EVMS Training – CAM 101

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Project Controls

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Outline

- Earned Value Management (EVM)
- Organization
- Planning, Scheduling & Budgeting
- Analysis and Management Reporting
- Change Control

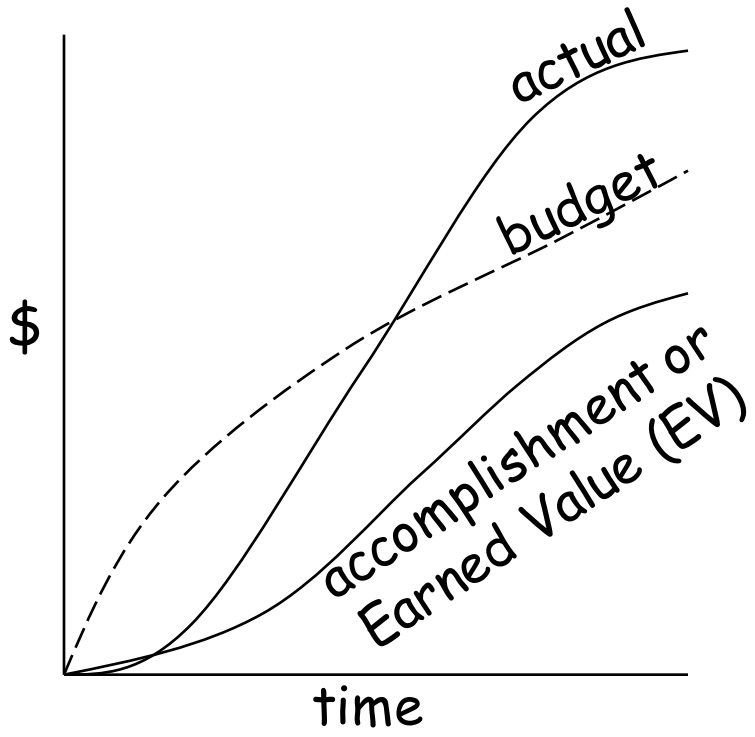
Earned Value Management (EVM) Definition

- Definition
  - A systematic project management process that results in an integrated plan against which performance is measured objectively
  - A systematic approach for calibrating the heath of a project
- Application
  - Work is planned, budgeted, & scheduled in time-phased increments
  - Takes into consideration risk, uncertainties, & assumptions
  - Involves project manager, control account managers (CAM), contractors, customers, etc
- Objective
  - Provide both the government and contractors the ability to examine detailed schedule information, critical program and technical milestones, and cost data
- The ANSI/EIA-748-C contains a set of 32 Guidelines that defines the requirements that an Earned Value Management System (EVMS) must meet

Earned Value Management (EVM)
Why Use EVM?

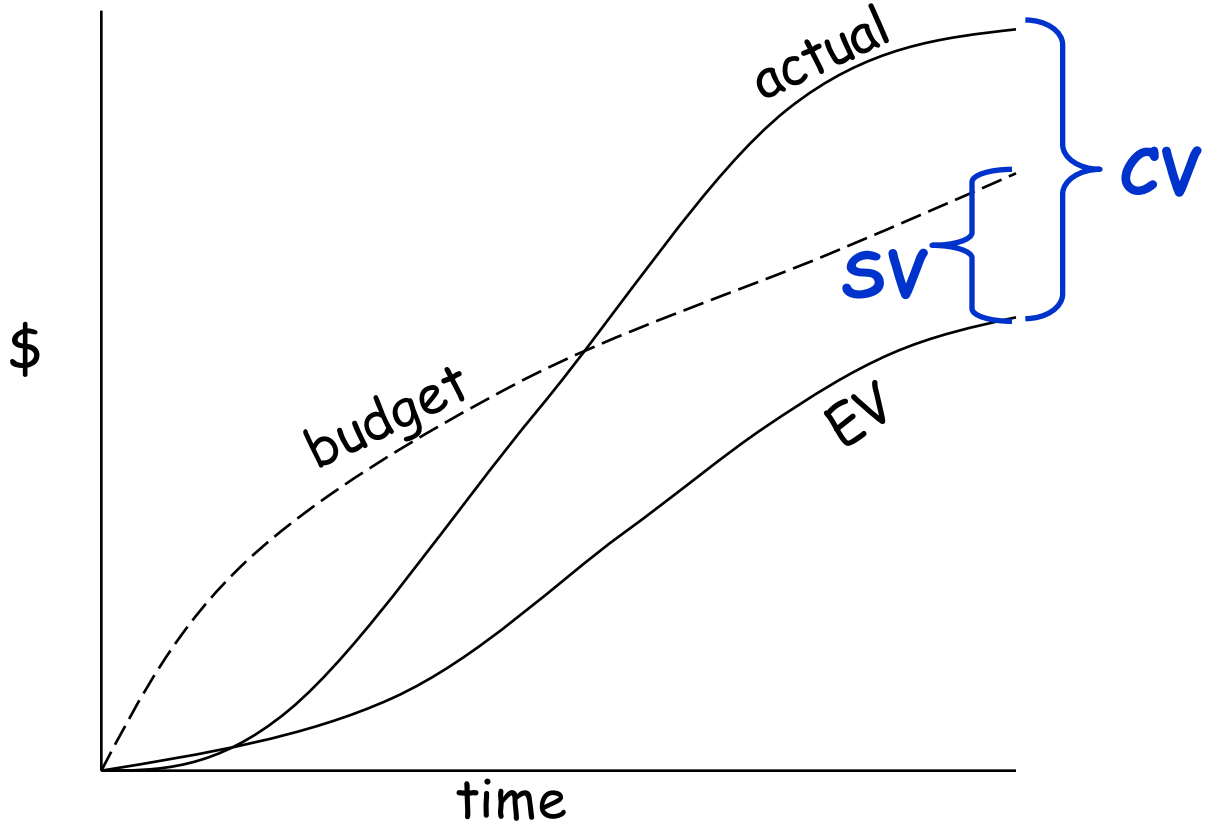
- Earned Value Management System (EVMS) is required by NSF to strengthen the overall performance of project management and the acquisition of capital assets
- EVMS allows both government and contractor managers to gain significant insights into technical, cost, and schedule progress of contracts and projects
- Earned Value provides a concise and timely view of project progress, enabling early forecasting and resolution of cost and schedule issues.
- When the performance indices (CPI and SPI) are analyzed over time, potential future issues, which can be resolved through immediate action, are clearly identified. This makes Earned Value a very powerful tool for forecasting and mitigating risks.

Earned Value Management(EVM) System [1]



- Plan all project work
  - » Objectively assess progress at the performance level
  - » Accomplished work is from planned tasks progressed
  - » The budgeted cost of the work quantifies the amount of accomplishment
  - » Summarize data for progressively higher levels of project management
  - » Analyze significant deviations form the baseline plan
  - » Forecast impacts on cost and schedule
  - » Maintain the baseline

Earned Value Management(EVM) System [2]



- Cost Variance (CV)

  CV=EV-Actual

- Favorable or unfavorable

- Schedule Variance (SV)

  SV = EV – Budget (Planned)

- Ahead or behind

Earned Value Management (EVM) Acronyms

- BCWS (Budgeted Cost Of Work Scheduled)
  - Value of work planned to be accomplished during a given period of time. How much work should be done? Also called planned value (PV)
- BCWP (Budgeted Cost Of Work Performed)
  - Value of work accomplished or earned value. How much work is done? Also called earned value (EV)
- ACWP (Actual Cost Of Work Performed)
  - Cost of work accomplished or actual cost. How much did it cost? Also called actual cost (AC)
- TPC (Total Project Cost)
  - Sum of all project costs (including contingency). How much could it all cost?
- BAC (Budget At Completion)
  - Sum of all budgets thru any given level (without contingency). What was the total job supposed to cost?
- ETC (Estimate To Completion)
  - Estimated value of the authorized work remaining to be completed. How much will the remaining work cost?
- EAC (Estimate At Completion)
  - Estimate of total cost of all authorized work thru project completion. What do we now expect the total job to cost?
- SV & CV (Schedule Variance & Cost Variance)
  - Measure of cost & schedule performance on a project. How far ahead or behind cost or schedule am I?
- SPI & CPI (Schedule Performance Index & Cost Performance Index)
  - Schedule & cost efficiency representing the ratio of work performed to work scheduled or costed. How efficiently am I accomplishing work?

Earned Value Management (EVM) Role as a Control Account Manager (CAM)

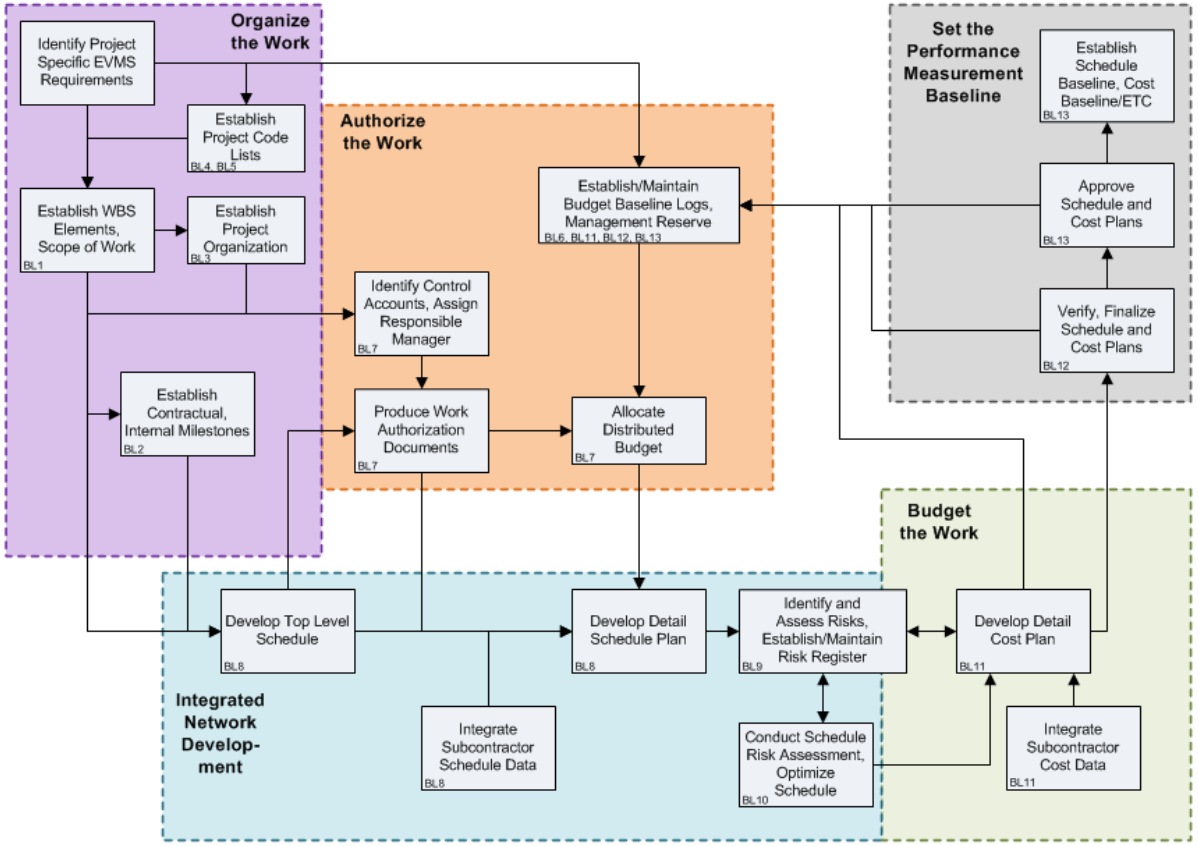
- The CAM plays a critical role in an earned value management system
- A CAM can manage multiple accounts
- A CAM maintains responsibility for each individual control account (CA) that represents the work assigned to one responsible organizational entity (or integrated work team) for a single program WBS element
- A CAM is responsible for the planning, coordination and achievement of all work within a CA and provides a single authority for all scope, technical and cost issues for the CA
- The next slides will introduce the processes and tools that can help the CAM to achieve their goals and report work progress

Earned Value Management (EVM) Role as a Control Account Manager (CAM)

- Am I on schedule?
- How do I provide schedule status and changes to the IMS?
- How are the budget and the schedule linked?
- What is Earned Value reporting and why are we doing it on LSST?
- What is a Control Account and Work Package?
- What is my budget ?
- How much have I spent to date and how does it compare to my baseline plan?
- What happens if I do not spend all my budget?
- When is a change request needed and how are change requests processed?

