Jet Propulsion Laboratory
California Institute of Technology

PLM Innovation in Far Away Places

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Facts About the Jet Propulsion Laboratory

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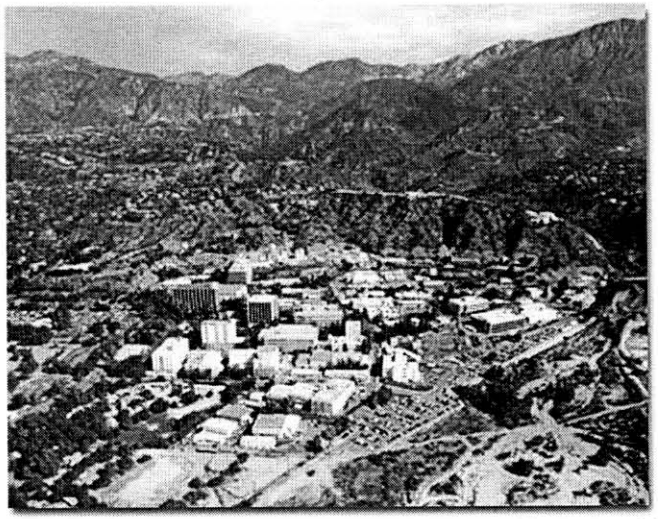
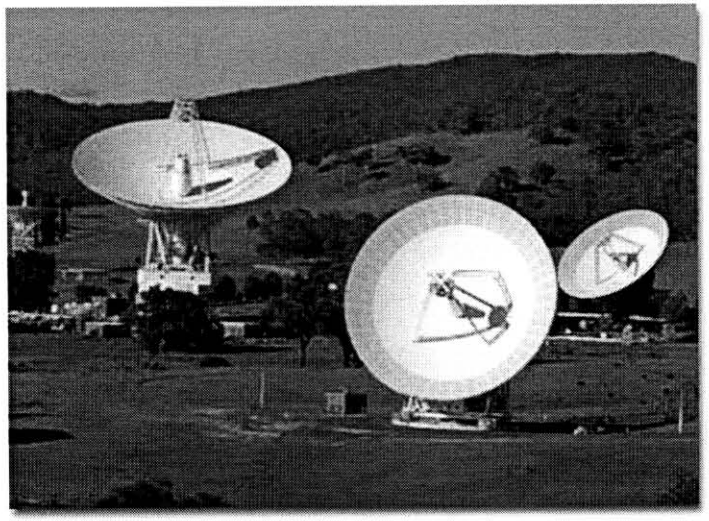
- Managed by the California Institute of Technology
- NASA's lead center for robotic exploration of the solar system
  - ~$1.6B contract per year, ~ 5300 employees
  - 177 acre facility located in Pasadena, CA





  - Manages worldwide Deep Space Network
    - 3 Locations - Goldstone CA, Madrid Spain, Canberra Australia
    - Spacecraft Command & Control - Recording scientific data
- 50+ years experience in spacecraft design, production and operation

JPL spacecraft have visited all planets in our solar system except Pluto!

Business &Cultural Considerations in PDM

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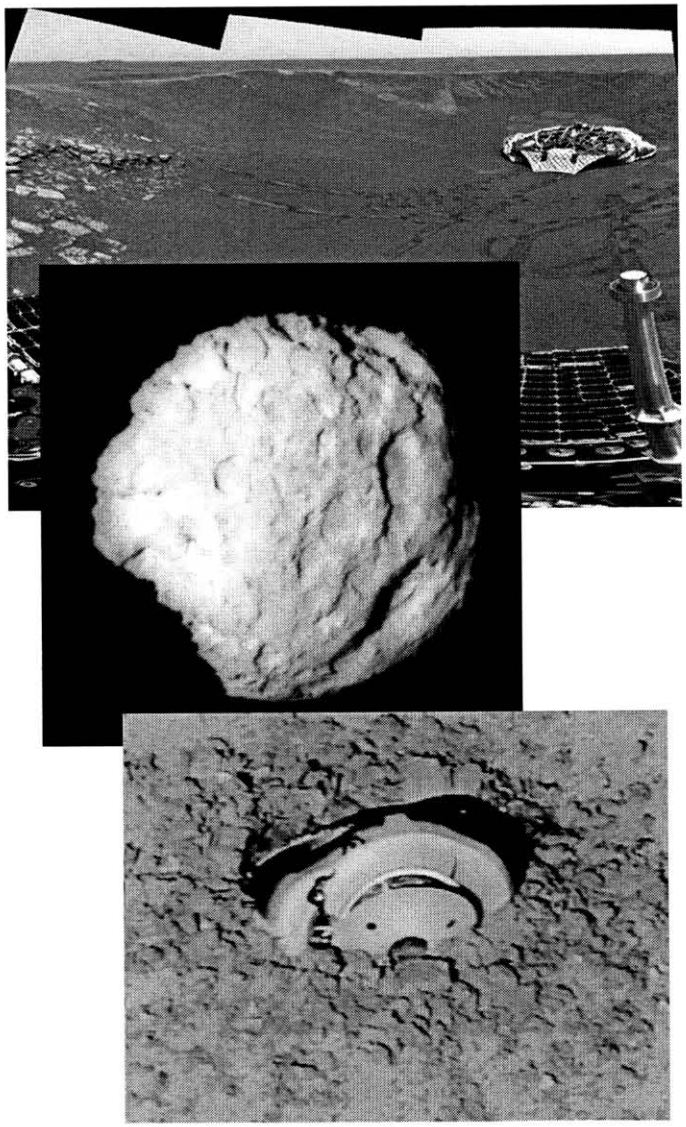

Understanding the JPL "culture"

University Focus

- Scientific Research
  - World class Scientists in residence working with universities worldwide

