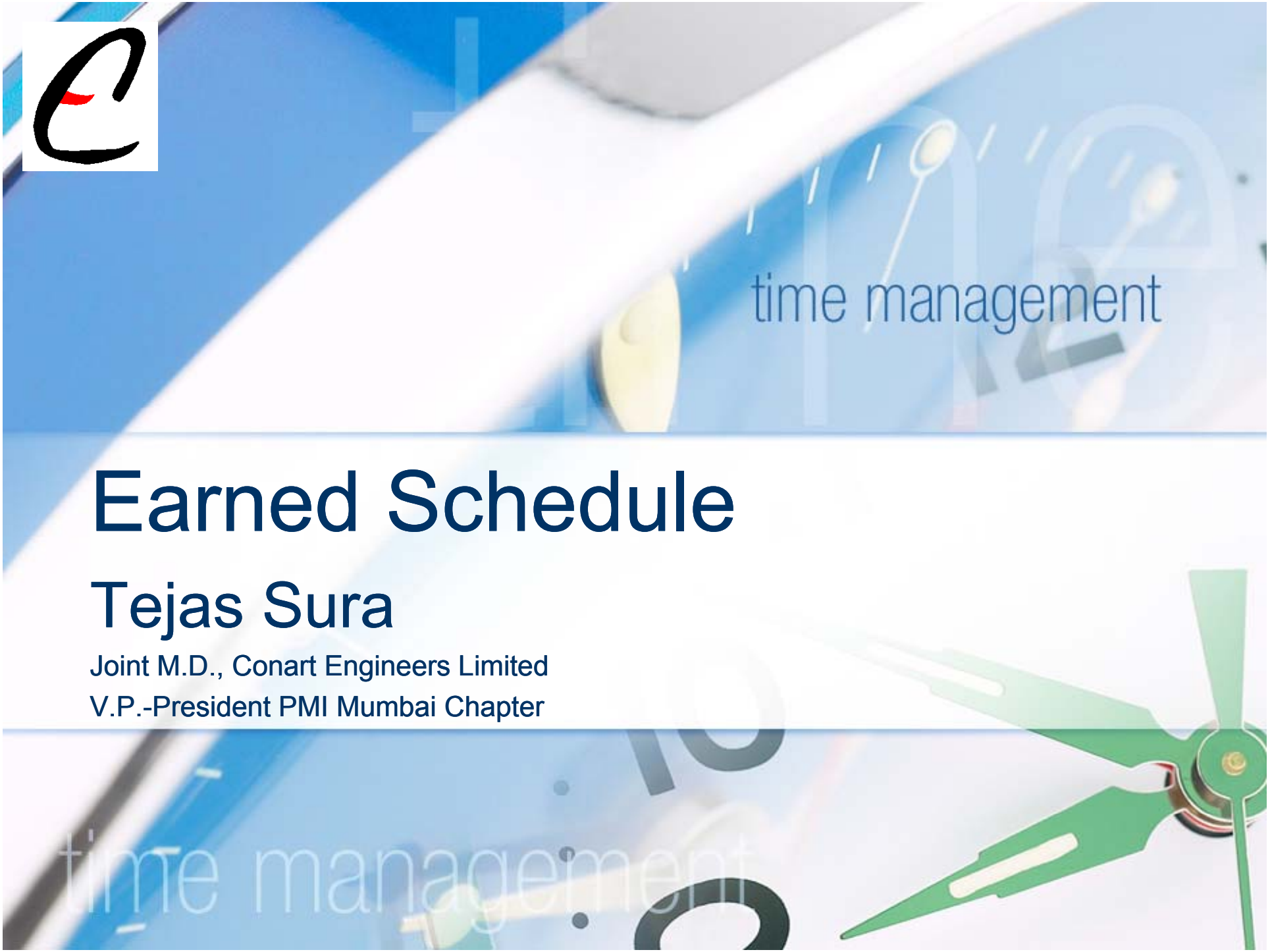


Earned Schedule

Tejas Sura

Joint M.D., Conart Engineers Limited

V.P.-President PMI Mumbai Chapter

We are here to know……

“HOW TO GUIDE OUR PROJECT BY PROJECT MANAGEMENT TOOLS”

time management

Project Monitoring

- “Monitoring is collecting, recording, and reporting information concerning any and all aspects of project performances that the project manger and all other in the organization wish to know.”

(Jack R. Meredith, Samuel J. Mantel)

Project Monitoring

- What tools can I use?
  - Meetings
  - Reports on progress
  - Reports on finances
  - ERP (enterprise resource planning)
    - comprehensive concept about providing communicating network between projects, programs and portfolios management system

Project Controlling

- “Controlling is determining what is being accomplished, that is, evaluating performance and if necessary, apply corrective measure so that the performance takes place according to plan.”

