Multi-User Scheduling on Mars Science Laboratory in collaboration with MS Project

Seattle

June 28 - July 1, 2009 at the Sheraton Seattle Hotel

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Thomas Barnhart, Lockheed Martin Space Systems

AACE International’s 53rd Annual Meeting Seattle, Washington
A change in JPL schedule paradigm – Prior distributed schedule architecture versus a single, integrated program

- Outline MSL program background and mission complexity
- Integrate vendor/JPL MS Project schedules and into one master schedule
- Evaluate two different methods for file integration
  - Step by step process to import/export MS Project data
  - Step by step process for using ProjectLink
- Assess pros and cons regarding importing versus ProjectLink
- Review lessons learned
NASA’s Mars Exploration Program

Strategic Priorities:
- Follow the water, assess habitability
- Return a sample
- Prepare for humans

Operational Missions:
- Mars Global Surveyor
- Mars Odyssey
- ESA Mars Express
- Mars Reconnaissance Orbiter (Italian SHARAD)
- Competed Scout Mission
- Mars Exploration Rovers
- Phoenix
- Mars Science Laboratory

Next Decade:
- Explore the Evolution of Mars
- Search for Evidence of Past Life
- Search for Present Life
- Explore Hydrothermal Habitats

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MSL Project Overview

**Science**
Focus on Past & Present Habitability of Mars
Highly Capable Analytical Laboratory
Next Generation Remote Sensing & Contact Investigations
Suite of Environmental Monitoring Instruments

**Technical Capabilities**
One Mars Year surface operational lifetime (669 sols/687 days)
Discovery Responsive over wide range of latitudes and altitudes
Precision Landing via Guided Entry
Skycrane Propulsive Landing
Long Distance Traverse Capability (20 km)
Flexible & Robust Sample Acquisition & Processing

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MSL Spacecraft Major Elements

- Cruise Stage
- Backshell
- Descent Stage
- Rover
- Heatshield with MEDLI
- Backshell Interface Plate (BIP)
- Parachute Support Structure (PSS)
- Parachute
- Bridle & Umbilical Device
- Separations & Pyros

This Image is the property of NASA and JPL Caltech
Who’s Your Daddy?

Seattle, Washington

AACE International’s 53rd Annual Meeting

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Project Facts

- 10 Yr Project Concept Through Operations
- Project Value Over $1 Billion
- Project Employed 20% of Lab Resources at peak
- 675 Vendors
- 40,000 tasks cost and resource loaded
- Over Forty Individual Project File Elements
- Seven Full-Time JPL Schedule Analysts
- Fifty Licenses for P6 Web
Problem Statement

- Complex project w/many players & different scheduling tools
- Limited business support budget and personnel
- JPL technical staff unaccustomed to scheduling best business practices
- Must leverage limited resources, consolidate program data and provide timely status
- Must have proactive management to address delivery impacts to the program
- MS Project not suited to large program integration
- Cannot afford inefficiency of file locking in Project
Develop File Enterprise Structure

Architecture has 40 individual files by responsible project manager at WBS Lvl 2
MSL Aeroshell Project Overview

- MSLA Deliverables consist of one Aeroshell (A Backshell and Heatshield) plus one additional backup Heatshield
- Aeroshell protects rover from launch through landing. 4.5m in diameter and 3.3m in height
- Aeroshell is made of composite laminated materials, with Shuttle-like tiles on heatshield to protect rover during fiery entry
- Project Start Sept 2006 – End May 2009
- Integrated Master Schedule (IMS) is a fully networked and resource loaded MS Project 2003 file to track progress
MLL Aeroshell

Aeroshell just before Separation Test.

Backshell

Heatshield

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MSLA Heatshield

Largest Aeroshell Ever Built

This Image is the property of NASA and JPL Caltech
Monthly MSL Aeroshell Status

- Monthly IMS submitted to JPL in MS Project 2003 format
- Critical Path analysis performed
- Schedule margin position
- IMS provides status against task baseline
- IMS provides status against key program level milestones
- Key program level milestones mapped into data and linked into JPL Master Program Schedule
- IMS is the basis for Earned Value system and cost position status
Sample MS Project File

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Import Example
Create P6 Custom Mapping Fields
Import MSP to Primavera
Select Import Data Type
Select Import File
Select File/EPS Import Location
Create Import/Export Template

Map Custom Fields into P6
Identify Activity Import Mapping
Identify Resource Mapping
Click Finish to Proceed
Import Complete
Import Sample
Check Data Types

MSProject Default Activity Types
- Task = Resource Dependent
- % Compl = Duration
- Duration = Fixed Duration
- Calendar = Global MPT

Primavera Default Activity Types
- Task = Task Dependent
- % Compl = Duration
- Duration = Fixed Units/Time
- Calendar = Global at EPS
ProjectLink Example
ProjectLink Basic Facts

- Primavera ProjectLink plug-in allows user to store MS Project 2003 file into Primavera Database
- Gives access to use Primavera resource dictionaries but not activity code dictionaries
- ProjectLink file managed within MSP but stored to Primavera
- Primavera reporting tools gives visibility into MSP schedule
- ProjectLink help menu is available
Select File Location
Select Code Field Mappings
Click Finish to Proceed
MSP Save to P6 Complete
MSP Managed File in P6
Connecting Logic from MSP Managed File to P6
Tie Logic P6 to MSP (Task to Task)
Updating P6 Linked MSP file
File Updating: Change P6 File Status to “Checked Out”
Status Changed in P6
### Changes Made to MSP File in MSP

