

EARNED VALUE AS A RISK ASSESSMENT TOOL

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CMM Level Three
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Introduction

- Earned Value Definition:
 - Employment of a Single Management Control System Providing Accurate, Consistent, Reliable, and Timely Data That Management at All Levels Can Use to Monitor Performance Throughout the Life Cycle of a Project or a Repetitive Production Effort.
 - A Legacy of Cost/Schedule Control Systems Criteria (C/SCSC) Created to Manage the Risk of Cost Growth in DoD Contracts.



Organization of Presentation

- Establishing Earned Value Project Management
- Establish Risk Management As Part of Earned Value Management
- Design and Implement Control Panel
- Monitor Earned Value Performance Including Risk
- Summary
- Conclusions
- Future Considerations
- Future Goals



Establishing Earned Value Project Management

- Organizing
 - Establish Contract Work Breakdown Structure (CWBS)
 - Identify Internal and Subcontractor Organizational Elements (I&SOE)
 - Integrate CWBS and I&SOE
 - Identify Indirect Cost and Management Cost Center



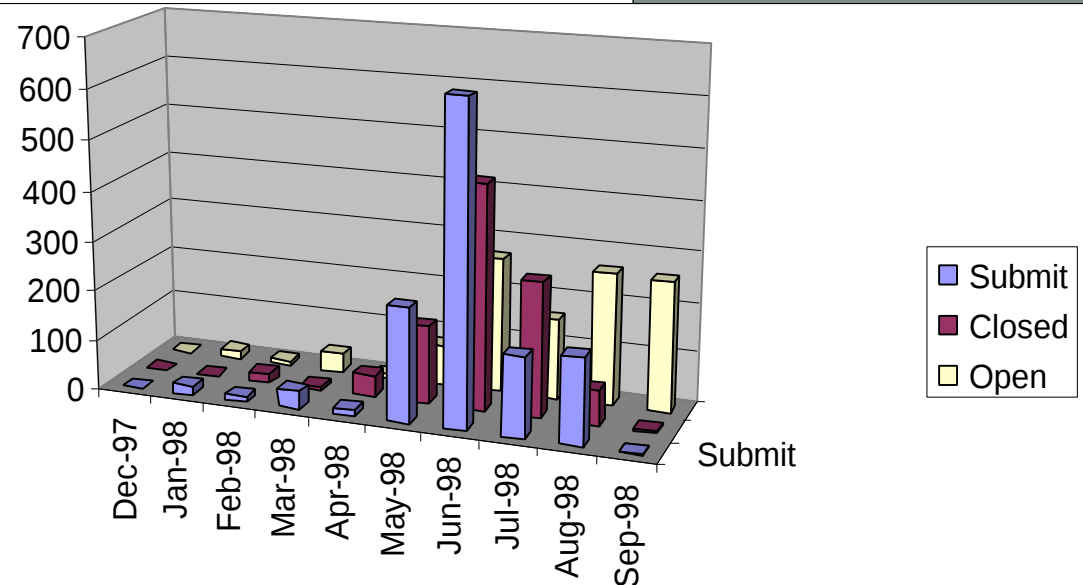
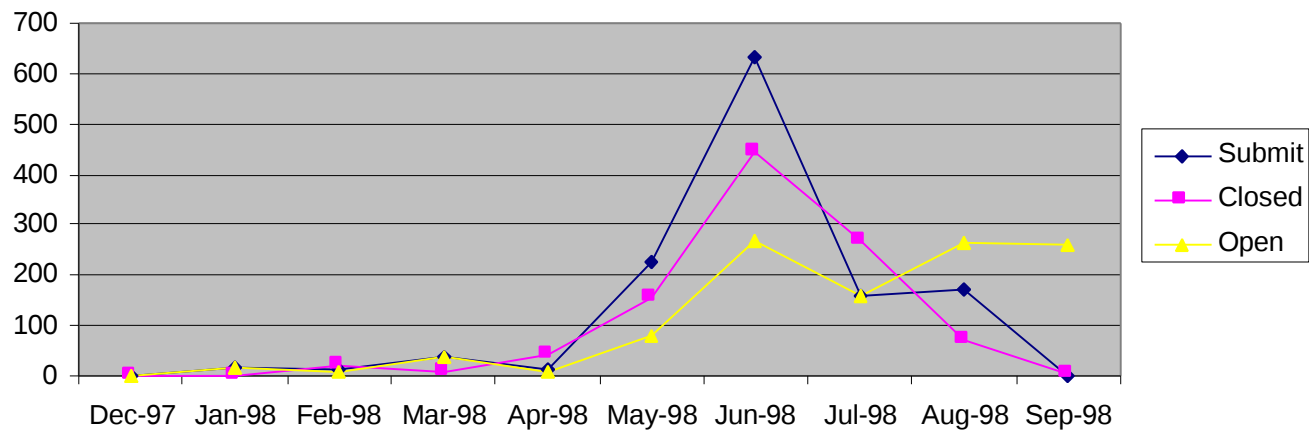
Establish Risk Management As Part of Earned Value Management