(George R. Terry)

Project Controlling

- ALL about controlling;
  - Establishing standard- Performance Management Baseline (PMB)
  - Measuring performance against these standards
  - Correcting variations from standard
- How can I Monitor & Control my project;
  - Gantt Charts
  - Variance Analysis
  - Leading parameter technique
  - Activity based ratios
  - Earned value & Earned Schedule

Construction Projects…. Today's Situation

- 70% of projects are:
  - Over budget
  - Behind schedule
- 62% of projects finish at 25-30% more than initial budget
- And after huge investments of time and money answer is simply……
- ……."Still….Not….Finish"
- Source: The Standish Group

How to answer the question:

"Have we done what we said we'd do?"

- Manager is always worried about:
  - % of Budget spent
  - % of work done
  - % of time elapsed

- Answer… "Earned Value Management"

SO……Is it new?

- Earned Value Management (EVM)
  - It's been around since the sixties.
  - "cost/schedule control system criteria" (C/SCSC)
  - 1990s, EVM emerged as a project management methodology by DOD (Department of Defense) in U.S.

What's Important to the Project Manager

- Are we ahead of or behind schedule?
- How efficiently are we using our time?
- When is the project likely to be completed?
- Are we currently under or over our budget?
- How efficiently are we using our resources?
- What is the remaining work likely to cost?
- What is the entire project likely to cost?
- How much will we be under or over budget at the end?

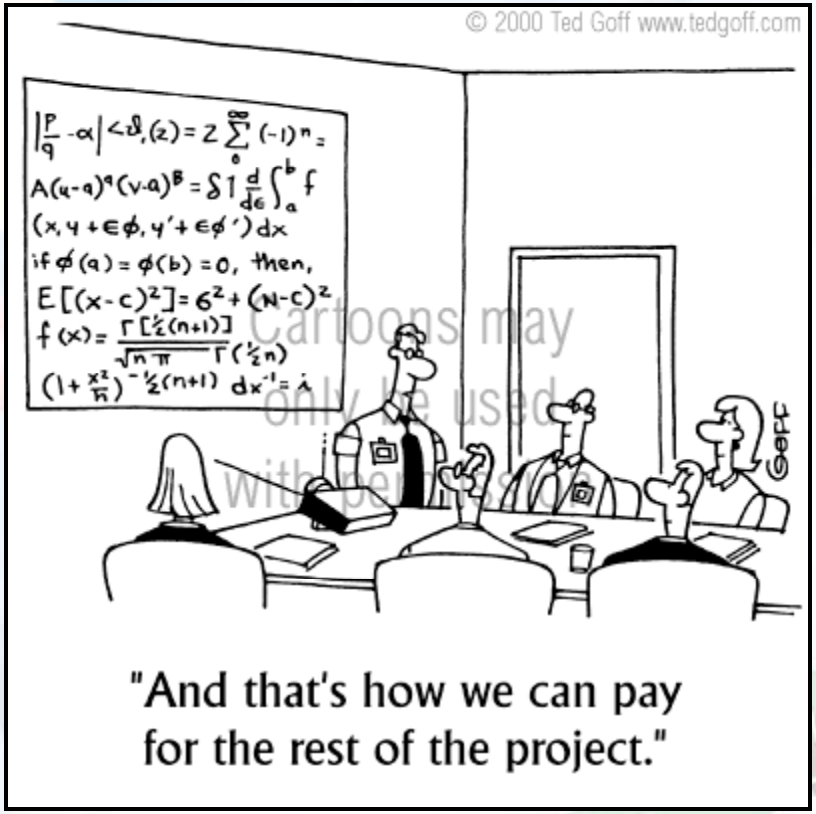
EVM answers it all!

- EVM methodology helps identify
  - Where problems are occurring.
  - Whether the problems are critical or not.
  - What it will take to get the project back on track.

Source: EVM practice standard, PMI

Earned Value is needed because...

