Assessing Project Progress and Performance

What is the importance of this topic?

- **The project has started. We are doing work now.**
- **Management wants to know how the project is doing?**
  - **Are we on schedule?**
  - **Are we within the budget?**

Management Question:

What is the Progress of the Project?

Classic Management Control

Earned Value Analysis

Measures and Indicators of Project Performance

Budget and Cost Analysis

Estimating Final Project Cost

Importance of this Section
It is important to be able to assess the performance of the project, once it has begun to be implemented. Your higher-level management may be asking you or expecting you to make periodic reports. Or, your customer may be interested in how the project is progressing.

As the project manager, you will be expected to answer the questions of "how is the project doing?" Is it still within the budget? Is it still within the planned scheduled? At various points in performing the actual project, you will want to make project progress reports. If the project is spending over the budget, somebody will need to make arrangements for extra money to be available to pay for the extra project work necessary to complete the project.

This section explains the measures used to provide the answers to the progress performance questions.

Measuring Project Efficiency and Progress

1. Part I

Managers are responsible for project performance and the final results. What are the concerns of project managers and of the customers, in general?

Measure of Project Performance:

1. Budget
2. Schedule
3. Quality (customer requirements)

Questions about the project:

1. How is the Project Doing? What is the Progress of the Project?
    a. Budget.
        i. How are we spending the budget?
            1. Over budget? Spending too much and we need more money.
            2. Under budget? Spending less than anticipated. Saving money.
        ii. What does this imply for the future (remainder of the project)?
    b. Schedule?
        i. How is the project schedule progressing?
            1. Are we on schedule or ahead of schedule?
            2. Are we behind schedule?
        ii. What does this imply for staying on schedule in the future?

Classic Budget Control Analysis: Comparing Budget Costs to Planned Budget

Situation #1. Assume the following is the report at the 30% point in the project. How is it going?

Expected	
Planned (PV)	Actual Cost (AC)
$100	$80

Data

- Planned objective was to spend $100 for the project at the 30% reporting point.
- Actual cost spent was $80.

Analysis

- The budget spent is **less** than anticipated by $20.

Classical Management Conclusion:

- The project manager is happy. The project is not over spending (saving $20)

Situation #2. Assume the following is the report at the 30% point in the project. How is it going?

Expected	
Planned (PV)	Actual Cost (AC)
$100	$120

Data

- Planned objective was to spend $100 for the project at the 30% reporting point.
- Actual cost spent was $120.

Analysis

- The budget spent is **more** than anticipated by $20.

Classical Management Conclusion:

The project manager is sad. The project is over spending by $20

But, Classic Mgt Perspective is Wrong!! It is Incomplete
We Need EARNED VALUE to Analyze Project Performance

The preceding perspective is incomplete. We do not know how much work that the workers got accomplished up to the reporting period.

EXPLAIN THE FOLLOWING

- If we plan $100 and accomplish $120 of work, then our schedule would be **efficient**.
  - **Spending** $120: **NORMAL** for the work we accomplished. **OK** on cost.
  - **Spending** $200: **OVERSPENDING** for the work we accomplished. **BAD** on cost.
  - **Spending** $80: **UNDERSPENDING** for the work we accomplished. **GOOD** on cost.
- If we plan $100 and accomplish $80 of work, then our schedule would be **inefficient**, AND
  - **Spending** $80: **NORMAL** for the work we accomplished. **OK** on cost.
  - **Spending** $120: **OVERSPENDING** for the work we accomplished. **BAD** on cost.
  - **Spending** $50: **UNDERSPENDING** for the work we accomplished. GOOD on cost.

	PV = $100 Planned EV = $120 Accomplished	PV = $100 Planned EV = $80 Accomplished
Spending $80	**UNDERSPENDING** for the work we accomplished.	***NORMAL*** *for the work we accomplished.*
Spending $120	**NORMAL** for the work we accomplished.	***OVERSPENDING*** *for the work we accomplished.*
Spending $200	**OVERSPENDING** for the work we accomplished.	***VERY OVER SPENT*** *for the work we accomplished.*
Spending $50	***VERY UNDER SPENT*** *for the work we accomplished.*	**UNDERSPENDING** for the work we accomplished.
Spending $80	***UNDER SPENT*** *for the work we accomplished.*	**NORMAL** for the work we accomplished.
Spending $120	***NORMAL*** *for the work we accomplished.*	**OVERSPENDING** for the work we accomplished.

Five Fundamental Measures for Project Performance

The Project Management Institute (PMI.com) advocates various measures for project performance. Project management professionals often use only ***five measures (values or numbers)*** to assess the efficiency and progress of a project, after the project has begun.

PV	Planned Work ($$)	BCWS	**Work effort** we **plan** to accomplish (or get done) in the **future**.
AC	Actual Cost ($$)	ACWP	Actual **$$$ paid** for **work effort** performed.
EV	Earned Value ($$)	BCWP	**Work effort** that we have completed in the **past** (up to this reporting period). Also. **work effort** that **was** planned and some or all of it has now been **completed**.
BAC	Original scheduled budget	BAC	**Total project work effort**, summed across the initial time-phased budgets for every the task.
EAC	Estimated Budget at Completion	EAC	New estimated total project cost due to changes in the project schedule. Based on revised costs (for the remaining work effort) to end of project.

Test your understanding of the wording that can be used with EV in contrast with PV

Go to next page first—Then try this quiz.

(Answers are at the bottom of the next page.)

1. $50 of work is anticipated. $75 of work got done or was accomplished.

   EV = _____ PV = _____

2. $200 of work is expected to actually be accomplished for the first reporting period. The report of actual work that was planned to be accomplished was $175.

   EV = _____ PV = _____ AC = _____

3. $120 is the money spent on the planned work for the reporting period. $100 is what you planned to earn for that period. The cost value of the actual amount of work that you performed was $150.

   EV = _____ PV = _____ AC = _____

Summary:

- **EV:** $$ **Dollar value** of **work** we have actually **accomplished** (earned work or earned value)
- **PV:** $$ **Dollar value** of **work** we **plan** to accomplish in the **future**.
- **AC:** $$ Dollar **Cost** of work we have **paid** real money for, i.e., any reference to cost **paid** from our bank account (must be in the past).

From #2 above, AC = no value. Actual work is not the same as actual cost paid.

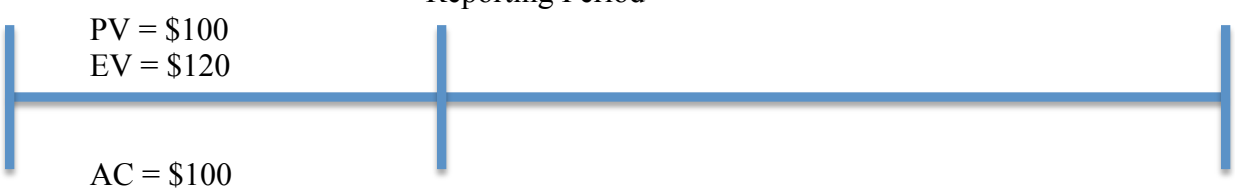
The **Earned Value** is the key measure.
Provides ***insights*** into **how well** the project is progressing.