Organization

- Implementation Phase
  - Organize the Work
  - Authorize the Work
  - Schedule the Work
  - Budget the Work
  - Set the PMB



Organization
Work Breakdown Structure (WBS)

- The LSST WBS is a product-oriented, hierarchical outline of individual scopes of work required to accomplish the LSST Project
- Level 4 WBS elements are assigned to individual Control Account Manager (CAM) as control accounts
- A CAM can manage multiple accounts
- Work Breakdown Structure (WBS) is documented in WBS Dictionary

Code	Description
1.02C	Data Management Construction
1.02C.00	
1.02C.00.00	DM Level 2 Milestones
1.02C.01	System Management
1.02C.01.01	Project Management
1.02C.01.02	Science Data Quality Integration and Test
1.02C.01.02.01	Science Data Quality Assessment Pipeline
1.02C.01.02.02	Science Data Quality Analyst Toolkit
1.02C.01.02.03	Science Pipeline Toolkit
1.02C.02	System Engineering
1.02C.02.01	Data Management Science
1.02C.02.02	Data Management Architecture
1.02C.03	Alert Production
1.02C.03.00	Alert Production Management Engineering and Inte
1.02C.03.01	Single Frame Processing Pipelines
1.02C.03.02	Association Pipelines
1.02C.03.03	Alert Generation Pipeline
1.02C.03.04	Image Differencing Pipeline
1.02C.03.05	Application Framework for Exposures
1.02C.03.06	Moving Object Pipelines (Day and Night)
1.02C.03.07	Photometric Self-Calibration Pipeline
1.02C.03.08	Astrometric Calibration Pipeline

Organization
WBS Dictionary

- Scope of work for each control account is defined by each CAM and approved by project manger
- Approved scope is listed within the WBS Dictionary

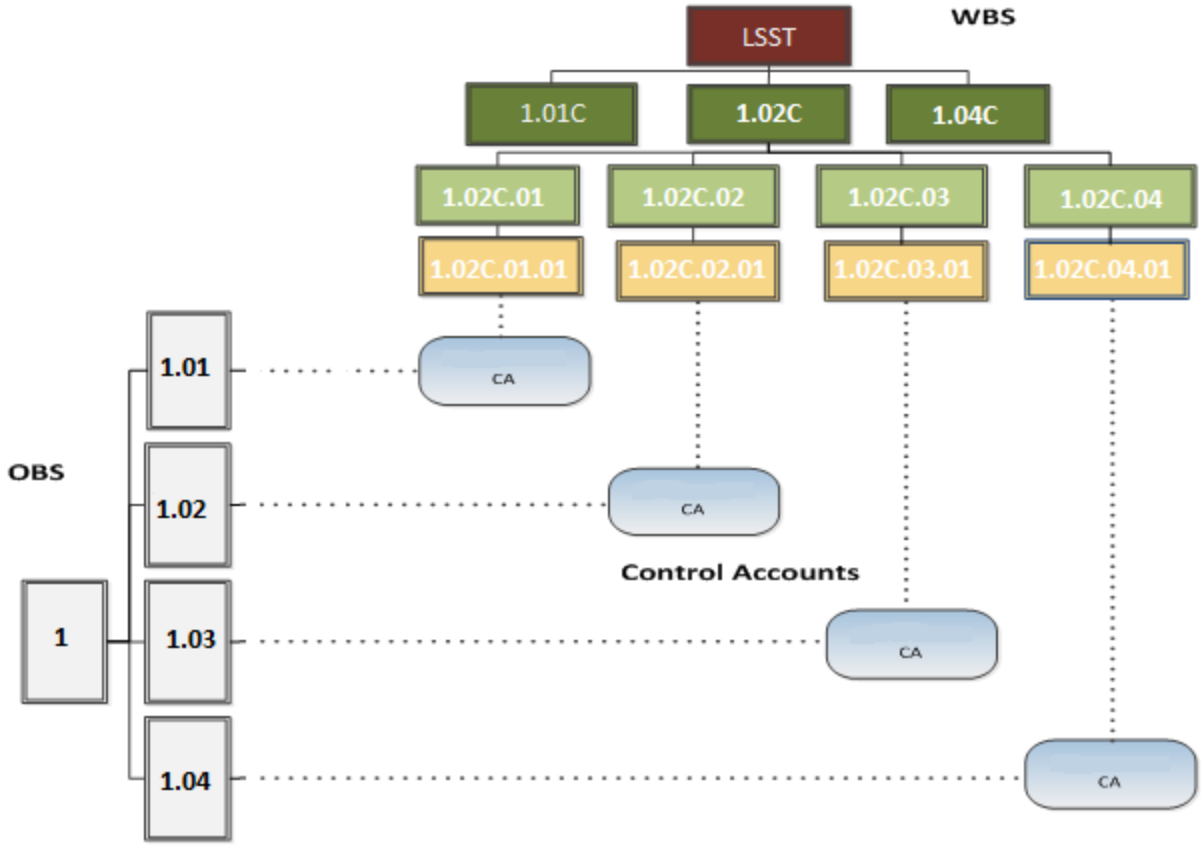
WBS Code	WBS Name
02C	**Data Management Construction**
Notebook Topic	Notebook Description
WBS Definition	This WBS element provides the complete LSST Data Management System (DMS). The DMS has these main responsibilities in the LSST system: Process the incoming stream of images generated by the Camera Subsystem during observing to generate and archive the LSST nightly data products. Provide real-time information on data quality to the Observatory Control System (OCS) during observing. Process the entire survey data each year to produce deep catalogs of objects and precise measurements of those objects. Capture and process calibration images from the Camera Subsystem. Incorporate pipeline improvements and correct errors. Provide a VO-compliant interface that makes publicly available all generated data products.
02C.00	**DM Level 2 Milestones**
Notebook Topic	Notebook Description
WBS Definition	This WBS element defines the Level 2 milestones for this project. These milestones represent the top-level subsystem deliverables and interface milestones with other subystems.

Organization
Organizational Breakdown Structure (OBS)

- LSST's OBS defines the organizational entities where the work will be planned and controlled
- The OBS is hierarchical and is defined at the second level by Institution

Code	Description
1	LSST
1.01	LSST
1.02	SLAC
1.03	IPAC
1.04	NCSA
1.05	UW
1.06	Princeton
1.07	NOAO
1.08	Adler
1.09	UCD
1.10	Arcadis
1.11	UA
1.12	FIU
1.13	RAL
1.14	Purdue
1.15	PFLOW
1.16	REUNA

Organization
Control Account



- A control account is a management control point at which budgets (resource plans) and actual costs are summarized and compared to earned value for management control purposes
- A control account is the unique mapping of one WBS element and one OBS element
- A CAM would be assigned one or more control accounts by Division director or Project Manager
- Information about control accounts and its CAM can found in document RAM (CAM)

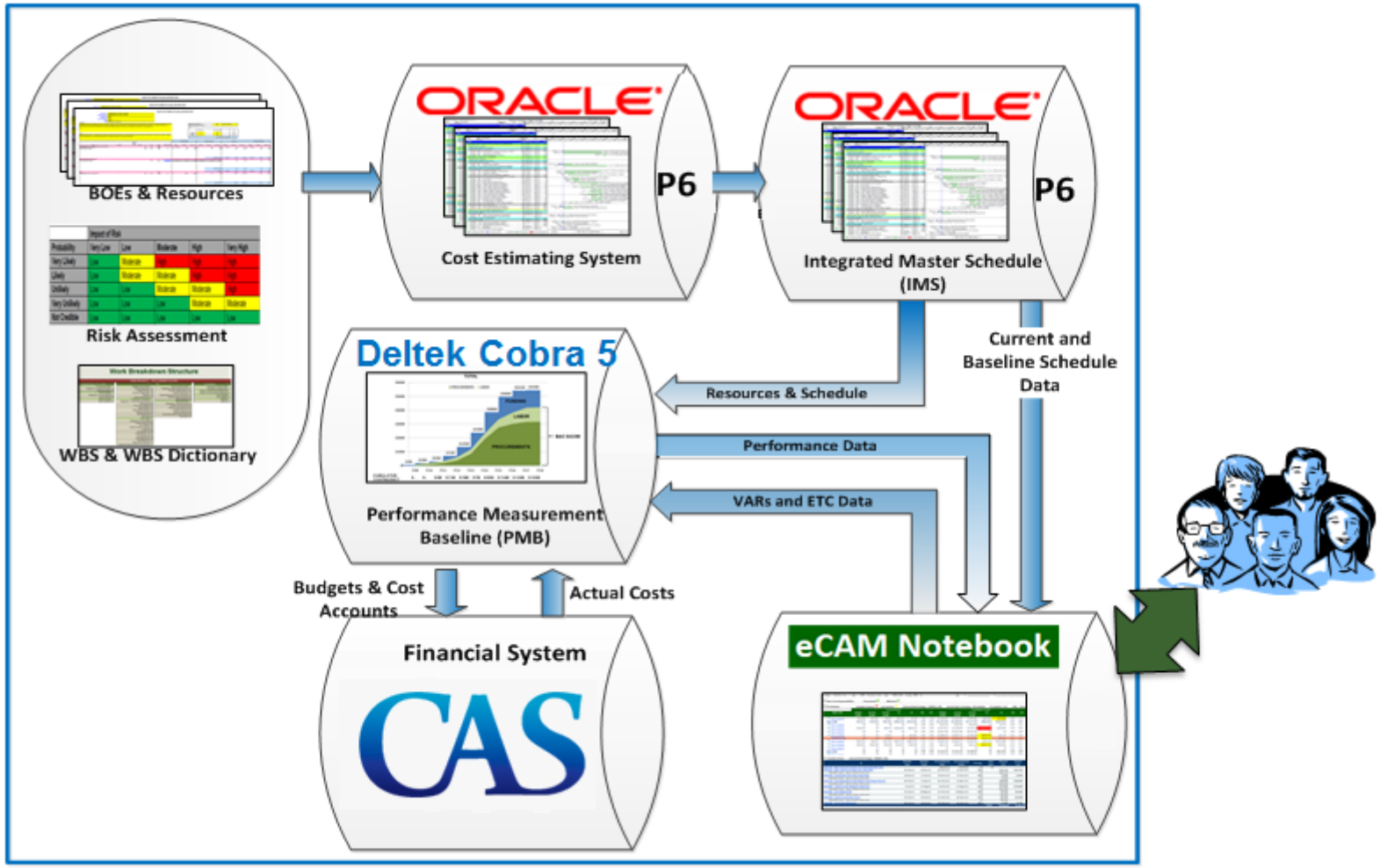
Organization Responsibility Assignment Matrix (RAM)

