



Team X Support to the Planetary Science Decadal Survey

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Planetary Science Decadal Survey Steering Group Meeting, July 6-8,
2009

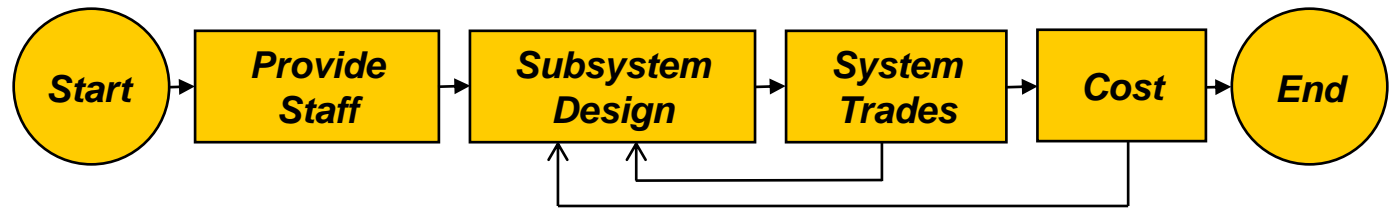


Team X – JPL’s Approach to Advanced Concept Design

- Team X: An advanced concept design team for generating rapid-turnaround, innovative space mission concepts
 - People, Processes, and Tools
 - Owned and backed by the organizations responsible for executing flight projects
 - Staffed by discipline experts with significant flight project experience
- Achieved through:
 - Concurrent engineering: Spacecraft subsystem experts (“chairs”) working in the same room, communicating in real time
 - Augmented with domain specialists as needed (e.g., EDL, EP, surface ops, sample return)
 - Models: Design tools, cost estimation relationships
 - Electronic integration: Spreadsheet inputs and outputs tied together across the chairs, automatic construction of technical resource and cost roll ups

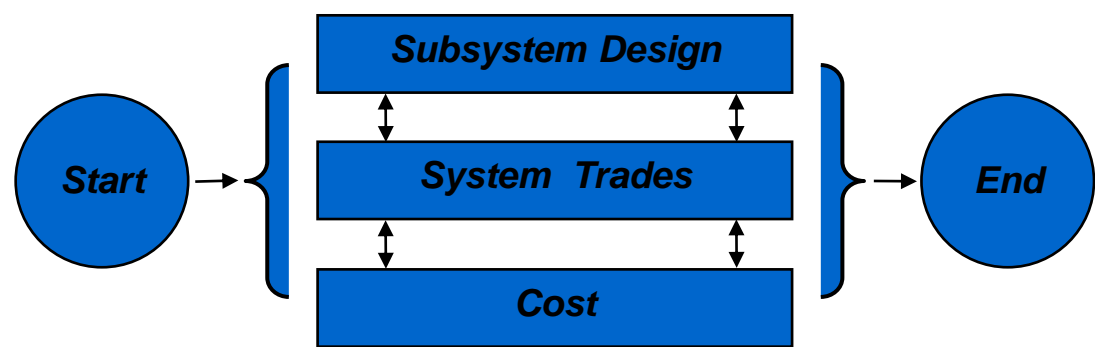
Concurrent Engineering – What is it?

- Traditional Method – Serial



- Concurrent Engineering – Parallel

- Diverse specialists working in real time, in the same place, with shared data, to yield an integrated design