Aerospace Business Focus

- State-of-the-art Engineering Design & Development
  - Spacecraft and Instruments
  - Communication and Navigation
- High Precision Production of Mechanical & Electrical Assemblies
  - In-house capability
  - Industry partners and suppliers worldwide

Other Factors

- Intelligent, creative, free thinking people
- Very visible - in the news

"Typical" Project

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- JPL provides system management for a team of:
  - Project Scientists from around the world
  - Multiple JPL design teams with some in-house production
  - One or more NASA centers doing trade studies and perhaps developing instruments
  - One or more space agencies from outside the US also developing instruments
  - Industry Partners and vendors assisting with design and production of spacecraft, large assemblies, or components

Our Mission - Upgrade PDMS

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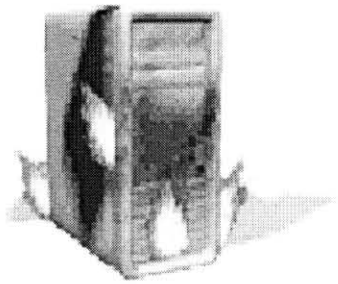
- **PDMS-Sherpa (COTS product) was deployed – 1993 at JPL**
  - Contains 850,000 records on JPL spacecraft design and production
  - 78 JPL Projects have active records in PDMS
  - Utilizes automated lifecycles for efficiency
  - Remote access & collaboration

- **PDMS Sherpa Usage is Strong!**
  - System Users up 200%, Transactions up 300% in 14 months
  - Authenticated FY 2001 accesses ~536,000 from ~2,000 unique IP addresses (95% from JPL)
  - Used daily by 900 JPL engineers, techs, designers, and managers
  - 45 simultaneous users



Sherpa Software is Obsolete and not Supported!

- **Sherpa must remain operational <u>until projects are fully migrated</u> to new PDMS**

Reason for change ...

- The JPL Project environment has changed
  - Increased competition
    - Deliver the most product for the money
    - Cost caps
  - Many more missions
    - Approximately 3 projects ten years ago is near 50 today
    - More technical complexity
  - Greater use of industry partners
- Significant potential for cost avoidance on JPL/NASA missions through extensive reuse of designs and process lifecycle reduction
- Multiple disconnected information systems inhibit productivity and increase costs of design and fabrication
- JPL projects require a collaborative information management system to effectively manage multiple design partners, within a secure, ITAR compliant environment

Long Term Vision

- State-of-the-Practice, efficient, evolvable, and cost-effective
- Appropriate to all levels/disciplines
- Permits rapid development of high-quality designs
- Makes collaborative, distributed engineering easy, routine, and effective
- Tools are seamlessly connected to each other (and to previous phases of the design) to assure necessary coordination among functions
- Workflow based to assure that proper processes are followed
- Makes configuration control easy and continuous
- Connects to business system and ERP to support best business practices, earned-value management, etc.

Innovation Objectives

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Establish a Common Engineering Environment/Platform

- Deploy a common environment for supporting engineering based upon a commercially available suite centered on a "product data management system" (PDMS)
  - Workflow based mechanism for capturing, storing, and relating all of the system engineering products to assure proper coordination and control
  - Proposed changes are identified throughout the system, the defined change approval process is invoked and managed, official documents and drawings are properly updated, cognizant engineers and managers are notified, etc.
  - Links to computer-aided engineering and design systems assure that the results of the changed requirement can be easily and correctly assessed
  - Workflow-based system easily configured to specific needs and processes of any project
  - Links to most commonly used system engineering tools, such as requirements repositories, document and information management systems, design tools, failure reporting systems, and enables data to be passed among them
  - Provides for remote concurrent engineering with built-in ITAR safeguards
  - Incorporates capabilities which accommodate team-based interactions, such as action item tracking and notification, task list maintenance and coordination, calendaring, messaging, etc.
- Represents a potential "sea change" for the working-level engineer

Innovation Objectives (con't)

