Enterprise Architecture Challenges

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The Plan for Space Exploration

Innovation

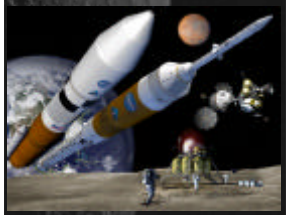
Int'l commercial participation

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

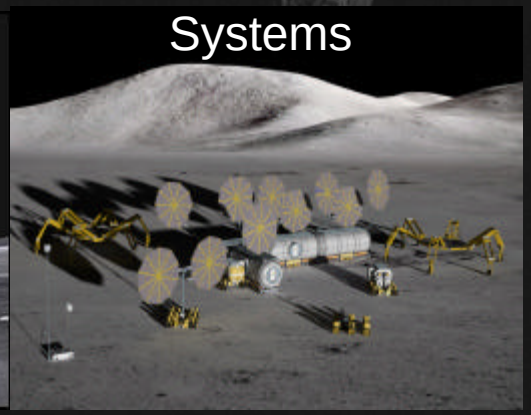
Extravehicular Activities

Mission Operations

Ground Operations

Altair

Lunar Surface Systems



Constellation's Workforce – NASA

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

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

White Sands Test Facility
-Orion Launch Abort System test site

Stennis Space Center
-Rocket propulsion testing for Ares

Constellation's Workforce – Contractors

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

- 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)
- 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)
- 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)
- 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

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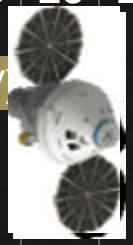
Initial Capability Orion (CEV)