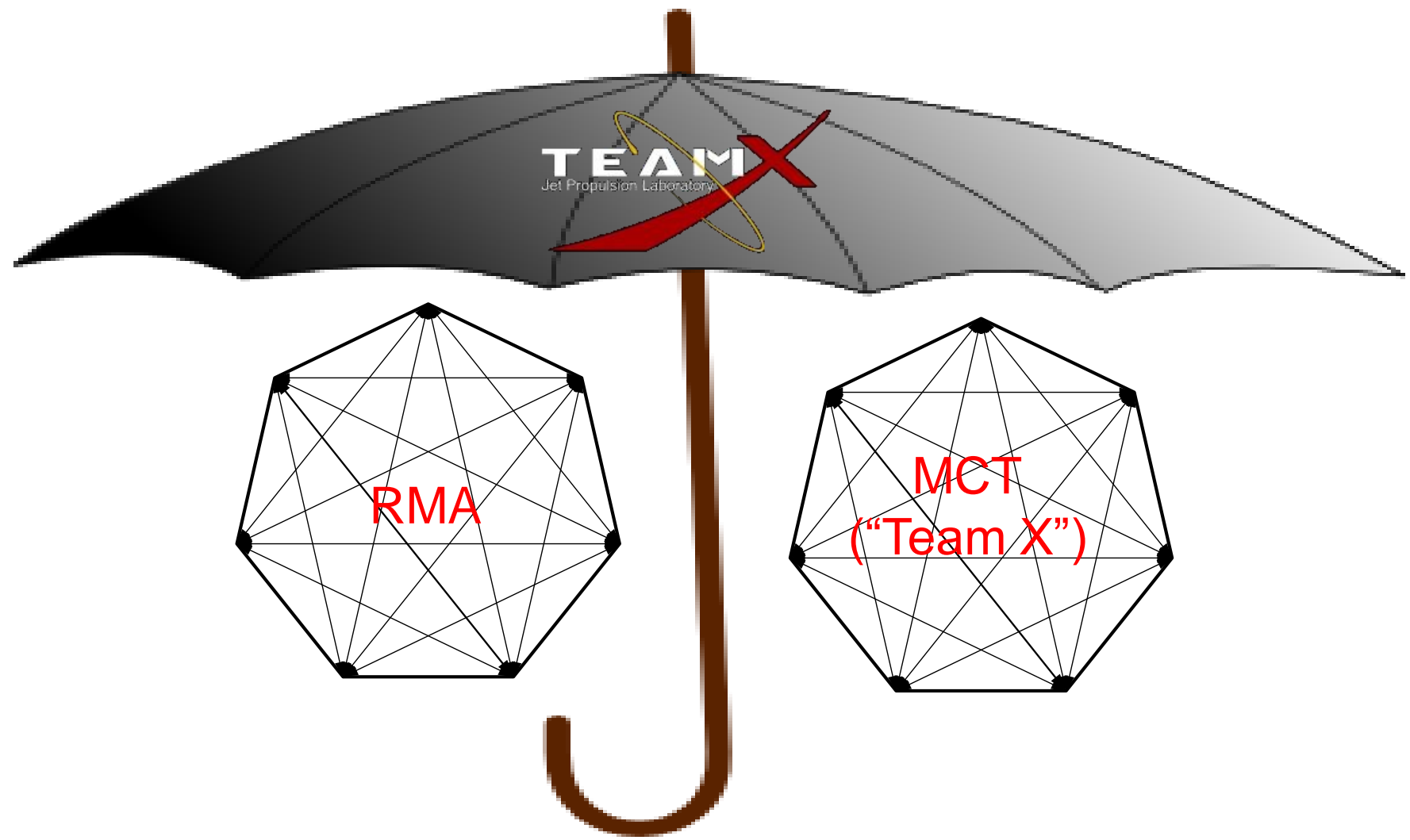
Team X History

- Created in 1995 in conjunction with The Aerospace Corp. to address the need to create and evaluate many concepts in a short period of time
- NASA's original concurrent engineering team
- Emulated by other Centers and industry
- Over 900 studies completed in the last 13 years
- Focus on continuous process improvement
- **Profiled in Time magazine (Nov., 2005)**