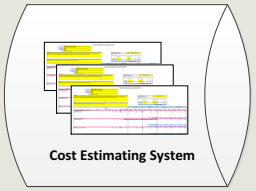
- The mapping of control accounts to CAMs or the OBS is maintained in a Responsibility Assignment Matrix (RAM by CAM or RAM by OBS)
- Sum of budgets for each control account and the CAM who is responsible for it

	CAMs													
Control Accounts	Andrew J	Angeli G	Barr J	Becla J	Chandrasekharan S	Claver C	Delgado F	Freemon M	Gressler W	Hileman E	Jacoby S	Kantor J	Krabbendam V	Krughoff S	Lambert R
1.01C.01.00 / 1.01													$20,748,008		
1.01C.01.00 / 1.05													$1,750,429		
1.01C.01.00 / 1.09													$1,725,071		
1.01C.02.00 / 1.01													$4,908,123		
1.01C.03.00 / 1.01													$2,992,763		
1.01C.04.00 / 1.01													$4,420,823		
1.01C.04.00 / 1.05													$87,619		
1.01C.04.00 / 1.06													$112,265		
1.01C.05.00 / 1.01													$8,300,233		
1.02C.01.01 / 1.01												$6,153,868			
1.02C.01.02 / 1.01												$6,228,467			
1.02C.02.01 / 1.01												$1,848,802			
1.02C.02.02 / 1.01												$1,628,857			
1.02C.03.00 / 1.05														$1,165,846	
1.02C.03.01 / 1.05														$3,702,603	
1.02C.03.02 / 1.05														$178,311	
1.02C.03.03 / 1.05														$128,459	
1.02C.03.04 / 1.05														$2,850,455	
1.02C.03.05 / 1.05														$1,149,553	
1.02C.03.06 / 1.05														$506,453	
1.02C.03.07 / 1.05														$195,697	
1.02C.03.08 / 1.05														$27,231	
1.02C.04.00 / 1.06															
1.02C.04.01 / 1.06															
1.02C.04.02 / 1.06															
1.02C.04.03 / 1.06															

Planning, Scheduling & Budgeting Schedule & Cost Elements

- Process flow for the integration of technical, schedule & cost elements in LSST



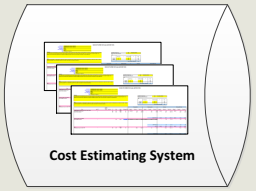


Planning, Scheduling & Budgeting Cost Estimating System [1]

- PMCS refers to all of the project controls tools and processes. The Project schedule is knows as the IMS, or Integrated Master Schedule

- Primavera has been used as the Cost Estimating System. Logically linked tasks in Primavera have associated resource assignments thus producing an optimum and accurate cost estimate that considers budget, technical performance, cost, and risk for the whole project

- Code fields in Primavera facilitate the integration with the EVMS tools, Fast Lane reporting, Cost Book generation, and other data used in Audits and reviews.



Planning, Scheduling & Budgeting Cost Estimating System [2]

- The basis for low level estimates were developed using the following methodologies:
  - Historical Data (HD)--Components that have been designed and built before, with well known performance and associated costs
  - Catalog Prices (CP)--Components that are off-the-shelf and routinely available either from vendors or within the organization, with well-known costs
  - Vendor Quotations (VQ)--Component that must be custom designed and built for which a vendor quotation has been received
  - Engineering Estimate (EE)--An estimate by an expert in the field for which a specific design has not yet been established (also known as Professional Judgment)

Planning, Scheduling & Budgeting
Project Schedule

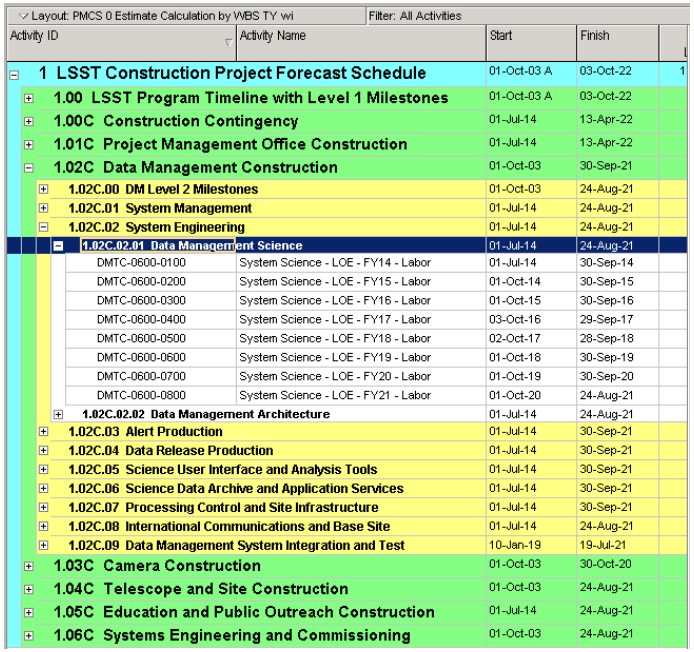
- Since FDR the individual project schedules have been merged into one integrated master schedule
- Only project controls has write access to the baseline and forecast schedules

Layout:LSST EPS

Project ID	Data Date	Project Name	Responsible Manager
ARCHIVE		Archive for month end Baselines and Sta...	LSST Corporation
1 ME 06-14	01-Oct-03	LSST Month End June 2014	Admin-Access-Only
LSST PMB	01-Oct-03	LSST Construction Project PMB	Admin-Access-Only
LSST-PRG		LSST Program	LSST Corporation
LSST-ALL		LSST All Phases	LSST Corporation
LSST-CON		LSST Conceptual Design	LSST Corporation
LSST-PRE		LSST Preliminary Design	LSST Corporation
LSST-FIN		LSST Final Design	LSST Corporation
LSST-CCM		LSST Construction and Commissioning	LSST Corporation
00	01-Oct-03	LSST Program Timeline with Level 1 Milestones	Admin-Access-Only
00C	01-Jul-14	Construction Contingency	Admin-Access-Only
01C	01-Jul-14	Project Management Office Construction	LSST Program Management...
02C	01-Jul-14	Data Management Construction	LSST Data Management
03C	03-Oct-11	Camera Construction	Admin-Access-Only
04C	01-Jul-14	Telescope and Site Construction	LSST Telescope and Site
05C	01-Jul-14	Education and Public Outreach Construction	LSST Education and Public ...
06C	01-Jul-14	Systems Engineering and Commissioning	LSST System Engineering
1	01-Oct-03	LSST Construction Project Baseline Schedule	Read Only Access
LSST	01-Oct-03	LSST Construction Project Forecast Schedule	Read Only Access
Telescope Sar		Telescope Sandbox	LSST Corporation
LCRs		EPS to hold LCRs	LSST Corporation

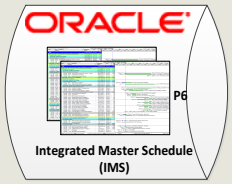
Planning, Scheduling & Budgeting
Project Schedule [1]

- The detailed Integrated Master Schedule (IMS) resides in P6 (Primavera)
- The IMS contains project milestones, discrete tasks, and resource loads.
- The IMS is structured by the WBS and can be summed up to different WBS levels
- The IMS contains sufficient detail to facilitate the calculation of the project critical path



Layout: PMCS 0 Estimate Calculation by WBS TY wi | Filter: All Activities

Activity ID	Activity Name	Start	Finish
1	LSST Construction Project Forecast Schedule	01-Oct-03 A	03-Oct-22
1.00	LSST Program Timeline with Level 1 Milestones	01-Oct-03 A	03-Oct-22
1.00C	Construction Contingency	01-Jul-14	13-Apr-22
1.01C	Project Management Office Construction	01-Jul-14	13-Apr-22
1.02C	Data Management Construction	01-Oct-03	30-Sep-21
1.02C.00	DM Level 2 Milestones	01-Oct-03	24-Aug-21
1.02C.01	System Management	01-Jul-14	24-Aug-21
1.02C.02	System Engineering	01-Jul-14	24-Aug-21
1.02C.02.01	Data Management Science	01-Jul-14	24-Aug-21
DMTC-0600-0100	System Science - LOE - FY14 - Labor	01-Jul-14	30-Sep-14
DMTC-0600-0200	System Science - LOE - FY15 - Labor	01-Oct-14	30-Sep-15
DMTC-0600-0300	System Science - LOE - FY16 - Labor	01-Oct-15	30-Sep-16
DMTC-0600-0400	System Science - LOE - FY17 - Labor	03-Oct-16	29-Sep-17
DMTC-0600-0500	System Science - LOE - FY18 - Labor	02-Oct-17	28-Sep-18
DMTC-0600-0600	System Science - LOE - FY19 - Labor	01-Oct-18	30-Sep-19
DMTC-0600-0700	System Science - LOE - FY20 - Labor	01-Oct-19	30-Sep-20
DMTC-0600-0800	System Science - LOE - FY21 - Labor	01-Oct-20	24-Aug-21
1.02C.02.02	Data Management Architecture	01-Jul-14	24-Aug-21
1.02C.03	Alert Production	01-Jul-14	30-Sep-21
1.02C.04	Data Release Production	01-Jul-14	30-Sep-21
1.02C.05	Science User Interface and Analysis Tools	01-Jul-14	30-Sep-21
1.02C.06	Science Data Archive and Application Services	01-Jul-14	30-Sep-21
1.02C.07	Processing Control and Site Infrastructure	01-Jul-14	30-Sep-21
1.02C.08	International Communications and Base Site	01-Jul-14	24-Aug-21
1.02C.09	Data Management System Integration and Test	10-Jan-19	19-Jul-21
1.03C	Camera Construction	01-Oct-03	30-Oct-20
1.04C	Telescope and Site Construction	01-Oct-03	24-Aug-21
1.05C	Education and Public Outreach Construction	01-Jul-14	24-Aug-21
1.06C	Systems Engineering and Commissioning	01-Oct-03	24-Aug-21



