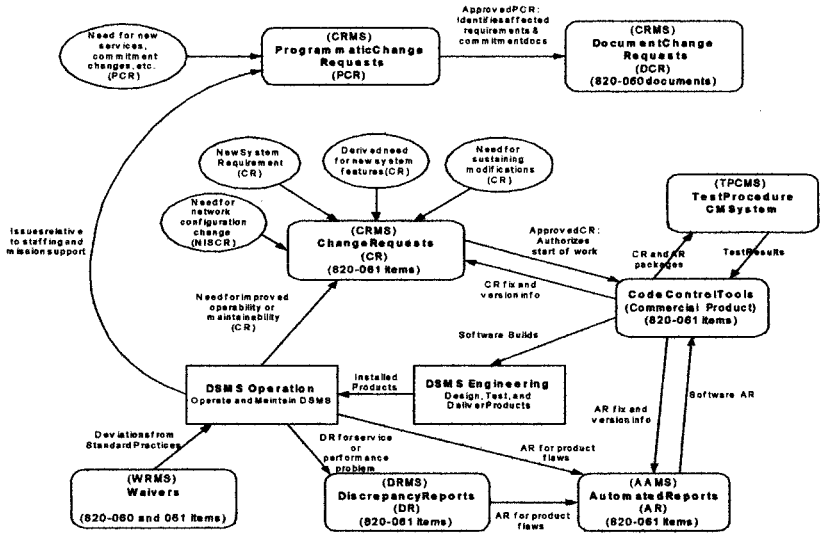
Integrating Configuration Management Processes and Tools into Legacy Systems

T.M. Cooper [1]; J. Lin [2];M. Chatillon [3];R. W. Sible, Jr.[1],

[1]Jet Propulsion Laboratory (JPL)/ California Institute of Technology (Caltech), Pasadena, California, USA;
[2]Chase Computing International, Corp., Alhambra, California, USA;
[3]Raytheon Australia, Canberra Deep Space Communication Complex, Canberra, Australia

In 1963, a memo from Dr. William Pickering, JPL Director at that time, announced the establishment of the Deep Space Network, consolidating the communications organizations that JPL had begun building in 1958, and creating the first integrated global communications capability to deep space. This is an excerpt from the news release marking the 40th anniversary of the Deep Space Network (DSN) on December 24, 2003. Over the past 40 years the system has evolved from predominantly hardware and some assembly code to a complex system of hardware, firmware and software. The set of controlled products numbers in the thousands. The CM put in place in the past three decades has not kept pace with the evolution of the DSN. Manual paper processes with data entry into several related databases became difficult to maintain and provide consistent reporting. To add to the challenge, in 1997, the DSN and the Multimission Ground Systems Office (MGSO) merged to become the Deep Space Mission System (DSMS), each bringing a unique set of processes and databases. As a result of the merger, we began combining the separate CM entities by understanding the relationships of the two CM processes and to system engineer the information flow.

DSMS Change Management Tool Interaction



As we worked towards a common set of processes and tools it became apparent that a unified product database would establish the thread linking the different tools and would also serve as a single source for email notifications from the different tools. By centrally controlling the list of products and the personnel responsible for those products, it provided a means to standardize (make consistent) the writing of anomalies and changes. Because the product list is hierarchical, metrics can be reported at an assembly level or at a subsystem level. Documents, anomalies, change requests, code are all written against the same set of products defined in a database (DSMS document 820-061).

DSMS Subsystem, Configuration Item and Responsibility Assignments
820-061 Numerical Configuration Item Report as of 2/13/2004 (1:01:14PM)

