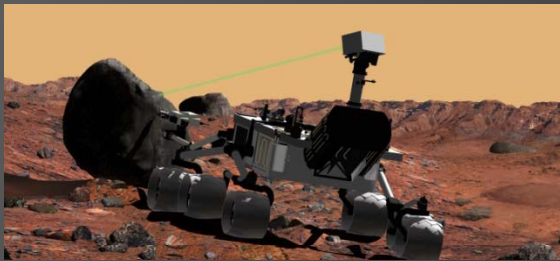
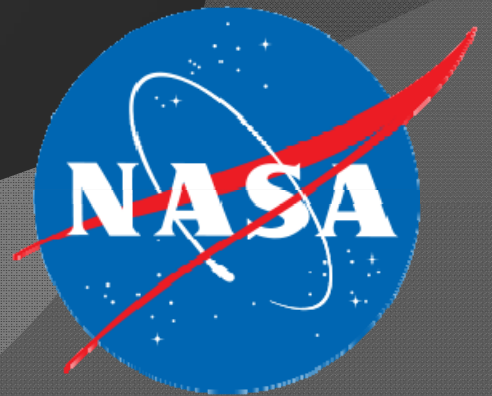


NASA IV&V Workshop 2012

A DATA OBJECT MODEL FOR IV&V ANALYSIS

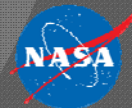


The MSL Experience



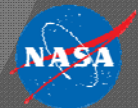
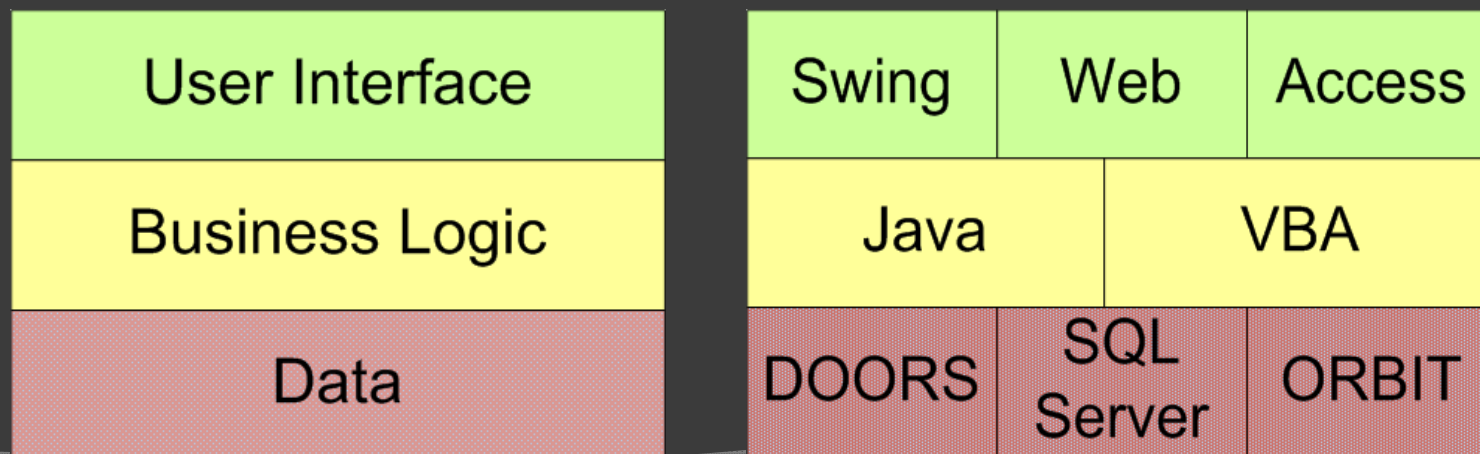
Developing a Data Object Model

- Data Object Model – An implementation of the Data and Information Viewpoint (DIV) in DoDAF
- In support of the integrated analysis techniques being developed for the Mars Science Laboratory (MSL) IV&V project
- What we did on MSL
- What we could have done better
- Where we can take it



