

A space-themed background featuring a view of Earth from space, showing the blue atmosphere and white clouds. In the upper right, the Moon and Mars are visible against the blackness of space. The title text is centered in a white, italicized serif font.

Enterprise Architecture Challenges

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The Plan for Space Exploration



Innovation



Int'l commercial participation



Develop Orion



Return to the Moon



Humans across solar system



Sustained program



Complete ISS



Fly STS until 2010



Constellation's Projects



The Constellation Program is comprised of seven Projects:

Ares- Launch Vehicle



Orion-Crew Exploration Vehicle



Extravehicular Activities



Mission Operations



Ground Operations



Altair



Lunar Surface Systems



Constellation's Workforce – NASA



Ames Research Center

- Lead thermal protection system development
- Aero-Aerothermal database
- Ares abort simulators
- Software and Guidance, Navigation & Control support

Glenn Research Center

- Lead Service Module and Spacecraft Adapter integration
- Flight Test Article "Pathfinder" fabrication
- Ares I-X upper stage simulator lead
- Ares power thrust vector control and sensors lead
- J-2X engine altitude/in-space testing
- Systems Engineering and Integration support

Langley Research Center

- Lead Launch Abort System integration
- Lead landing system Advanced Development Program
- Ares I-X vehicle integration
- Ares aerodynamics lead
- System Engineering & Integration support

Goddard Space Flight Center

- Communications support

Michoud Assembly Facility

- Orion and Ares component mfging
- Rocket propulsion testing for Ares

Marshall Space Flight Center

- Home for Ares Project
- Ares I and V development and integration lead
- LAS and SM Systems Engineering and Integration support

Dryden Flight Research Center

- Lead abort test flight integration/operations
- Abort test booster procurement
- Flight Test Article development/integration

Johnson Space Center

- Home for Constellation Program
- Home for Projects: Orion, Mission Ops, EVA, Altair and Lunar Surface Systems
- Lead Crew Module integration
- Orion spacecraft integration
- GFE projects management
- Flight Test Program

Kennedy Space Center

- Home for Ground Operations Project
- Ground processing
- Vehicle integration
- Launch operations
- Recovery operations

JPL (Jet Propulsion Laboratory)

- Thermal protection system support
- Mission Operations support
- Test and Verification support

Stennis Space Center

- Rocket propulsion testing for Ares

White Sands Test Facility

- Orion Launch Abort System test site

Constellation's Workforce – Contractors



Additional Companies with > \$10M Contracts:

- American Synthetic Rubber Co. (KY)
- Ensign Bickford (CT)
- Kirkhill-TA Company (CA)
- Ladish Company (WI)
- Moog, Inc. (NY)
- Andrews Space, Inc. (WA)

University Contracts:

