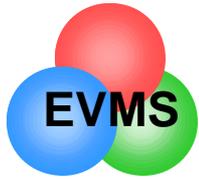


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# Basic Earned Value Management for Program Managers

Eleanor Haupt  
ASC/FMCE



# Training Objectives

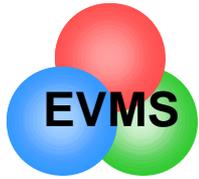
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- Understand basic concepts
- How to evaluate performance
- How to manage using Earned Value

need to  
answer:

does EVMS =

common sense project  
management???

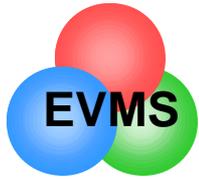


# What We'll Cover...

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- Who, what, where, when and why
- Basic EVMS terms
- Earned value and the project management cycle
  - Planning
  - Executing
  - Controlling
- Managing with earned value data
- Closing Thoughts
- References (for further reading)



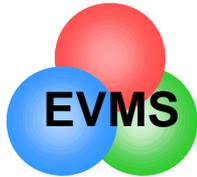


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Who, What, Where, When

&

Why

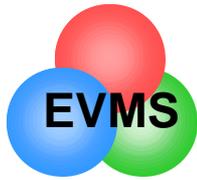


# Why use EVMS?

---

## Life without EVMS

- Given:
  - total budget of \$100,000
  - 12 month effort
  - produce 20 units
- Status:
  - spent to date: \$64,000
  - time elapsed: 6 months
  - units produced: 8 complete, 2 partial
- **How are you doing, and how do you know how you are doing?**
- **How far along are you? (64%, 50%, >40%)**

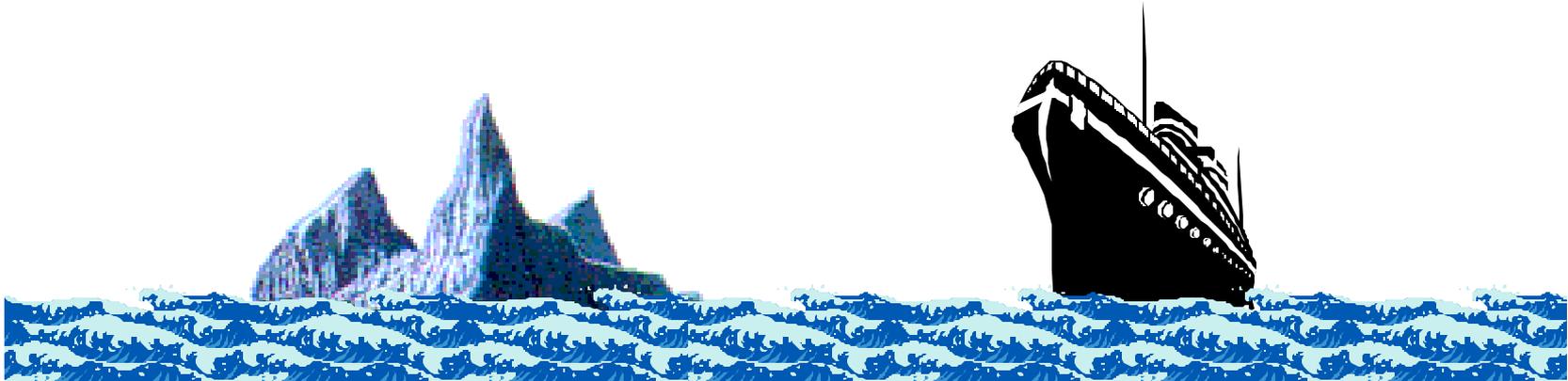


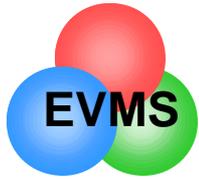
# Why do we need Early Warning?

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Course corrections are easier  
when you have time to make  
small adjustments

It's too late when you're this  
close to the iceberg!

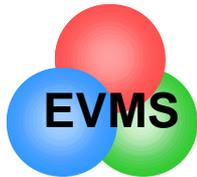




# Why use EVMS?

---

- Early and accurate identification of trends and problems
- Accurate picture of contract status
  - cost, schedule, and technical
- Basis for course correction
- Supports mutual goals of contractor and customer
  - bring project in on schedule and cost

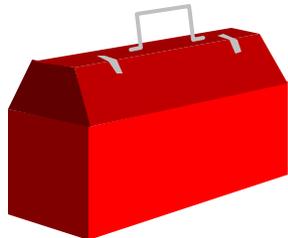
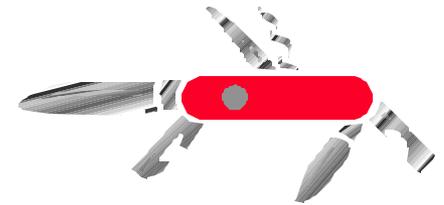


# What is EVMS?

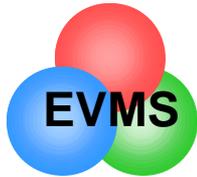
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**EVMS** is the primary project management tool...

that integrates the **technical**, **schedule**, and **cost** parameters of the contract.



The **project manager** is the primary tool in the EVMS toolbox.

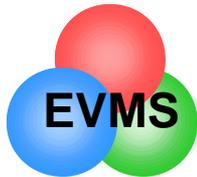


# What is the process?

---

- The contractor establishes a management control system
  - May be required to show that system meets 32 criteria
- An integrated baseline plan is established
  - work is defined, scheduled, and resources are allocated
- Work and resources are driven down to lowest level for execution
- A work authorization system is set up that controls changes to the baseline
- Budgets are “earned” as work is completed = EARNED VALUE
- Status provided against baseline
  - schedule and cost variances are isolated
- Problem assistance
  - early warning
  - corrective plans
- Early insight provided into final estimated cost





# Who's Who in EVMS

- Primary Users

Program/Project Managers  
Technical Staff and IPTs



- Primary Implementers

EVMS specialists  
control account administrators

- Executive Agent  
(compliance)

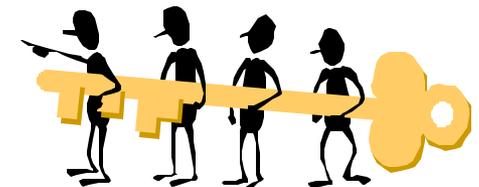
Defense Contract Management  
Command (DCMC) (EVMS Center)

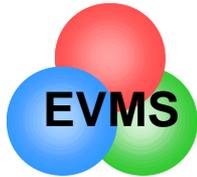
- DoD Policy

OSD/AT&L (SA/PM)

- Air Force Policy

SAF/AQX

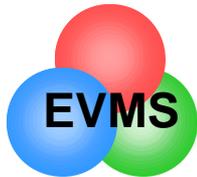




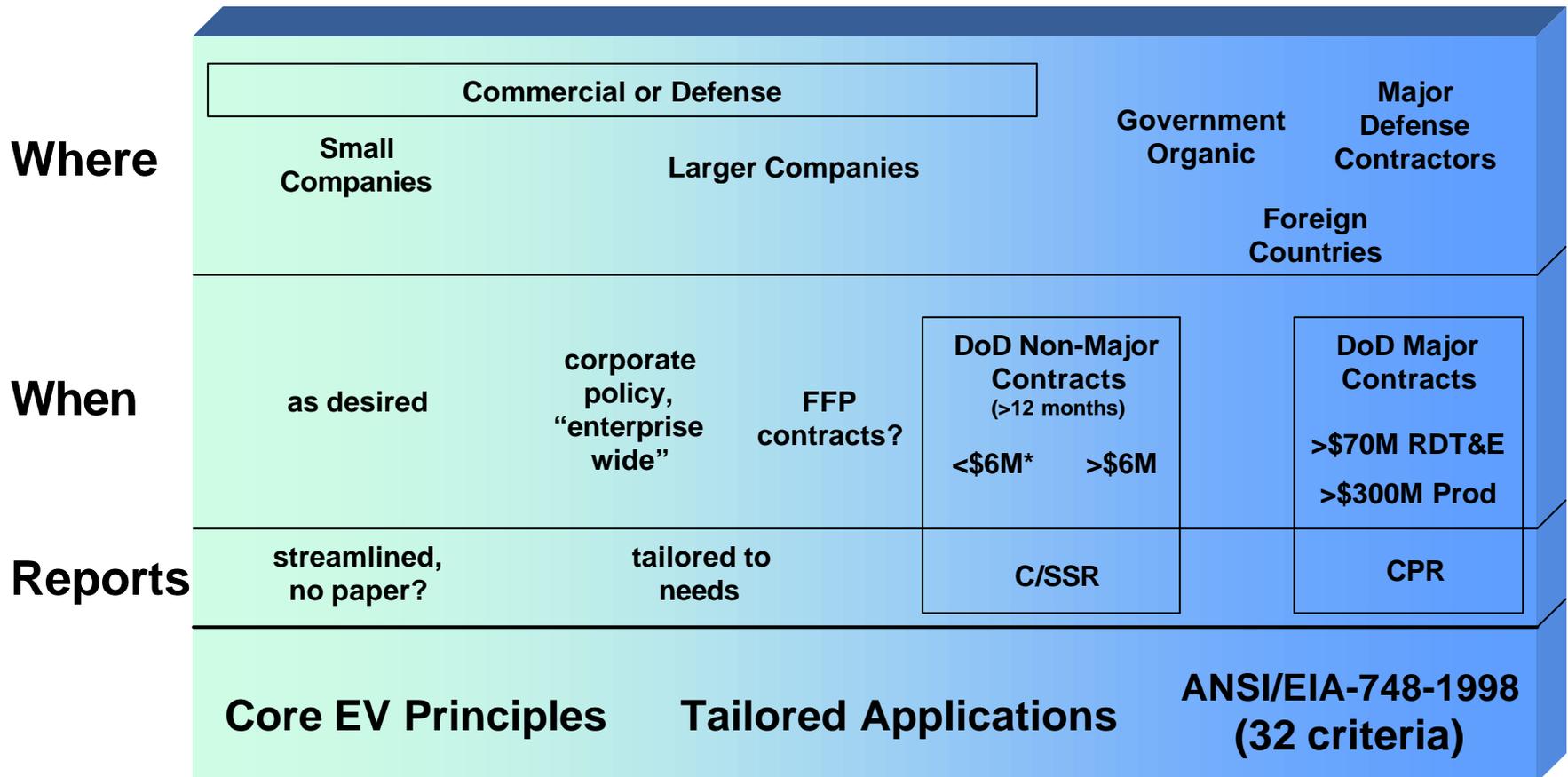
# EVMS Criteria

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- **Major DoD Programs**
  - Contractor's management control system must meet certain criteria
    - DoD needs accurate and timely data
  - Don't impose a specific system
  - Acceptance of management system performed by DCMC
- OSD adopted ***industry developed*** EVMS Standard
  - ANSI/EIA-748-1998, Earned Value Management Systems
  - 32 criteria
    - 5 major groups
      - I        Organization (5)
      - II       Planning & Budgeting (10)
      - III      Accounting (6)
      - IV      Analysis (6)
      - V       Revisions and Access to Data (5)

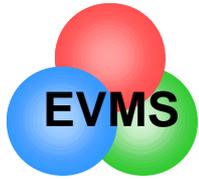


# A Spectrum of Implementation

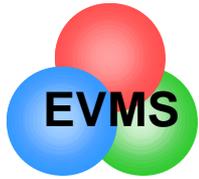


\*with judgement

All \$ are BY96

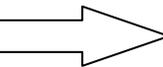
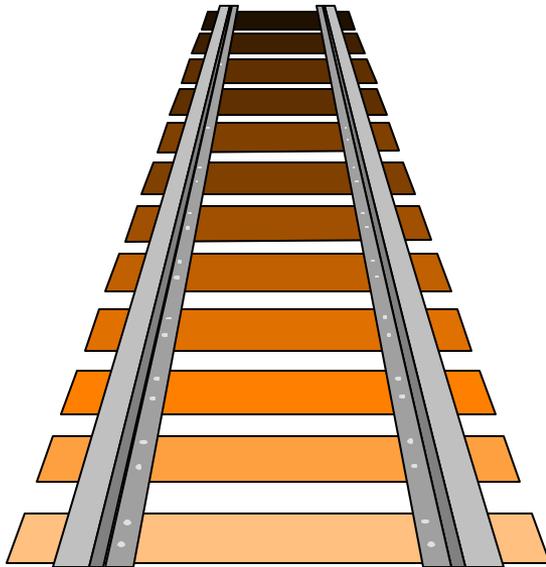


# Basic EVMS Terms



# EVMS measures progress

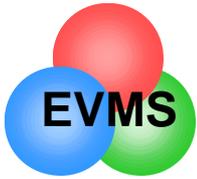
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*Progress = Movement Forward*

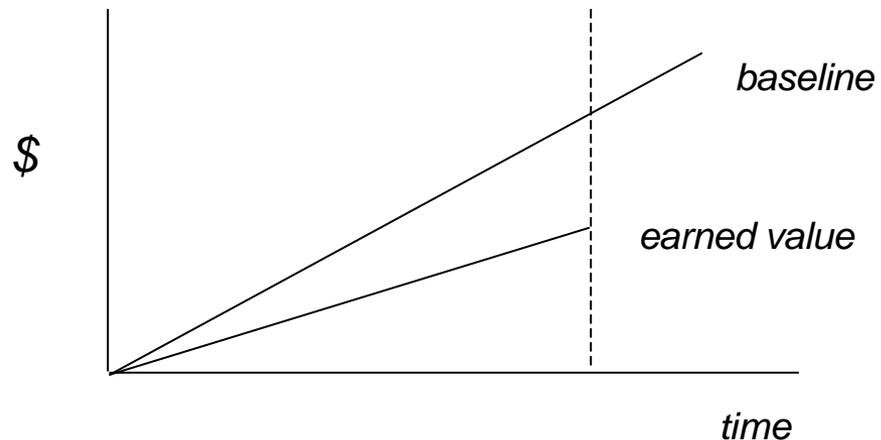
*to measure progress,  
there must be a standard  
against which the forward  
movement may be compared*

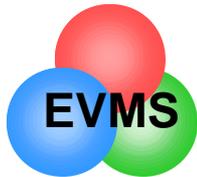
*EVMS establishes a baseline  
to measure progress*



# What do we measure progress against?

- Performance measurement baseline
  - budget that is spread over . . .
  - time, to accomplish the scope of
  - work
  - and against which progress can be measured
- Earned Value is key concept
  - how much progress did I make against my original plan?
  - expressed in dollars or hours

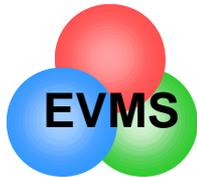




# Five Basic Elements

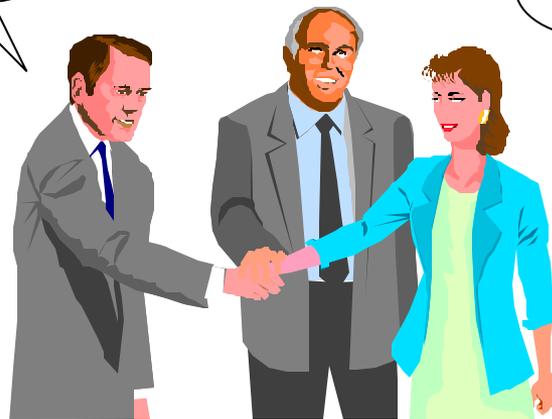
BCWS	Budgeted Cost of Work Scheduled
BCWP	Budgeted Cost of Work Performed
ACWP	Actual Cost of Work Performed
BAC	Budget at Completion
EAC	Estimate at Completion





# Total Budget

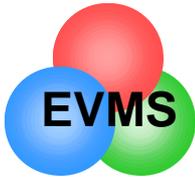
It's my pleasure to award you this contract for a new railroad track



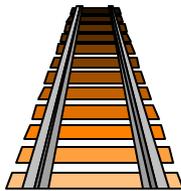
*hmm...5 miles of track, 5 months to do it all....\$5000 budget... This is going to be tough!*

What is the total job supposed to cost?

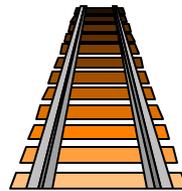
What is the value of the contract at cost?



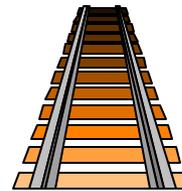
# Budgeted Cost of Work Scheduled (BCWS)



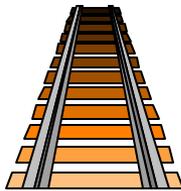
Month 1  
BCWS = \$1,000



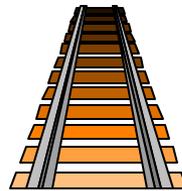
Month 2  
BCWS = \$1,000



Month 3  
BCWS = \$1,000



Month 4  
BCWS = \$1,000

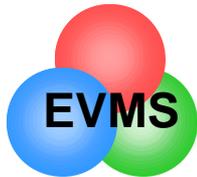


Month 5  
BCWS = \$1,000

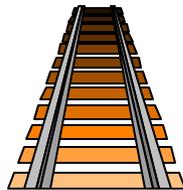
Total Budget = \$5,000  
to be spent over 5 months  
I plan to lay 1 section  
of track each month at an  
estimated cost of \$1,000.  
BCWS each month = \$1,000



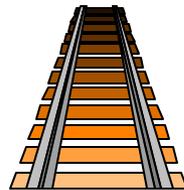
**each dollar of BCWS represents a specific dollar of work scope**



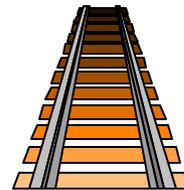
# Budgeted Cost of Work Scheduled (BCWS)



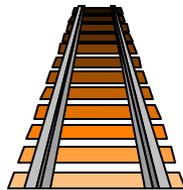
Month 1  
BCWS = \$1,000



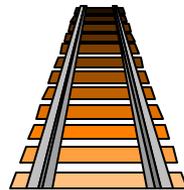
Month 2  
BCWS = \$1,000



Month 3  
BCWS = \$1,000



Month 4  
BCWS = \$1,000

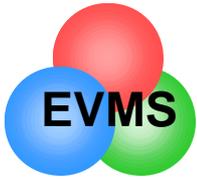


Month 5  
BCWS = \$1,000

Total Budget = \$5,000  
Total BCWS = \$5,000

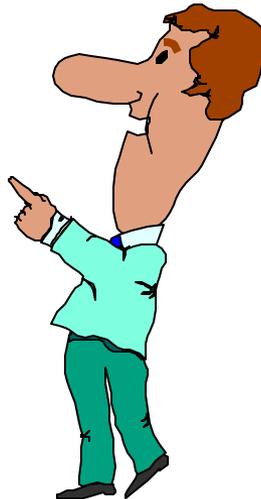
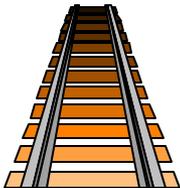


**BCWS is aggregated and summed as the performance measurement baseline**



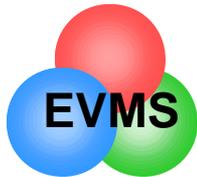
# Budgeted Cost of Work Performed (BCWP)

the **EARNED VALUE** concept



We're at the end of the second month, but only 1 section of track is complete. Value of work performed = \$1,000

**You earn value the same way  
as it was budgeted in baseline**



# Schedule Variance

BUDGET BASED

BC	WS
BC	WP

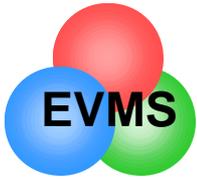
of the work I scheduled to have done,  
how much did I budget for it to cost?

of the work I actually performed,  
how much did I budget for it to cost?