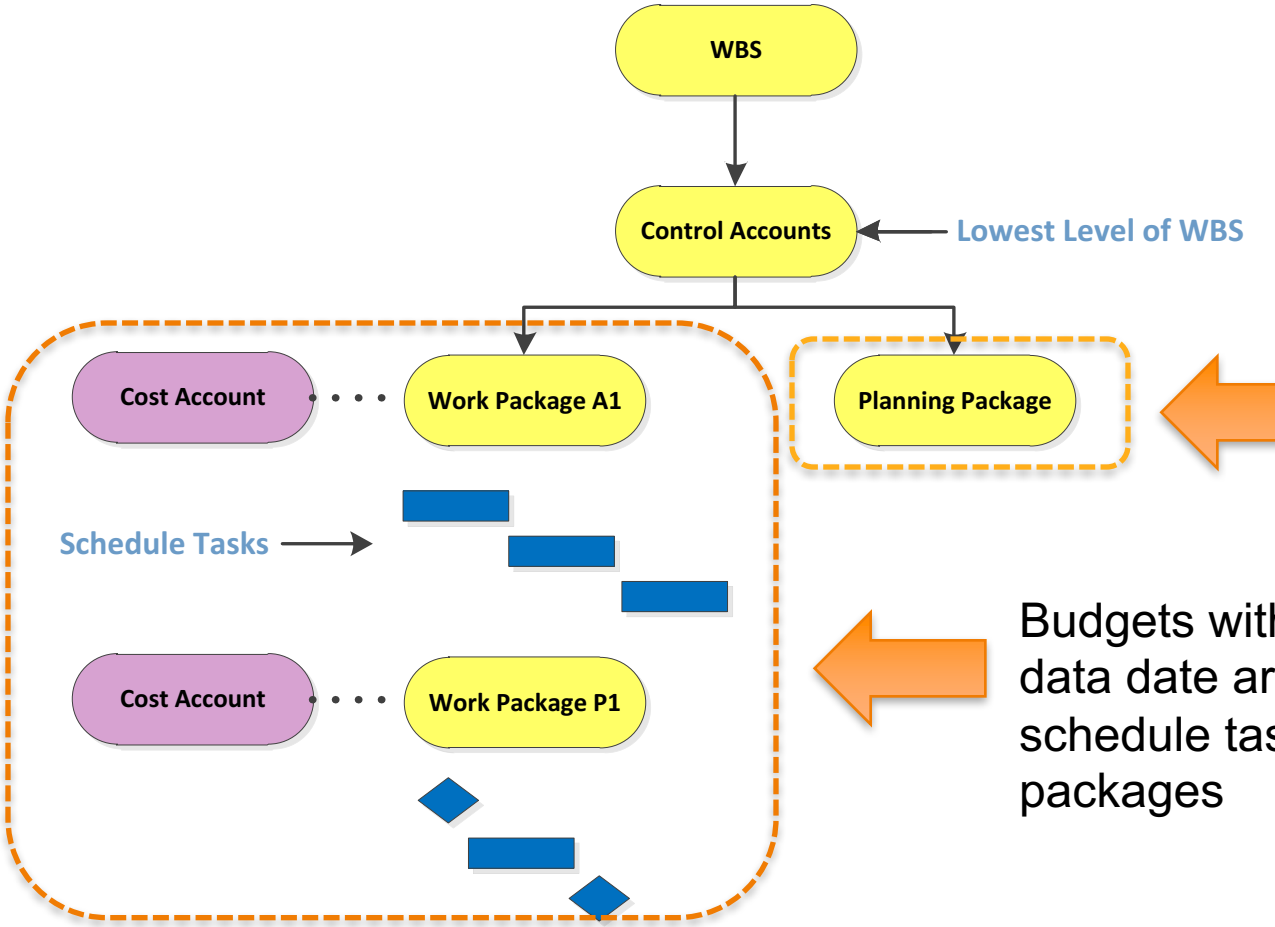
Planning, Scheduling & Budgeting Project Schedule [2]

- The schedule development process is iterative with level of detail and confidence increasing with iterations
- The IMS contains detailed schedule tasks in the near term for work packages and summary tasks (planning packages) for the out years
- As the design matures, summary tasks are expanded into more extensive detail including additional tasks and logic
- CAM is responsible for developing the detailed control account work plans/schedules consisting of coordinated tasks, resources, logic, reporting milestones, and completion criteria as a basis for authorizing work for each control account
- Detail schedules created by CAM are put into P6 by Project Control representatives

Planning, Scheduling & Budgeting
Project Schedule [3]

- Milestones
  - Milestone Levels can be identified by their location in the WBS and by Activity Code Field “Milestone Level”
  - Five levels of Milestones defined for the LSST Project:
    - Level 1 – Reporting to the NSF
    - Level 2 – Reporting to the Project Manager
    - Level 3 – Reporting to the Division Manager
    - Level 4 – Reporting to the WBS Manager
    - Level 5 – Reporting to the CAM
  - Identified in collaboration with the Product Team Leads and Project Management
  - Distributed across project teams and project timeline

Planning, Scheduling & Budgeting Project Schedule [3]

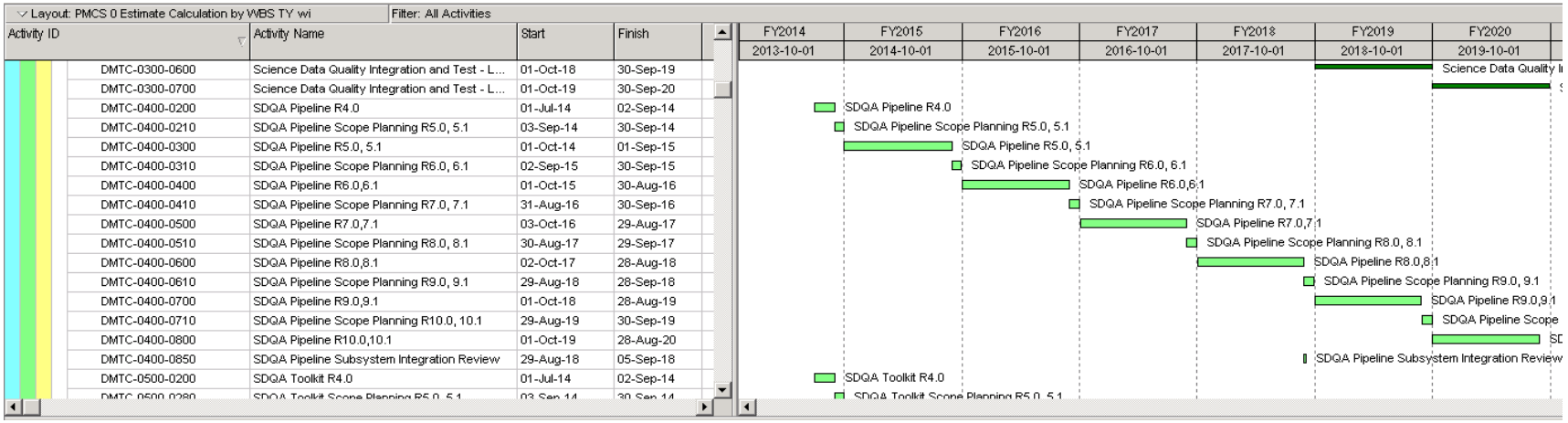


Future budgets beyond 6 months from data date are held in Planning Packages

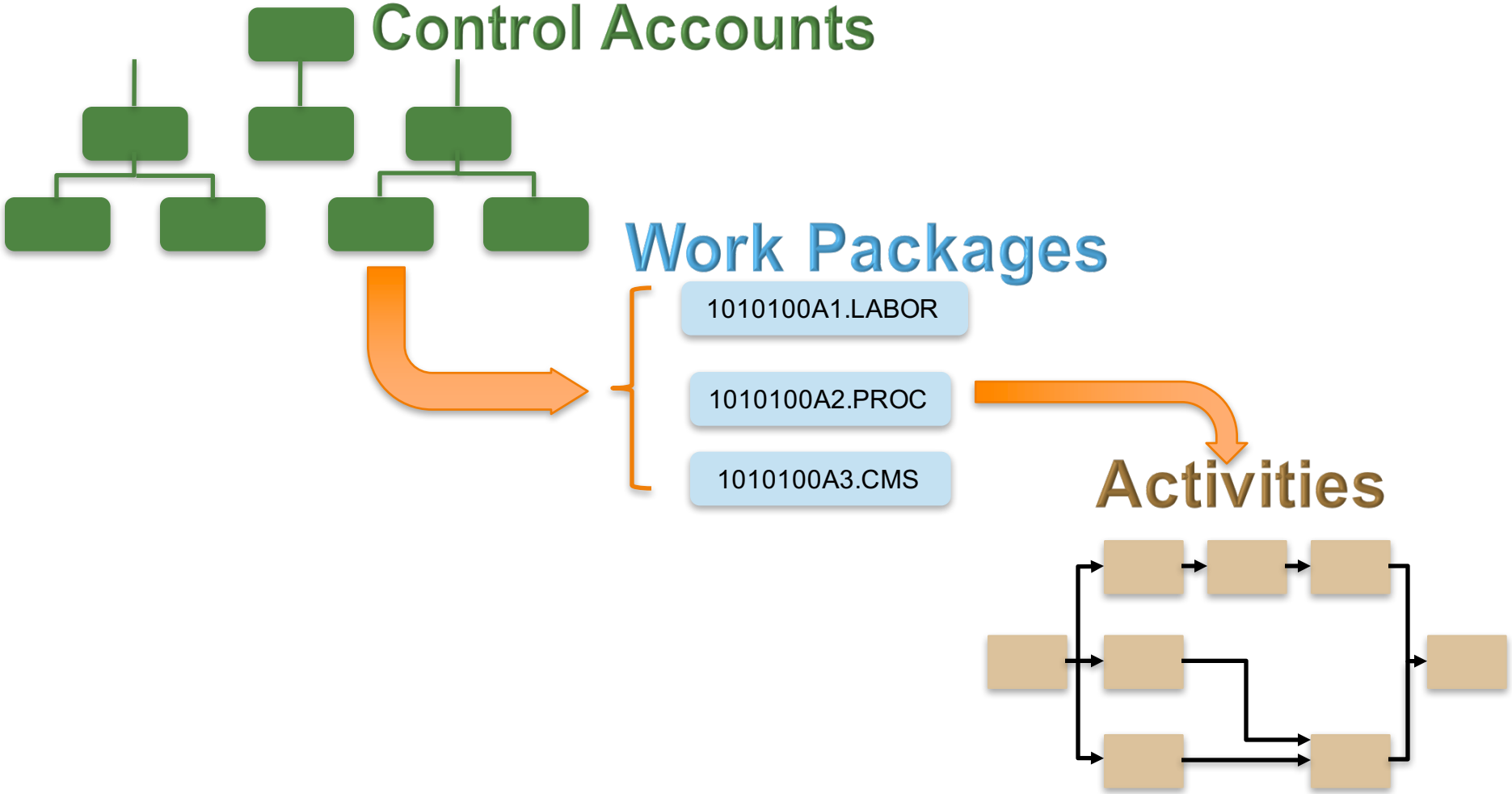
Budgets within 6 months from the data date are broken down into schedule tasks and work packages

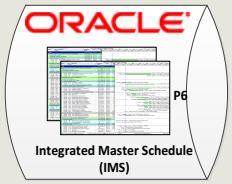
Planning, Scheduling & Budgeting Time-Phased Budgets

- CAM will define each activity's description and duration
- The predecessor and successor for each activity should be defined in order to logically sequence the work
- Resources are assigned to activities per cost information provided in BOE
- With activity, logic, and resource information, project controls will enhance the detail of the schedule in Primavera
- The result of this work is an Integrated Master Schedule (IMS)



Planning, Scheduling & Budgeting
Control Accounts/Work Packages/Activities [1]





Planning, Scheduling & Budgeting
Control Accounts/Work Packages/Activities [2]

- All control accounts managed by CAM consist of work packages and planning packages
- Work packages and planning packages are defined in P6 with activity codes and are only set on resource loaded tasks
- Activities are the detail elements that define work using durations, resources, relationships, and milestones

- Each Work Package must have a unique earned value technique.
  - »A Level of Effort
  - »B Milestone
  - »C % Complete
  - »E 50-50
  - »F 0-100
  - »K Planning Package

% Complete

- When using the Percent Complete EV method, the CAM will report earned value based on an evaluation of the progress to date within the given Work Package.
- The Control Account Manager should maintain documentation that serves as quantifiable backup data to monitor progress.
- Tasks in the IMS that are > 44 days in duration (~2 months) must have at least 4 activity steps to define an objective method in measuring performance.
  - Steps are assigned a weight which is used to calculate % complete
  - It is best practice not to modify steps once the activity is in progress. Doing so can result in negative earned value in the current period.

