



# **One NASA Cost Engineering Database (ONCE)**

**2015 NASA Cost Symposium**

**NASA: James K Johnson and Eric Plumer**

**SAIC: Mike Blandford and Julie McAfee**



# Overview

Cost  
Analysis  
Division

- **ONCE and CADRE Background**
  - Brief overview
  - 2014 Symposium, release of “ONCE 2.0”
- **By the Numbers**
  - CADRe Dashboard
  - Download Dashboard
  - User Dashboard
  - Model Downloads
  - Numbers Summary
- **Enhancements**
  - Home Screen Dashboard
  - Inflation
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  - Help & Instructional Resources
  - CADRe Developer Workshop feedback status
- **Quality Assurance Activities**
  - Background
  - Goals
  - Summary
  - Completeness Metrics
  - Upload process improvement
  - QA reports & process
  - Targeted improvement activities

## ***The “Plan”***

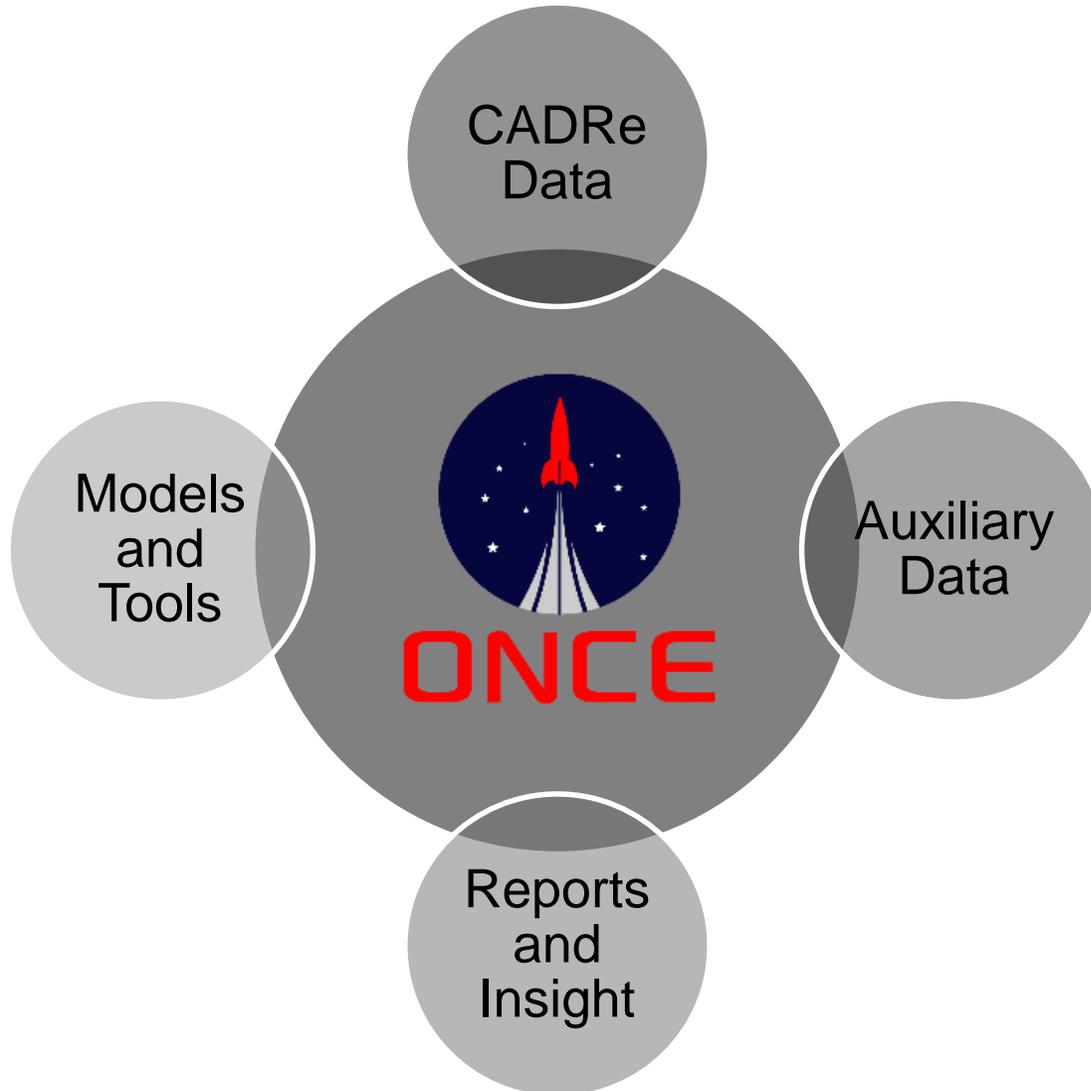
- *This brief is designed to be a primer*
- *Invite everyone to attend the ONCE demo later with more content*

*Note: All numbers shown current as 06 Aug*



# Last Time...at 2014 Symposium

Cost  
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- ONCE 2.0 is significant improvement and puts the database at the center of CAD's efforts to build and improve the NASA community.
- ONCE is now the center of CAD's efforts to empower analysts and improve cost estimating at NASA by providing access to:

- **CADRe Data**

- Active filtering for custom user reports
- CADRe Library

- **Auxiliary Data**

- Normalized datasets

- **Reports and Insight**

- Dynamic graphical & tabular reports
- Structured database reporting

- **Models and Tools**

- Model Portal sharing access across community



# Since then...we've been working!

- **ONCE improvements resulting from 2014 Symposium demo**
  - Interface created that visualizes the ONCE standard WBS
    - Located under Resources Menu
  - Developed metrics on QA reports
    - New dashboards that document percent of completeness
  - Select all mission event's instruments when "Instrument n" is selected on standard WBS
  - Created a Symposium Library
    - 2006 – 2014 presentations currently available
  - Additional Libraries added
    - Inflation Indices, Decision Memos, CADRe Templates, MS Project Files
  - Models added to ONCE Model Portal
    - ACEIT, DOCTOR, PRICE, SMART



**ONCE**

**By the Numbers**



# CADRe Dashboard

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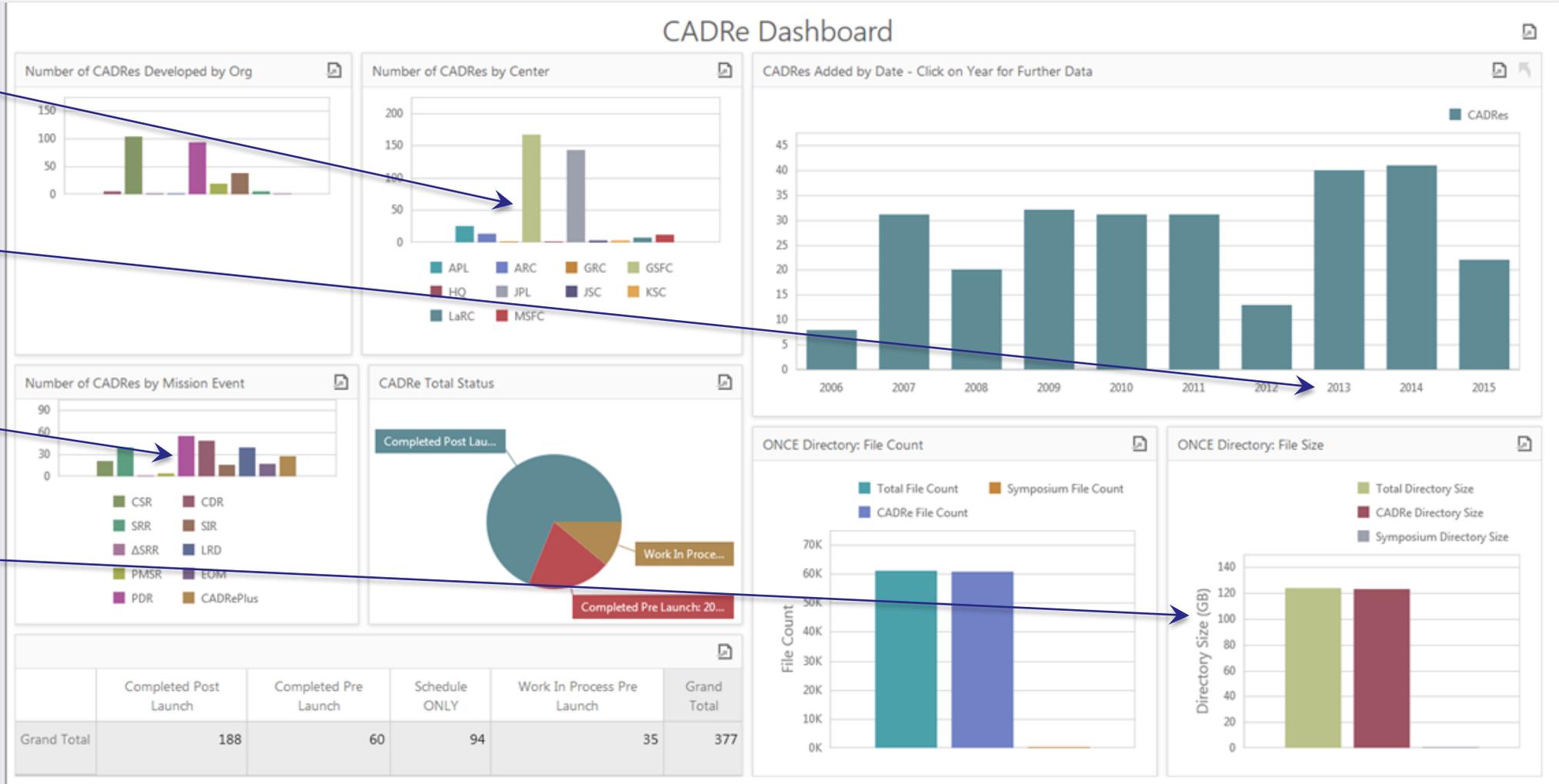
SMD Missions

Great CADRe Years!