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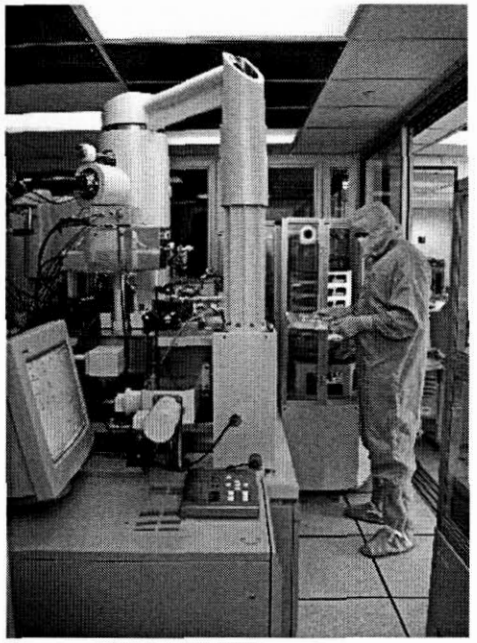
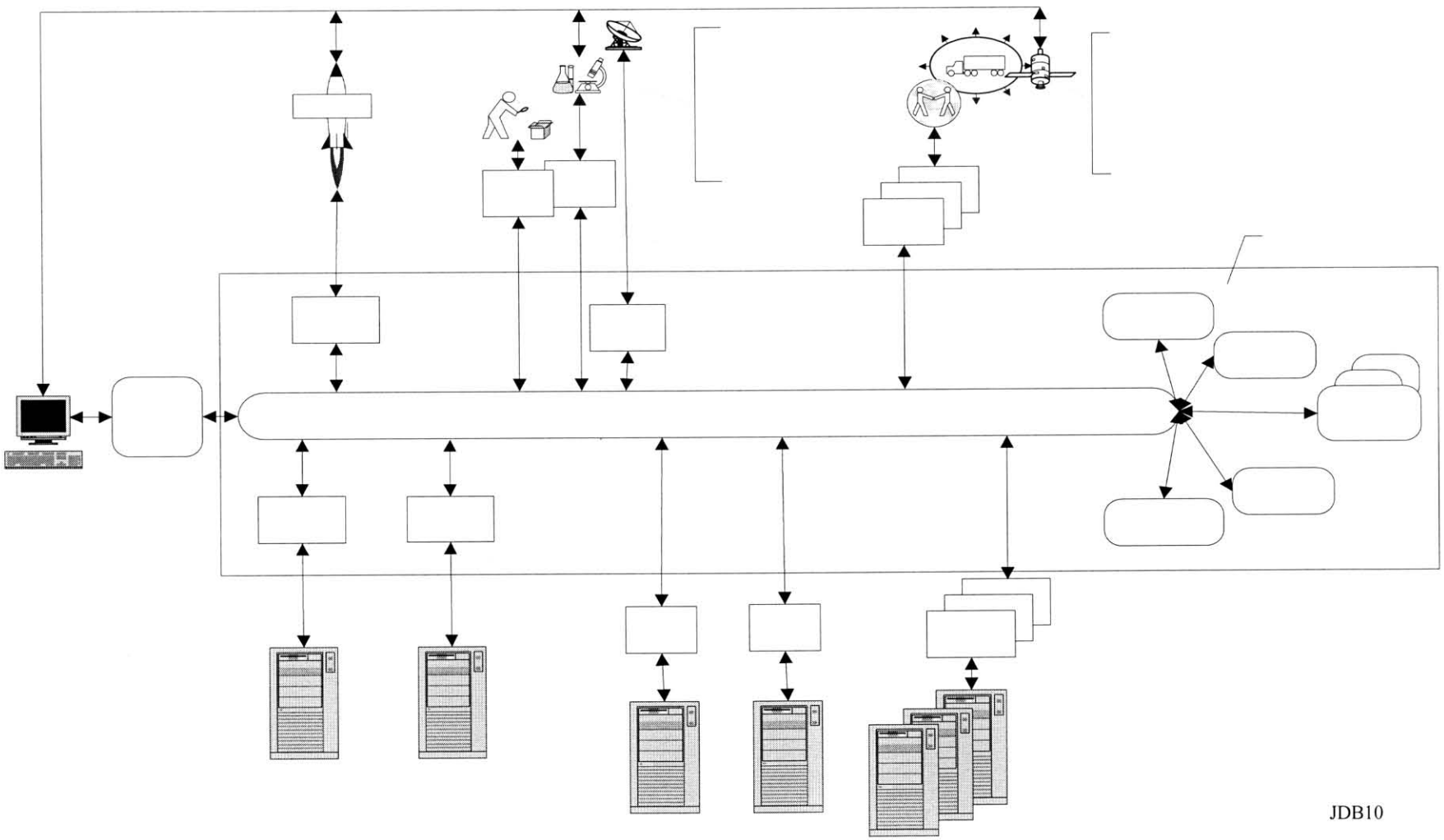
Implement an Enterprise Resource Planning System (iPICS)

- Consolidate a large number of different, locally operated, non-communicating inventory systems into a single ERPS
  - This system provides an electronic link between the PDM design vaults and JPL's ERP based fabrication and business system
  - Consolidation will significantly increase the agility of design engineers in identifying and locating needed system elements, to automatically determine and track costs, and to incorporate that knowledge into system designs in a controlled way



Early Architecture Concepts – May 2000



Previous State - Disconnected Information Systems

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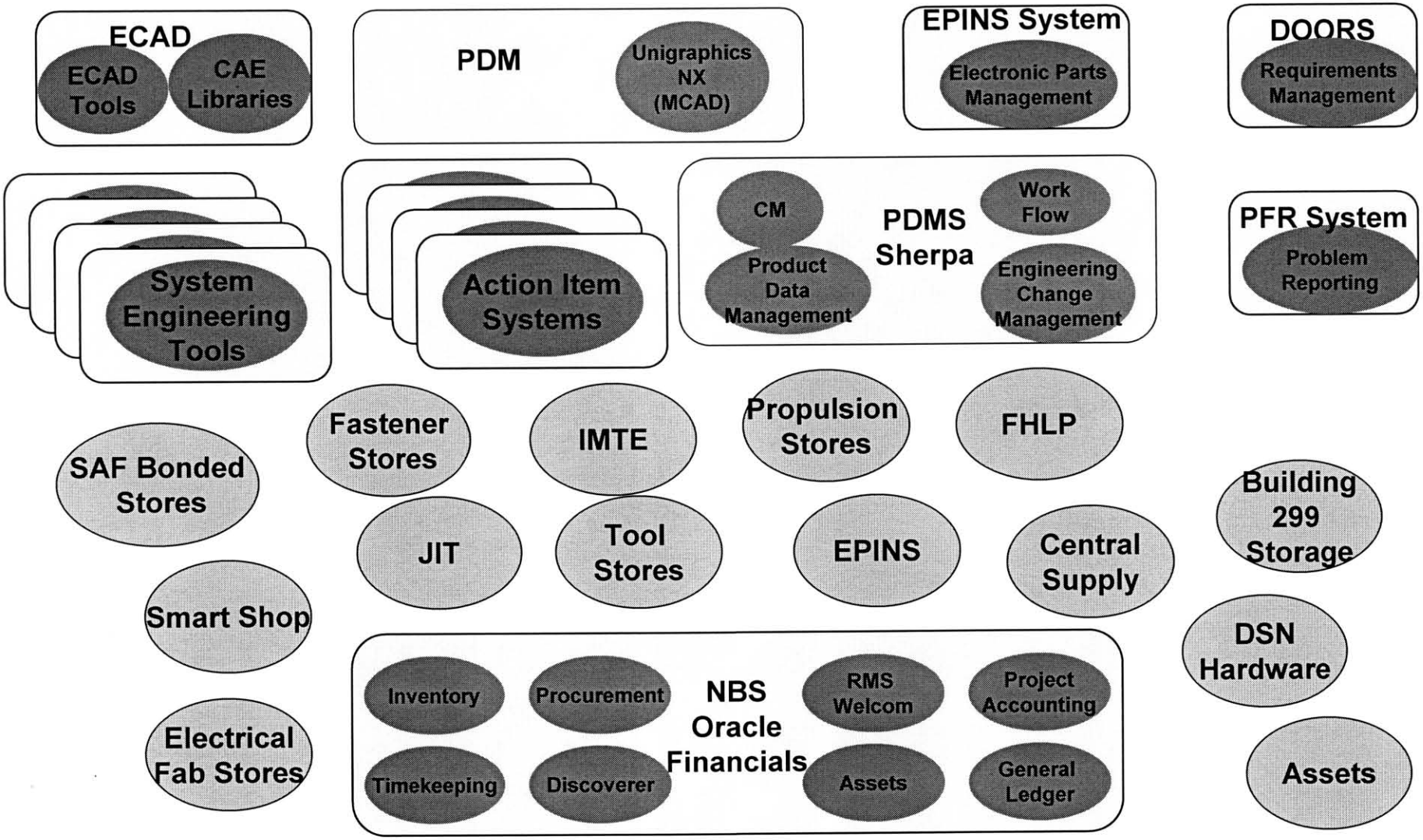