Lunar Robotic Missions

Lunar Outpost Buildup

Commercial Crew/Cargo

Space Shuttle Operations

SSP Transition

Ares I Development

Orion Development

Ares I-X
Test Flight
April 2009

Orion Production and Operation

Lunar Lander Development

Ares V & Earth Departure Stage

Surface Systems Development

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 model

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

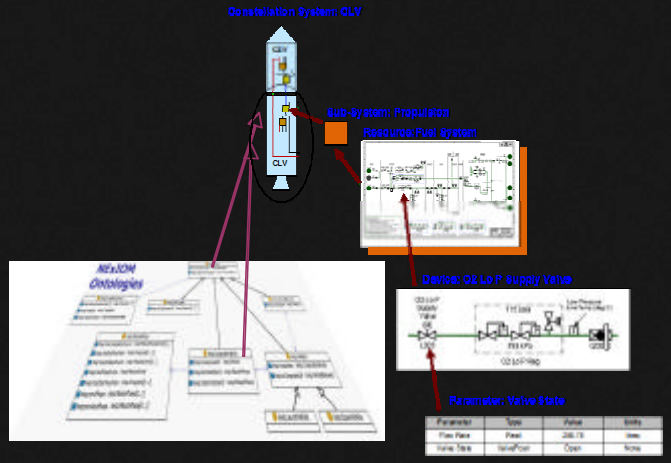
EVA Progress

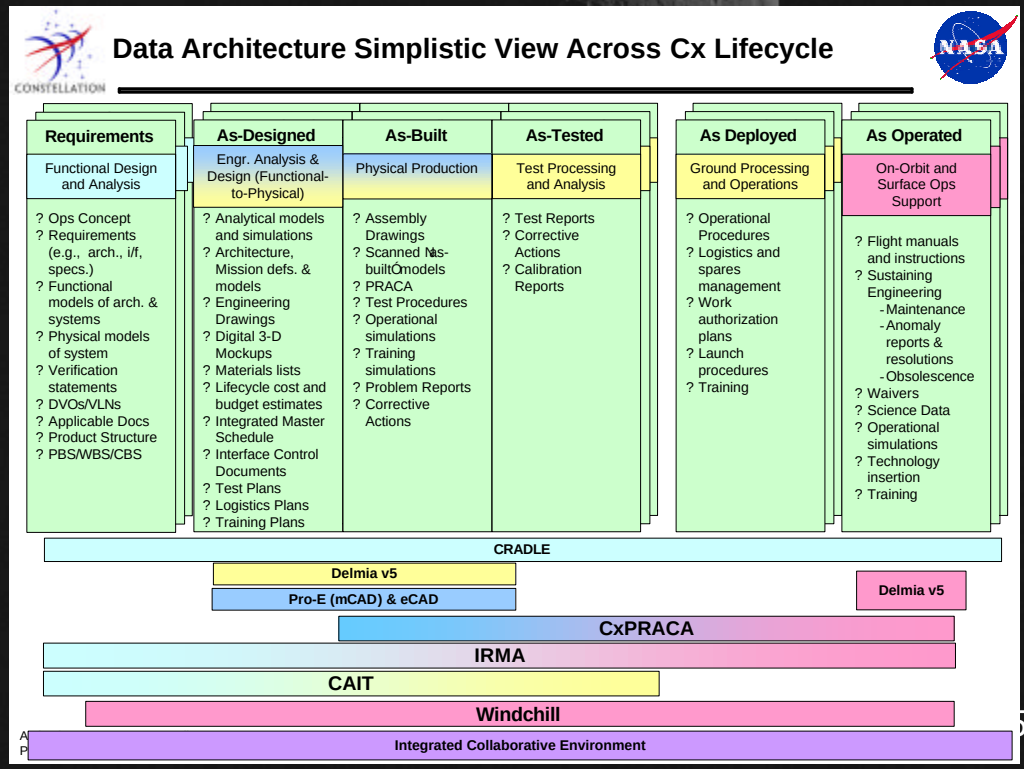
EVA Project Design Evaluation

- 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





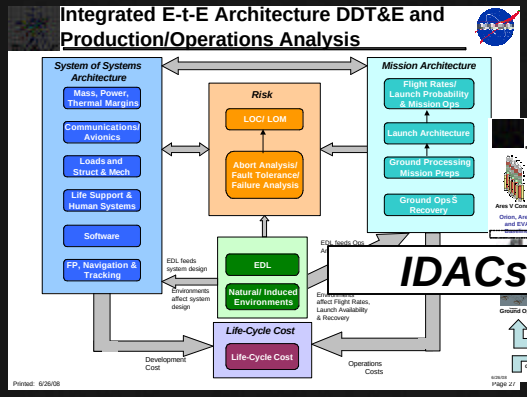
Current State of IS - "Environment Challenge"

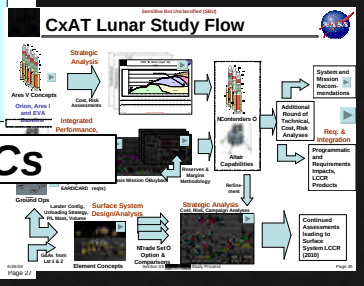
- NASA Approach: 10 centers, multiple autonomous levels, separated IT infrastructures, separate tools
  - "Corporate like" within a single center and/or a directorate at the Centers, particularly the Engineering Directorates
  - Sharing data across centers, programs and projects, contractors all with different tools requires a new level of collaboration
- Corporate Approach: Common IT infrastructure within common firewall
  - Sharing data easier through common tools/infrastructure

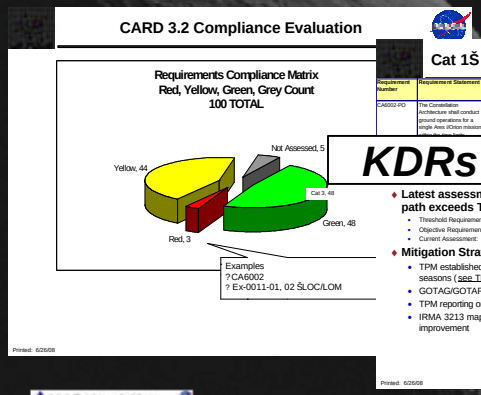
- Common Problem (both NASA and Corporate): data sharing across corporate boundaries, e.g., between primes, sub's and numerous equipment suppliers, is still problematic and must be managed