CADRe

CDR, PDR, SRR, & LRD

Continued growth





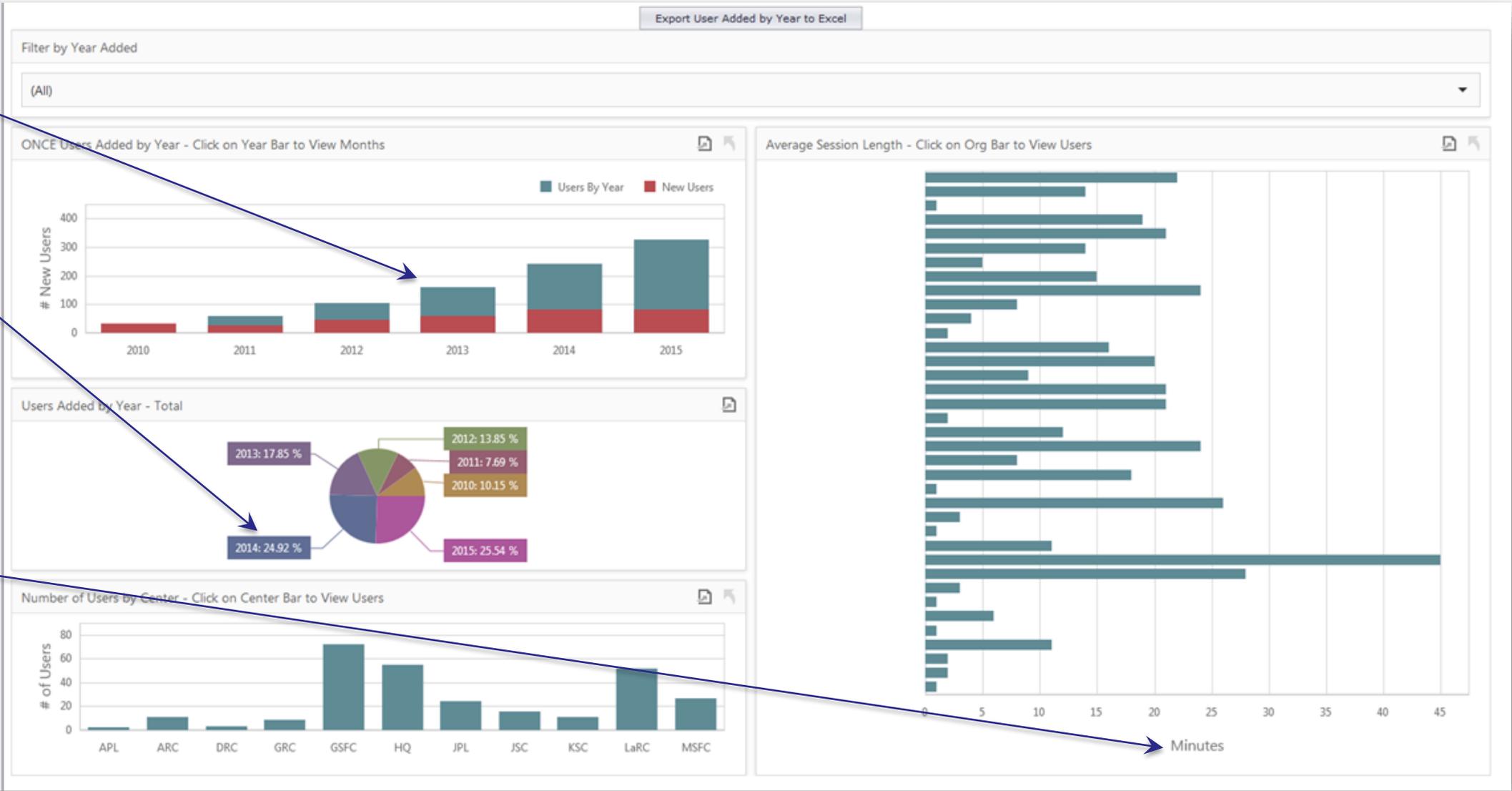
# User Dashboard

Cost  
Analysis  
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Year over  
Year  
growth

Growth in  
users  
linked to  
CADRe

Users  
online  
time is  
positive  
indicator





# Downloads Dashboard

Cost  
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CADRe  
Library  
has high  
activity

Export Downloads to Excel

### Dashboard

Filter Downloads by User: (All)

Filter Downloads by Type: (All)

Downloaded Date	File Name	User Name
8/6/2015	MAVEN_CSR_CADRe_Part_A_signed.doc	
8/6/2015	MAVEN_CSR_CADRe_Part_C_signed.xlsx	
8/6/2015	MAVEN_SRA_CADRe_Part_A.doc	
8/6/2015	MAVEN_SRA_CADRe_Part_C_Final.xlsx	
8/5/2015	CADRe TDRS-M SIR-PER Part C 20150618.xls	
8/5/2015	CADRe_Part_C_TDRS_K_L_-_K_Launch.xlsx	
8/5/2015	GALEX_LAUNCH_CADRe_Part_B_Rev_A_HQ_05.05.11.xls	
8/5/2015	GALEX_LAUNCH_CADRe_Part_C_Rev_A_HQ_05.05.11.xls	
8/5/2015	GSDO PDR CADRe Part A_Signed.doc	
8/5/2015	GSDO PDR CADRe Part B_Signed.xlsx	
8/5/2015	GSDO PDR CADRe Part C_Signed.xlsx	
8/5/2015	LADEE Launch CADRe Part B.xlsx	
8/5/2015	OCO_Launch_CADRe_Part_B_Approved.xlsx	
8/5/2015	OCO-2 Lanuch CADRe_Part_B_HQ_Rev_09.25.2014.xlsx	
8/5/2015	TDRS_K_CADRe_Part_C.xls	
8/5/2015	TDRS_K_PDR_CADRe_Part_C_revised_30_June_2009.xls	
8/5/2015	TDRS_KL_SIR_CADRe_Part_C_9_29_2011_v1.xls	

File Types Downloaded

File Type	Percentage
CADRe Library	36.57 %
Technical Report	4.03 %
Symposium: 2014	2.69 %
Symposium: 2013	2.88 %
Symposium: 2012	4.15 %
Symposium: 2011	2.96 %
Symposium: 2010	1.38 %
Symposium: 2006	1.34 %
Part C	10.26 %
Part B	8.14 %
Part A	5.80 %
NICM Report	0.31 %
NAFCOM Report	0.23 %
Inflation Indices	0.15 %
Decision Memos	3.00 %
Cost Report	11.76 %
Comment Report	0.19 %

Amount Downloaded from ONCE

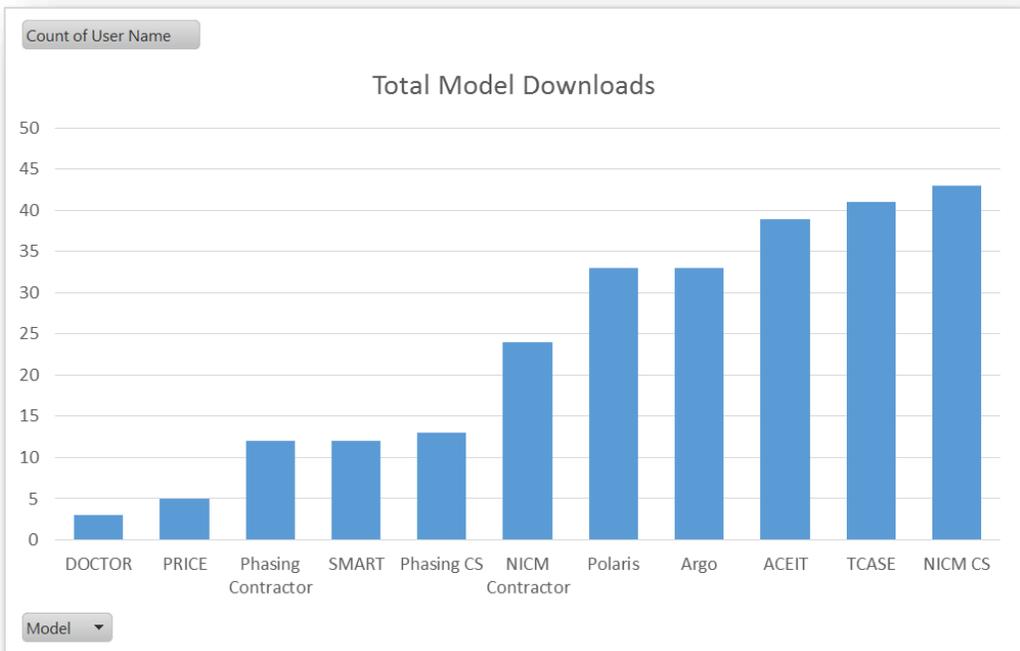
Year	File Size Total (MiB)
2015	~12,500





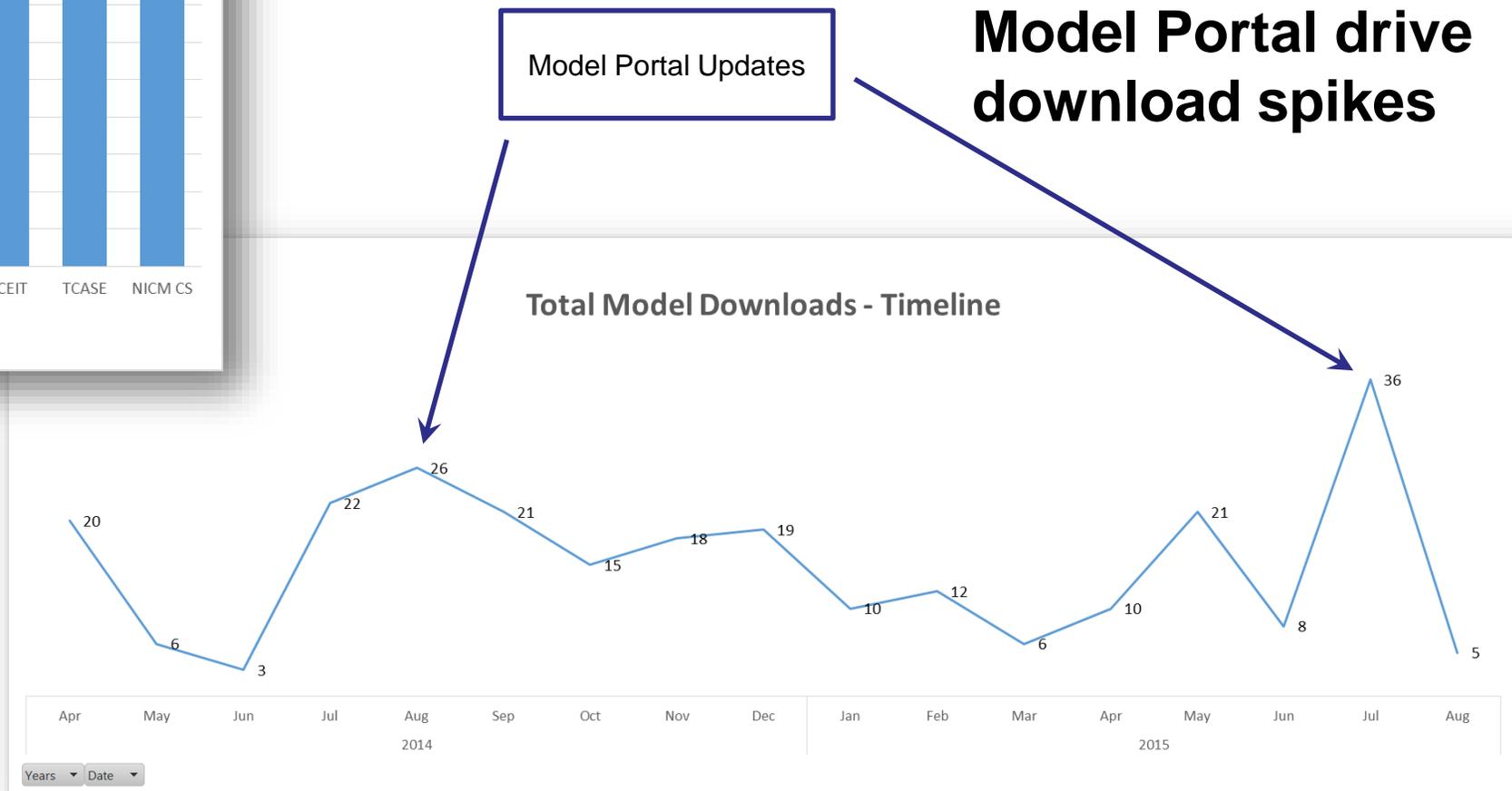
# Total Model Downloads

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- **362 Total Model Downloads**
- **Updates to the Model Portal drive download spikes**

