



# *Office of Exploration Systems*

## *Program Overview*



*March 2 - 3, 2004*

*Associate Administrator,  
Office of Exploration Systems  
Rear Admiral Craig E. Steidle (Ret.)*



# 2004 President's Vision for Space Exploration A New Future for U.S. Civil Space Programs

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*"This cause of exploration and discovery is not an option we choose; it is a desire written in the human heart."*

President George W. Bush  
February 4, 2003

*"We leave as we came, and God willing as we shall return, with peace and hope for all mankind."*

Eugene Cernan (Commander of last Apollo mission)  
December 17, 1972

*". . . America will make those words come true."*

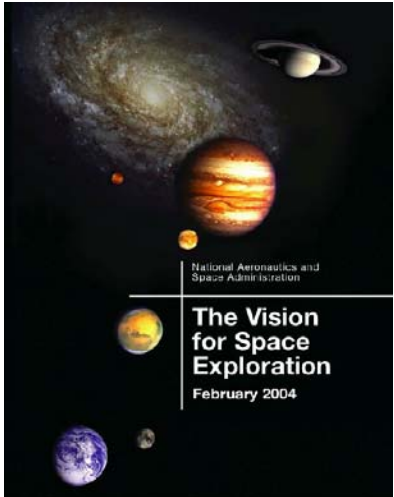
President George W. Bush  
January 14, 2004



- On January 14, 2004, President Bush articulated a new Vision for Space Exploration in the 21st Century
- This Vision encompasses a broad range of human and robotic missions, including the Moon, Mars and destinations beyond
- It establishes clear goals and objectives, but sets equally clear budgetary 'boundaries' by stating firm priorities and tough choices
- It also establishes as policy the goals of pursuing commercial and international collaboration in realizing the new vision
- *Advances in Human and Robotic Technology will play a key role as enabler and major benefit of the new Vision...*



# The Vision for Space Exploration - National Benefits Key Role of Innovation and Technology...



- **Background**

- “...U.S. achievements in space...have led to the development of technologies that have widespread applications to address problems on Earth...”
- “In preparation for future human exploration, we must advance our ability to live and work safely in space and, at the same time develop the technologies to extend humanity’s reach to the Moon, Mars and beyond. The new technologies required for further space exploration also will improve the Nation’s other space activities and may provide applications that could be used to address problems on Earth.”

- **Policy Objective (Technology)**

- “Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about the destinations for human exploration...”

- **National Benefits (Technology)**

- “Preparing for exploration and research accelerates the development of technologies that are important to the economy and national security. The space missions in this plan require advanced systems and capabilities that will accelerate the development of many critical technologies, including power, computing, nanotechnology, biotechnology, communications, networking, robotics, and materials.”
- “These technologies underpin and advance the U.S. economy and help ensure national security. NASA plans to work with other government agencies and the private sector to develop space systems that can address national and commercial needs.”



# The Nation's Vision

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1. Return the Shuttle to safe flight as soon as practical, based on CAIB recommendations
2. Use Shuttle to complete ISS assembly
3. Retire the Shuttle after assembly complete (2010 target)
4. ***Focus ISS research to support exploration goals; understanding space environment and countermeasures***
5. Meet foreign commitments
6. ***Undertake lunar exploration to support sustained human and robotic exploration of Mars and beyond***
7. ***Series of robotic missions to Moon by 2008 to prepare for human exploration***
8. ***Expedition to lunar surface as early as 2015 but no later than 2020***
9. ***Use lunar activities to further science, and test approaches (including lunar resources) for exploration to Mars & beyond***
10. ***Conduct robotic exploration of Mars to prepare for future expedition***
11. ***Conduct robotic exploration across solar system to search for life, understand history of universe, search for resources***
12. ***Conduct advanced telescope searches for habitable environments around other stars***
13. ***Demonstrate power, propulsion, life support capabilities for long duration, more distant human and robotic missions***
14. ***Conduct human expeditions to Mars after acquiring adequate knowledge and capability demonstrations***
15. ***Develop a new Crew Exploration Vehicle; flight test before end of decade; human exploration capability by 2014***
16. ***Separate cargo from crew as soon as practical to support ISS; acquire crew transport to ISS after Shuttle retirement***
17. Pursue international participation
18. Pursue commercial opportunity for transportation and other services



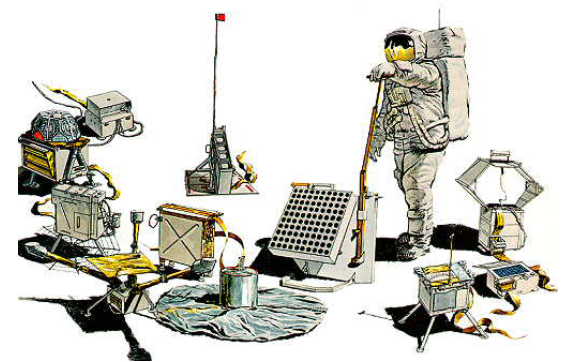
# Key Elements of the Nation's Vision

- **Objectives**

- Implement a sustained and affordable human and robotic program
- Extend human presence across the solar system and beyond
- Develop supporting innovative technologies, knowledge, and infrastructures
- Promote international and commercial participation in exploration

- **Major Milestones**

- 2008: Initial flight test of CEV
- 2008: Launch first lunar robotic orbiter
- 2011 First Unmanned CEV flight
- 2014: First crewed CEV flight
- 2015: Jupiter Icy Moon Orbiter (JIMO)/Prometheus
- 2015-2020: First human mission to the Moon







# ***Craig Steidle Background***

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- 1993 Secretary of Defense “Bottom-Up” Review
- Shut-down Navy Advanced Fighter (AF/X) program
- Shut-down Air Force Multi-Role Fighter (MRF) program
- Established Joint Advanced Strike Technology Office
- Established Advanced Short Take Off/ Vertical Landing program



