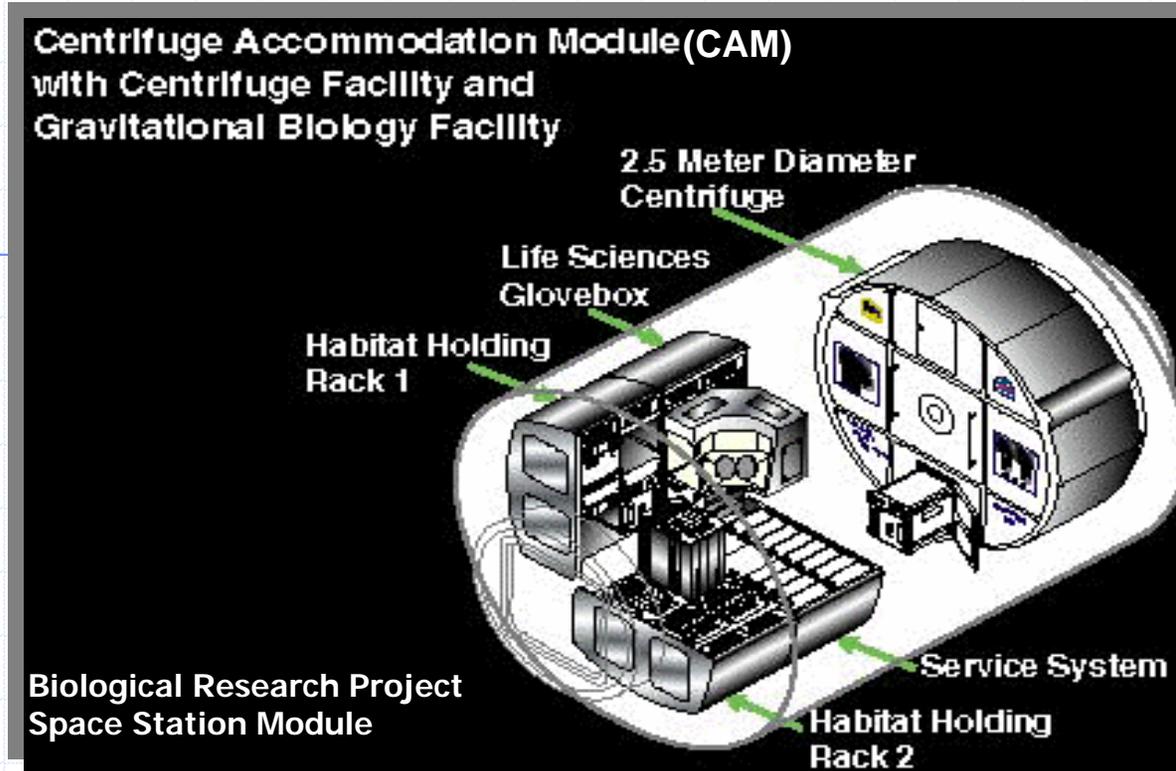


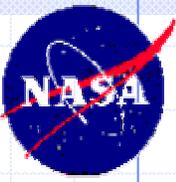
Implementing EVM Data Analysis: Adding Value from a NASA Project Manager's Perspective



Jerald Kerby
NASA-MSFC
256-544-3243
gerald.g.kerby@nasa.gov

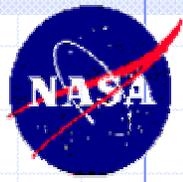
March 2004

Stacy Counts
NASA-MSFC
256-544-6004
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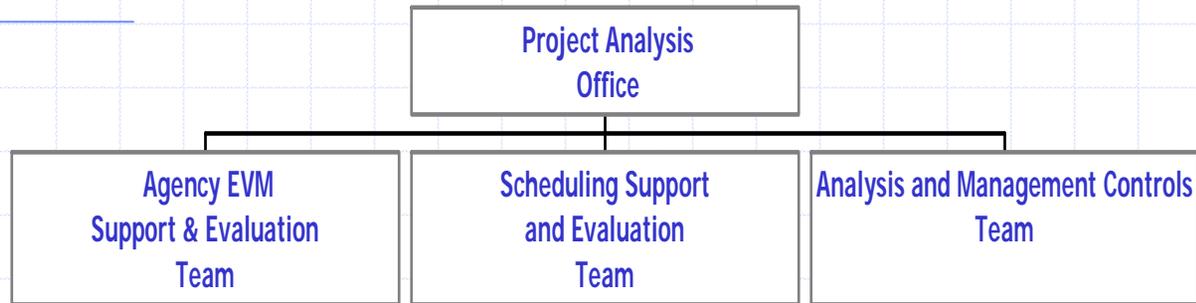


Outline

- ◆ Data Analysis Implementation
- ◆ Project Analysis Office Role
- ◆ HHR Project Overview
- ◆ Standard Report
- ◆ Benefits to Project
- ◆ Where to Next?

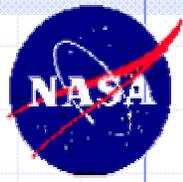


RS40 Project Analysis Office

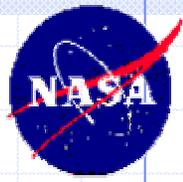


- ◆ Diverse, complimentary skill mix
 - EVM Analysts
 - Schedule Analysts
 - Accountants & Auditors
 - Data Administrators
 - Software Developers
 - Engineers

Why Implement Data Analysis?