- Risk Identification List
 - Create Schedule/Cost Risk Correlation Matrix of Earned Value Metrics to Risk Events
 - Create Technical Risk Correlation Matrix to Quality Assurance Metrics
 - Develop Control Charts for All Metrics



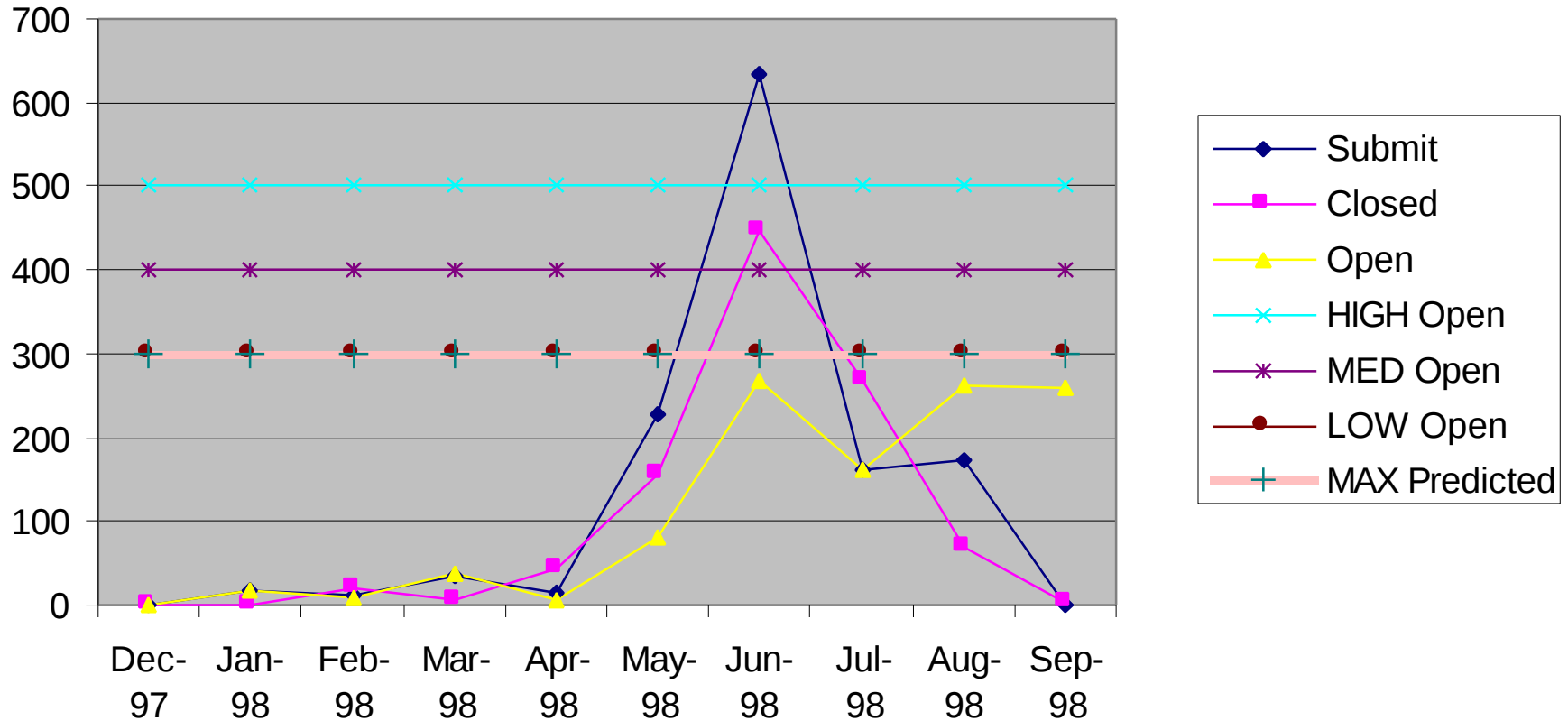
Trend Graph Examples

FLS TREND Graph



Control Chart Example

FLS DEFECT CONTROL CHART



Risk Analysis

- Risk Analysis
 - Assess Probability of Cost and Schedule Risk Using MS Project 4.0
 - Choose Confidence (L, M, H)
 - Set Control Limits Percent
 - Choose Curve (Uniform, Triangle, Normal, Beta)
 - Prioritize Risk Using Pairwise Comparison Technique