The Development Architecture

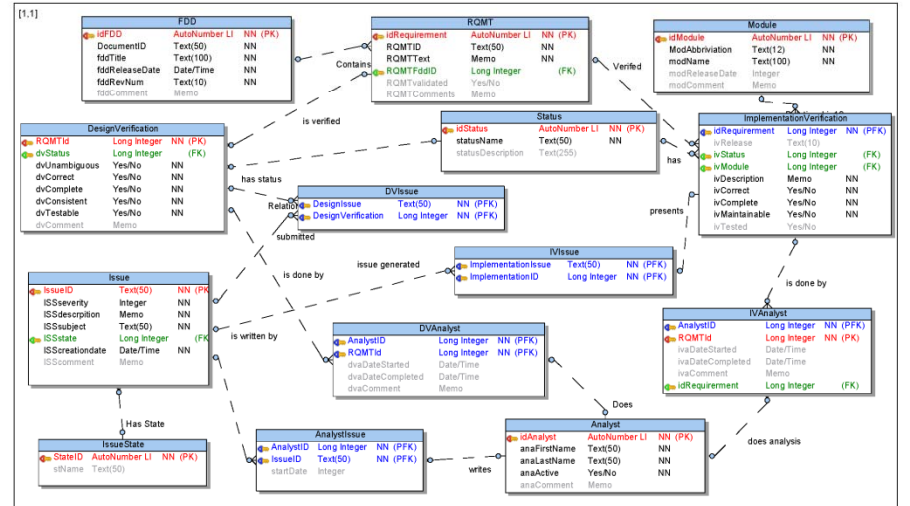
- Capture essential information from the integrated analysis
- Maintain data in a central repository
- Support multiple user interfaces (N-tier Development)



Capture the essential information

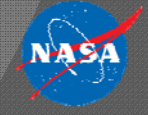
Item ID	Description	Status	Test Results
1	After the RCE FTR is executed, the test results are...	Pass	...
2	If a SGA command is executed before the power timeout...	Pass	...
3	The power timeout counter shall begin counting within 5...	Pass	...
4	There shall be a warning when power timeout occurs...	Pass	...
5	The function returns '1' upon 'Enter' selection; 'max'...	Pass	...
6	The function returns '1' upon 'Enter' selection; 'max'...	Pass	...
7	The timeout expiration function is done by means of...	Pass	...
8	The camera feed power timeout counter shall start count...	Pass	...
9	The RCE FTR shall allow the camera to be powered on...	Pass	...
10	The RCE FTR shall ensure that the RCE does not send a...	Pass	...
11	The MMN RCE FTR shall have a configurable 'wait'...	Pass	...
12	The MMN RCE FTR shall require the camera to be powered...	Pass	...
13	If an command requires the camera ready to be powered...	Pass	...
14	If the power timeout warning fails to power the SGA...	Pass	...
15	RCE FTR shall allow the operation of Power on and...	Pass	...
16	When a SGA command is completed camera by the RCE...	Pass	...
17	RCE FTR shall allow the MMN camera to request image...	Pass	...
18	RCE FTR shall allow MMN camera acquisition during...	Pass	...
19	RCE FTR shall allow MMN camera acquisition during...	Pass	...
20	RCE FTR shall receive the RCE command (i.e. port)...	Pass	...
21	If an image is requested the result is SGA powered on...	Pass	...
22	If an image is requested the result is SGA powered on...	Pass	...
23	If an image is requested the result is SGA powered on...	Pass	...
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96	If an image is requested the result is SGA powered on...	Pass	...
97	If an image is requested the result is SGA powered on...	Pass	...
98	If an image is requested the result is SGA powered on...	Pass	...
99	If an image is requested the result is SGA powered on...	Pass	...
100	If an image is requested the result is SGA powered on...	Pass	...