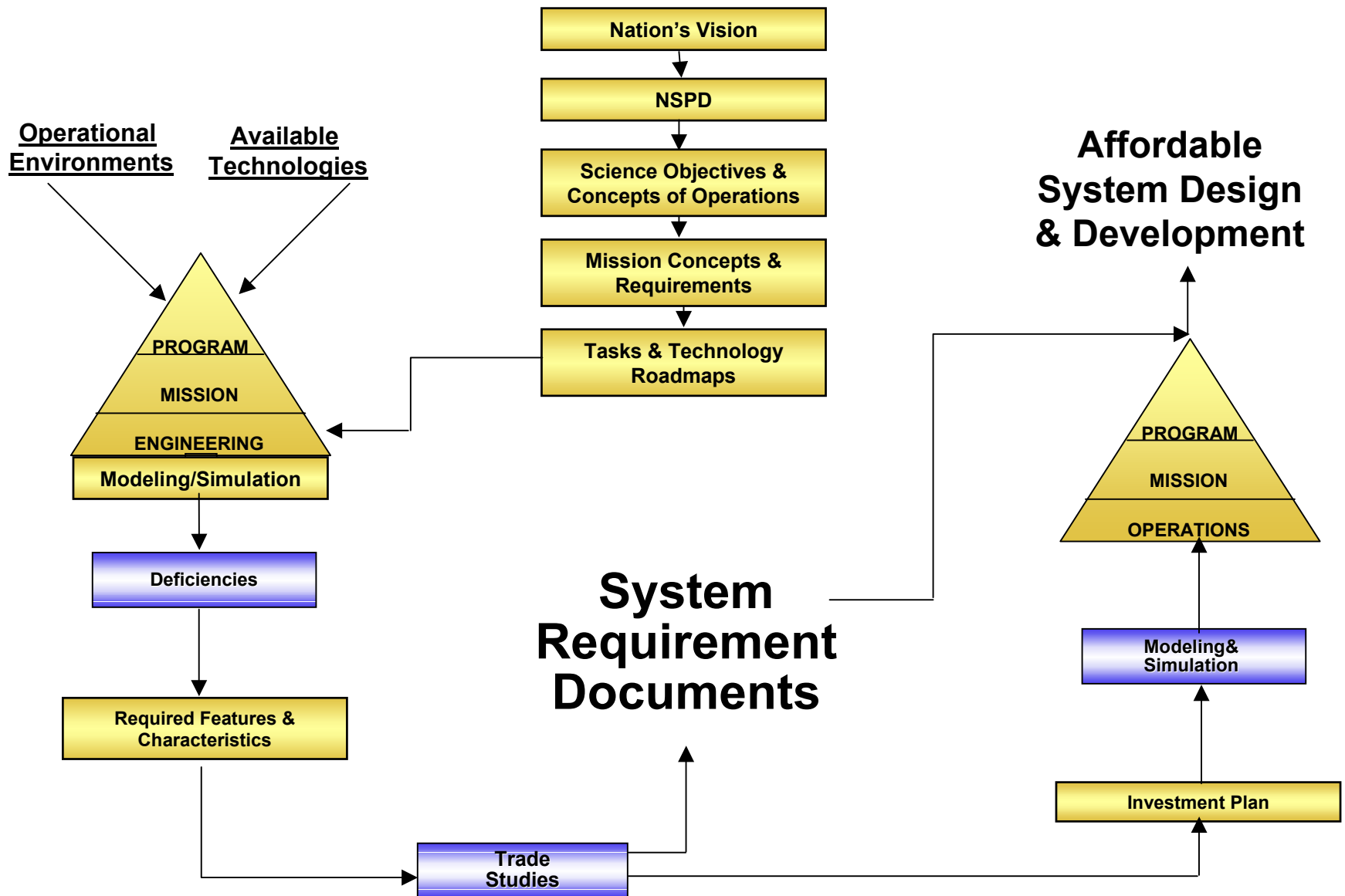
# ***Exploration Systems: Building on Past Findings and Lessons Learned***

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- **Packard Commission Findings**
  - Get operators and technologists together to enable the leveraging of cost-performance trades
  - Apply technology to lower cost of system, not just to increase its performance
  - Mature technology prior to entering engineering and systems development
  - Partnerships with Industry to identify innovative solutions
- **Report of the DSB/AFSAB (Young Report)**
  - Requirements definition and control are dominant drivers of cost, schedule, and risk in space systems development programs