Budget Assessment:

CV (cost variance) = EV – AC (work accomplished relative to money spent on work)
Negative values mean we are over spending, i.e., AC is costing more than work performed.

Schedule Assessment

SV (schedule variance) = EV – PV (work accomplished relative to planned work to be done)
Negative values indicate schedule is late, i.e., work accomplished is less than work planned.



This discussion is about how PV and EV are VERY CLOSELY RELATED.

- PV is the amount of work effort we **plan, anticipate, or expect** to get done.
  - PV is future perspective.
  - PV is **anticipation** of work to be accomplished.

Now, notice the similarity, but difference in EV with PV.

- EV is work effort **accomplished** (sounds simple enough).
  - EV is $ value of work effort **actually earned** by a person on the job.
  - EV is the $ amount of work effort **performed** or that we "**got done**."
  - **EV is the $ amount of planned work effort that we finished**
    - Finished means past tense, already accomplished (EV)
    - It is referring to work already accomplished.
- Referring back to Diagram above:
  - We planned $100 of work effort.
  - How much of that planned work effort did we accomplish (earn)? **Answer: $120.**
  - EV is $120 of work effort that **was planned to be accomplished**?
  - EV is $120 of the **actual work effort (that we got done**).
    - It was **planned and anticipated** to be performed **before** the project began.

Notice: all 3 of the indicators (AC, PV, EV) have dollar signs, i.e., they are expressed as cost amounts.

- **AC:** Certainly this is a cost. It is the amount that the accounting department records and reports that was ACTUALLY spend on labor, materials, etc.
- **PV:** This is the planned cost value of the work effort that we plan to accomplish in the future. It
- is a cost as it is calculated as pay rate * hours worked.
- **EV:** This is the cost value of what we earned. We estimated a **dollar value** to the future amount of work that we planned to accomplish (PV), and now, the EV is the actual **dollar value** of work effort we accomplished or earned. This actual **dollar [cost] value** is **NOT** the same as the AC, which is money we **spent** from our bank account and reported by accounting.

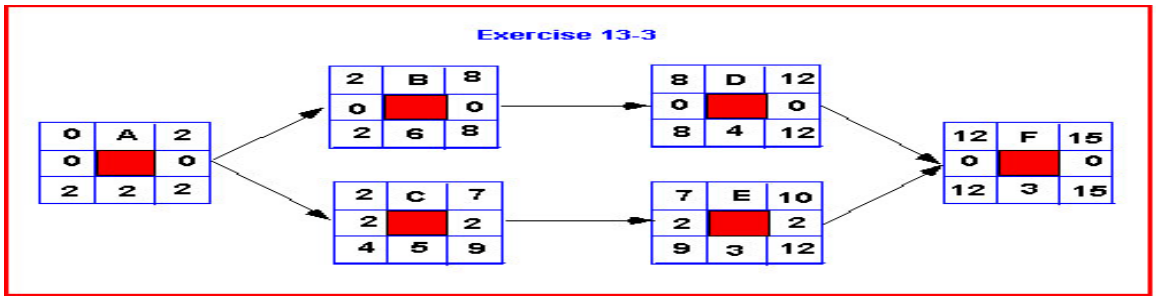
1. EV = $75 PV = $50 **2. EV = $175 PV = $200 AC = None** **3. EV = $150 PV = $100 AC = $120**

2. Part II

Let's work a simple exercise to see how these measures can us the progress of a project.

Is this project in good condition or in trouble?

Given the project network and baseline information below, complete the form below to develop a status report for the project at the end of period 4 and the end of period 4. From the data you have collected and computed for period 4, what information are you prepared to give tell the customer about the status of the project at the end of period 4?



Exercise 13-3b

Project Baseline (PV) (in $)

Task	Dur.	Budget (PV)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	2	400	200	200														
B	6	2400			200	600	200	600	200	600								
C	9	1500			200	400	500	100	300									
D	4	1600									400	400	400	400				
E	5	900								300	400	200						
F	3	600													200	100	300	
Period PV Total			200	200	400	1000	700	700	500	900	800	600	400	400	200	100	300	
Cumulative PV Total			200	400	800	1800	2500	3200	3700	4600	5400	6000	6400	6800	7000	7100		7400

The three values for the assessment variance are for **up to the reporting period**.

- EV is earned value (percentage of planned work accomplished) at end of the reporting period.
- AC is the cost reported by the accounting department at the end of the reporting period.
- **PV** is the amount of work **PLANNED** up to the **END OF THE REPORTING PERIOD.**

NOTE: The PV value is **NOT** the total time-phased budget PV value for the task.

End of Period 4

(AC values are from Accounting Dept in the company these values will be provided to you on the exam)

Task	Actual % Complete	EV	AC	PV	CV	SV
A	Finished	____	300	____	____	____
B	50%	____	1000	____	____	____
C	33%	____	500	____	____	____
D	0	____	0	____	____	____
E	0	____	0	____	____	____
F	0	____	____	____	____	____

Cumulative Totals	____	____	____	____	____

Results:

Budget:

Schedule:

Conclusions:

End of Period 8. Let's look further at period 8 and see how the project is progressing.

Task	Actual % Complete	EV	AC	PV	CV	SV
A	Finished	____	300	400	____	____
B	Finished	____	2200	____	____	____
C	Finished	____	1500	____	____	____
D	25%	____	300	____	____	____
E	33%	____	300	____	____	____
F	0	____	0	____	____	____
Cumulative Totals		____	____	____	____	____

Results (progress indicators or assessment indicators)

Budget:

Schedule:

How is this project doing from periods 4 to 8? (Improving or going bad?)

Are you concerned about any poor performance, or does the project seem to show good management measures?

What is the evidence that Task D started early? Look at the network diagram & explain WHY it would start early.

1. What is the critical path?

2. What is the predecessor for Task D?

ANSWERS TO EXERCISE PROBLEM

Status at the end of Period 4

Task	Actual % Complete	EV $	AC $	PV $	CV $	SV $
A	Finished	400	300	400	+100	0
B	50%	1200	1000	800	+200	+400
C	33%	500	500	600	0	-100
D	0	0	0	0	0	0
E	0	0	0	0	0	0
F	0	0	0	0	0	0
Cumulative Totals		**$2100**	**$1800**	**$1800**	**$ +300**	**$ +300**

Status at the end of Period 8

Task	Actual % Complete	EV $	AC $	PV $	CV $	SV $
A	Finished	400	300	400	+100	0
B	Finished	2400	2200	2400	+200	0
C	Finished	1500	1500	1500	0	0
D	25%	400	300	0	+100	+400
E	33%	300	300	300	0	0
F	0	0	0	0	0	0
Cumulative Totals		**$5000**	**$4600**	**$4600**	**$ +400**	**$ +400**

The project appears to be doing well.
In both periods 4 and 8 the **cost variance is positive**:

- +$300 and + $400 respectively.
- This suggests a pattern of good cost variance that is under budget.