MS Project Risk Probability Chart (Cost)

FLSI2V2.MPP

Risk Histograms as of 10/20/98

ID	Task Name	Duration	Start	Finish	Mean Dur	Std Dev Dur
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"FLS Increment 2 Requirements Analysis - Phase 1" continued

Date: 10/20/98 10:47:08 AM

Number of Samples: 14

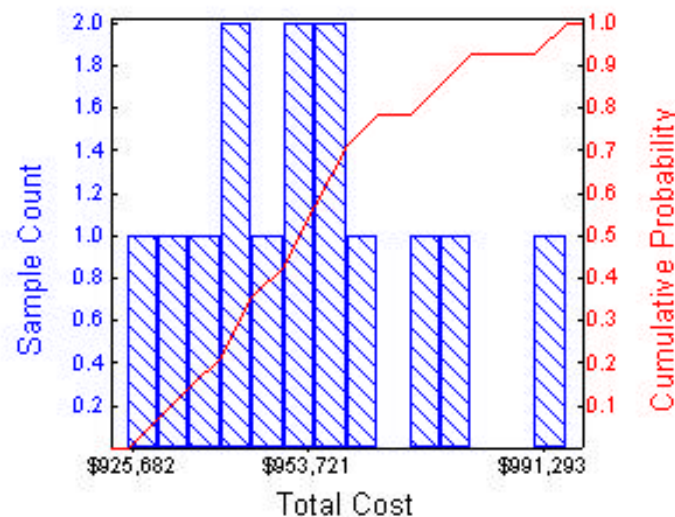
Unique ID: 1

Name: FLS Increment 2 Requirements Analysis - Phase 1

Cost Std Deviation: \$17,290

95% Confidence Interval: \$9,057

Each bar represents \$4,999



Cost Probability Table

Prob	Cost	Prob	Cost
0.05	\$647,977	0.55	\$952,275
0.10	\$929,258	0.60	\$953,484
0.15	\$934,755	0.65	\$955,387
0.20	\$935,691	0.70	\$957,762
0.25	\$938,330	0.75	\$960,765
0.30	\$941,301	0.80	\$965,211
0.35	\$943,399	0.85	\$972,635
0.40	\$947,116	0.90	\$975,161
0.45	\$950,142	0.95	\$980,685
0.50	\$951,886	1.00	\$991,293



MS Project Risk Probability Chart (Completion)

FLSI2V2.MPP

Risk Histograms as of 10/20/98

Task Name	Duration	Start	Finish	Mean Dur	Std Dev Dur
FLS Increment 2 Requir	53d	2/17/98	4/30/98	62.7d	3.2d

Date: 10/20/98 10:47:08 AM

Number of Samples: 14

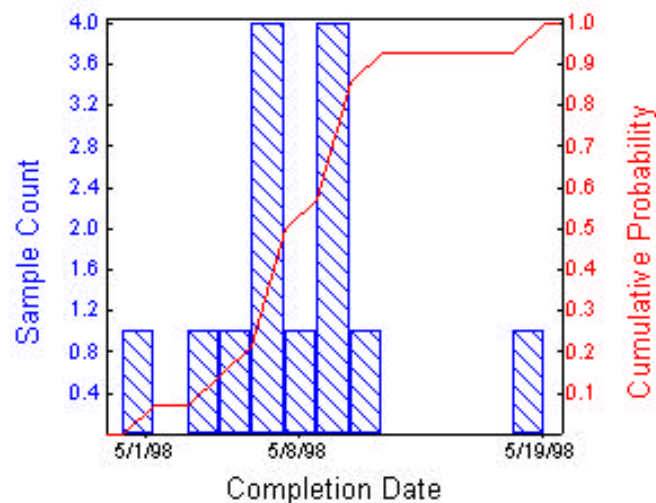
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Name: FLS Increment 2 Requirements Analysis - Phase 1

Completion Std Deviation: 2.7d

95% Confidence Interval: 1.4d

Each bar represents 1d.