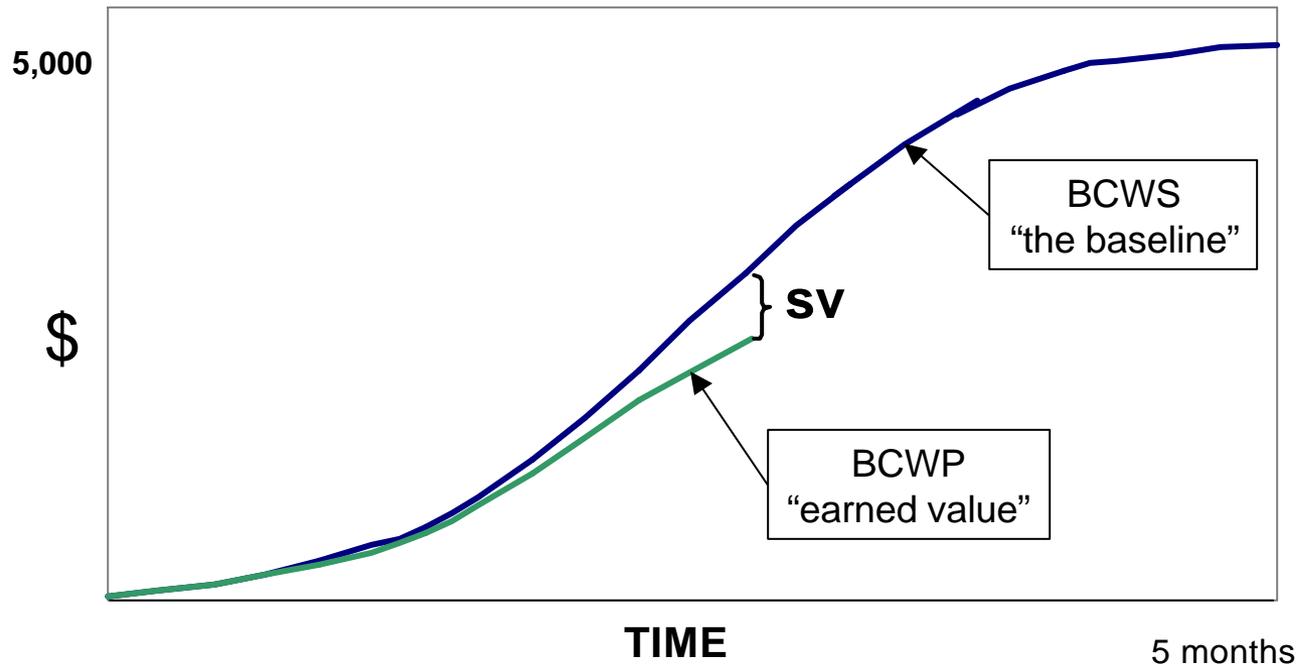
**SCHEDULE VARIANCE** is the difference between work scheduled and work performed (expressed in terms of budget dollars)

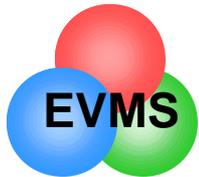
**formula:**  $SV \$ = BCWP - BCWS$

**example:**  $SV = BCWP - BCWS = \$1,000 - \$2,000$   
 $SV = -\$1,000$  (negative = behind schedule)

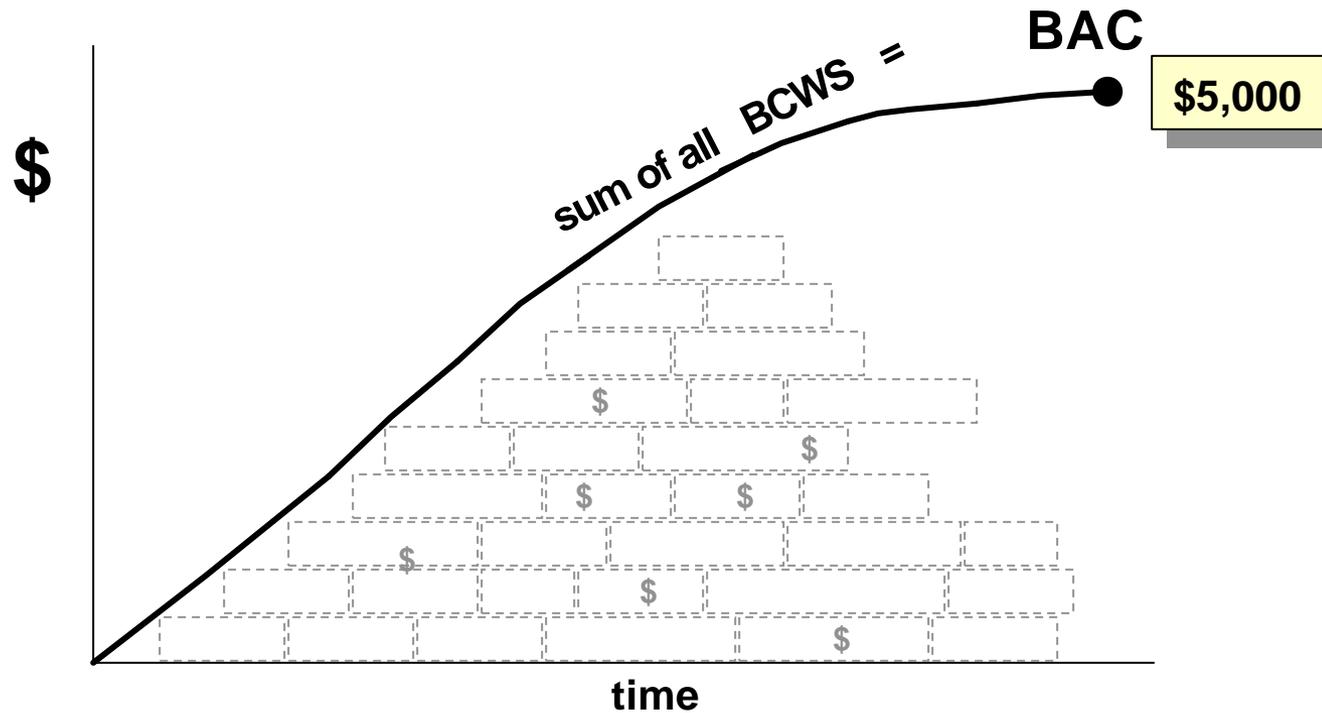


# Schedule Variance

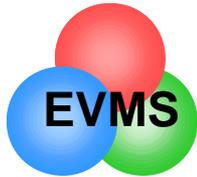




# Budget at Completion (BAC)



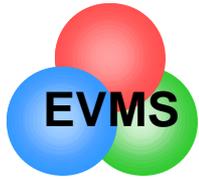
- when all work has been phased, cumulative BCWS = BAC  
e.g., \$5,000 = \$5,000



# At the end...

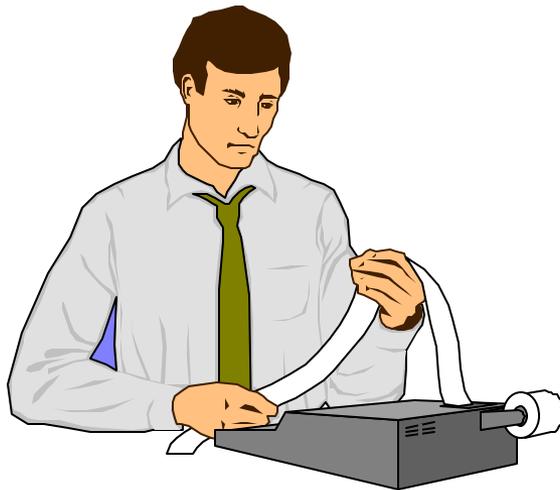
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- At the **end** of the contract, when all work has been completed:
  - I've "earned" all of my budget (\$5,000)
    - BCWP (cumulative) = **\$5,000**
    - BCWS (cumulative) = **\$5,000**
    - therefore, schedule variance (\$) = 0
  - Formal schedule will reflect whether milestones were achieved on time
- Example:
  - I finished late, but I did finish
    - $SV (\$) = \$ 0$
    - Formal schedule shows a 5 month actual delay in completing the contract



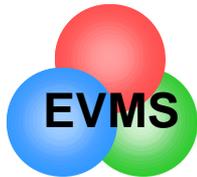
# Actual Cost of Work Performed (ACWP)

---



Labor came to \$1,300,  
and materials cost  
\$1,100. That first section  
of track cost \$2,400!

**actual expenditures vs. budget**



# Cost Variance

BC WP  
AC WP

PERFORMANCE BASED

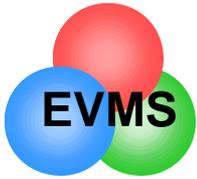
of the work I actually performed,  
how much did I budget for it to cost?

of the work I actually performed,  
how much did it actually cost?

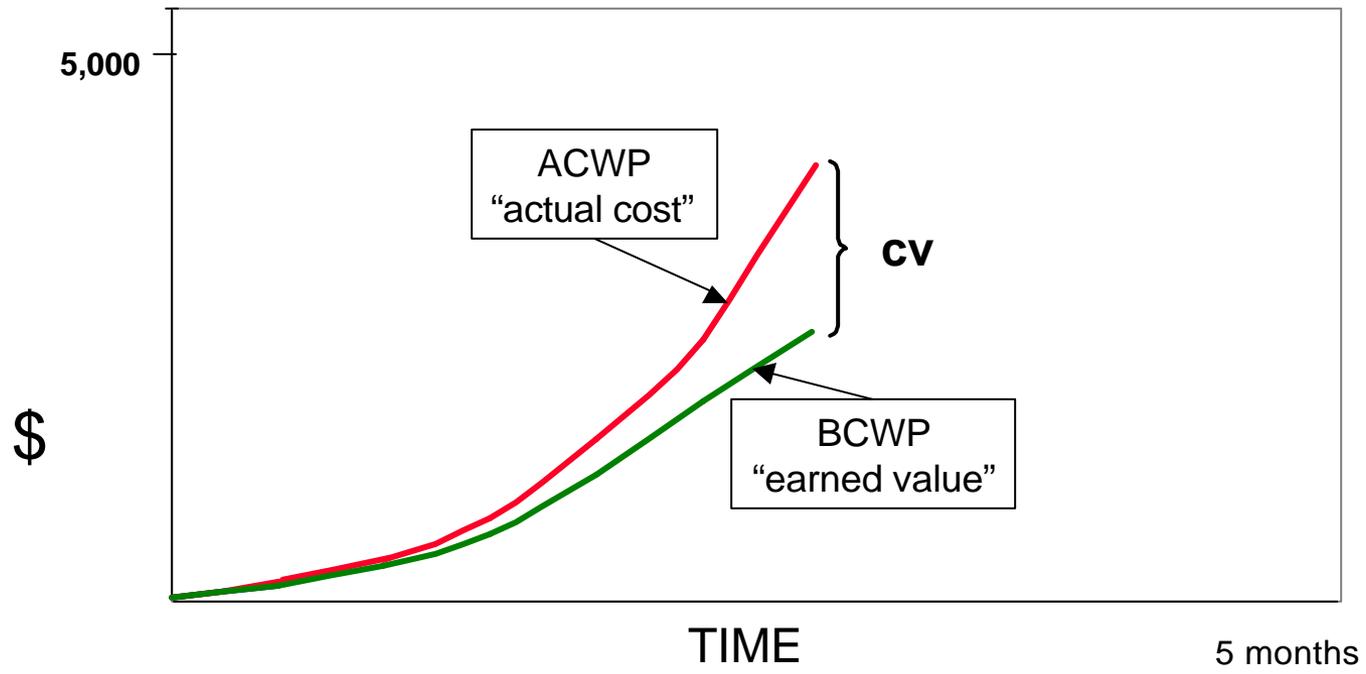
**COST VARIANCE** is the difference between budgeted cost and actual cost

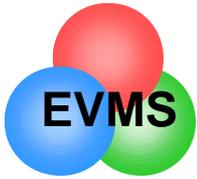
**formula:**  $CV \$ = BCWP - ACWP$

**example:**  $CV = BCWP - ACWP = \$1,000 - \$2,400$   
 $CV = -\$1,400$  (negative = cost overrun)



# Cost Variance

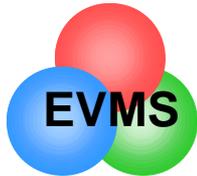




# Estimate at Completion (EAC)

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# Variance at Completion (VAC)

BAC

what the **total** job is supposed  
to cost

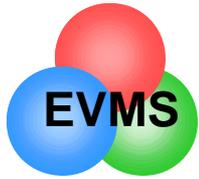
EAC

what the **total** job is expected  
to cost

**VARIANCE AT COMPLETION** is the difference between what the total job is supposed to cost and what the total job is now expected to cost.

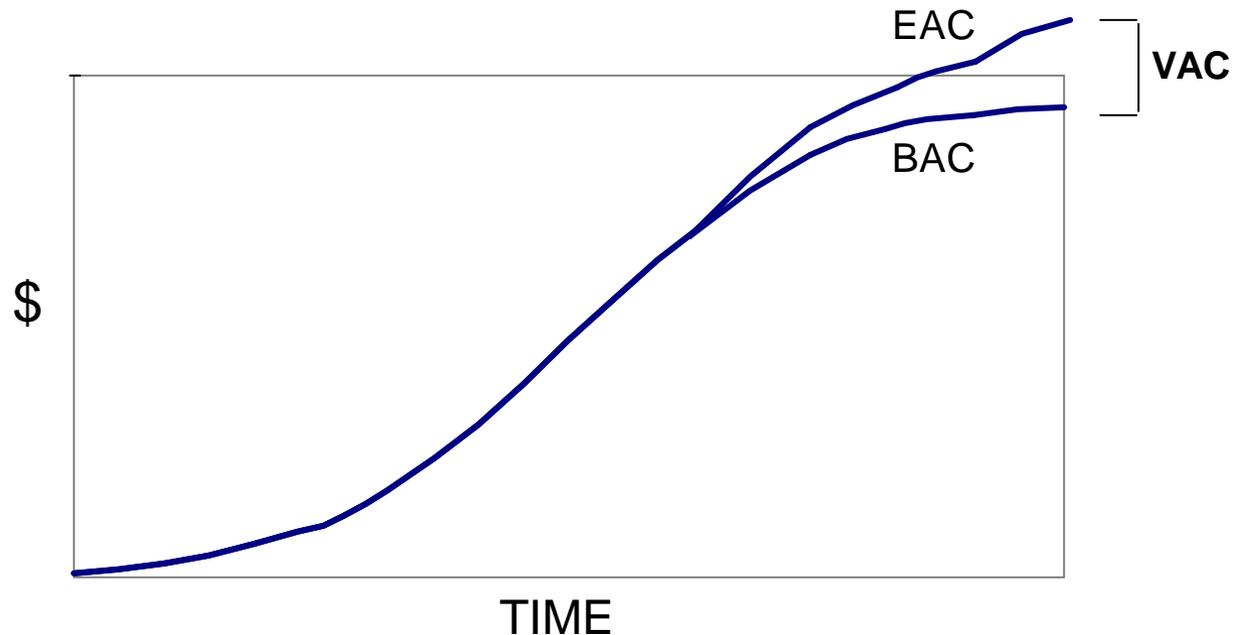
**FORMULA:**      **$VAC = BAC - EAC$**

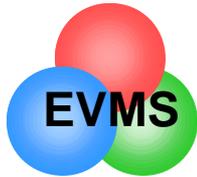
Example:      $VAC = \$5,000 - \$7,500$   
                  $VAC = - \$2,500$  (negative = overrun)



# Variance at Completion (VAC)

$$\begin{aligned} \mathbf{VAC} &= \text{Budget at Completion} - \text{Estimate at Completion} \\ &= \text{BAC} - \text{EAC} \end{aligned}$$