- Provides an “Early Warning” signal for prompt corrective action.
  - Gives time to recover
  - Facilitates timely request for additional funds



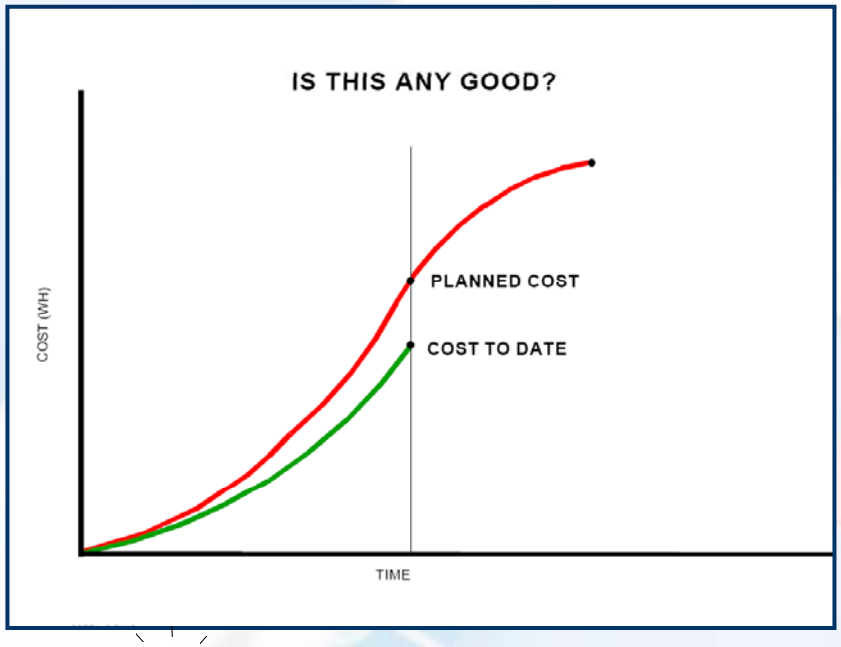
Enter….
"Earned Value Analysis"

- Work is "Earned" or credited as it is completed.
- "Earned Value Analysis":
  - Measures a project's progress,
  - Forecasts its completion date and final cost, &
  - Provides schedule and budget variances along the way.
- HOW?
  - By integrating three elements, it provides consistent, numerical indicators with which you can evaluate and compare projects.

Three Elements ?

- Planned value <PV> (Budgeted Cost of Work Scheduled)
  - “how much do we plan to spend?”
  - Project baseline (PMB): Cumulative planned value for work scheduled.
- Actual cost <AC> (Actual Cost of Work Performed)
  - The actual cost to accomplish the work at specific date
  - “how much did we actually spend ?”