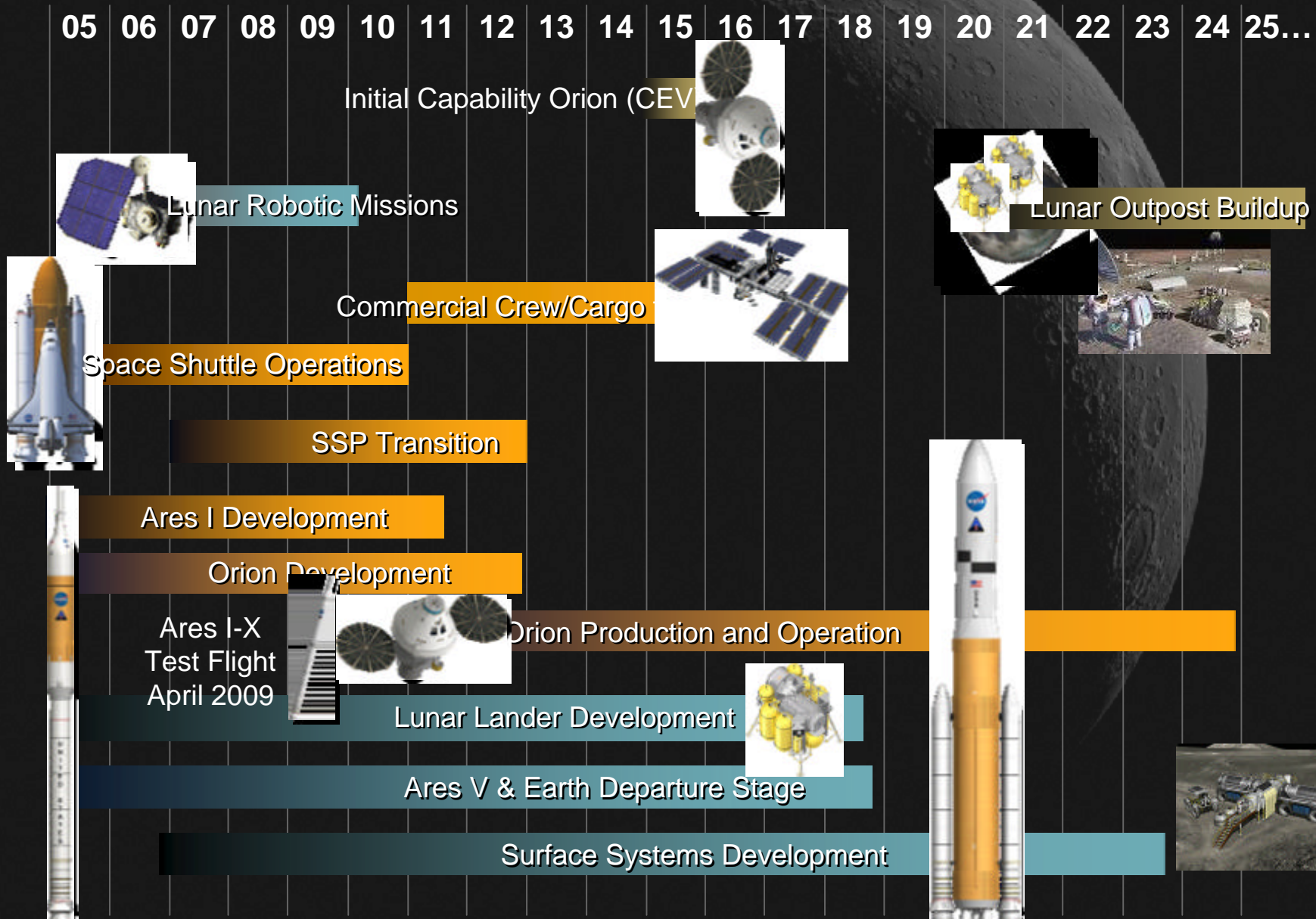
- Brigham Young University (UT)
- University of Illinois (IL)
- University of Texas – El Paso (TX)



Selected Subcontracts < \$10M (currently more than 200 across 33 states & Puerto Rico):

- | | | | |
|--|--|---|--|
| <ul style="list-style-type: none"> • Northrop Grumman Systems (AL) • Teledyne-Brown Engineering (AL) • Magellan Aerospace Turbine (AZ) • Curbell Plastics (AZ) • Aero Spring & Manufacturing (AZ) • Pilot Engineering (AZ) • Shultz Steel Company (CA) • Laurel Sheet Metal Prod., Inc. (CA) • Standard Tool & Die Co. (CA) | <ul style="list-style-type: none"> • Rudell Carbide, Inc. (CA) • Advanced Products Co. (CT) • E.I. Dupont De Nemours & Co. (DE) • Parker Hannifin Corp. (FL) • Productivity APEX (FL) • Global Equipment Co. (GA) • Snap-On Industrial (IL) • Varian Associates Inc. (IL) • Smalley Steel Ring-Co. (IL) | <ul style="list-style-type: none"> • The Caldwell Group (IL) • Major Tool & Machine Inc. (IN) • Dynamic Flowform Corp. (MA) • Standex International (MA) • Remmele Engineering, Inc. (MI) • Hitchcock Industries, Inc. (MN) • AV Chem, Inc. (MO) • JPM of Mississippi, Inc. (MS) • Turbocam, Inc. (NH) | <ul style="list-style-type: none"> • Software House International (NJ) • United States Welding Corp. (NV) • UFC Aerospace Corporation (NY) • PCB Piezotronics, Inc. (NY) • Special Metals Corporation (NY) • Metalflex Manufacturing, Inc. (OH) • PCC Structurals, Inc. (OR) • Stein Seal Company (PA) • Electrolizing, Inc. (RI) |
|--|--|---|--|