- ◆ Cancelled Projects
- ◆ Cost Control Team Recommendations
 - Need for better analytical tools
 - Need for better project analysis and data analysis
- ◆ MSFC Center Director's Cost Control White Paper
- ◆ Better Data Analysis will enable MSFC Programs/Projects increased insight into performance
- ◆ COLSA Recommendations – Habitat Holding Racks (HHR) Specific
- ◆ Recent Documents Addressing NASA Project Management
 - NPG No. 7120.5A "NASA Program and Project Management Processes and Requirements"
 - Mars Program Independent Assessment Team summary Report – March 14, 2000
 - Mars Climate Orbiter Reports
 - NASA Integrated Action Team – December 21, 2000
 - Report by the International Space Station (ISS) Management and Cost Evaluation (IMCE) Task Force (*Young Report*)
- ◆ The President's Management Agenda – Fiscal Year 2002

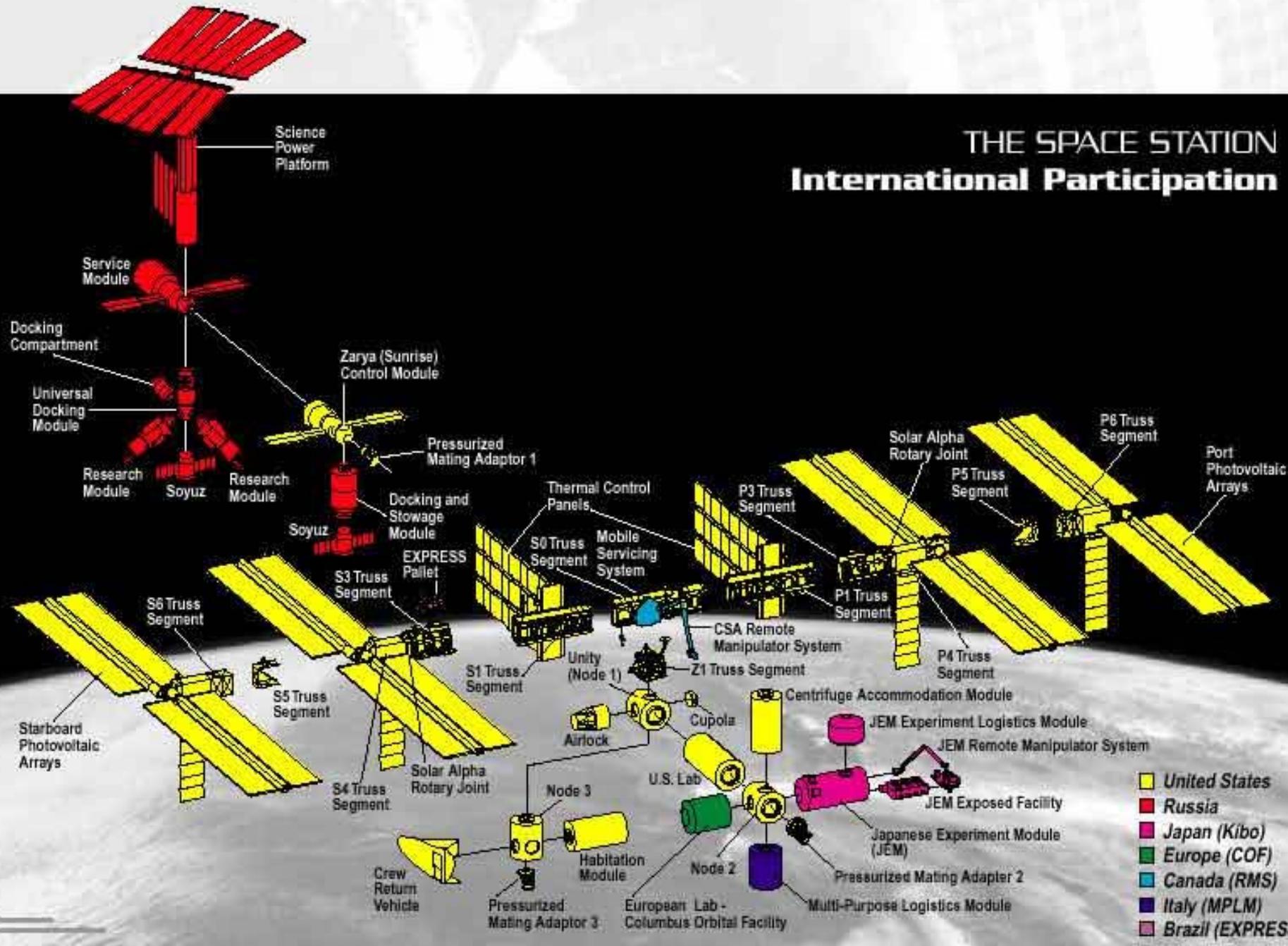


Biological Research Project (BRP) Overview – Space Station Project

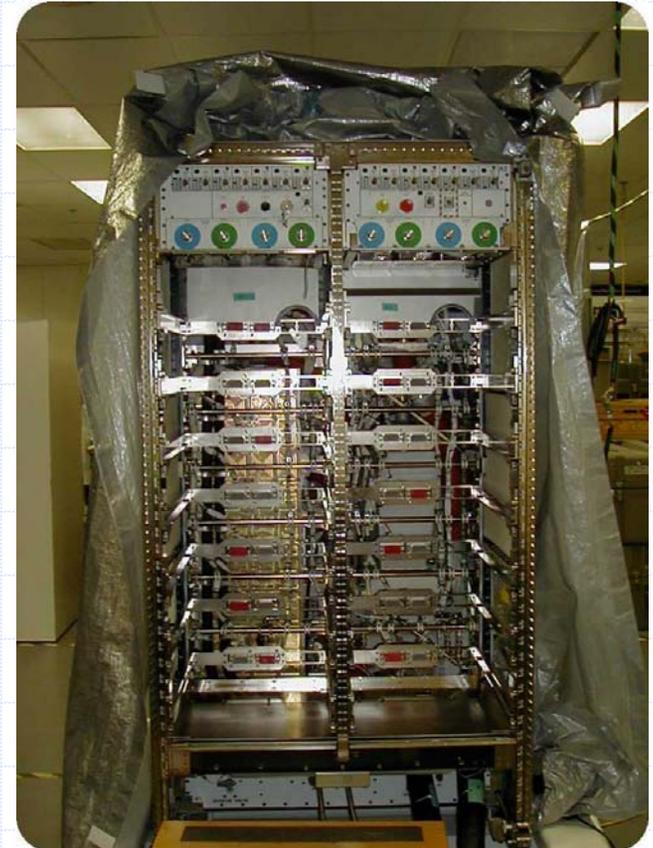
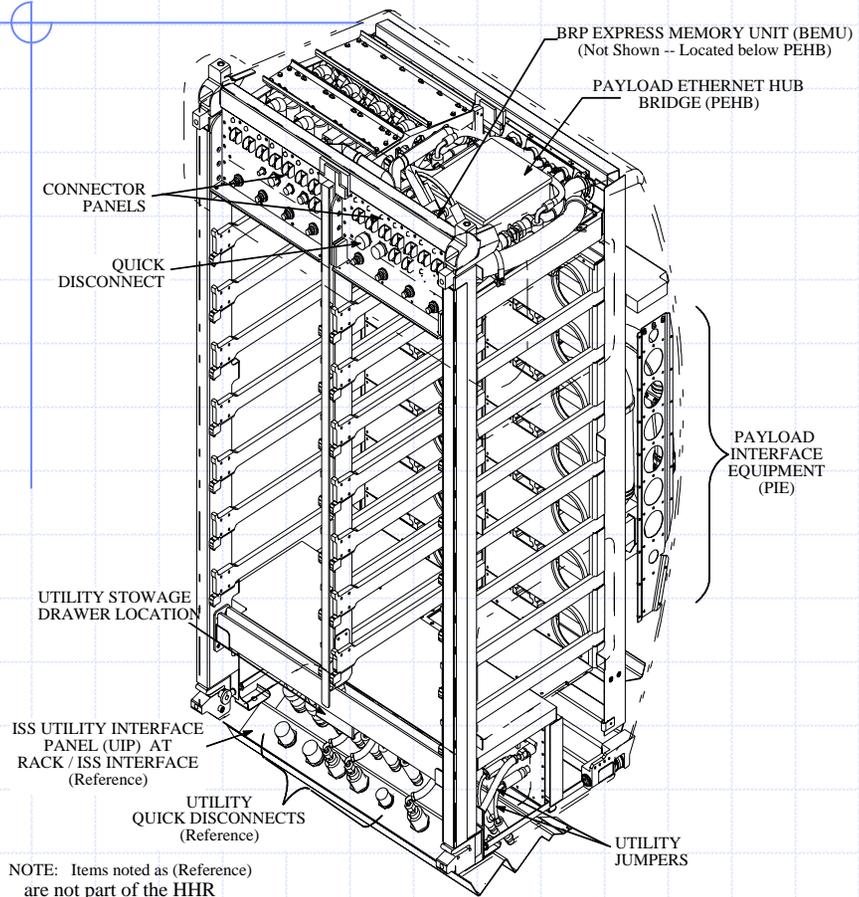
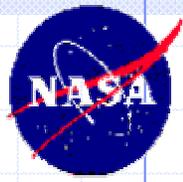
- ◆ Enabling project of NASA's non-human life sciences research program managed by Ames Research Center.