The schedule variance is also positive:

- + $300 and +$400 for period 4 and period 8.
- Task D is already 25% complete.
- Task B must have been completed before the end of its last time period #8.

The CV and SV indicators are slowly increasing to the positive side. This project appears to be progressing very well. The customer and project manager should be very happy with the performance of this project up to period 8.

Explanation for the positive progress of the project

- Task B was finished early (+$400) and under budget (+$200).
  - +$400 means ahead of schedule
  - +$200 means ahead of the budget, with some extra money still available.
- Task B is on the CRITICAL PATH. If B finishes early, then Task D starts earlier (FS linkage).
- Possibly the following may have happened:
  - Task D started 25% work one period earlier (period 8).
  - 25% for Task D is $100 of $400 planned, hence about 2 hours of an 8-hour day.
  - Task B must have finished approximately 2 hours early during period 8.
  - Task B was going faster than planned and saved maybe $150 over the first five time periods, getting done 25% earlier (150/600).

We need to look at MS Project to see the actual data and know for sure about Task B and D.

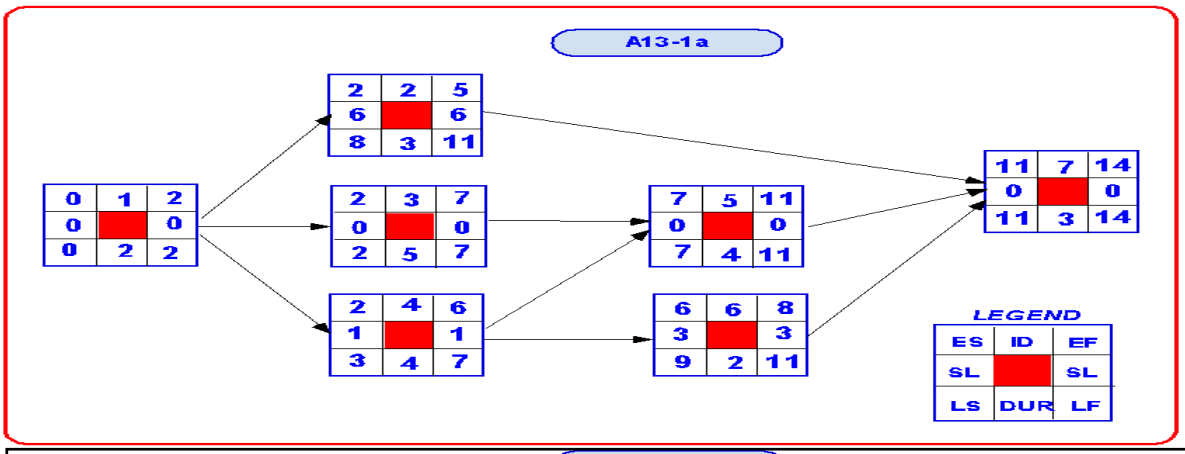
Value for the Dollar

- How **much work** are we accomplishing for each $1 of actual cost that we have already spent?
- How **much work** are we accomplishing for each $1 of work we HAD PLANNED to accomplish?

Let's introduce three other measures of performance:

- **CPI** (cost performance index) = **EV / AC**
  - **Dollar [cost] value** of work accomplished for **$1.00 spent** budget.
- **SPI** (schedule performance index) = **EV / PV**
  - **Dollar value** of work accomplished for **$1.00 scheduled** work.
- **PCI-B** (percent complete index) = **EV/BAC**
  - Amount of work accomplished to total planned work for the project.
  - Comes from cumulative time-phased budgets.

1. Given the information provided for development of a product warranty project for periods 1 through 7, compute the SV, CV, SPI, and CPI for each period. Plot the EV and the AC on the PV graph provided. Explain to the owner your assessment of the project at the end of period 7 and the future expected status of the project at completion.



A13-1b

SCHEDULE INFORMATION							BASELINE BUDGET NEEDS														
EV RULE	ACTI WP	DUR	ES	LF	SL	TOTAL PV	TIME PERIOD 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	1	2	0	2	0	6		6													
2	2	3	2	11	6	20			10		10										
1	3	5	2	7	0	30			9	6	6	6	3								
1	4	4	2	7	1	20			8	2	5	5									
1	5	4	7	11	0	16								4	4	4	4				
1	6	2	6	11	3	18							9	9							
2	7	3	11	14	0	8												4		4	
TOTAL PV BY PERIOD							0	6	27	8	21	11	12	13	4	4	4	4	0	4	
CUMULATIVE PV BY PERIOD							0	6	33	41	62	73	85	98	102	106	110	114	114	118	

Rule
1 = %complete
2 = 50/50
3 = 0/100

The table on the next page shows the data for **EV, AC, PV, CV, and SV**

Status Report: Ending Period 1

Task	% Complete	EV	AC	PV	CV	SV
1	0%	0	3	0	-3	0
Cumulative Totals		**0**	**3**	**0**	**-3**	**0**

Status Report: Ending Period 2

Task	% Complete	EV	AC	PV	CV	SV
1	Finished	6	5	6	+1	0
Cumulative Totals		**6**	**5**	**6**	**+1**	**0**

Status Report: Ending Period 3

Task	% Complete	EV	AC	PV	CV	SV
1	Finished	6	5	6	+1	0
2	0%	0	5	10	-5	-10
3	30%	9	7	9	+2	0
4	25%	5	5	8	0	-3
Cumulative Totals		**20**	**22**	**33**	**-2**	**-13**

Status Report: Ending Period 4

Task	% Complete	EV	AC	PV	CV	SV
1	Finished	6	5	6	+1	0
2	0%	0	7	10	-7	-10
3	50%	15	10	15	+5	0
4	50%	10	8	10	+2	0
Cumulative Totals		**31**	**30**	**41**	**+1**	**-10**

Status Report: Ending Period 5

Task	% Complete	EV	AC	PV	CV	SV
1	Finished	6	5	6	+1	0
2	50%	10	8	20	+2	-10
3	60%	18	12	21	+6	-3
4	70%	14	10	15	+4	-1
Cumulative Totals		**48**	**35**	**62**	**+13**	**-14**