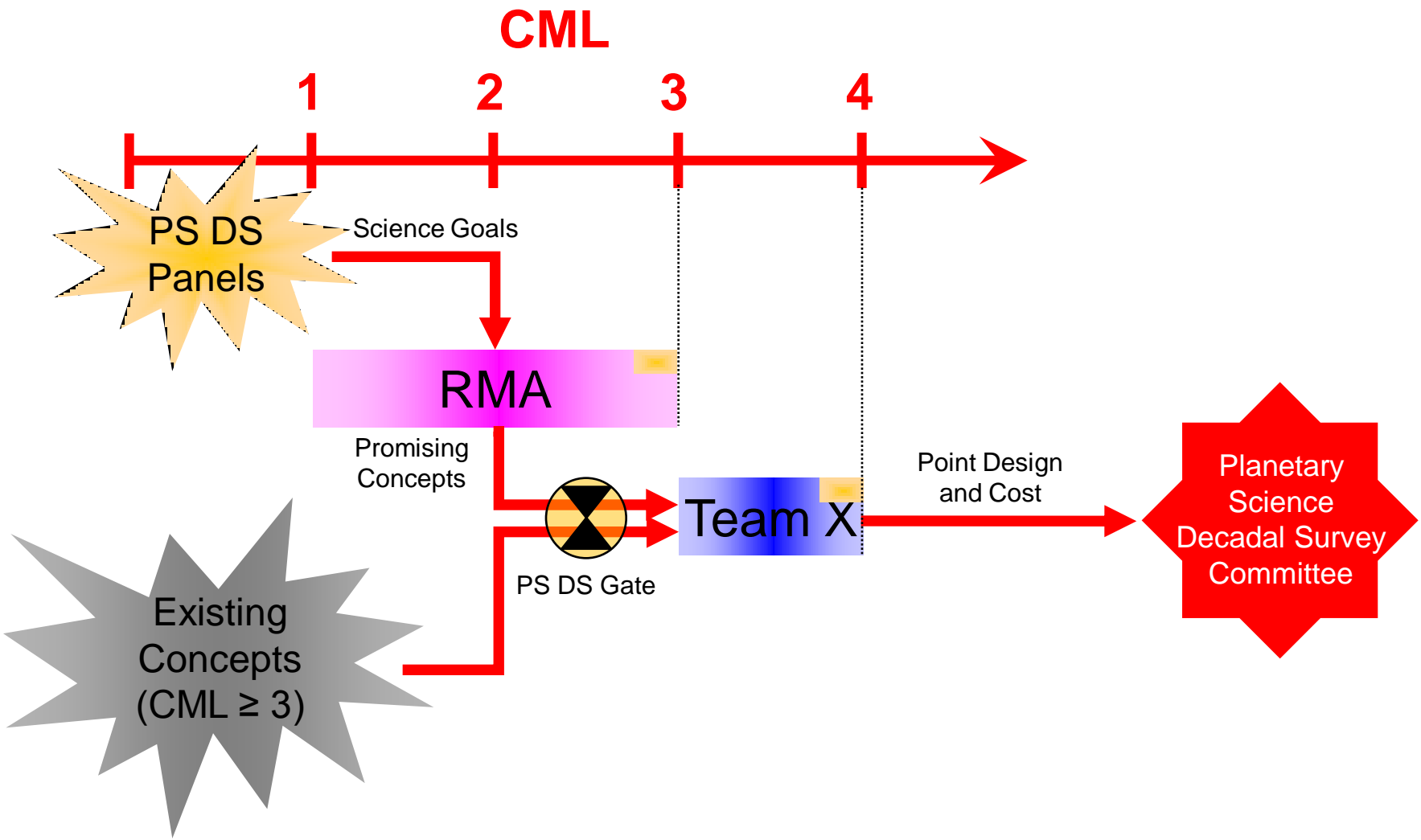


Team X Now





Team X as Applied to the Decadal Survey





Team X in Action

- Team X – a concurrent engineering environment for rapid design and analysis of mission concepts
- Networked subsystems compute real-time design changes as the PI works with the team
- Visibility across subsystem disciplines facilitates issue resolution and identification of novel trades