- ◆ Consists of the:
 - Centrifuge
 - Life Sciences Glovebox
 - Habitat Holding Racks (HHR) (Located in US Lab or CAM)
 - Various animal and plant habitats as well as other life science experiments.
- ◆ ARC-BRP Mission Requirements Document specifies a high degree of commonality in the various hardware items to function efficiently as a fully integrated facility.
- ◆ ARC-BRP chose Boeing via MSFC to design, build, test, and integrate the BRP Habitat Holding Racks and supporting systems utilizing the EXPRESS Rack as the design basis.
- ◆ Much of the HHR hardware is common in function, fit, and form with other Biological Research Project hardware.

THE SPACE STATION

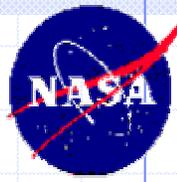
International Participation



BRP - Habitat Holding Rack



Biological Research Project Funding Profile

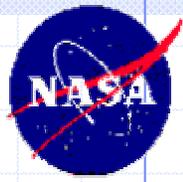


April 1996 Program Operating Plan (POP) Submit	\$45.7
April 1998 POP Submit	\$49.4
November 2000	\$88
September 2001	\$73
January 2002	\$80
Present	\$88.5

(\$'s in Million)

Delivery Date Mar. 31, 2004

Why Data Analysis?