Status Report: Ending Period 6

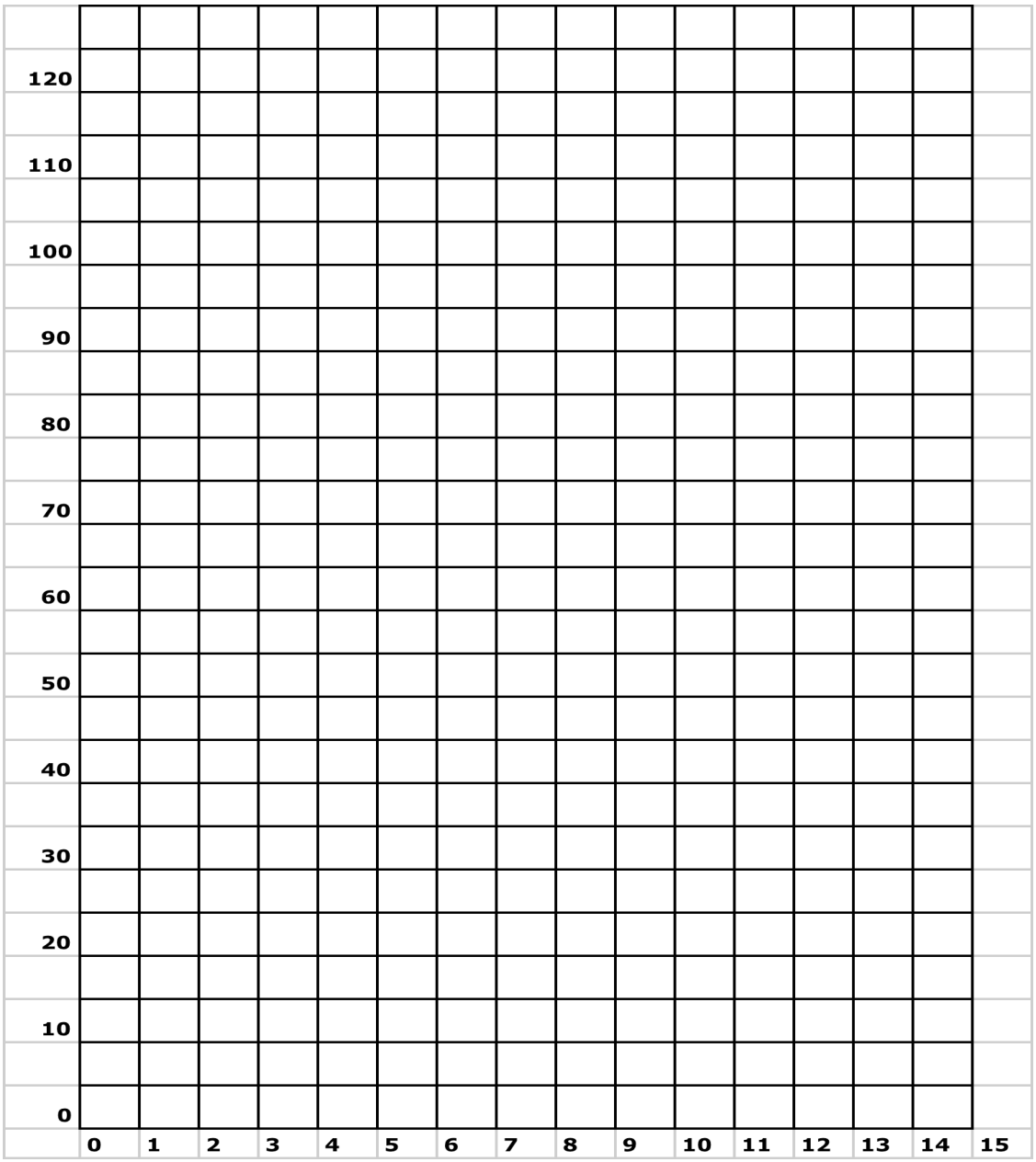
Task	% Complete	EV	AC	PV	CV	SV
1	Finished	6	5	6	+1	0
2	50%	10	10	20	0	-10
3	80%	24	16	27	+8	-3
4	Finished	20	15	20	+5	0
Cumulative Totals		**60**	**46**	**73**	**+14**	**-13**

Status Report: Ending Period 7

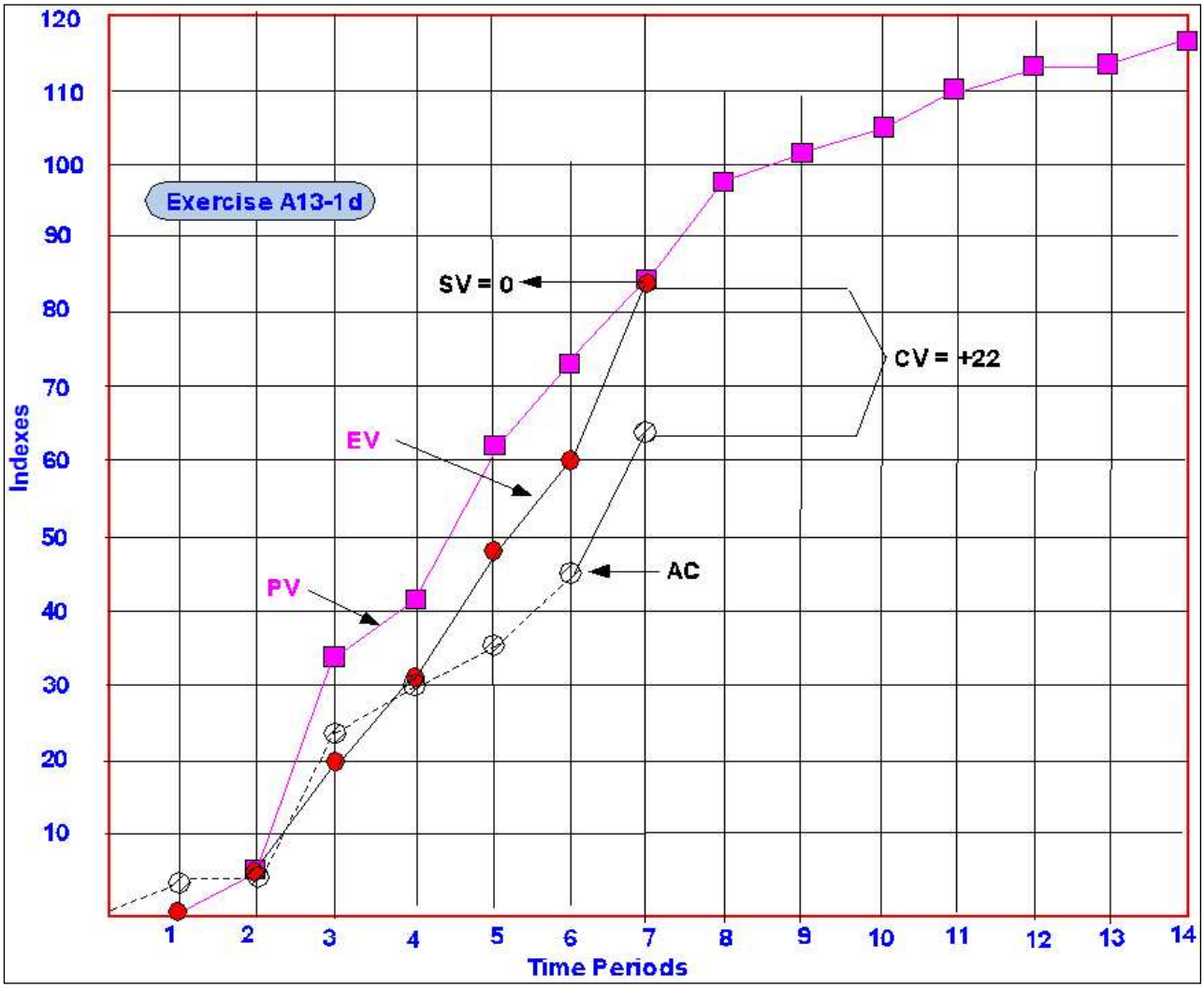
Task	% Complete	EV	AC	PV	CV	SV
1	Finished	6	5	6	+1	0
2	Finished	20	14	20	+6	0
3	Finished	30	20	30	+10	0
4	Finished	20	15	20	+5	0
5	0%	0	0	0	0	0
6	50%	9	9	9	0	0

