A collage of four overlapping, slightly tilted photographs of the Martian surface. The images show a vast, reddish-brown landscape with scattered rocks and low hills under a hazy, orange-tinted sky, characteristic of a Martian sunset or sunrise.

# CM and Drawing Release in a Rapid Prototyping Environment

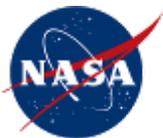
**Michael Stefanini**  
Technical Group Supervisor  
Project Control & Enterprise Applications



# CM and Drawing Release

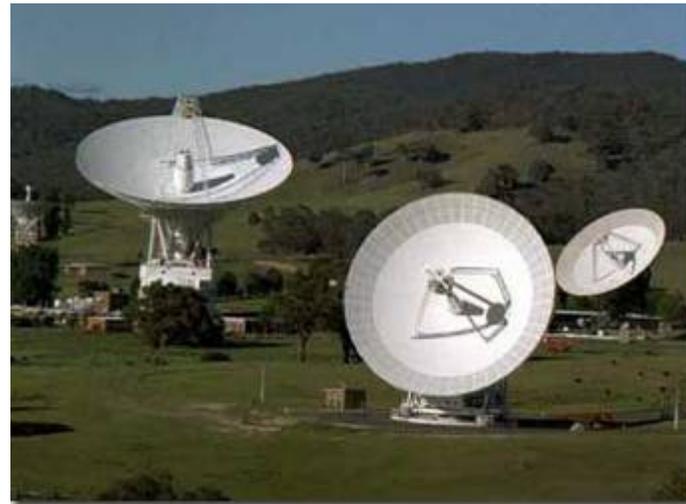
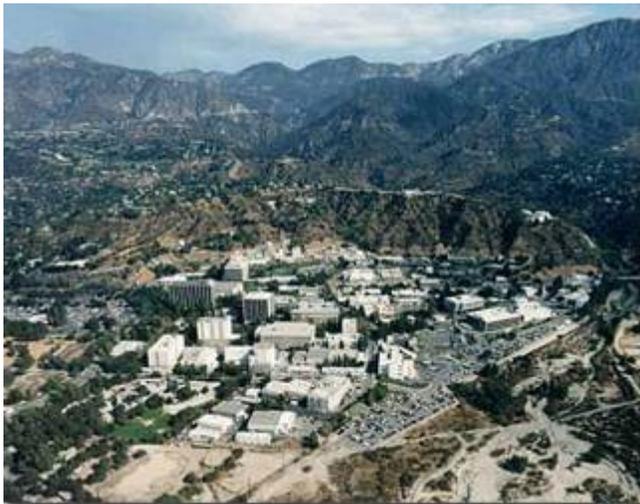


- JPL and the “JPL Way”
- Past, Present, and Future of Drawing Release
- Leveraging Tools – The Technology Catches Up!
- Integration and the Service-Oriented Approach
- Questions and Comments



# Facts About the Jet Propulsion Laboratory

- 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!



## Understanding the JPL “culture”

### University Focus

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

### Aerospace Business Focus

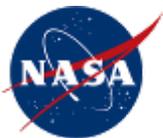
- State-of-the-art Engineering Design & Development
  - Spacecraft and Instruments
  - Communication and Navigation
- High Precision Production of Mechanical & Electrical Assemblies
  - In-house capability
  - Industry partners and suppliers worldwide



### Other Factors

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



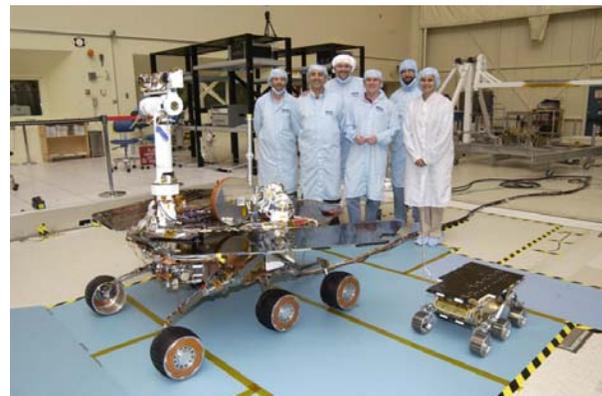


# “Typical” Project

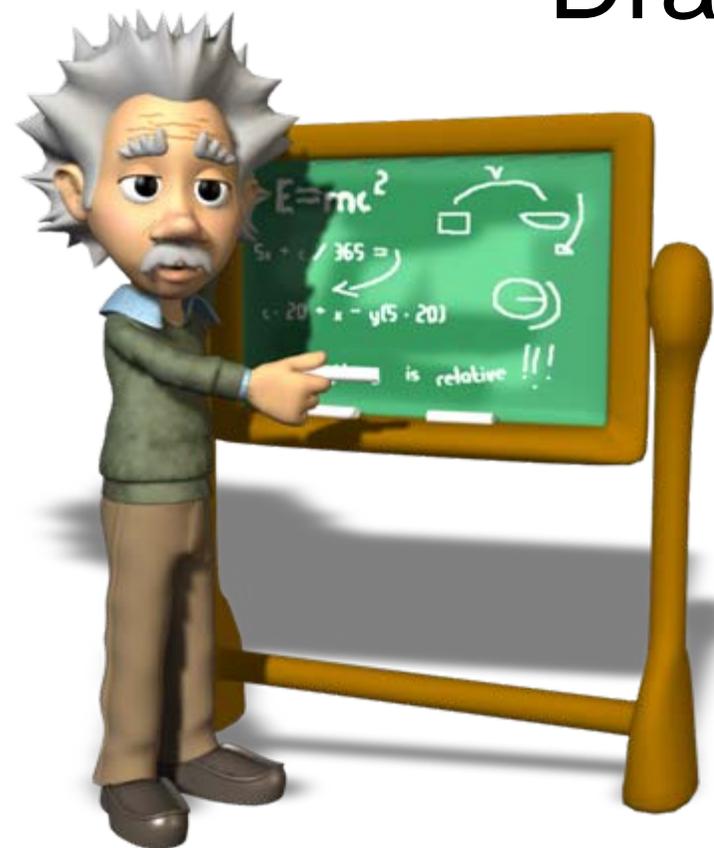
- JPL provides system management for a team of:
  - Project Scientists from around the world
  - Multiple JPL design teams with some in-house production
  - One or more NASA centers doing trade studies and perhaps developing instruments
  - One or more space agencies from outside the US also developing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



- JPL Projects are all (well, almost all) One-of-a-Kind endeavors
- No Mass Production
- No Significant Heritage from previous missions
- Fresh teams
- Very Rapid development cycles
- Finding relevant Lessons Learned, Design Information, or other previous knowledge is a challenge
- Releasing Designs must be a Rapid – but Controlled affair