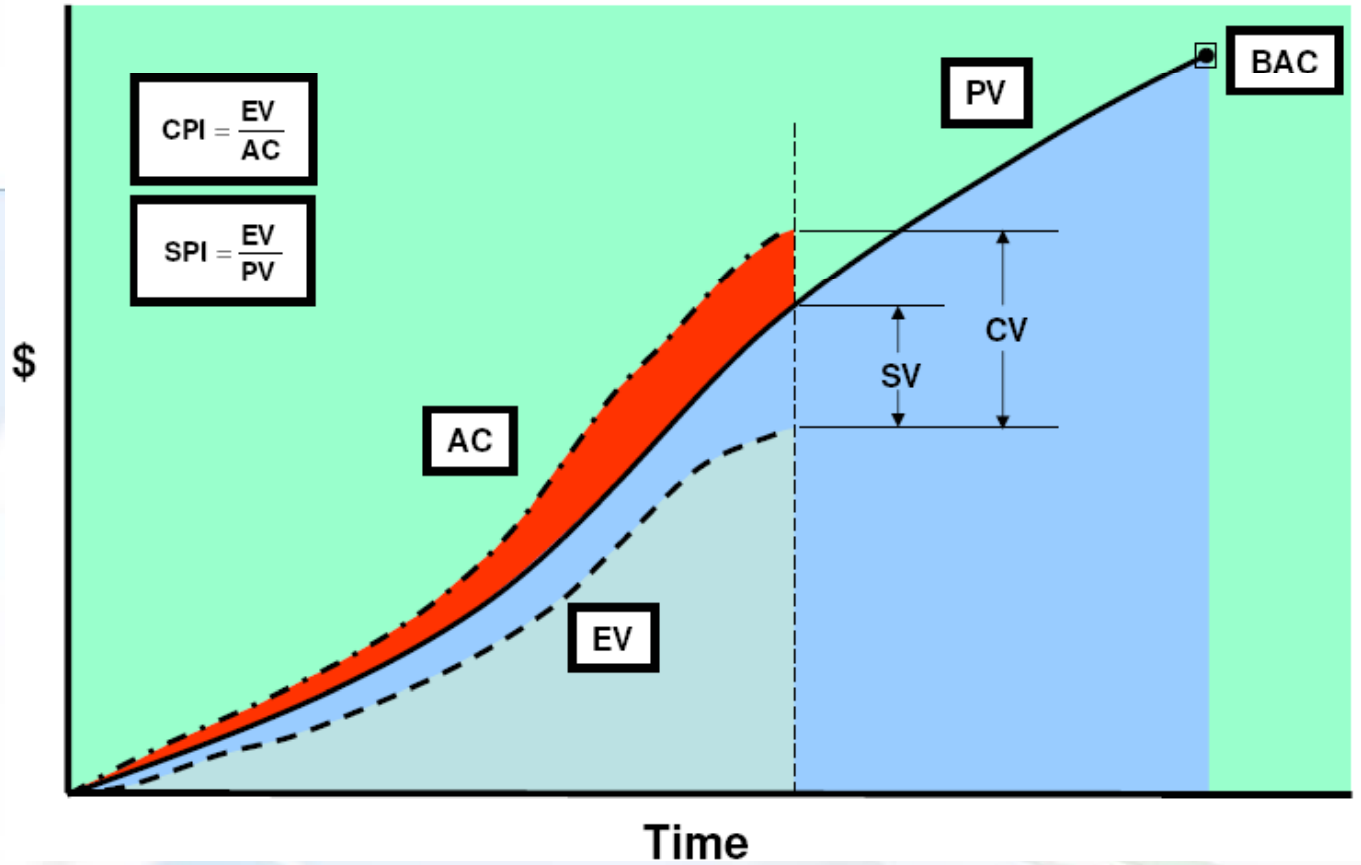
Traditional variance analysis



Well, **I've spent 10 days** , Does that mean **I've accomplished 10 days Work?**

- Compare Planned cost & Actual cost
- No idea about work completed
- "Actual Cost is not an indication of work progress, only an indication of money spent."

time management



The Whole Story…… (see Earned Value graph above)

Earned Value <EV> (Budgeted Cost of Work Performed)

This is the cost originally budgeted to accomplish the work that has been completed.

“how much work has been actually completed ?”

Earned value parameters

- A] Indicators
  - Schedule Indicators
    - Schedule Variance (SV)
      - “Are We Ahead Or Behind Schedule?”
      - A negative variance means project is behind schedule
      - SV = EV - PV
      - SV% = SV / PV
    - Schedule Performance Index (SPI)
      - “How efficiently are we using time?”
      - SPI greater than 1 indicates project ahead of schedule
      - SPI = EV / PV

Earned value parameters

- A] Indicators
  - Cost Indicators
    - Cost Variance (CV)
      - “Are we under or over our budget?”
      - Negative variance indicates over budget
      - CV = EV - AC
      - CV% = CV / EV
    - Cost Performance Index (CPI)
      - “How efficiently are we using our resources?”
      - CPI greater than 1 indicates within budget
      - CPI = EV / AC

Earned value parameters

- A] Indicators
  - Critical ratio (CR)
    - “overall performance of project “
    - CR=CPI*SPI

Earned value parameters

- B] Predictors
  - To-Complete Performance Index (TCPI)
    - “How efficiently must we use our remaining resources?”
    - TCPI > 1 indicates a need for increased performance for the remaining work in order to stay within budget
    - TCPI = (BAC - EV) / (BAC - AC)
  - Estimate at Completion (EAC)
    - “What is the project likely to cost?”
    - EAC1 = AC + [(BAC – EV)/CPI] = BAC/CPI
    - EAC2= AC + [(BAC – EV)/ (CPI*SPI)]

Earned value parameters

- B] Predictors
  - Variance at Completion (VAC)
    - “Will we be under or over budget?”
    - VAC1 = BAC - EAC1
    - VAC2= BAC – EAC2
  - Estimate to Complete (ETC)
    - “What will the remaining work cost?”
    - ETC = (BAC - EV) / CPI
    - ETC = EAC – AC

Earned value parameters

- B] Predictors
  - Independent Schedule at Completion (ISAC)
    - Calculate final cost depending upon schedule performance at that date
    - ISAC = BAC/ SPI

EVM Limitations

- While EVM has many very significant achievements in analyzing project cost performance, this success has not extended to schedule performance.