Cumulative Totals	**85**	**63**	**85**	**+22**	**0**

Draw a PV graph showing the PV for all time periods. Show AC and EV values up to the end of reporting period 7. Show the CV and SV for the end of the reporting period 7.



ANSWER: PV Graph for Product Warranty Project



Which of the following statements best represents the project progress in the graph?

a. The schedule variance is positive and doing very well.

b. The overall cost variance trend is negative, but improving.

c. The cost performance index shows the budget under spending.

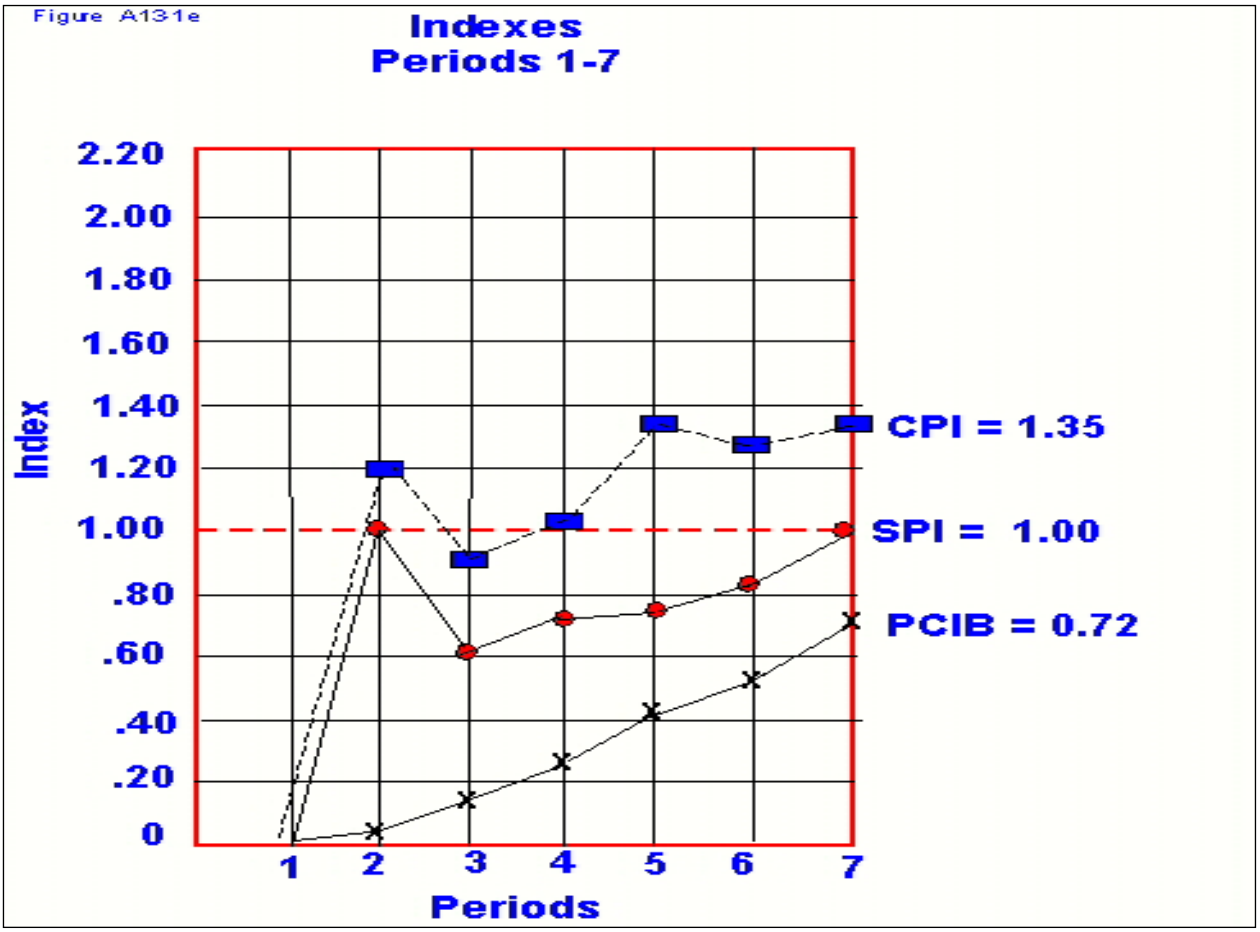
Which of the following statements best represents the SPI in the graph above?

a. The schedule performance is getting worse because the actual cost is less than planned.

b. The schedule performance is improving because the money spent is less than the earned value.

c. The schedule performance is improving because we are earning more than we planned.

d. The following graph of CPI, SPI, and PCIB shows the project performance much more easily to analyze and draw conclusions.



Refer to the OVERALL graph above to answer the following True/False questions.

1. **True** **False** This project would be performing better if the CPI were below 1.00.
2. **True** **False** The cost spent to keep the project on schedule will increase.
3. **True** **False** The EV is improving compared to the cost spent on work.
4. **True** **False** The EV is improving compared to the work we planned to accomplish.
5. **True** **False** You are happy with the positive trend of the CPI in the graph above at period #7.

Explain what is going on in this graph about the project performance.

ANSWERS to Graph Questions

Which of the following statements best represents the project progress in the graph?

- **d.** The schedule variance is positive and doing very well.
  - **a.** No. EV is < PV and this is not a case of doing well.
- **e.** The overall cost variance trend is negative, but improving.
  - **a.** No. **CV=EV-AC**. Overall, the CV is positive b/c EV > AC
- **f.** The cost performance index shows the budget under spending.
  - **a.** True, because EV > AC, the budget spending is less than cost of work being earned.