- **NICM model is widely used (43)**
- **TCASE has become very popular**

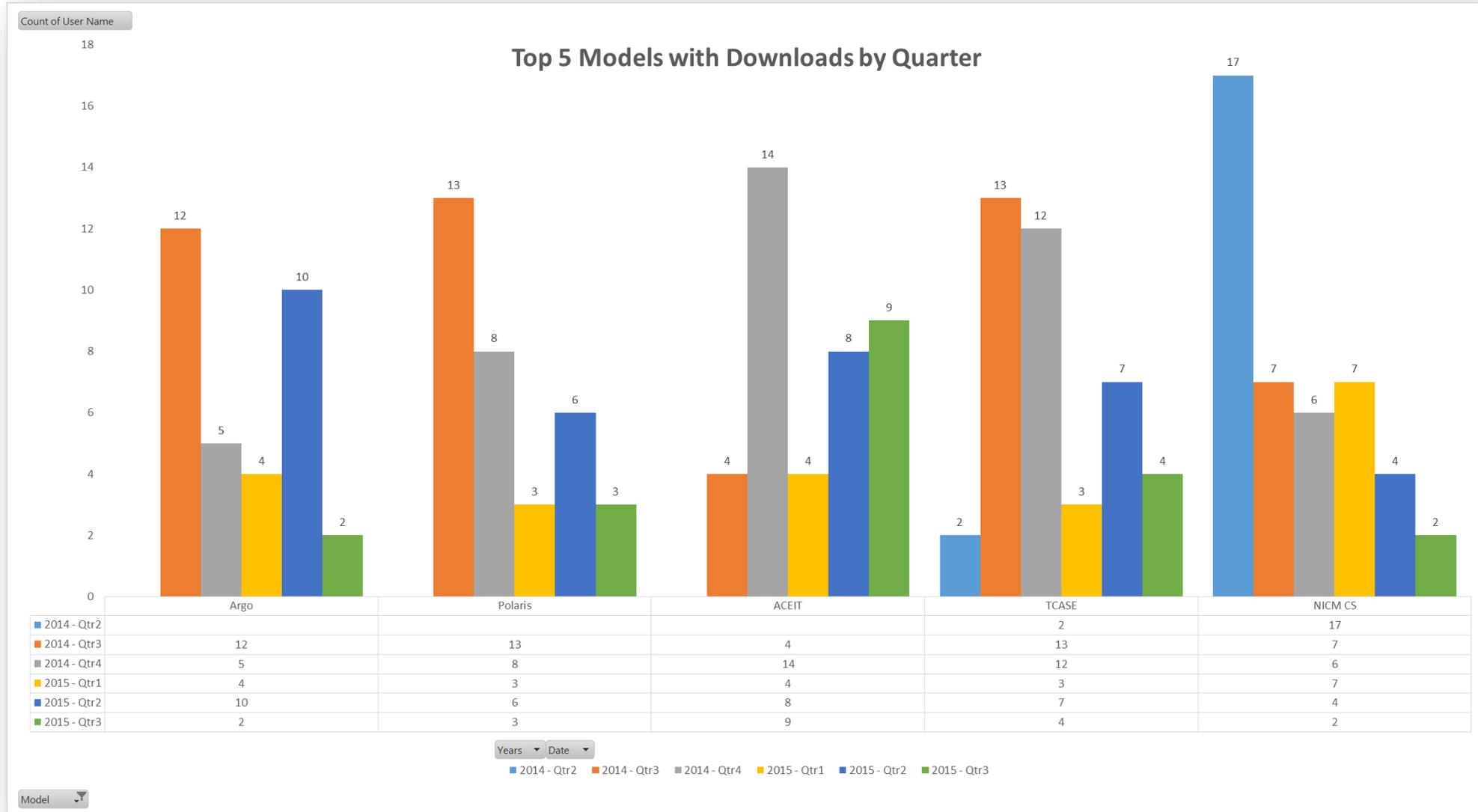




# Top Downloads

Cost  
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- **NICM - 43**
- **TCASE - 41**
- **ACEIT - 39**
- **Polaris - 33**
- **Argo - 33**





# Numbers Summary

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- **Total CADRe = 378**
  - 2015 = +22, 2014 = +41, 2013 = +40
- **Total Project = 110**
  - 56 PDR, 49 CDR, 40 SRR, and 40 LRD
- **Total User = 325**
  - 2015 = +94, 2014 = +81, 2013 = +53
- **Total Size = 60k documents and 120GB**
  - CADRe Library and Symposium Library most popular
- **Total Model Downloads = 362**
  - 2015 = 191
  - Top 5 Models are: NICM, TCASE, ACEIT, Argo, and Polaris



**ONCE**

**Enhancements**



# New Home Screen

Cost  
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**ONCE**  
ONE NASA COST ENGINEERING DATABASE

- ONCE
- Search
- User Reports
- User Charts
- Libraries
- CADRe Dashboard
- Status Screen
- Model Portal
- CADRe
- Administration
- Resources
- CADRe Info
- Find POCs
- Other Links
- Part A Instructions
- Part B Instructions
- Part C Instructions
- NASA STD CADRe WBS
- ONCE STD WBS
- Documentation
- Technical Support
- CADRe Inbox

Template Ver.	Project	Acronym	Event	Status
	Advanced Composition Explorer	ACE	SRR	Schedule ONLY
	Advanced Composition Explorer	ACE	PDR	Schedule ONLY
	Advanced Composition Explorer	ACE	CDR	Schedule ONLY
	Advanced Composition Explorer	ACE	EOM	Schedule ONLY
5.0	ACRIMSat	ACRIMSat	EOM	Completed Post Launch
4.2	Aeronomy of Ice in the Mesosphere	AIM	SRR	Completed Post Launch
4.2	Aeronomy of Ice in the Mesosphere	AIM	PDR	Completed Post Launch
4.2	Aeronomy of Ice in the Mesosphere	AIM	CDR	Completed Post Launch

### ONCE

Message from CAD

ONCE (One NASA Cost Engineering) is a web based database that provides controlled access to the CADRe data and information. Automated search and query of CADRe information is available via the ONCE database. The data stored in ONCE mimicks the CADRe templates - Parts A, B, and C. CADRe developers are able to quickly upload the documents and information and customized reporting is available for analysts and users.

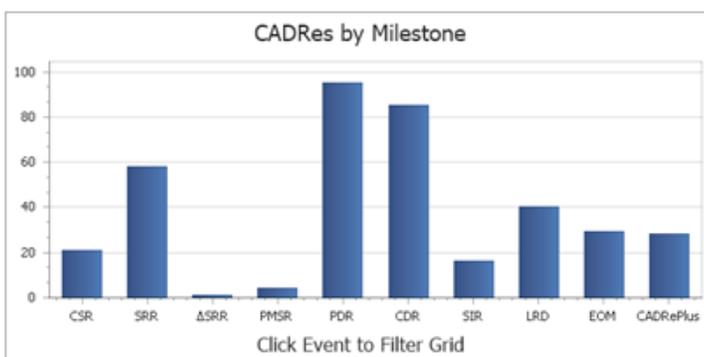
Points of Contact

HQ CAD: [Eric Plumer](#)  
HQ CAD: [James Johnson](#)

### Recently Added Data

### NASA Breaking News

[NASA, Space Station Partners Announce Crew Members for Missions in 2017](#)  
NASA and its International Space Station (ISS) partners have announced the crew ... [Details](#)



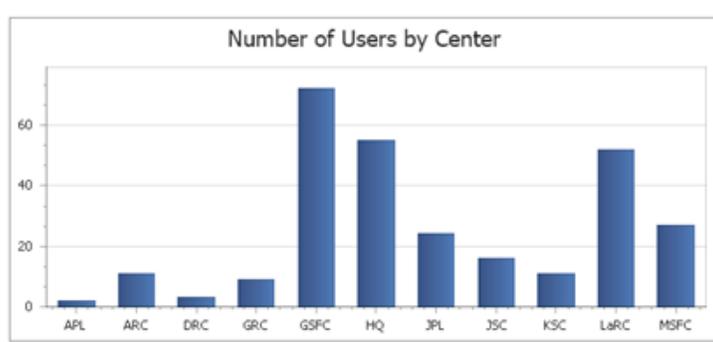
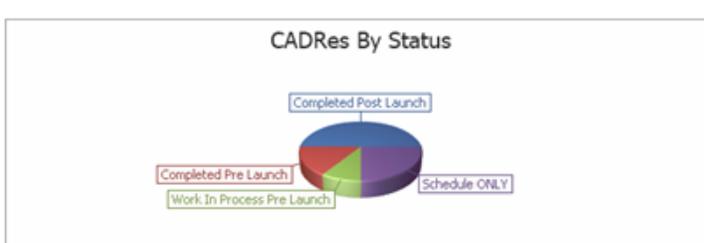
### ONCE Breaking News

8/4/2015  
The InSight SIR CADRe has been added to ONCE!

7/22/2015  
The eCryo SRR CADRe has been added to ONCE!

### Who's Online?

Johnson, James



### Questions or Comments?

[Email Us!](#)  
Phone: 843-360-9394

### ONCE Hot Spots

**CADRE LIBRARY**   **USER CHARTS**   **CADRE DASHBOARD**   **MODE PORT/**



# Document Search & Retrieval

**Search ONCE:**  
Search data incorporated into the ONCE database.

**Search CADRe/Source Document Files:**  
Full text search of over 60,000 files --123 GB--stored in CADRe Library.

**User Defined Search:**  
Provides ability to search user defined technical parameters.

The screenshot shows the ONCE search interface with three tabs: "Search ONCE", "Search CADRe/Source Document Files", and "Search User Defined Technical Parameters". The search text "solar array" is entered, and the "Perform Search" button is visible. Below the search bar is a table of search results. A callout box points to a file link in the results, stating "User clicks on file hyperlink to open." Another callout box points to a search result in a detailed view, stating "User searches within opened file to highlight." The detailed view shows a table with columns for parameters and values, with "Solar Array (coupon tests)" highlighted.

Mission	Event	File Location	File
GRACE	EOM	SourceDocuments	In-Orbit_Temp_Prediction.pdf
Deep Impact		AdditionalSource	581437... DWG NO. 581437 SH 1 REV C APPLICATION REVISIONS NEXT ASSY USED ON
NPP	LRD	SourceDocuments	NPP_CDRL_28... Ball Aerospace & Technologies Corp. BATC Commercial Space Operations NPP CDRL 028 NPP Satellite Cr
NOAA-N Prime	LRD	SourceDocuments	P&CH.pdf
NOAA-N			
GRACE			
GLORY			
Aqua			
Solar Probe Plus			
Deep Impact			
TRMM			