Subsystem Major Assembly	Assembly Abbr	Title	Software Program ID or Hardware Drawing	Type	Eng. Lead CDE	Ops. Lead OE
101	ANT70	70m Antenna Subsystem				
		SSM: Jeffrey Osman SSDE: Arthur Freiley	SSE: John Cucchissi	CM Classification: OPS	Organization: DSN	
101.1		70m Antenna Structures and Drives				Michael Wert
101 101	ASA	Antenna Structure Assembly (70m)	9611128	H/W	Benjamin Saldua	Peter Kiss
101 102	DMA	Drives and Mechanical Assembly		H/W	Jun Lin	Peter Kiss
101 103	CAS	Antenna Cassegrain Assembly (70m)	9606231	H/W	Asim Sehic	Peter Kiss
101 104	ITA	Antenna Instrumentation and Tooling Assembly (70m)		H/W	Timothy Sink	Peter Kiss
101 105	ADA	Antenna Drive Assembly (70m)	9479927	H/W	Harlow Ahlstrom jr	Gary Wazzig
101 106	AHA	Antenna Hydraulics Assembly		H/W	Jun Lee	Peter Kiss
101 107	ASM	Antenna Structure Monitor	9604680	H/W	William Almassy	Gary Wazzig
101.2		Antenna System Configuration Documents		DOC		Michael Wert
101 202		Antenna RF Optics Configuration		DOC		Michael Wert
101.3		Antenna Control (70m unique)				Michael Wert
101 301	MEC	Master Equatorial Drive Control Assembly		H/W	Harlow Ahlstrom jr	William Almassy
101 304	ASC	Antenna Servo Controller Assembly (70m)	9479929	H/W	Harlow Ahlstrom jr	William Almassy
101 305	ACM	Antenna Control and Monitor Assembly (70m)	9616701	H/W	Farrokh Baher	Gary Wazzig
101 306	SRC	Subreflector Controller Assembly (70m)	9605820	H/W	Farrokh Baher	Gary Wazzig
101 309	ACM	Antenna Control and Monitor Firmware (70m)	DFA-5188-OP	F/W	Martha Strain	Gary Wazzig
101 310	ASM	Antenna Structure Monitor Software	DFA-5241-TP	S/W	William Almassy	Gary Wazzig
101 311	ASC	Antenna Servo Controller Firmware (70m)	DFA-5352-OP	F/W	Henry Valner	William Almassy
101 312	SRC	Subreflector Controller Firmware (70m)	DSA-5578-OP	F/W	Martha Strain	Gary Wazzig
101 313	MEC	Master Equatorial Controller Firmware	DFA-5262-OP	F/W	Henry Valner	William Almassy
101 315	FHD	Film Height Detector Address Translation ROM	DQA-5294-OP	S/W	Henry Valner	William Almassy
101 319		Antenna Control Configuration and Cabling (70m)		H/W	Harlow Ahlstrom jr	Gary Wazzig
101 320	ALC	Antenna Logic Controller (70m)		H/W	Farrokh Baher	Gary Wazzig
101 321	MCC2	Motor Control Center No 2 Ladder Logic	DFA-6107-EP	F/W	Farrokh Baher	Gary Wazzig
101 322	MCC2	Motor Control Center No 2 Maintenance Software	DFA-6107-SP	S/W	Farrokh Baher	Gary Wazzig
101 323		Antenna Logic Controller Firmware (70m)	ANT-6219-OP	F/W	Harlow Ahlstrom jr	Gary Wazzig
101 324		ALC User Display Firmware (70m)	ANT-6220-SP	F/W	Harlow Ahlstrom jr	Gary Wazzig
101 330	MESA	Master Equatorial Servo Assembly		H/W	Harlow Ahlstrom jr	William Almassy

Legend: IST = Information Services and Tools RAD = Research and Development
OTM = Operations Team OPS = Operational

Author: K. Kimball
Page 1 of 17

No one wanted to change, "We've been doing it this way for 25 years!" But now there are over 10 million lines of software code, ISO, ITAR, IT Security, CMMI, and full cost accounting. Management needed metrics that meant something, not bean counting; users needed something that was easily accessible, provided notification to responsible personnel, and to be able to find information quickly; CM wanted engineering and operations personnel following clearly defined consistent processes.

The first tool that was introduced was the anomaly reporting tool. The engineers and operations personnel were accustomed to documenting problems, so providing them a tool to make this task easier and standardize the input was a logical place to begin.

A requirement gathering team was formed in 1998 with personnel representing the DSN and MGSO problem reporting processes, operations, development, and management. The requirement and design document was released in July of 1998. Reviews and walkthroughs were held throughout the

development; data was migrated from the two databases being utilized by the two organizations that were now one. Training sessions for the Deep Space Mission System personnel and outside users were conducted several times a week over a four week period. The system went operational in April 1999. This same process was followed in the development of the Discrepancy Reporting Management System which is a tool that supports operations. The requirements definition began in early 2000 and the system went operational in June 2001. We learn that no matter how much time was devoted to defining requirements, it wasn't until the tool was utilized for daily work that the users truly understood what they wanted in the system. We utilized this same process in all our tool development activities, but now that we have a proven track record, the size and extent of the requirements gathering team is reduced, the oversight of the development is less intensive, and the design and development time is shortened relative to the complexity of the tool. Because all the tools have the same look and feel, utilize common features such as 'TO DO' lists, proxy capabilities, and query functions, training took less time and resistance to using the new tools was reduced.