HHR Project Content History

END ITEMS

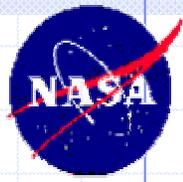
Qualification Rack	1
Flight Racks	2
Suitcase Simulators	2
Habitat Fluid Transfer System	3
Closeout Covers	3
Habitat Functional Simulator Suite	2 (one added in PCP 1186)
Habitat Mass Simulator Complement	1 set
Transportation Racks	2
ARC Trainer	1
JSC Trainer	1
Habitat Checkout Units	4
Rack Interface Support Equipment	1
Spares	2 sets
Portable User Operations Station	1
Command/Telemetry Databases	1

- Remains
- Deleted 1st Phase
- Deleted 2nd Phase

TASKS

- Habitat Physical Integration
- Analytical Integration
- Integrated Rack KSC Support
- Passive Damping/Rack Isolation Analysis
- User Operations Facility Display Development
- Centrifuge/Glovebox Developer Support
- User Operations Facility Console Operations

Why Data Analysis?



Implementation Approach

◆ Two step approach

- Equip
 - ◆ Tools
 - ◆ System
 - ◆ Knowledge

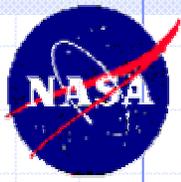
- Support
 - ◆ Standard Reports
 - 5 Pager
 - ◆ Training
 - ◆ Hands-on

Products

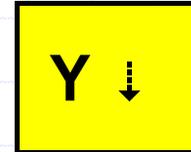
- wInsight
 - Schedules
 - Filters
 - Training - EV, wInsight, Schedule
 - Policies, DRs, etc.
 - Summary Reports
-
- CPRs
 - Training – EV, wInsight, Schedule, Data analysis, etc.
 - Schedule Support

Standard 5 Pager

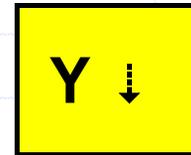
SAMPLE DATA



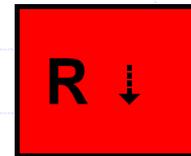
SCHEDULE PERFORMANCE



COST PERFORMANCE



TO MEET BUDGET AT COMPLETION (BAC)

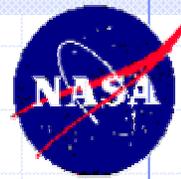


TO MEET CONTRACTOR'S LATEST REVISED ESTIMATE (LRE)



Performance Indicator Key		At Completion Indicator Key
Worse than -10%	R	TCPI > CPI by more than 5%
Between -10% and -5%	Y	TCPI > CPI by less than 5%
Better than -5%	G	TCPI < CPI
Change Threshold = 5%		

HHR Worse than - 5% = Red

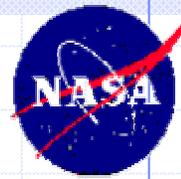


EVM Quick-Look Report

SAMPLE DATA

Dollars in Thousands

\$\$ in Thousands	BCWS	BCWP	ACWP	Schedule Variance			Cost Variance			Funding Status																																																																																																								
Current Pd.	1,645	1,509	1,707	-136	-8.3%	Y ↓	-198	-13.1%	R ↓	Funding Status \$\$ in Millions 																																																																																																								
Cumulative	7,279	6,851	7,350	-428	-5.9%	Y ↓	-499	-7.3%	Y ↓																																																																																																									
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2"></th> <th>NASA</th> <th>Ktr.</th> <th colspan="4">Variance Status Indicator Key</th> </tr> </thead> <tbody> <tr> <td>BAC</td> <td></td> <td>20,796</td> <td>↑</td> <td>R Worse than -10%</td> <td>G Better than -5%</td> <td colspan="2">Change Threshold = 5%</td> </tr> <tr> <td>EAC</td> <td>22,480</td> <td>20,761</td> <td>↑</td> <td>Y Between -10% and -5%</td> <td colspan="3"></td> </tr> <tr> <td>VAC</td> <td></td> <td>35</td> <td>↓</td> <td colspan="4"></td> </tr> <tr> <td>EAC Forecast</td> <td><u>Min.</u></td> <td><u>Max</u></td> <td></td> <td>SPI</td> <td>Current</td> <td>0.92</td> <td>↓</td> </tr> <tr> <td></td> <td>22,022</td> <td>23,385</td> <td></td> <td></td> <td>Cumulative</td> <td>0.94</td> <td>↓</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>CPI</td> <td>Current</td> <td>0.88</td> <td>↓</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Cumulative</td> <td>0.93</td> <td>↓</td> </tr> <tr> <td>Percent Scheduled</td> <td></td> <td>35.0 %</td> <td></td> <td>3 Mo. Avg CPI</td> <td></td> <td>0.95</td> <td></td> </tr> <tr> <td>Percent Complete</td> <td></td> <td>32.9 %</td> <td></td> <td>6 Mo. Avg CPI</td> <td></td> <td>0.92</td> <td></td> </tr> <tr> <td>Percent Spent</td> <td></td> <td>35.3 %</td> <td></td> <td>To Compl Perf Index (TCPI) BAC</td> <td></td> <td>1.04</td> <td>↑</td> </tr> <tr> <td>3 Mo. Avg Spend Rate</td> <td>1,441</td> <td>(7%)</td> <td></td> <td>To Compl Perf Index (TCPI) LRE</td> <td></td> <td>1.04</td> <td>↓</td> </tr> <tr> <td>6 Mo. Avg Spend Rate</td> <td>1,067</td> <td>(5%)</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>													NASA	Ktr.	Variance Status Indicator Key				BAC		20,796	↑	R Worse than -10%	G Better than -5%	Change Threshold = 5%		EAC	22,480	20,761	↑	Y Between -10% and -5%				VAC		35	↓					EAC Forecast	<u>Min.</u>	<u>Max</u>		SPI	Current	0.92	↓		22,022	23,385			Cumulative	0.94	↓					CPI	Current	0.88	↓						Cumulative	0.93	↓	Percent Scheduled		35.0 %		3 Mo. Avg CPI		0.95		Percent Complete		32.9 %		6 Mo. Avg CPI		0.92		Percent Spent		35.3 %		To Compl Perf Index (TCPI) BAC		1.04	↑	3 Mo. Avg Spend Rate	1,441	(7%)		To Compl Perf Index (TCPI) LRE		1.04	↓	6 Mo. Avg Spend Rate	1,067	(5%)					
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Top Issues Summary