Data



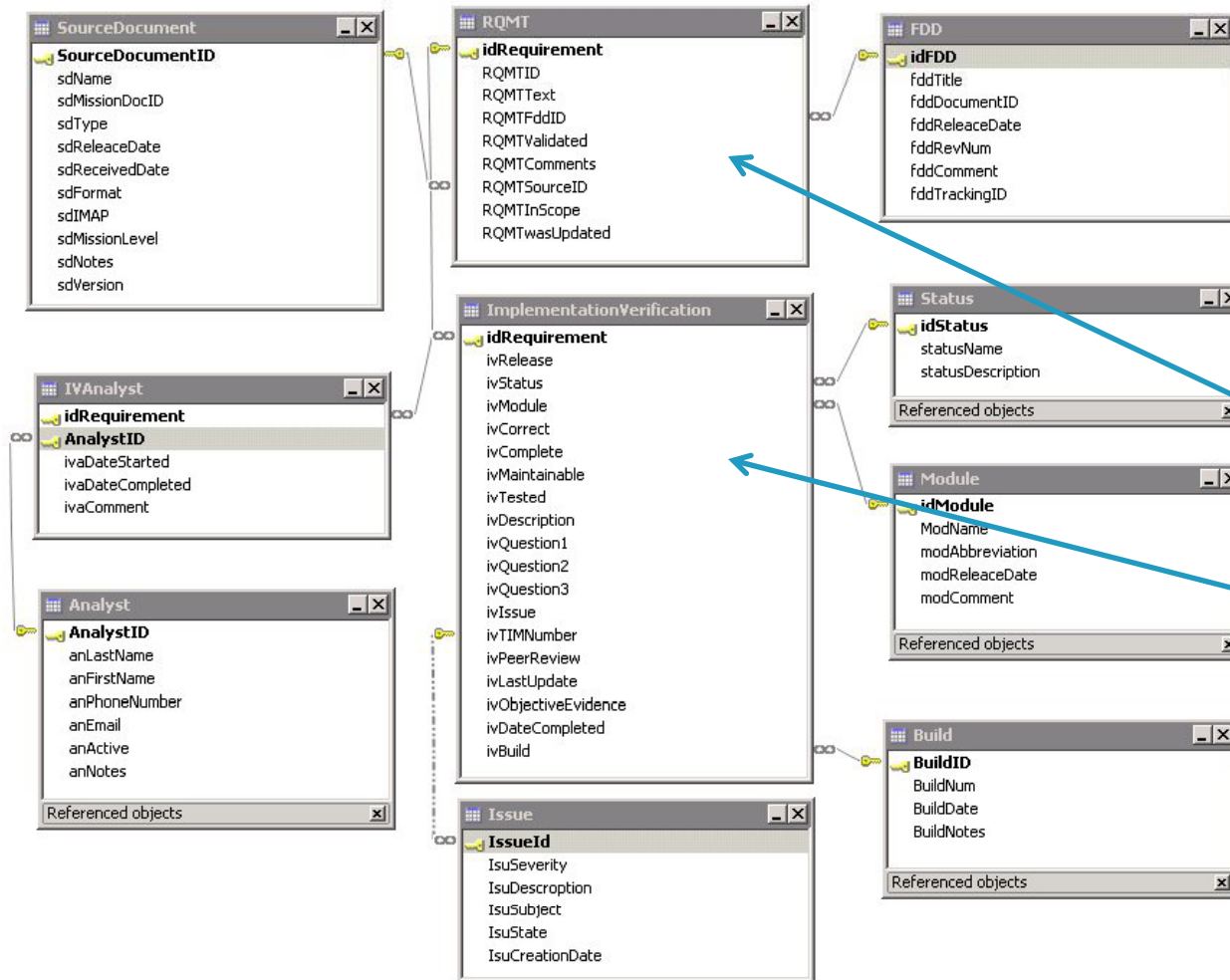
“It depends on the business rules”
Rules may affect any or all of the layers.
Which rules define data?

What “Hidden” data, such as status of the analysis, is not on the spreadsheet?