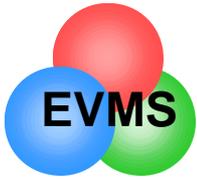




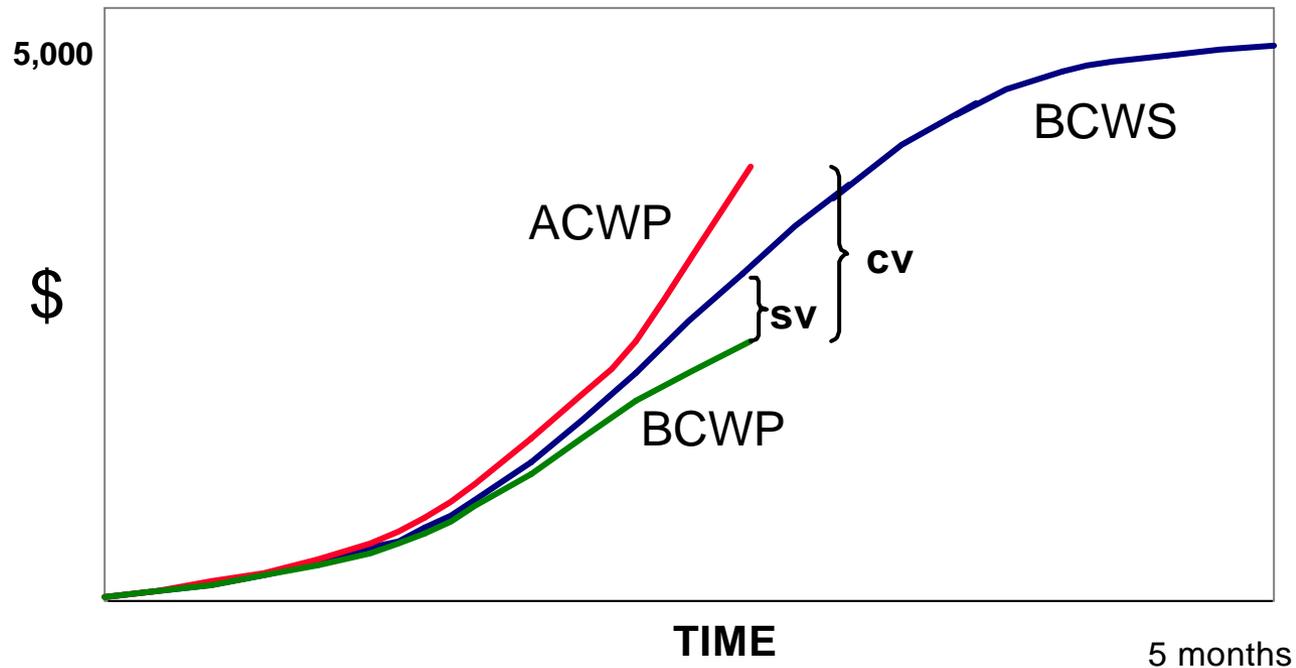
# FIVE BASIC PERFORMANCE DATA QUESTIONS & ANSWERS



<b><u>QUESTION</u></b>	<b><u>ANSWER</u></b>	<b><u>ACRONYM</u></b>
How much work <u>should</u> be done?	Budgeted Cost for Work Scheduled	BCWS
How much work <u>is</u> done?	Budgeted Cost for Work Performed	BCWP
How much did the <u>is done</u> work cost?	Actual Cost of Work Performed	ACWP
What was the total job <u>supposed</u> to cost?	Budget at Completion	BAC
What do we <u>now expect</u> the total job to cost?	Estimate at Completion	EAC



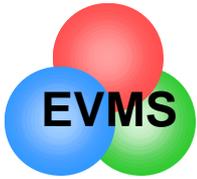
# BCWP Allows Isolation of Schedule and Cost Variances



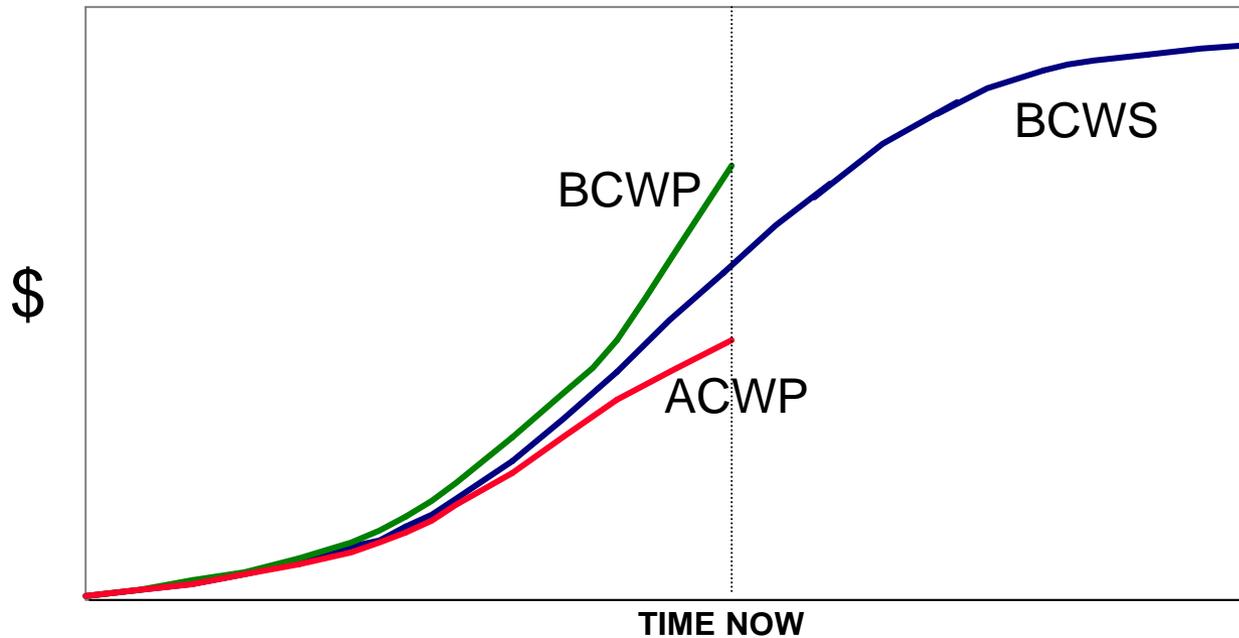
**schedule variance = BCWP - BCWS = negative number**  
**cost variance = BCWP - ACWP = negative number**



**behind schedule,  
over cost**

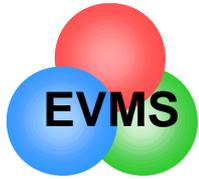


# Pop Quiz

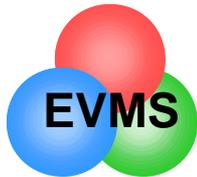


schedule variance =  $BCWP - BCWS =$   
cost variance =  $BCWP - ACWP =$

→  schedule,  
 cost



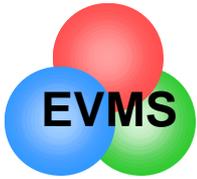
# Earned Value Management and the Project Management Cycle



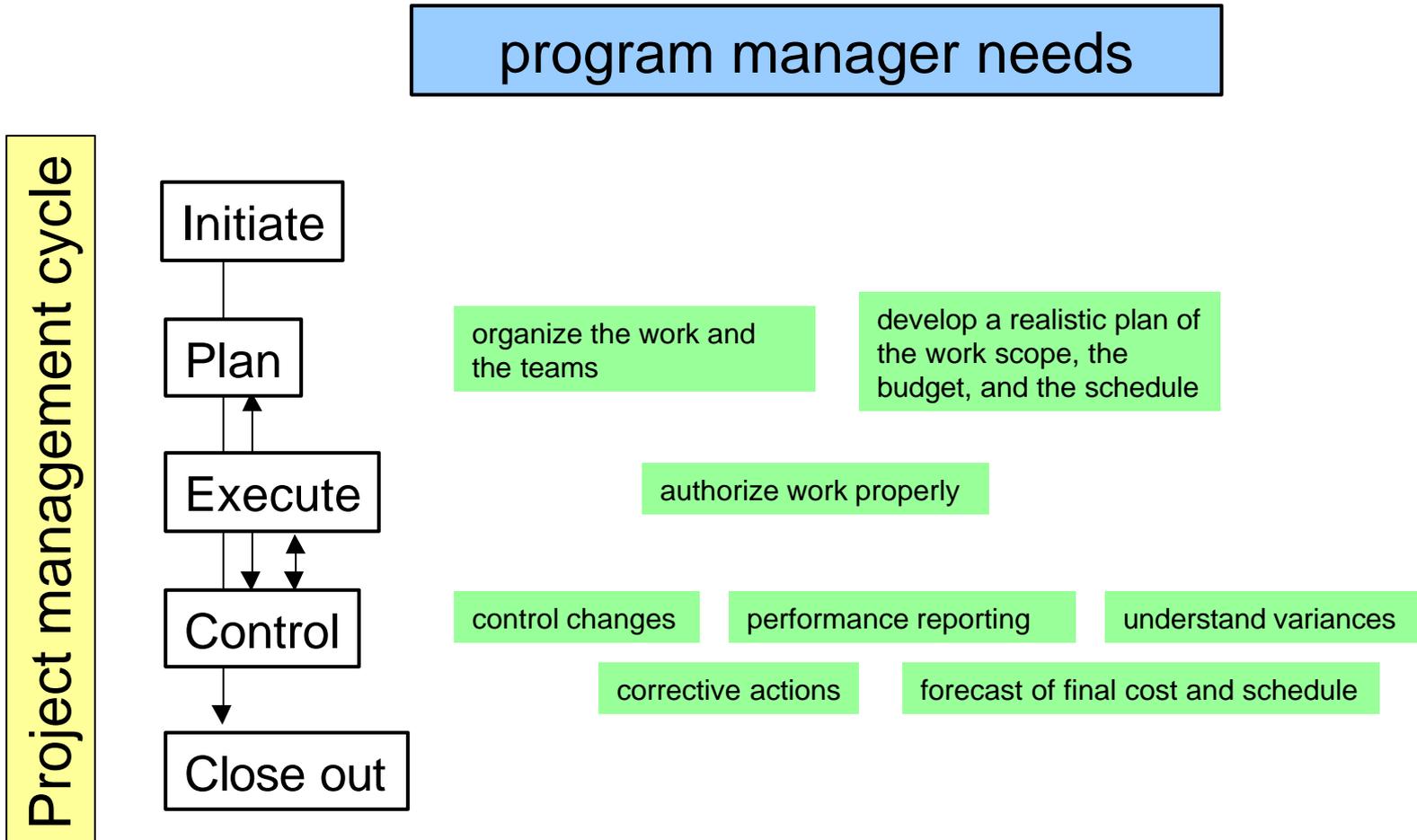
# Project Management Processes

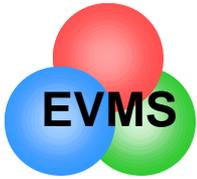
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Initiating	Recognizing that a project or phase should begin and committing to do so
Planning	Devising and maintaining a workable scheme to accomplish the business need that the project was undertaken to address
Executing	Coordinating people and other resources to carry out the plan
Controlling	Ensuring that project objectives are met by monitoring and measuring progress and taking corrective action when necessary
Closing	Formalizing acceptance of the project or phase and bringing it to an orderly end

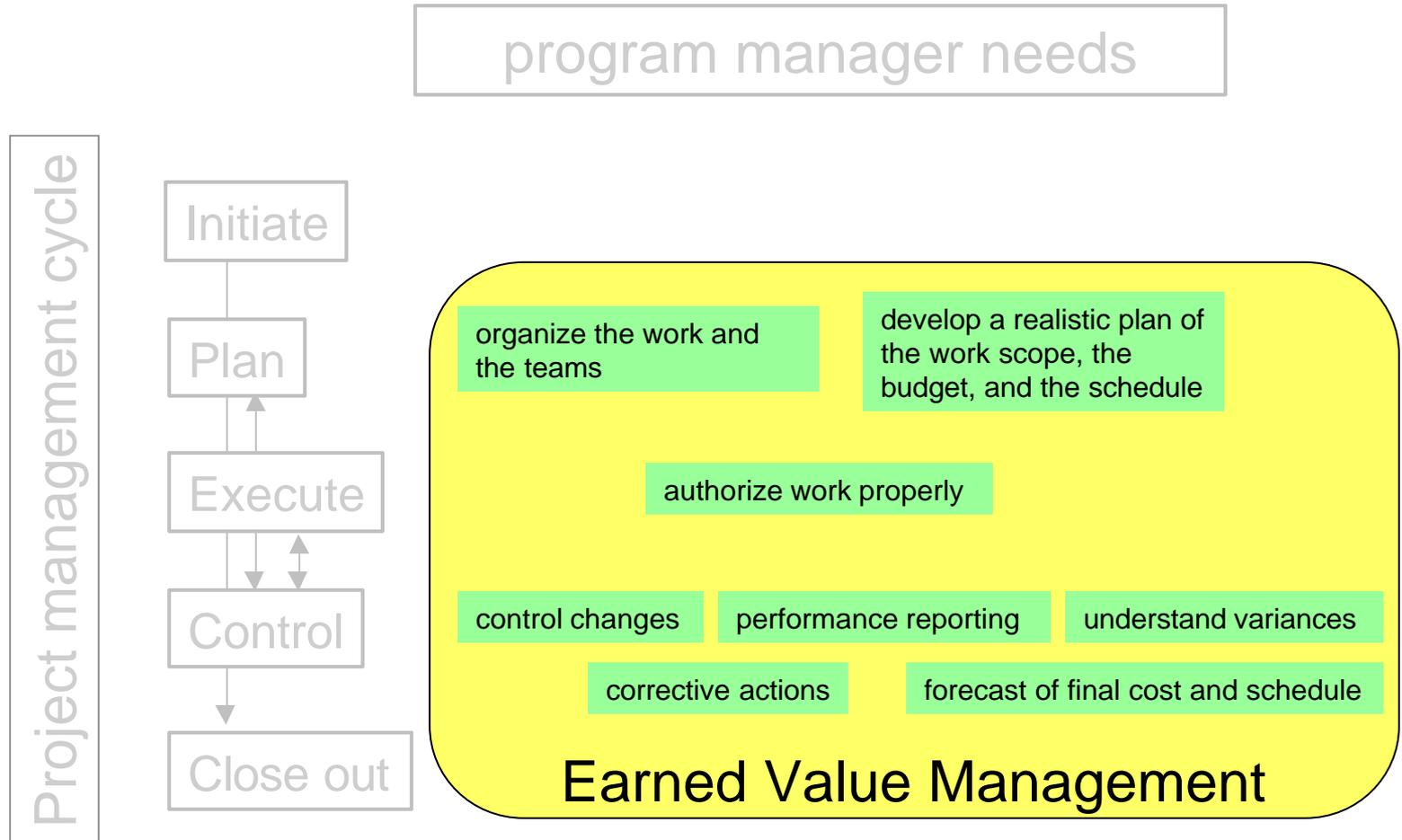


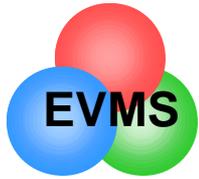
# How does EVMS fit into Program Management?





# EVMS fits naturally into the Project Management Cycle

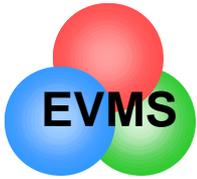




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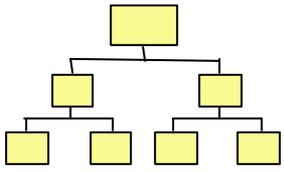
# Planning



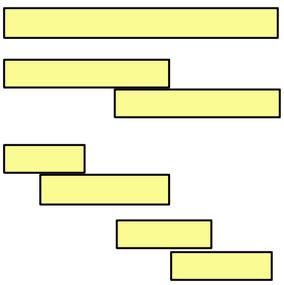


# Planning is a 3 Step Process

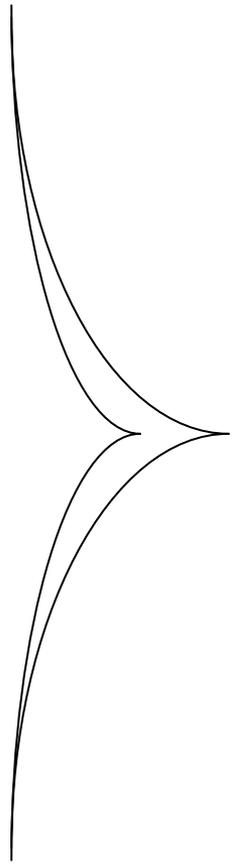
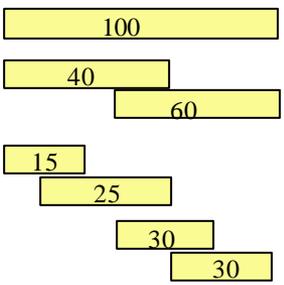
## 1. DEFINE THE WORK AND ORGANIZE TEAMS