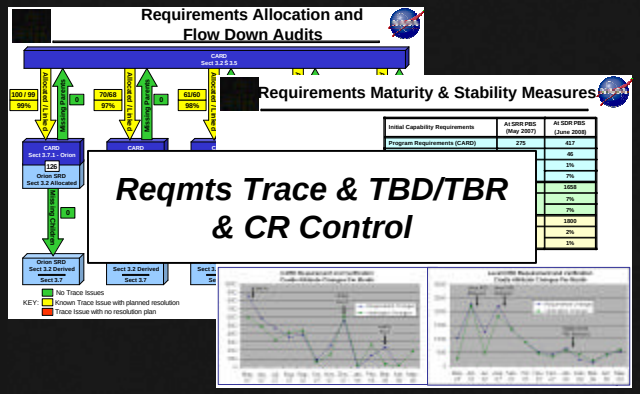
- Constellation Program: Integrating data from 10 "corporate-like" NASA Centers and prime contractors and numerous suppliers

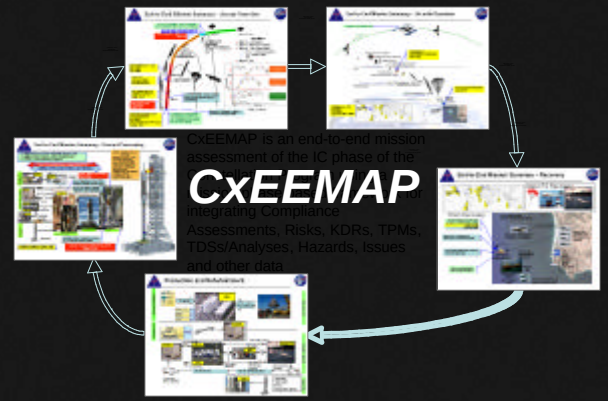
Current State of IS - “Data Challenge”