NASA's Exploration Roadmap



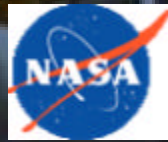
Ares Progress

Ares I-X Test Rocket

Workers at NASA's Glenn Research Center in Ohio inspect the latest simulated segments for the Ares I-X test rocket to complete production.



Ares Progress



Ares J-2X Engine Testing

Engineers at NASA's Space Flight Center in Huntsville, Alabama, completed a series of test on a key component of the J-2X engine, which will propel the next-generation Ares Rocket on its journey to space. The test on August 15, 2008 was the last of 20 in this series.

Ares Progress



**Solid Rocket Motor
Testing
Promontory, UT**

**Main Parachute
Fabrication
Columbia, MS**

**Main Parachute Test
Yuma, AZ**



Orion Progress



Motor firing for Launch Abort System

Orion Progress



Wind Tunnel test of the Orion Launch Abort System model¹¹

Orion Progress



Landing System Airbag Tests

Orion Progress



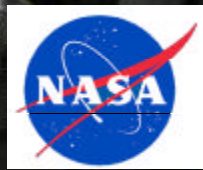
After Painting at Dryden Flight Research Center



Crew Module Boilerplate Test Article – Entering Structural Testing at Langley Research Center



EVA Progress



EVA Project Design Evaluation

- I-Suit Test on DC-9**
- Mark III Ladder Test**
- Suit-seat Test**
- I-Suit Through Lids Tunnel**



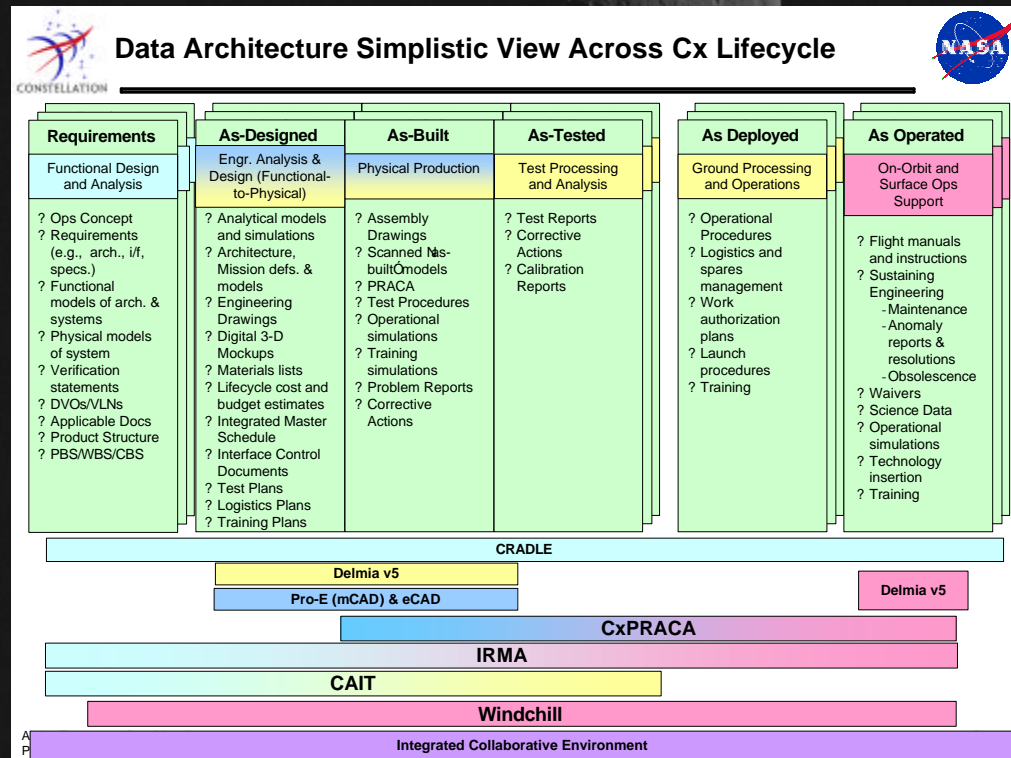
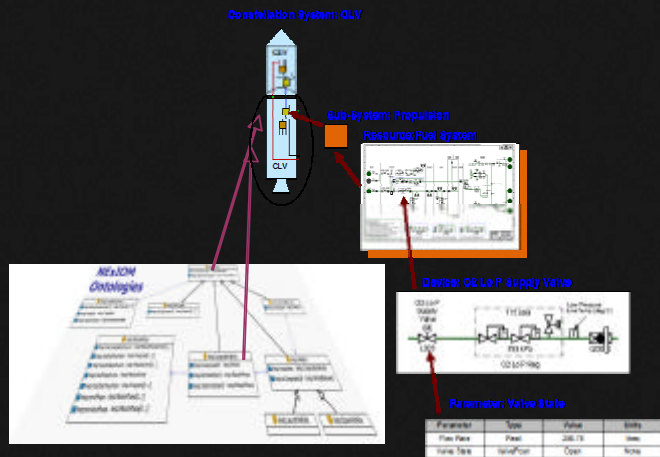
CxP Information Systems (IS) Office



