



Goddard Space Flight Center

IMDC
ADVANCING CONCEPTS TO REALITY

The IMDC provides specific engineering analyses & services for mission design, and provides end-to-end mission design products. IMDC capabilities include:

- *Mission Studies, including System/Subsystem Concepts, Requirements & Trades*
- *New Technologies & Risk Assessments*
- *Technical Reviews & Focused Studies*

Specific System/Subsystem capabilities include the following:

SYSTEMS ENGINEERING

SERVICES: *Assist with Pre-Work & Requirements Definition; Facilitate Communication throughout Mission Design Process; Perform Trades & Select (with Customer) Best-Fit Options; Identify Modes of Operation; Verify Final Design Meets Customer Requirement*

PRODUCTS: *Operational Scenarios; System Requirements, Rational & Verification; Risks; System-Level Mass, Power, & Cost; Trades & Assumptions; Recommended Future Work*

COMMAND & DATA HANDLING (C&DH)

SERVICES: *Analyze Data Flow & Storage; Determine Processor Requirements; Perform Technology Surveys*

PRODUCTS: *Functional Block Diagram, Data Storage Type & Size; Data Processing Devices & Speeds; Mass, Size, and Power Consumption; Reliability; Cost*

RADIO FREQUENCY (RF) COMMUNICATIONS

SERVICES: *Define Mission Technical Profile (Model Data Volumes, Routes & Destinations, Space Segment Operational Requirements, Space Segment Autonomy Capabilities/Profile); Perform Trade Analysis including Implementation Options*

PRODUCTS: *Link Calculations; Uplink & Downlink Data Rates; Ground Station Selection & Number of Contacts; Cost*

ATTITUDE CONTROL SYSTEMS (ACS)

SERVICES: *Analyze Pointing, Jitter, Drift, Slewing, and Attitude Determination; Evaluate Targeting Scenarios (including Pointing Constraints, Observation Efficiency, & Sun/Earth/Moon Avoidance); Analyze Tip-Off, Acquisition, & Safe-Hold*

PRODUCTS: *ACS Scenario & Modes; Expected Control System Performance (Pointing, Jitter); Sensor Performance Specifications, Availability, Maturity & Cost; Actuator Availability, Sizing, Cost, & Maturity; Mass Estimate; MathCAD/ Excell/MatLab Calculations; New Technology Options; References*

FLIGHT DYNAMICS/MISSION DESIGN

SERVICES: *Define Orbit Type & Parameters; Identify Launch Vehicle/Mass Tradeoffs; Analyze Orbit Perturbations; Evaluate Orbit Stability; Define Maneuver Profile; Evaluate Propulsion Requirements; Compute Shadow Prediction; Compute Beta Angle Prediction; Compute Station Coverage Prediction; Evaluate Navigation System; Determine Tracking Requirements; Design Launch Window; Calculate Attitude Error Budget; Identify Re-entry Scenarios*

PRODUCTS: *Communications Coverage Analysis; Instrument Coverage Analysis; Orbit Maneuver Modeling; Orbit Maintenance Analysis; Lifetime Estimates; Delta-V Estimates; Operations Costs*

RISK ANALYSIS

SERVICES: *Identify Risks Unique to the Mission Architecture; Determine Possible Means of Reducing the Risk or Eliminating Altogether; Determine Likelihood of Risk Occurring and Severity of the Consequences if the Risk Did Occur*

PRODUCTS: *Table of Risks With Mitigation & Elimination Possibilities; Risk Matrix Showing Likelihood & Severity for Each Identified Risk*

MISSION OPERATIONS

SERVICES: *Analyze Size & Complexity of Mission Operations Required To Manage the Mission; Determine Profile of Operations Staff Build-up Before Launch, Size of Staff During Normal Operations & Phase-down at End of Life*

PRODUCTS: *Operations Scenarios & Approaches; Spreadsheet of Operations Costs, Including Control Center Acquisition Cost & Staff Cost Throughout the Mission Life Cycle*