Component	Parameter	Value	Similarity	System	Foot			
Harness (Connectors on unit temp.)	-180 / +120	-180 / +120	-180 / +120	CHAMP System TV-Test	No			
	-180 / +115	-170 / +135	-170 / +135	CHAMP & other S/C heritance	Yes			
Nadir & Zenith S-Band Antenna	-100 / +100	-100 / +100	-100 / +100	CHAMP Similarity	No			
	-100 / +100	-105 / +105	-105 / +105	System TV-Test	Yes			
<b>Centre of Mass Trim System</b>								
Electronics	-20 / +40	-20 / +40	-50 / +70	Heritage other S/C	No			
	-20 / +30	-20 / +30	-20 / +45	New design	No			
Mechanism	-20 / +40	-25 / +50	-25 / +50		No			
	-20 / +30	-20 / +30	-20 / +45		No			
<b>Attitude Control System</b>								
Inertial Measurement Unit Cold Switch-on -30°C	-20 / +50	-20 / +50	-50 / 70	-35/60	-25/55	-25 / +80	No	Baseplate
	-160 / 130	-160 / 130	-160 / 130	CHAMP Similarity	-165 / 135	-180 / 130	Yes	Reference Foot
Magnetic torque rods Cold Switch-on -30°C	-20 / +50	-20 / +50	-50 / +70	-30 / +60	-35 / +55	-25 / +80	No	Ref. Foot.
	-20 / +50	-20 / +50	-50 / +70	-30 / +60	-35 / +55	-25 / +80	No	Ref. Foot.
<b>Cold Gas System</b>								
Tanks	-20 / +30	-20 / +40	-20 / +40	CHAMP Similarity		-30 / +50	No	Outer Surfaces
	-20 / +40	-45 / +107	-45 / +107	CHAMP Similarity			Yes	Reference Foot
Thrusters	-20 / +40	-50 / +60	-50 / +60	CHAMP Similarity		-60 / +70	Yes	Outer Surfaces
	-20 / +40	-50 / +60	-50 / +60	CHAMP Similarity		-55 / +65	No	Reference Foot
Relieve Valves	-20 / +40	-35 / +60	-35 / +60	CHAMP Similarity		-40 / +65	No	Reference Foot
	-20 / +40	-50 / +60	-50 / +60	CHAMP Similarity		-55 / 65	No	Reference Foot
High Pressure Latch Valve	-20 / +40	-50 / +60	-50 / +60	CHAMP Similarity		-60 / +70	No	Reference Foot
	-20 / +40	-50 / +60	-50 / +60	CHAMP Similarity		-55 / 65	No	Reference Foot





# New Inflation Capability

**Inflation  
Radio Button**

Mission phased cost output (if selected on previous screen):

Export to Excel

Display Events as Columns

Real Year

Base Year (2012\$)

- 1 Denotes Phase A/B costs phased programmatically by ONCE.
- 2 Denotes Phase C/D costs phased programmatically by ONCE.
- 3 Denotes Phase A/B and Phase C/D costs phased programmatically by ONCE.
- 4 Denotes all costs phased programmatically by ONCE.

		Phase A							Phase A Total	Phase B							
		Prior Yrs	2002	2003	2004	2005	2006	2007	2008		Prior Yrs	2002	2003	2004	2005	2006	2007
AIM	SRR	AIM-SRR															
		Project Management															
		Systems Engineering															
		Safety and Mission Assurance															
		Science/Technology															
AIM	PDR*	Payload(s)															
		AIM-PDR															
		Project Management															
		Systems Engineering															
		Safety and Mission Assurance															
AIM	CDR	Science/Technology															
		Payload(s)															
		AIM-CDR															
		Project Management															
		Safety and Mission Assurance															

- **Inflation handling capability has been incorporated into the ONCE interface**
  - Users can now choose to output their report costs in standard Base Year dollars (e.g. BY2012\$)
  - The legacy Real Year dollars will continue to be an option for reported costs so as to not lose traceability to historical CADRe phased costs.
  - The 2014 NASA New Start Inflation Index was integrated into the ONCE database to calculate inflation.
- **A radio button has been added to the phased cost output grid to allow users to switch their output between Real Year and Base Year (2012\$)**
- **A base year of 2012 was selected to parallel with the year dollar outputs from the other datasets in the ONCE database (NICM and NAFCOM)**

- The base year for cost element was derived by:
  - Determining the real year for the cost element
  - Determining the correct inflation factor from the 2014 NASA New Start Inflation Index (NNSI)
    - Note on NNSI: The NNSI is intended to estimate new efforts and for normalizing historical cost from prior missions. It is suggested that NNSI should not be used to estimate NASA CS personnel costs. Future ONCE capabilities will include the ability to apply other indices to specific cost elements.
  - Inflating/deflating the cost element to 2012 dollars using the derived inflation factor.



# Updated Resources - Overview

ONCE  
Resources  
received  
major  
updates

Documentation  
has many new  
additions

- ONCE
  - Search
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  - User Charts
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      - Part B Instructions
      - Part C Instructions
      - NASA STD CADRe WBS
      - ONCE STD WBS
      - Documentation
      - Technical Support
  - CADRe Inbox

## CADRe and ONCE DATABASE OVERVIEW

CADRe (Cost Analysis Data Requirement)

The CADRe is a formal project document that describes the programmatic, technical, and life-cycle cost and cost/schedule risk information of a project. It is a 3 part document that describes a NASA project at each milestone, and provides historical record of cost, schedule, and technical project attributes so that estimators can better estimate future analogous projects. A 2005 initiative, the CADRe is NASA's unique response to the need to improve cost and schedule estimates during the formulation process, providing a common description of a project at a given point in time.

### HISTORY OF CADRe

Over the past 15 years, NASA has been criticized for its inability to provide credible cost and schedule estimates for its space projects. In 1992, the Government Accountability Office (GAO) reported that NASA space projects sustained a 62 percent average growth rate over their initial cost estimates. Through a number of programmatic changes over the years, the Agency was able to reduce project cost growth rate to 30 percent. This was a good improvement, but the GAO still considered a 30 percent growth rate to be unacceptable.

In 2004 the GAO came out with harsh report on NASA titled "Lack of Disciplined Cost Estimating Processes Undermines NASA Ability to Manage Their Flight Projects". The GAO made a number of recommendations to NASA such as developing a document to fully describe a project and including the actual costs of the project so that estimators could use such data to better estimate similar future projects. Agency project managers (PMs) have historically estimated the cost of their projects using a bottom up method; otherwise known as "grass-roots estimating". The result is that these estimates are highly optimistic and don't tend to include all potential risks. To combat this tendency, the GAO recommended using actual historical costs and building a repository of cost and technical data for use in preparing cost estimates.

In response, the Agency, agreed (in line with the GAO recommendations) that all major space projects would develop what is now known as a Cost Analysis Data Requirement (CADRe), which contains the cost, technical and programmatic history of the various space projects. This document would serve as a formal means to capture and archive cost, technical and programmatic data for use in estimating future NASA projects. Over the course of several months unique templates for each part of the CADRe (A, B, C) were developed to standardize the development of the document across all of NASA's flight projects. Shortly afterwards the CADRe document was formally established in 7120.5C which was a new policy and direction to implement CADRe across all of NASA. The CADRe requirement continued in the release of 7120.5D and 7120.5E. With the framework in place, CAD began implementing CADRe on current mission as well as preparing CADRe for many historical flagship missions.

### CADRE PURPOSE

The CADRe program satisfies a foundational cost-estimating need, which is to provide historical cost data that is vital to performing estimates for future missions. The CADRe provides information to support an Independent Cost Estimate (ICE) as well as actual cost and technical information so that estimators can do a better job of projecting the cost and schedule of future analogous projects. This way important data is captured across all major flight projects at NASA including major instruments that fly on foreign partner spacecraft.

### CADRE OWNERSHIP

The CADRe is a project owned document and is signed by the project manager; therefore, it does not include any independent assessments or evaluations, or opinions about the project. It simply records the known configuration at the specific milestone. HQ/CAD provides the necessary funding and support to prepare the document on behalf of the project using existing project documentation prepared during the milestone review process. In the few cases where a CADRe is prepared for a previously launched mission, CAD will make the determination if there is enough data, and if so CAD will prepare a single Launch or End of Mission (EOM) CADRe. These CADRes are also very useful for historical benchmarking and understanding cost, schedule, and technical trends over time.

### CADRE STRUCTURE

Composed of three parts, the CADRe captures detailed programmatic, technical, and cost data in a standardized format. The document is prepared six times during the life cycle of a project at major milestones (SRR, PDR, CDR, SIR, Launch, End of Mission).

The three parts of a CADRe are as follows:

PART A Describes a NASA project at each milestone (SRR, PDR, CDR, SIR, launch and End of Mission), and describes significant changes that have occurred. This section includes essential subsystem descriptions, block diagrams, heritage assumptions needed for cost analysis purposes. The templates for robotic or human space flight missions can be found at: <http://www.nasa.gov/offices/ooe/CAD.html>

PART B Contains standardized templates to capture key technical parameters that are considered to drive cost such as mass, power, data rates, and software metrics in an Excel Workbook. The formats of this template follow standard NASA terminology such as Current Best Estimates (CBE) and CBE Plus Contingency. (See <http://www.nasa.gov/offices/ooe/CAD.html>)

PART C Captures the NASA project's cost estimate and actual life-cycle costs within the project's WBS and a NASA Cost Estimating Work Breakdown Structures (WBS) in an Excel Workbook. This section also captures the project schedule, risks, and ground rules and assumptions. (See <http://www.nasa.gov/offices/ooe/CAD.html>)

The source documents that make up a CADRe include all the various documentation that the project is already producing. The CADRe is always written using existing project documents, and CAD does not force the project to produce any unique documentation to produce the CADRe. This is one of the key aspects of CADRe that makes it a one-stop source of data. As can be seen in the figure below Part A includes documents such as the Project Plan and Milestone briefing charts, Part B uses the project mass and power reports, and Part C uses the project's cost estimates, schedules and cost reports. See the figure below for many of the key documents used.



# New Resources - Documentation

Cost  
Analysis  
Division

ONCE  
ONE NASA COST ENGINEERING DATABASE

- ONCE
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  - User Charts
  - Libraries
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  - Status Screen
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- Resources
  - CADRe Info
  - Find POCs
  - Other Links
  - Part A Instructions
  - Part B Instructions
  - Part C Instructions
  - NASA STD CADRe WBS
  - ONCE STD WBS
  - Documentation
  - Technical Support
  - CADRe Inbox

Documentation Tutorial Videos CADRe Template Versions

## DOCUMENTATION

- CADRe Documentation
- CADRe Information
    - CADRe ONCE Overview Brochure
    - CADRe WBS Definitions
- ONCE Documentation
- User's Manual
    - ONCE Inflation Capability
    - ONCE Overview - Prezi Presentation
    - ONCE Enhancements: 2014 Cost Symposium Presentation

ONCE  
ONE NASA COST ENGINEERING DATABASE

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Part C Instructions  
NASA STD CADRe WBS  
ONCE STD WBS  
Documentation  
Technical Support  
CADRe Inbox

One NASA Cost Engineering Database (ONCE)  
Insight and Management of CADRe Data

User's Manual

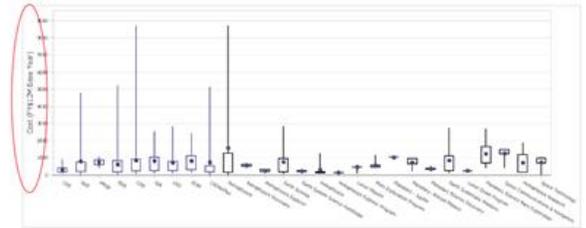
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Automatic Zoom

6

## Base Year Calculations Crosscheck

- The base year costs were used in all ONCE cost charting.