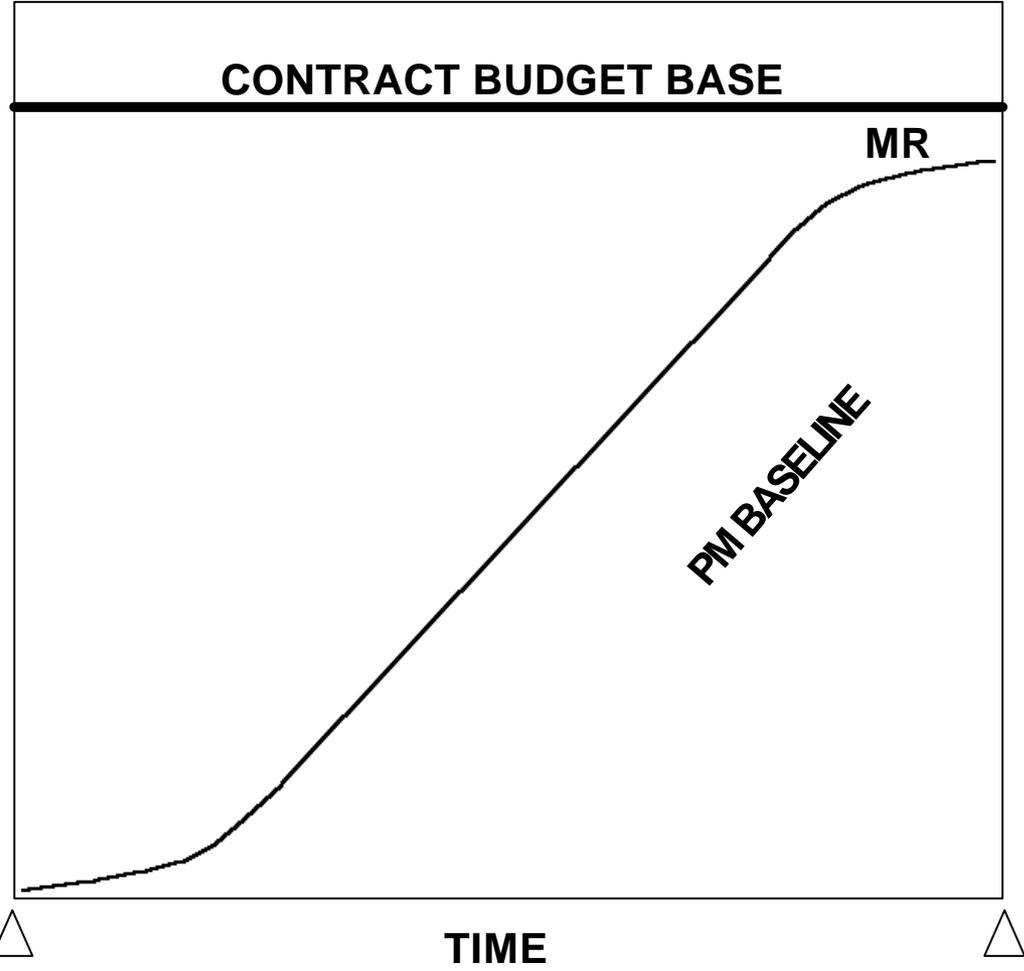
## 2. SCHEDULE THE WORK

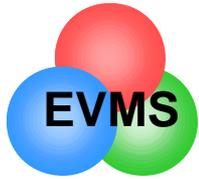


## 3. ALLOCATE BUDGETS



\$



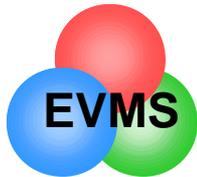


# Organizing

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- Objectives of organizing
  - establish a clear picture of the total project work scope
    - do we know what all of the work is?
  - assign responsibility to the right people

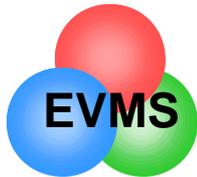




# The Organizing Process

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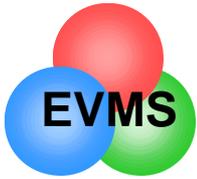
- Process
  - **Step 1:** define the authorized work using a work breakdown structure (WBS)
    - “decompose the work” into manageable chunks
    - provides a framework for
      - program and technical planning
      - cost estimating and resource allocation
      - performance measurements and status reporting
  - **Step 2:** define the organizational structure
  - **Step 3:** assign a single chunk of work to a single manager
    - **control account manager (CAM)**



# Organizing the Work and Teams

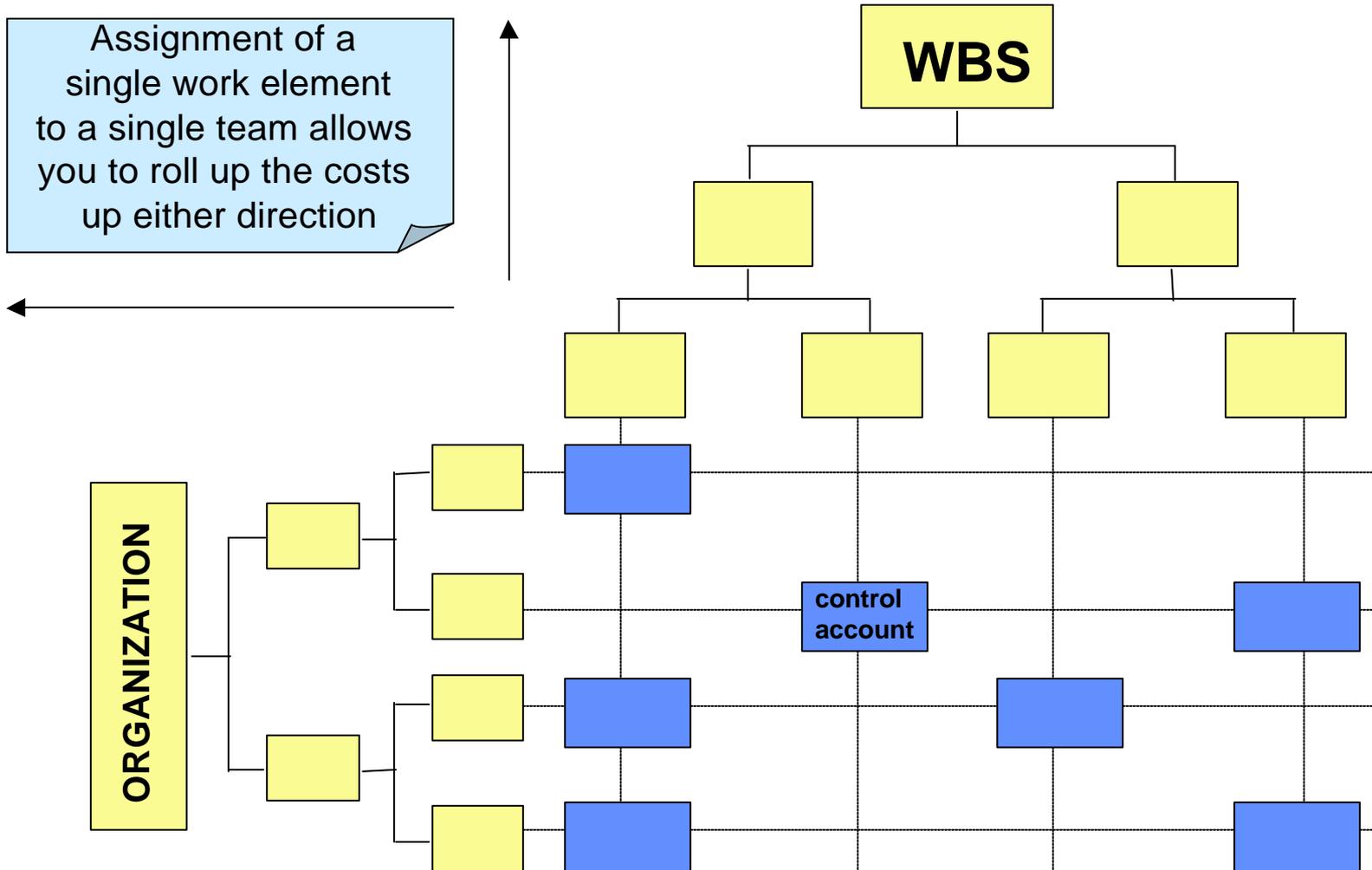
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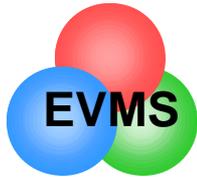
- **Customer responsibility**
  - Define upper levels of the WBS (to level 3)
    - MIL-HDBK-881, Work Breakdown Structure
    - Write initial WBS dictionary and include in request for proposal
  - Specify performance reporting levels
- **Contractor responsibility**
  - Extend WBS to level where work is performed
    - define the elements
    - extend WBS dictionary
  - Identify organizational structure
    - include major subcontractors



# Assigning Work

Assignment of a single work element to a single team allows you to roll up the costs up either direction



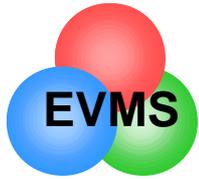


# Control Account

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- Control Account - where the work is done
  - Intersection of WBS and organization
- Develop Responsibility Assignment Matrix (RAM)
  - contractor developed
  - Assigns work and resources at lowest level (control account)
  - Establishes responsibility for WBS elements
    - Control Account Manager (CAM)
    - include responsibility for overhead

**sum of all control accounts (BAC) = complete statement of work**

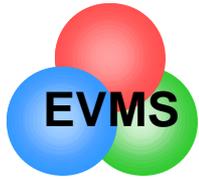


# Integration at the lowest level

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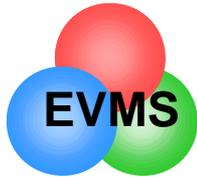
- **Control Account - the key control point**
  - integrates:
    - work scope
      - WBS element
      - organization
      - work authorization
    - schedule
    - time phased budget (BCWS)
    - actual cost accumulation (ACWP)
  - earned value determination (BCWP)
  - variance analysis (cost and schedule)
    - calculation and explanation
  - corrective action
  - estimate at completion (EAC)





# Case Study

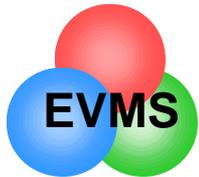
## Part 1



# Contract Award

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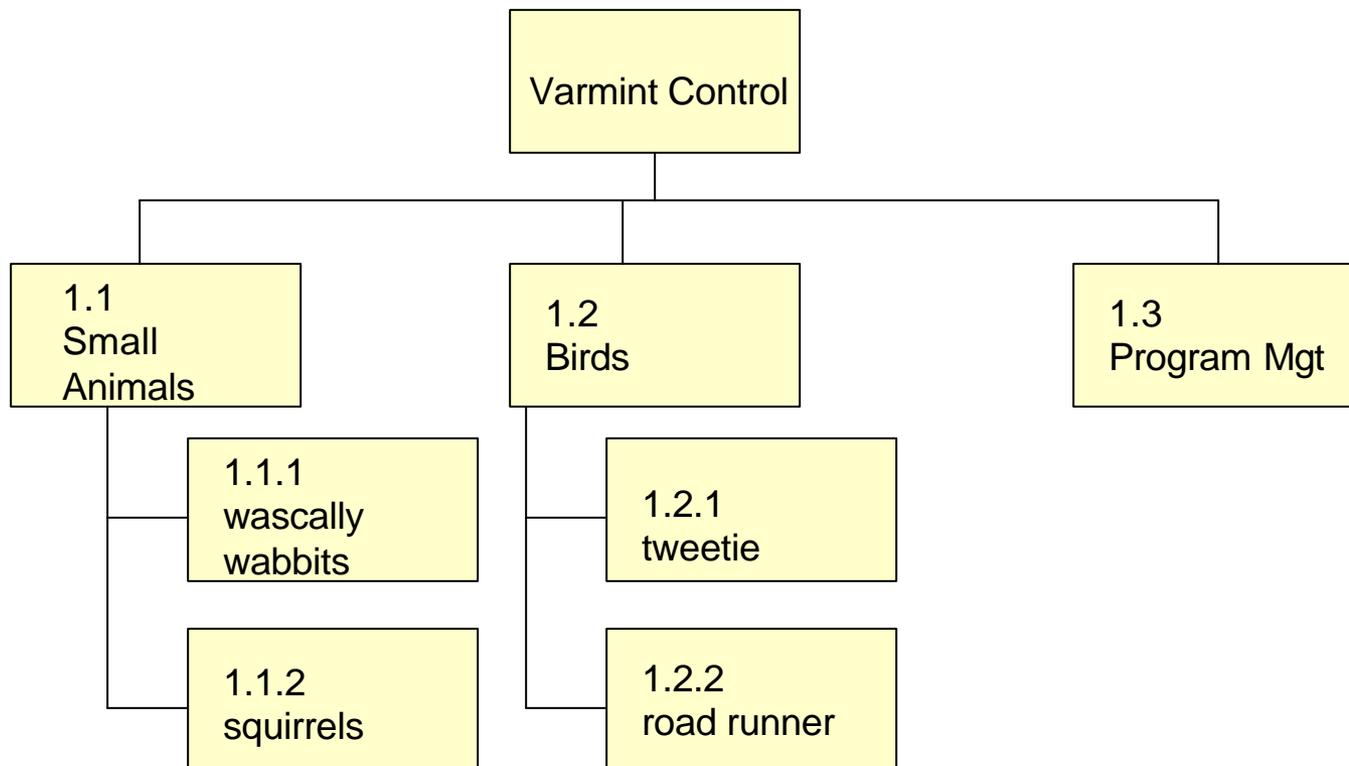
- You are the program manager, I. M. Taz
- You just won a contract to eliminate varmints within the state of Arizona
  - birds (tweetie and road runner types)
  - small animals
- You have an organization of highly trained specialists
  - L. M. Fudd
  - Sil Vester the cat
  - Wile E. Coyote
  - Daffie Duck (your deputy and the CAM for management)
- You have allocated the following budgets from your \$50,000 award
  - wascally rabbits (\$5,000)
  - squirrels (\$5,000)
  - tweetie birds (\$20,000)
  - road runners (\$10,000)
  - program management (\$10,000)

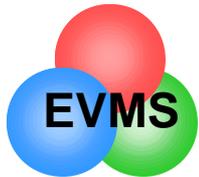


# Organize the work

---

- Build a simple work breakdown structure

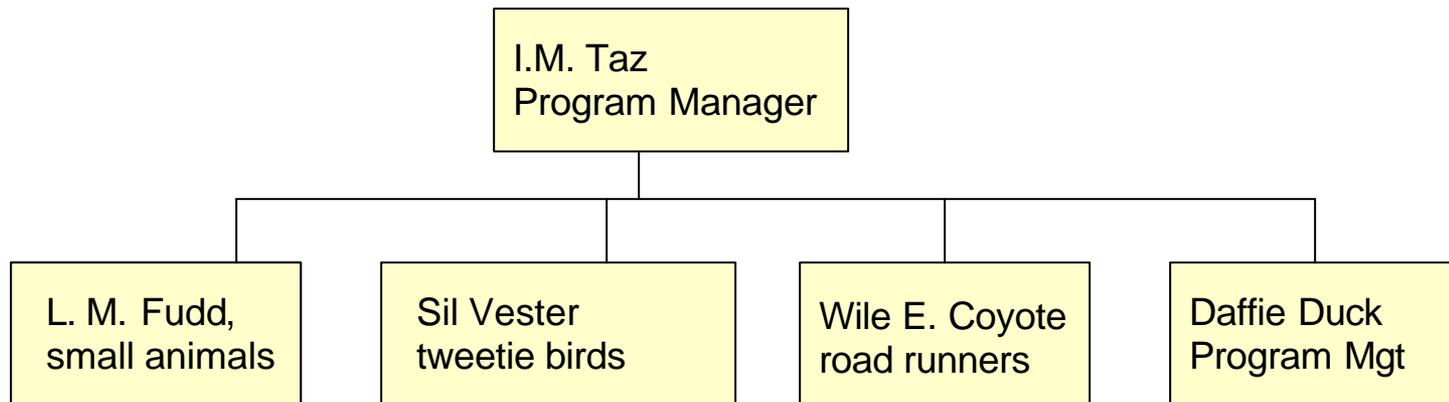


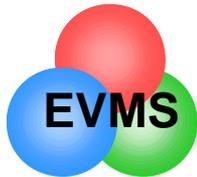


# Organize the workers

---

- Build a simple organization breakdown structure

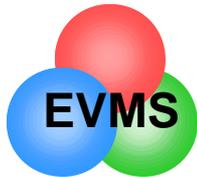




# Build a RAM and allocate work

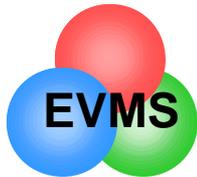
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	Sil Vester	L. M. Fudd	Wile E. Coyote	Daffie Duck
1.1.1 wascally wabbits				
1.1.2 squirrels				
1.2.1 tweetie birds				
1.2.2 road runner				
1.3 program management				



# Build a RAM and allocate work

	Sil Vester	L. M. Fudd	Wile E. Coyote	Daffie Duck
1.1.1 wascally wabbits		\$5,000		
1.1.2 squirrels		\$5,000		
1.2.1 tweetie birds	\$20,000			
1.2.2 road runner			\$10,000	
1.3 program management				\$10,000

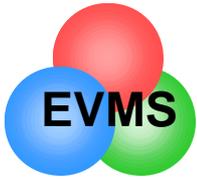


# What makes a good control account?

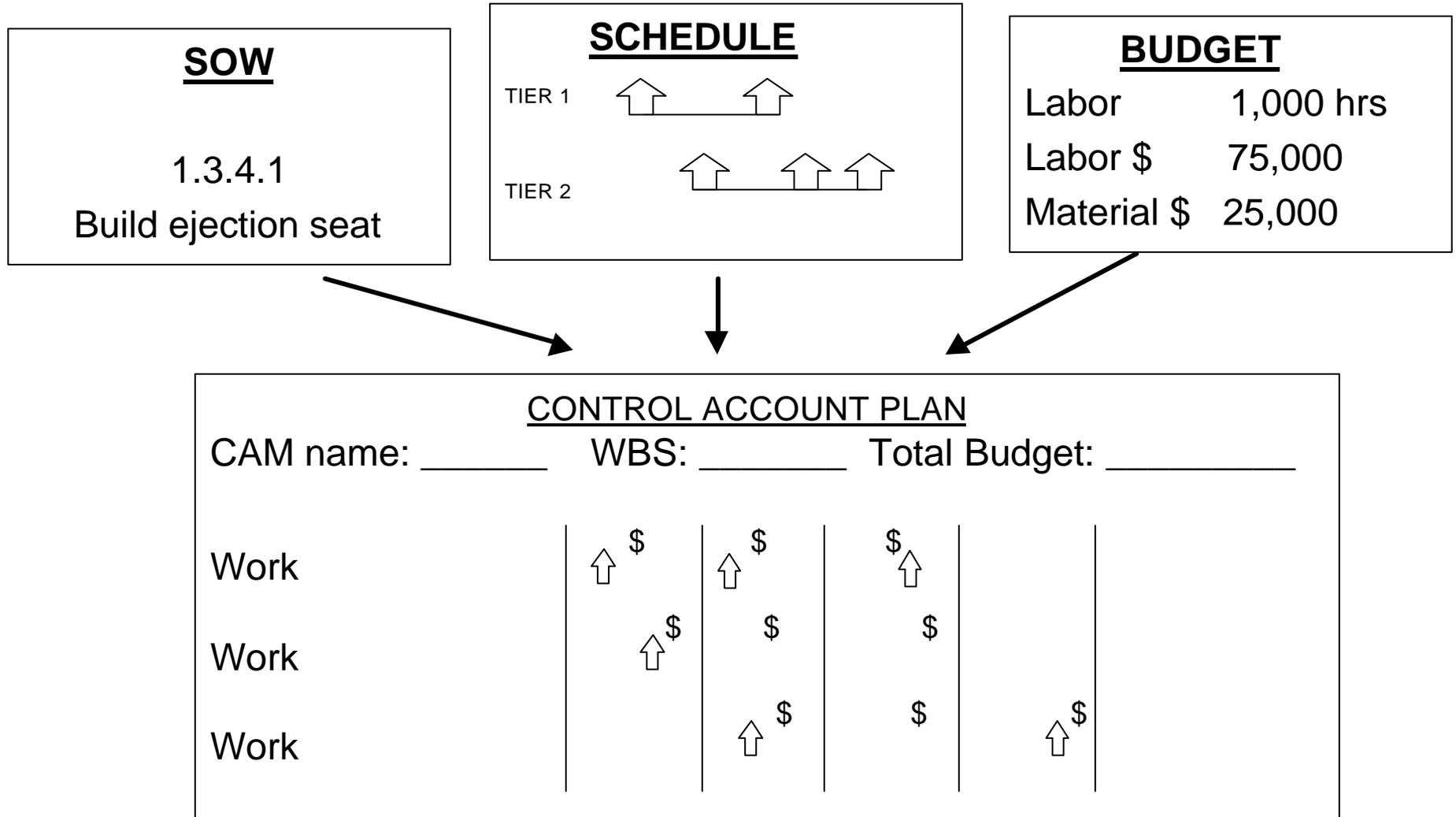
- **Rules of Thumb for Control Account size**