■ CxP Information Systems Office

- Manages the Constellation information systems that support the program's processes across the lifecycle phases - DDT&E, Operations & Support, Retirement and Disposal.
 - Approve IS efforts to provide capabilities across the program
 - Identify and develop (if necessary) of IS standards
 - Identify and document authoritative data sources
 - Establish and manage organizational IS agreements internal and external to program

- Represent CxP IS to
 - HQ and Centers
 - NASA Institutional Orgs
 - Program Integration Offices
 - Projects and elements
 - Primes



Current State of IS - “Environment Challenge”

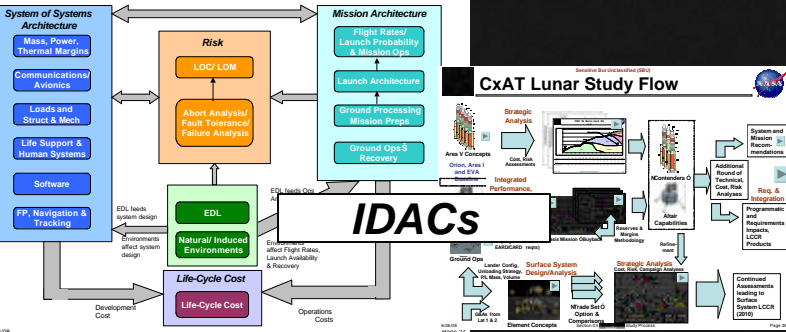


- NASA Approach: 10 centers, multiple autonomous levels, separated IT infrastructures, separate tools
 - “Corporate like” within a single center and/or a directorate at the Centers, particularly the Engineering Directorates
 - Sharing data across centers, programs and projects, contractors all with different tools requires a new level of collaboration
- Corporate Approach: Common IT infrastructure within common firewall
 - Sharing data easier through common tools/infrastructure
- Common Problem (both NASA and Corporate): data sharing across corporate boundaries, e.g., between primes, sub’s and numerous equipment suppliers, is still problematic and must be managed
- Constellation Program: Integrating data from 10 “corporate-like” NASA Centers and prime contractors and numerous suppliers

Current State of IS - "Data Challenge"



Integrated E-t-E Architecture DDT&E and Production/Operations Analysis



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CARD 3.2 Compliance Evaluation