0-100

- Is used for Work Packages with a duration of one reporting period
- No Earned Value can be claimed until the task is complete
- The advantage of this measurement technique is that there is no subjective evaluation of status required as 100% of the Work Package BAC is claimed as Earned Value when the Work Package is completed.
- Example WP:
- Budget = $10K
- Task Duration = 1 month
- Reporting Period = Month 1 (3 out of 5 tasks completed + 50% of task 4 completed)
- Earned Value (Earned Value = $0K): The Provider will "earn" no value (Earned Value = $5). Regardless of when the work is completed the remaining 50% will not be earned until all the work is finished.

50-50

- Is used for Work Packages with a duration of one or two reporting periods
- 50% is claimed when work is started and 50% when work is completed
- Example WP:
- Budget = $10K
- Task Duration = 1 month
- Reporting Period = Month 1 (3 out of 5 tasks completed + 50% of task 4 completed)
- Earned Value (Earned Value = $5K): The Provider will "earn" 50% (Earned Value = $0) and will show a schedule slippage. If in month 1, all activities associated with the task were completed, the Provider will "earn" all the value associated with the task (Earned Value = $10K)

Level of Effort

- LOE is work scope that is of a general or supportive nature and for which performance measurement cannot be measured or is impracticable to measure.
- Earned value is claimed with the passage of time.
- Guidance: This EV method should be used for "support" activities. A good rule of thumb is deciding whether or not the task can slip. If the activity absolutely starts on schedule and can not be behind schedule, it is best defined as a LOE task. Another appropriate use of this task is when it is impracticable to use discrete measures.

Planning, Scheduling & Budgeting Cobra

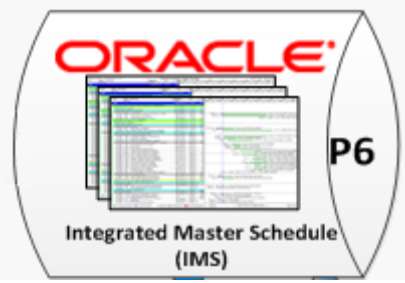
- Deltek's Cobra is the earned value tool
- As a CAM you are not required to know how to use Cobra
- Defines a time-phased budget for each WBS cost element i.e. Establish Performance Measurement Baseline (PMB)
  - Labor, Travel, & Nonlabor
  - Escalation
- Import actuals from CAS accounting system
- Integrates with IMS
- Manage contingency and tracks changes
- Standard EVMS reports, variances, indices, Cost Performance Report (CPR)

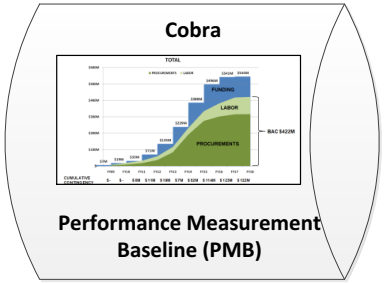
Planning, Scheduling & Budgeting
Cobra Integration Fields

WBS	Activity ID	Activity Name	Institution	Work Package	CAM	Cobra WBS	OBS	EVT	Start	Finish	Budgeted Labor Units	Budgeted Material Cost	Budgeted Total Cost no Contingency
LSST LSST Construction Project Forecast Schedule									01-Jul-14	13-Apr-22	1299976.15	$300,050,884.03	$436,246,700.58
LSST.00C Construction Contingency									01-Jul-14	13-Apr-22	0.00	$78,977,279.75	$78,977,279.75
LSST.01C Project Management Office Construction									01-Jul-14	30-Sep-21	206184.77	$22,641,189.30	$38,635,510.36
LSST.01C.01 LSST Project Office									01-Jul-14	24-Aug-21	157030.77	$7,128,573.00	$20,345,524.89
LSST.01C.01	PMOC-0100-0010	Project Office and Support FY 2 - LOE Labor	LSST	1010100A1.LABOR	Krabbendam V	1.01C.01.00	1.01	A	01-Oct-14	30-Sep-15	16083.10	$0.00	$1,412,625.64
LSST.01C.01	PMOC-0100-0020	Project Office and Support FY 3 - LOE Labor	LSST	1010100A1.LABOR	Krabbendam V	1.01C.01.00	1.01	A	01-Oct-15	30-Sep-16	17917.10	$0.00	$1,498,284.79
LSST.01C.01	PMOC-0100-0030	Project Office and Support FY 4 - LOE Labor	LSST	1010100A1.LABOR	Krabbendam V	1.01C.01.00	1.01	A	03-Oct-16	29-Sep-17	17922.69	$0.00	$1,499,167.19
LSST.01C.01	PMOC-0100-0050	Project Office and Support FY 6 - LOE Labor	LSST	1010100A1.LABOR	Krabbendam V	1.01C.01.00	1.01	A	01-Oct-18	30-Sep-19	17919.89	$0.00	$1,498,724.30
LSST.01C.01	PMOC-0100-0060	Project Office and Support FY 7 - LOE Labor	LSST	1010100A1.LABOR	Krabbendam V	1.01C.01.00	1.01	A	01-Oct-19	30-Sep-20	15217.10	$0.00	$1,378,427.90
LSST.01C.01	PMOC-0100-0070	Project Office and Support FY 8 - LOE Labor	LSST	1010100A1.LABOR	Krabbendam V	1.01C.01.00	1.01	A	01-Oct-20	24-Aug-21	12700.17	$0.00	$1,172,807.96
LSST.01C.01	PMOC-0100-0000	Project Office and Support FY 1 - LOE Labor	LSST	1010100A1.LABOR	Krabbendam V	1.01C.01.00	1.01	A	01-Jul-14	30-Sep-14	2957.50	$0.00	$285,082.12
LSST.01C.01	PMOC-0100-0040	Project Office and Support FY 5 - LOE Labor	LSST	1010100A1.LABOR	Krabbendam V	1.01C.01.00	1.01	A	02-Oct-17	28-Sep-18	17919.81	$0.00	$1,498,712.09
LSST.01C.01	PMOC-0100-0110	Project Office and Support FY 2 - LOE Non...	LSST	1010100A2.PROC	Krabbendam V	1.01C.01.00	1.01	C	01-Oct-14	30-Sep-15	0.00	$418,367.89	$418,367.89
LSST.01C.01	PMOC-0100-0120	Project Office and Support FY 3 - LOE Non...	LSST	1010100A2.PROC	Krabbendam V	1.01C.01.00	1.01	C	01-Oct-15	30-Sep-16	0.00	$422,477.88	$422,477.88
LSST.01C.01	PMOC-0100-0130	Project Office and Support FY 4 - LOE Non...	LSST	1010100A2.PROC	Krabbendam V	1.01C.01.00	1.01	C	03-Oct-16	29-Sep-17	0.00	$424,464.59	$424,464.59
LSST.01C.01	PMOC-0100-0150	Project Office and Support FY 6 - LOE Non...	LSST	1010100A2.PROC	Krabbendam V	1.01C.01.00	1.01	C	01-Oct-18	30-Sep-19	0.00	$508,206.28	$508,206.28
LSST.01C.01	PMOC-0100-0160	Project Office and Support FY 7 - LOE Non...	LSST	1010100A2.PROC	Krabbendam V	1.01C.01.00	1.01	C	01-Oct-19	30-Sep-20	0.00	$572,257.29	$572,257.29

Planning, Scheduling & Budgeting
Cobra, Primavera & CAS

- P6 schedule is loaded into Cobra creating the performance measurement baseline (PMB)
- The PMB is used for calculating and reporting performance measurements
- Planned Value (PV) for each work package is calculated by Cobra and authorized by project manager
- PV and charge numbers are loaded into our financial system (CAS)
- Actual cost (AC) for both labor and non-labor is collected in CAS against each work package





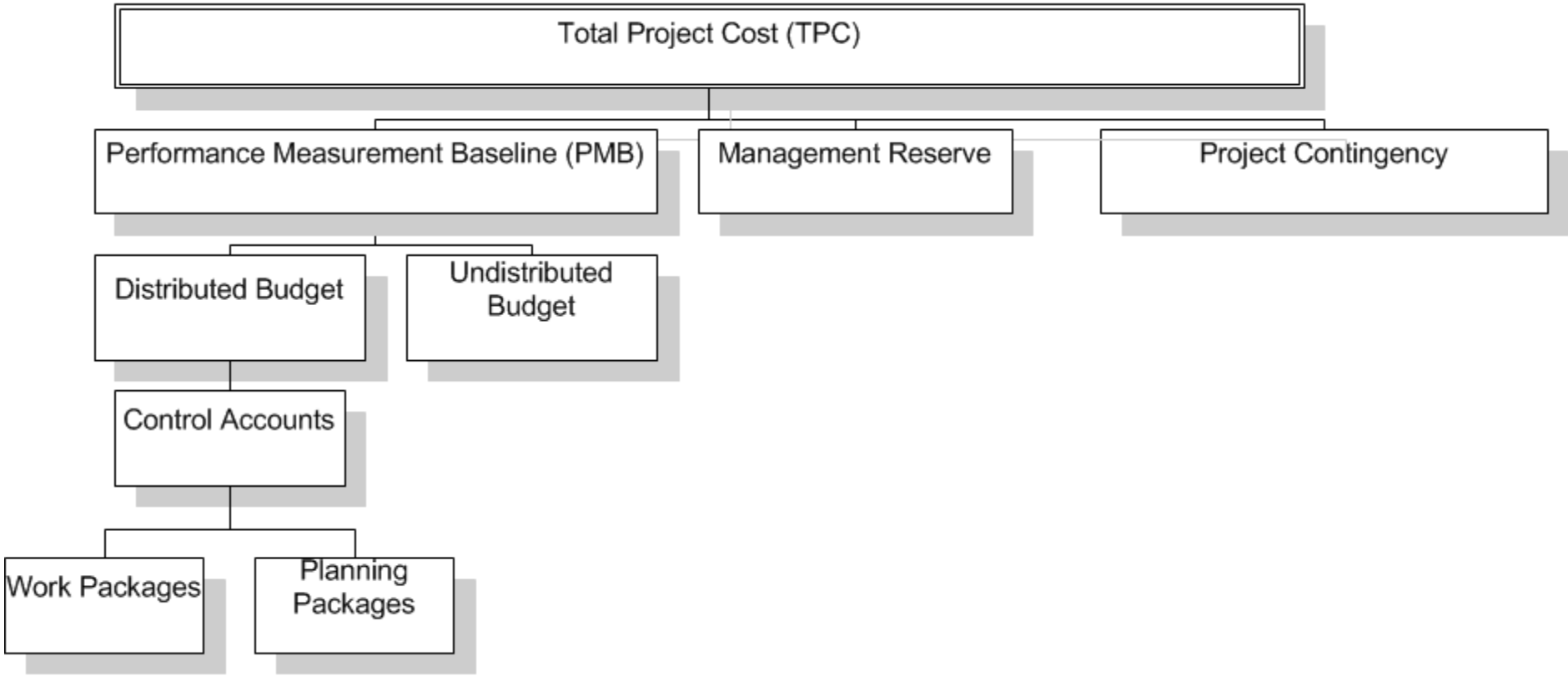
Planning, Scheduling & Budgeting
Work Authorization