July 6-8, 2009

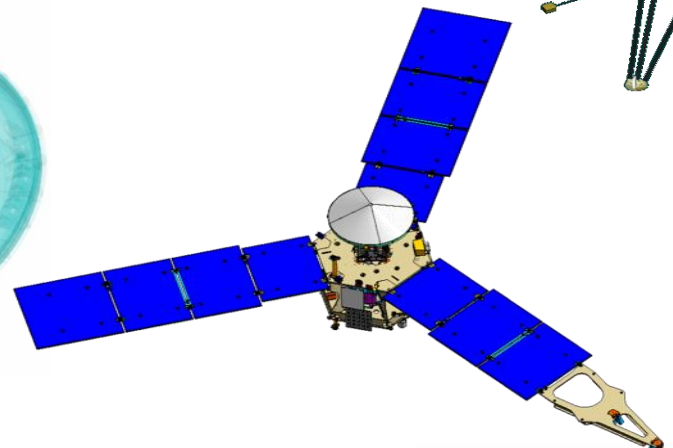
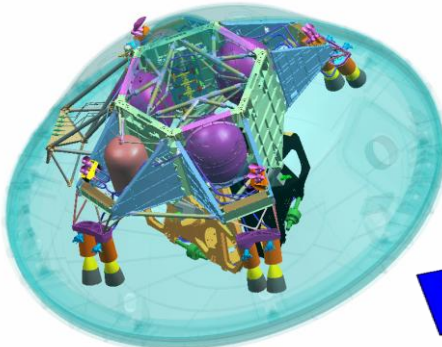
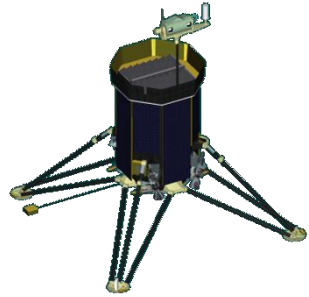
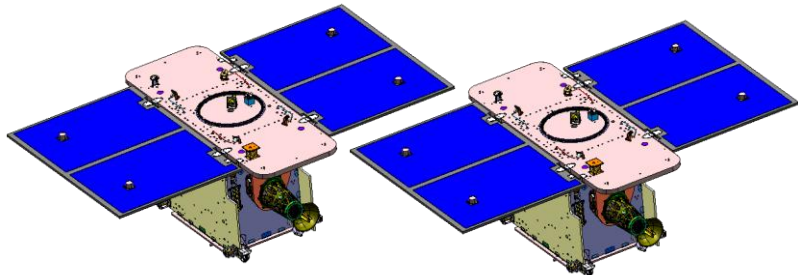
JPL Support to Solar System Decadal Survey

JMK-7



900+ Diverse, Science-Driven Studies Completed

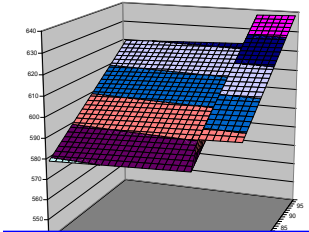
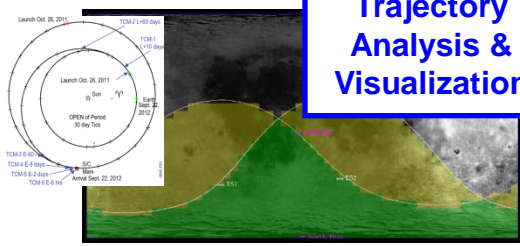
- Architectures
 - S/C Constellations
 - Campaigns
- Space Missions
 - Planetary
 - Mars
 - Earth
 - Lunar
 - Astrophysics
 - Human
- Flight Systems
 - Orbiters
 - Rovers
 - Landers
 - Aerobots
- Instruments
 - Remote sensing
 - *In situ*