Requirements Compliance Matrix
Red, Yellow, Green, Grey Count
100 TOTAL

Cat 1S CA6002 compliance

Requirement Number	Requirement Statement	FRM	IRMA (Req) Number	ES Number	YDR	Methods	Objective Evidence	Compliance Rationale	Testing Status
CA602-PR	The Controller Architecture and control logic shall be developed in a single Aes V-Block transaction.	Control Critical Path	3213 (DR) 1761 (Aes) 1760 (GR)	020-01-016 (Aes)	(Aes)	Eng. (Software) Mechanical (Mechanical) Electrical (Electrical)	One of Seven Analytical Requirements met (value not 020748)	TPM and Req 3213 (Software) Algorithm not developed Steps to Develop Steps to	Not Started

KDRs & Compliance

Latest assessment shows IC ground prelaunch critical path exceeds Threshold & Objective requirements

- Threshold Requirement: 879 Hours (45 Days @ 8-day/3-8R)
- Objective Requirement: 738 Hours (45 Days @ 8-day/3-8R)
- Current Assessment: 909 Hours (GOTAR2 May 2008)

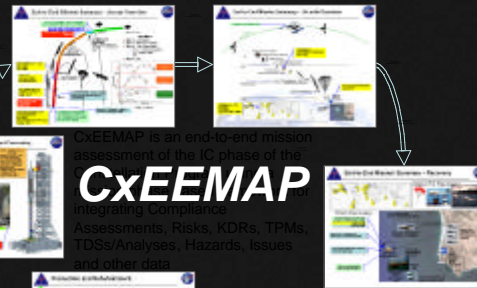
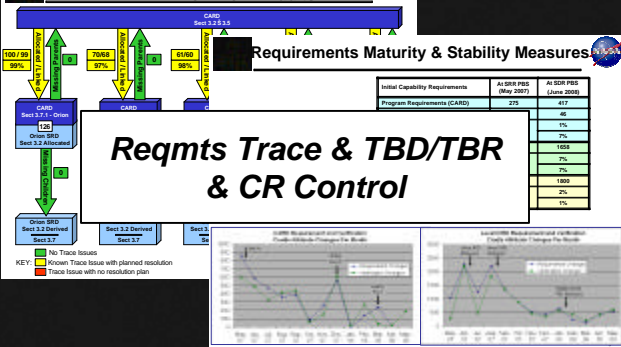
Mitigation Strategy

- TPM established to focus and refine assessment throughout PR
- GOTAG/GOTAR provides integrated forum for assessment
- TPM reporting on a 2-month cycle
- IRMA 3213 mapping mitigation actions and identifying opportunities for improvement

Threshold Performance Status	Yield
Test Time	Not Started
Block Launcher FSD Deployment	Not Started
FSD Test Launcher Prep	Not Started
First Stage Docking	Not Started
Upper Stage MMS & Crosslocks	Not Started
REVELD Installation	Not Started
REVELD Test MMS & Crosslocks	Not Started
Aes V Flight Ops	Not Started

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Requirements Allocation and Flow Down Audits