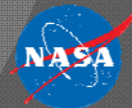
The SemanticAnalysis Object

The Data Layer



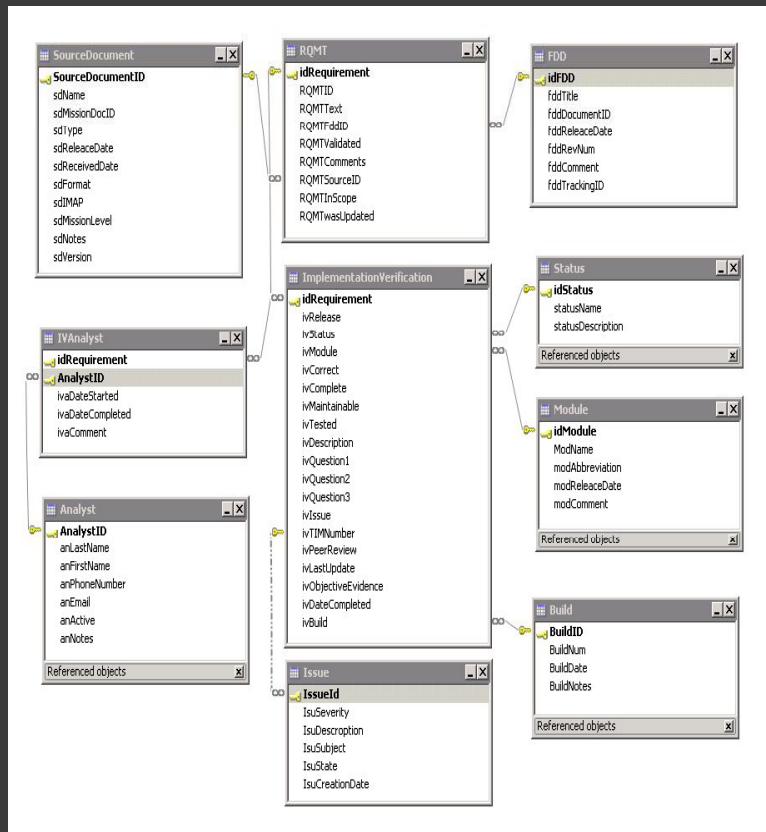
The object contains information about:

- The requirement being analyzed
- The analysis activity



The SemanticAnalysis Object

The Business Logic Layer



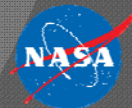
spGetSA

A set of stored procedures was written to facilitate object construction

```
SemanticAnalysis  
-idRequirement : int  
-RqmtNum : string  
-RqmtText : string  
-FddId : int  
-FddTitle : string  
-SourceID : int  
-InScope : bool  
-WasUpdated : bool  
-AnalystId : int  
-AnalystFirst : string  
-AnalystLast : string  
-ivStatus : int  
-statusName : string  
-ivModule : int  
-modName : string  
-ivRelease : string  
-buildNum : string  
-ivBuild : int  
-ivCorrect : bool  
-ivComplete : bool  
-ivMaintainable : bool  
-ivTested : bool  
-ivQuestion2 : bool  
-ObjectiveEvidence : string  
-AnalystFindings : string  
-PeerReview : string  
-ivIssue : bool  
-ivTIMNNumber : string  
-lastUpdated : Date  
+isEmpty() : bool  
+cancelChanges()  
+getSqlUpdate() : string  
-initializeChanged()  
-setChanges()  
-boolToInt(in b : bool) : int  
-getSqlDate() : string
```

A lesson learned:
•The object is one of several analysis objects

- An abstract Analysis class should have been designed
- The class should have been decomposed and common items such as Analyst or FDD should be independent classes



The SemanticAnalysis Object

The User Interface Layer

MSL Analysis Tracking Tool

```
class SemanticAnalysis {
    -idRequirement : int
    -RqmtNum : string
    -RqmtText : string
    -FddId : int
    -FddTitle : string
    -SourceID : int
    -InScope : bool
    -WasUpdated : bool
    -AnalystId : int
    -AnalystFirst : string
    -AnalystLast : string
    -ivStatus : int
    -statusName : string
    -ivModule : int
    -modName : string
    -ivRelease : string
    -buildNum : string
    -ivBuild : int
    -ivCorrect : bool
    -ivComplete : bool
    -ivMaintainable : bool
    -ivTested : bool
    -ivQuestion2 : bool
    -ObjectiveEvidence : string
    -AnalystFindings : string
    -PeerReview : string
    -ivIssue : bool
    -ivTIMNNumber : string
    -lastUpdated : Date

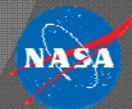
    +isEmpty() : bool
    +cancelChanges()
    +getSqlUpdate() : string
    -initializeChanged()
    -setChanges()
    -boolToInt(in b : bool) : int
    -getSqlDate() : string
}
```