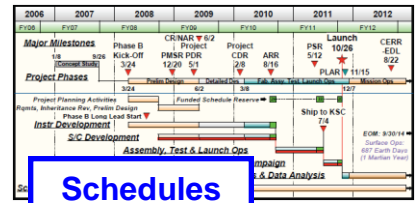


Well-Defined Set of Study Products

Trajectory Analysis & Visualization

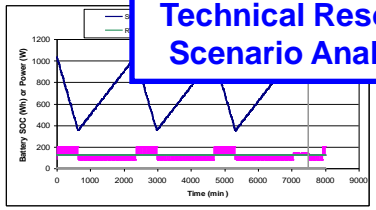


Sensitivity Analysis



Schedules

Technical Resource Scenario Analyses

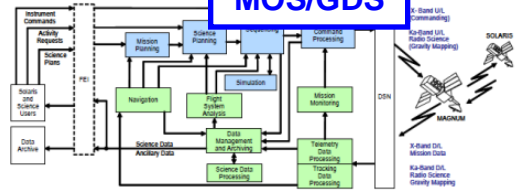


SYSTEMS WORKSHEET: Lunar Precursor Power Options 2005-12

Send Request	Mass (kg)	Cost (\$)	Power (W)	Power (W)	Power (W)	Power (W)	Power (W)
10%	3.9	0.0	5.3	30.0	1.8		
20%	3.9	0.0	9.3	30.0	1.8		
30%	3.9	0.0	13.3	30.0	1.8		
40%	3.9	0.0	17.3	30.0	1.8		
50%	3.9	0.0	21.3	30.0	1.8		
60%	3.9	0.0	25.3	30.0	1.8		
70%	3.9	0.0	29.3	30.0	1.8		
80%	3.9	0.0	33.3	30.0	1.8		
90%	3.9	0.0	37.3	30.0	1.8		
100%	3.9	0.0	41.3	30.0	1.8		

System-Level Resource Estimates

MOS/GDS



Master Equipment List

Equipment	QTY	Part No.	Part Name	Part Description
ORBIT	01.01	01.01	ORBIT	ORBIT
ORBIT	01.02	01.02	ORBIT	ORBIT
ORBIT	01.03	01.03	ORBIT	ORBIT
ORBIT	01.04	01.04	ORBIT	ORBIT
ORBIT	01.05	01.05	ORBIT	ORBIT
ORBIT	01.06	01.06	ORBIT	ORBIT
ORBIT	01.07	01.07	ORBIT	ORBIT
ORBIT	01.08	01.08	ORBIT	ORBIT
ORBIT	01.09	01.09	ORBIT	ORBIT
ORBIT	01.10	01.10	ORBIT	ORBIT
ORBIT	01.11	01.11	ORBIT	ORBIT
ORBIT	01.12	01.12	ORBIT	ORBIT
ORBIT	01.13	01.13	ORBIT	ORBIT
ORBIT	01.14	01.14	ORBIT	ORBIT
ORBIT	01.15	01.15	ORBIT	ORBIT
ORBIT	01.16	01.16	ORBIT	ORBIT
ORBIT	01.17	01.17	ORBIT	ORBIT
ORBIT	01.18	01.18	ORBIT	ORBIT
ORBIT	01.19	01.19	ORBIT	ORBIT
ORBIT	01.20	01.20	ORBIT	ORBIT
ORBIT	01.21	01.21	ORBIT	ORBIT
ORBIT	01.22	01.22	ORBIT	ORBIT
ORBIT	01.23	01.23	ORBIT	ORBIT
ORBIT	01.24	01.24	ORBIT	ORBIT
ORBIT	01.25	01.25	ORBIT	ORBIT
ORBIT	01.26	01.26	ORBIT	ORBIT
ORBIT	01.27	01.27	ORBIT	ORBIT
ORBIT	01.28	01.28	ORBIT	ORBIT
ORBIT	01.29	01.29	ORBIT	ORBIT
ORBIT	01.30	01.30	ORBIT	ORBIT
ORBIT	01.31	01.31	ORBIT	ORBIT
ORBIT	01.32	01.32	ORBIT	ORBIT
ORBIT	01.33	01.33	ORBIT	ORBIT
ORBIT	01.34	01.34	ORBIT	ORBIT
ORBIT	01.35	01.35	ORBIT	ORBIT
ORBIT	01.36	01.36	ORBIT	ORBIT
ORBIT	01.37	01.37	ORBIT	ORBIT
ORBIT	01.38	01.38	ORBIT	ORBIT
ORBIT	01.39	01.39	ORBIT	ORBIT
ORBIT	01.40	01.40	ORBIT	ORBIT
ORBIT	01.41	01.41	ORBIT	ORBIT
ORBIT	01.42	01.42	ORBIT	ORBIT
ORBIT	01.43	01.43	ORBIT	ORBIT
ORBIT	01.44	01.44	ORBIT	ORBIT
ORBIT	01.45	01.45	ORBIT	ORBIT
ORBIT	01.46	01.46	ORBIT	ORBIT
ORBIT	01.47	01.47	ORBIT	ORBIT
ORBIT	01.48	01.48	ORBIT	ORBIT
ORBIT	01.49	01.49	ORBIT	ORBIT
ORBIT	01.50	01.50	ORBIT	ORBIT