These tools have been or are being introduced across the Deep Space Mission System:

Discrepancy Reporting Management System (DRMS)

The DRMS is used to report. via the Discrepancy Report (DR) any condition that negatively impacts the quantity or quality of committed data or service to a scheduled DSN customer. The system collects, processes, communicates and records data discrepancies, equipment resets, physical equipment status, and provides an internal Station Log capability. Additionally, a DR can automatically generate hardware or software Anomaly Reports (AR's).

Automated Anomaly Management System (AAMS)

The Automated Anomaly Management System (AAMS) is used to report, via Anomaly Reports (AR's) defects against DSMS software and hardware products. The system collects, processes, communicates, and records software and hardware anomalies. ARs against software are sent to the Harvest system upon origination and go through the software development process phases with information being sent to AAMS

Change Request Management System (CRMS)

The CRMS supports several different types of changes requests that have different review, approval, and implementation cycles. A CR requests new capabilities or enhancements. CRs against software are sent to the Harvest code control system upon approval and go through the software development process phases with version and test information being sent to CRMS. Each CR has the version information and the test status.

A Program Change Request (PCR) requests changes to customer commitments or high level services the DSMS offers to Flight Projects or customers outside of JPL. A Program Change request can automatically generate a Document Change request (DCR).

Document Change Request (DCR)

The DCR is used to record changes needed to the high level requirements or policy documents that govern the DSMS products. It provides the system engineer with a list of changes pending against their document.

Waiver Request Management System (WRMS)

The WRMS is used to document non-compliance to a specific DSMS policy or standard practice.

Code Control

All Fusion Harvest is a commercial code control tool utilized to manage changes to software. Code modules are checked out, changed, checked back in identifying "packages" (ARs, CRs, etc.). An interface has been created to exchange data between Harvest and AAMS and between Harvest and CRMS.

Test Procedure Configuration Management Tool (TPCMS)

A web-based application to document test procedures and to produce multi-dimensional test status reports by version, build, and subsystem. This tool is linked to the Harvest database and links test procedures to the Harvest change packages (ARs, CRs, etc)

The tools utilize a product workflow mechanism based on phases and actions. A phase represents where the change or anomaly is in the process lifecycle. The action is what the designated person assigned the role (i.e. Operations Engineer, Cognizant Development Engineer, etc.) must do to move to the next phase. This provides the means to enforce a consistent process with the actions being performed by the appropriate functional areas. The ability to find the number of changes or anomalies in a particular phase allows us to easily identify bottlenecks in the process.

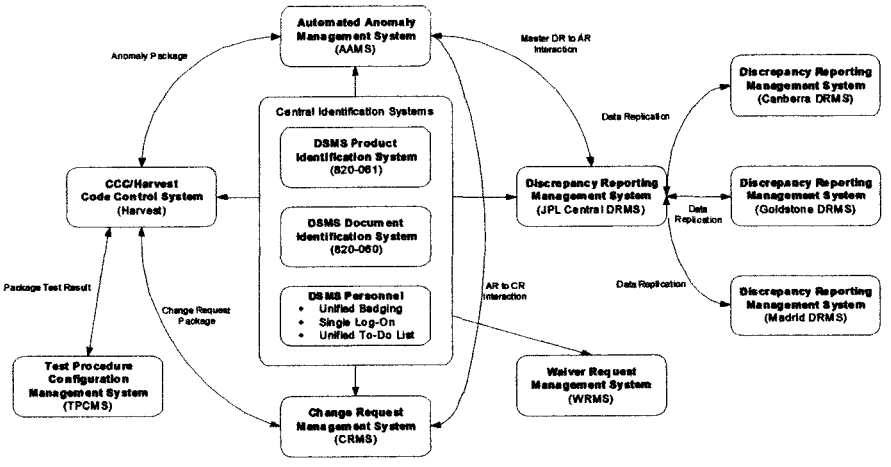
The data infrastructure that feeds the tools is as important as the tools themselves. The product hierarchy must be constantly maintained to reflect new products going into the field and old ones being deactivated. The list of responsible personnel must be maintained and a history of changes kept. This underlying data infrastructure ensures that reporting is consistent and that the correct people get notified.

Queries can get the set of ARs, DRs, CRs and Waivers against a particular assembly, or against all assemblies in a subsystem to provide a look at performance or work that needs to be done across the

subsystem. Nearly all data fields can be queried and data grouped and sorted. Queries can be saved and edited and the hyperlink can be emailed to appropriate managers, engineers, or operators.
The tools have allowed the development and operations personnel to maintain an overview of how their product performs in the field. A cross-functional team is using the DRMS to monitor specific outages in an effort to improve data capture and reliability. Management can make use of metrics to identify trends in product performance or overall system reliability. CM and Management can use metrics to see where a process is breaking down.