Which of the following statements best represents the SPI in the graph above?

- **e.** The schedule performance is getting worse because the actual cost is less than the planned cost.
  - **a.** No. Cannot compare AC to PV. This is the classic management weakness.
- **f.** The schedule performance is improving because the money spent is less than the earned value.
  - **a.** False. The question is asking about the schedule, not the cost spent and paid for.
- g. The schedule performance is improving because we are earning more than we planned to accomplish.
  - a. True, EV is > PV

ANSWERS to CPI and SPI graph questions

Refer to the OVERALL graph above to answer the following True/False questions.

1. **True** **False** This project would be performing better if the CPI were below 1.00.
   False: CPI=EV/AC. When EV>AC, this is good. So, we want CPI above 1.00.

2. **True** **False** The cost spent to keep the project on schedule will increase.
   SPI is not about cost of money spent. This is comparing AC to PV—classic mgmt mistake.

3. **True** **False** The EV is improving compared to the cost spent on work.
   True, this is EV compared to AC, the CPI. The CPI >1.0, hence EV is > AC.

4. **True** **False** The EV is improving compared to the work we planned to accomplish.
   Yes. SPI is about comparing EV to PV (EV/PV), and the SPI value is increasing.

5. **True** **False** You are happy with the positive trend of the CPI in the graph above at period #7.
   True, above 1.0 is more EV per AC, i.e., more work (EV) for $1 of money spend

Explain what is going on in this graph about the project performance.

Overall, this project is progressing well. This is very encouraging to the PM.

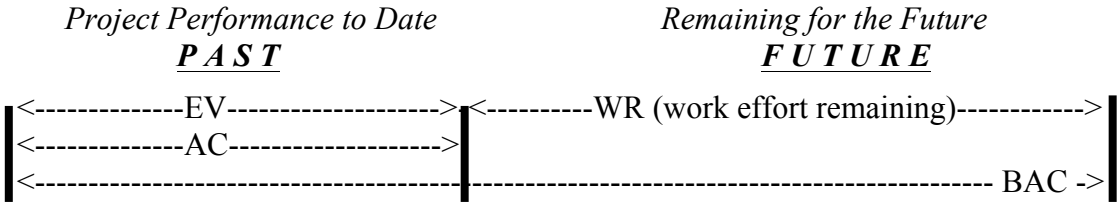
- After 7 time periods the project is roughly 72% complete and is currently getting an extra 35 cents worth of work completed for each dollar spent.
- The project is currently $22 under budget.
- The schedule variance is 0 and the project is currently on schedule at the end of time period #7.
- The **CPI** has consistently been above 1.00.
- The **SPI** shows the project was behind schedule, but has caught up to EV = PV at period 7.
- The project is 72% complete at the end of 7 weeks **(PCI-B**).
  - This is what was planned to be accomplished.
  - This is a favorable situation.

What does all of this mean for the budget at the end of the project?

Uncertainty abounds in life. This means that projects don't go as planned: delays, strikes, weather, transportation problems, unexpected complexities, etc.

The customer would like to know the estimated cost to complete the project based on the performance of the project so far, taking into account any or all of these kinds of risks to project performance.

We can calculate and estimate new future values for the project based on the past performance up to a particular reporting period. We know the following about the project:

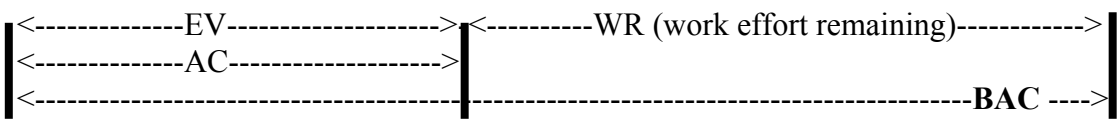


We can calculate a forecast for the final estimated budget at completion ($EAC_{(f)}$). Here is the logic for calculating the EAC:

- **PAST:** **Actual Cost Spent:** We know the actual amount of money (**AC)** that we have **spent** for the **work effort** completed so far up to the reporting period.

- **FUTURE: Remaining Cost:** Need to calculate **$ COST** of completing the remaining **work effort**.
  - We know the dollar **value** of the planned work effort (work remaining **WR**).
  - But we do **not** know the **dollar cost to complete** the remaining work.
    - It could possibly cost more than the **planned dollar cost**.
    - It could possibly cost less than the **planned dollar cost**.

We can calculate and estimate new future values for the project based on the past performance up to a particular reporting period. We know the following about the project:



Our final estimated cost for our project when it is completed will be based on the following:

AC **Dollar Cost** ***(from the bank account)***

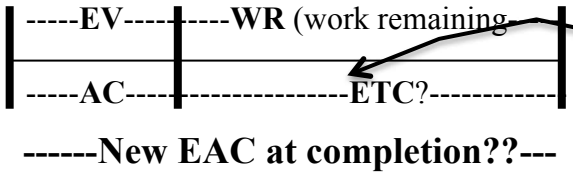
FINAL TOTAL COST = Money already spent + Future money to finish the remaining work.

AC = the money we have already spent (*actual dollars from bank account*)

FUTURE MONEY to finish the remaining work will be explained on the following pages.

The total **estimated** project **dollar cost** to finish our project can be stated as a simple formula using our past indicators, based on the project's performance up to the present reporting period.

Total Project Cost: The final cost estimate for the project will be:



$EAC_{(f)}$	=	AC	+	$ETC_{(f)}$
Estimate at completion		Actual Cost		Cost to Complete Remaining Work

Where:

- **AC** is **dollar cost** spent up to the end of the reporting period ***(from bank account)***
- **ETC(f)** is the estimated **dollar cost** to complete the **remaining work**.

  = WR * 1/CPI where WR = BAC – EV

  - **1/CPI** is the past rate of spending your budget (budget usage)
  - **1/CPI** is the burn rate of past budget spending

The real question remaining for the project manager is:

***** What is the DOLLAR COST to complete the work remaining in the project?**

i.e., **WR** is the **DOLLAR VALUE** of work effort remaining,
What is the Dollar Cost, i.e., how much will you **SPEND** to **accomplish this work**?

- Simple answer is 3 possible scenarios:
  - I will spend my budget at the same rate as in the past.
  - I have overspent my budget in the past, so probably, I will overspend a lot in the future.
  - If I underspent in the past, then most likely I will underspend in the future.

- **WR** is the **$ dollar value** of work remaining = **(BAC – EV)**
- **CPI** is the cost performance index
  - Indicator of how we are spending our budget
  - **1/CPI** = **AC/EV**, the **$ cost** to accomplish $1.00 of earned work (earned value).
  - **1/CPI** = **BURN RATE =** Budget dollars spent to accomplish $1 of earned value.