SAIC

ONCE  
ONE NASA COST ENGINEERING DATABASE

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CADRe Status Screen  
My CADRe  
Who's Online

“ONCE 2.0”

2014 NASA Cost Symposium  
James K Johnson, Eric Plumer, Mike Blandford, and Julie McAfee

SAIC

Prezi CREATE EXPLORE LEARN & SUPPORT PRICING LOG IN GET

Report Output Multiple Datasets Charting Capability

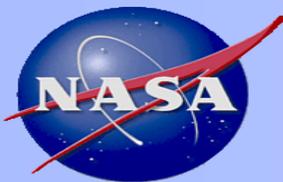
Report Interface One NASA Cost Engineering (ONCE) Overview Model Portal

Access to CADRe Data CADRe Library

ONCE Overview

Share Embed Like

Public



# New Resources – Tutorial Videos

Cost  
Analysis  
Division

Tutorial Videos  
tab under  
Documentation

Multiple new  
videos

ONCE  
ONE NASA COST ENGINEERING DATABASE

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Documentation Tutorial Videos CADRe Template Versions

Project	Acronym	Event	Status
Advanced Composition Explorer	ACE	SRR	Schedule ONLY
Advanced Composition Explorer	ACE	PDR	Schedule ONLY
Advanced Composition Explorer	ACE	CDR	Schedule ONLY
Advanced Composition Explorer	ACE	EDM	Schedule ONLY
ACRIMSat	ACRIMSat	EDM	Completed Post Launch
Aeronomy of Ice in the Mesosphere	AIM	SRR	Completed Post Launch
Aeronomy of Ice in the Mesosphere	AIM	PDR	Completed Post Launch
Aeronomy of Ice in the Mesosphere	AIM	CDR	Completed Post Launch
Aeronomy of Ice in the Mesosphere	AIM	LRO	Completed Post Launch
Aqua (PM-1)	Aqua	SRR	Schedule ONLY
Aqua (PM-1)	Aqua	PDR	Schedule ONLY

**ONCE**  
Message from CAD

**Points of Contact**  
HQ CAD: Eric Flanagan  
HQ CAD: James Johnson

**Recently Added Data**

**NASA Breaking News**

**ONCE Breaking News**

5/5/2015  
The Solar Orbiter CADRe has been added!

4/30/2015  
The Mars 2020 SRR CADRe has been added to ONCE!

**Who's Online?**  
McFee, Julie

**Questions or Comments?**  
Email List  
Phone: 843-360-9394

**Number of Users by Center**

**CADRes by Milestone**

**CADRes By Status**

**ONCE Hot Spots**  
CADRe LIBRARY USER CHARTS CADRe DASHBOARD MODE PORTJ

**Welcome**  
Welcome to ONCE!  
3:38

User Reports  
Utilizing ONCE reports  
5:07

User Charts  
Using the ONCE chart interface  
2:50

ONCE Resources  
Description of resources available to the user  
2:42

Document Search  
Tutorial on using the full text search tool  
1:49



# Resources – CADRe Template Versions

CADRe  
Template  
Version History

Template  
Version #  
displayed with  
Project CADRe

Template #	Version Name	Version Description
1.0	Version 1.0: 3/10/06	Part A- First Baselined Template Part B- First Baselined Template Part C- First Baselined Template
2.0	Version 2.0: 12/06/06	Part A- Introduces a CADRe Plus section that attempts to document all cost, technical, schedule, and programmatic changes that occurred from SRR to LRD  Part B- New instructions for completing CADRe, added FFRDC section in FTE/WYE table, Report AS OF dates added, Re-engineered MOS/GSD tables, Removed LV System Params and LV Stage params.  Part C-Improved the Instructions. Added Basis of Estimate Sheet, and Detailed Element WBS Costs
3.0	Version 3.0: 3/26/07	Part A- Added Program/Project History Table, Added Milestone Event on cover, Added Sig Event Cost log, Workforce Analysis Log.  Part B- Updated Instructions for completing a CADRe, Added Support Contractor and Prime WYE tables.  Part C- Provided Level 2 WBS breakout for Project WBS and LCCE sheet with Corp G&A and CMO, Added early schedule data sheet.
4.0	Version 4.0: 4/29/08	Part A- Adjusted CADRe Plus instructions for Section A.S.  Part B- Added Additional CADRe Plus Template.  Part C- Improved Instructions, Added Cost Assumptions Tab which has 2 sections-Ground Rules and Basis of Estimate.
4.1	Version 4.1: 12/1/08	Part A- Added Project Logo instruction, Added Milestone Data and Revision Date, Added Table of Contents & Table of Figures, Added SBU Footnote.  Part B- Added MOS to System Level Params, Re-Organized MOS/GSD table.  Part C- Added Risk Assessment Sheet - but no structure.
4.2	Version 4.2: 10/01/09	Part A- No Change to Part A.  Part B- Improved Cell Definitions (Thermal, Power), Broke out Separate MOS and GDS sections in the MOS/GSD tab.  Part C- No Change.
5.0	Version 5.0: 3/10/11	Part A- No Change to Part A.  Part B- Added pull down menus, added Instrument Builder Name, Added breakout of Physical and Logical SLOC in SW sheet.  Part C- Added Directions to include source sheets, Added new schedule table to Schedule Tab, Added Risk Tab prompts for SX5s, JCL results, and Risk lists.
6.01	Version 6.01: 4/20/15 – UNDER DEVELOPMENT	Part A- Added List of Tables (separate from list of Figures), Re-ordered A.1.2. System Overview & Launch, Added Internal vs External changes in Section A.S.  Part B- Moved Milestone Schedule to Schedule Tab, Moved Key Tech Params to System Level Param, Added additional units as provided by Developers, Added Check Sum formulas.

Template  
Version #,  
Name, and  
Description



# ONCE

## Enhancements – CADRe Developer Workshop Status



# Summary

Cost  
Analysis  
Division

- **CADRe Developers Workshop held on 27-28 May 2015 at JPL in Pasadena, CA**
  - 32 attendees including phone participants
  - Topic focus on: ONCE updates, CADRe upload, TDM missions, Part B template revisions, Data Completeness metrics, Collecting schedule data, and Collecting risk data
- **Notes with full Action Item Listing sent on 2 June 2015 Date**
  - General Actions, CADRe Template Actions, and ONCE Actions
- **ONCE Action Items**
  - 15 of 21 Action Items marked Complete
- **Part B Action Item for CADRe Developers**
  - All teams have submitted their feedback, thank you!
- **Part B Template Revision**
  - HQ CAD is revising Part B template and will provide draft back to CADRe Developers for revisions and comment at later date



# ONCE

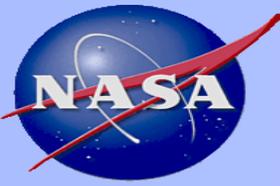
## Quality Assurance Activities



# Quality Assurance Activities - Background

Cost  
Analysis  
Division

- **ONCE contains the data from CADRes in a SQL DB (database)**
  - Primarily from Part B (Technical) and Part C (Cost)
- **Quality Assurance activities refer to the CADRe data stored in the DB**
  - Easy to say, hard to put your finger on:
    - CADRe has evolved over time (template changes, quality improvements, etc.)
    - Database has evolved over time (version upgrades, schema improvements, etc.)
    - CADRe is technically a Project document
      - Current design is as a “Flight Recorder”; quality is therefore a pass-thru
      - When Projects data products are healthy, CADRe quality is high and vice-versa
- **Prior research and feedback has indicated QA activities have value**
  - Reduce time spent formatting, structuring, and cleaning up datasets for analysis
  - Increase the completeness to provide more data points for queries
- **Put simply, QA activities involve:**
  - Improving the underlying CADRe data quality (focused on Part B and Part C)
  - Improving the structure and functions of the ONCE DB
  - Analyzing the DB and CADRe to develop metrics
- **Efforts have been underway perpetually and increased since Summer 2014**
  - Next slides provide metrics, achievements, and selected screenshots



# Quality Assurance - Goals

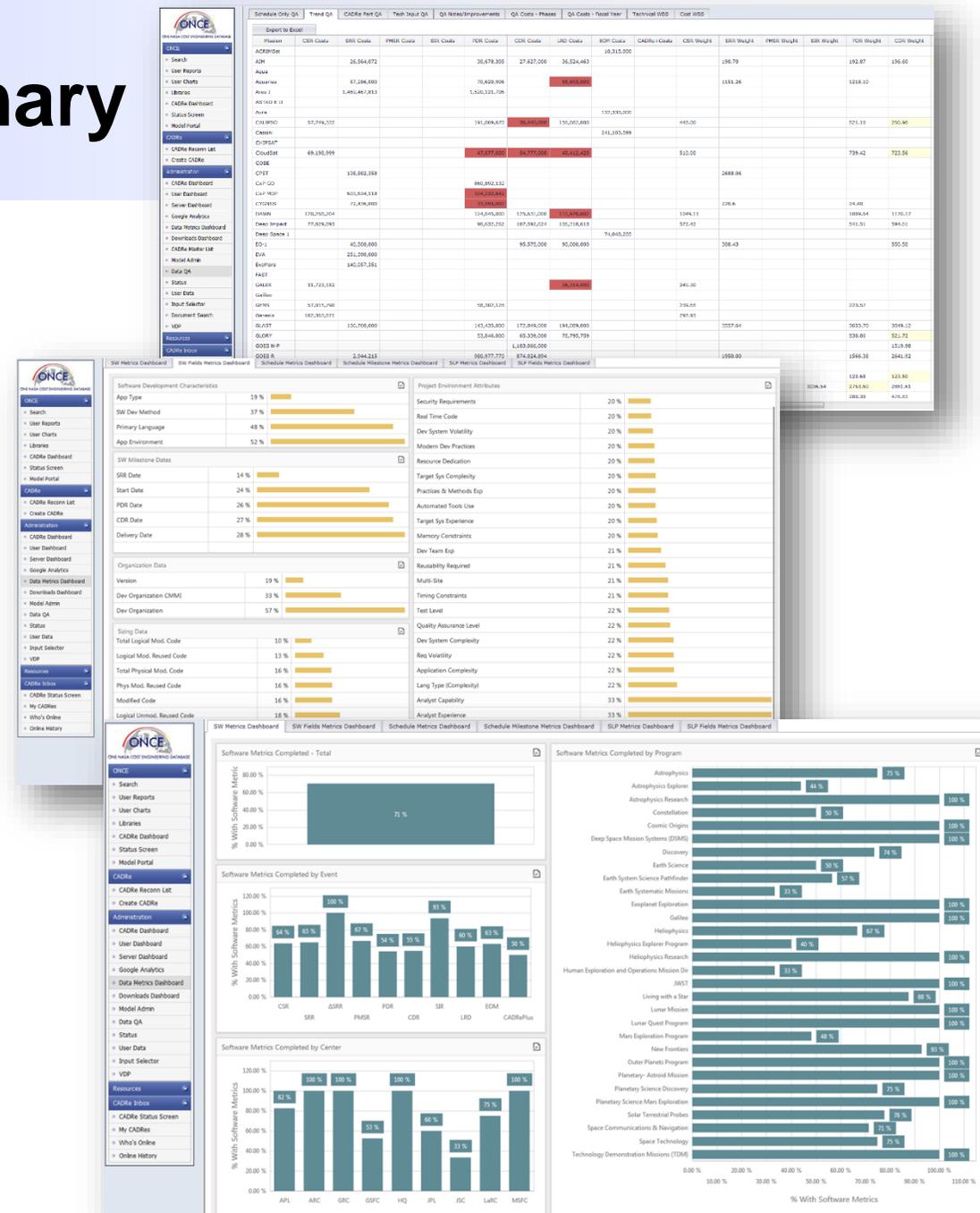
Cost  
Analysis  
Division

- **Establishing and analyzing data quality metrics will have a large impact on the entire estimation & analysis community**
  - More than 300 users today, at 10 centers, representing more than 30 orgs
- **Goal #1**
  - Establish meaningful data quality metrics that leverage automation and advanced database analysis techniques.
    - **“Build Good and Smart Data Quality Metrics.”**
- **Goal #2**
  - Use the data quality metrics to identify specific areas of the database that can be improved which will yield the largest total impact.
    - **“Use Metrics to Identify the Biggest Bang for the Buck.”**
- **Goal #3**
  - Continually measure and perform trend analysis on the data quality metrics to inform future decisions on CADRe data collection and ONCE database management.
    - **“Utilize Metrics to Perform Trend Analysis Over Time.”**
- **Goal #4**
  - Maintain the credibility and integrity of the CADRe data stored in ONCE by documenting any revisions that occur as a part of quality control / quality assurance activities.
    - **“Ensure the Integrity of CADRe and ONCE with Good Documentation.”**