# Past, Present, and Future of Drawing Release



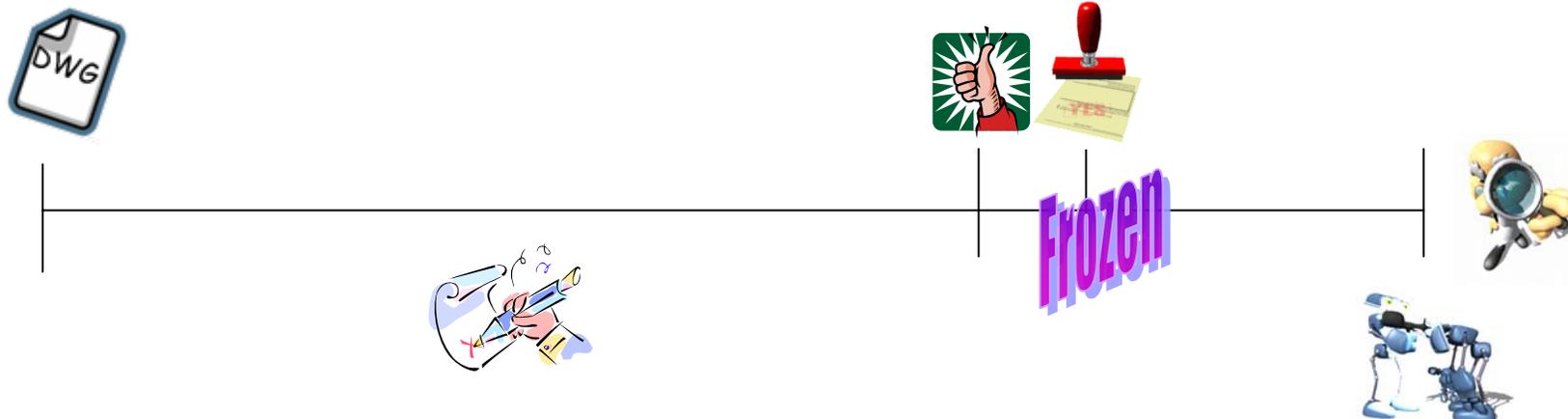


# The Past

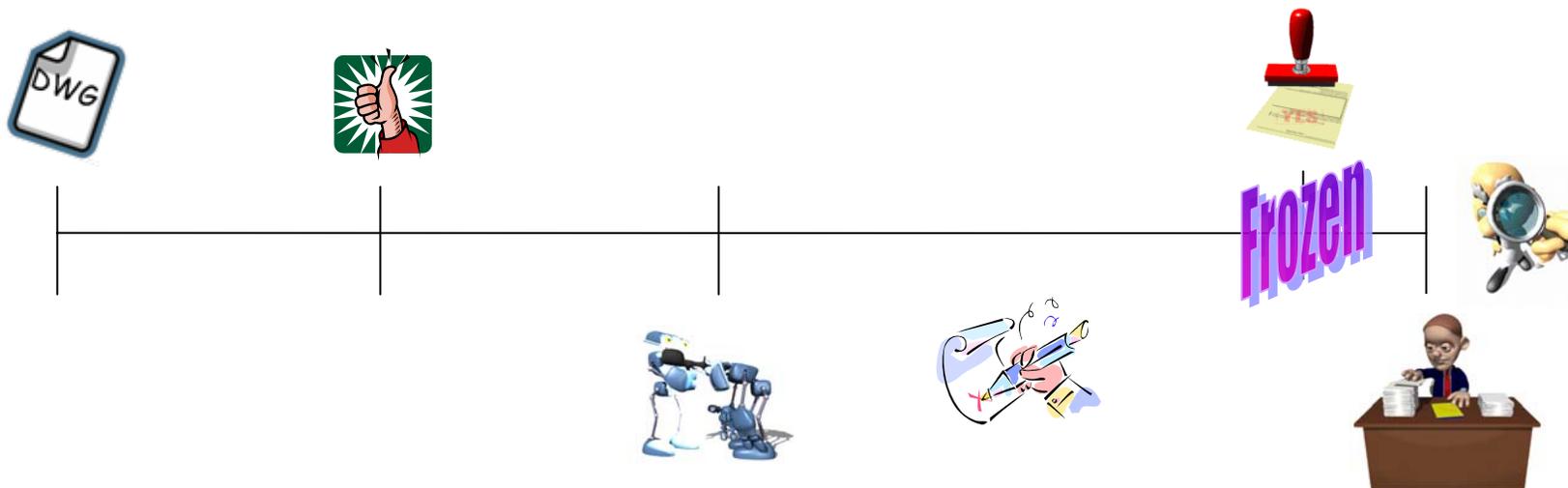
- Old Drawing Process (in order to build)
  - ❖ Get all signatures on the DWG, then CM releases
  - ❖ –OR –
  - ❖ Create and approve an X-Revision design, build, then get all signatures and release as Rev. A,
    - ❖ Then provide both X and A to QA to review for final inspection
- Issues
  - ❖ With Full Release, all signatures need to be gathered before build
  - ❖ X Revisions can only be used prior to Initial Release
    - ❖ But Most JPL drawings fly as Rev A!
  - ❖ If there is an X-Revision, you need to keep it for inspection
  - ❖ Most X-Revisions are never released



# Current Drawing Process – How it works



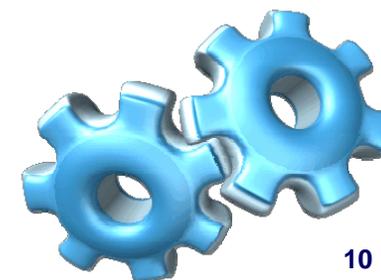
X-Revision:





# Rational for the Past

- Designs and Changes are done REAL TIME
- There is no history or precedence for assemblies
- Models are integrated from a variety of partners and often issues are found in the Fabrication and Assembly phase
- All the same issues you find in a normal R&D or Prototyping environment





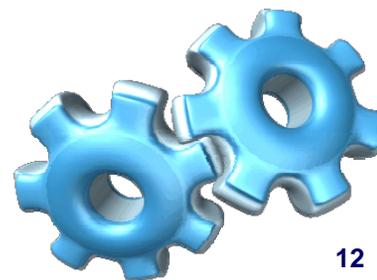
# Re-iteration of the issues

- Drawings and designs go out for costing and fabrication without being released
- Traceability can be lost when changes occur
- The X-number scheme is unwieldy and not desired
- Sequence numbers (Versioning) is basically the same as X-revs
- Versioning poses some numbering issues (E.g.: A1, A2, A3, A, B1, B2, B) and will require custom coding on ERP and PLM systems
- The current release process is an All-Or-Nothing affair.
- There are no conditions put on the use of a drawing.



# Present Day Release Process

- We will discuss the benefits of the new Release Level concepts
- List of the Proposed Release Levels
- A practical example
- Summary and review





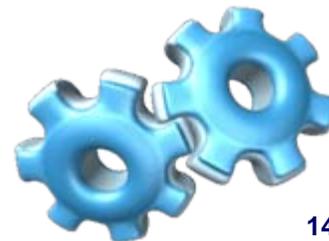
# Benefits of Release Levels

- Freezes any design that leaves the modeling tools
- Only full revision letters are ever referenced outside of design
- Control over the USE of the drawing is maintained
- No confusion when matching designs to Hardware



# Explanation of Release Levels

What are they and How do they work?