Concept Diagram for Collaborative Environment

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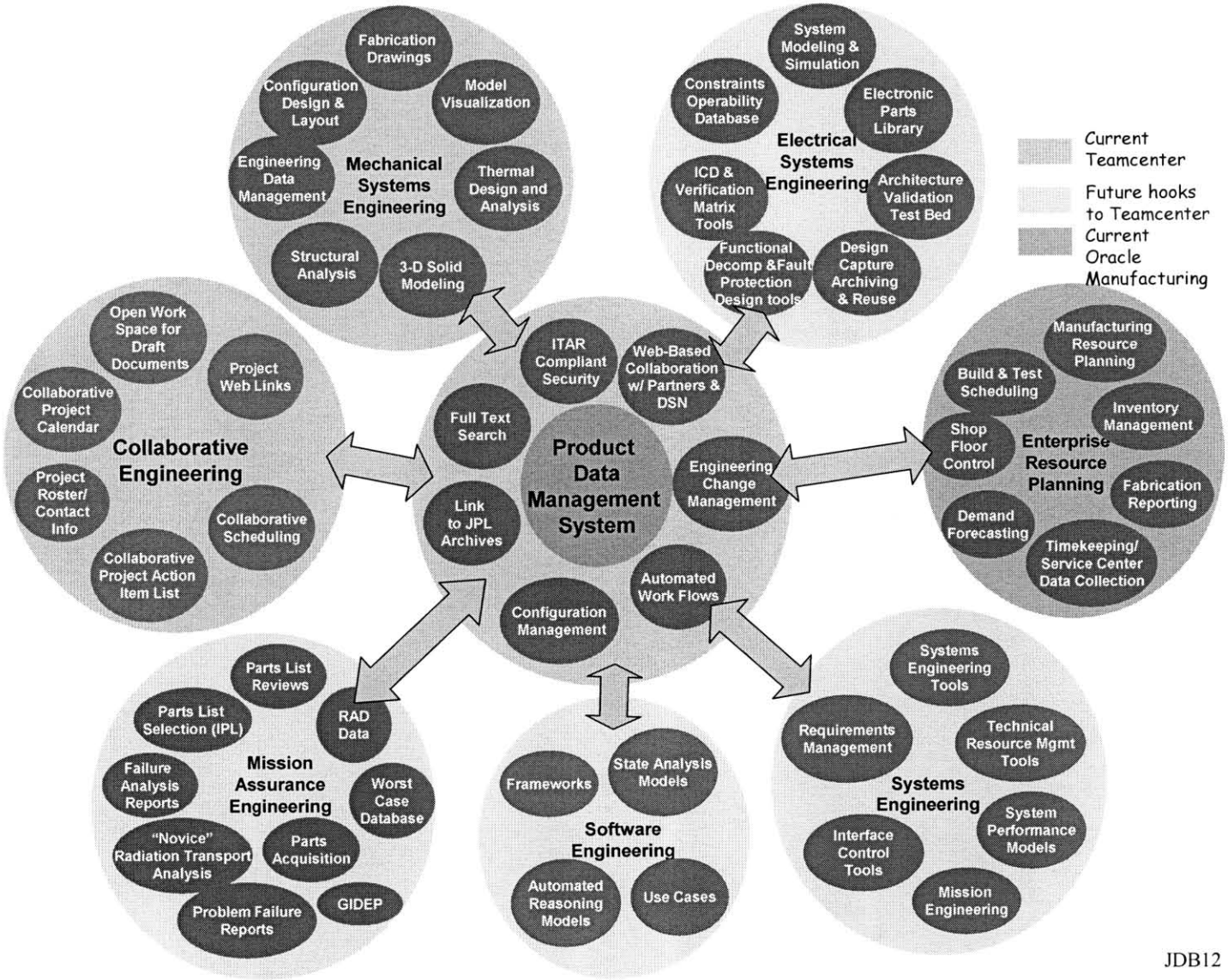