# QA Achievements - Summary

- **9 Data Completeness Dashboards**
  - Software (3), Schedule (3), System Level Parameters (3)
- **9 Quality Assurance Dashboards and Tools**
  - Schedule Only QA, Data Trends, CADRe Part, Tech Input QA, QA Notes/Improvements, QA Costs by Phase , QA Costs by FY, Technical WBS, and Cost WBS
- **25 Closed QA Activities Completed**
  - 12 Open, QA Activities are fed by dashboards and tools, and tracked for closure
- **NICM vs CADRe QA Completed**
  - Documentation, live reporting, delta analysis, etc.
- **15 out of 21 QA Action Items from 2015 CADRe Developer Workshop complete**
  - Status report sent to CADRe Developer community



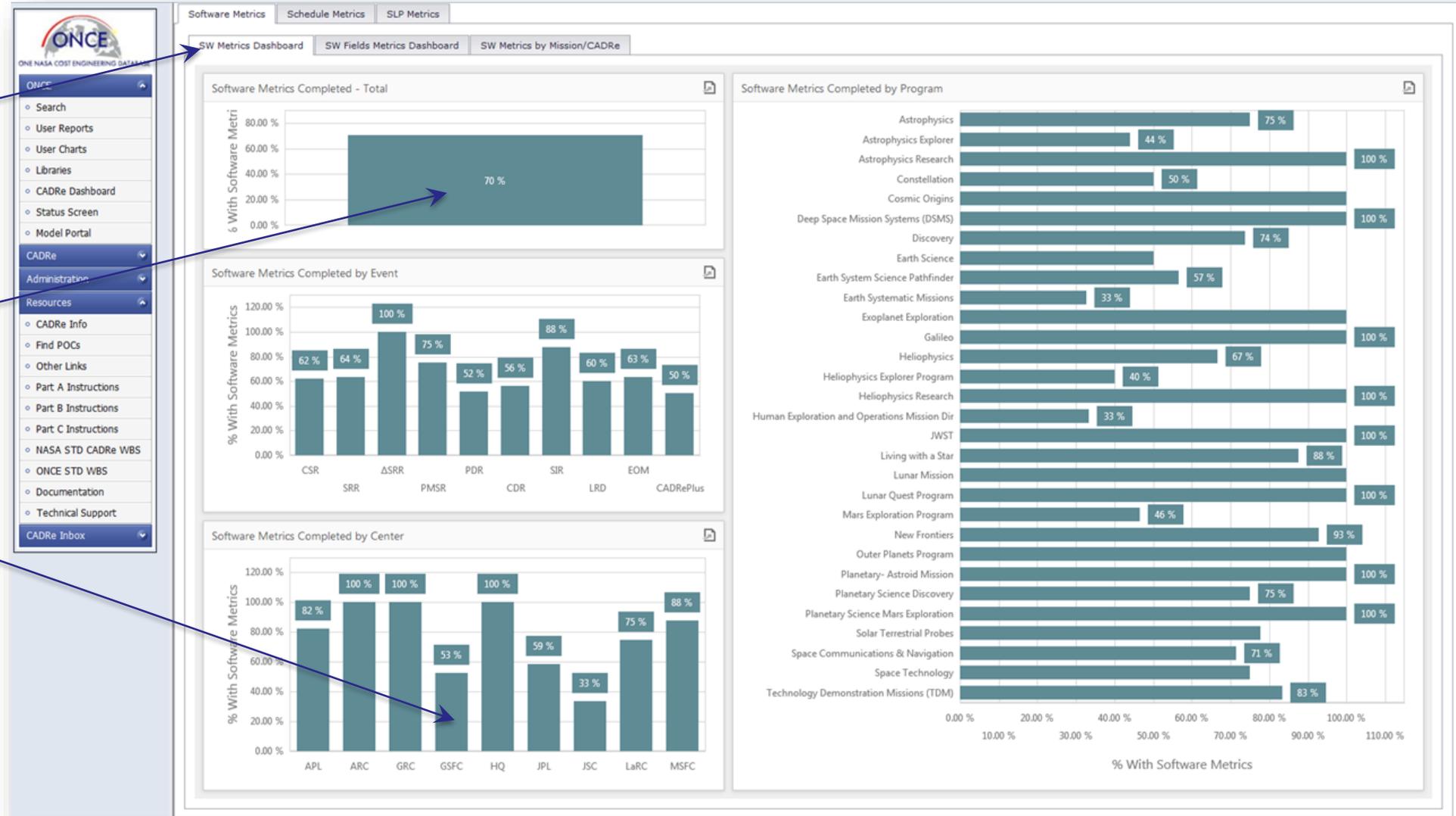


# Data Completeness Dashboard – Type 1

Type 1 provides high level overview metrics

70% of all CADRe has some value in Software area

53% of all GSFC CADRe has some value in Software area

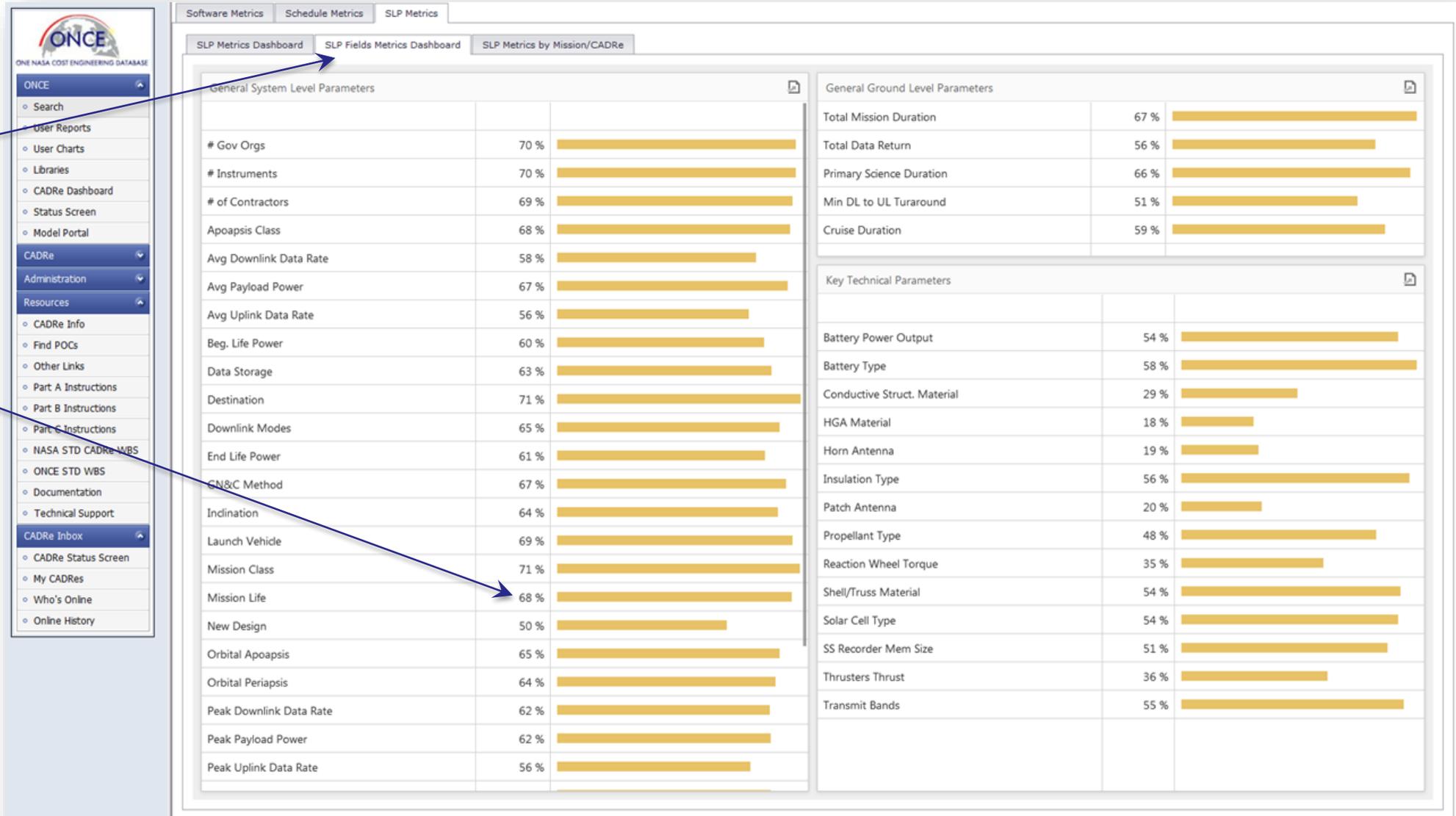




# Data Completeness Dashboard – Type 2

Type 2 provides specific parameter metrics

68% of all CADRe has value for Mission Life in System Level Parameters (SLP)