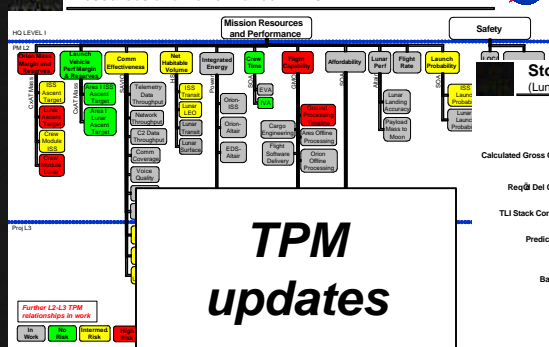


Top SE&I Technical Risks

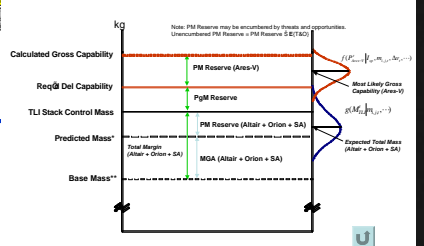
IRMA 2149	IRMA 1976	IRMA 1977	IRMA 1978	IRMA 1979	IRMA 2000	IRMA 2001	IRMA 2002	IRMA 2003	IRMA 2004	IRMA 2005	IRMA 2006	IRMA 2007	IRMA 2008	IRMA 2009	IRMA 2010	IRMA 2011	IRMA 2012	IRMA 2013	IRMA 2014	IRMA 2015	IRMA 2016	IRMA 2017	IRMA 2018	IRMA 2019	IRMA 2020	IRMA 2021	IRMA 2022	
Thrust Oscillation	Closing the Architecture 8 Lunar	Closing the Architecture 5 Lunar	Closing the Architecture 6 Lunar	Closing the Architecture 7 Lunar	Closing the Architecture 9 Lunar	Closing the Architecture 10 Lunar	Closing the Architecture 11 Lunar	Closing the Architecture 12 Lunar	Closing the Architecture 13 Lunar	Closing the Architecture 14 Lunar	Closing the Architecture 15 Lunar	Closing the Architecture 16 Lunar	Closing the Architecture 17 Lunar	Closing the Architecture 18 Lunar	Closing the Architecture 19 Lunar	Closing the Architecture 20 Lunar	Closing the Architecture 21 Lunar	Closing the Architecture 22 Lunar	Closing the Architecture 23 Lunar	Closing the Architecture 24 Lunar	Closing the Architecture 25 Lunar	Closing the Architecture 26 Lunar	Closing the Architecture 27 Lunar	Closing the Architecture 28 Lunar	Closing the Architecture 29 Lunar	Closing the Architecture 30 Lunar	Closing the Architecture 31 Lunar	Closing the Architecture 32 Lunar

SE&I Top Technical Issues Weekly Status 6/24/2008

Current & In Work Mission Resources and Performance TPMs



Stochastic Margins Analysis @TLI (Lunar Outpost Mission)



Risk ID, Integration & Mitigation

IRMA 2149

Closing the Architecture 8 Lunar

IRMA 1135

The current Altair project has been completed L2/L3 and is being incorporated into the current Altair project. The current Altair project has been completed L2/L3 and is being incorporated into the current Altair project. The current Altair project has been completed L2/L3 and is being incorporated into the current Altair project.

Cx Program Characteristics

Impacting Configuration and Data Management



- **Schedule**
 - Multi-decadal program
 - Some systems in operation while other systems are in development
- **Technical**
 - “Multi-planetary body” infrastructure
 - Massive amounts of data generated
 - Massive amount of legacy design data exists
 - Existing and new applications being used in parallel
 - Agency enterprise architecture in parallel development
 - ITAR and SBU data
- **Organizational**
 - Multiple organizations supporting DDT&E
 - Separate organization supporting operations
 - International partnerships being discussed/worked
 - A PROGRAM spread across 10 NASA centers