Cost Estimates

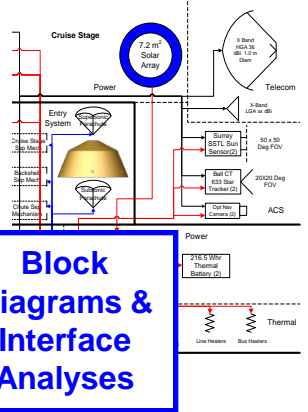
Final Point Design Report and Cost



Structures & Configuration



Block Diagrams & Interface Analyses





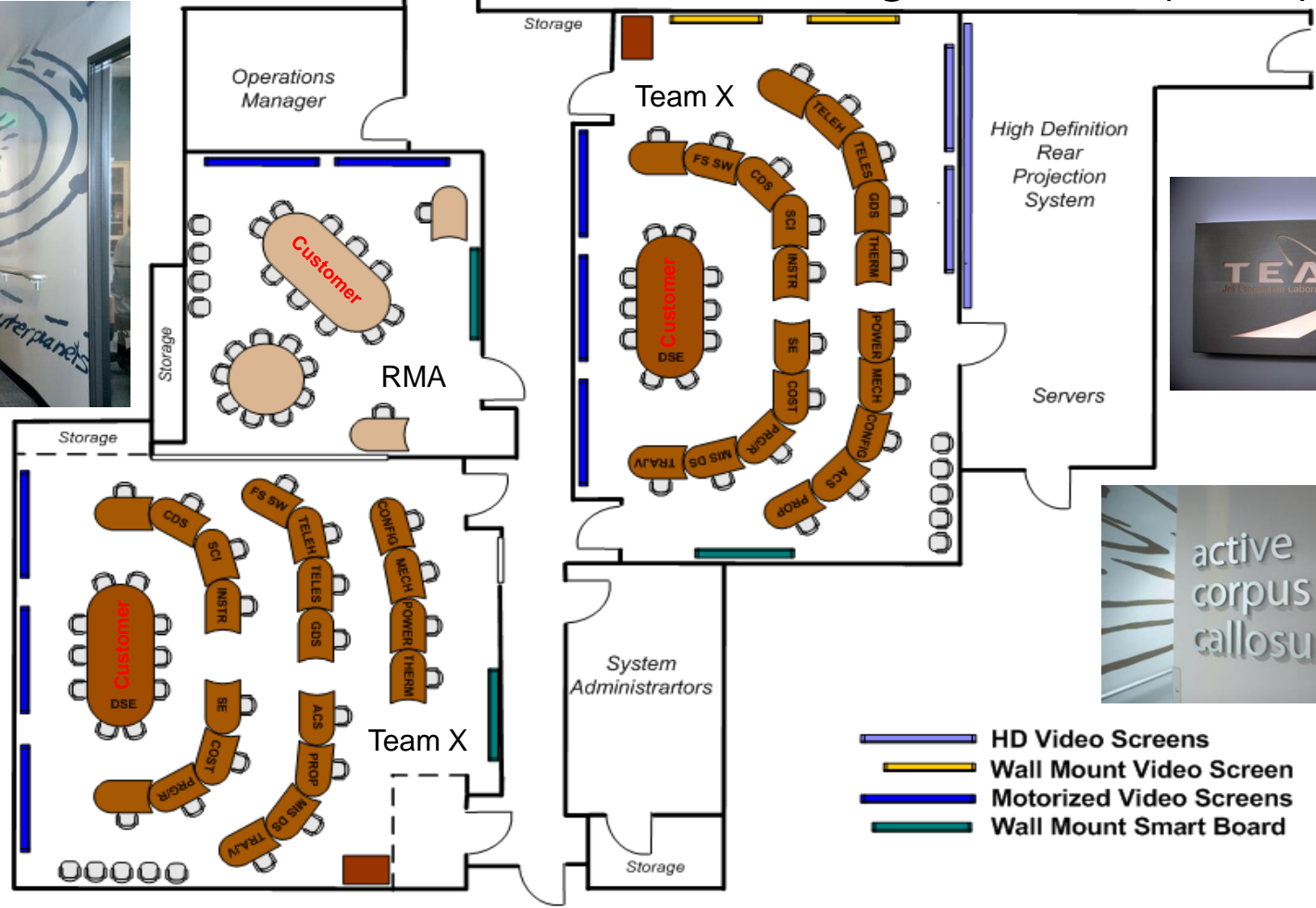
Staff Covers the Breadth of JPL's Capabilities