Top Schedule Variances

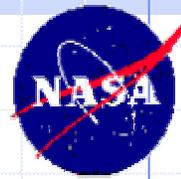
	WBS	Description	SV	CV	VAC	CPI	TCPI-LRE	CPI to LRE	SV	CV	BAC	LRE	% Budget
1	3200	COMMUNICATIONS	R ↑	R ↓	G ↔	0.84	1.03	-0.19	(203)	(131)	2,043	2,130	9.8%
1	3700	DATA DISPLAY	R ↑	G ↔	G ↔	1.00	1.00	0.00	(113)	0	388	388	1.9%
1	3300	AUX EQUIP	R ↓	G ↓	G ↓	1.13	0.96	0.17	(93)	78	2,418	2,410	11.6%
1	3100	SENSORS	Y ↑	G ↓	G ↔	0.97	0.99	-0.02	(37)	(11)	1,728	1,750	8.3%
1	2100	PROJ MANAGEMEN	G ↑	Y ↔	G ↔	0.94	1.04	-0.10	(12)	(17)	618	622	3.0%

Top Cost Variances

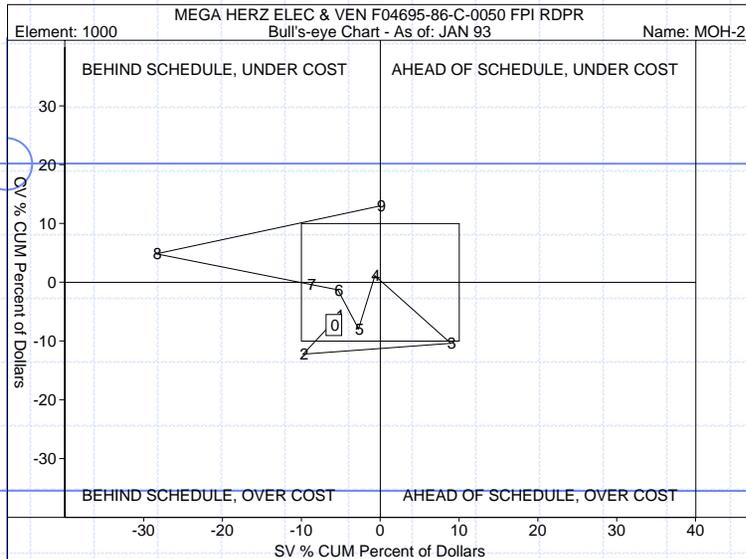
	WBS	Description	SV	CV	VAC	CPI	TCPI-LRE	CPI to LRE	SV	CV	BAC	LRE	% Budget
1	3600	PCC	G ↓	R ↑	G ↔	0.85	1.03	-0.18	(11)	(296)	5,801	5,988	27.9%
2	3200	COMMUNICATIONS	R ↑	R ↓	G ↔	0.84	1.03	-0.19	(203)	(131)	2,043	2,130	9.8%
3	2200	SYS ENGINEERING	G ↔	R ↓	G ↔	0.90	2.65	-1.75	6	(26)	283	283	1.4%
4	3800	I & A	G ↓	G ↓	G ↔	0.96	1.00	-0.05	83	(24)	1,440	1,465	6.9%
5	2100	PROJ MANAGEMEN	G ↑	Y ↔	G ↔	0.94	1.04	-0.10	(12)	(17)	618	622	3.0%

Top LRE Issues

	WBS	Description	SV	CV	VAC	CPI	TCPI-LRE	CPI to LRE	SV	CV	BAC	LRE	% Budget
1	3600	PCC	G ↓	R ↑	G ↔	0.85	1.03	-0.18	(11)	(296)	5,801	5,988	27.9%
2	3200	COMMUNICATIONS	R ↑	R ↓	G ↔	0.84	1.03	-0.19	(203)	(131)	2,043	2,130	9.8%
3	4000	SPARES	G ↑	Y ↑	G ↔	0.95	1.00	-0.06	1	(8)	756	762	3.6%
4	2100	PROJ MANAGEMEN	G ↑	Y ↔	G ↔	0.94	1.04	-0.10	(12)	(17)	618	622	3.0%
5	2200	SYS ENGINEERING	G ↔	R ↓	G ↔	0.90	2.65	-1.75	6	(26)	283	283	1.4%