■ Cx Information Systems “Architecture” Diagramming

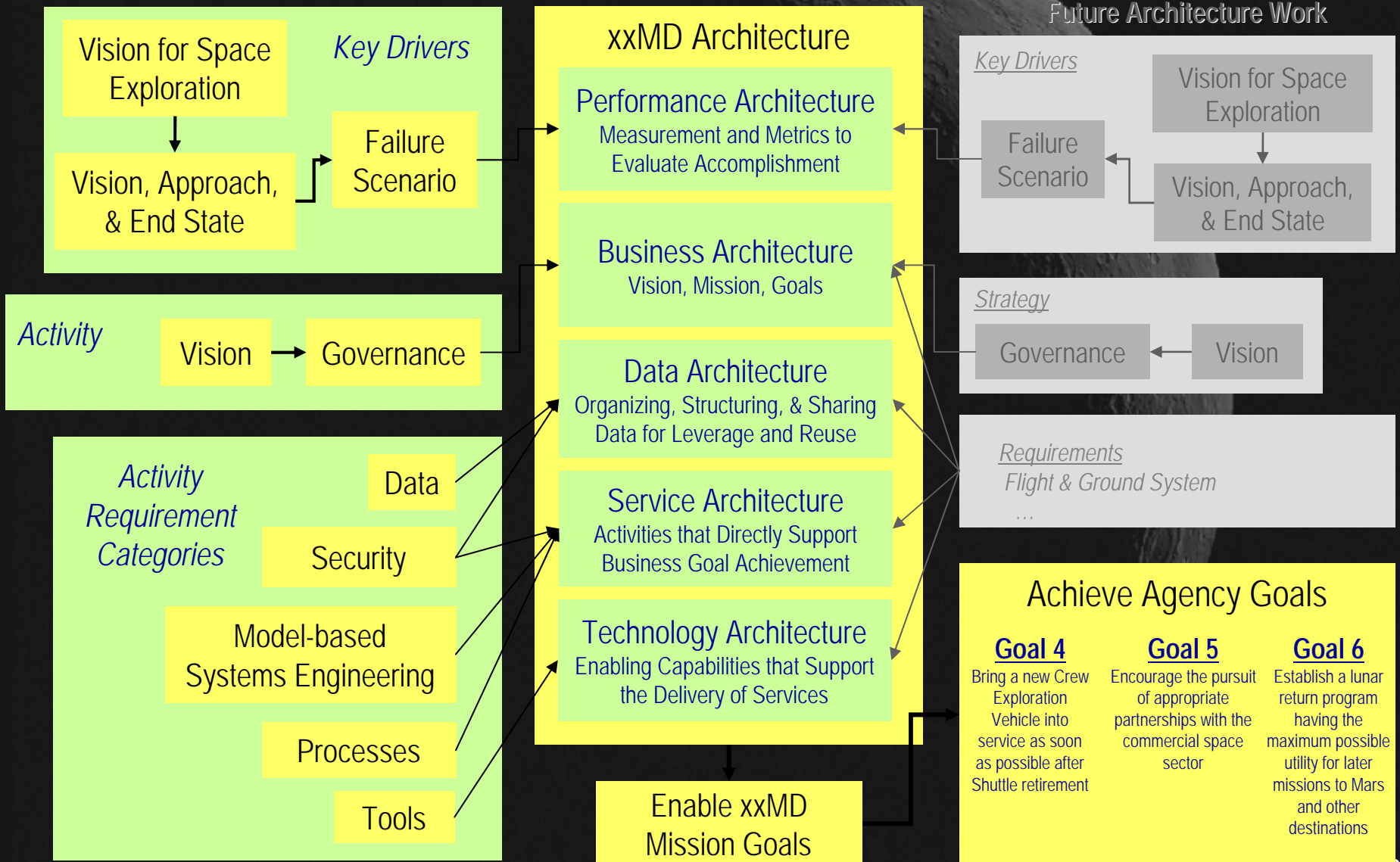
– Four diagrams will be developed that will describe the Cx IS architecture:

- Capabilities Architecture
 - Business processes
- Data Maps
 - Data Sets
 - Data Flow Diagrams
- Application Architecture
 - SW Application diagram and corresponding table
 - Registries and databases
- Physical Architecture
 - Hardware, facilities and networking