Collaborative Environment System Architecture

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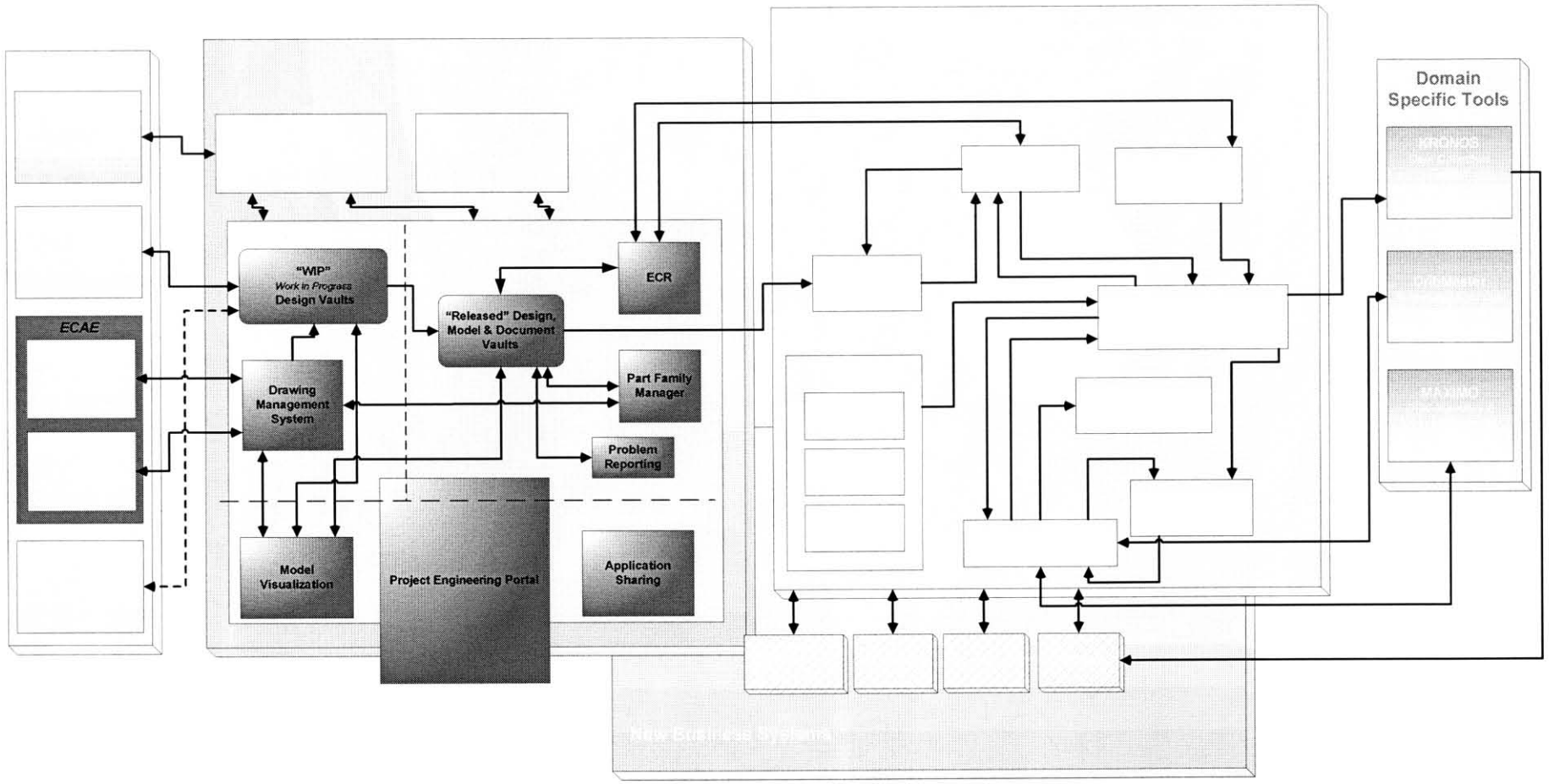