# Strategy-to-Task-to-Technology Process

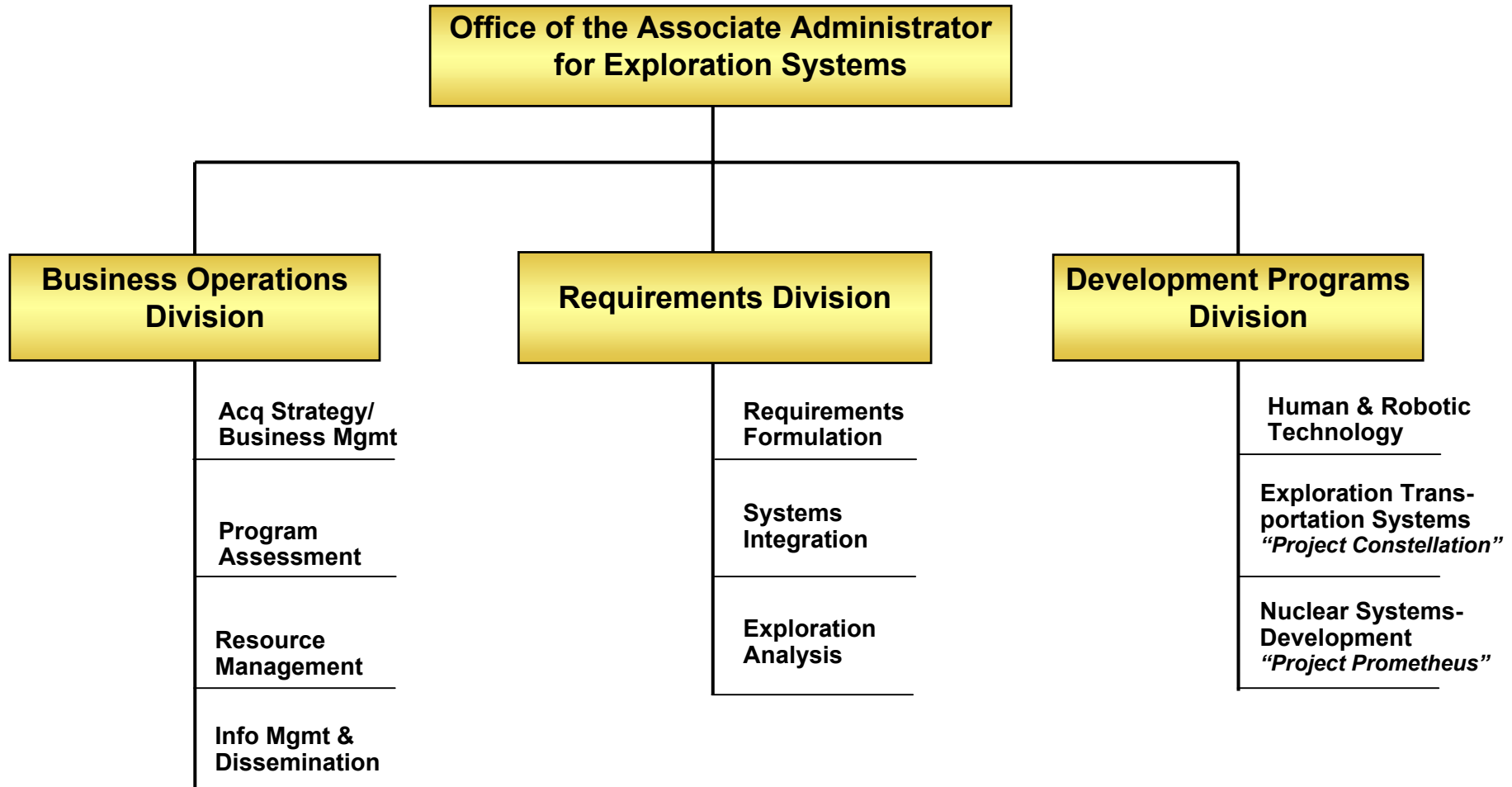








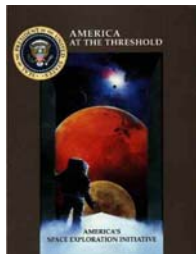
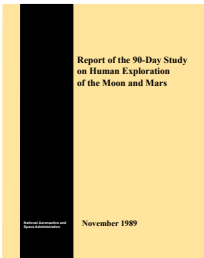
# Office of Exploration Systems Organization





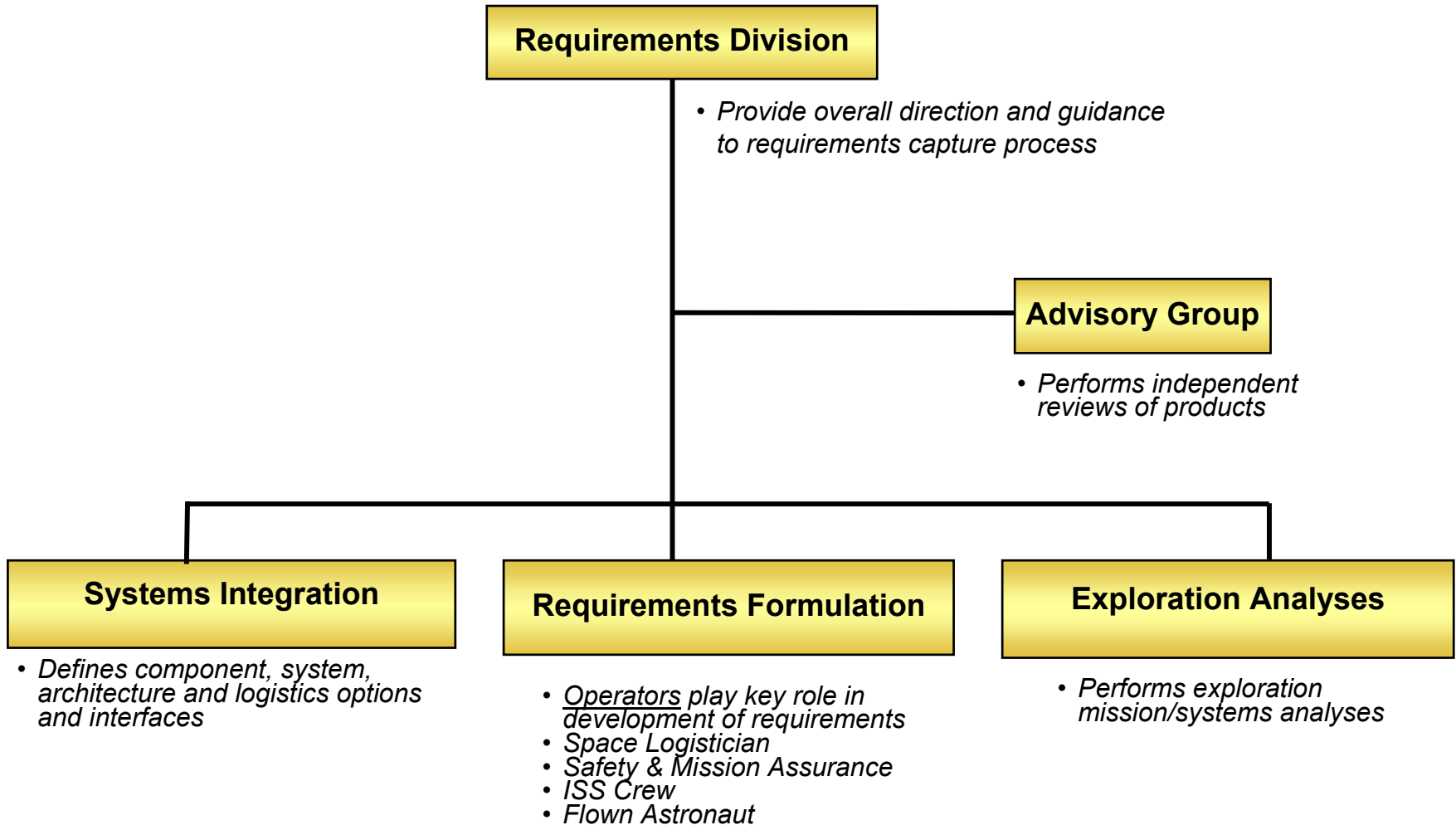
# History of Exploration Architecture Studies

- 1988 Case Studies
- 1989 Case Studies
- NASA 90-Day Study – 1989
- “The Synthesis Group” – 1991
- First Lunar Outpost – 1993
- Early Lunar Resource Utilization – 1993
- Human Lunar Return – 1996
- Mars Exploration Missions
- Mars Combo Lander-1999
- Dual Landers- 1999
- Decadal Planning Team/NEXT- 2000-2002
- Exploration Study 1 – 2002-2003
- Special Studies 2003