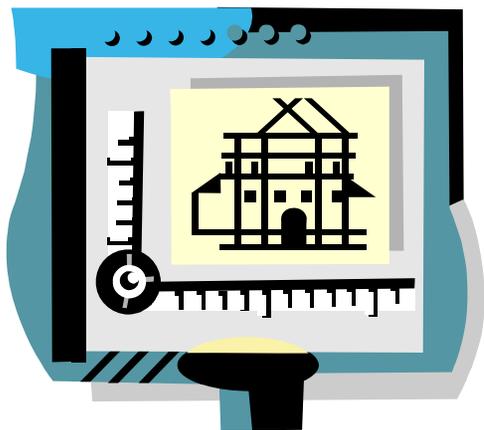




# Levels of Release

- There are THREE levels of JPL release
  - Released for **Planning**
  - Released for **Procurement or Fabrication (Build/Buy)**
  - **Final or Full Release**
- There is also a “Vendor Released” level
- There have also been other levels suggested
  - Released for Integration
  - Released for Testing
  - Released for Inspection
  - Development
- Other Concerns
  - Need to take into account Red-Lines
  - Paper Release
  - Vendor Drawings
  - ECIs (Engineering Changes to Drawings)

# Release Levels



Designer Signature = Planning



CogE Signature = Build/Buy



Design Supervisor Signature

CM Group Signature

Thermal Signature

.  
. .  
. . .

**= Final**



# Drawing Approvals - Signatures



- ❖ Released and:
  - ❖ Approved for Planning
    - ❖ Designer or COGE
    - ❖ CM
  - ❖ Approved for Build/Buy
    - ❖ COGE
    - ❖ CM
  - ❖ Approved for Final Inspection
    - ❖ Specified Functional Engineers
    - ❖ COGE
    - ❖ Design Supervisor
    - ❖ CM



# Description of Level Usage

- Planning
  - These drawings can be used for design reviews, base-line packages, or reference designs
  - These CANNOT be used for purchase, procurement, or fabrication
    - ie. Funds cannot be committed
- Build/Buy
  - These drawings can be used to receive a quote or even begin fabrication or procurement
  - Parts released for Build/Buy can even be used in non-flight assemblies
  - These parts will NOT pass final inspection
- Final
  - These parts have passed final review or been OK'd by the Cog-E
  - These are OK for all uses at JPL



# Review of Benefits

- **All** drawings are now Released
  - Before they are used in Planning or Costing
  - Before Fabrication or Procurement
  - Whenever they leave the design environment (TC Engineering)
- Freezes any design that leaves the modeling tools
- Only full revision letters are ever referenced outside of design – Ends numbering scheme issue
- Control over the USE of the drawing is maintained
- No confusion when matching designs to Hardware



# Issues with Release Level Concept



- Shift in the culture at JPL
- Release letters may reach Y or even AA, AB, etc



# Use in Industry

- Large or slower moving Aerospace companies tend to use Full Revisions
- Some (ex: Hamilton-Sunstrand) use X-Revisions, but they always release drawings before integration
- Rapid development companies like HP use release levels or Full release on all designs



# Summary and Conclusion



- This presentation is a simple overview
- The concept is sound and proven in industry
- It involves minimum intrusion into JPL's actual practices, BUT
- It involves a change in the JPL cultural concept of Release



# Building to a Drawing

- ❖ 1) Call CM or use PDMS to reserve a drawing number.

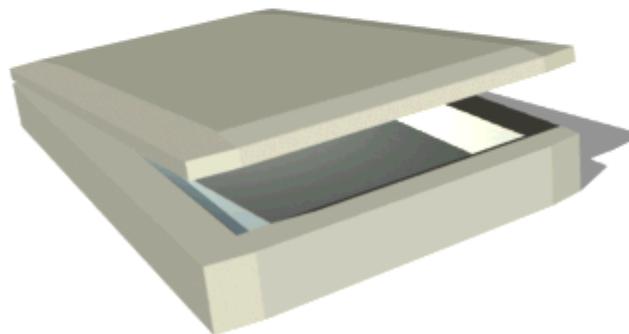




# Building to a Drawing

## 2) Capture the drawing:

- ❖ Scan the drawing if necessary.
- ❖ Upload the drawing file.



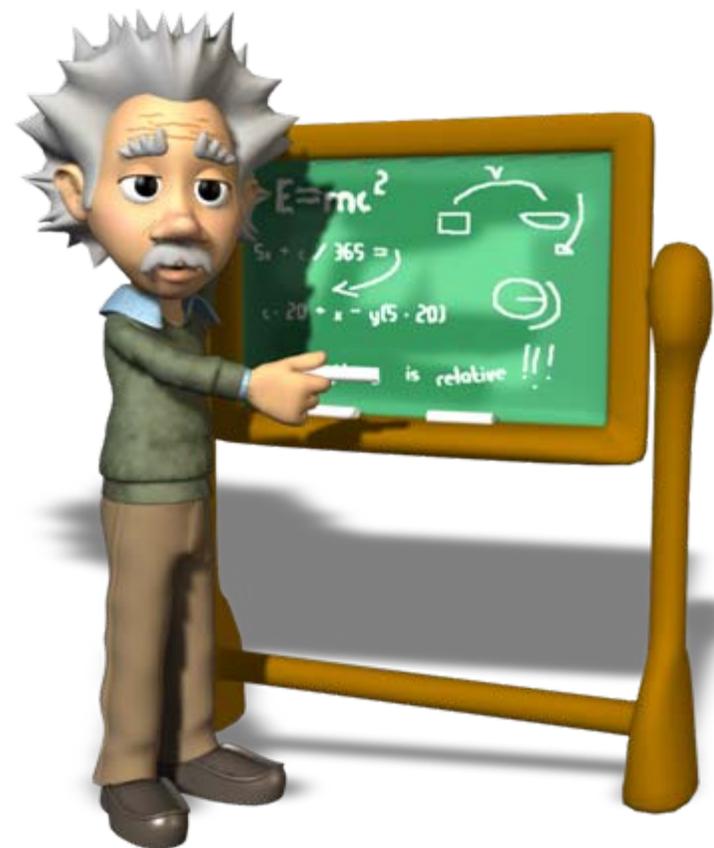
- ❖ 3) Sign-off the drawing:
  - ❖ Electronically
  - ❖ On the paper drawing itself



- ❖ If you need to expedite the drawing:
  - ❖ Leave the signed drawing with CM
  - ❖ E-mail the drawing to CM and include a note that it is approved and okay to build



# Revision Process





# Building to a Revised Drawing

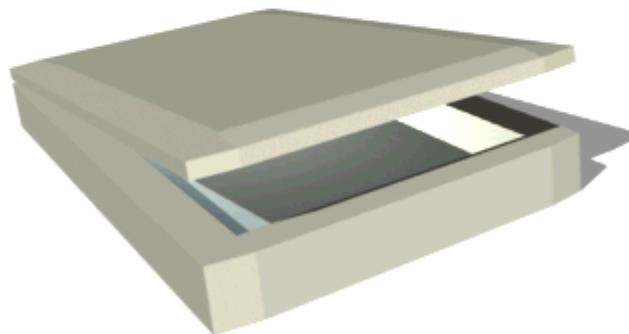
- ❖ 1) Call CM to reserve a revision letter.





# Building to a Revised Drawing

- 2) Capture the revised drawing:
  - ❖ Scan the revised drawing if possible
  - ❖ Upload the revised drawing file





# Building to a Revised Drawing

- ❖ 3) Sign-off the revised drawing:
  - ❖ Electronically
  - ❖ On the paper revised drawing itself





# Redline Process – How it works

You may do a redline if the redlines are:

- ❖ Legible
- ❖ Signed
- ❖ Dated

Make sure to reserve a revision letter from CM.