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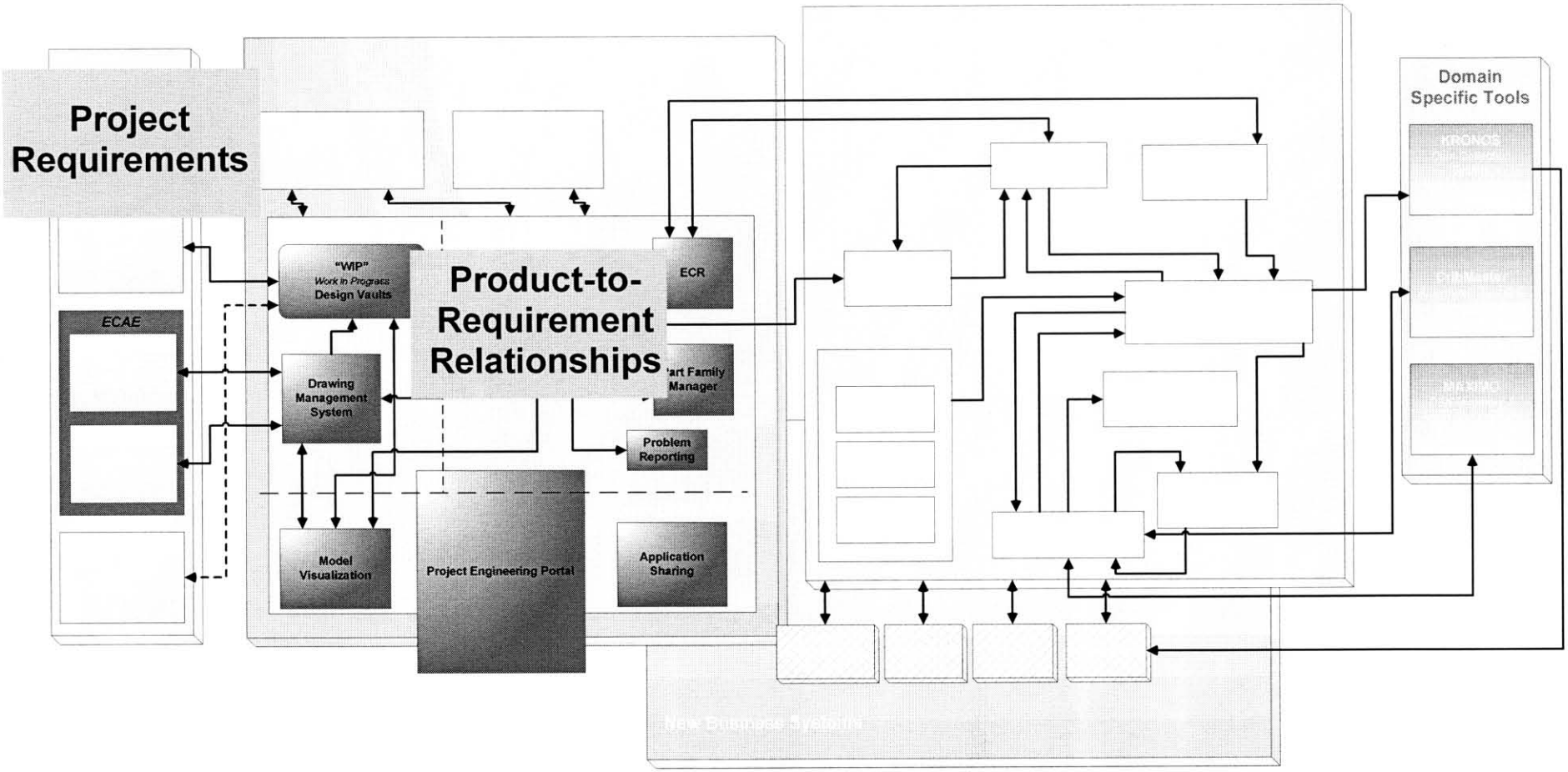

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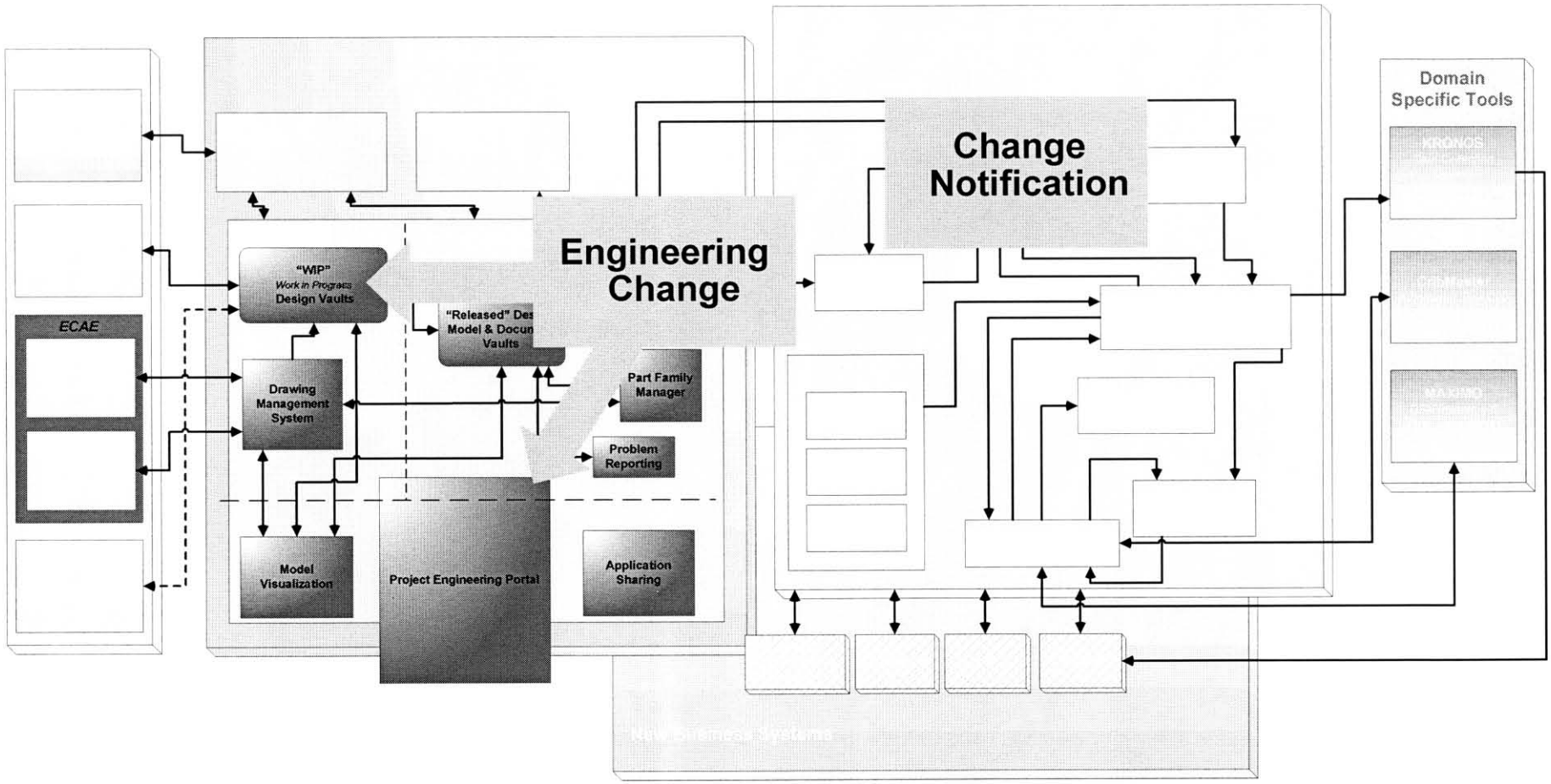