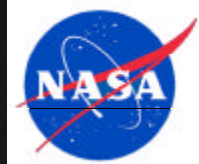
Cx IS
Enterprise
Architecture

– Initial Diagrams developed; currently being updated for Build 2

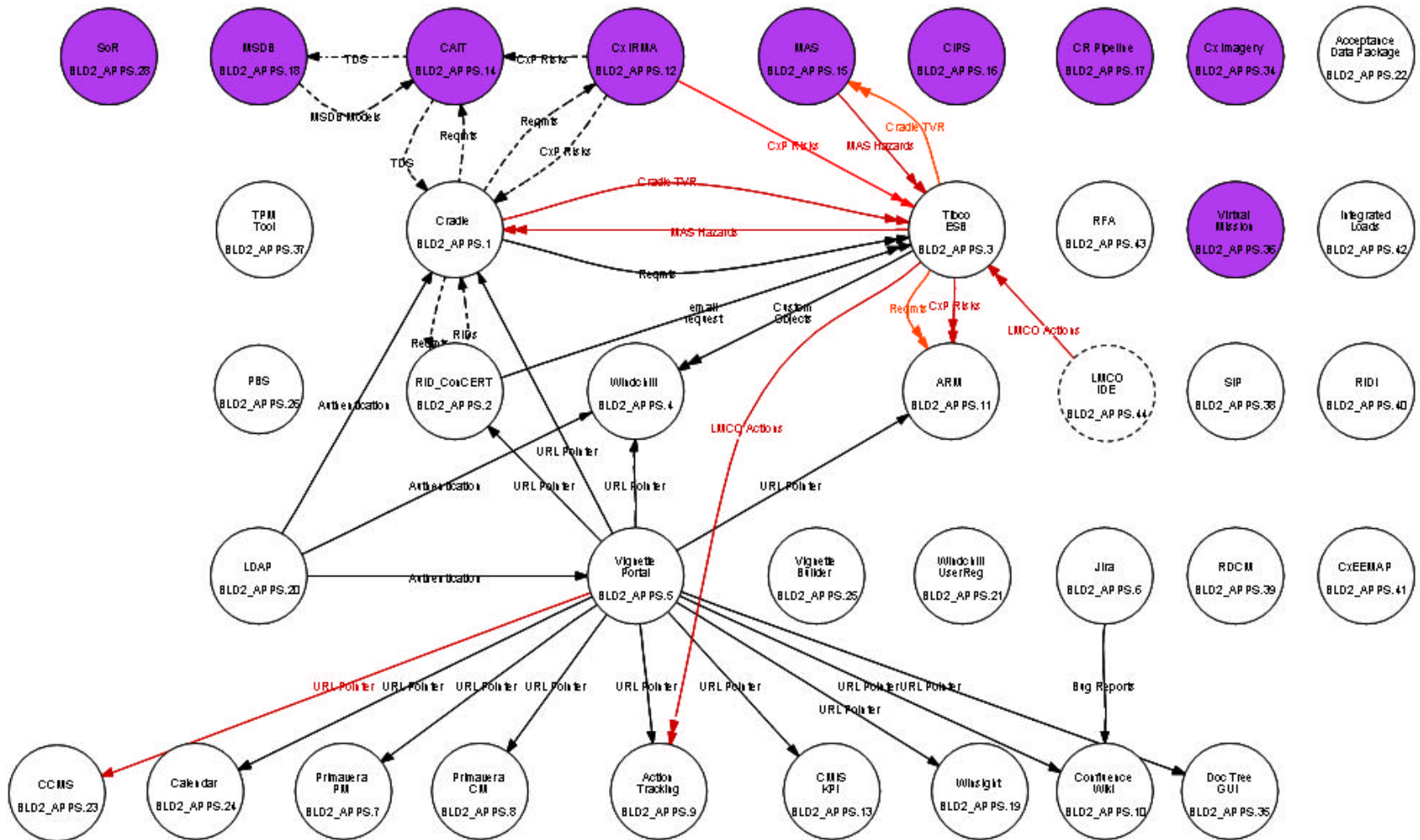
NASA Agency Enterprise Architecture Efforts



Build 2 Application Architecture Diagram

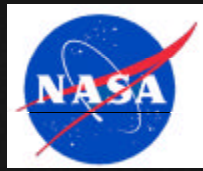


I	BLD2_APPS	Owner: TOM	Versn:	Dft: A	Created: 09/22/08
DFD	Build 2 Application Architecture		Baseline:		Last Mod: 09/24/08





- Early support to defining enterprise architectures
- Configuration and data management processes that adapt to emerging technology capabilities
- Model-based project management and systems engineering
- Application-independent data descriptions / models
- Evolving support across the whole lifecycle of a program



- Constellation's success is highly-dependent upon the CM and DM community's support and proactive involvement
- Data is "KING"...for many years in CxP
- The Constellation Program has significant, and sometimes unique, challenges to consider when applying CM and DM