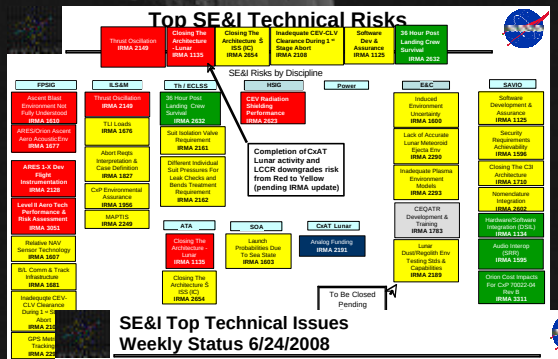


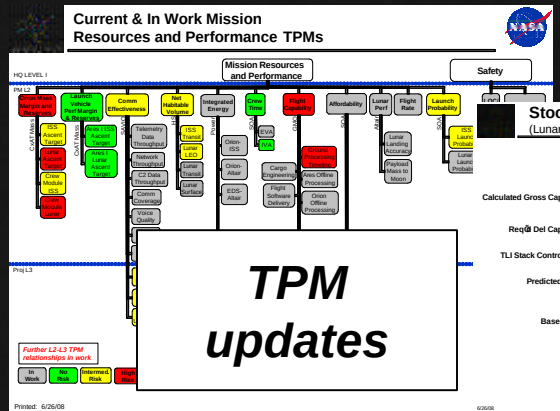


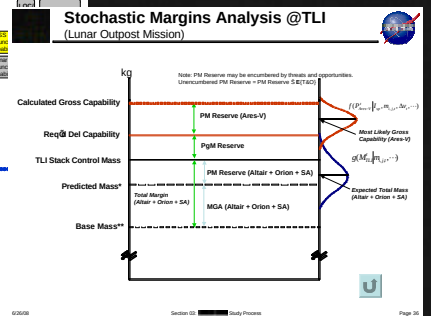












Cx Program Characteristics Impacting Configuration and Data Management

- 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

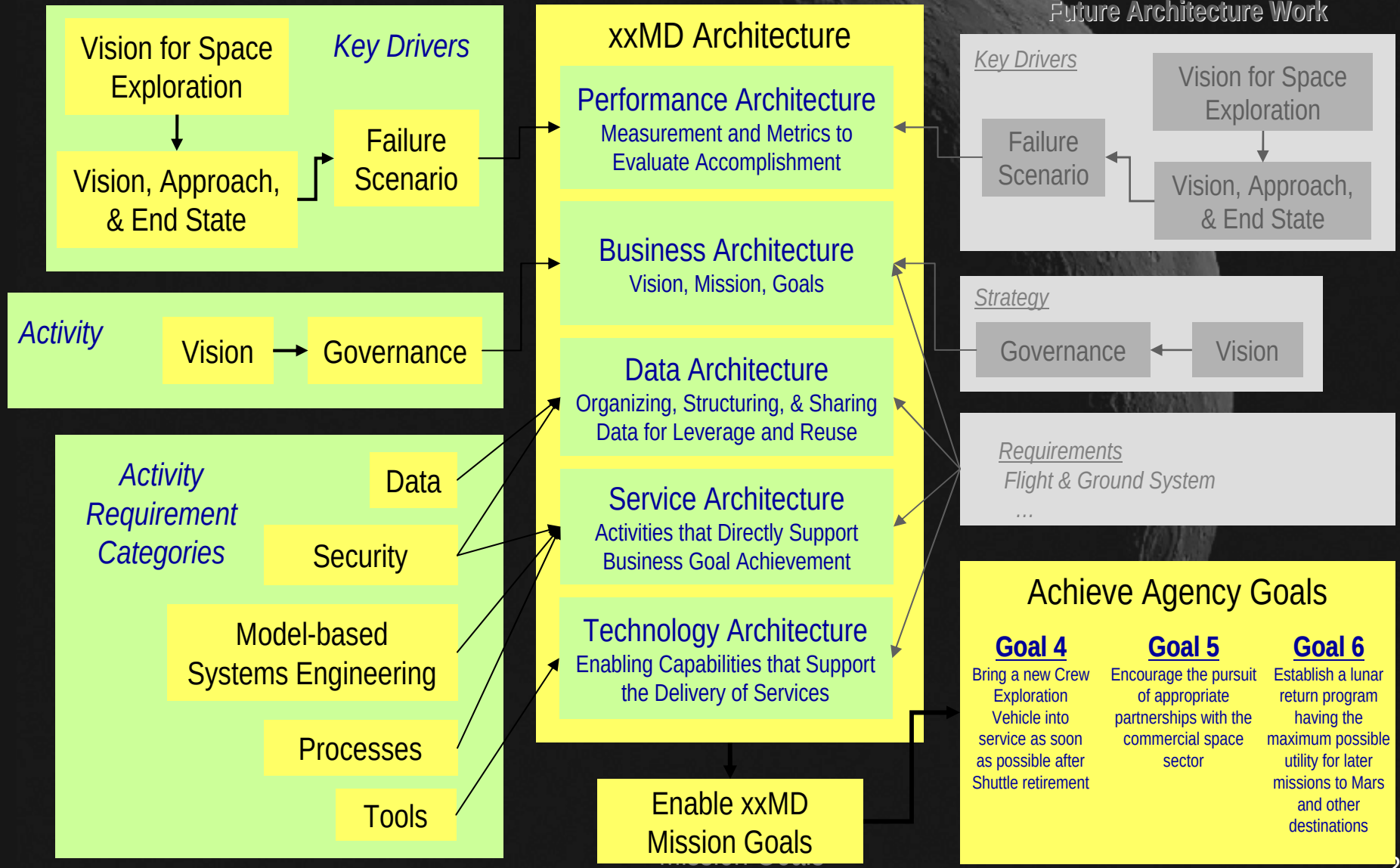
IS Office Near-term Priorities (Cont.)