Completion Probability Table

Prob	Date	Prob	Date
0.05	4/9/98	0.55	5/8/98
0.10	5/4/98	0.60	5/8/98
0.15	5/5/98	0.65	5/11/98
0.20	5/6/98	0.70	5/11/98
0.25	5/6/98	0.75	5/11/98
0.30	5/7/98	0.80	5/11/98
0.35	5/7/98	0.85	5/11/98
0.40	5/7/98	0.90	5/12/98
0.45	5/7/98	0.95	5/14/98
0.50	5/7/98	1.00	5/19/98

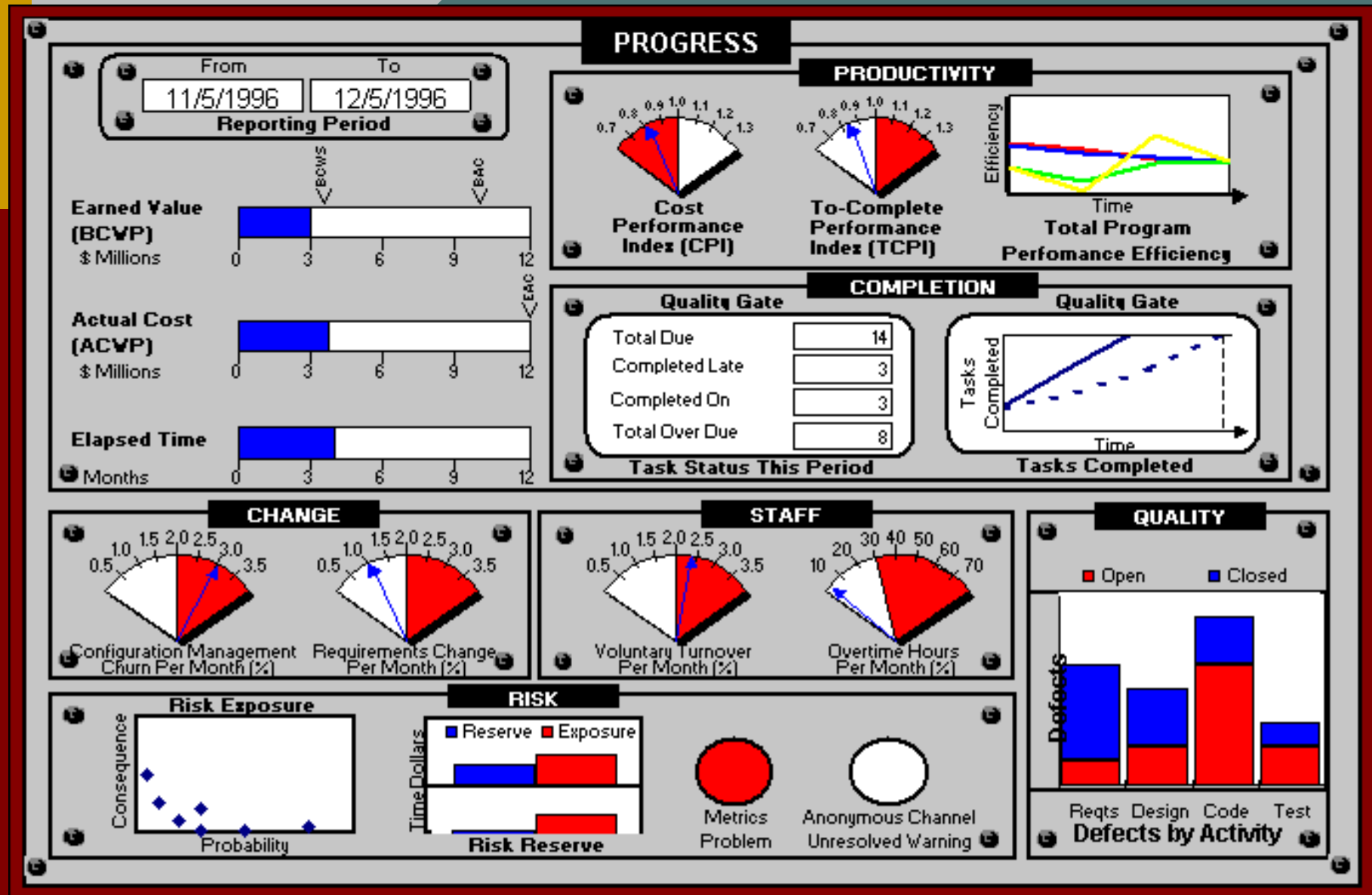


Risk Management Planning

- Integrate Risk Management Tasks With PMP and Track in PVCS Tracker Project Control Panel
- Resolve Risk
 - Analyze
 - Develop Mitigation Plan
 - Monitor Risk Mitigation Plan
 - Monitor Risk Mitigation in PVCS Tracker and MS Project and Project Control Panel
 - Report Via Project Control Panel and Monthly Progress Report in MS Project and on WEB Via Tracker.

