5 Tb / day

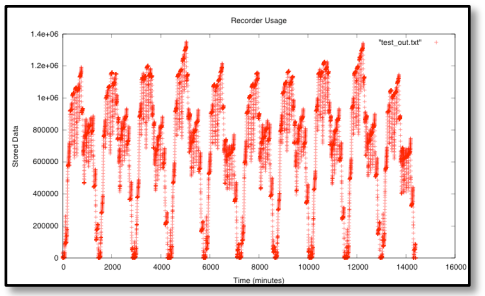
	VSWIR	TIR
rate (Mbps)	288.5	59.2
duty_cycle ratio	0.148	0.400
effective rate	42.700	23.672
overhead	10%	10%
avg rate w/ ovrhd	46.970	26.039
Obstruction ratio	0.2	0
After screening	37.576	26.039

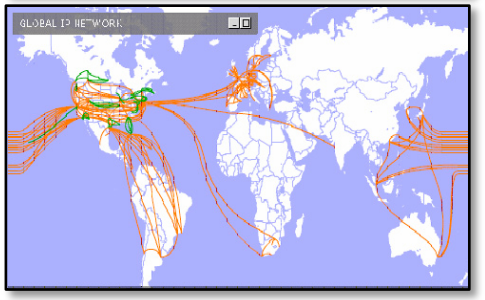
WorldView-1: 331 Gb/orbit
DESDynI: 352 Gb/orbit

HyspIRI data-set is comparable to existing commercial and other future NASA missions.

Managing the Data Volume

- On board storage
  - 3 Tb (WorldView-1 has 2.2 Tb)
- Downlink options
  - X-band
    - Upgrade 3 existing stations to 600 Mbps
    - WorldView-1 (launched 2007/09) 800 Mbps
  - Ka-band
  - Optical communications
  - TDRSS
- Ground communications / latency





HyspIRI will require more capabilities than currently used by NASA. Suitable solutions are being used by existing commercial missions.

Spacecraft and Launch Vehicle

- Spacecraft
  - Most accommodation requirements can be met by typical COTS spacecrafts.
  - Unique needs for HyspIRI were met by adding the cost of upgrades using commercially available parts.
  - We plan to work with industry to refine our understanding of suitable spacecrafts.
- Launch vehicle
  - The combined mass of the payload and a candidate spacecraft can be launched with 9% margin (over CBE +contingencies) by a Taurus-class launch vehicle.
  - Available volume in the launch vehicle fairing has also been verified.

Suitable spacecrafts and launch vehicles exist.
A conservative cost estimate was used by TeamX.

Science and Science Data System

- Science:
  - Includes science management, project scientist, science teams and their involvement in algorithm development, science sequence development, instrument pre-launch calibration
- Science Data System:
  - Produces and archive L0 and L2 products during phase E and F.
- Archiving and data analysis costed separately.

NASA is defining the scope of SDS for Decadal Survey missions, between ESSP and EOS models.

Project Cost

- Methodology, margins
- Bottom line
- Comparison to DS
- Opportunities for cost reductions
  - Evaluate alternate mission implementations
    - Assess potential of newer technologies: lower cost, higher margins.
  - Evaluate alternate science (less, or more with partner)
  - Evaluate international cooperation
  - NASA investments

In-line wit the DS.
There are opportunities to reduce the cost.

Project Development Schedule

- Studied schedule
  - Based on mature science (TBC)
- Launch readiness date
  - Based on existing technologies
- Impact/opportunities with a delayed start
  - Increased cost for early phases
  - Potential cost decrease due to new technology
  - Later availability of science products

HyspIRI maturity is consistent with a 2014 LRD.
Working toward a possible transition to phase-A by October 2009.

Next Steps

- Assess impact of workshop.
- Support work on level 1 requirements (a NASA HQ document)
- Work on cost reduction opportunities
- Involve industry
- Prepare Mission Concept Review