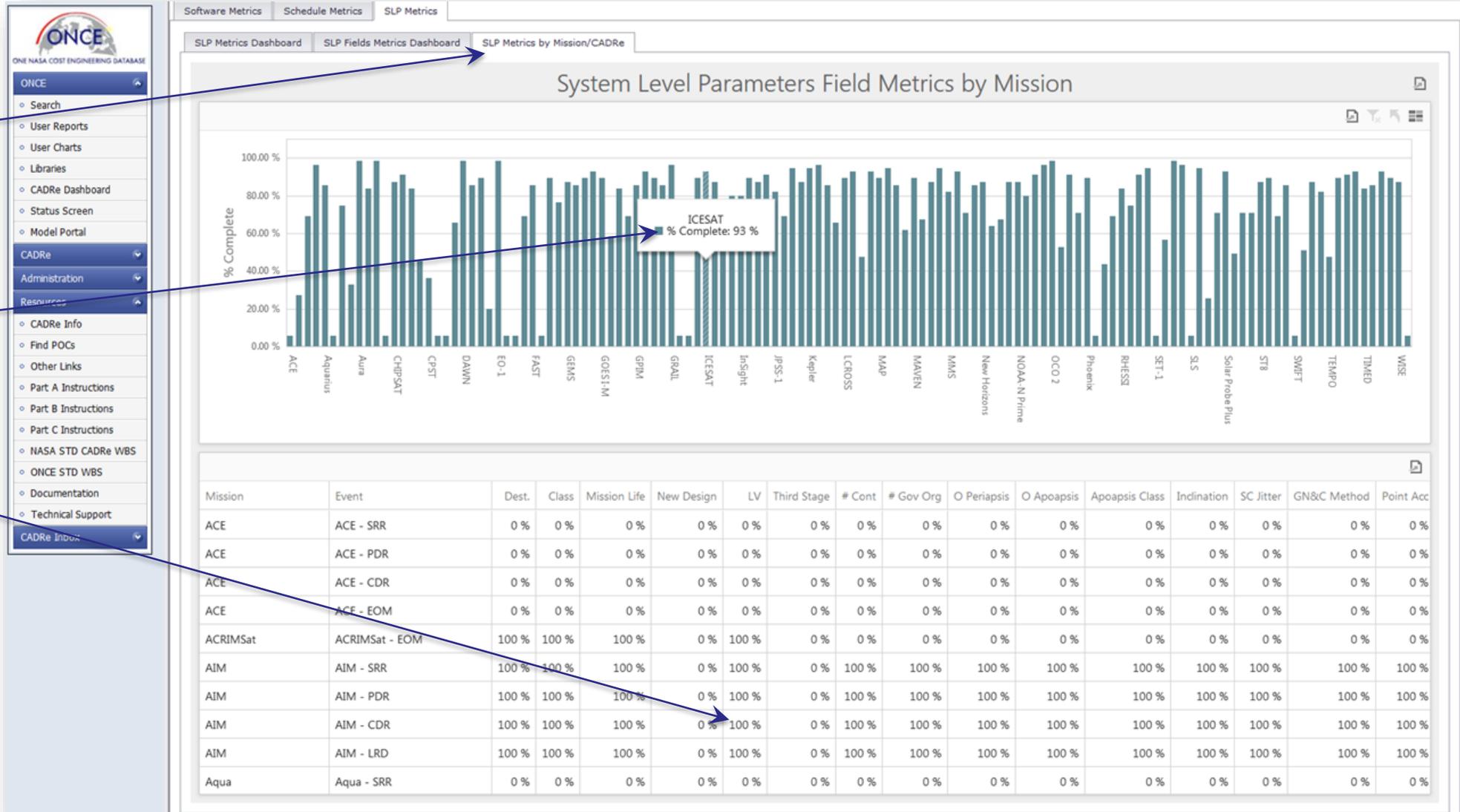
# Data Completeness Dashboard – Type 3

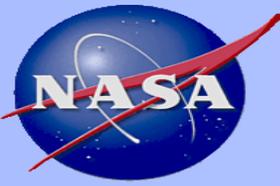
Cost  
Analysis  
Division

Type 3 provides specific metrics by Mission and CADRe

ICESAT CADRes sum to 93% complete

Completeness detail per CADRe per Mission





# Upload Process Improvement

Values  
automatically  
imported

CADRe Part B  
File Upload

- **Approximately 50% of the CADRe entry process is automated.**
  - CADRe System Level Parameters Automation
    - All inputs populated in a few seconds.
    - Screen is updated with values allowing for sanity check before saving to database (e.g. removing units or “N/A” entries).

**General System Level Information**

System Name: AIM	Program Name: Heliophysics Explorer Program	Destination: [dropdown]	Mission Class: [dropdown]	Mission Life (months): [input]	Percent New Design: [input]	Launch Vehicle: [input]	Third Stage?: No
Num of Contractors: [input]	Num Gov Organizations: [input]	Orbital Periapsis (Km): [input]	Orbital Apoapsis (Km): [input]	Apoapsis Class: [dropdown]	Inclination: [input]	Spacecraft Jitter (s <sup>2</sup> /m): [input]	GN&C Method: 3-axis Zero Momentum Bias - F
Pointing Accuracy (arc seconds): [input]	Pointing Knowledge (arc seconds): [input]	Number of Instruments: [input]	Thermal Control: [dropdown]	Total Dry Mass (Kg): [input]	Total Dry Mass w/Cont (Kg): [input]	Average Payload Power (Watt usage): [input]	Peak Payload Power (Watt usage): [input]
Beginning of Life Power (Watts): [input]	End of Life Power (Watts): [input]	Data Storage (on-board in GB): [input]	Processor Type (make and model): [input]	Downlink Modes (list all): [input]	Average Downlink Data Rate (Megabits per sec (MBPS)): [input]	Peak Downlink Data Rate (Megabits per sec (MBPS)): [input]	Uplink Model (list all): [input]
Average Uplink Data Rate (Megabits per sec (MBPS)): [input]	Peak Uplink Data Rate (Megabits per sec (MBPS)): [input]	Slew Rate (deg/s): [input]					

**General Ground Level Information**

Total Mission Duration (months): [input]	Cruise Duration (months): [input]	Primary Science Duration (months): [input]	Is there science during cruise?: No	Total Data Return: [input]	Min. Downlink to Uplink Turnaround Time: [input]
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**Key Technical Parameters Summary**

Structures & Mechanisms | Thermal Control | Electrical Power & Dist. | Guidance, Navigation & Control | Propulsion | Telecommunication | C&DH

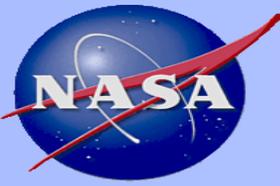
Load Carrying Shell/Truss Material: [input]      HGA Assembly Material: [input]      User Defined: [input]

[Browse] [Import] [Legend] [Comment exists for field]



# Upload Process Improvement

- **Metrics were established to measure the time for new automated entry vs. old manual entry**
- **Test case produced a 67% increase in productivity with new upload process and automation**
  - **Less time to complete, more throughput**
- **The test case took 10 hours total to manually enter the CADRe**
  - **5 of those 10 hours are now automated.**
  - **New upload process only takes 1 hour to enter the same information**
  - **That 1 hour includes the time to upload, enter all the comments, and double check all values**



# Conclusion

- **Good work continues on ONCE from 2014**
  - 110 missions, 300+ CADRe's, and 120GB of files available
- **Major enhancements include:**
  - Inflation capability
  - Search and retrieval
  - Completeness Dashboards
  - New Home Screen...and many more!
- **Quality Assurance activities utilize new capabilities to focus improvements**
  - Dashboards, reports, etc
  - CADRe Developer Workshop produced high quality list of QA activities
  - Targeted improvements will focus efforts on particular Missions, CADRes, or Parameters
- **Invitation to the ONCE Overview**
  - Tuesday 4:00 to 4:30
  - Room 171, Bldg 152



# BACKUP

**Slides not included in Symposium Brief  
Will be briefed during the ONCE Demo**



# Segregation of TDMs CADRes

Mission Type  
Radio Button

Mission List  
Auto-  
Populated  
based on user  
selection

- TDM CADRe's are different than a "standard" CADRe due to multiple factors
  - CADRe Workshop feedback

CADRe Parameters Report Output

Filter Missions

Centers Filter

Select/Deselect All:

- APL
- ARC
- GRC
- GSFC
- HQ

Events Filter

Select/Deselect All:

- CSR
- SRR
- ΔSRR
- PMSR
- PDR

Programs Filter

- Astrophysics
- Astrophysics Explorer
- Astrophysics Research
- Constellation
- Cosmic Orignis

Missions

Mission Type:  Manned  Unmanned  TDM

Select/Deselect All:  Include Schedule Only:

<input type="checkbox"/> GPIM		
<input type="checkbox"/> GPIM	SRR	
<input type="checkbox"/> GPIM	PDR	
<input type="checkbox"/> GPIM	CDR	
<input checked="" type="checkbox"/> LDSD		
<input type="checkbox"/> LDSD	SRR	
<input type="checkbox"/> LDSD	PDR	

WBS Selector - Click Report Output tab for results.

Mission Total Only:

Cost Data  Technical Data

Select/Deselect All:  Recursive Selection:

- System Name
  - Project Management
  - Systems Engineering
  - Safety and Mission Assurance
  - Science/Technology
  - Payload(s)
    - Payload Management
    - System Engineering
    - Payload Product Assurance
    - Instrument n
      - Instrument Management
      - Instrument Systems Engineering
      - Instrument Assurance
      - Antenna
      - Optics
      - Sensors/Detectors
      - Structures & Mechanisms
      - Thermal Control
      - Electronics
      - Power

Filter Phased Cost Events

Phase A  Phase B  Phase C  Phase D  Phase E  Phase F  Total  % of Total  Suppress Fiscal Year Output  Work Force Data



# Report Filter Settings

Filters display directly on the report

- Report “filter settings” now show up in the report output
- When you export to Excel the user selected filters are shown

The screenshot shows the CADRe software interface with three filter panels on the left: 'Centers Filter', 'Events Filter', and 'Progress Filter'. The 'Centers Filter' has 'HQ', 'JPL', and 'JSC' listed, with 'JPL' checked. The 'Events Filter' has 'CDR', 'SOR', 'LAD', 'EOM', and 'CADRePlus' listed, with 'CADRePlus' checked. The 'Progress Filter' has 'Astrophysics', 'Astrophysics Explorer', 'Astrophysics Research', 'Constellation', and 'Cosmic Origins' listed, all unchecked. The 'Missions' panel shows a list of missions with 'JPL' selected. The 'Report Output' tab is active, showing a 'Missions Selector' and 'Cost Data' options. An Excel spreadsheet is overlaid on the right, showing the report output with columns for 'Phase A' through 'Phase F' and 'Total'. The spreadsheet header is 'Centers: JPL; Events: CADRePlus'. A red arrow points from the 'CADRePlus' filter to the 'Events: CADRePlus' part of the header. A white rounded rectangle is present in the bottom right of the spreadsheet area.

	Phase A	Phase B	Phase C	Phase D	Phase E	Phase F	Total
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							



# Report Filter Settings

- Report “filter settings” now show up in the report output
- When you export to Excel the user selected filters are shown

The screenshot shows the CADRe software interface with the 'Report Output' tab selected. The 'Filters Missions' section has 'JPL' selected. The 'Events Filter' section has 'CADRePlus' selected. The 'Missions' list includes Galileo, Genesis, JASON 1, Mars Odyssey, MER, MGS, MP, and OSTM. The 'WBS Selector' shows 'System Name' selected. An Excel window titled 'ONCE Phased Cost Output.xlsx' is overlaid, showing a table with columns for 'Phase A' through 'Phase F' and 'Total'. The table data is as follows:

			Phase A	Phase B	Phase C	Phase D	Phase E	Phase F	Total
1									
2									
3	Galileo	CADRePlus	Galileo-CADRe+						
4	Genesis	CADRePlus	Genesis-CADRe+						
5	JASON 1	CADRePlus	JASON 1-CADRe+						
6	Mars Odyssey	CADRePlus	Mars Odyssey-CADRe+						
7	Mars Pathfinder	CADRePlus	MP-CADRe+						
8	MER	CADRePlus	MER-CADRe+						
9	MGS	CADRePlus	MGS-CADRe+						
10	OSTM	CADRePlus	OSTM-CADRe+						
11									
12									
13									
14									
15									
16									
17									



# ONCE Workshop Action Item Listing

## Page 1

Cost  
Analysis  
Division

Item #	Title Description	Status
1	Develop interface to display cell and spreadsheet comments in ONCE reports	Complete
2	Change New Design input on Sys Level Params to have drop down of choices	Complete
3	Develop ability for ONCE to handle data ranges in CADRe spreadsheets	In-Progress
4	Change Sys Level Params upload to allow for new template with summary data	In-Progress
5	Review Phase E of each CADRe for Launch Vehicle costs	Complete
6	Partition TDM missions in ONCE so reports are pulled separately	Complete
7	Include flag or notation on costs that were phased by the DB and not by CADRe	Complete
8	Add description of each dataset to ONCE Users Manual	Complete
9	Research methods to determine missing data between CADRe and ONCE	In-Progress
10	Create CADRe Summary Table report across milestones so devs don't need to update	Complete
11	Document each CADRe version and include in the ONCE Resources section	Complete
12	Notate which CADRe version for each CADRe in DB and include hyperlink to resources	Complete



# ONCE Workshop Action Item Listing

## Page 2

Cost  
Analysis  
Division

Item #	Title Description	Status
13	Remove repetition of total variables (total cost, total mass) in whole CADRe report	Complete
14	Change CADRe Library modified date to transfer date	Complete
15	Add preference button to user reports for recursive selection of children	Complete
16	Add title to report outputs to delineate filters chosen and make exportable	Complete
17	Double check templates in template library for currency	Complete
18	Research how to handle missions with blank data – consider data completeness	In-Progress
19	Remove Film Camera from Instrument Type field and double check on values	Complete
20	Research including an electronic survey for ONCE to incorporate user feedback	In-Progress
21	Revise CADRe Part B Template per feedback	In-Progress



# Data Completeness Dashboard Calculations

Cost  
Analysis  
Division

- **Type 1: High Level Overview Metrics**
  - Each CADRe is scanned for data existing in *any* of the parameters within the data type (e.g. all software data fields). For example, if the CADRe contains data in at least one of the software fields then it's added to a counter. Once all CADRes are scanned then the counter is divided by the total number of CADRes to get a total completeness percentage. That dataset is then grouped by event, center and program in order to report those metrics.