Project Control Panel

QAO





Project Control Panel - Configuration Management

- Configuration Management = # Baseline Configuration Items (CI) Modified and Rechecked Into CM System to Date Divided by Total # of Baselined CIs
- Requirements Change Per Month (%) = # of New, Changed, or Deleted Requirements During Month, Divided by Total Number of Requirements As of End of Reporting Month



Project Control Panel - Staffing

- Voluntary Turnover Per Month = Number of Staff Leaving During Month, Divided by Number of Staff at Beginning of Month
- Overtime Per Month = Overtime Hours Divided by Base Month Working Hours



Project Control Panel - Progress Block (Gauges 1 - 8)

- The Earned Value (BCWP) Gauge Shows Cumulative Earned Value to Date
 - The cumulative earned value indicator bar shows the amount of work that has been completed on the project.
 - The triangle indicator shows the cumulative planned value or BCWS, which is the total value of work scheduled for completion by the end of this reporting period.
 - The maximum value is the total original budget for the project (BAC).



Project Control Panel - Progress Block (Gauges 1 - 8)

- The Actual Cost (or ACWP) Gauge Shows the Cumulative Actual Cost Incurred on the Project to Date
 - Estimate at Completion (EAC) Is the Maximum Value on This Gauge, Which Represents the Current Best Estimate for Total Cost of the Project.



Project Control Panel - Progress Block (Gauges 1 - 8)

- The Elapsed Time Gauge Shows the End Date for the Current Reporting Period
 - The SAC mark shows the original scheduled completion date for the project.



Project Control Panel - Progress Block (Gauges 1 - 8)

- The Cost Performance Index (CPI) Gauge Shows How Efficiently the Project Team has Turned Costs into Progress to Date.
 - It is a Historical Measure of Average Productivity Over the Life of the Project, and Is Calculated by Dividing Cumulative Earned Value by the Cumulative Actual Cost (BCWP/ACWP).



Project Control Panel - Progress Block (Gauges 1 - 8)

- The To-Complete Performance Index (TCPI) Gauge Shows the Future Projection of the Average Productivity Needed to Complete the Project Within an Estimated Budget.
 - It is Calculated by Dividing the Work Remaining by the Current Estimate of Remaining Cost $((BAC - BCWP) / (EAC - ACWP))$.



Project Control Panel - Progress Block (Gauges 1 - 8)

- The “ABBA Chart,” Also Known As the Total Program Efficiency Chart, Compares Four Indicators That Show Trends in Historical and Projected Efficiency to Date. They Are:
 - TCPI (Gauge 5)
 - Completion Efficiency (CE) ($\text{BAC} \div \text{EAC}$)
 - CPI (Gauge 4)
 - Monthly CPI (Monthly Earned Value Divided by the Monthly Actual Cost)



Project Control Panel - Progress Block (Gauges 1 - 8)

- Quality Gate Task Status This Month Shows the Completion Status of Tasks During the Current Reporting Period.
 - A Quality Gate Is a Predefined Completion Criterion for a Task.
 - The Criterion Must Be an Objective Yes / No Indicator That Shows a Task Has Been Completed.



Project Control Panel - Progress Block (Gauges 1 - 8)

- The Indicators are:
 - **Total Due** is the total number of tasks scheduled for completion during this reporting plus any overdue tasks from previous periods. This indicates the total quantity of work required for the project to keep pace with the schedule.
 - **Completed on Time** is the number of tasks originally scheduled for completion during this reporting period that were completed by the original scheduled date. This number indicates how well the project is keeping up with scheduled work.



Project Control Panel - Progress Block (Gauges 1 - 8)

- The Indicators are:
 - **Completed Late** is number of tasks completed late during this reporting period. This number includes those tasks scheduled for this period that were completed late as well as any overdue tasks from previous periods that were completed in this period. This indicates how well the project is completing work, even if it is late.
 - **Total Overdue** is the total number of tasks for all previous periods that are overdue by the end of the current period. This is an indicator of the quantity of work needed to get the project back on schedule.