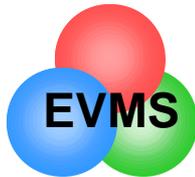
- integrated cost and schedule baseline
  - three legged stool
    - legs (cost, schedule, technical) are equal
- homogeneity of work
- what is logical to manage every day
- look at:
  - character of work
  - breakout of labor
  - span of control
- typically
  - 6 - 18 months for discrete effort
  - level of effort can be longer





# So, what's in a Control Account?





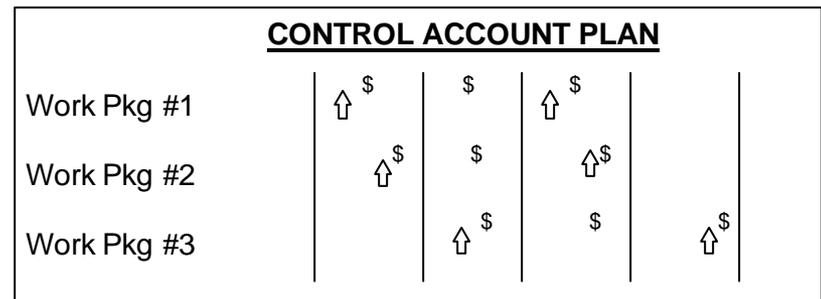
# Work Package

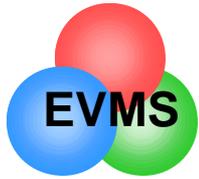
- **Development of Control Account Plans**

- MAY break down the control account budget into smaller work packages

- **Work Packages**

- subset of control account
- reasonably short in duration
- single element of cost (e.g., labor)
- single technique for earning value
- consistent with detail schedules
- has same characteristics as control account
  - scope of work
  - milestone completion criteria
  - single performing organization
  - start and end dates

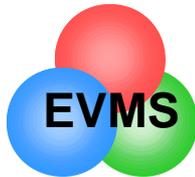




# Work Package Characteristics

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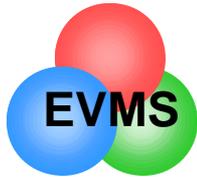
- discrete and measurable
- products or accomplishments
- examples:
  - design drawing package
  - conduct design review
  - install rudder
- rolling wave
  - detailed plans made for near term work packages
  - planning packages are for future work and are not detailed
  - CAMs periodically plan another increment of work packages
- open vs. closed packages



# Ways of Earning Value

---

- **Earned Value techniques**
  - **Discrete**
    - physical, tangible end product
  - **Apportioned**
    - discrete, dependent on another discrete work package
    - example: quality assurance
    - planned as historical estimating factor (e.g., 7%)
  - **Level of Effort**
    - no tangible end product
    - basis of measurement: time
    - when clock starts ticking, you automatically accumulate earned value
    - no schedule variance
    - example: management personnel
- **Should be a quantitative and discrete way to measure the work**
- **May tie in with success criteria or technical measure**
  - e.g., successful completion of a specific test, reliability growth curve

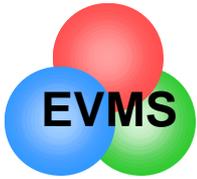


# Be Discrete!

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- **Discrete EV Techniques:**

<b><u>Method</u></b>	<b><u>How Value is Earned</u></b>
0/100	no EV at opening, 100% EV at close of WP
50/50	50% EV at opening, 50% EV at close of WP
Units Completed	same budget value for identical units
Equivalent Units	planned unit standards, allows partial credit
Weighted Milestone	each milestone weighted based on planned resources ideal to have a milestone each month
Percent Complete	subjective (least desirable)



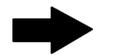
# Material Concerns

- **Material and Subcontracts**

- Earned Value: taken no earlier than receipt

define

order



receipt

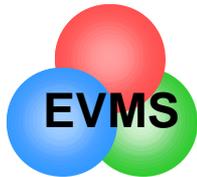
payment

to inventory

usage



- accurate cost accumulation and assignment to contract
- should perform price and usage variances
- should match earned value to payment period
  - otherwise, take estimated actuals to avoid artificial cost variance

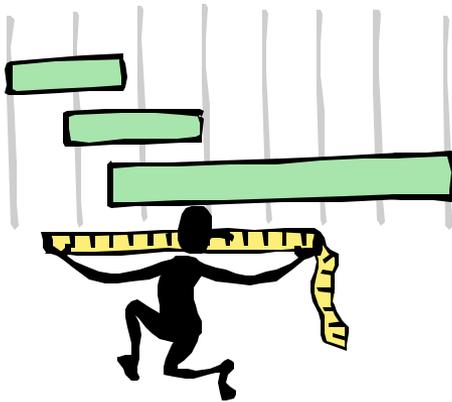


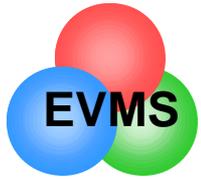
# Scheduling

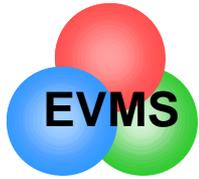
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- **Scheduling system characteristics**

- complete
  - all work included
- formal
  - everyone uses same schedule
- traceable
  - vertical (Master, Intermediate, Detail)
  - horizontal (between tasks)
- consistent
- identifies sequence of tasks, interdependencies







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# CASE STUDY

## Part 2



# Contract SOW

## SOW Paragraph 1.2.2:

The contractor shall design, build, and install a system to capture and eliminate the species “Road Runner” within the state of Arizona.

## Contractor’s Winning Design:

The basic system shall consist of five miles of road, a fake tunnel painted on a side of the mountain, plus a device to drop an anvil on the Road Runner.



# BEEP BEEP INDUSTRIES

## CONTROL ACCOUNT AUTHORIZATION

Control Account: Roadrunner

Control Account Manager: Wile E. Coyote

Reason for Issue: Contract to rid Arizona of all unwanted creatures,  
F33657-96-C-0221

Scope Description: Perform scope in accordance with Statement of Work.  
WBS Element 1.2.2

Schedule Requirement: Perform in accordance with Control Account Plan

Budget Authorization: \$10,000



# Schedule Information

- The contract was awarded in Month 1, and will be complete by the end of Month 6.
- You can begin building the road immediately, and plan on it taking about one month to complete one mile of road.
- It will take approximately three months to develop, build, and quality test the anvil support mechanism (ASM).
- You should begin the ASM install during the last month of the build cycle, during quality test. The ASM will take three months to install, and should be the last item completed on the contract, in Month 6.
- Based on past experience, you believe that it will take you two months to paint the fake tunnel. You will start it one month before the anvil support mechanism (ASM) begins installation.
- The anvil supplier, Acme Anvils, has been a good supplier for you in the past. The anvil is commercial off-the-shelf equipment. You need delivery one month before the install is complete.

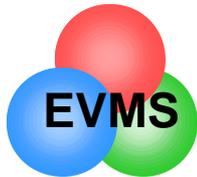


# Budget Estimate - BAFO

	<u>Budget Estimate</u>
1. Procure anvil (sole source - ACME Anvil)	\$1,500
2. Paint fake tunnel	\$1,000
3. Build 5 miles of road	\$3,000
4. Develop and build anvil support mechanism (ASM)	\$3,000
– design drawings complete & signed off (CDR) (Milestone 1)	(\$1,000)
– build unit (Milestone 2)	(\$1,000)
– quality test (Milestone 3)	(\$1,000)
5. Install system on-site	\$1,500
Total	\$10,000





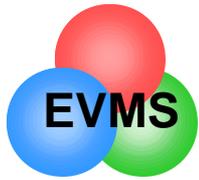


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## ***basic rules of the road...***



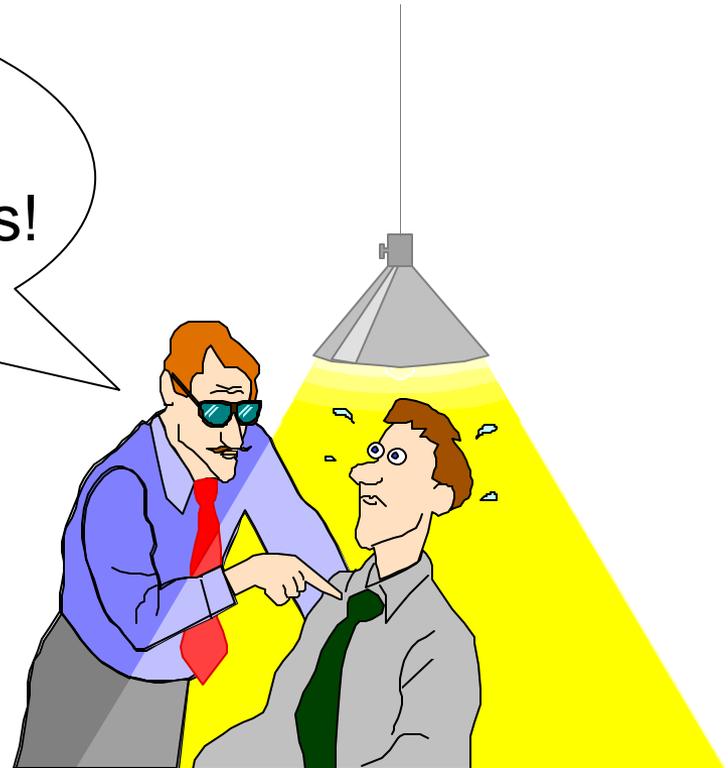
- **value is earned using the same method as it was planned**
- **sum of the work packages equals the control account budget**
- **sum of the control accounts equals the budget baseline**
- **span of lower tier schedules supports upper schedules**

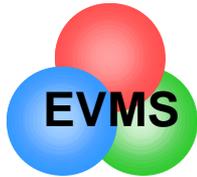


# *More Acronyms!*

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Apparently, you're starting to understand this!





# at the total contract level....

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## **UB      Undistributed Budget**

= authorized work held at top level until it can be planned in detail  
(will eventually have performance measurement)

## **PMB      Performance Measurement Baseline**

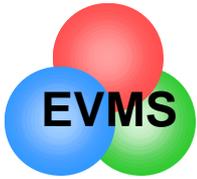
= time phased budget plan  
= detailed planning + UB

## **MR      Management Reserve**

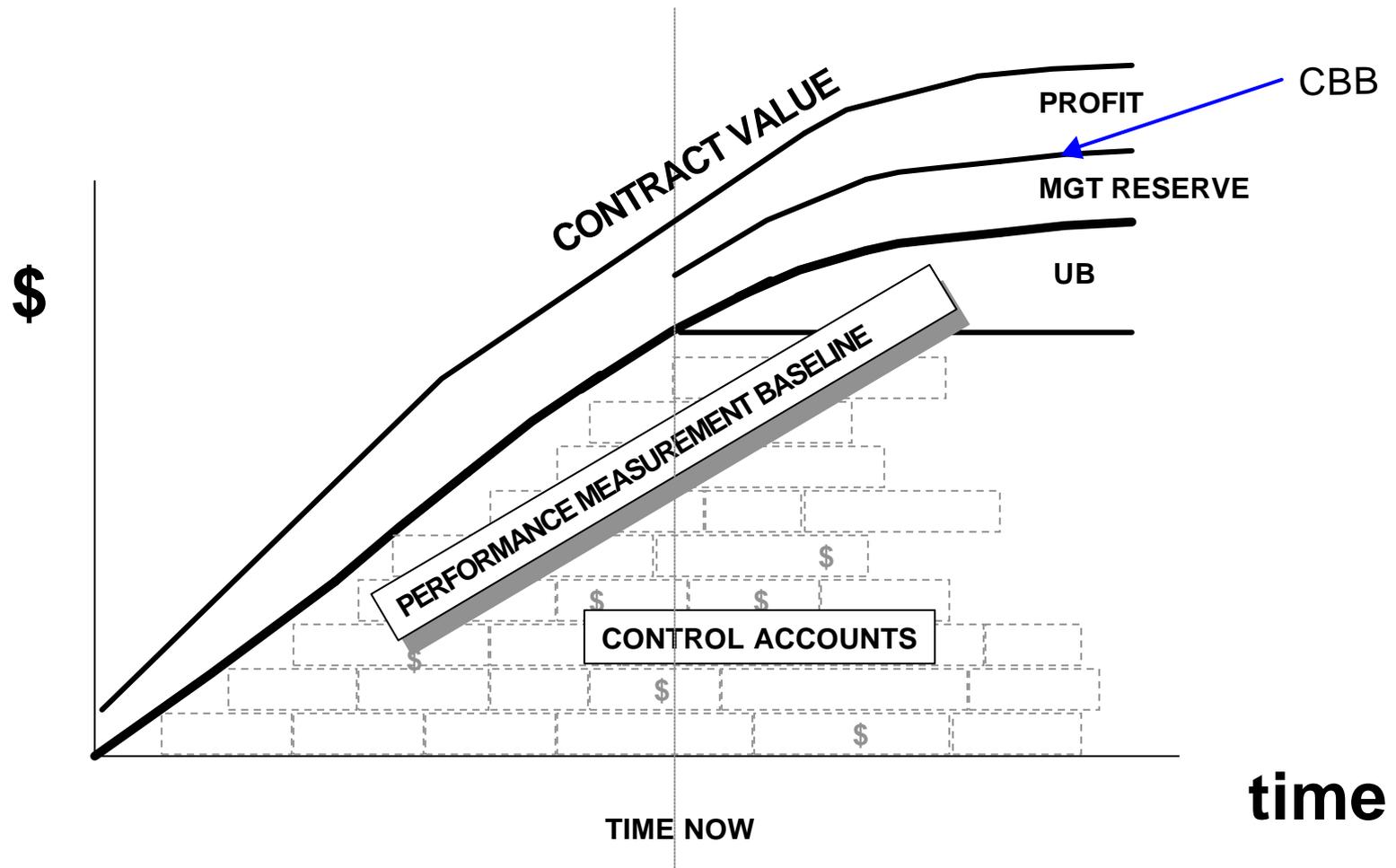
= amount withheld at top level for control purposes  
(no performance measurement)  
= used for unforeseen changes that are within scope of the contract

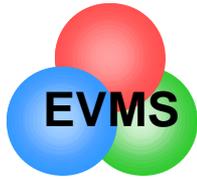
## **CBB      Contract Budget Base**

= PMB + MR  
= contract at cost



# Rolling Up the Work

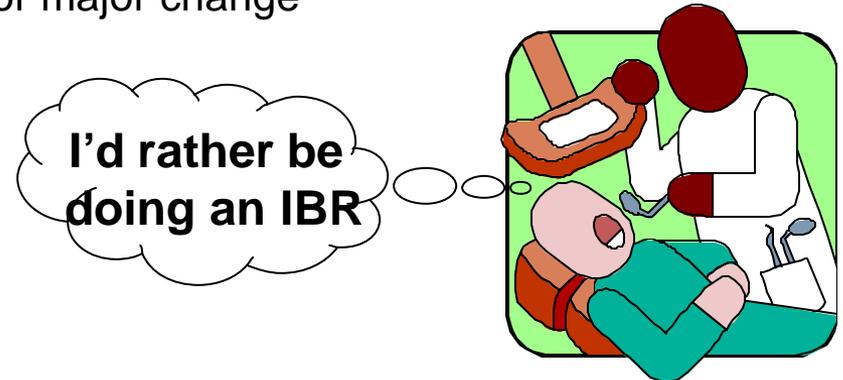


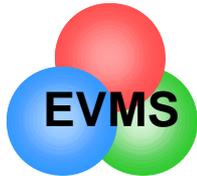


# Plans are in place..

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- The baseline is now in place
  - you've broken down all the work
  - assigned it to teams
  - scheduled the work and integrated the schedules,
  - and assigned budget resources.....
  - schedules and budgets roll up to match the contract
- Let's take the time to evaluate the realism of the baseline
  - Integrated Baseline Review (IBR)
  - joint contractor/government team
  - within 6 months of contract award or major change



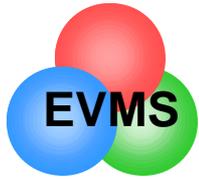


# Case Study IBR

## Historical Data from other Beep Beep programs

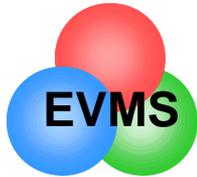
1. Average historical cost per mile of road = \$750
2. Contractor has no experience in painting tunnels.
3. Contractor has never worked in this part of the country before.
4. Price of raw aluminum on the open market just recently skyrocketed due to heavy demand.