The Internet

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INTEGRATION & TEST

SERVICES: Recommend Tests & Testing Flow; Evaluation of Schedule/Cost vs. Risk for Testing

PRODUCTS: Planned Tests, Cost Estimates & Trades; Work Breakdown Structure, Assumptions, Assembly Recommendations; Cost

MECHANICAL

SERVICES: Perform Solar Array Trades (including Body Mounted vs. Deployed Paddles, Single or Dual Wing, Articulated or Fixed); Package Solar Array; Analyze Array Stiffness; Analyze Fields of View (FOV), Package Appendages (Booms, Arms, Hatches, Covers and Shielding); Place all other Components within LV Envelope with Consideration for Thermal, Propulsion, Shadowing, & Other Mission-Unique Constraints

PRODUCTS: CAD Drawings; Launch Vehicle Payload Envelope; Payload Attached Fitting (PAF) Requirements; Load Analysis; Mass; Center of Mass; Moments of Inertia; Center of Pressure; Volume; Placement of Booms, Arms, Hatches, Covers & Shielding; FOV Locations; Cost

ELECTRICAL AND POWER SYSTEMS

SERVICES: Determine Power Budgets for Payload & Bus; Recommend Margin Allocation; Identify Power Management Schemes; Determine Orbital & Spacecraft Mechanics Effects on Design; Design/Size Solar Array; Perform Trade Studies to Determine Most Effective Solar Array Configuration; Determine & Plot Solar Array Power Margin; Select Battery Technology/Size; Assess Technology Options; Select Power System Electronics

PRODUCTS: Power Budget; Plot of Available Power over Mission; Description of Solar Array Configuration; Summary of Solar Array Sizing & Losses; Rationale for Battery Sizing & Technology Selection; New Technology Options; Summary of Power System Electronics; Block Diagram; Mass; Vendor Contacts; References; Cost

PROPULSION

SERVICES: Evaluate Propulsion System Needs; Evaluate Redundant Systems; Assess Thruster Plume

PRODUCTS: Location & Type of Thrusters/Propellant Tanks; Pressurization Method; Thruster Cant Angles; Operating Pressure; Pressure Blowdown Parameters; Plumbing Flow Loss Parameters; Conceptual Propulsion Layouts; Dry Mass & Materials; New Technology Options; Cost

THERMAL

SERVICES: Analyze Temperature Control & Temperature Gradients; Size, Place & Configure Radiators; Select Thermal Coatings; Determine Heater Sizing; Select Temperature Sensor; Perform Technology Trades; Define Attitude Constraints (Sun/Earth Avoidance)

PRODUCTS: Thermal Control System Design; Thermal System Performance; Heater Circuit Design; Heater Power Budget; Thermal Hardware Specifications & Availability; Thermal Hardware Maturity; Thermal Modeling & Analysis; New Technology Options; References; Mass; Cost

LAUNCH VEHICLE

SERVICES: Identify Launch Vehicles Capabilities; Typical Launch Profiles and Fairing Dimensions

PRODUCTS: For Each Possible Launch Vehicle: Information on Shroud Dimensions and Typical Launch Profile; Description of Launch Vehicle Options, Such as Added Stages Required for the Mission; Cost

FLIGHT SOFTWARE

SERVICES: Analyze Required Onboard Software Functions; Identify Required Software Simulators for Preparation and Test of Software; Define Fallback Plan in Case Onboard Software Exhibits a Functional Problem

PRODUCTS: Flight Software System Design; Diagrams of Software Simulators or Test Fixtures; List of Software Functions Required; Cost

PARAMETRIC COST ANALYSIS

SERVICES: Using Price-H Application, Estimate Cost of Spacecraft Bus Based on Spacecraft Design; Determine Complexity and Other Factors Affecting Cost for Each Bus Subsystem

PRODUCTS: Parametric Cost Estimate and Rationale; Data File for Price-H Application; Spreadsheet of All Cost Elements Utilized in the Price-H Analysis