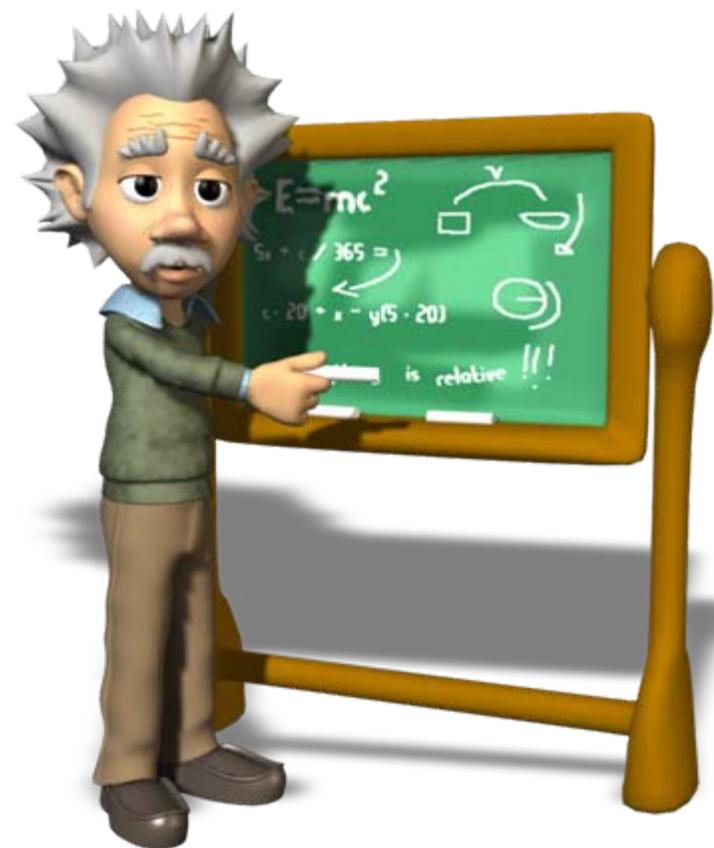




# Redline Process

- ❖ ECI information (was-is) is captured when a new revision letter is issued
- ❖ Redlines may be done electronically on the drawing PDF
- ❖ Redlines may be marked on the physical drawing
- ❖ ECIs May Substitute for a Red-Line

# Take-Aways





# Drawing Summary

- ❖ Drawings must be released prior to Build or Buy
- ❖ Sketches (Cat-E drawings) must also be released
- ❖ Models can be released as Cat-E drawings
- ❖ Drawing numbers are issued by CM or PDMS
- ❖ Drawings can be released with one signature & CM
- ❖ Released Drawings are authorized for specific purposes:
  - ❖ Planning
  - ❖ Build/Buy
  - ❖ Final Inspection
- ❖ All Drawing information will now be captured electronically
- ❖ CM is there to assist you



# Revision Summary

- ❖ Revision letters come from CM or PDMS
- ❖ Revisions get signed and released just like Drawings
- ❖ Redlines can be released



# Drawing Release – The Future



- Full Integration with Design and Modeling Tools
- Model-Based Release and Red-lining
- Capture design changes that happen in Assembly or off-site
- Electronic Mark-up and capture
- Eventual goal is to have NO red-lines or ECIs!



# Long Term Vision

- COTS, state-of-the-Practice, efficient, evolvable, and cost-effective
- Scalable to all levels/disciplines
- Make collaborative, distributed engineering easy, routine, and effective
- Seamlessly connect tools 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
- Permit rapid development of high-quality designs
- Configuration control is easy and continuous
- Connects to business system and ERP to support best business practices, earned-value management, etc.



# New Interface

## Main Page

TEAMCENTER

PDMS  
**Drawing Management Tool**  
Workspace - View All Tasks

Drawing Number

Designer

[Release Package Queue \(0\)](#)

## Drawing Tool

Select a View

- All Tasks
- Drawing
- Release Package

Wizards

- Create Drawing
- Create Release Package

Type	Number	Title
<input type="checkbox"/> ReleasePackage	RP-000091.A.1	
<input type="checkbox"/> Drawing	10270019.A.1	SHARON2 TEST LIFECYCLE
<input type="checkbox"/> Drawing	DAJ5002001.1.A.1	DAJ 5 TRY 2
<input type="checkbox"/> Drawing	DAJ500101.1.A.1	DAJ AS CREATRY 1
<input type="checkbox"/> Drawing	DAJ5001001.2.A.1	DAJ SERIES 5
<input type="checkbox"/> Drawing	DAJ4004002.A.1	DAJ HALOWE
<input type="checkbox"/> Drawing	DAJ4004001.A.1	DAJ HALOWE
<input type="checkbox"/> Drawing	DAJ4004003.A.1	DAJ HALOWE
<input type="checkbox"/> Drawing	10020030041.A.1	TEST NUMBER
<input type="checkbox"/> Drawing	10020030042.A.1	TEST RP WIT

1 2 3 4

Project Name\*

Organization Name\*

Drawing/Vendor Number\*

Revision\*

Title\*

Reference Designator

Cognizant Engineer

Designer

Drawing Control\*

Drawing Classification\*

Comments

Cad No Of Sheet

Cad Authoring Tool

Cad File Location

Cad Comments

**Release Package Wizard**

Remove | Expand | Collapse

- RPK-666666
- Drawings(1)
  - DRW-11115.C
- Distribution List(0)

Queue item description

Save Submit

## DRI Tool

Creation Wizard | Step 2 of 5 | 6 Drawings found.

Update Add Drawing Function Signature Distribution

Drawing Number

Project

Reference Designator

Cognizant Engineer

Designer

Search

DWC #	Rev	Title
DRW-11111	A	A test drawing number one
DRW-11112	A	A test drawing number two
DRW-11113	B	A test drawing number three
DRW-11114	A	A test drawing number four
DRW-11115	C	A test drawing number five
DRW-11116	B	A test drawing number six

Add to Queue (or drag-drop items)

Back Next

Status: Search and add drawings

\* indicates a required field



# The Technology Catches Up



Innovations in UI Design

&

The SOA Solution



# Innovation Objectives

## 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



# New Features

Modify | Attach File | Sign Off History | Add To RP Queue | Add Bookmark | Show URL

**10270073,A,1** has the following metadata

Project Name	SRTM
Organization Name	JET PROPULSION LAB (23835)
Drawing/Vendor Number	10270073
Revision	A
Title	PILOT TESTING
Reference Designator	SHUTTLE RADAR TOPOGRAPHY MAPPER
Cognizant Engineer	creator
Designer	advocate
Drawing Control	Lab
Classification	A
Lifecycle State	
Release Date	
Comments	Pilot Presentation Use ONLY!!!
CAD # of Sheet	
CAD Authoring Tool	Solidwks
CAD File Location	SwPdm
CAD Comment	
Out For Change Date	
Out For Change By	
Create Date	2005/11/10-20:31:30:930
Created By	super user
Date Modified	
Metadata Last Updated By	
Drawing Source	TcEnt

**10270073,A,1** has the following attachments [Upload File](#)

No files are attached to the drawing record

**10270073,A,1** has the following parts

Item Number	Relationship	Edit Record	Delete Record
<a href="#">10270073-1,A,1</a>	Has Part	<input type="button" value="Modify"/>	<input type="checkbox"/>
Add <input type="text"/>	# of new parts to this drawing	<input type="button" value="Add"/>	<input type="button" value="Delete"/>

**NO MORE  
POP UP  
Windows!!!**



# New Features

Modify | Attach File | Sign Off History | Add To RP Queue | Add Bookmark | **Show URL**