The class has been implemented in both Java, for a client for analysts, and Visual Basic for Applications, for an Access application to manage the database

The screenshot displays the MSL Analysis Tracking Tool interface. It features a top navigation bar with tabs for 'System Information', 'Requirements Validation', 'Design Verification', 'Semantic Code Analysis', 'Test Analysis', and 'Search'. The main window is divided into several sections:

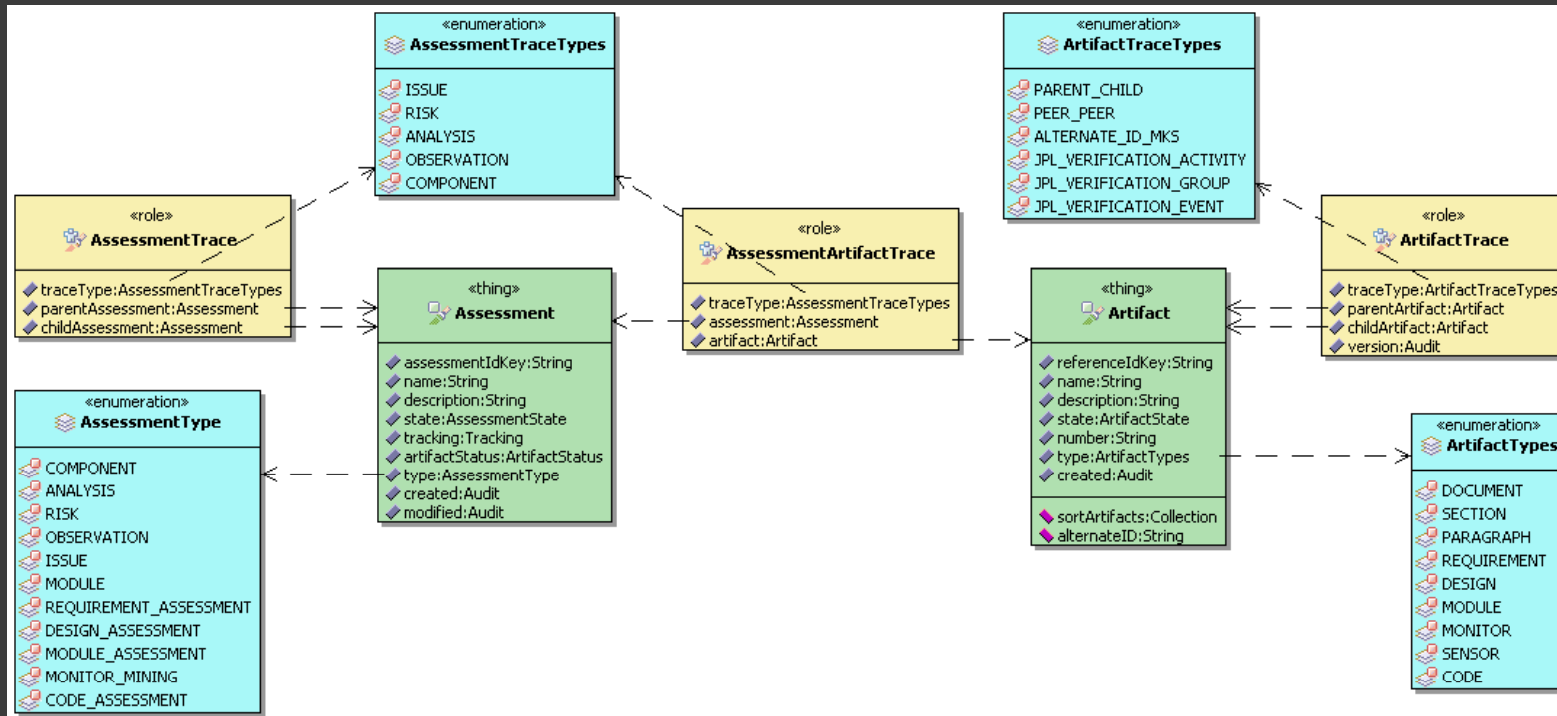
- Analysis Information:** A central pane showing 'Objective Evidence' and 'Analysis' details for a specific requirement.
- Requirement Information:** A table listing various requirements with columns for Requirement ID, FDD, Module, Status, Release, and Issue.
- Collection of SA Objects:** A table listing Semantic Analysis objects with columns for ID, FDD, Module, Status, Release, and Issue.
- Validation Analysis:** A sidebar on the right showing 'Additional Analysis' and 'Test Analysis' results.