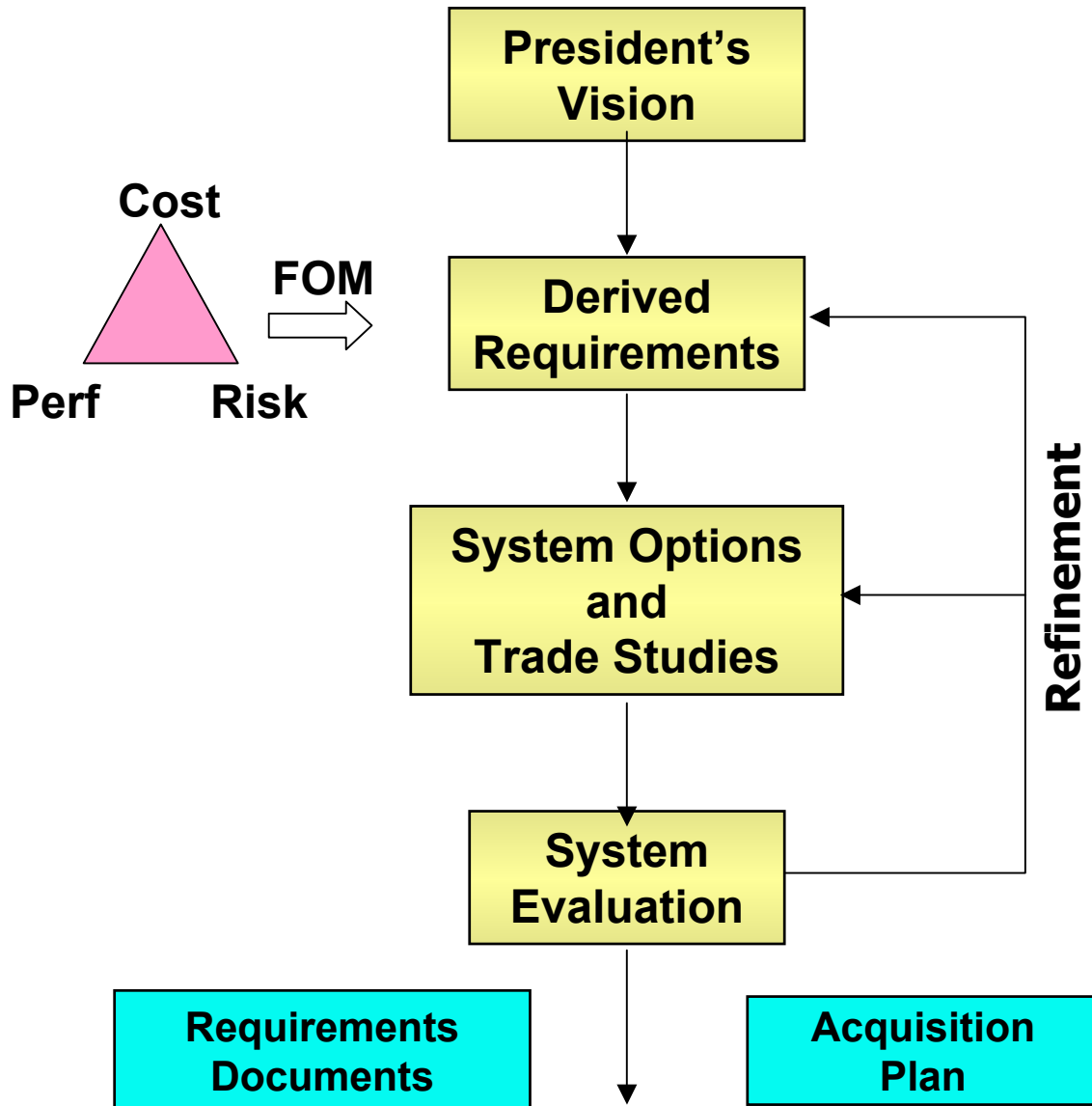


# Requirements Division Organization



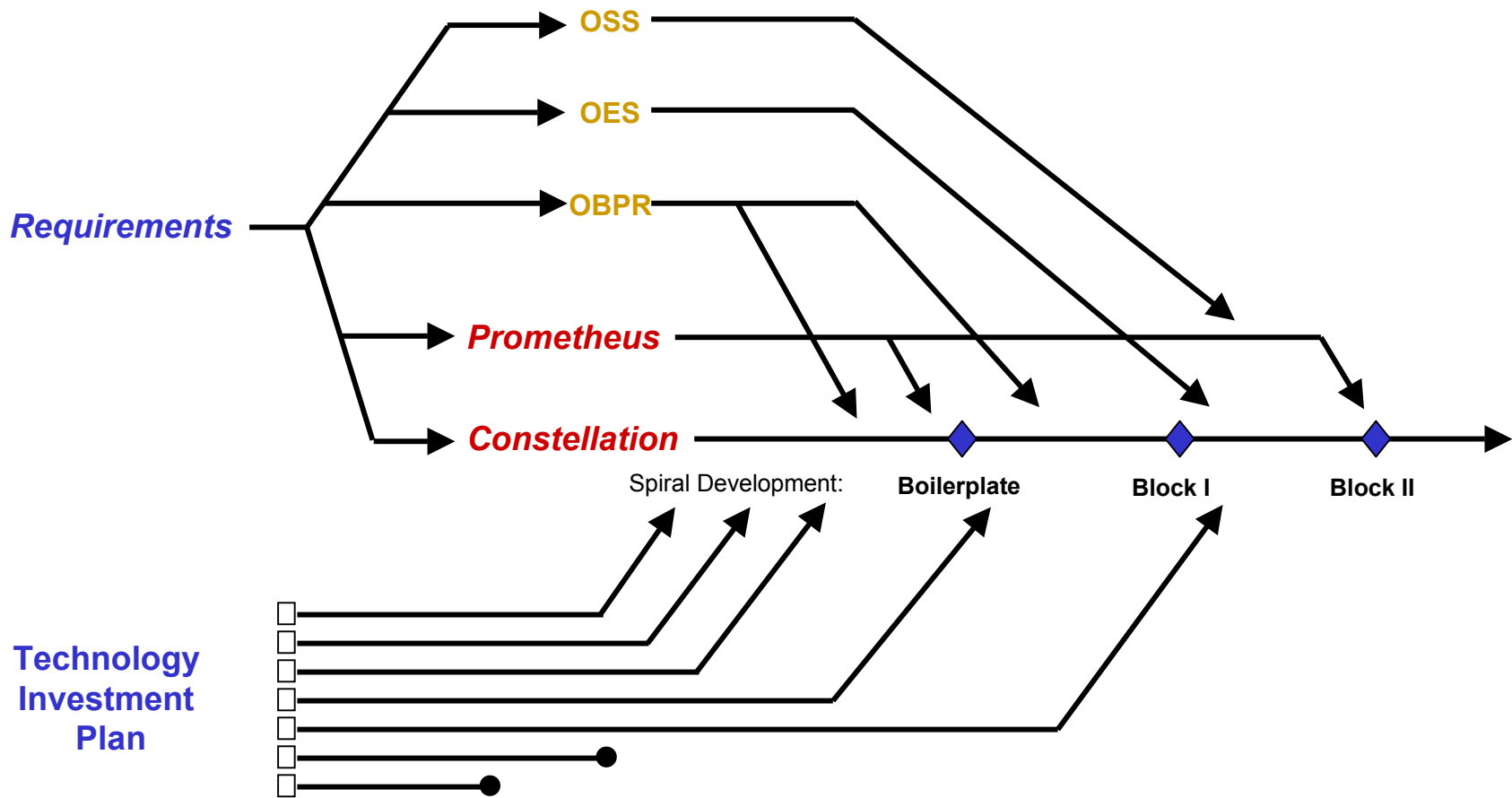


# Requirements Capture Process





# Requirements and Technology Investment Flow







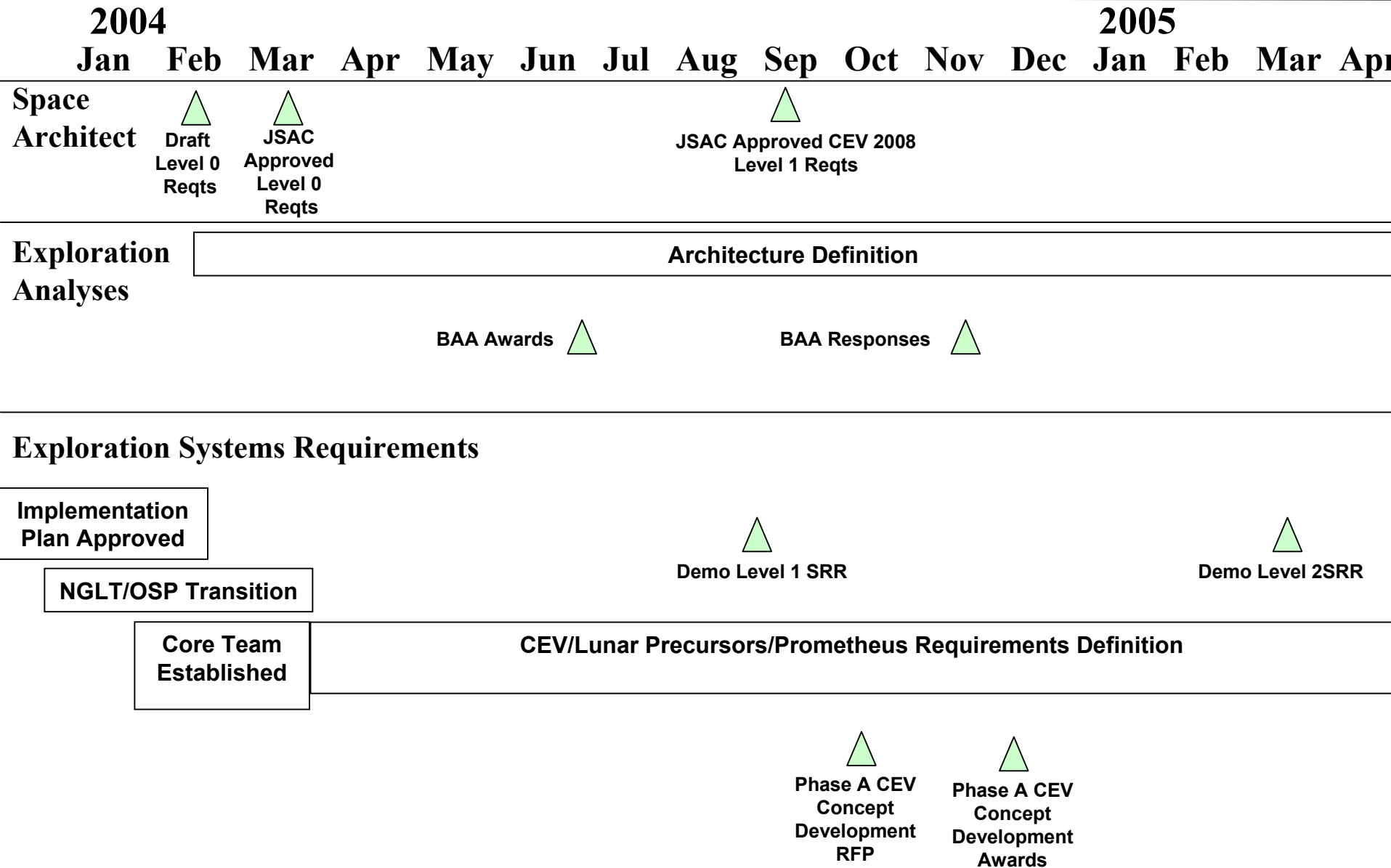
## ***Requirement Division FY04 Products***

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- **Crew Exploration Vehicle (CEV) Level 1 requirements with supporting documentation (concept of operations, QFD analyses, technology assumptions, etc.)**
- **Lunar orbiter mission Level 1 requirements with supporting documentation**
  - Technology guidelines, initial concepts, and use of existing hardware
- **Lunar lander mission Level 1 requirements with supporting documentation**
  - Technology guidelines, initial concepts, and use of existing hardware
- **Prometheus Level 1 capability development requirements**
- **Integrated Agency capability and technology traceability assessment showing linkages from development activities to Space Architect's space strategy**
- **Summary Report with supporting documentation**

