Team X Support
to the Planetary Science Decadal Survey

James M. Kaufman
Manager, Advanced Concepts Development Office

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

RMA

MCT (“Team X”)

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JMK-5
Team X as Applied to the Decadal Survey

CML

1 2 3 4

PS DS Panels
Science Goals

RMA

Promising Concepts

Team X

PS DS Gate

Point Design and Cost

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Existing Concepts (CML ≥ 3)

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JMK-6
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
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

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JMK-8
Well-Defined Set of Study Products

- Trajectory Analysis & Visualization
- Technical Resource Scenario Analyses
- System-Level Resource Estimates
- Sensitivity Analysis
- Schedules
- MOS/GDS
- Master Equipment List
- Cost Estimates
- Final Point Design Report and Cost
- Structures & Configuration
- Block Diagrams & Interface Analyses

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JMK-9
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)

- Customer
- Operations Manager
- RMA
- Team X
- Team X
- System Administrators
- Storage
- High Definition Rear Projection System
- Servers

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

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JMK-11
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