- The work authorization is for the lifecycle of the project
- The work authorization represents the agreement between the PM and CAM to deliver the scope at budget and schedule
- Funding will be authorized based on schedule status and funding availability
- LSST work authorization will eventually reside in an eCAM system
- Any change to work authorization will be implemented through the change control process
- Work authorization reports will be distributed to cams for signatures very soon.

Planning, Scheduling & Budgeting
Contingency and Undistributed Budget [1]

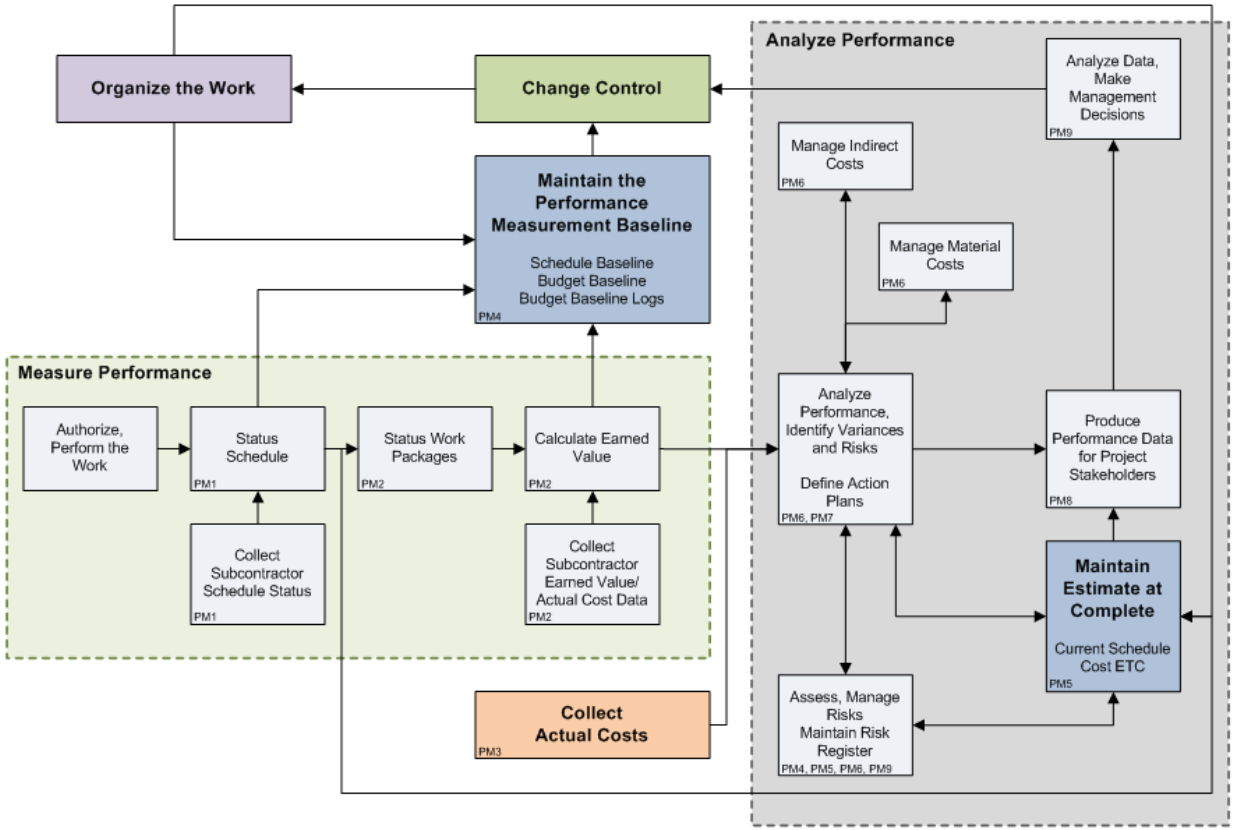
- Expenditures of contingency are authorized by the Project Manager and NSF
- Contingency can be transferred from Contingency to a control account through a LCR
- Undistributed Budget (UB) is a temporary holding place for budget of approved work scope not yet distributed at the control account level

Planning, Scheduling & Budgeting
Contingency, Management Reserve and Undistributed Budget [2]



Execution

- Execution Phase
  - Authorize the Work
  - Measure Performance
  - Maintain PMB and EAC
  - Analyze Performance



Analysis and Management Reporting Monthly Status

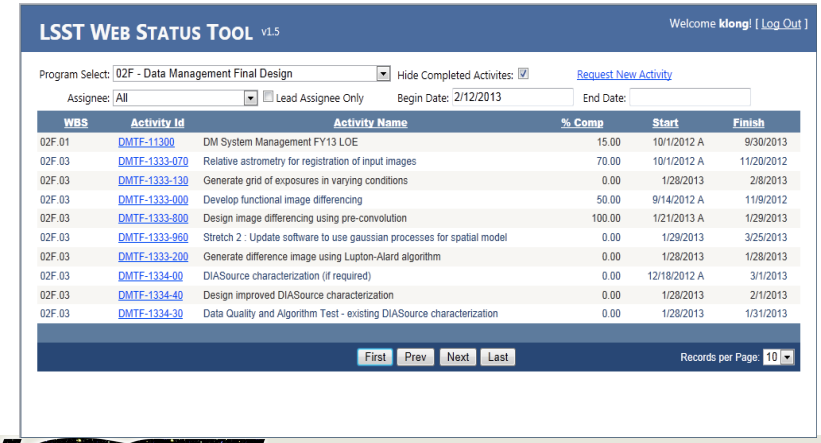
- Control Account Managers (CAMs) on the LSST Project have been delegated responsibility to deliver certain scope for a agreed-upon cost on a set schedule, safely and with high quality
- The current Integrated Master Schedule (IMS) is the forecast schedule that is statused monthly and then compared to the Baseline schedule
- CAMs provide monthly progress status on all remaining and in-progress schedule activities on our web status tool
- This status update together with financial information from accounting forms the basis for project performance measurement against the Performance Measurement Baseline and is reported to NSF
- Statusing a schedule activity means recording the Actual Start, Actual Finish, work progress, and estimated finish as of a certain date which is referred to as the data date

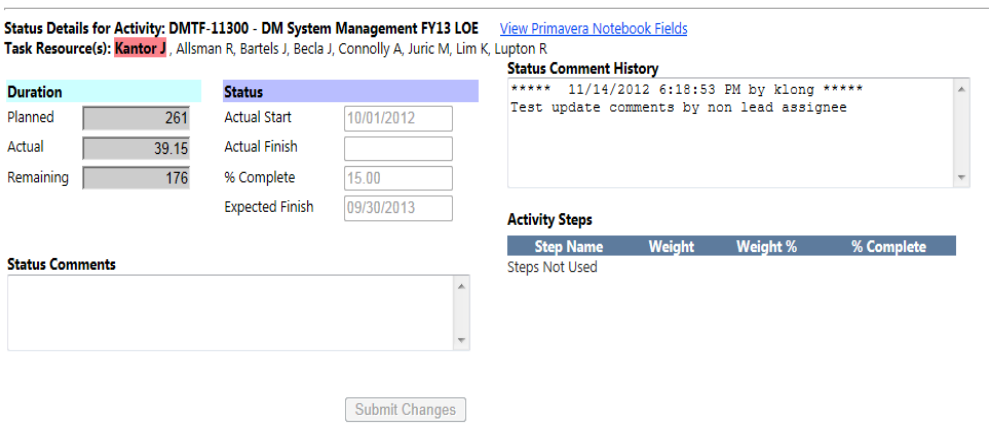
Analysis and Management Reporting Monthly Status

- Here is the information a control account manager needs to provide in order to determine the status of the remaining and in-progress activities:
  - Actual start dates for activities begun during the status period
  - Actual finish dates for activities completed during the status period
  - Actual finish dates for milestones accomplished during the status period
  - Forecast completion dates for milestones that cannot complete as planned (or that are expected to complete early)
  - Physical percent complete of activities started but not complete
  - Expected finish dates for activities previously started but not yet completed

Web Status

- LSST uses a web interface to collect status from the CAMs https://www.lsstcorp.org/LSSTStatus/Login.aspx
- Actual Start dates for activities and milestones started in the status period
- Actual finish dates for activities and milestones completed in the status period
- Physical percent complete for all activities that are in progress. For activities that use Activity steps each step will be statused and activity physical complete will be calculated based on the weight of each step
- Expected Finish dates for all in progress activities
- The status comments section of the web status tool updates directly to Primavera's notebook topic "Status Report"