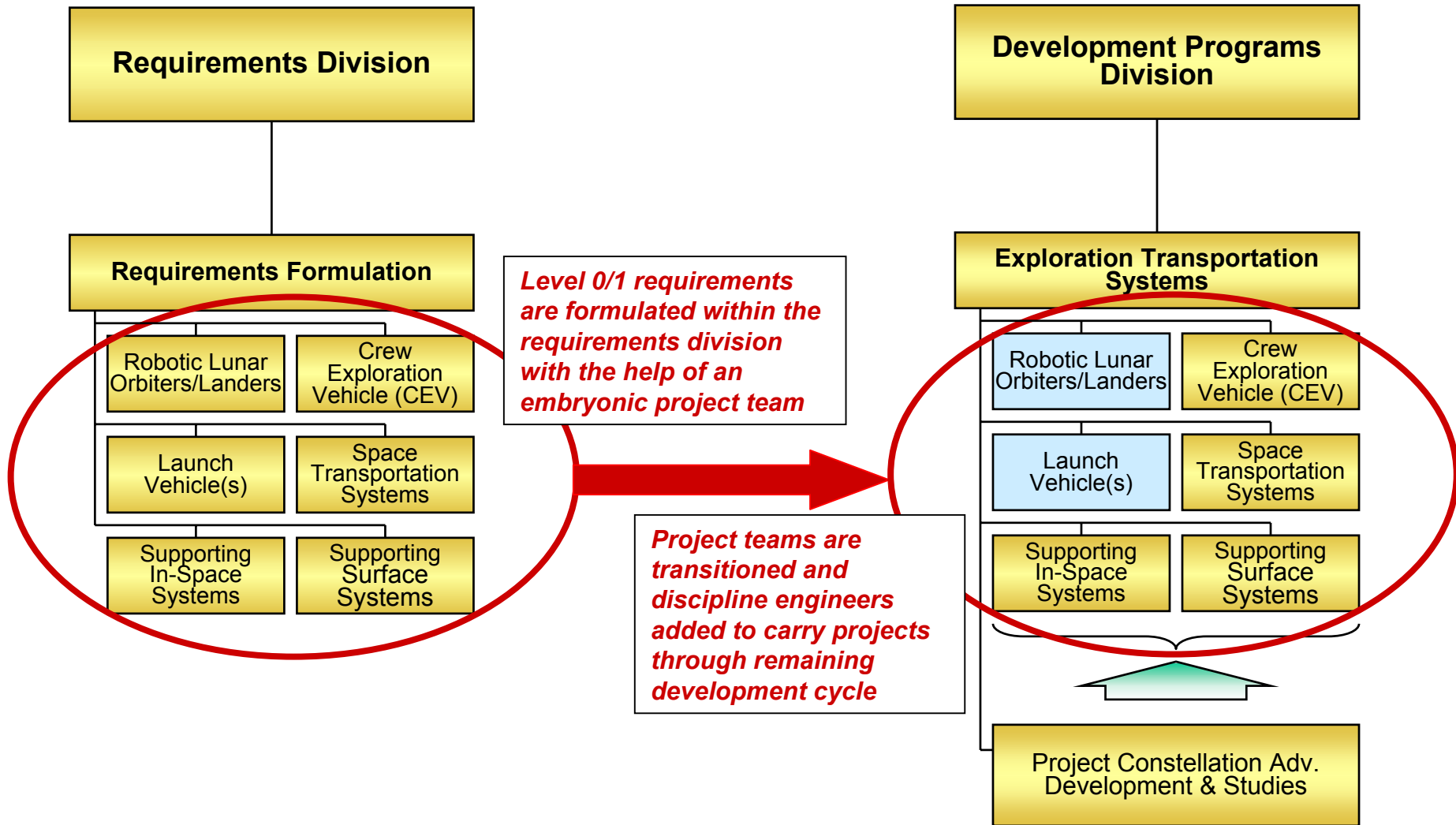


# CEV Requirements Development





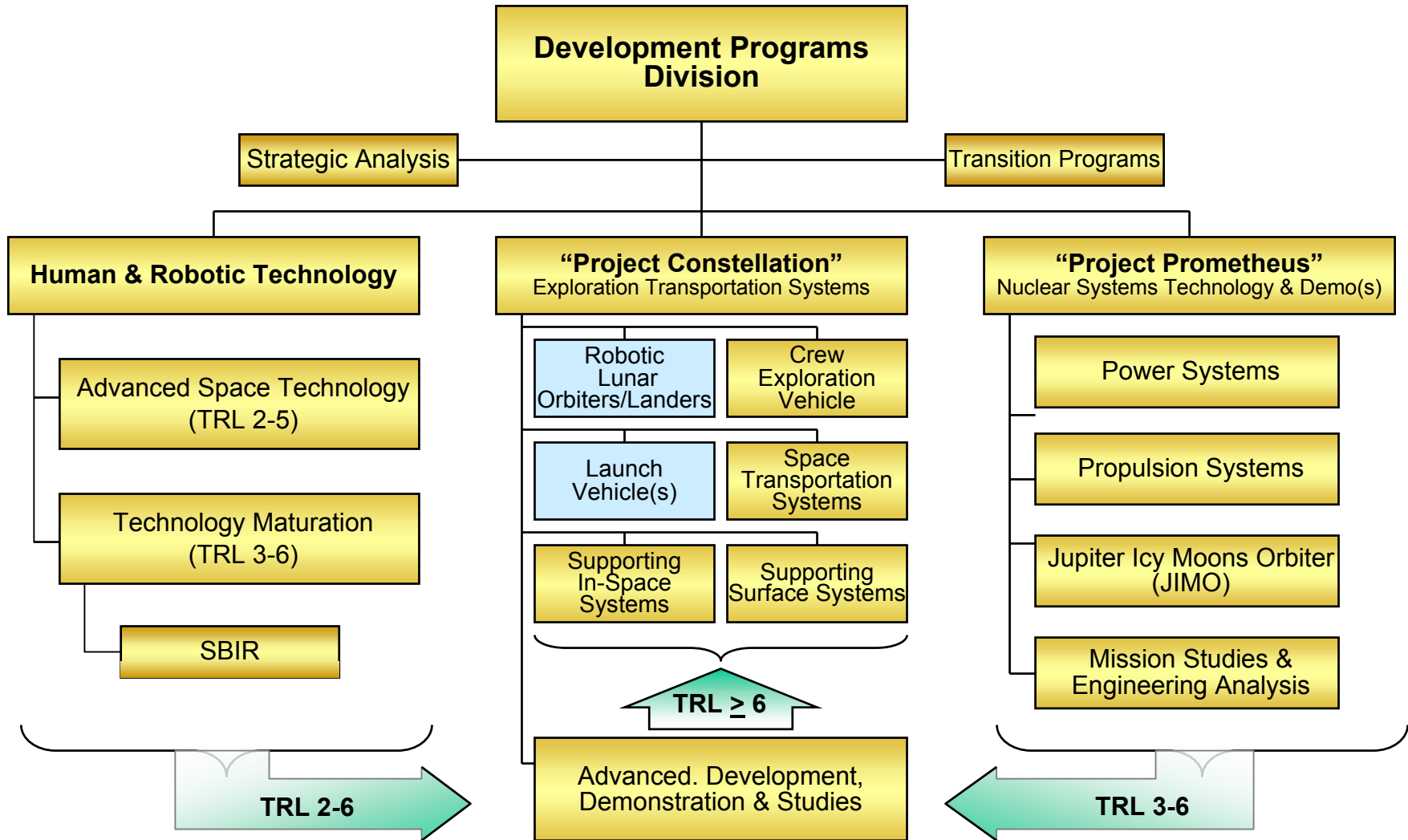
# Requirements to Development Programs Hand-off