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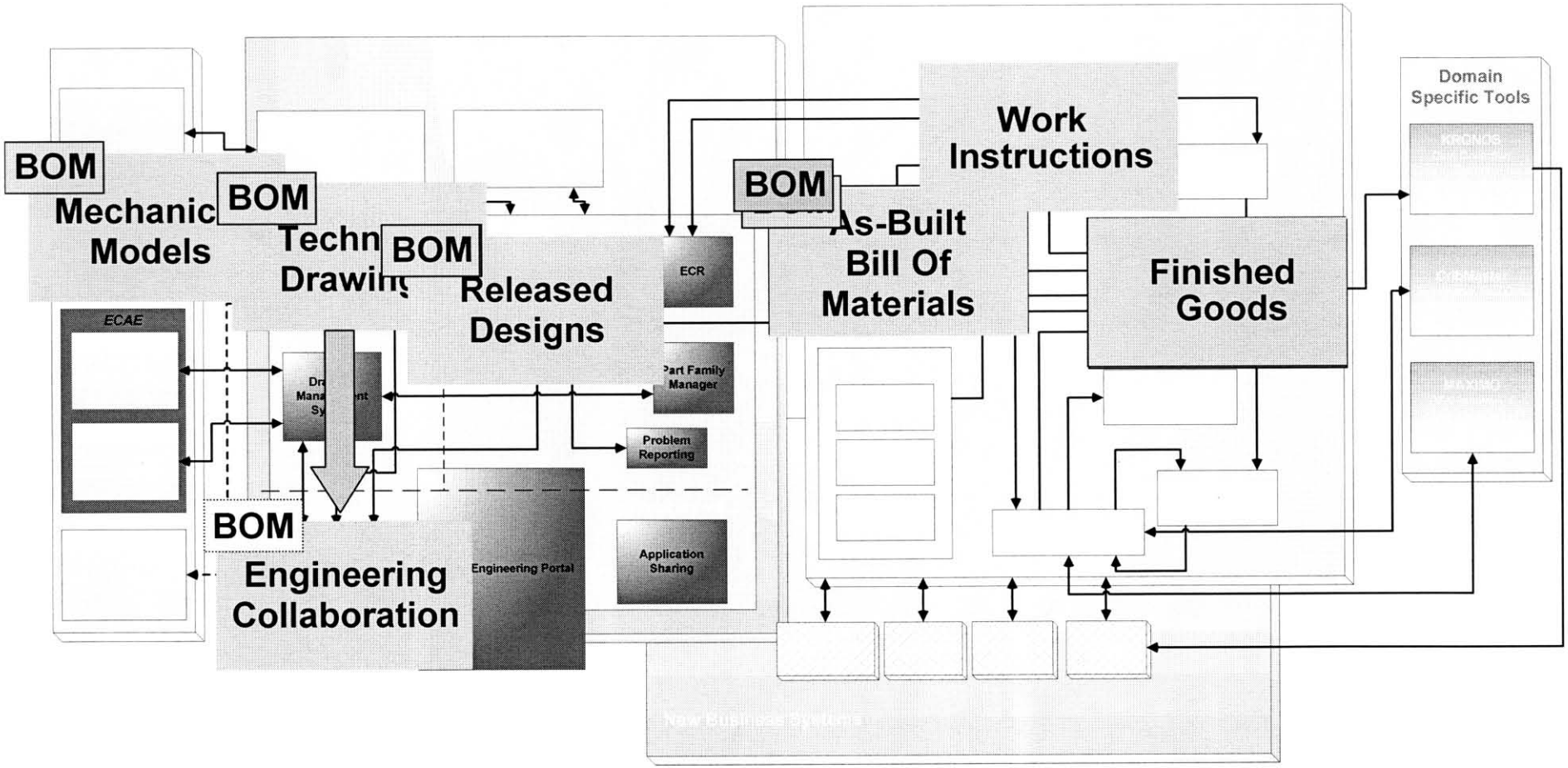

PDMS Phased Deployment

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Phase I

Teamcenter Foundation Basic Capability

- TC Enterprise V2.0
- Production Server Suite – 1TB Storage Array
- 2 Development Environments
- "Sandbox" Test Environment
- Basic Parts & Doc Management
- Basic Change Management
- Collaborative Environment
- Basic Reports

Completed May 2002

Phase II

Expand Functionality

- TC Enterprise V3.0
- Full CMII Compliant Change Process
- Electronic DRI Process
- Upgraded ECR Process
- Part Serialization tracking
- Full ITAR Compliance
- Waiver B
- Upgraded UI
- New Search Capability
- ECI Capabilities
- Subscriptions, etc

Completed March 2003

Phase II.x

Usability Updates (3 Releases)

- TC Enterprise V3.1
- Usability Enhancements
  - Files
  - Reports
- Added Tool Sets
  - Action Item System
- TC Community 4.2x Admin Interfaces

Completed Oct 2003

PDMS Phased Deployment

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Phase III

Closing the Gap

- TC Enterprise V4.0
- Replicate Remaining Sherpa Functionality
  - •Metadata
  - •Lifecycles
  - •Project Setup
- Added Tool Sets
  - •Drawing Tools
  - •Cog-E Tools
- Integration with:
  - •MCAD Tools
  - •Requirements Tools (DOORS)
  - •EBS/iPICS

Completed July 2004

Phase IV

Flight Project Migration From Sherpa

- Migrate Sherpa Flight Project data to Teamcenter
- Archive deprecated or legacy data
- Test functionality
- Project Training and user Migration