Part IV

Let's revisit the previous problem (Exercise 13-3 at the beginning of this section) at time period 8 and forecast (predict) how much the project would cost based upon the performance indicators at period 8.

Exercise 13-3b

Project Baseline (PV)
(in $)

Task	Dur.	ES	LF	Slack	Budget (PV)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	2	0	4	0	400	200	200														
B	6	2	8	0	2400			200	600	200	600	200	600								
C	9	2	9	2	1500			200	400	500	100	300									
D	4	8	12	0	1600									400	400	400	400				
E	3	7	12	2	900								300	400	200						
F	3	12	15	0	600													200	100	300	
Period PV Total						200	200	400	1000	700	700	500	900	800	600	400	400	200	100	300	
Cumulative PV Total						200	400	800	1800	2500	3200	3700	4600	5400	6000	6400	6800	7000	7100	7400	

Status at the end of Period 8

Task	Actual % Complete	EV $	AC $	PV $	CV $	SV $
A	Finished	400	300	400	+100	0
B	Finished	2400	2200	2400	+200	0
C	Finished	1500	1500	1500	0	0
D	25%	400	300	0	+100	+400
E	33%	300	300	300	0	0
F	0	0	0	0	0	0
Cumulative Totals		**$5000**	**$4600**	**$4600**	**$ +400**	**$ +400**

Calculate the EAC. Show all the calculation steps for CPI, WR, BR, ETC
Answer on last page.

CPI =

BR =

ETC =

EAC =

Exercise 13-3b

	Period #4	Period #8
CPI		
BR		
WR		
ETC		
EAC		

What is the **trend** for this project?

- **BR**
- **EAC**

Exercise A13-1a

	Period #4	Period #7
CPI		
BR		
WR		
ETC		
EAC		

What is the **trend** for this project?

- **BR**
- **EAC**

Budget Burn Rate

This simply means how fast we are burning the budget.

BURN RATE and future cost of Work Remaining

Recall that CPI is EV/AC and means:

- Money's worth of work performed for each one dollar ($1) spent from the budget.
- It is the ratio of work accomplished to budget spent.

Now, the 1/CPI is the ratio of Budget spent to the one dollar ($1) of work performed.

1/CPI is the rate at which we burn the budget, i.e., spend the budget.

WR * 1/CPI is a way of applying the past burn rate (of budget) to the future work remaining.

- The past spending of the budget is the 1 / CPI = 1/ (EV/AC).
- 1/CPI is also **AC/EV**.
- So WR * 1/CPI is same as WR * AC/EV

If we have a **BR = 2.0** then we are spending $2.00 to accomplish $1.00 of work, i.e., burning at 2x rate.
So, if we had $200 of work remaining to accomplish,
Then at the 2x rate of burning our budget, it would cost us $400 to finish the remaining work.

If we have a **R = 0.5** then we are spending $0.50 to accomplish $1.00 of work, i.e., burning at ½ rate.
So, if we had $100 of work remaining to accomplish,
Then at the ½ (0.5) rate of burning our budget, it would cost us $100 to finish the remaining work.

Formula for Burn Rate

$$\text{Burn rate is} = \frac{1}{\text{CPI}} = \frac{1}{\frac{\text{EV}}{\text{AC}}} = \frac{\text{AC}}{\text{EV}}$$

When the work is **inefficient** (CPI < 1), the burn rate of 1/CPI will be high.

When the work is **efficient** (CPI > 1), the burn rate of 1/CPI will be low

Burn Rate is a coefficient indicating $$$ spent to get work accomplished.
Applying BR to WR (work remaining) allows us to **calculate estimated $ cost** to accomplish the WR.

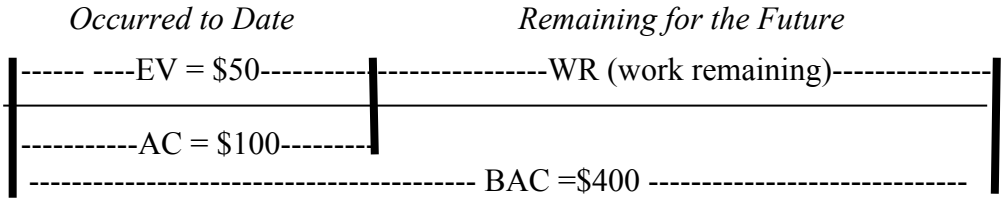
==========

ANSWER (from previous page)

What are the differences between BAC and EAC?

BAC is the planned budget at completion. It is calculated by summing the values from the time-phased task budgets (from the WBS). EAC is the estimate at completion. EAC can be calculated simply by formula, which is used in software programs. The formula applies a **budget performance ratio** (**1/CPI** from the budget usage in past work on the project) to the remaining future work to calculate the estimated future cost of the project (EAC).

Sample problems to explore the concept of burn rate and past budget performance.



1. Assume we have a project that has spent $100 and accomplished $50. The CPI would be:

CPI = EV/AC = 50/100 = .5 ***50 cents of work for each ONE dollar spent.***

BURN RATE: $\frac{1}{CPI} = \frac{1}{\frac{EV}{AC}} = \frac{AC}{EV} = \frac{100}{50} = \$2.00$ ***Spending $2 for each $1 of work performed.***

This is a **VERY INEFFICIENT** use of the budget. With this kind of budget performance, the COST of the work remaining will be **DOUBLE** of what was **ORIGINALLY PLANNED** before the project began.

ETC = WR * BR = (400 – 50) * 2.0 = 350 * 2 = $700.

Multiplying the FUTURE PLANNED WORK by the rate of using the budget from the PAST is how we forecast the future, i.e., how we actually play out the assumption that the future will behave the same as the past (the $2.00 spending rate from the past).

- The PAST is what has ACTUALLY HAPPENED, i.e., the $2.00 spending or burn rate.
- The future PLANNED VALUE is the dollar value of WORK EFFORT REMAINING
- The future ESTIMATED COST for the work remaining depends upon the PAST BURN RATE.

Assume you have AC=$100, EV=$150.

- CPI = $150/$100 = 1.50 (earning more than spending, or burn rate is slower than planned)
- 1/CPI would be AC/EV = $100/$150 = 2/3 or about .66.
  - 66 cents of the budget needed to accomplish $1 of work. This is GOOD.
  - Budget is being used conservatively, i.e., being spent more slowly than planned.
  - Anticipation is that we would have extra budget left over at project finish.
- Assume the work remaining (WR) is $450.
- How much will it cost to perform the $450 work remaining, i.e., the four hundred fifty dollars of remaining work until the end of the project?
  - $350? Only if we are burn the budget efficiently and spend less than planned.
  - $550? Only if we work inefficiently and spend more of the budget than planned.