Coordination responsibility with other Enterprises



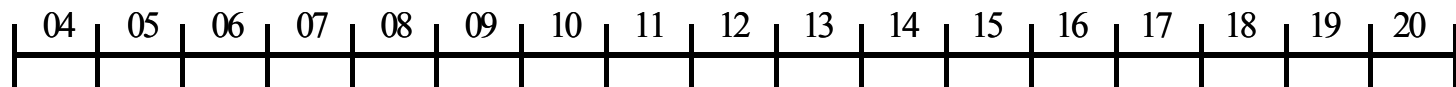
# Development Programs Division



 Coordination Responsibility with other Enterprises

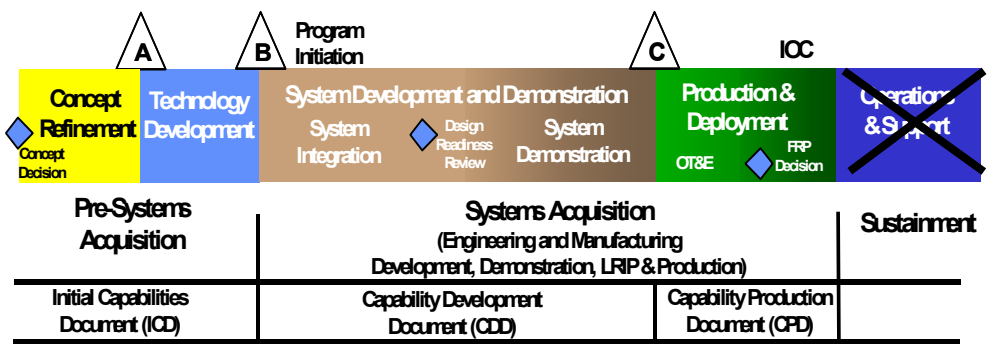


# Project Constellation Timeline



Nation/NASA Vision

Requirements  
Level 0, 1...  
Spiral 1



Unmanned Space Vehicle

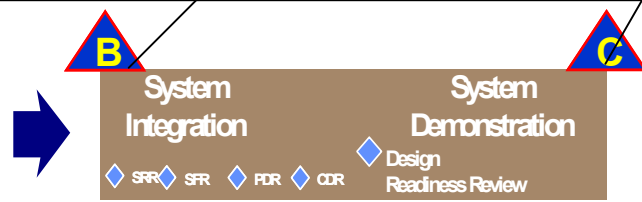
Requirements  
Level 0, 1...  
Spiral 2



Manned Space Vehicle

Spiral nth? → Mars (2020+)

Critical Milestones during System Integration and Demonstration (Notional Only)



Non-advocacy Reviews Independent Cost Reviews



## Development Division FY 04 Products

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- **Create Work Breakdown Structure (WBS) based on requirements for Exploration Systems**
- **WBS populated by re-aligned Advanced Space Technology, Technology Maturation, and NGLT demonstration technology projects plus OSP lessons-learned**
- **Investment Plan based on WBS gap analysis**
- **Single Acquisition Management Plan Framework to include:**
  - Key Performance Parameters (KPPs), and Operational Thresholds and Objectives
  - Spiral Development Objectives and Milestones
  - Acquisition Strategy/Acquisition Program Baseline (APB)
  - Performance-Based measures for cost, schedule & performance
    - Integrated Baseline Reviews, EVMS tracking, Risk Analysis and Mitigation, Entrance/Exit Criteria...





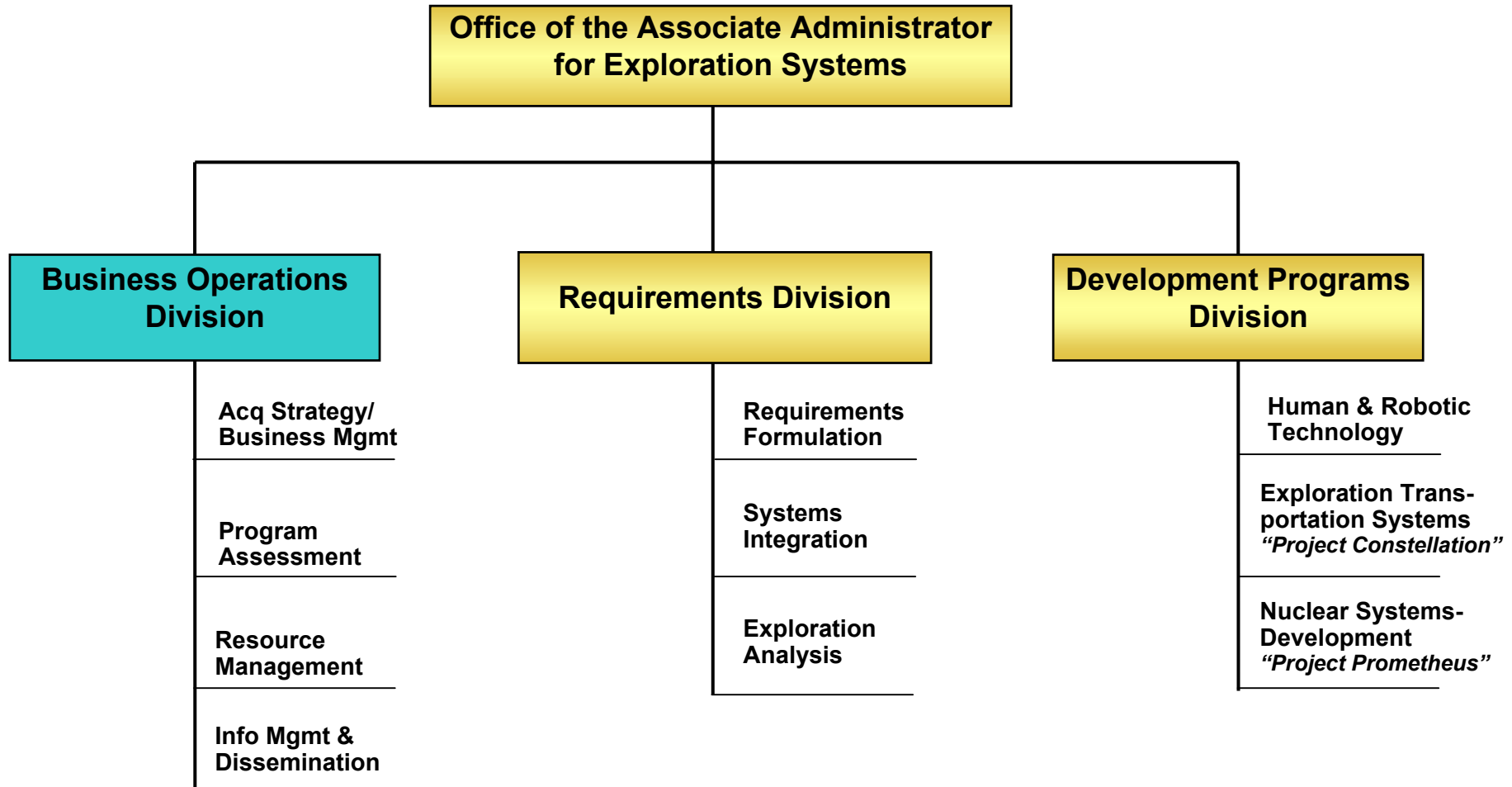
# ***Current Development Programs Status***