**10270073,A,1** has the following metadata

Project Name	SRTM
Organization Name	JET PROPULSION LAB (23835)
Drawing/Vendor Number	10270073
Revision	A
Title	PILOT TESTING
Reference Designator	SHUTTLE RADAR TOPOGRAPHY MAPPER
Cognizant Engineer	creator
Designer	advocate
Drawing Control	Lab
Classification	A
Lifecycle State	
Release Date	
Comments	Pilot Presentation Use ONLY!!!
CAD # of Sheet	
CAD Authoring Tool	Solidwks
CAD File Location	SwPdm
CAD Comment	
Out For Change Date	
Out For Change By	
Create Date	2005/11/10-20:31:30:930
Created By	super user
Date Modified	
Metadata Last Updated By	
Drawing Source	TcEnt

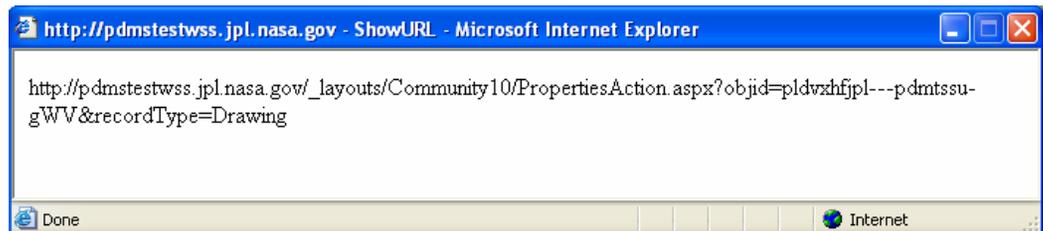
**10270073,A,1** has the following attachments [Upload File](#)

No files are attached to the drawing record

**10270073,A,1** has the following parts

Item Number	Relationship	Edit Record	Delete Record
<a href="#">10270073-1,A,1</a>	Has Part	<input type="button" value="Modify"/>	<input type="checkbox"/>
Add <input type="text"/>	# of new parts to this drawing	<input type="button" value="Add"/>	<input type="button" value="Delete"/>

Want the URL to a Drawing Record??





# New Features

Modify | Attach File | Sign Off History | Add To RP Queue | **Add Bookmark** | Show URL

**10270073,A,1** has the following metadata

Project Name	SRTM
Organization Name	JET PROPULSION LAB (23835)
Drawing/Vendor Number	10270073
Revision	A
Title	PILOT TESTING
Reference Designator	SHUTTLE RADAR TOPOGRAPHY MAPPER
Cognizant Engineer	creator
Designer	advocate
Drawing Control	Lab
Classification	A
Lifecycle State	
Release Date	
Comments	Pilot Presentation Use ONLY!!!
CAD # of Sheet	
CAD Authoring Tool	Solidwks
CAD File Location	SwPdm
CAD Comment	
Out For Change Date	
Out For Change By	
Create Date	2005/11/10-20:31:30:930
Created By	super user
Date Modified	
Metadata Last Updated By	
Drawing Source	TcEnt

**10270073,A,1** has the following attachments [Upload File](#)

No files are attached to the drawing record

**10270073,A,1** has the following parts

Item Number	Relationship	Edit Record	Delete Record
<a href="#">10270073-1,A,1</a>	Has Part	<input type="button" value="Modify"/>	<input type="checkbox"/>
Add <input type="text"/>	# of new parts to this drawing	<input type="button" value="Add"/>	<input type="button" value="Delete"/>

Want to bookmark an important Drawing??



# New Features

## Original process

### Release Package Wizard

Release Package Queue

Remove | Expand | Collapse

- RPK-666666
  - Drawings(1)
    - DRW-11115,C
  - Distribution List(0)

Queue item description

Creation Wizard : Step 2 of 5 6 Drawings found.

Update **Add Drawing** Function Signature Distribution

Drawing Number

Project

Reference Designator  ...

Cognizant Engineer  ...

Designer  ...

DWG #	Rev	Title
DRW-11111	A	A test drawing number one
DRW-11112	A	A test drawing number two
DRW-11113	B	A test drawing number three
DRW-11114	A	A test drawing number four
DRW-11115	C	A test drawing number five
DRW-11116	B	A test drawing number six

(or drag-drop items)

Status: Search and add drawings

Want to add Drawings on to a Release Package?



# New Features

## New Process

Modify | Attach File | Sign Off History | **Add To RP Queue** | Add Bookmark | Show URL

10270073,A,1 has the following metadata

Project Name: SRTM  
 Organization Name: JET PROPULSION LAB (23835)  
 Drawing/Vendor Number: 10270073  
 Revision: A  
 Title: PILOT TESTING  
 Reference Designator: SHUTTLE RADAR TOPOGRAPHY MAPPER  
 Cognizant Engineer: creator  
 Designer: advocate  
 Drawing Control: Lab  
 Classification: A  
 Lifecycle State:  
 Release Date:  
 Comments: Pilot Presentation Use ONLY!!!  
 CAD # of Sheet:  
 CAD Authoring Tool: Solidwks  
 CAD File Location: SwPdm  
 CAD Comment:  
 Out For Change Date:  
 Out For Change By:  
 Create Date: 2005/11/10-20:31:30:930  
 Created By: super user  
 Date Modified:  
 Metadata Last Updated By:  
 Drawing Source: TcEnt

10270073,A,1 has the following attachments [Upload File](#)

No files are attached to the drawing record

10270073,A,1 has the following parts

Item Number	Relationship	Edit Record	Delete Record
<a href="#">10270073-1,A,1</a>	Has Part	<input type="button" value="Modify"/>	<input type="checkbox"/>
Add <input type="text"/>	# of new parts to this drawing	<input type="button" value="Add"/>	<input type="button" value="Delete"/>

Want to add Drawings on to a Release Package?



# Multiple Drawing Modification

Modify **Multiple Update** | Attach File | Sign Off History | Add To RP Queue

<input checked="" type="checkbox"/>	Type	Number	Revision	Title	Status	File	Project	CogE	Release Date
<input checked="" type="checkbox"/>	DWG	<a href="#">10270010,A,1</a>	A	SHARON STILL TESTING	j0Assigned		DSMS	super user	10/25/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270028,A,1</a>	A	TEST CAT E	j0Assigned		DSMS		11/3/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270030,A,1</a>	A	TEST	j0Assigned		DSMS	advocate	11/3/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270031,A,1</a>	A	TEST	j0Assigned		DSMS	advocate	11/3/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270032,A,1</a>	A	TESTING 101!!!	j0Assigned		DSMS	advocate	11/3/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270033,A,1</a>	A	TESTING 102	j0Assigned		DSMS	advocate	11/3/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270038,A,1</a>	A	TESTAAAA	j0Assigned		DSMS	creator	11/8/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270039,A,1</a>	A	FOR THE LOVE OF GOD	j0Assigned		DSMS	creator	11/9/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270040,A,1</a>	A	HELP ME	j0Assigned		DSMS	creator	11/9/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270042,A,1</a>	A	HELP ME	j0Assigned		DSMS	creator	11/9/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270043,A,1</a>	A	HELP ME	j0Assigned		DSMS	creator	11/9/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270044,A,1</a>	A	HELP ME	j0Assigned		DSMS	creator	11/9/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270045,A,1</a>	A	TEST	j0Assigned		DSMS	creator	11/9/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270046,A,1</a>	A	HHHHHHHHHHHELP	j0Assigned		DSMS	creator	11/9/2005
<input checked="" type="checkbox"/>	DWG	<a href="#">10270047,A,1</a>	A	TESTING NEW TOOL	j0Assigned	1	DSMS	creator	11/9/2005