Completed December 2004

Phase V

Linkage to Other JPL Systems

- Integration with:
  - ECAD Tools
  - Systems Engineering Suite
  - Mission Assurance Tools
  - Scheduling Tools
  - Project Library tools
- Part Family Management
- 2-D Part Marking

Planned Completion Fall 2005

Implementation Lessons Learned

- Re-engineer processes - involving direct user groups
  - Build an integrated architecture and framework from the beginning
  - Develop top-down strategy for common processes (and tools)
- Key technical staff committed to support the project for its duration
  - Copilot with consultants but train your own staff
- Philosophy : Stay with COTS - Minimize customization
- Early development of a pilot system with demos to all
  - PowerPoint charts are ineffective – everyone wants a demo
  - Use "real – project" data to show how it works -It helps to train your staff
  - Senior management is more willing to fund a working pilot
  - Collaborative demos from Vendor and Partner locations build interest in the new system
- Phase implementation
  - Manage the shock of change - take small steps – don't over promise
  - Advertise, Advertise, Advertise

Benefits Realized!

- Production implementation is in process- Rollout started on January 3,2005
  - Few metrics are available at this point
  - Project interest in the new system is VERY strong
  - Requests exceed our planned support levels
  - Vendors and Partners expressing interest in using our system

Innovation Top 5 List

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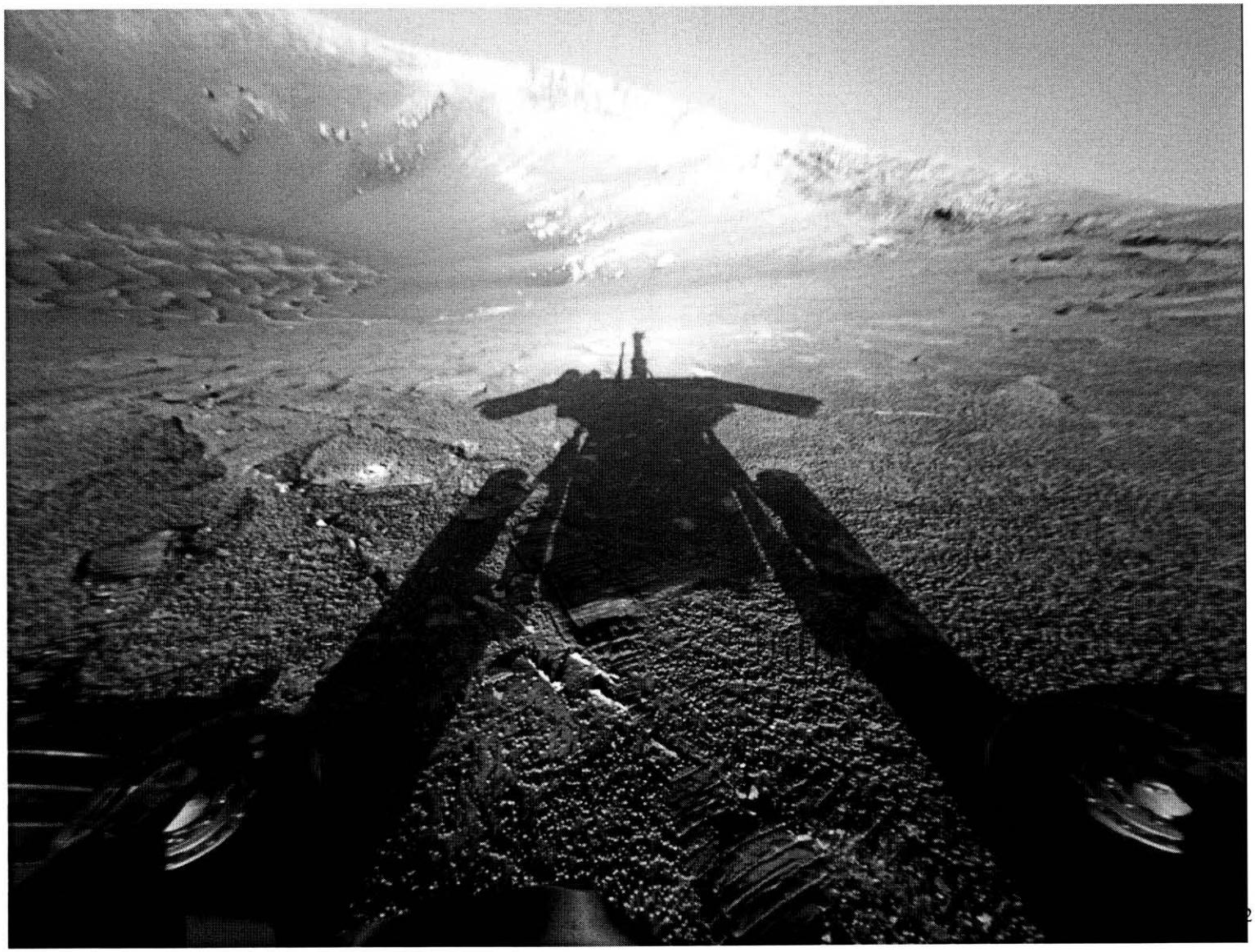
1. Fully support an implementation, or don't support it at all
2. Build a solid team of innovative people forward thinking and experienced in state of the industry software/systems
3. Focus your priority and experienced personnel on reworking your processes first
   - Question why you have "Always done that?"
4. Find stable COTS systems, stay with COTS, minimize customization
   - Change processes to fit COTS without customization
5. Put a large focus on change management (pilots, demos, presentations, advertising changes, etc) to build consensus
6. Electronic exchange of information with your subcontractors is very important – watch compatibility with contractor systems

Questions?

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