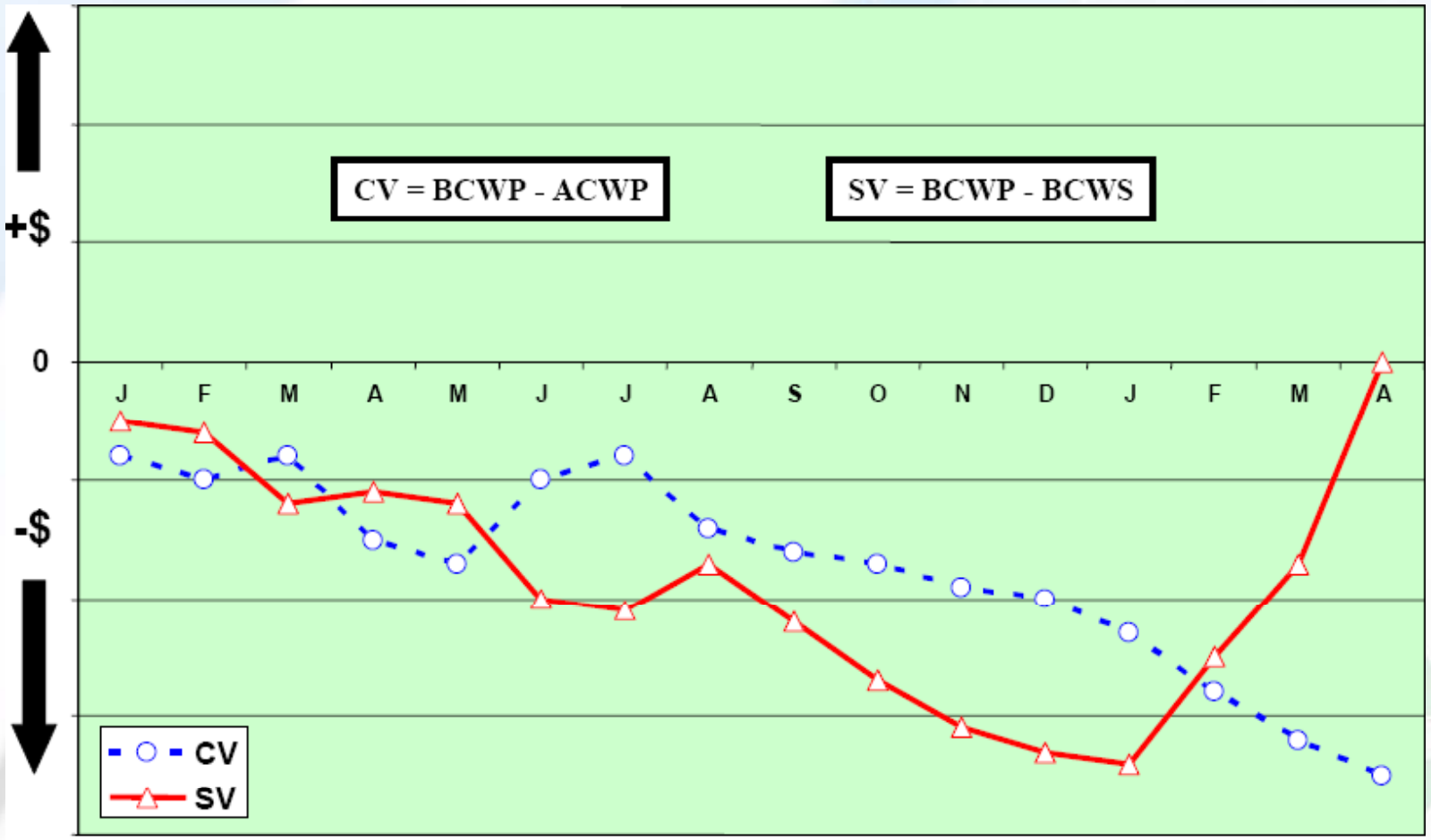
So, what's the problem?

- Traditional schedule EVM metrics are good at beginning of project
  - Show schedule performance trends
- But the metrics don't reflect real schedule performance at end
  - Eventually, all "budget" will be earned as the work is completed, no matter how late you finish
    - SPI improves and ends up at 1.00 at end of project
    - SV improves and ends up at $0 variance at end of project
  - Traditional schedule metrics lose their predictive ability over the last third of project
    - Impacts schedule predictions, EAC predictions
- Project managers don't understand schedule performance in terms of budget
  - Like most of us!