- Did we fully plan all work? Do we understand the work?
- Do we have a reasonable schedule, with logic indicated?
- Do we have enough budget?
- Are the earned value techniques valid?
- Is the program manager paying attention?
  
- Bottom line: where are the risks to the program?



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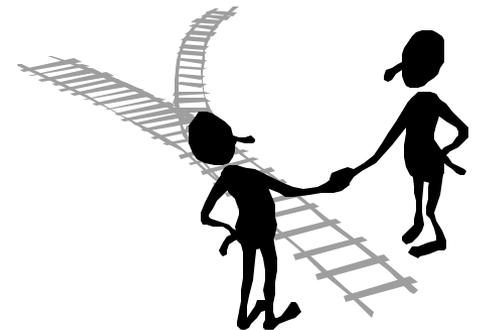
**Execute!**

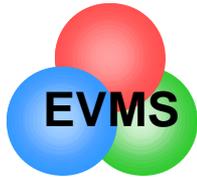


# Authorizing the Work

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- Can only charge to open work packages
  - contractor system sets procedure
- Contractor maintains baseline log which tracks:
  - distribution of budget from Undistributed Budget (UB) to control accounts
  - distribution of Management Reserve (MR)
  - additions of authorized work
  - total equals Contract Budget Base
- Contract changes incorporated in disciplined manner
  - cannot start work without authorization or budget
- Baseline changes are controlled
  - Internal replanning
  - Over Target Baseline, Over Target Schedule



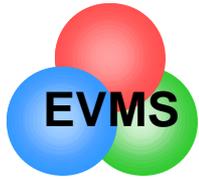


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## *more rules of the road...*



- cannot move budget and work independently
- cannot use management reserve to cover overruns
- may replan open work packages as necessary
  - contractor sets internal policy
  - maintain valid performance information
- cannot change budgets or costs for completed work
  - except to fix errors



# Case Study Part 3

# EV Update and End of Month Actuals

- Month 1: 1 section of road built (\$700)
- Month 2: Design drawings were completed and signed off (\$980)  
1 section of road built (\$720)
- Month 3: The work package for the fake tunnel was opened (\$200)  
A labor strike prevented a section of road from being built (\$300)  
The ASM began to be built, but the unit was not complete (\$800)
- Month 4: The tunnel was not completed (\$400)  
The crew went back on the job, and got paid overtime. 2 road sections built for \$1500.  
Milestone 2 for the ASM was finally complete. Quality test was pushed out 1 month. (\$400)  
The install of the ASM was delayed, due to the delay in build.  
The anvil was ordered.
- Month 5: The anvil was delivered and final cost was \$1,700.  
The tunnel was complete ( painted). (\$500)  
The last section of road was built for \$700.  
Qual test completed. (\$1,900)  
The CAM estimated that the install was approximately 20% complete (\$400)
- Month 6: Additional work crews were hired, and the installation was completed.  
The additional crews cost an additional \$1,000. (\$2,100 total)

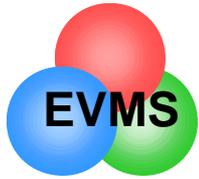
EV Techniques      0/100, 50/50, Units Complete,  
% Complete, Milestones

CONTROL ACCT. TITLE: Roadrunner

CONTROL ACCOUNT MANAGER: Wile E. Coyote

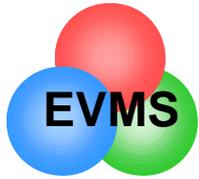
BUDGET: \$10,000

TIER I MILESTONE			↑ KT AWD					↑ KT COMP		
WP#	WORK DESCRIPTION	EV METHOD	MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6	TOTAL BAC	
1	Procure Anvil	0/100	<b>BCWS</b>				1,500		1,500	
			<b>BCWP</b>				▲ 1,500			
2	Paint Fake Tunnel	50/50	<b>BCWS</b>			▲ 500	▲ 500	◆	1,000	
			<b>BCWP</b>			▲ 500		◆ 500		
3	Build Road	units complete	<b>BCWS</b>	▲ 600	▲ 600	▲ 600	▲ 600	▲ 600	3,000	
			<b>BCWP</b>	▲ 600	▲ 600	-	▲ 1,200	▲ 600		
4	Build ASM	milestone	<b>BCWS</b>		▲ 1,000	▲ 1,000	▲ 1,000	◆	3,000	
			<b>BCWP</b>		▲ 1,000	▲ 1,000	▲ 1,000	◆ 1,000		
5	Install ASM	% complete	<b>BCWS</b>				▲ 500	▲ 500	▲ 500	
			<b>BCWP</b>				▲ 500	◆ 300	▲ 1,200	
TOTAL CONTROL ACCOUNT PLAN			<b>BCWS</b>	600	1,600	2,100	2,600	2,600	500	10,000
			<b>BCWP</b>	600	1,600	500	2,200	3,900	1,200	10,000
<b>Schedule Variance</b> month										
cumulative										
<b>Actual Costs</b>										
<b>Cost Variance</b> month										
cumulative										



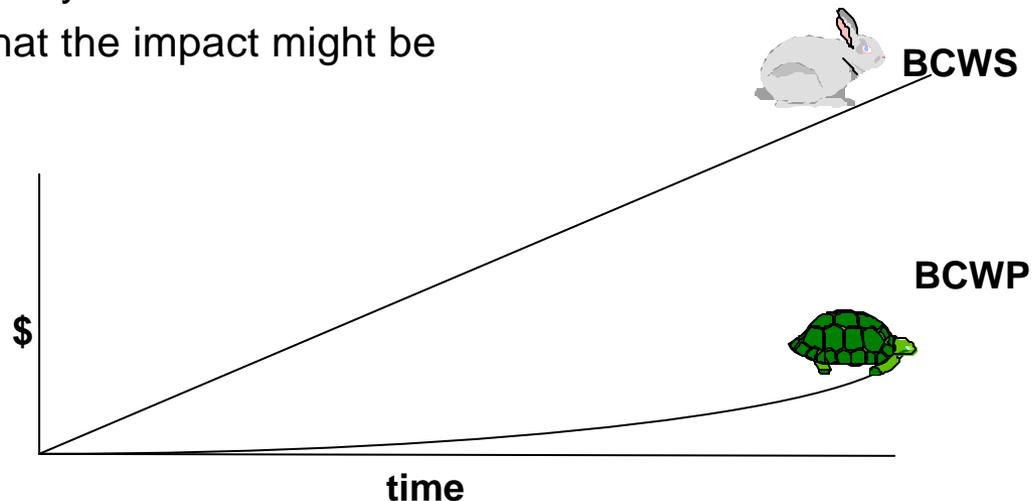
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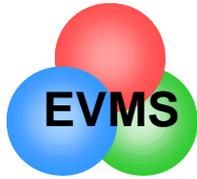
# Control



# Control

- So, your project has been baselined and work has started
- Is everything going according to plan?
- Next step in the process:
  - figure out your status
  - figure out the problems
  - figure out what you need to do to fix them
  - figure out what the impact might be



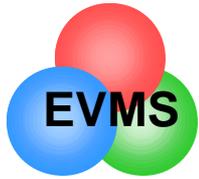


# Status Reporting

---

- **Assumption**: An accurate management control system yields accurate data
- **Basic principles**:
  - Report on periodic basis
    - weekly
    - monthly
  - Only ask for the data that you really need and use
    - can eliminate certain formats
      - WBS versus organizational reporting
    - tailor level of reporting to match risk
  - Tailor the data to match how you're managing
    - IPTs?
  - Make it as real time as possible

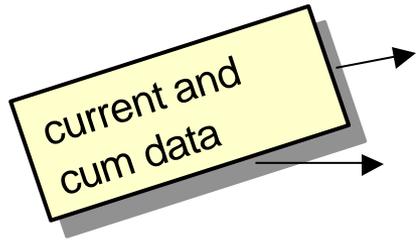




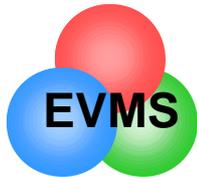
# Contractor Reports

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- **Cost Performance Report (CPR)**



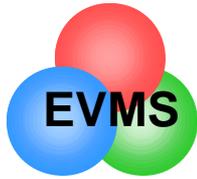
- Format 1: cost and schedule progress by **WBS**  
(specified reporting level usually at level 3)
- Format 2: cost and schedule progress by **organization**
- Format 3: changes to performance measurement baseline
- Format 4: manpower forecast
- Format 5: variance analysis



# Formats 1 and 2

- Contents
  - header:
    - basic contract information (target, ceiling, name of contractor, etc.)
    - range of final estimates
  - body
    - performance data
    - variances
    - budget at completion, estimate at completion

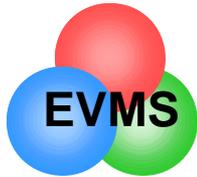
	CURRENT					CUMULATIVE					AT COMPLETION		
	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	CV	BUDGET	ESTIMATE	VARIANCE
ELEMENT													
ELEMENT													
ELEMENT													
ELEMENT						<b>WBS or ORGANIZATION</b>							
ELEMENT													
ELEMENT													
TOTAL													
UB													
PMB													
MR													
TOTAL													



# Cost/Schedule Status Report (C/SSR)

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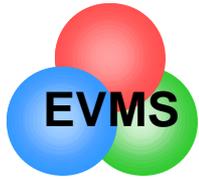
- Similarities to CPR
  - Format 1 (WBS)
  - Format 5 (Problem Analysis)
- Differences
  - Does not require use of approved management system & criteria
  - No current period reporting
  - BCWS and BCWP may be calculated by logical means at higher levels
- Application
  - non-major contracts



# Reform Initiatives

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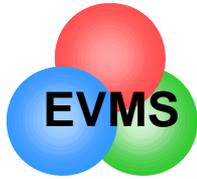
- Contractor format acceptable
- Electronic submission required
  - ANSI X12 data set
- Tailoring
  - Only ask for the data that you are really going to use
- Timing
  - flash data (early submittal of performance data before variance analysis)



# Analysis Techniques

or

figuring out where the problems are

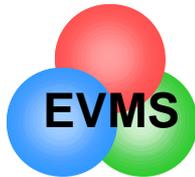


# Analysis Techniques

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- Sort on significant variances
  - eliminate almost complete, just starting, etc.
- Graph and analyze trends
- Look at comparative data
  - e.g. cumulative performance vs. projected performance
- Examine written analysis by contractor
  - does it answer why?
  - adequacy of corrective action plans
- Analysis of schedule trends, critical path
- Analysis of EAC realism

what are the drivers?  
what can we do about them?



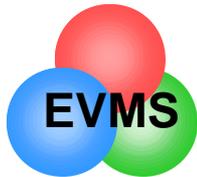
# Where are the significant problems?

sorted by CV \$



	WBS	DESCRIPTION	Proj Ofcr	%Comp	%Spent	CPI	CV	CV	CV %	VAC	VAC
1	3600	PCC	Zepka	28.99	34.09	0.850	↑	-296.2	-17.62	↔	-187.2
2	3200	COMMUNICATIONS	Tideman	34.63	41.03	0.844	↓	-130.8	-18.49	↔	-87.0
3	G&A	GEN & ADMIN		33.67	36.11	0.932	↓	-45.2	-7.26	↔	-36.8
4	2200	SYS ENGINEERING	Price	85.04	94.35	0.901	↓	-26.4	-10.95	↔	0.0
5	3800	I & A	Troop	35.40	37.08	0.955	↓	-24.2	-4.75	↔	-24.8
6	2100	PROJ MANAGEMENT	Brown	45.70	48.51	0.942	↔	-17.4	-6.16	↔	-3.2
7	2300	FUNC INTEGRA	Price	71.62	75.23	0.952	↓	-17.4	-5.03	↔	-30.8
8	5200	MANAGEMENT DATA	Simmons	84.18	98.10	0.858	↓	-13.2	-16.54	↑	-16.0
9	3100	SENSORS	Smith	20.87	21.49	0.971	↓	-10.6	-2.94	↔	-21.6
10	4000	SPARES	Blair	17.87	18.90	0.945	↑	-7.8	-5.78	↔	-6.2
11	6200	SYSTEM TEST	Hall	60.82	61.66	0.986	↑	-5.6	-1.38	↔	-2.0
12	5100	ENG DATA	Novak	38.51	52.80	0.729	↓	-4.6	-37.10	↔	0.0
13	MR	MGT RESERVE		0.00	0.00			0.0		↔	439.2
14	UB	UNDIST BUDGET						0.0			0.0
15	COM	COST OF MONEY						0.0			0.0
16	3700	DATA DISPLAY	Troop	41.13	41.13	1.000	↔	0.0	0.00	↔	0.0
17	OV	OVERHEAD						0.0			0.0
18	6100	TEST FACILITIES	Smart	100.00	98.02	1.020	↔	2.0	1.98	↔	0.0
19	3500	COMP PROGRAMS	Pino	46.46	44.66	1.040	↓	3.4	3.87	↔	-1.4
20	6300	PCC TEST	Bond	23.13	22.64	1.021	↓	4.2	2.10	↔	0.0
21	3400	ADPE	Zepka	41.89	39.79	1.053	↓	12.6	5.02	↔	4.6
22	3300	AUX EQUIP	Tideman	27.57	24.33	1.133	↓	78.2	11.73	↓	8.4





# Analysis of Variances

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CURRENT OR CUM TO DATE

**Schedule Variance**

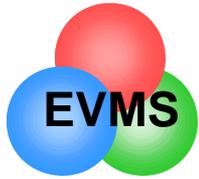
$$SV (\$) = BCWP - BCWS$$

$$SV (\%) = \frac{BCWP - BCWS}{BCWS} \times 100\%$$

**Cost Variance**

$$CV (\$) = BCWP - ACWP$$

$$CV (\%) = \frac{BCWP - ACWP}{BCWP} \times 100\%$$



# CASE STUDY

## Part 4

# Case Study - Accounting Data

• Month 1	road	\$700	700
• Month 2	road	\$720	1,700
	drawings	\$980	
• Month 3	road	\$300	1,300
	tunnel	\$200	
	ASM	\$800	
• Month 4	road	\$1,500	2,300
	tunnel	\$400	
	ASM	\$400	
• Month 5	road	\$700	5,200
	tunnel	\$500	
	ASM	\$1,900	
	anvil	\$1,700	
	install	\$400	
• Month 6	install	\$2,100	<u>2,100</u>
• total			\$13,300

EV Techniques      0/100, 50/50, Units Complete,  
% Complete, Milestones

CONTROL ACCT. TITLE: Roadrunner

CONTROL ACCOUNT MANAGER: Wile E. Coyote

BUDGET: \$10,000

TIER I MILESTONE			↑ KT AWD					↑ KT COMP		
WP#	WORK DESCRIPTION	EV METHOD	MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6	TOTAL BAC	
1	Procure Anvil	0/100	<b>BCWS</b>				1,500		1,500	
			<b>BCWP</b>				▲ 1,500			
2	Paint Fake Tunnel	50/50	<b>BCWS</b>		▲ 500	▲ 500	◆		1,000	
			<b>BCWP</b>			△ 500		◆ 500		
3	Build Road	units complete	<b>BCWS</b>	▲ 600	▲ 600	△ 600	▲ 600	▲ 600	3,000	
			<b>BCWP</b>	▲ 600	▲ 600	-	▲ 1,200	▲ 600		
4	Build ASM	milestone	<b>BCWS</b>		▲ 1,000	△ 1,000	▲ 1,000	◆	3,000	
			<b>BCWP</b>		▲ 1,000	-	▲ 1,000	◆ 1,000		
5	Install ASM	% complete	<b>BCWS</b>				▲ 500	▲ 500	1,500	
			<b>BCWP</b>				△ -	▲ 1,200		
TOTAL CONTROL ACCOUNT PLAN			<b>BCWS</b>	600	1,600	2,100	2,600	2,600	500	10,000
			<b>BCWP</b>	600	1,600	500	2,200	3,900	1,200	10,000
<b>Schedule Variance</b> month										
cumulative										
<b>Actual Costs</b>										
<b>Cost Variance</b> month										
cumulative										

EV Techniques

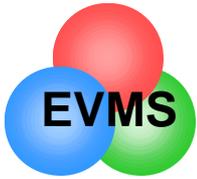
0/100, 50/50, Units Complete,  
% Complete, Milestones