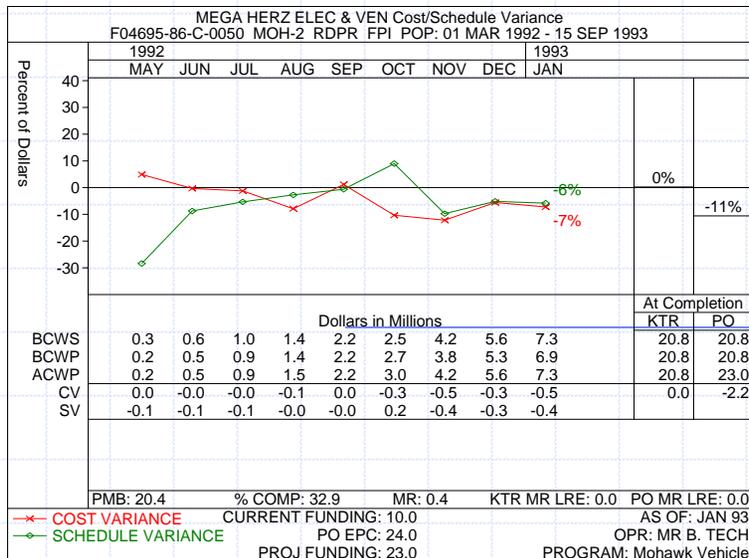


Bulls-Eye



- The Bulls-Eye Chart provides overall status at a glance. The point labeled '0' represents the status for the current month. The point labeled '1' represents the status one month ago.
- The project is currently behind schedule.
- The project is currently over cost.
- Normally, a negative schedule variance will have a negative impact on cost by program completion. Special attention should be paid to cost for behind-schedule elements as the contract approaches completion.

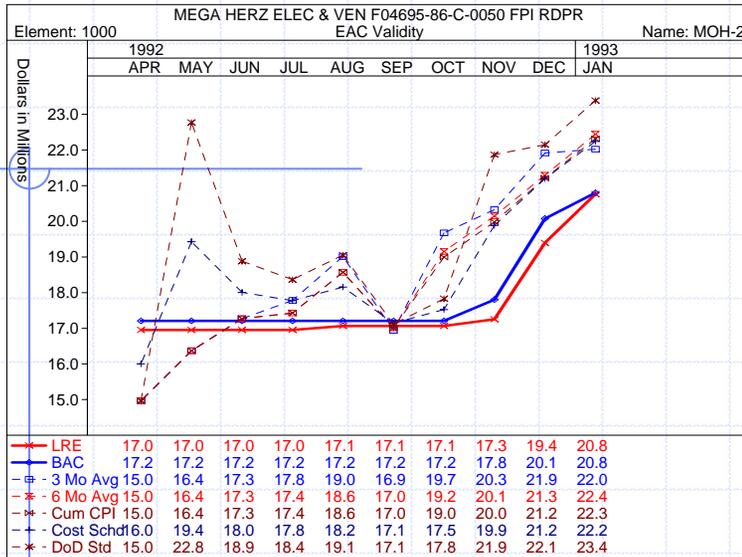
Cost/Schedule Variance



- The Cost/Schedule Variance Chart graphically depicts the cost and schedule variances in percentages, and provides the associated values in dollars (in thousands).
- Currently, the contractor has an unfavorable schedule variance of -428 (-6%) and an unfavorable cost variance of -499 (-7%).
- The Budget at Completion (BAC) is 20,796 and the effort is 33% complete.
- The contractor's Latest Revised Estimate (LRE), which depicts their Estimate at Completion (EAC), is 20,761, which is 35 less than the BAC.

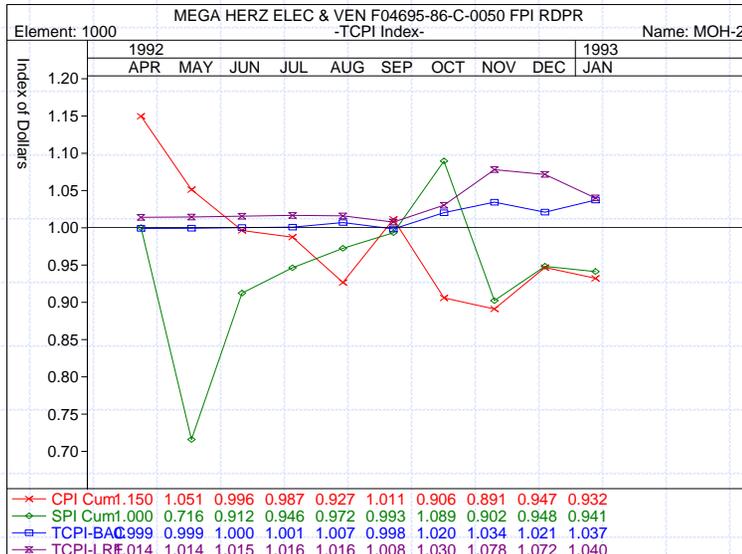


Estimate at Completion Validity

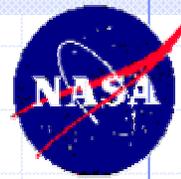


- The LRE Validity Chart compares the contractor's Latest Revised Estimate (LRE) to several statistically derived values for the Estimate at Completion (EAC). The LRE and EAC are terms that are often used interchangeably, representing the estimate of the total direct charges against the contract. The LRE should be somewhere within the range of the calculated values.
- Currently, MEGA HERZ ELEC & VEN LRE of 20,761 is 35 less than the BAC
- The LRE appears to be below the range of the statistically derived values.
- "Since the LRE falls outside the range of calculated values, the contractor should re-evaluate the LRE as soon as possible."

To Complete Performance Index (TCPI)



- The To Complete Performance Index (TCPI) chart illustrates the efficiency rate that the contractor must accomplish to meet the BAC or LRE, based on the contractor's performance to date.
- To date, the cost performance efficiency has been 0.932. In other words, for each dollar spent, the contractor has accomplished \$0.93 worth of the work budgeted.
- To meet the BAC, the contractor must accomplish \$1.04 of work for each dollar spent.
- Given the performance to date, it does not seem likely that the contractor will be able to meet the BAC.
- To meet the LRE, the contractor must accomplish \$1.04 of work for each dollar spent.
- Given the performance to date, it does not seem likely that the contractor will be able to meet the LRE.