1 2



**Update** | Cancel

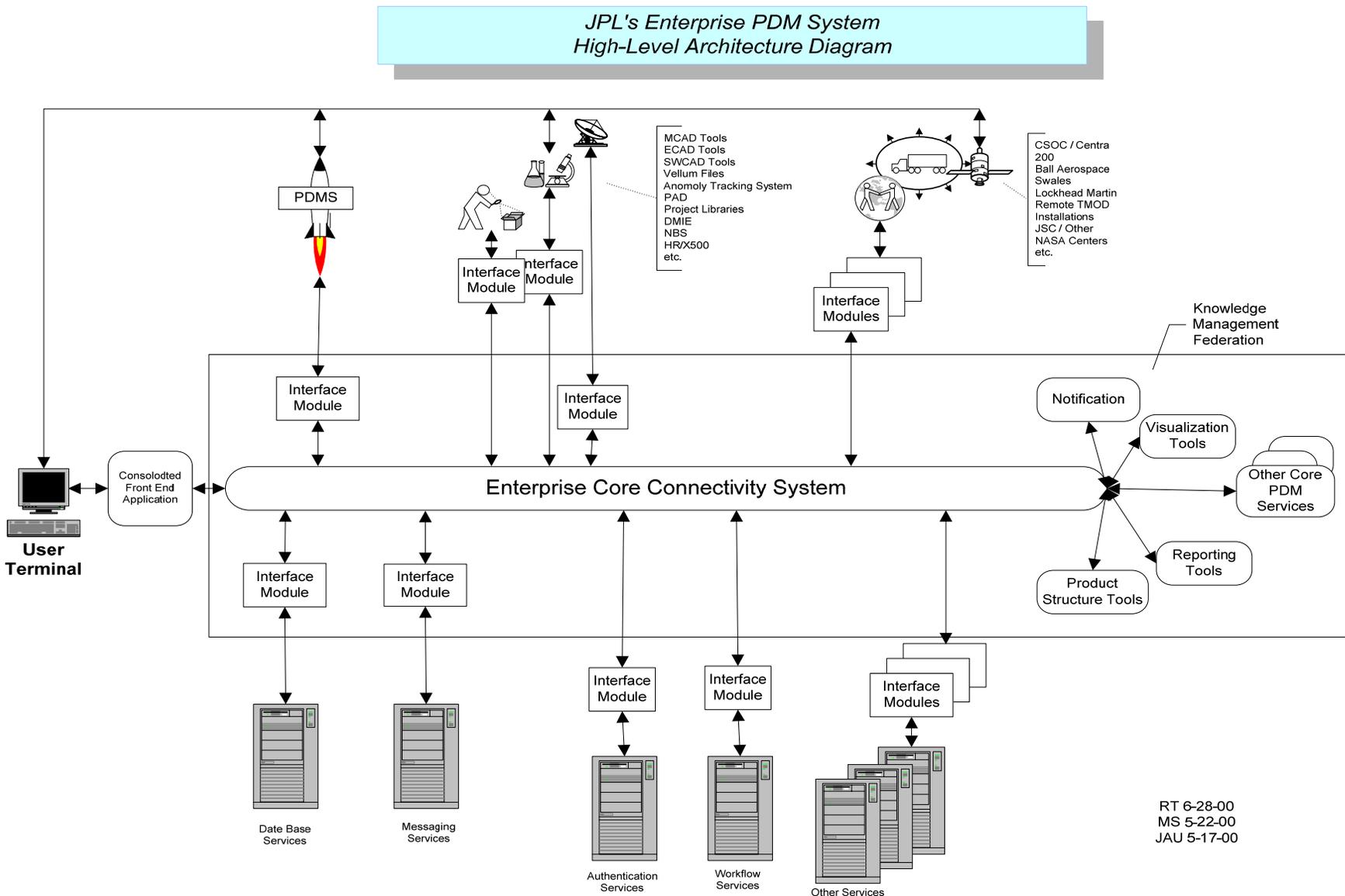
Cognizant Engineer:

Designer:

Title:

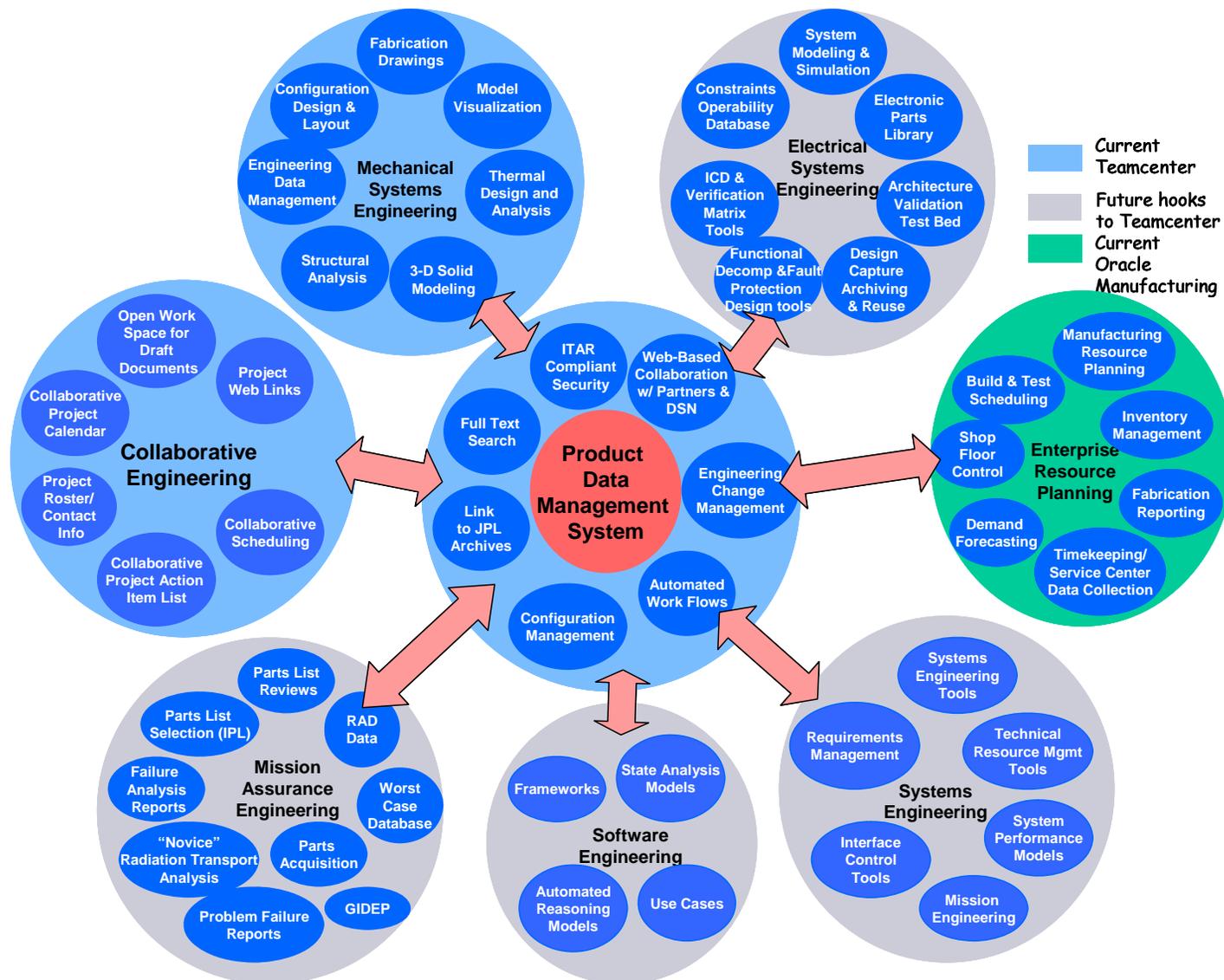


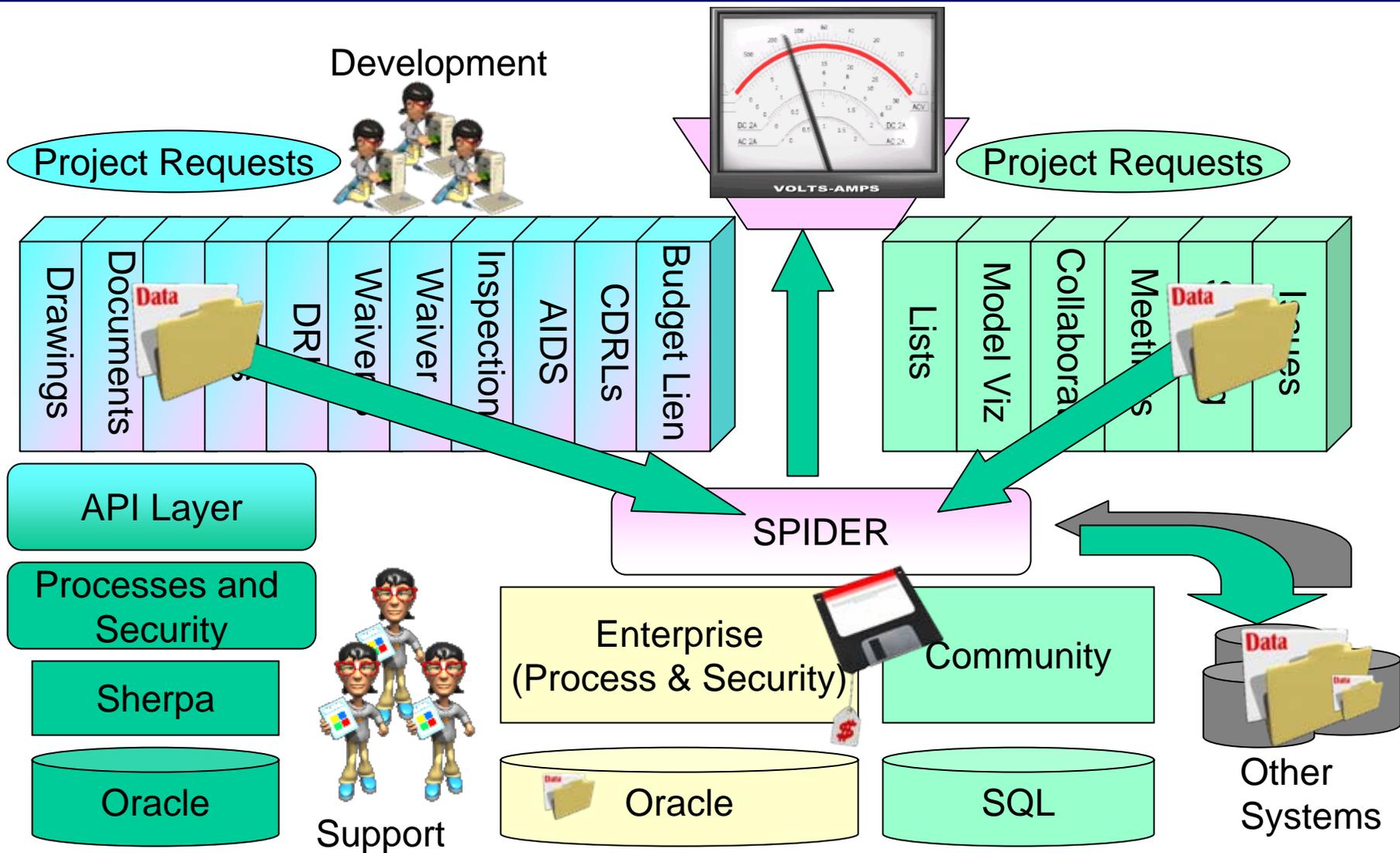
# Early Architecture Concepts – May 2000

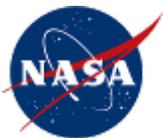




# Concept Diagram for Collaborative Environment







# Red Line Drawing Digitizer Tablet



# Topic

- Existing Redline drawing process
- What need to be improved
- Use Case Scenario