EVM Schedule Indicators

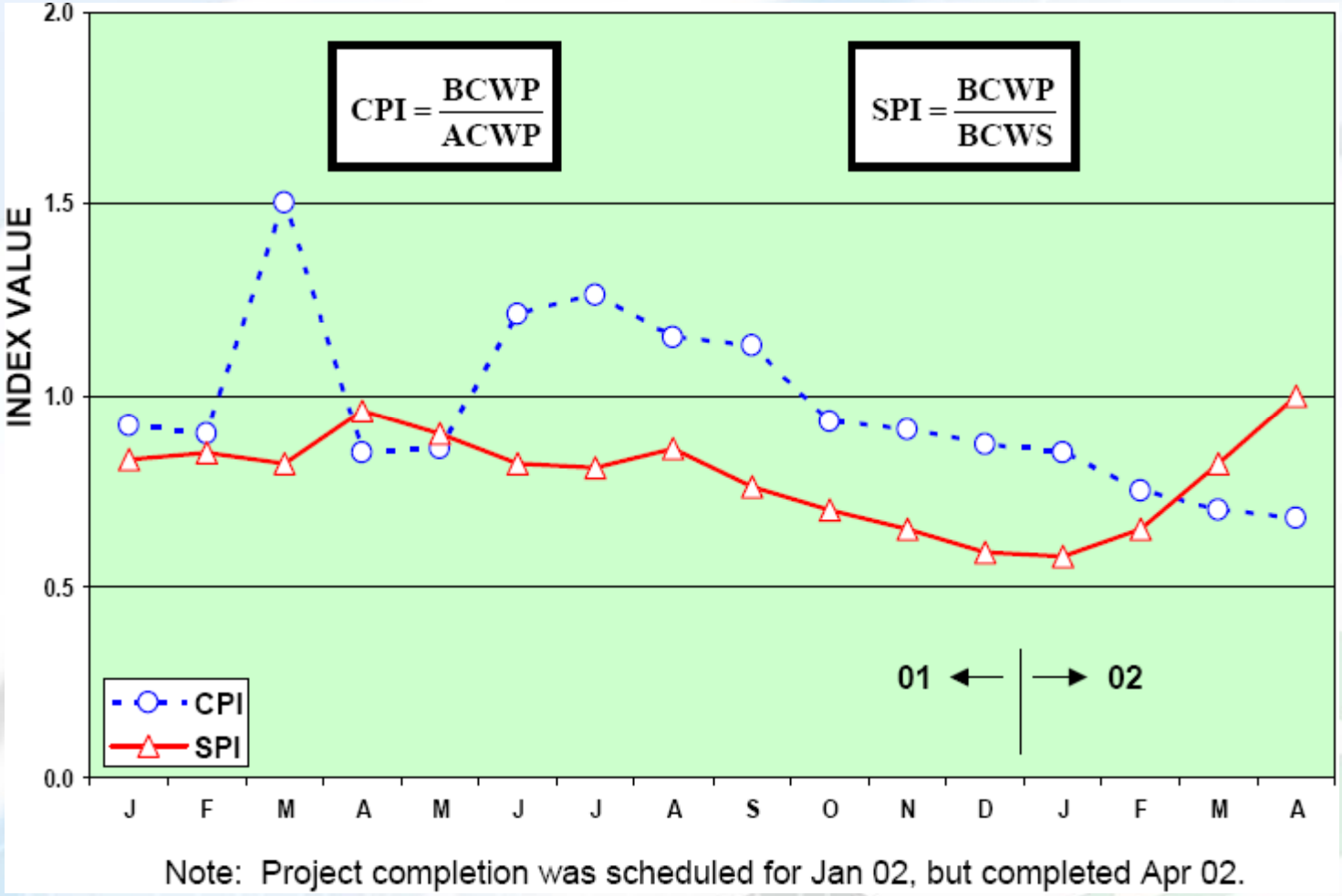
- Why does this happen?
  - SV = EV – PV
  - SPI = EV / PV
- At planned completion PV = BAC
- At actual completion EV = BAC
- When actual > planned completion
  - SV = BAC – BAC = $000
  - SPI = BAC / BAC = 1.00
- Regardless of lateness !!

Cost and Schedule Variances



Note: Project completion was scheduled for Jan 02, but completed Apr 02.