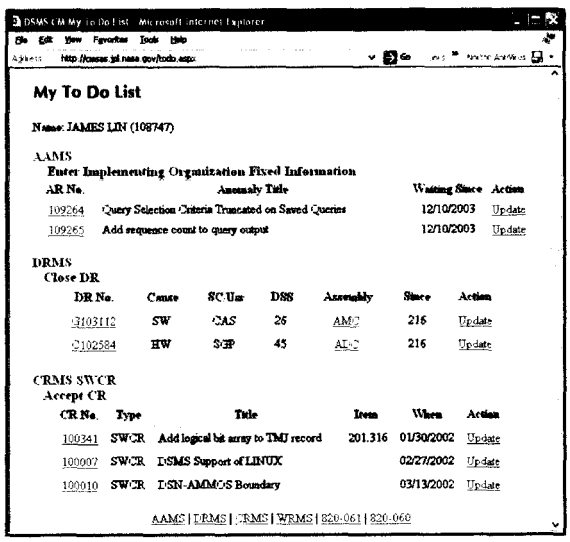
Database and web technology is constantly moving. We are planning to move to a true object oriented approach to obtain a unified framework. This will allow us to implement a new capability and have it shared by all the tools. The most recent development of the product database (820-061) is our first implementation on Microsoft's .NET architecture. The other tools will need to be re-implemented to achieve the unification of the tools. The CM record will serve as the base class with AR, CR, DR, and others record types inheriting from the base class to eliminate duplicate work for common capabilities while maintaining their own unique features and data collection. All CM records would be based on a central product identification hierarchy (820-061), a central document identification system (820-060), and a unified personnel database.

DSMS CM Systems and Interfaces



We would then be able to have a common state-transition based workflow engine at the core level. Individual lifecycles could be determined by the combination of product and CM record type. This would support more granularity on updating privileges based on the combination of product, CM record type, lifecycle, phase, and action.

All tools would share a single unified log-in, a unified to-do list across the CM record types for users, unified metric reports across all CM record types managers, a unified querying capability across systems and enable process orchestration across systems through XML web services for the CM developers and administrators.



My To Do List

Name: JAMES LIN (108747)

AAMS
Enter Implementing Organization Fixed Information

AR No.	Anomaly Title	Waiting Since	Action
109264	Query Selection Criteria Truncated on Saved Queries	12/10/2003	Update
109265	Add sequence count to query output	12/10/2003	Update

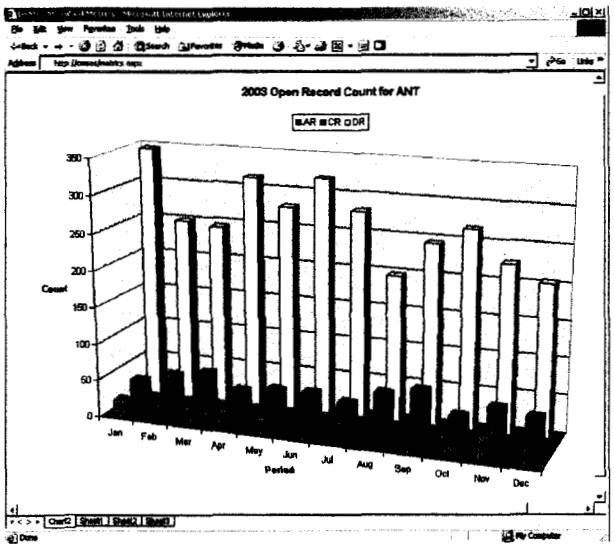
DRMS
Close DR

DR No.	Cause	SC Use	DSS	Assembly	Since	Action
3103112	SW	CAS	26	AM2	216	Update
2102584	HW	SGP	45	AL2	216	Update

CRMS SWCR
Accept CR

CR No.	Type	Title	Item	When	Action
100341	SWCR	Add logical bit array to TMJ record	201.316	01/30/2002	Update
100007	SWCR	DSMS Support of LINUX		02/27/2002	Update
100010	SWCR	DSN-AMMOS Boundary		03/13/2002	Update

AAMS | DRMS | CRMS | WRMS | 820-061 | 820-060



ACKNOWLEDGMENT: This work was carried out at and performed for the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement by the United States Government, the Jet Propulsion Laboratory, California Institute of Technology, Raytheon-Australia, or Chase Computing,