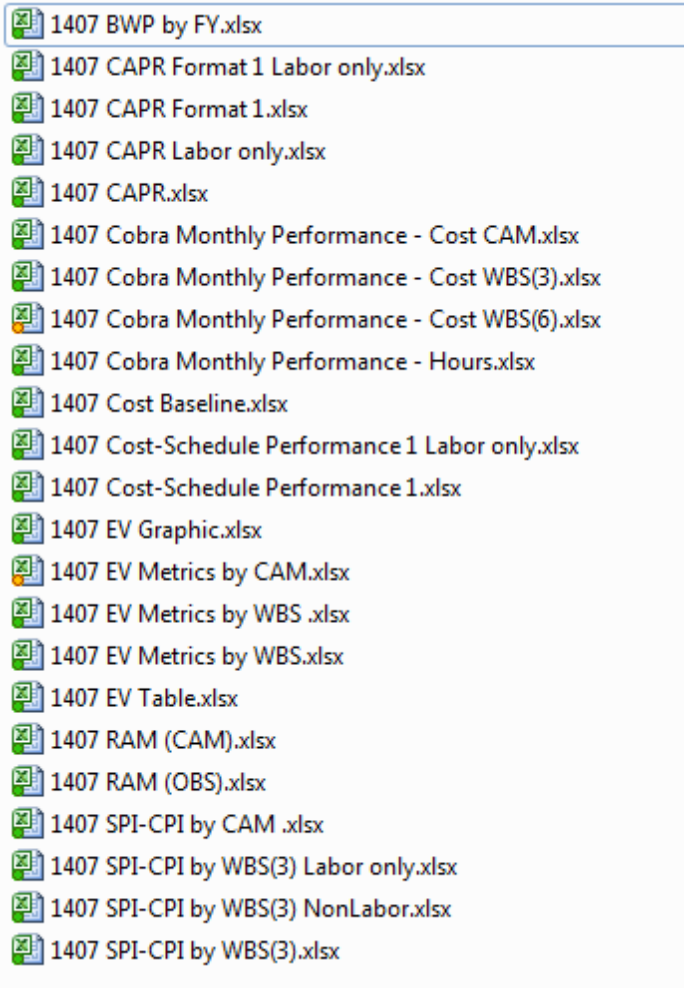




Analysis and Management Reporting Reporting

- Cobra will be used to gather actual costs from CAS and status information from the forecast schedule
- Cobra will calculate monthly performance values and generate monthly EVMS Report
- P6 schedule data and Cobra EVMS data will be integrated in eCAM notebook for analysis
- Monthly EVMS reports are published on Docushare and available to both CAMs and management team
  - 1.0 Project Management\f. Project Schedules, Work Packages, and WBS\LSST Project Data (WBS, Project Schedules, Estimates)\Project Database Backups\Monthly Reporting\LSST Construction Reporting\2014\1407
- Both CAMs and management team use these reports to review performance measurement data on cost, schedule, and work scope, and to assess the impact of these conditions on the baseline and future work

Analysis and Management Reporting Sample Reports



Analysis and Management Reporting Analysis

- Key data a CAM should review in monthly EVMS Report:
  - EV (Earned Value)
  - AC (Actual Cost)
  - Schedule Variance (Favorable ≥ 0, Unfavorable < 0)
    - » SV = EV – PV
  - Schedule Efficiency (Favorable > 1.0, Unfavorable < 1.0)
    - » Schedule Performance Index (SPI) = EV / PV
  - Cost Variance (Favorable ≥ 0, Unfavorable < 0)
    - » CV = EV – AC
  - Cost Efficiency (Favorable > 1.0, Unfavorable < 1.0)
    - » Cost Performance Index (CPI) = EV / AC
  - Estimate At Completion
    - » EAC = ETC+AC
  - Variance At Completion (Favorable ≥ 0, Unfavorable < 0)
    - » VAC = BAC – EAC

Analysis and Management Reporting Analysis

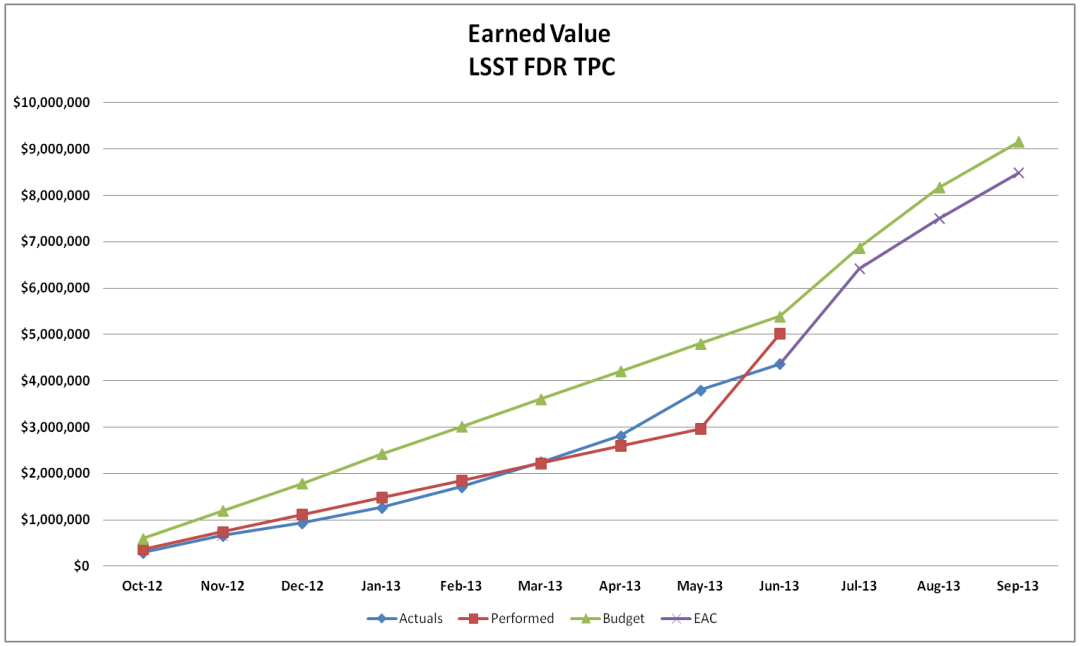
- Schedule Variance & Cost Variance in monthly EVMS Report are measured against Variance Analysis Thresholds table
- CAMs are responsible for writing narratives, including corrective actions, for any Schedule Variance or Cost Variance that is over Red Thresholds at control account level
- CAMs need to provide description of the issue for any Schedule Variance or Cost Variance that is over Yellow Thresholds

Variance Thresholds		
Cumulative CV or SV	>= 75k < $100k	>= $100k
Cumulative CPI or SPI	>= 5% < 10%	>= 10%
Schedule Float	>= 20% of Baseline Total Float	>= 50% of Baseline Total Float

Analysis and Management Reporting Analysis

- At least annually, the project develops a comprehensive bottoms-up Estimate To Complete (ETC)
- Actuals to date + ETC = EAC (Estimate At Completion)
- This comprehensive bottoms-up ETC is reviewed by management and judgment is applied to the EAC as it occurs and thus improves and validates the accuracy of the reported EAC

Analysis and Management Reporting Sample Reports



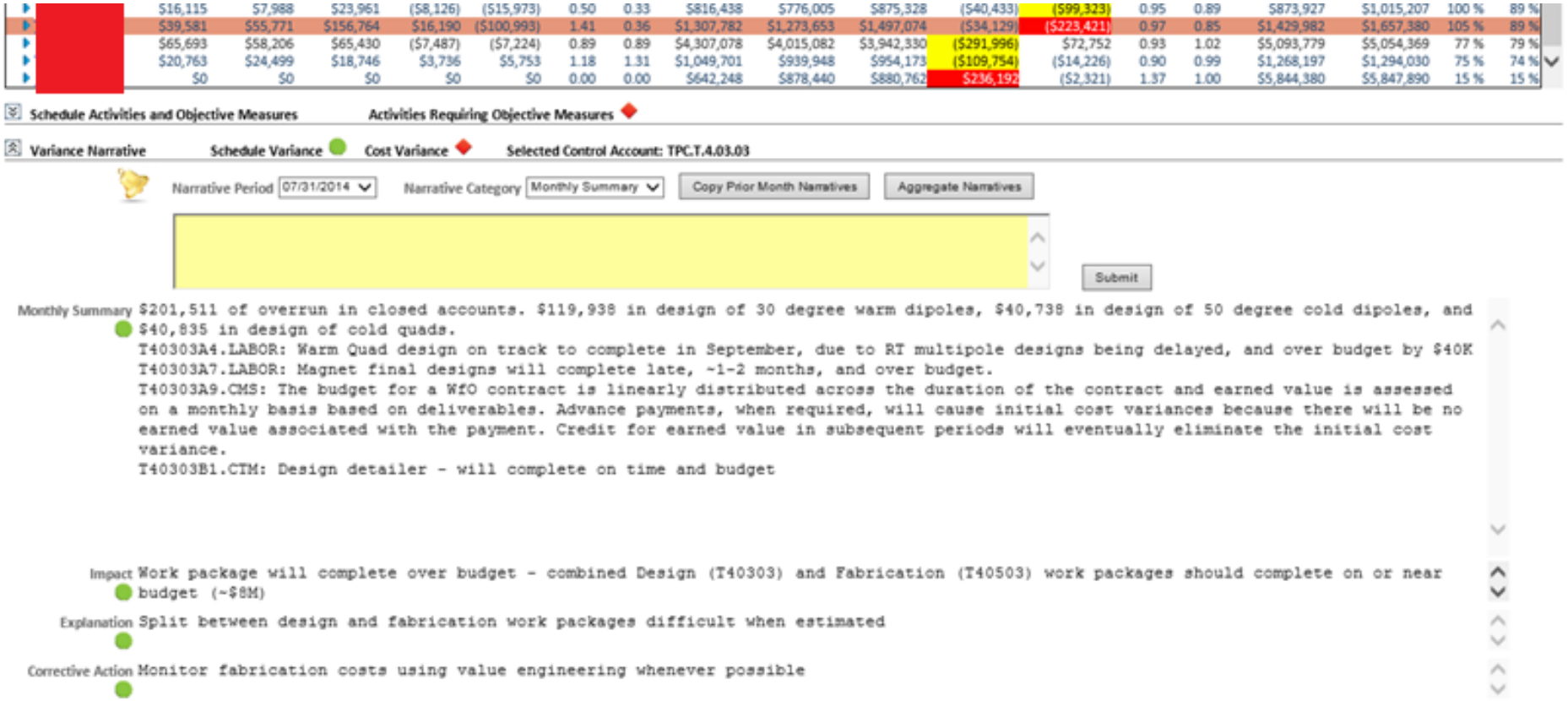
LSST Project as of 30 Jun 2013	Current Period ($k)	Cum-to-date ($k)
Plan (BCWS)	$ 595	$ 5,395
Actual (ACWP)	$ 564	$ 4,364
Earned (BCWP)	$ 2,051	$ 5,015
CV	$ 1,487	$ 651
SV	$ 1,456	$ (381)
CPI	3.64	1.15
SPI	3.45	0.93
Budget at Complete (BAC)		$ 9,360
Calculated Estimate at Completion (EAC_{calc})		$ 7,553
Management Estimate at Completion (EAC_{mgmt})		$ 7,553
Contingency		$ -
Total Project Cost (TPC)		$ 9,360
Planned % Complete		57.6%
Earned % Complete		53.6%
BAC-to-go (Work Remaining)		$ 4,346
Cost Contingency as a % of BAC-to-go		0.0%
Remaining Duration (months)		3
Management Estimate Remaining Duration (months)		3
Schedule Contingency (months)		0
Schedule Contingency (% of remaining duration)		0.0%