EVM Definitions

TERMINOLOGY

- ACWP ACTUAL COST OF WORK PERFORMED (ACTUAL COST)
- BAC BUDGET AT COMPLETION (ALLOCATED BUDGETS)
- BCWP BUDGETED COST OF WORK PERFORMED (EARNED VALUE)
- BCWR BUDGETED COST OF WORK REMAINING
- BCWS BUDGETED COST OF WORK SCHEDULED (PLANNED VALUE)
- CBB CONTRACT BUDGET BASELINE (TOTAL AUTHORIZED WORK)
- CPI COST PERFORMANCE INDEX
- CV COST VARIANCE (BCWP-ACWP)
- EAC ESTIMATE AT COMPLETION (GOVERNMENT'S EAC)
- ETC ESTIMATE TO COMPLETE
- LRE LATEST REVISED ESTIMATE (CONTRACTOR'S EAC)
- MR MANAGEMENT RESERVE
- PMB PERFORMANCE MEASUREMENT BASELINE
- SPI SCHEDULE PERFORMANCE INDEX
- SV SCHEDULE VARIANCE (BCWP-BCWS)
- UB UNDISTRIBUTED BUDGET

COMMON CAUSES FOR VARIANCE

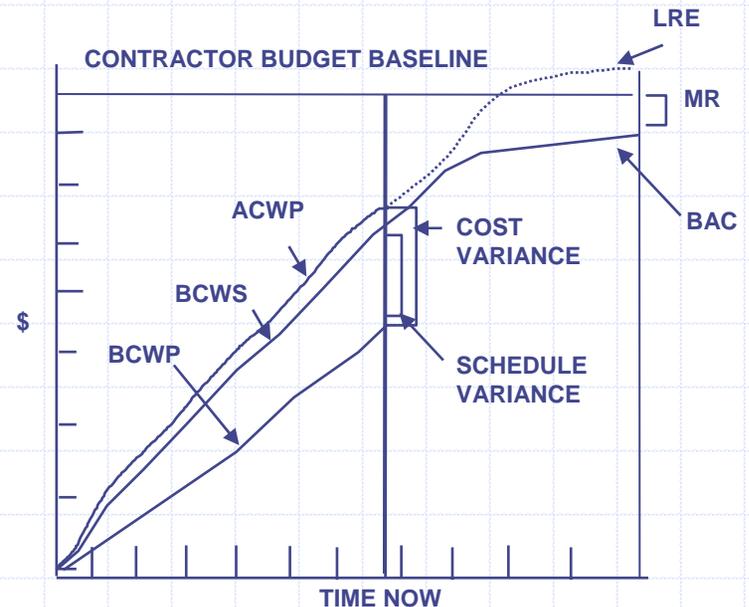
FAVORABLE

- POOR INITIAL PLANNING OR ESTIMATING
- TECHNICAL BREAK THROUGH
- COST OF LABOR AND MATERIAL LOWER THAN PLAN
- FRONT END LOADING
- METHOD OF EARNING BCWP

UNFAVORABLE

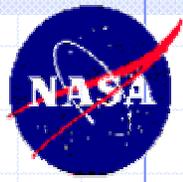
- POOR INITIAL PLANNING OR ESTIMATING
- TECHNICAL PROBLEM
- COST OF LABOR OR MATERIAL HIGHER THAN PLAN
- INFLATION
- NEW LABOR CONTRACTS
- WORK STOPPAGE

USE OF CONTRACTOR PERFORMANCE MEASUREMENT DATA



- CPR COST PERFORMANCE REPORT
- C/SSR COST/SCHEDULE STATUS REPORT

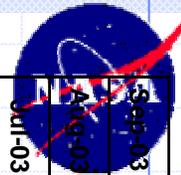
PURPOSE: TO OBTAIN CONTRACT COST AND SCHEDULE STATUS INFORMATION ON WHICH TO BASE PROGRAM MANAGEMENT DECISIONS



Benefits of EVM Data Analysis

- ◆ NO SUPRISES!
- ◆ EVM provides a more realistic approach to cost planning based on statistical data
- ◆ EVM provides a tool for Project Managers to utilize in reviewing Contractor data
 - Direct comparisons between contractor data and wInsight data is very beneficial
- ◆ Provides a solid means to forecast future cost requirements based on previous contractor performance
- ◆ Shows Valid History
 - Looks at both total contract and new baseline performance
- ◆ Provides estimate of required contractor performance to maintain budget within project schedule
 - Provides projections/justifications for future budgets
 - Provides good Estimates at Completion (EAC)
- ◆ Provides trends analysis to reflect whether contractor performance is decreasing or increasing
- ◆ Identifies Cost/Schedule drivers
- ◆ Helps determine risks to project
- ◆ Information to support hunches

MSFC wInsight Implementation Schedule



Infrastructure

Current

◆ July 2001 SLI CITRIX Established

◆ RS40 Mirror Established

◆ MSFC Transition to RS40 Server Complete

RS40 Server

wInsight Suite
Oracle
wInsight Web

- ◆ Reserve Hardware and Funding
- ◆ Set up hardware, install software
- ◆ Perform Security Scan
- ◆ Draft IT Security Plan
- ◆ Initial Testing Complete
- ◆ Transfer to MSFC Domain
- ◆ Install and Test Web Component
- ◆ Perform Security Scan