- Over 20 discipline experts at the subsystem level
- Extensive bench depth allows rapid staffing
- ***Planetary Science DS Panel Scientist***
 - Study Lead
 - Systems Engineer
 - Deputy Systems Engineer
 - Science
 - Instruments
 - Mission Design
 - Trajectory and Visualization
 - Configuration
 - Power
 - Propulsion
 - Mechanical
 - Thermal
 - Attitude Control Systems
 - Command and Data Systems
 - Telecom Hardware
 - Telecom Systems Engineering
 - Flight Software
 - Ground Data Systems
 - Programmatics / Risk
 - Cost
 - Domain specialists as needed



Facilities Enable Parallel Studies

Product Design Center (PDC)



-  HD Video Screens
-  Wall Mount Video Screen
-  Motorized Video Screens
-  Wall Mount Smart Board



DS Panel Interactions With Team X

- Planning meeting – understand study needs
- Begin preparation of inputs to Team X — Technical Data Package (TDP)
- Pre-session – review study plan, schedule, and cost
- Review TDP
- Discuss needed pre-session design work
 - Complicated trajectory analysis (multi-body tours, etc.)
 - Special subsystem analysis (extreme environments, sample acquisition, etc.)
 - Payload definition (likely from DS panel)
- Non-concurrent pre-session work (by Team X personnel and/or DS Panel)
- Sessions — concurrent engineering design / costing
- Typically, three 3-hour sessions to design and cost a mission
- Post-session, non-concurrent product completion
- Product delivery and closeout



Team X – Mature Point Designs for a Broad Class of Missions

- Rapid-turnaround, cost-effective mission concept development spanning early to mid CMLs, leading to CML 4 products for PS Decadal Survey
- Capabilities allow:
 - Wide breadth of mission concepts/disciplines
 - High Pre-Phase A concept definition maturity – CML 4
- Backed by refined and validated, institutionally supported integrated tools, models, and processes
- Study results readily flow into larger, dedicated, in-depth study teams
- Well-suited for all aspects of the Pre-Phase A design activities required by the PS Decadal Survey