	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
	BUDGETED COST		ACTUAL	VARIANCE		BUDGETED COST		ACTUAL	VARIANCE		BUDGETED	ESTIMATED	VARIANCE
	WORK SCHEDULED	WORK PERFORMED	COST WORK PERFORMED	SCHEDULE	COST	WORK SCHEDULED	WORK PERFORMED	COST WORK PERFORMED	SCHEDULE	COST			
FDP LSST Final Design Plan	**595,418**	**2,051,245**	**563,962**	**1,455,828**	**1,487,283**	**$ 5,395,321**	**$ 5,014,596**	**$ 4,363,535**	**$ (380,725)**	**$ 651,061**	**$ 9,154,922**	**$ 8,490,280**	**$ 664,642**
FDP.01 Project Management Office Final Design	194,553	413,775	102,709	219,223	311,066	$ 1,750,976	$ 1,750,976	$ 1,360,309	$ 0	$ 390,667	$ 2,334,634	$ 1,943,968	$ 390,667
FDP.02 Data Management Final Design	80,965	736,833	218,024	655,868	518,809	$ 765,251	$ 736,833	$ 1,232,345	$ (28,418)	$ (495,511)	$ 2,834,582	$ 3,315,255	$ (480,673)
FDP.04 Telescope and Site Final Design	166,363	569,932	130,140	403,569	439,791	$ 1,497,266	$ 1,144,959	$ 805,293	$ (352,307)	$ 339,666	$ 2,127,497	$ 1,789,088	$ 338,408
FDP.05 Education and Public Outreach Final Desig	39,471	132,722	30,713	93,251	102,009	$ 355,236	$ 355,236	$ 249,380	$ (0)	$ 105,856	$ 489,419	$ 383,563	$ 105,856
FDP.06 Systems Engineering Final Design	114,066	197,983	82,376	83,917	115,607	$ 1,026,593	$ 1,026,593	$ 716,209	$ -	$ 310,384	$ 1,368,790	$ 1,058,406	$ 310,384

Analysis and Management Reporting Management Action

- The management team and CAMs will review any or all of the following items together on a monthly basis (monthly status meeting):
  - CPI/SPI trends
  - Variances and variance analysis and corrective actions
  - Estimates at completion
  - Critical path activity performance
  - Project personnel and staffing
  - Project baseline change actions
  - Contingency (used and remaining)
  - Risk strategies

Variance Narratives



	$16,115	$7,988	$23,961	($8,126)	($15,973)	0.50	0.33	$816,438	$776,005	$875,328	($40,433)	($99,323)	0.95	0.89	$873,927	$1,015,207	100 %	89 %
	$39,581	$55,771	$156,764	$16,190	($100,993)	1.41	0.36	$1,307,782	$1,273,653	$1,497,074	($34,129)	($223,421)	0.97	0.85	$1,429,982	$1,657,380	105 %	89 %
	$65,693	$58,206	$65,430	($7,487)	($7,224)	0.89	0.89	$4,307,078	$4,015,082	$3,942,330	($291,996)	$72,752	0.93	1.02	$5,093,779	$5,054,369	77 %	79 %
	$20,763	$24,499	$18,746	$3,736	$5,753	1.18	1.31	$1,049,701	$939,948	$954,173	($109,754)	($14,226)	0.90	0.99	$1,268,197	$1,294,030	75 %	74 %
	$0	$0	$0	$0	$0	0.00	0.00	$642,248	$878,440	$880,762	$236,192	($2,321)	1.37	1.00	$5,844,380	$5,847,890	15 %	15 %

Schedule Activities and Objective Measures Activities Requiring Objective Measures

Variance Narrative Schedule Variance Cost Variance Selected Control Account: TPC.T.4.03.03

Narrative Period 07/31/2014 Narrative Category Monthly Summary Copy Prior Month Narratives Aggregate Narratives Submit

Monthly Summary
$201,511 of overrun in closed accounts. $119,938 in design of 30 degree warm dipoles, $40,738 in design of 50 degree cold dipoles, and $40,835 in design of cold quads.
T40303A4.LABOR: Warm Quad design on track to complete in September, due to RT multipole designs being delayed, and over budget by $40K
T40303A7.LABOR: Magnet final designs will complete late, ~1-2 months, and over budget.
T40303A9.CMS: The budget for a WfO contract is linearly distributed across the duration of the contract and earned value is assessed on a monthly basis based on deliverables. Advance payments, when required, will cause initial cost variances because there will be no earned value associated with the payment. Credit for earned value in subsequent periods will eventually eliminate the initial cost variance.
T40303B1.CTM: Design detailer - will complete on time and budget

Impact
Work package will complete over budget - combined Design (T40303) and Fabrication (T40503) work packages should complete on or near budget (~$8M)

Explanation
Split between design and fabrication work packages difficult when estimated

Corrective Action
Monitor fabrication costs using value engineering whenever possible

Analysis and Management Reporting Management Action

- Corrective actions are reviewed by project management and either approved for implementation or rejected
- Rejection can be due to several factors such as the prohibitive cost of the plan, the need to rework the plan, or a corrective action is not required (i.e. the variance may be self-correcting)
- By reviewing the variance narratives at the monthly project status meeting, project management will be able to see the progress of the corrective actions

Change Control
Change Control Process

- Changes to the PMB are authorized through the change control process
- Each candidate change is documented in a Project Change Request (LCR) which defines the impact and justification of the change and provides the basis for change
- A Change Control Board advises the Project Manager on the disposition of each LCR (adoption, rejection, etc.)
- The magnitude of the change determines the approval requirements as defined in the LSST Configuration Management Plan
- Changes will be implemented in Primavera and Cobra by Project Controls. Details of the changes will be communicated by CAMs in excel files, emails with detailed instructions, or sandbox schedules.

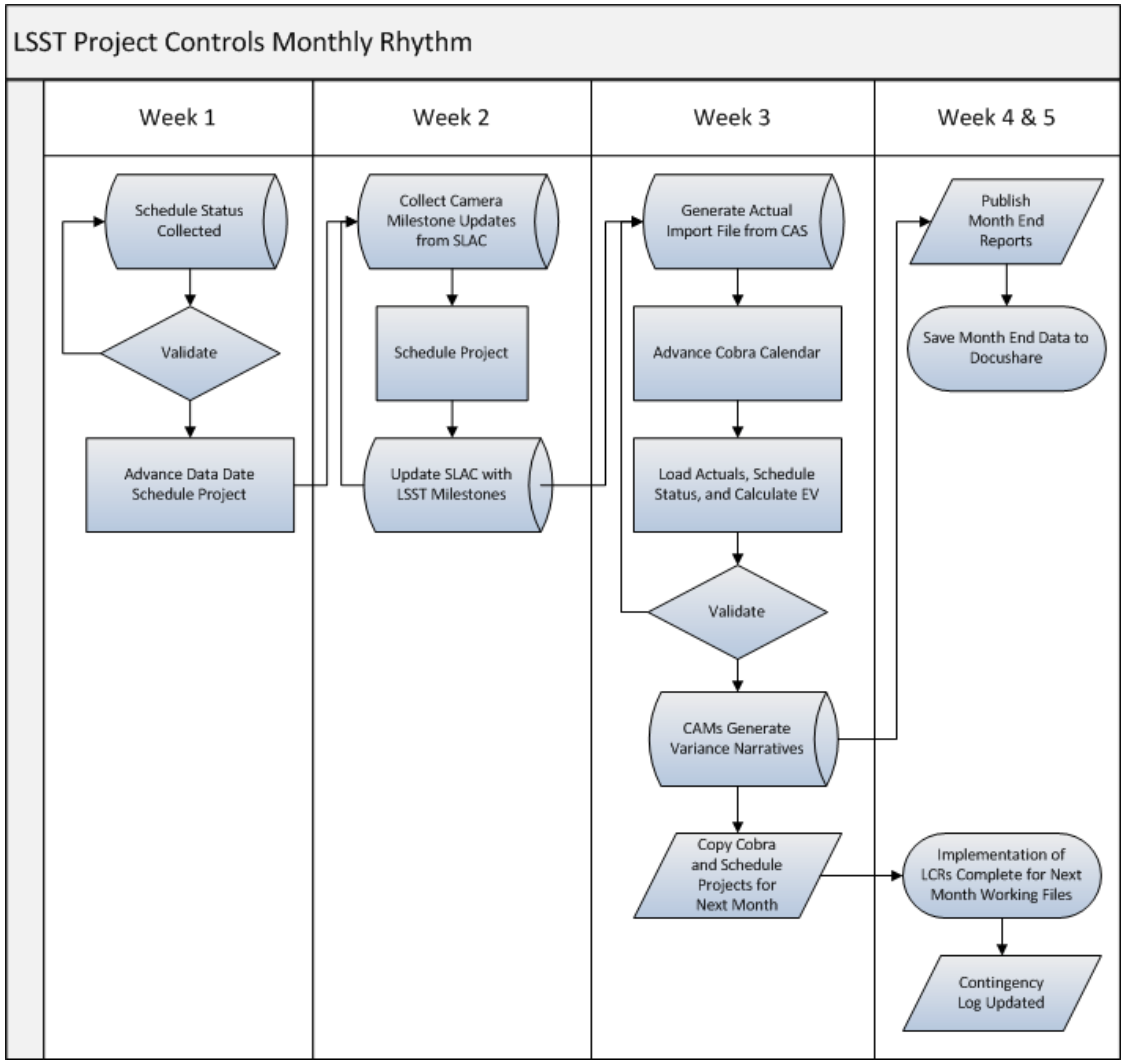
Change Control
Change Control Process

- The CCB through the project management must ensure consistency of change to all three areas: cost, schedule and technical.
- Project controls will determine the cost and schedule impact of a proposed change in Primavera and Cobra.
- Each LCR that has a Cost and or schedule impact will be modelled in Primavera under a project named after the LCR being evaluated.
- Each LCR will be evaluated individually to understand the true nature of the cost and schedule impact. Each activity affected by the change will be flagged using an Activity code field and the LCR number.
- Each LCR that receives the appropriate final approval based on its classification is implemented by Project Controls. The change requested in the LCR is incorporated into the Cost and Schedule Baselines.

Change Control Examples

- Examples trigger LCR:
  - Changes to the PMB for modifying work plans
  - Changes to the PMB for converting planning packages to work packages
  - Changes to the PMB for refinement of preliminary estimates and/or plans
  - Changes to the PMB for externally driven changes (i.e., request from NSF)
  - Scope, schedule, and budget transfers between control accounts
  - Changes to the work approach that change the control account scope or BAC
  - Future rate changes significant enough to warrant update
  - Funding revisions that affect resource availability
  - Adjusting contract budget values to reflect negotiated values
  - Adjusting material budgets to reflect modifications after design phases
  - Change in make/buy plans
- LCRs Cannot
  - Change historical data, unless categorized as an administrative correction
  - Make changes to current period data. All LCRs should affect >= current period + 1 month.
  - Release remaining amounts of budget to Contingency

PMCS Process Flow Diagram



Next Steps

- Develop systems for increasing visibility to schedule milestones, risks, and major procurements
- Conduct continuous CAM Training
- Begin Rolling Wave planning
- Implement eCAM tool for reporting and schedule tracking.

CAM INTERVIEW SAMPLE QUESTIONS

- Discuss the CAM's responsibilities:
- Would you please tell me about your area of responsibility on the program?
- How long have you been in this position?
- Is your time totally dedicated to this program, or do you also work on other programs?
- Please show me how you fit into the organization and to whom you report?
- To whom do you report and what are your responsibilities to this person?
- How do you know the performance status of their work?
- For how many control accounts are you responsible?
- What is a "Control Account"? How many control accounts are you responsible for?
- What is the total dollar value of your control accounts?