Requirement ID	FDD	Module	Status	Release	Issue
FSW MOB-101	Mobility	mom	Complete	RI0.3	No
FSW MOB-102	Mobility	mom	Complete	RI0.2	No
FSW MOB-103	Mobility	mom	Complete	RI0.1	No
FSW MOB-104	Mobility	mom	Complete	RI0.1	No
FSW MOB-105	Mobility	mom	Complete	RI0.2	No
FSW MOB-106	Mobility	mom	Complete	RI0.2	No
FSW MOB-107	Mobility	mom	Complete	RI0.2	No
FSW MOB-108	Mobility	mom	Complete	RI0.2	No
FSW MOB-109	Mobility	mom	Complete	RI0.3	No
FSW MOB-110	Mobility	mom	Complete	RI0.2	No
FSW MOB-111	Mobility	mom	Complete	RI0.2	No
FSW MOB-112	Mobility	mom	Complete	RI0.2	No
FSW MOB-113	Mobility				
FSW MOB-114	Mobility				
FSW MOB-115	Mobility				
FSW MOB-116	Mobility				
FSW MOB-301	Mobility				
FSW MOB-302	Mobility				
FSW MOB-303	Mobility				
FSW MOB-304	Mobility				
FSW MOB-305	Mobility				
FSW MOB-306	Mobility				
FSW MOB-307	Mobility				
FSW MOB-308	Mobility				
FSW MOB-309	Mobility				
FSW MOB-310	Mobility	nav	Complete	RI0.1	No
FSW MOB-311	Mobility	nav	Complete	RI0.1	No
FSW MOB-312	Mobility	mom	Complete	RI0.1	No
FSW MOB-313	Mobility	mom	Complete	RI0.1	No
FSW MOB-314	Mobility	mom	Complete	RI0.2	No
FSW MOB-314	Mobility	mom	Complete	RI0.5	No

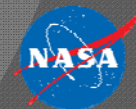


Independent Verification and Validation Facility

What an IV&V Domain Model Might Look Like

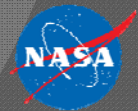


Used by the SMAP team



Benefits of a Domain Model

- Supports a common definition of the IV&V analysis data architecture.
- Provides building blocks for evidence based IV&V analysis.
- Encourages creation and reuse of analysis support utilities across technologies
- Leverages current IV&V technology investments



Resources

- DoD Architecture Framework Ver. 2.02
Data and Information Viewpoint
(http://dodcio.defense.gov/dodaf20/dodaf20_data.aspx)
- NASA, Office of the Chief Information Officer: Enterprise Portfolio Management
(<http://www.nasa.gov/offices/ocio/portfolio/index.html>)
- The Java Tutorials: Object-Oriented Programming Concepts
(<http://docs.oracle.com/javase/tutorial/java/concepts/>)
- U.S Department of Defense, Chief Information Officer: Data Strategy Community of Interest
(<http://dodcio.defense.gov/CommunitiesofInterest/DataStrategyCOITraining.aspx>)