![Microsoft Project Screenshot]

#### Table of Changes

<table>
<thead>
<tr>
<th>Task ID</th>
<th>Task Name</th>
<th>Duration</th>
<th>% Complete</th>
<th>Start</th>
<th>Finish</th>
<th>Baseline Start</th>
<th>Baseline Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Protection Start (MDU Layup Start)</td>
<td>0 d</td>
<td>100%</td>
<td>6/12/07</td>
<td>6/12/07</td>
<td>3/11/07</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>NELA Critical Design Review (CDR) Completed (12th S18)</td>
<td>0 d</td>
<td>100%</td>
<td>6/12/07</td>
<td>6/12/07</td>
<td>4/20/07</td>
<td>4/20/07</td>
</tr>
<tr>
<td>9</td>
<td>Headshell #1 Fabrication Completed</td>
<td>0 d</td>
<td>100%</td>
<td>2/20/08</td>
<td>2/20/08</td>
<td>12/18/07</td>
<td>1/2</td>
</tr>
<tr>
<td>10</td>
<td>Backshell Fabrication Completed</td>
<td>0 d</td>
<td>100%</td>
<td>4/11/08</td>
<td>4/11/08</td>
<td>1/23/08</td>
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<tr>
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<td>Static/Separation Load Test Complete</td>
<td>0 d</td>
<td>100%</td>
<td>4/13/08</td>
<td>4/13/08</td>
<td>1/23/08</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>B/A/R #4 Contract Delivery Date</td>
<td>0 d</td>
<td>0%</td>
<td>6/10/08</td>
<td>6/10/08</td>
<td>6/10/08</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>CDE - HS #1 On Dock JPL</td>
<td>0 d</td>
<td>100%</td>
<td>9/29/09</td>
<td>9/29/09</td>
<td>8/12/00</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>CDE - HS #1 On Dock JPL</td>
<td>0 d</td>
<td>100%</td>
<td>10/19/09</td>
<td>10/19/09</td>
<td>8/12/00</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>CDE - HS #2 On Dock JPL</td>
<td>0 d</td>
<td>100%</td>
<td>4/1/09</td>
<td>4/1/09</td>
<td>8/12/00</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>CDE - HS #2 On Dock JPL</td>
<td>0 d</td>
<td>100%</td>
<td>4/1/09</td>
<td>4/1/09</td>
<td>8/12/00</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>CDE - HS #2 On Dock JPL</td>
<td>0 d</td>
<td>100%</td>
<td>4/1/09</td>
<td>4/1/09</td>
<td>8/12/00</td>
<td></td>
</tr>
</tbody>
</table>

#### Diagram of Task Flow

![Project Management Diagram]
Save to Primavera
Location Locked to Previous
Click Finish to Activate Upload
Open Files in P6 and Re-Calc
Updated File Shows Changes
# Import Consolidation Pros vs. Cons

<table>
<thead>
<tr>
<th>Method</th>
<th>Pro</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Import</strong></td>
<td>Data controlled within P6</td>
<td>Data reconfiguration may be required</td>
</tr>
<tr>
<td></td>
<td>Synchronized Calculation Allowed</td>
<td>Network troubleshooting necessary</td>
</tr>
<tr>
<td></td>
<td>Allows access to database codes, custom fields, etc.</td>
<td>Potential different calculation</td>
</tr>
<tr>
<td></td>
<td>Unlimited data mining, reports etc.</td>
<td></td>
</tr>
</tbody>
</table>
## ProjectLink Consolidation

<table>
<thead>
<tr>
<th>Method</th>
<th>Pro</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Link</strong></td>
<td>Stored as read-only. Calculation not-possible</td>
<td>Data controlled by MSP</td>
</tr>
<tr>
<td>Task linking ProjectLink to P6</td>
<td>No assurance for complete network logic</td>
<td></td>
</tr>
<tr>
<td>Data reconfiguration not-required</td>
<td>No access to database codes</td>
<td></td>
</tr>
<tr>
<td>No Potential for different calculations</td>
<td>Check In/Out Required and configuration tricky</td>
<td></td>
</tr>
</tbody>
</table>
Import Lessons Learned

- Prior to import set MSP calculation default to move uncomplete tasks based upon status date. (i.e. Tools, Tracking, Reschedule uncompleted work to start after status date for entire project)
- Use import for internal controlled files and run health checks before import
- Give a sample of cleaned file to responsible party before import
- Import to a test database to help clean corruption
- After import check data type defaults and correct where necessary
- Watch for calendar changes on import
Project-Link Lessons Learned

- Use project link for vendor schedules
- Maintain integrity of submitted vendor schedules
- Cannot recalculate vendor data so it remains pristine
- Accommodates different accounting calendars
- Utilize shared folder for joint file use not posted schedules, else re-linking required
Comparing Calculated Import vs. Project Link
Notice Milestone Dates Changes
QUESTIONS
Appendix: Installing ProjectLink
Welcome!

Welcome to the installation wizard for Primavera. Refer to the printed administrator's guide for detailed instructions or view it online (admin_guide.pdf).

It is strongly recommended that you exit all Windows programs before running this Setup Program.

Click Cancel to exit Setup and close any programs you have running. Click Next to continue with the Setup Program.

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Ready to Install the Program
The wizard is ready to begin installation.

Click Install to begin the installation.

If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.