CONTROL ACCT. TITLE: Roadrunner

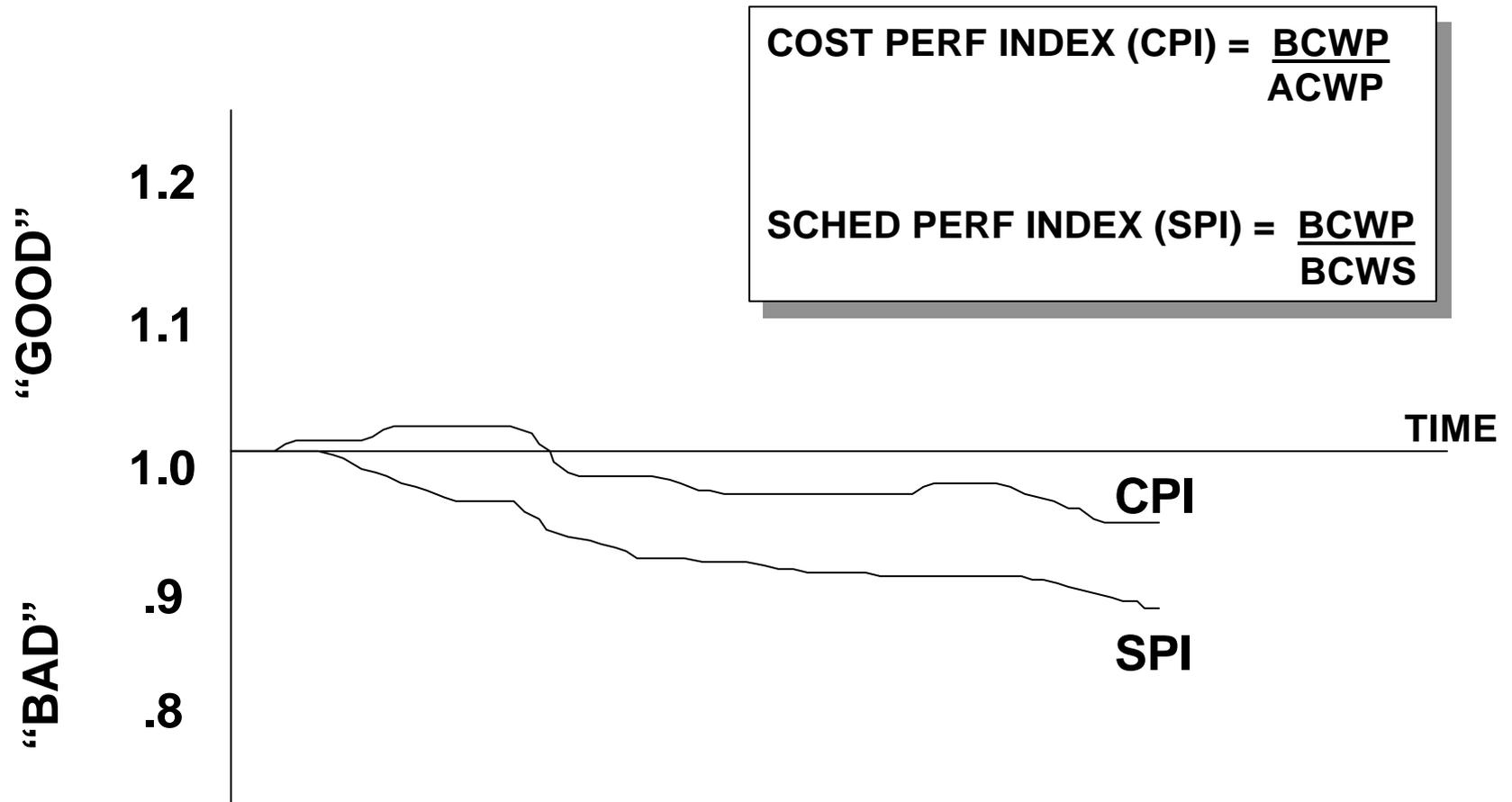
CONTROL ACCOUNT MANAGER: Wile E. Coyote

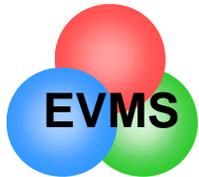
BUDGET: \$10,000

TIER I MILESTONE			↑ KT AWD					↑ KT COMP		
WP#	WORK DESCRIPTION	EV METHOD	MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6	TOTAL BAC	
1	Procure Anvil	0/100	<b>BCWS</b>				1,500		1,500	
			<b>BCWP</b>				▲ 1,500			
2	Paint Fake Tunnel	50/50	<b>BCWS</b>		▲ 500	▲ 500	◆		1,000	
			<b>BCWP</b>			500	500	◆		
3	Build Road	units complete	<b>BCWS</b>	▲ 600	▲ 600	▲ 600	▲ 600	▲ 600	3,000	
			<b>BCWP</b>	600	600	-	1,200	600		
4	Build ASM	milestone	<b>BCWS</b>		▲ 1,000	▲ 1,000	▲ 1,000	◆	3,000	
			<b>BCWP</b>		1,000	-	1,000	1,000		
5	Install ASM	% complete	<b>BCWS</b>				▲ 500	▲ 500	▲ 500	1,500
			<b>BCWP</b>				-	300	1,200	
TOTAL CONTROL ACCOUNT PLAN			<b>BCWS</b>	600	1,600	2,100	2,600	2,600	500	10,000
			<b>BCWP</b>	600	1,600	500	2,200	3,900	1,200	10,000
<b>Schedule Variance</b>										
month			0	0	-1,600	-400	1,300	700		
cumulative			0	0	-1,600	-2,000	-700	0		
<b>Actual Costs</b>										
			700	1,700	1,300	2,300	5,200	2,100	13,300	
<b>Cost Variance</b>										
month			-100	-100	-800	-100	-1,300	-900		
cumulative			-100	-200	-1,000	-1,100	-2,400	-3,300		



# Performance Indices



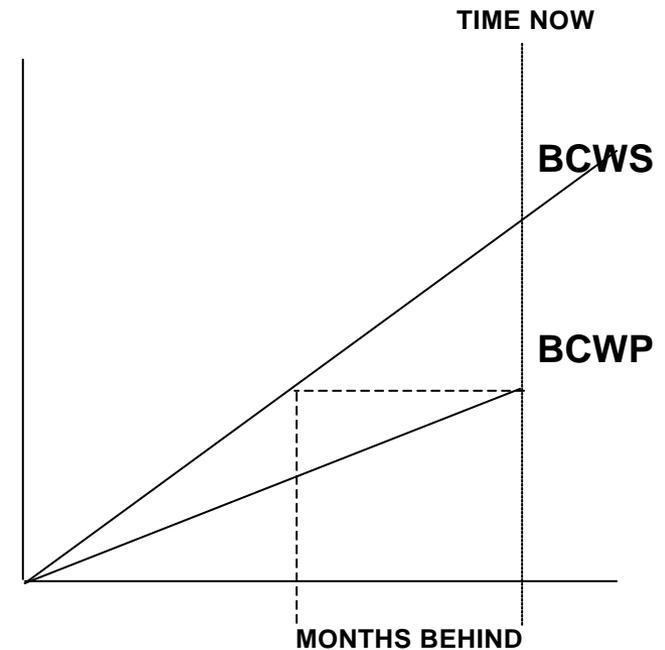


# Schedule Status

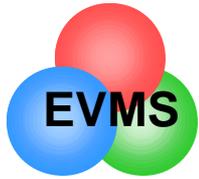
$$\% \text{ scheduled} = \frac{\text{BCWS}}{\text{BAC}} \times 100\%$$

compare

$$\% \text{ completed} = \frac{\text{BCWP}}{\text{BAC}} \times 100\%$$



$$\text{Months ahead or behind} = \frac{\text{SV \$}}{\text{Average monthly BCWS \$}}$$



# Budget Status

## budget status

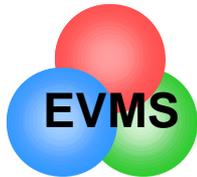
$$\% \text{ spent} = \frac{\text{ACWP}}{\text{BAC}} \times 100\%$$



**compare:**

**% spent vs. % complete**

**example: 60% spent vs. 50% complete**



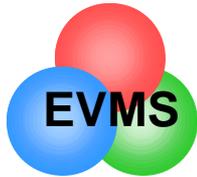
# Variance Explanations

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- **Format 5 variance analysis should address:**

- separate discussion of CV, SV (current and cum) and VAC
- clear description of reason for variance
- quantity variances (e.g., price vs. usage)
- be specific, not general
- corrective action
- technical, schedule, and cost impacts
- impact to estimate at completion
  
- should be written by CAM!

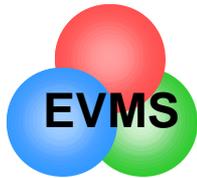




# Significant Variances

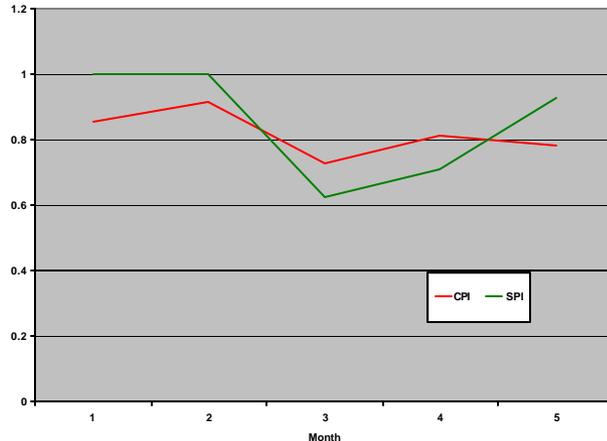
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- What is a **significant** variance?
  - % variance (e.g., >10%)
  - \$ variance (e.g., >\$50,000)
  - critical path element
  - risk/complexity
  - impact to other elements
  - Top 10, Top 20, etc.
  - contractor defined



# Case Study Analysis (month 5)

CPI and SPI



## Variance Analysis Report

The program is now 88% complete. We have now spent \$1,200 more than our original budget, primarily driven by two problems:

- 1) building the sections of roads (unforeseen grading problems)
- 2) manufacturing and quality testing of the ASM (increase in the price of raw stock and higher rates than forecast for quality personnel)

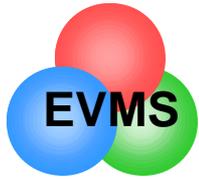
We are only 20% complete on installation, instead of our scheduled 66%. In order to meet contract schedule, we will have to expend overtime. Costs will increase by an expected \$1,000.

## Performance Report, Month 5

	BCWS	BCWP	ACWP	SV	CV	CV %
Procure Anvil	1,500	1,500	1,700	0	-200	-13%
Paint Fake Tunnel	1,000	1,000	1,100	0	-100	-10%
Build Road	3,000	3,000	3,920	0	-920	-31%
Build ASM	3,000	3,000	4,080	0	-1,080	-36%
Install ASM	1,000	300	400	-700	-100	-33%
	9,500	8,800	11,200	-700	-2,400	

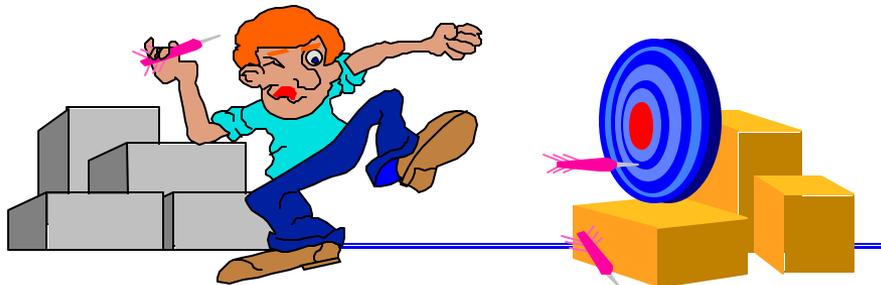


	BCWS	BCWP	ACWP	SV	CV	CV %
Build ASM	3,000	3,000	4,080	0	-1,080	-36%
Build Road	3,000	3,000	3,920	0	-920	-31%
Procure Anvil	1,500	1,500	1,700	0	-200	-13%
Paint Fake Tunnel	1,000	1,000	1,100	0	-100	-10%
Install ASM	1,000	300	400	-700	-100	-33%

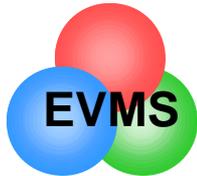


# What will be the final cost?

- **Estimate at Completion (EAC)**
  - defined as actual cost to date + estimated cost of work remaining
  - contractor develops comprehensive EAC at least annually
    - reported by WBS in cost performance report
  - should examine on monthly basis
  - consider the following in EAC generation
    - performance to date
    - impact of approved corrective action plans
    - known/anticipated downstream problems
    - best estimate of the cost to complete remaining work
  - also called latest revised estimate (LRE), indicated final cost, etc.



$$\text{ACWP} + \text{ETC} = \text{EAC}$$



# One method: statistical formulae

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- **Common EAC Formulae:**

EAC =

$$\frac{\text{BAC}}{\text{CPI}}$$

=

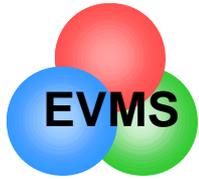
$$\text{ACWP}_{\text{cum}} + \frac{\text{Budgeted Cost of Work Remaining}}{\text{CPI}_3}$$

=

$$\text{ACWP}_{\text{cum}} + \frac{\text{Budgeted Cost of Work Remaining}}{.8(\text{CPI}) + .2(\text{SPI})}$$

=

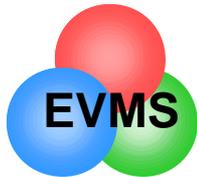
$$\text{ACWP}_{\text{cum}} + \frac{\text{Budgeted Cost of Work Remaining}}{\text{CPI} * \text{SPI}}$$



# Other methods of EAC calculation

---

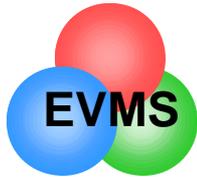
- “Grass Roots” or formal EAC
  - detailed build-up from the lowest level detail
  - hours, rates, bill of material, etc.
- Average of statistical formulae
- Show range of EACs (optimistic, most probable, pessimistic)
- Complete schedule risk analysis for remaining work, estimate work remaining



## Why do we need accurate EACs?

---

- **Variance at Completion vs. Contractor Loss**
  - **Positive VAC:**
    - $EAC < BAC$       underrun      contractor gain
  - **Negative VAC:**
    - $EAC > BAC$       share area      contractor partial loss
    - $EAC > \text{ceiling}$       overrun      contractor loss (100%)
- **Government develops top level EAC for comparison**
  - government will limit progress payments if EAC is greater than ceiling
  - government needs forecast of fund requirements
- **May still have time to change the final outcome**



# Survey says.....

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- over 800 military programs show that .....

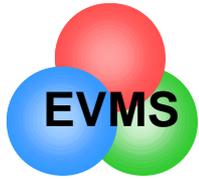
no program has ever improved performance better than the following EAC calculation

$$EAC = \frac{BAC}{CPI}$$

at 15% complete point in program

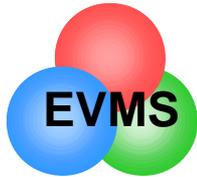
*no one pays enough attention in the*





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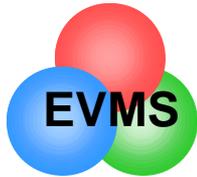
# Managing with Earned Value Data



# Managing with EVMS

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- Change the mindsight
- Tailor to how the contractor actually manages
- Make it forward looking
- Assign responsibility within the government program office
- Set up a faster response time
- Acquire and use software analysis tools

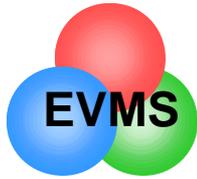


# The New Way to Do Business

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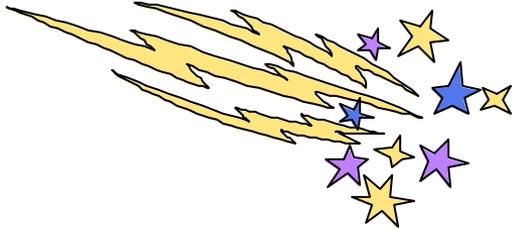
- Ownership by program managers and IPTs
- Industry taking lead to make EVMS a basis business practice
- Use of earned value reporting as management tool to avoid cost overruns (forward looking)
- Schedule management an integral part of project management
- New focus for reviews
  - baseline realism, executability
  - insight, not oversight

*EVMS is a cultural change for program managers*



# How can we manage programs using Earned Value?

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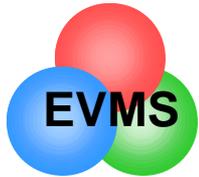


**In order for Earned Value to be used as a management tool....**

***We must tailor it to reflect the management structure, policy, and operating culture of the contractor.***

**Otherwise, it will be seen simply as an external report that reports history!**





# Forward Look

Time now

**Where we've been**

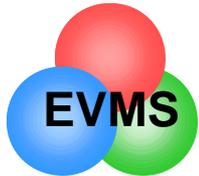
Cum SV\$  
CPI  
Cum CV\$  
Variance explanation  
SPI  
3 month avg

**COST HISTORY**

**Where we're going**

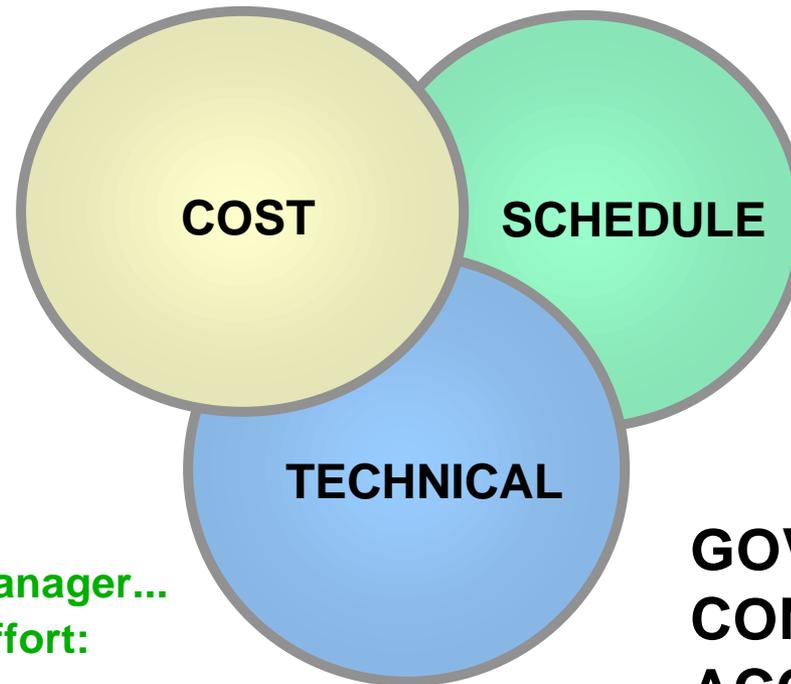
BCWR  
Schedule risk  
Technical risk  
TCPI-LRE  
ETC  
TCPI-BAC  
Projected variances

**COST AVOIDANCE**



# The Control Account Manager

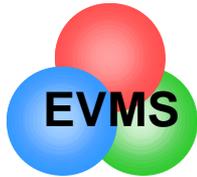
**CONTROL  
ACCOUNT  
MANAGER  
(CAM)**



**GOVERNMENT  
CONTROL  
ACCOUNT  
MANAGER  
(GCAM)**

**Empowered by program manager...**

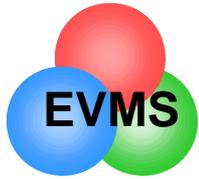
- **Manage assigned effort:**
  - **Technical**
  - **Schedule**
  - **Cost**
- **Monthly variance analysis**
- **Understand the baseline**