ANSWER: See bottom of next page.

What is the burn rate and ETC for the following?

1. EV = 100, PV = 120, AC = 120, BAC = 300

2. EV = 100, PV = 80, AC = 80, BAC = 300

3. PV = 120, AC = 100, BAC = 400, EV = 150

ANSWER to Problem 13-3b

Period #8						
PV	$ 4,600					
BAC	$ 7,400		WR = BAC - EV	$ 2,400		
EV	$ 5,000		EV/AC	1.09		
AC	$ 4,600					
			CV	$ 400	$5000 - $4600	EV - AC
			SV	$ 400	$5000 - $4600	EV - PV
			CPI	1.09	$5000/$4600	EV/AC
			SPI	1.09	$5000/$4600	EV/PC
			PCI-B	0.68	$5000/$7400	EV/BAC
Forecast Perspective						
			WR	$ 2,400	($7400 - $5000)	BAC - EV
			ETC(f)	$ 2,208	($7400 - $5000)/1.09	(BAC - EV)/CPI
			EAC(f)	$ 6,808	$4600 + $2208	EAC(f) = AC + ETC(f)

Answer previous page.
WR = $450. The cost of this work remaining will be 2/3*$450 or $300.

BURN RATE Problems

	#1	#2	#3
EV	$ 100	$ 100	$ 150
AC	$ 120	$ 80	$ 100
BR=AC/EV	1.20	0.80	0.67
BAC	$ 300	$ 300	$ 400
WR	$ 200	$ 200	$ 250
ETC=WR*AC/EV	$ 240	$ 160	$ 167

Exercise 13-3b

	Period #4	Period #8
CPI	**EV/AC = 21/18 = 7/6**	**5000/4600 = 1.09**
BR	**AC/EV = 6/7 = 0.86**	**= 1/1.09 = 0.92**
WR	**(BAC – EV) = 7400 – 2100 = 5300**	**7400 – 5000 = 2400**
ETC	**WR * BR = 5300 * .86 = 4560**	**2400 * .92 = 2208**
EAC	**AC + ETC = 1800 + 4560 = 6358**	**4600 + 2208 = 6808**

What is the **trend** for this project?

- **Burn Rate:** I**ncreased** from .86 to .92.
- **EAC:** **increased** from 6358 to 6808 (extra funds needed)

Exercise A13-1a

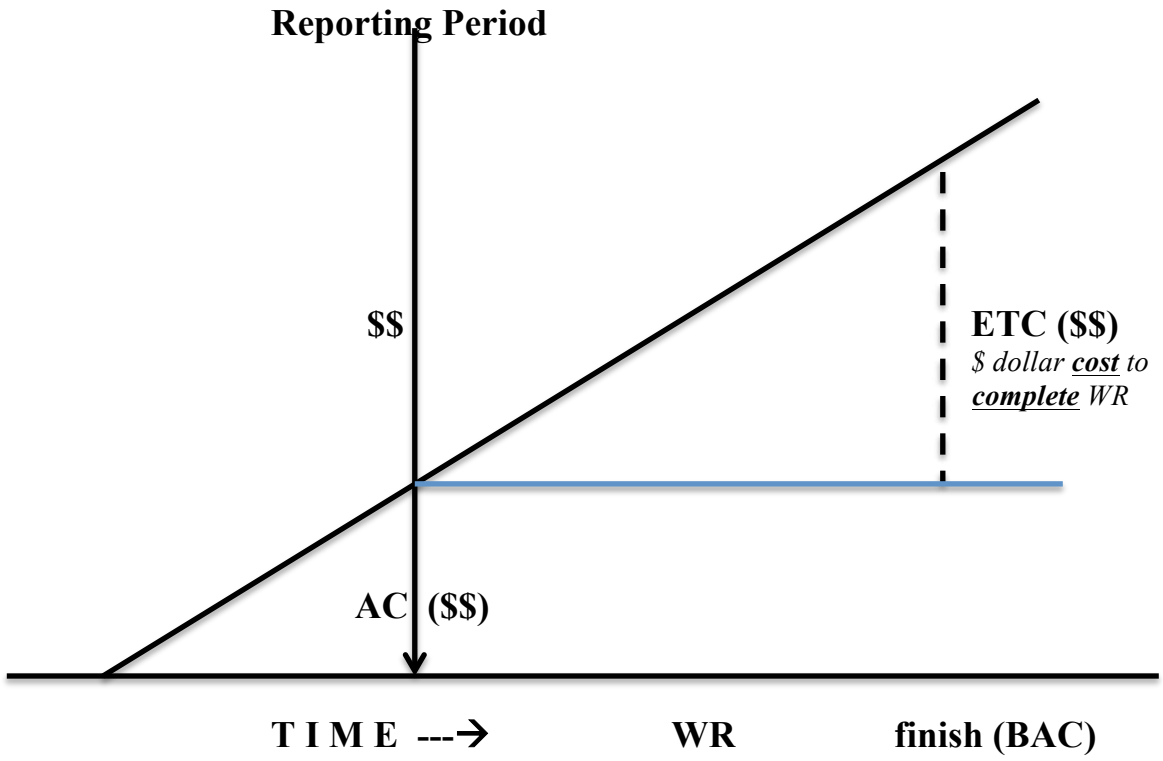
	Period #4	Period #7
CPI	**31/30 = 1.033**	**85/63 = 1.35**
BR	**= 1/1.033 = .97**	**=1/1.35 = 0.74**
WR	**118 – 31 = 87**	**118 – 85 = 33**
ETC	**= 87 * 0.97 = 84.2**	**33 * 0.74 = 24.5**
EAC	**30 + 84.5 = 114.2**	**63 + 24.5 = 87.5**

What is the **trend** for this project?

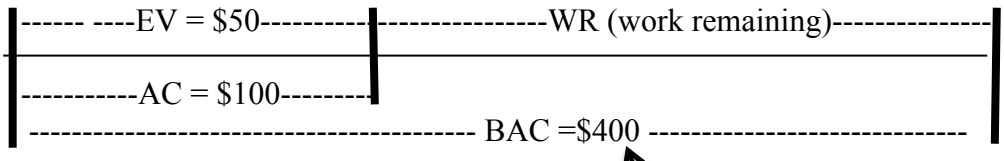
- **Burn Rate:** D**ecreased** from .97 to .74. *(Budget spending efficiency improving)*
- **EAC:** **Decreased** from 11,4200 to 87,500 (*Saving lots of budget*)

Y = aX + b **EAC = AC + ETC**

a = BR, the coefficient
b = AC, the sunk cost at WR time = 0
x = WR, which varies as the project progresses.



Example:



Y = a * X + b

EAC = BR * WR + AC

= 100/50 * (400 – 50) + 100

= 2.0 * 350 + 100

= 700 + 100 = **$800** **terrible burn rate and budget usage.**