- 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

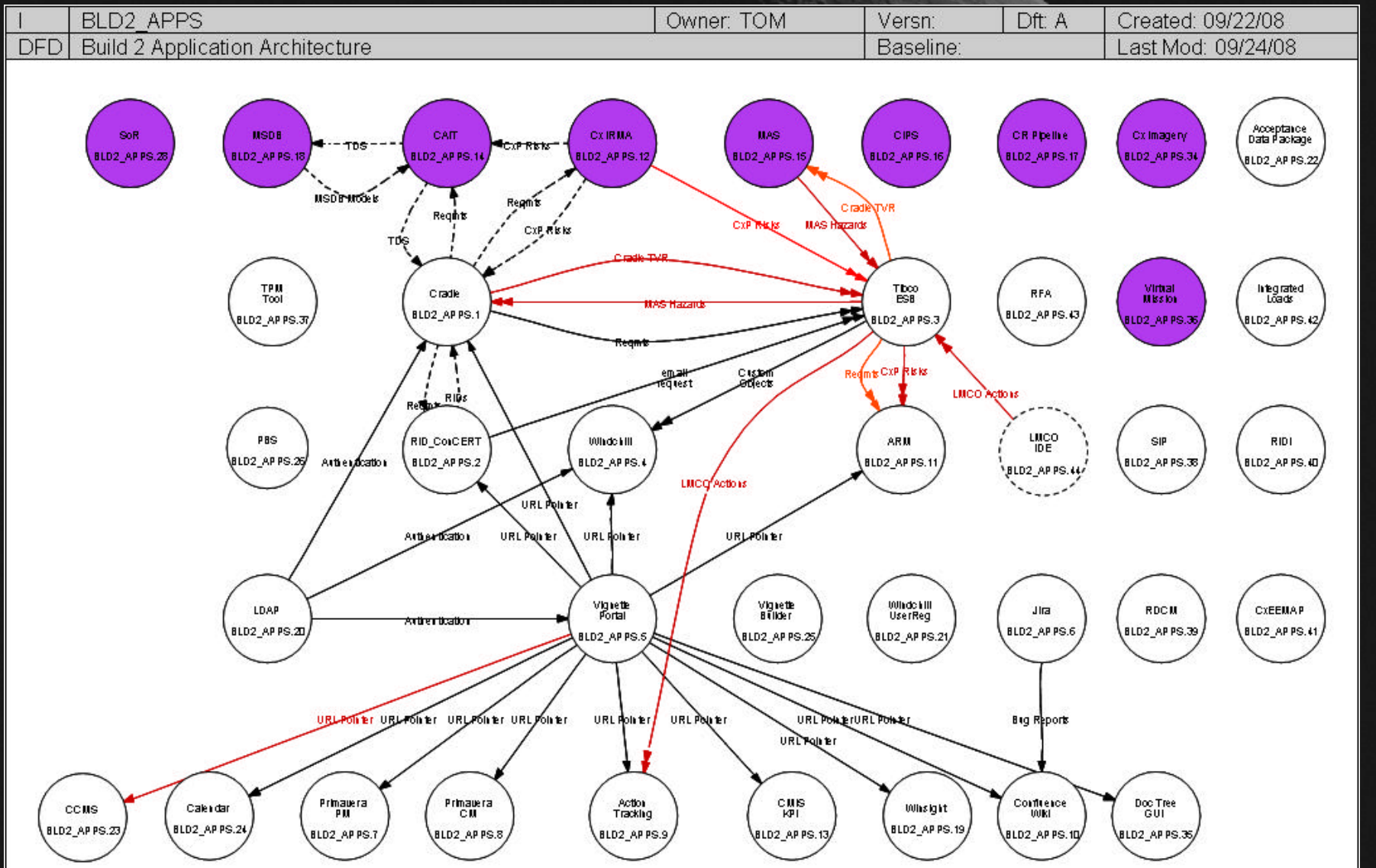
Cx IS Enterprise Architecture

  - Initial Diagrams developed; currently being updated for Build 2

NASA Agency Enterprise Architecture Efforts



Build 2 Application Architecture Diagram



Areas of Focus for CM/DM Community

- 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

Concluding Remarks

- 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