Project Control Panel - Progress Block (Gauges 1 - 8)

- The Quality Gate Tasks Completed Graph Shows the Cumulative Number of Tasks Completed by the End of Each Reporting Period to Date, Plotted with the Cumulative Number of Tasks Scheduled for Completion.



Planning & Budgeting

- Develop Schedule of Work and Identify Task Interdependencies and Critical Path
- Identify Output Measures of Effectiveness
 - Milestones
 - Documentation (Technical Publications / Specifications)
 - Products
- Develop Time-phased Budget Baseline Including Estimate of Budget at Completion (BAC)
 - Using Cost & Schedule Estimating Tools and/or Calibrations From Previous Similar Work



Planning & Budgeting (cont'd)

- Establish Budget for All WBS Items to at Least Third Level of WBS
- Identify WBS Elements That Are Level of Effort and Establish Budget for Each
 - Quality Assurance & Configuration Management
- Establish Overhead Budgets for Each Organization in Project Where Appropriate



Planning & Budgeting (cont d)

- Identify Management Reserves and Undistributed Budget
- Ensure Contract Target Cost Plus Estimated Cost of Authorized but Un-priced Work is Reconciled With Sum of All Internal Contract Budgets and Management Reserves



Accounting

- Record Direct Costs As Actual Cost of Work Performed (ACWP)
 - $\text{ACWP(H) Hours} / \text{ACWP(\$) Cost}$
- Direct Costs Controlled by Books of Account
- Summarize Cost Accounts Into WBS So That Each Represents a WBS Element at Least Third Level of WBS.



Accounting (*cont d*)

- Summarize Direct Costs From Cost Accounts Into Functional Organization Elements So That Each Is Assigned to WBS Elements Where Actual Work Will Be Performed.
- Record All Indirect Costs.
- Identify Unit Costs, Equivalent Unit Costs, or Lot Costs, If Appropriate.



Accounting (cont d)

- Ensure Accounting System Is Configured to Perform the Following:
 - Accurate Cost Accumulation to Cost Accounts
 - Determination of Price Variances by Comparing Planned Versus Actual Performance
 - Cost Performance Measurement at Least Monthly and at Delivery
 - Determination of Cost Variances Due to Excess Usage of Material
 - Determination of Unit or Lot Costs
 - Full Accountability of All Materials Purchased Including Residual Inventory



Analysis

- Use Accounting System to Determine at Cost Account Level
 - Comparison of Budgeted Cost of Work Performed (BCWP) & Actual Direct Costs of Work Performed (ACWP).
 - Variances Resulting From Comparisons Between Budgeted Cost for Work Scheduled (BCWS) and BCWP and Between BCWP and ACWP Classified in Terms of Labor, Material, or Other Appropriate Elements Together With Reasons for Significant Variances.



Analysis (cont'd)

- Identify on a Monthly Basis at a Minimum:
 - BCWP
 - ACWP
 - BCWS
 - Cost Performance Index (CPI)
 - Cost Variance Percent and Cost Variance Dollars
 - EAC
- Summarize at Contract / Project Level
- Summarize at WBS Level to at Least Third Level
- Identify Reasons for Significant Variances Between Planned and Actual Accomplishments



Analysis (cont d)

- Identify Variances As Risk
- Prioritize Risks
- Assign Risk Severity Level
- Analyze Risk and Develop Plan of Action Including Schedule and Cost Impact on Management Reserve
- Estimate Probability of Any Additional Risk Incurred by Risk Plan of Action
- Track Risk Until Alleviated
- Develop Revised Estimates of Cost at Completion (EAC) for Affected WBS Elements



SUMMARY

- Five Basic Steps Are Required to Implement Simplified Form of Earned Value Management:
 - Define Project With WBS
 - Plan and Schedule Project Scope
 - Budget Cost Account Plans and Functions
 - Establish and Maintain Performance Baseline
 - Monitor Performance and Forecast Final Results



CONCLUSIONS

- Even a Simplified Form of EVA Can Provide Great Insight for Risk Managers
- Control Diagrams Assigned to Each Measure of Effectiveness Can Provide Basis for Risk Severity Estimates
- Control Diagrams Can Show Trends Produced by Defect Corrective and Preventive Actions



FUTURE GOALS

- Optimize Contract Performance by Using EVA Historical Data as Calibration of Level of Effort for Future Similar Projects



FUTURE CONSIDERATIONS

- Bonus or Other Type Reward to Employees
 - Based on:
 - Earned Value Cost Performance
 - Earned Value Schedule Performance
 - Management of Critical Path Against Key Milestones