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- **Vision, mission and goals formulated**
  - Consistent with National vision
- **FY04 objectives in review**
  - Organizational structure being finalized
  - Staffing underway
- **Program-level Work Breakdown Structure in development**
  - Participation by all Code T divisions
- **Advanced Space Technology, Technology Maturation and NGLT projects being re-aligned**
  - Focused on Transportation System elements
- **Program management processes, tools and metrics being evaluated for ensuring on-cost, on-schedule & on-performance**
  - Integrated Baseline Reviews, EVMS Tracking, Technical Performance Measurement, Critical Path Method, etc.
- **Major events for Spiral 1 being determined**
  - Milestones A and B
  - SRR / SFR / PDR / CDR



# Office of Exploration Systems Organization





## Business Operations Division

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- **Institutionalize disciplined and repeatable business planning and management framework**
  - Complements Requirements Division and Development Programs Division activities
  - Provides resources, business acumen, tools, and communication networks to execute exploration systems mission
- **Hybrid staff/line unit continuously engaged and equally accountable for mission success**



# ***Business Operations Division Competency Areas***

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- **ACQUISITION STRATEGY**
  - Formulation, Review & Approval Process
  - Best Practices and Lessons Learned
  - Tools and Training
- **PROGRAM AND BUSINESS AUTHORIZATIONS**
  - Acquisition Plans, D&Fs, Solicitation Content Keyed to Developmental Spirals, Incentivization Construct, Business Clearance
- **BUDGET ANALYSIS AND ALLOCATION**
  - Enterprise Budget Formulation and Substantiation
  - Execution Planning and Performance to Goal Measurement
- **ENTERPRISE WORK FORCE UTILIZATION**
  - Efficient and Cost Effective Application of Human Capital
- **INTEGRATED PROGRAM ASSESSMENT MEASUREMENT**
  - Disciplined and Accurate Performance, Cost, Affordability and Schedule Indicators
  - Baselining and Uniform Reporting to Facilitate Trade-off Decisions
- **INFORMATION MANAGEMENT AND DISSEMINATION**
  - Electronic, Written and Face-to-Face Communication with all Stakeholders

**THRUST: SEAMLESS & RESPONSIVE BUSINESS PROCESSES  
THAT BROKER REQUIREMENTS INTO PROGRAM EXECUTION**



## ***Business Operations Division FY04 Products***

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- **Acquisition strategy & business formulation**
  - Enterprise system single acquisition and management plan (SAMP)
  - Conduct Industry and stakeholder roundtables
  - Head of Contracting Activity (HCA) delegations of authority to AA
- **Resource management**
  - Disciplined funds obligation & cost execution
  - Enterprise workforce business case assessment
- **Program assessment**
  - Integrated program & financial management module (EVMS)
- **Information management & dissemination**
  - Automated presentation archive & retrieval system, education plan, web site...



# ***Overview and Goals for Centennial Challenges***

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- **What Is Centennial Challenges?**
  - Program of contests in which NASA will establish prize purses to stimulate innovation and competition in technical areas of interest to space exploration and ongoing NASA priorities.
  
- **Program Goals for Centennial Challenges**
  - Stimulate innovation in ways that standard federal procurements cannot
  - Enrich NASA research by reaching new communities
  - Help address technology pitfalls
  - Achieve returns that outweigh program investment
  - Educate, inspire and motivate the public





# “Prehistory” of Centennial Challenges

- **Long History of Prizes for Technological Innovation**
  - 18<sup>th</sup> Century: British Longitude Prize
  - 20<sup>th</sup> Century: Aviation prizes including Orteig Prize (Lindberg)
  - Ongoing: X-Prize and DARPA Grand Challenge
- **1999 National Academy of Engineering Workshop**
  - “Concerning Federally Sponsored Inducement Prizes in Engineering and Science,” 1999
  - Blue ribbon committee recommended that “Congress encourage federal agencies to experiment more extensively with inducement prize contests in science and technology”
- **2003 NASA Space Architect Study**
  - X-Prize Foundation assisted
  - Interviews at field centers and headquarters generated list of 129 candidate challenges
  - Winnowed to 15 candidate challenges based on enterprise interests and other considerations
  - Estimated purse sizes and expected time to completion
  - Formed basis for Centennial Challenges program formulation





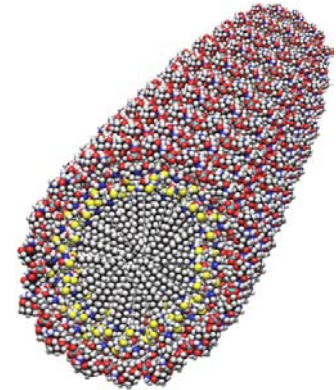
# Program Assumptions for Centennial Challenges

- **Challenges Will Address NASA Vision With Emphasis on Exploration**
  - To Improve Life Here
  - To Extend Life to There
  - To Find Life Beyond
  - Lean program with low overhead to preserve funding for challenges
- **Program Plan and Individual Challenges To Be Finalized After External Inputs**
  - Spring workshop to solicit external challenge ideas and refine best candidates
  - Website, including listserv and form for submitting challenge ideas
  - Press announcement on workshop and website expected shortly
- **Challenges Will Be Initiated on Annual Cycles**
  - FY 2004 cycle limited to existing authority (\$250K or less purses)
  - FY 2005 and later cycles to include larger purses (2005 NASA authorization bill)
  - Repeat workshops annually and solicit external ideas

} *Exploration Emphasis*

- **What Kinds of Challenges?**

- Revolutionary advances in fundamental technologies
- Breakthrough robotic capabilities
- Very low cost space missions
- Final challenges subject to external inputs and internal review and decisions



- **Who Can Participate?**

- U.S. citizens who are not federal employees (including FFRDCs) unless otherwise specified in challenge rules
- Industry, academia, non-profits, students, individuals
- Contestants will be required to register



- **How Can I Help?**

- Word of Mouth: Challenges improve with number and quality of contestants
- Expertise: Help with rules formulation and judging





# *Exploration Systems 2004 Objectives*

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- Obtain OSP/NGLT Government/Industry lesson's learned
- Bring Level 1 Constellation (CEV) and Prometheus requirements to SRR maturity
- Complete 1<sup>st</sup> round of Industry Concept Studies
- Complete preliminary requirements analysis
- Perform detailed technology assessments and baseline reviews
- ID high payoff areas for TM investment
- Competitively award follow-on Project Prometheus JIMO contract
- Hold several Industry Days
- Complete charter and 1<sup>st</sup> draft of exploration systems master plan
- Initiate risk mitigation plans
- Formulate acquisition strategy and initial acquisition plan
- Formulate demonstration plan



# Office of Exploration Systems

*We're not where we want to be,  
We're not where we're going to be,  
BUT we're certainly not where we  
were yesterday.*

*M.L. King, Jan '68*