Cost and Schedule Performance Indices



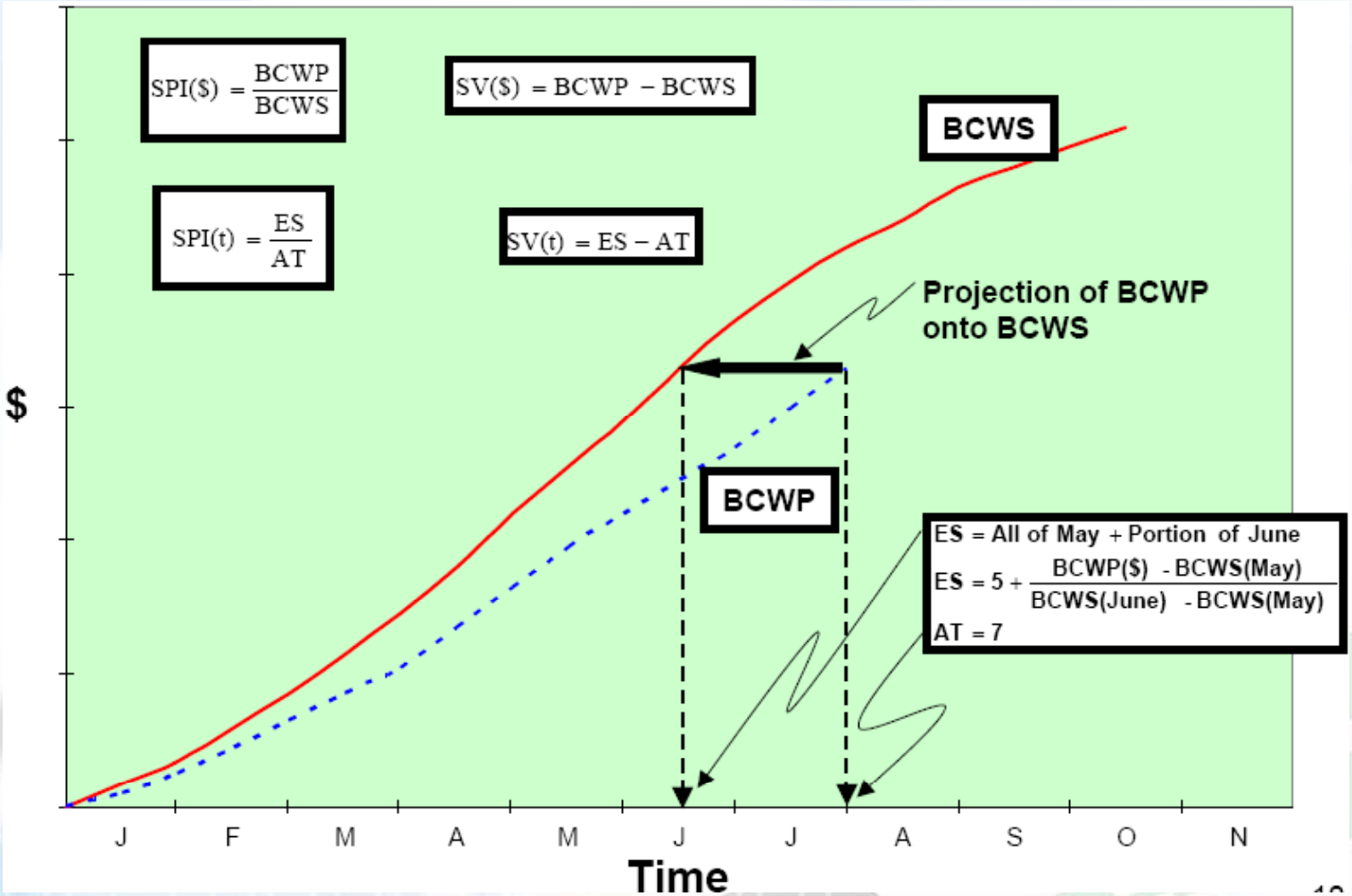
Note: Project completion was scheduled for Jan 02, but completed Apr 02.

So….Do we have any key……..?

- Solution
  - Mr. Walt Lipke
    - “Schedule is Different”
    - (The Measurable News) 2003
    - Training- “ Earned Schedule” (PMI Sydney Chapter, Australia)
  - “Earned schedule”
    - It’s a Extension to EVM theory
    - Time based measurement to help Project Manager

time management

Earned Schedule Concept



time management

Earned Schedule Metrics

- Required measures
  - Performance Management Baseline (PMB)
    - the time phased planned values (PV) from project start to completion
  - Earned Value (EV)
    - the planned value which has been “earned”
  - Actual Time (AT)
    - the actual time duration from the project beginning to the time at which project status is assessed
  - All measures available from EVM

Earned Schedule Metrics

- ES_{cum} is the:
  - Number of completed PV time increments EV exceeds + the fraction of the incomplete PV increment
- $ES_{cum} = C + I$ where:
  - C = number of time increments for EV ≥ PV
  - $I = (EV - PV_C) / (PV_{C+1} - PV_C)$
- $ESperiod(n) = EScum(n) - EScum(n-1) = \Delta ES_{cum}$
- ATcum
- $ATperiod(n) = ATcum(n) - ATcum(n-1) = \Delta AT_{cum}$
  - ΔAT_{cum} is normally equal to 1