# Analysis within the SPO

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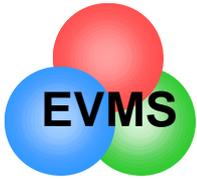
- Assign to technical managers within program offices
  - Government Control Account managers (GCAMs)
- Conduct monthly team variance meetings
- Open, honest communication essential
  - Oral, e-mail, and face-to-face discussions
  - Continuing dialogue dramatically improves Format 5
- Early warning analysis
  - Top level cost and schedule analysis by EVMS and schedule analysts
  - CAM/GCAM analysis at lowest level
- Work closely with DCMC team
- Share results of analysis with contractor



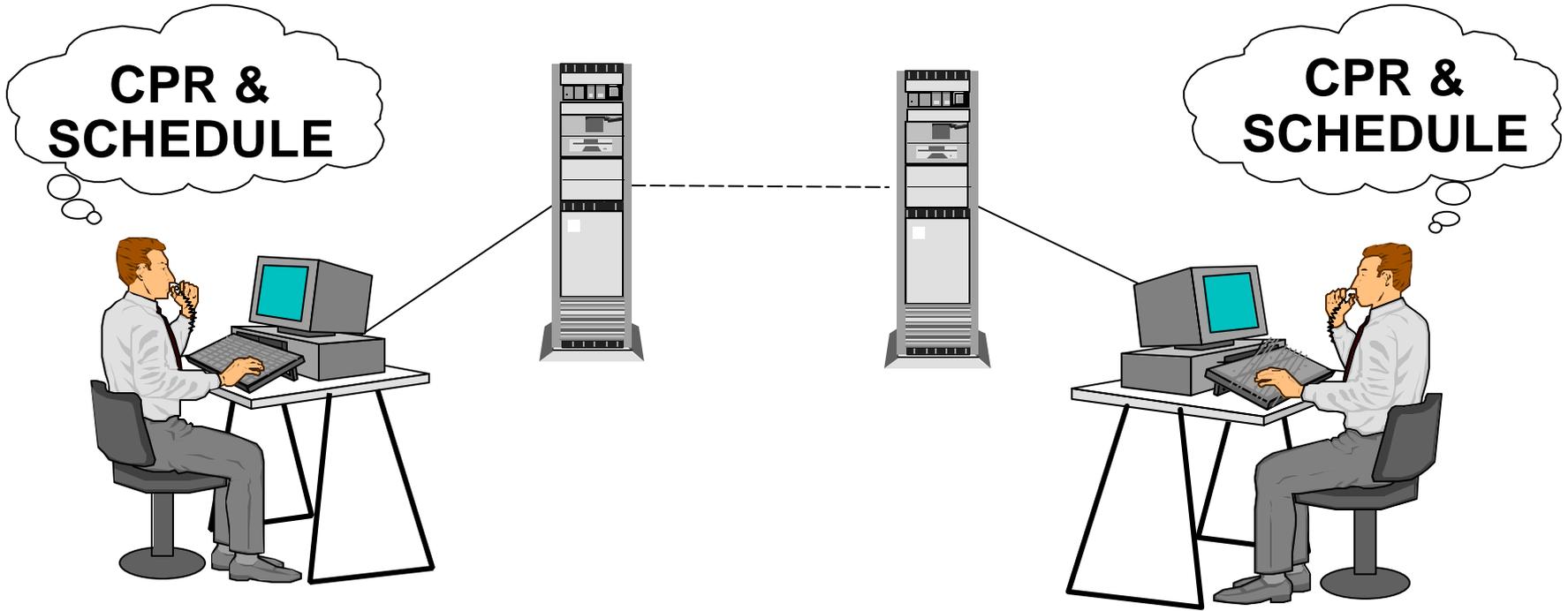
# Early Warning System

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- Flash data received ASAP, no written analysis
- EVMS and schedule managers review data
- Teleconference with DCMC
  - evaluate cost and schedule variances
  - evaluate trends
  - evaluate against program master schedule
- Prepare top level analysis to program manager and IPT leads
  - recommend elements for further analysis
- GCAMs discuss their elements with CAMs
  - write up own variance analysis
- Don't wait until you get the report to communicate!



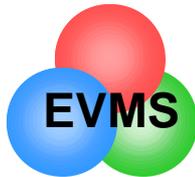
# New Advances in Software Analysis Tools



**CAM**



**GCAM**



# Let software tools do the number crunching

WBSight - MOH-2 WBS JAN 93 DOL

File Edit Sort Charts Reports Input Options Window Help

Sort: CUM CV Percent MOH-2 WBS JAN 93 DOL

	DESCRIPTION	LVL	LL	SV	CV	VAC	VAR	SV	CV	VAR
1	ENG DATA	3	✓	↓	↓	→		-6.6	-4.6	
2	COMMUNICATIONS	3	✓	↑	↓	→	sc	-203.2	-130.8	
3	PCC	3	✓	↓	↑	→		-11.4	-206.2	-1
4	MANAGEMENT DATA	3	✓	↑	↓	→		0.0	-13.2	
5	SYS ENGINEERING	3	✓	→	↓	→		6.4	-26.4	
6	GEN & ADMIN	2	✓	↓	↓	→		-39.0	-45.2	
7	PROJ MANAGEMENT	3	✓	↑	→	→		-12.0	-17.4	
8	SPARES	2	✓	↑	↑	→		1.2	-7.8	
9	FUNC INTEGRA	3	✓	↓	↓	→		-7.6	-17.4	
10	I & A	3	✓	↓	↓	→	sc	63.0	-24.2	
11	SENSORS	3	✓	↑	↓	→		-36.6	-10.6	
12	SYSTEM TEST	3	✓	↓	↑	→		12.0	-5.6	
13	OVERHEAD	2	✓					0.0	0.0	
14	UNDIST BUDGET	2	✓					0.0	0.0	
15	DATA DISPLAY	3	✓	↑	→	→	S	-113.0	0.0	
16	COST OF MONEY	2	✓					0.0	0.0	

CPI and SPI MOH-2 WBS JAN 93 DOL

AI Narrative Report MOH-2 WBS JAN 93 DOL

**WBS AI Narrative (Dollars)**

As of: JAN 93  
 Contract Name: MOH-2 Financial Analyst: MR E. I  
 Contract Number: F04695-86-C-0050 Contract Manager: MR B.  
 Contractor: MEGA HERZ ELEC & VEN

Element Code: 1000 Project Officer: Jones  
 Element Name: MOH-2 Office Symbol: JDHD

**CUMULATIVE PERFORMANCE**

As of JAN 93, the work scheduled was 7,278.6. This means that the effort was about 35.0% complete (100\*BCWS/BAC). Accomplishments, represented by B, indicate that 6,850.8 worth of work has been performed.

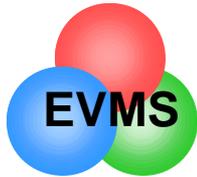
Work accomplished to date (BCWP) is less than the work that was scheduled (B, that the effort is behind schedule. Last period, BCWS was 5,633.2 and BCWP was

Actual expenditures through this period are 7,349.8, which means that to date, t

Cumulative Variance MOH-2 WBS JAN 93 DOL

Ready

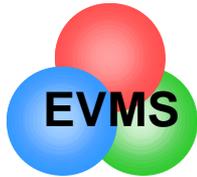
1000-MOH2 | CUM | DOL | LOWEST | All Elements



# Joint Use of Software Tools

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- **Trend Analysis - Where Have we Been?**
  - Lowest WBS level or IPT level
  - color codes, charts
- **Projection of future - How Bad Can it Get?**
  - EAC trends
  - comparison of cost efficiencies
- **Focus on problems - What are the significant drivers?**
  - Sort by elements, trends, CAM names
  - autosync to program schedule
- **Format 5 Analysis - What are we doing about it?**
  - Joint analysis, corrective plans, risk mitigation
- **Report generator**
  - all formats
  - can go **paperless**



## Notable EVMS Quotes

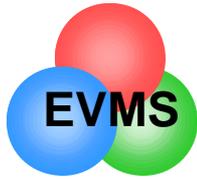
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**“Are we looking good, or are we in trouble? And, how do we know?”**

**CAPT Joe Dyer, USN  
F/A-18E/F Prog Mgr**

**“It forces you to plan, and then to manage to the plan.”**

**Lt Col Paul Vancheri, USAF  
JSTARS Production Prog Mgr**

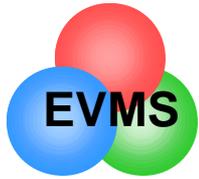


# Summary

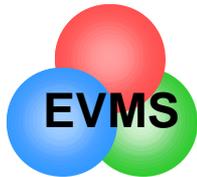
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- ***Measures of Successful Reform***
  - EVMS used to make daily decisions about program execution
    - contractor and government
  - Reports are not seen as burdensome  
and
  - **Programs are completed  
on time and within budget**





# Additional References

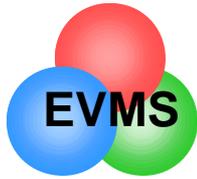


## SCHEDULE TYPES

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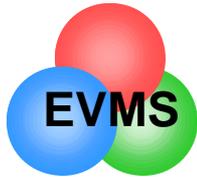
- **Gantt Chart**
  - **Activities Show a Specific Start and Stop Date**
- **Milestone Chart**
  - **Major Event Oriented. Shows Start or Stop Date of Activity**
- **Line of Balance**
  - **Depicts Production Activity. Actual versus Planned Output**
- **Networking**
  - **Identifies and Defines all Activities and Events for a Program and Links Them in Logical “Cause and Effect” Sequences**





# MATERIAL EARNED VALUE METHODOLOGIES

Category	Definition	Earned Value Approach
Material	Raw materials, piece parts, and low value purchased items	Percent complete against total projected purchase requirement. Milestones by order
Major Material	High cost items that are standard products such as from a catalog. These are individually tracked due to their cost or criticality to the program	Each item represents an individual milestone  An order of multiple items may use percent complete against the total quality
Fixed Price Subcontracts	High cost (usually negotiated) items purchased against specification or drawing. These items require individual management	Milestones against deliveries or subcontract milestones. May require estimated actuals or percent complete if no progress payments or interim deliveries
Cost Subcontracts	High cost (usually negotiated) items purchased against a specification or drawing. These items require individual management	Flow down of Cost/Schedule Status Report (C/SSR) or C/SCSC requirements. If small may use payments and negotiated subcontract milestones.



# PERFORMANCE STATUS...KEY THINGS TO TRACK

---

- **DO I HAVE ANY SIGNIFICANT COST/SCHEDULE VARIANCES?**

- Schedule Variance

- Plus (+) is good

- Minus (-) is bad

- What is the variance %

- Is it on the critical path

- Schedule slack?

- Is it in an area that has been identified as a risk element?

- Cost Variance

- Plus (+) is good

- Minus (-) is bad

- What is the variance %

- $$\frac{CV}{BCWP} \times 100$$

- $$\frac{SV}{BCWS} \times 100$$

- **WHAT IS THE TREND (GETTING BETTER OR WORSE)?**

- Chart the Cost/Schedule variance trends

- Does my contractor tell the same story as the data?

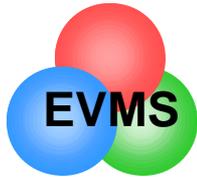
- When do I think the trend will improve?

- **WHAT AM I DOING ABOUT IT?**

- Causes

- Corrective actions

- Impact to the program



## USE DATA FOR DECISION MAKING

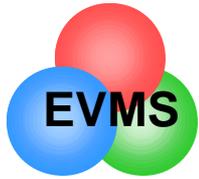
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- **Behind Schedule**

- How critical is schedule?
- Can I afford to work overtime to recover?
- Can I do tasks concurrently?
- Are there technical innovations which could speed up the process?
- Am I “gold plating” instead of just meeting requirements?
- Should I do a schedule risk assessment to project impact to program?

- **Over Cost**

- Can I reschedule tasks? (Timephasing)
- Is there a less costly facility I can use?
- Are there tasks which can be deleted?
- Should the element be added to my risk management profile?



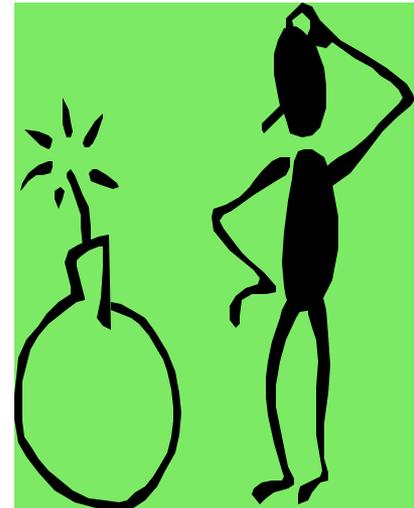
# EARNED VALUE PROBLEM INDICATORS

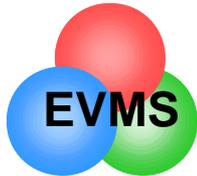
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**GOAL: To Verify That Effective Variance Analysis Processes Are Applied To Identify, Correct, And Report Problems**

- **POTENTIAL PROBLEM INDICATORS:**

- Zero variances
- Monthly trends turning negative or downward
- Schedule variances generally indicate cost will follow
- Actuals > Latest Revised Estimates (LRE)
- BCWP increases with no increase in ACWP
- Negative data elements





# PERFORMANCE EFFICIENCY AND EACs

- DO I THINK THE CONTRACTOR WILL COME IN ON BUDGET?

## COST PERFORMANCE INDEX:

CPI = cost efficiency for work performed to date  
(The value of work accomplished for each dollar spent)

$$= \frac{\text{BCWP}}{\text{ACWP}} = \frac{\text{WORK ACCOMPLISHED}}{\text{ACTUALS}} = \frac{\$1000}{\$2400} = .42$$

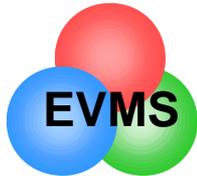
HISTORY

## Compare the CPI to the TCPI-BAC:

TCPI(BAC) = Efficiency necessary to complete on budget

$$= \frac{\text{BAC-BCWP}}{\text{BAC-ACWP}} = \frac{\text{WORK REMAINING BUDGET REMAINING}}{\text{BUDGET REMAINING}} = \frac{\$5000 - \$1000}{\$5000 - \$2400} = \frac{\$4000}{\$2600} = 1.54$$

FUTURE



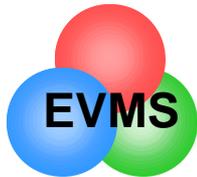
## PERFORMANCE EFFICIENCY AND EACs (cont'd)

---

### SCHEDULE PERFORMANCE INDEX:

**SPI = schedule efficiency with which work has been accomplished  
(The rate at which work is being accomplished)**

$$= \frac{\text{BCWP}}{\text{BCWS}} = \frac{\text{WORK ACCOMPLISHED}}{\text{WORK SCHEDULED}} = \frac{\$1000}{\$2000} = .50$$



## PERFORMANCE EFFICIENCY AND EACs (cont'd)

- **IS THE CONTRACTOR'S EAC (LRE) REASONABLE?**

Compare the CPI to the TCPI-LRE

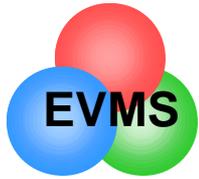
TCPI(LRE) = Efficiency necessary to complete at the contractor's estimate

$$= \frac{\text{BAC-BCWP}}{\text{LRE-ACWP}} = \frac{\text{WORK REMAINING}}{\text{ESTIMATE REMAINING}} = \frac{\$5000 - \$1000}{\$6400 - \$2400} = \frac{\$4000}{\$4000} = 1.00$$

↑  
reasonable?  
↓

Cumulative performance to date (CPI) = .42

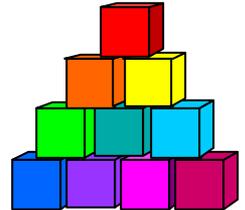
Contractor has been performing at 42% efficiency, but expects to complete remaining work at 100% efficiency!

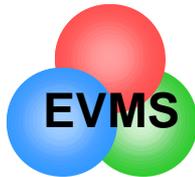


# Ten Wisdom Principles of EVMS

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1. Use a single management control system to provide accurate and timely performance data.
2. Integrate the scope of work, schedules, and costs using a common project language, such as a work breakdown structure.
3. Actual performance at the 15% complete point can be used to predict final performance.
4. Cumulative cost performance index ( $CPI_e$ ) measures efficiency and can be used to predict the final range of costs.
5. The schedule performance index (SPI) is useful in assessing how much work has been accomplished.
6. The CPI index provides a statistical basis for a “best case” final estimate.
7. The CPI and SPI indices may be combined to statistically forecast the “most likely” final estimate.
8. To Complete Performance Index provides a measure of efficiency required for the future work to achieve either a specified budget or estimate.
9. The periodic cost performance index for performance ( $CPI_p$ ), calculated by actuals/earned value, may be used to monitor weekly or periodic production progress.
10. Management should use management by exception to focus on significant variances to the plan and apply timely corrective actions.





## Key Documents in Understanding EVMS

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- Gary Christle, 22 Jan 94, paper, Implementation of Earned Value - A Model Program Approach
- USD(A&T) Letter, 25 Jan 94, Improved Cost and Schedule Performance Management
- Gary Christle, 15 Sep 94, paper, The Cost/Schedule Control Systems Criteria and Earned Value Management: A Vision
- USD(A&T) Letter, 1 Oct 96, Compliance Responsibility for the Cost/Schedule Control Systems Criteria (C/SCSC)
- 3 Oct 97, Earned Value Management Implementation Guide (Rev 1)
- USD(A&T) Letter, 14 Dec 96, Industry Standard "Guidelines for Earned Value Management Systems"
- Wayne Abba, article in Jan-Feb 97 Program Manager magazine, Earned Value Management - Reconciling Government and Commercial Practices
- ANSI/EIA 748-1998, Earned Value Management Systems
- Quentin W. Fleming & Joel M. Koppelman, book, Earned Value Project Management
- Earned Value web page: [www.acq.osd.mil/pm](http://www.acq.osd.mil/pm)