# Existing ECI Process

# How To Create an ECI (Part I)



EDMG



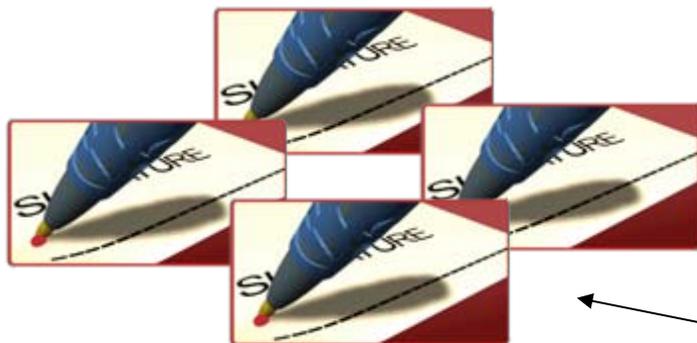
ECI Requestor



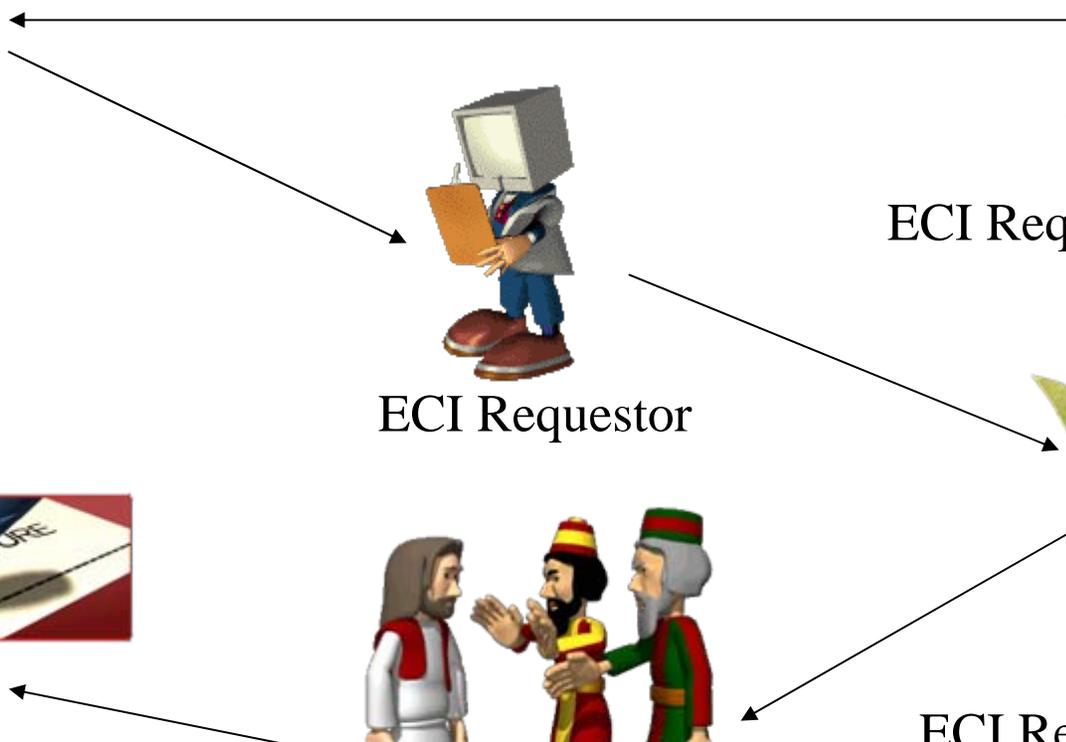
ECI Requestor



ECI Requestor

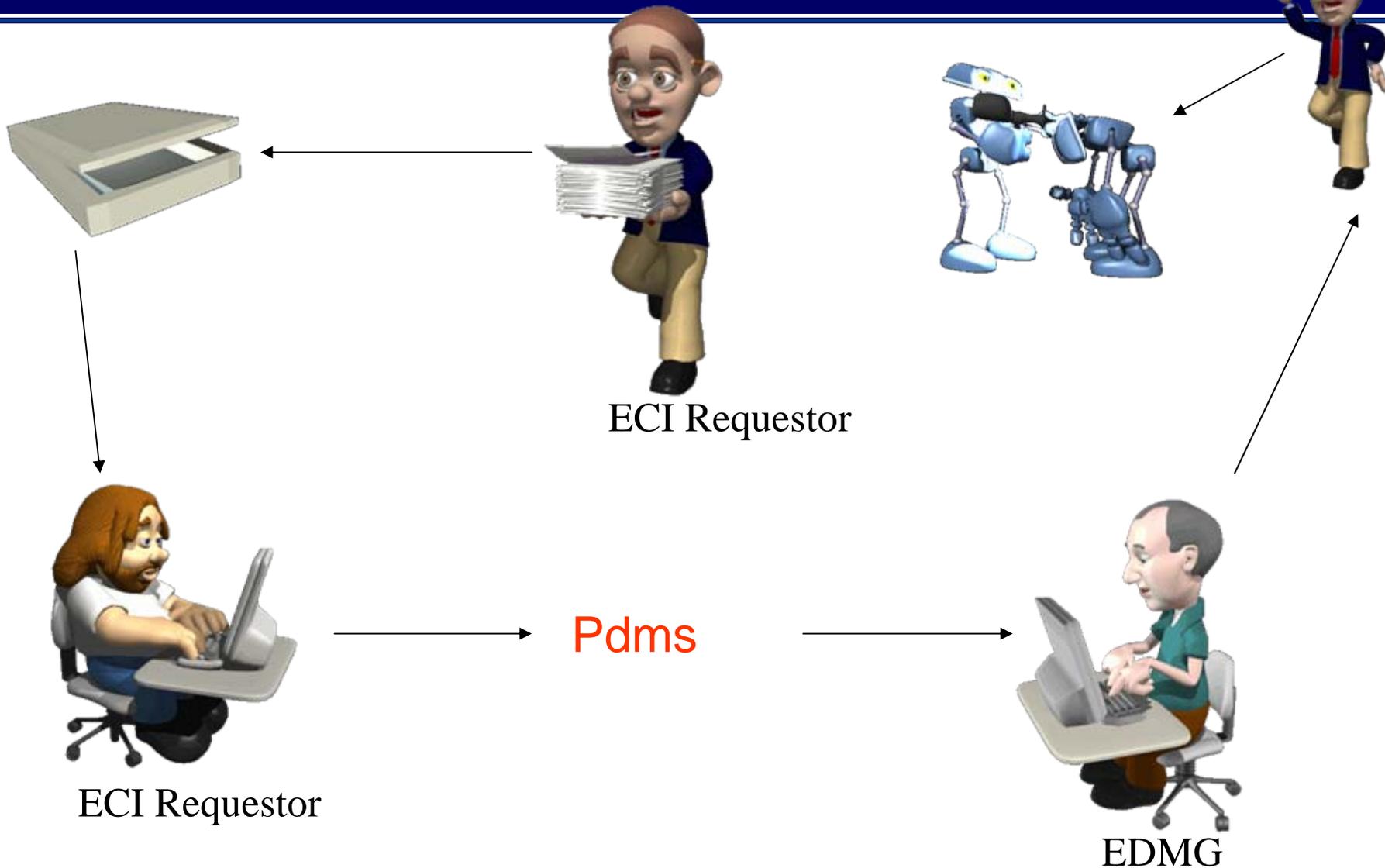


ECI Approver





# How To Create an ECI (Part II)





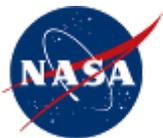
- Request an ECI record from EDMG
- Fill out ECI form
- Collect paper signature(s) on ECI form
- Scan ECI to PDF format
- Attach PDF to PDMS
- Print ECI and Drawing to machine shop

Total of 6 stops+

Time consuming while gathering signatures and scanning in ECI to PDMS



- Too many Drawings and ECIs sit right next to the Scanner
- Time consuming to get works done



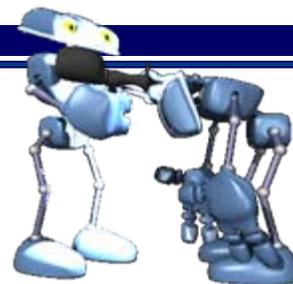
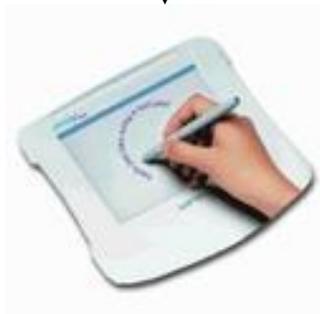
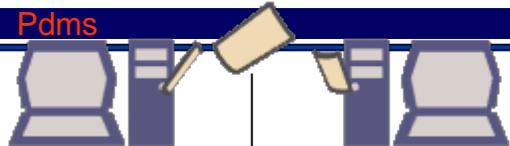
# Rapid Release Process



# PDMS Redline Tool Process



Pdms



ECI Requestor



EDMG





# Requestor Involvement in Rapid Release Process

- Login to PDMS
  - Search for the record
  - Redline the drawing
  - Electronic submit drawing for signatures
- Print out PDF to machine shop

Total of 2 stops

ECI vs. Redline = 6+ stops vs. 2 stops



## Result:

- No need to scan it ECI anymore
- No more Drawings and ECI sit next to scanner

## Advantages:

- Not only changes have captures and also a new rev. of drawing is released
- ECR is created
- And NO ECI is ever needed



# 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



- **Mechanical Design Process**

- Complete TC Engineering/Enterprise interface
- Enhance the TC Integrator connector to move as-built from ERP to PDMS for as-designed/as-built comparisons
- Expand process for models only (no drawing)
- Expand design connection to contractors

- **Electrical Design Process**

- Develop a design to ERP process
- Expand ERP to include electrical fabrication
- Expand PDMS with part-family management of electrical parts
- Mechatronics

- **Link to Windchill for ESMD programs**



**Thank You**



# Contact Information



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