Direct Support

SLI

Boeing
LMA
OSC
NG
PW
RD
In House
X-37

◆ Complete Testing

◆ Port existing data to RS40 Server

Shuttle

External Tank
PM Evaluation
Main Engine
Production Data
External Tank
Main Engine

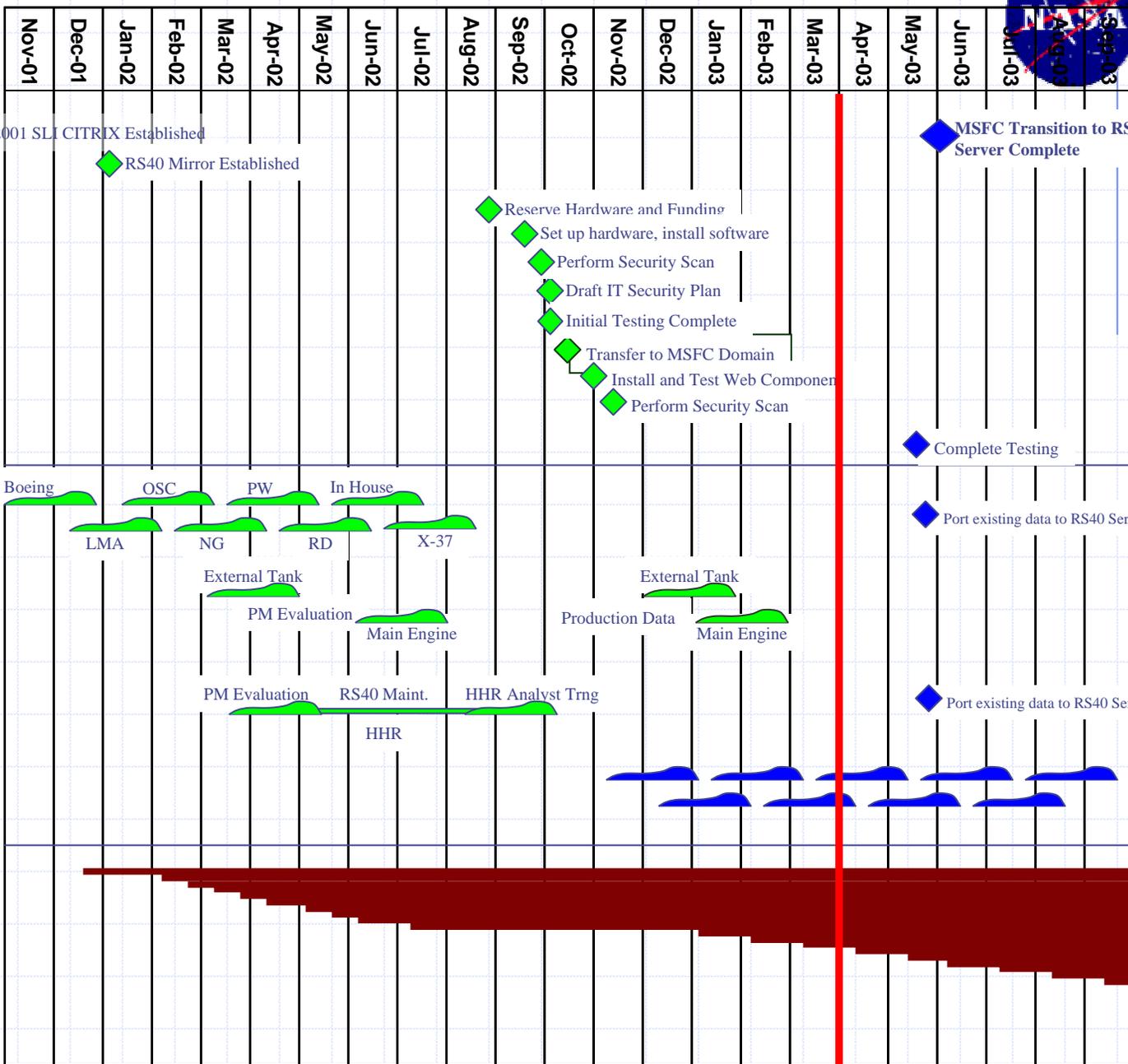
ISS

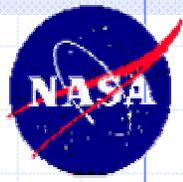
PM Evaluation
RS40 Maint.
HHR Analyst Trng
HHR

◆ Port existing data to RS40 Server

Future

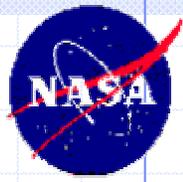
General Support





Progress to Date

- ◆ Hardware/Software setup
 - wInsight Implemented
 - CPRs Loaded
- ◆ Training
 - ◆ wInsight/Administrator
 - ◆ Basic EVM
 - ◆ Basic hands-on EVM training for analysts
 - ◆ Basic, Intermediate, and Advanced Scheduling techniques
 - ◆ Immediate Data Analysis
- ◆ CPR analysis support to Projects
- ◆ Integrated Baseline Review (IBR) support
- ◆ Developed Standard EVM Report (5 pager)
- ◆ Schedule Working Group



Where to Next?

- ◆ Rollout NASA-wide System for all NASA Projects
- ◆ Implement Data analysis tool NASA-wide
- ◆ Provide More Advanced EV and Analysis Training
- ◆ Establish Standard for Schedule Competencies
- ◆ Train, Train, Train, ...
- ◆ Coordinate with NASA HQ to conduct pilot test implementation of wInsight at selected NASA Centers