# Data Completeness Dashboard Calculations

Cost  
Analysis  
Division

- **Type 2: Specific Parameter Metrics**
  - All CADRes are scanned for data existing in *specific* parameters within the data type (e.g. all system level parameter fields). For example, if the design life parameter is populated then it's added to a counter. Once all of the design life parameters have been scanned then the counter is divided by the total number of CADRes to get a total completeness percentage for that parameter. The same calculation is completed for each parameter within the Data Completeness Dashboards.



# Data Completeness Dashboard Calculations

Cost  
Analysis  
Division

- **Type 3: Specific Metrics by Mission and CADRe**
  - Each CADRe is scanned for data existing in *specific* parameters within the data type (e.g. all schedule data fields). For example, if the CADRe's schedule data contains at least one populated field then it's added to a counter. Once all of the schedule parameters have been scanned for the CADRe then the counter is divided by the total number of schedule fields to get a total completeness percentage for schedule data for that CADRe.
  - The completeness percentage for all parameters is then averaged together to obtain a completeness percentage for the mission. For example, assuming a mission has four CADRe milestones and if the ATP date is populated for every milestone then the percentage completeness for the ATP date parameter is 100%. If the PDR date is populated for 1 out of the 4 milestones then the percentage completeness for the PDR date parameter is 25% for that mission. If the ATP and PDR dates were the only two schedule parameters then the percentage completeness for that mission would be 63% (the average of 100% and 25% or likewise 5 out of 8 parameters populated).



# Upload Process Improvement

- **A template has been created to automate CADRe entry into ONCE**
  - Goal is to consolidate the CADRe information for easier import into the database
  - Separate tabs for Part B and Part C
    - Mass and technical parameters for the payloads, instruments, Spacecraft, EDL, or Rover are now electronically transferred
  - Data from Excel is then copied directly into ONCE
    - Before copying, review is conducted for verification & validation
  - The ONCE automation interface allows for the WBS structures to be reviewed before saving to database
    - Hierarchy and element type assignments are verified
    - Check units, values, formatting, etc.



# Upload Process Improvement

- Data from each CADRe tab is consolidated into one WBS structure in the automation template.

Payload	Assembly Name	Mass CBE (kg)	Mass CBE+Cont (kg)	Average Po (w)
Camera	<b>Payload Total</b>			
	Total			
	Antennas			
	Optics			
	Sensors/Detectors			
	Structural & Mechanical			
	Thermal Control			
	Electronics			
	Power			
	Pointing Subsystem			
	Harness, Cabling, etc.			
	C&DH			
	Other			
DHU (Data Handling)	<b>Total</b>			
	Total			
	Antennas			
	Optics			
	Sensors/Detectors			
	Structural & Mechanical			
	Thermal Control			
	Electronics			
	Power			
	Pointing Subsystem			
	Harness, Cabling, etc.			
	C&DH			
	Other			

CADRe File

	Mass (CBE)	Mass Cont	Avg PowInst	Avg Pow ContInst	Peak PowInst	MTBF
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
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Automation Template



# Upload Process Improvement

- Each WBS element is consolidated into the template.

Report As Of Date: 8/11/2014 ALL ITEMS ARE MAPPED DIRECTLY FROM THE PROJECT MEL SHEET

Assembly Name	Mass (CBE)	Mass (CBE+Cont)	Average Power (CBE)	Average Power (CBE+Cont)	Peak Power
<b>Structures &amp; Mechanisms</b>					
Structures & Mechanisms Total					
Primary Structures					
Load Carrying Shell/Truss					
Equipment Compartments					
Booms					
Adapters					
Secondary Structures					
Equipment (Instrument) Mountings					
Ballast Mass					
Mechanisms					
Positioning					
Deployment and Storage Equipment					
Docking Mechanisms					
Other					
Pyrotechnics					
Other					
<b>Thermal Control</b>					
Thermal Control Total					
Active Devices					
Cryogenic Devices					
Liquid Loops					
Electric Cooling (Thermoelectric)					
Electric Heaters Thermistors & Switches					
Passive Devices					
Radiator Panel/Fins					
Coatings					
Heat Pipes					
Insulation					
Conductive Structures					
Heat Activated Structures					
Sun Shields					
Second Surface Mirrors					
Other					
<b>Electrical Power &amp; Distribution</b>					
Electrical Power & Distribution Total					
Electrical Power Generation					
Solar Cells					
Nuclear Reactor					
Radioisotope Thermionic Generator					
Chemical (Fuel Cells)					
Aux Power Unit(s)					
Electrical Power Conditioning					
Power Control Electronics					
Power Conversion Electronics					
Power Dissipation Devices					
Power Distribution Electronics					
Electrical Power Storage					
Batteries					
Charge Control Electronics					
Harnesses & Cables					
Other					

GN&C

Project MEL System Level Parm Payload Parm **Spacecraft HW Parm**

	Mass (CBE)	Mass Cont	Avg PowInst	Avg PowContInst	MTBF
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
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48					
49					
50					
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59					

CADRe File

Automation Template



# Upload Process Improvement

- The data is then copied into ONCE after all the data is consolidated within the template.

	Mass (CBE)	Mass Cont.	Avg PowInst	Avg Pow ContInst M	Peak PowInst MTEF	Peak Pow ContInst # B	DimensionsInst # Ch	Fit HeritageInst
Tess PDR								
Payload(s)								
Camera								
Optics								
Sensors/Detectors								
Structural & Mechanical								
DHU (Data Handling Unit)								
C&DH								
Flight System / Spacecraft								
Spacecraft								
Structures & Mechanisms Total								
Primary Structures								
Load Carrying Shell/Truss								
Secondary Structures								
Equipment (Instrument) Mountings								
Other								
Thermal Control Total								
Electrical Power & Distribution Total								
Electrical Power Generation								
Electrical Power Storage								
Batteries								
Charge Control Electronics								
Harnesses & Cables								
Other								
GN&C Total								
Attitude Determination								
Sun Sensors								
Star Tracker/Sensors								
Inertial Reference Unit								
Attitude Control								
Reaction Wheels								
Propulsion Total (Dry)								
Tanks								
Propellant Tanks								
Plumbing								
Maneuvering Thrusters								
Monopropellant								
Translation Thrusters								
Monopropellant								
Other								
Communications Subsystem Total								
Antennas								
Omnidirectional								
Parabolic								
Maneuvering/Routers								
Multiplexers								
W								
R								
T								
T								
Di								
C&D								
Pro								
Decoders								
Command Units								

Text copied from automation template

**Create/Edit Project WBS - Part B**

Paste the fully expanded WBS from the CADRe into the text box.

**Step 1:** Identify each element's Level. Mission Level is 0 and all direct children of the mission should be level 2.

**Step 2:** Identify each element's WBS Element type.

**Step 3:** Click Save Changes.

**Step 4:** Click View Hierarchy to check WBS structure.

Tess PDR

Payload(s)

Camera

Optics

	Node ID	Parent ID	WBS Level	Element	Order	Element Type
Delete Add Child Select Parent	933-1	933-0	0	Tess PDR	1	System Name
Delete Add Child Select Parent	933-6	933-1	2	Payload(s)	2	Payload(s)

Pasted into ONCE



# Upload Process Improvement

- **CADRe Entry Automation**
  - WBS Automation
    - Corresponding Part B **technical parameters** are imported as well.
    - Element assignments are performed before saving to the database.

Create/Edit Project WBS - Part C

Paste the fully expanded WBS from the CADRe into the text box.

**Step 1:** Identify each element's Level. Mission Level is 1 and all direct children of the mission should be level 2.

**Step 2:** Identify each element's WBS Element type.

**Step 3:** Click Save Changes.

**Step 4:** Click View Hierarchy to check WBS structure.

SORCE CADRe+

- Project Management
- Systems Engineering
- Science/Technology
- Payload(s)
- Flight System \ Spacecraft
- Spacecraft
- Launch Vehicle/Services
- Mission Operations System (MOS)
- LASP Mission Operations
- CSOC Mission Operations
- Contingency (GSFC)
- Chase Plane (LRC)

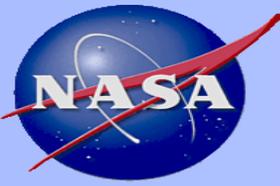
	Node ID	Parent ID	WBS Level	Element	Element Type
Delete Add Child Select Parent <input type="checkbox"/>	932-1	932-0	1	SORCE CADRe+	System Name
Delete Add Child Select Parent <input type="checkbox"/>	932-2	932-1	2	Project Management	Project Management
Delete Add Child Select Parent <input type="checkbox"/>	932-3	932-1	2	Systems Engineering	Systems Engineering
Delete Add Child Select Parent <input type="checkbox"/>	932-4	932-1	2	Science/Technology	Science/Technology
Delete Add Child Select Parent <input type="checkbox"/>	932-6	932-1	2	Payload(s)	Payload(s)
Delete Add Child Select Parent <input type="checkbox"/>	932-26	932-1	2	Flight System \ Spacecraft	Flight System \ Spacecraft
Delete Add Child Select Parent <input type="checkbox"/>	932-30	932-26	3	Spacecraft	Spacecraft
Delete Add Child Select Parent <input type="checkbox"/>	932-31	932-1	2	Launch Vehicle/Services	Launch Vehicle/Services
Delete Add Child Select Parent <input type="checkbox"/>	932-32	932-1	2	Mission Operations System (MOS)	Mission Operations System (MOS)
Delete Add Child Select Parent <input type="checkbox"/>	932-33	932-32	3	LASP Mission Operations	Mission Operations System (MOS)
Delete Add Child Select Parent <input type="checkbox"/>	932-34	932-32	3	CSOC Mission Operations	Mission Operations System (MOS)
Delete Add Child Select Parent <input type="checkbox"/>	932-35	932-1	2	Contingency (GSFC)	Contingency
Delete Add Child Select Parent <input type="checkbox"/>	932-36	932-1	2	Chase Plane (LRC)	Other Costs (e.g. ONC)

[Save changes](#) [Cancel changes](#)

**WBS structure can be altered**

**WBS structure and technical parameters pasted from Excel**

**Allows for Element Type Assignment**



# Targeted improvement activities

- **QA activities and capabilities have provided opportunities for targeted improvement**
  - Robotic Flight Software data collection
    - Completeness dashboard indicate that FSW is one of our most challenging areas of data collection
    - Many parameters are left unpopulated including key sizing information such as Logical SLOC
    - Determining which Missions, which CADRes, and which parameters can be improved
    - Goal is to execute a task to improve FSW data completeness and quality
  - Schedule activities and duration(s)
    - Schedule dates in the CADRe are very well populated, but sometimes inconsistent over a project lifecycle
    - Many additional schedule files from Projects include activities and duration(s)
    - Arnold Hill/Schedule Initiative is embracing collection of schedule data, review of existing data, and strategies to improve