Earned Schedule Indicators

- Schedule Variance: SV(t)
  - Cumulative: $SV(t) = ES_{cum} - AT_{cum}$
  - Period: $\Delta SV(t) = \Delta ES_{cum} - \Delta AT_{cum}$
- Schedule Performance Index: SPI(t)
  - Cumulative: $SPI(t) = ES_{cum} / AT_{cum}$
  - Period: $\Delta SPI(t) = \Delta ES_{cum} / \Delta AT_{cum}$

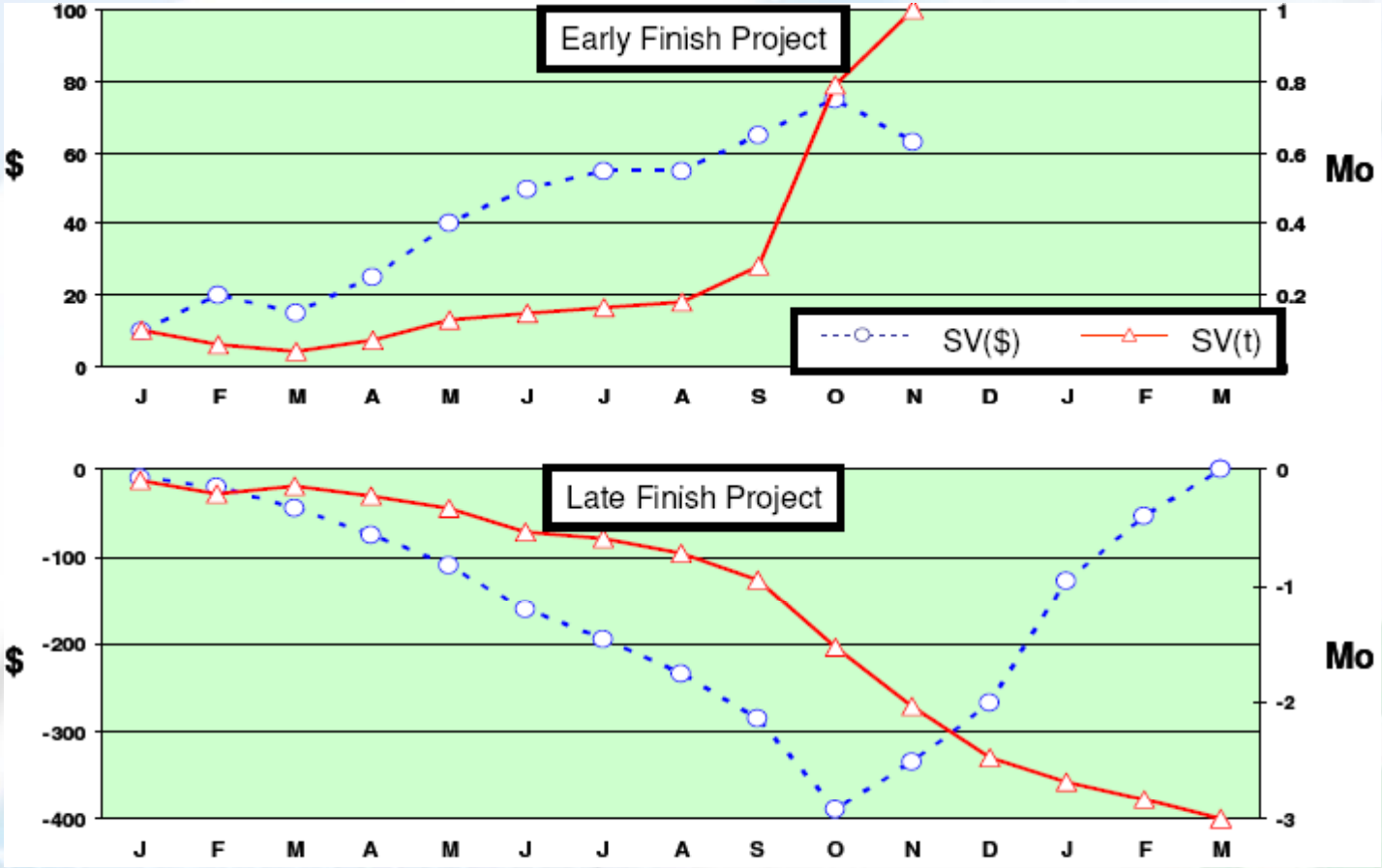
Earned Schedule Indicators

- What happens to the ES indicators, SV(t) & SPI(t), when the planned project duration (PD) is exceeded (PV = BAC)?
  - They Still Work …Correctly!!
- ES will be ≤ PD, while AT > PD
  - SV(t) will be negative (time behind schedule)
  - SPI(t) will be < 1.00
  - Reliable Values from Start to Finish !!

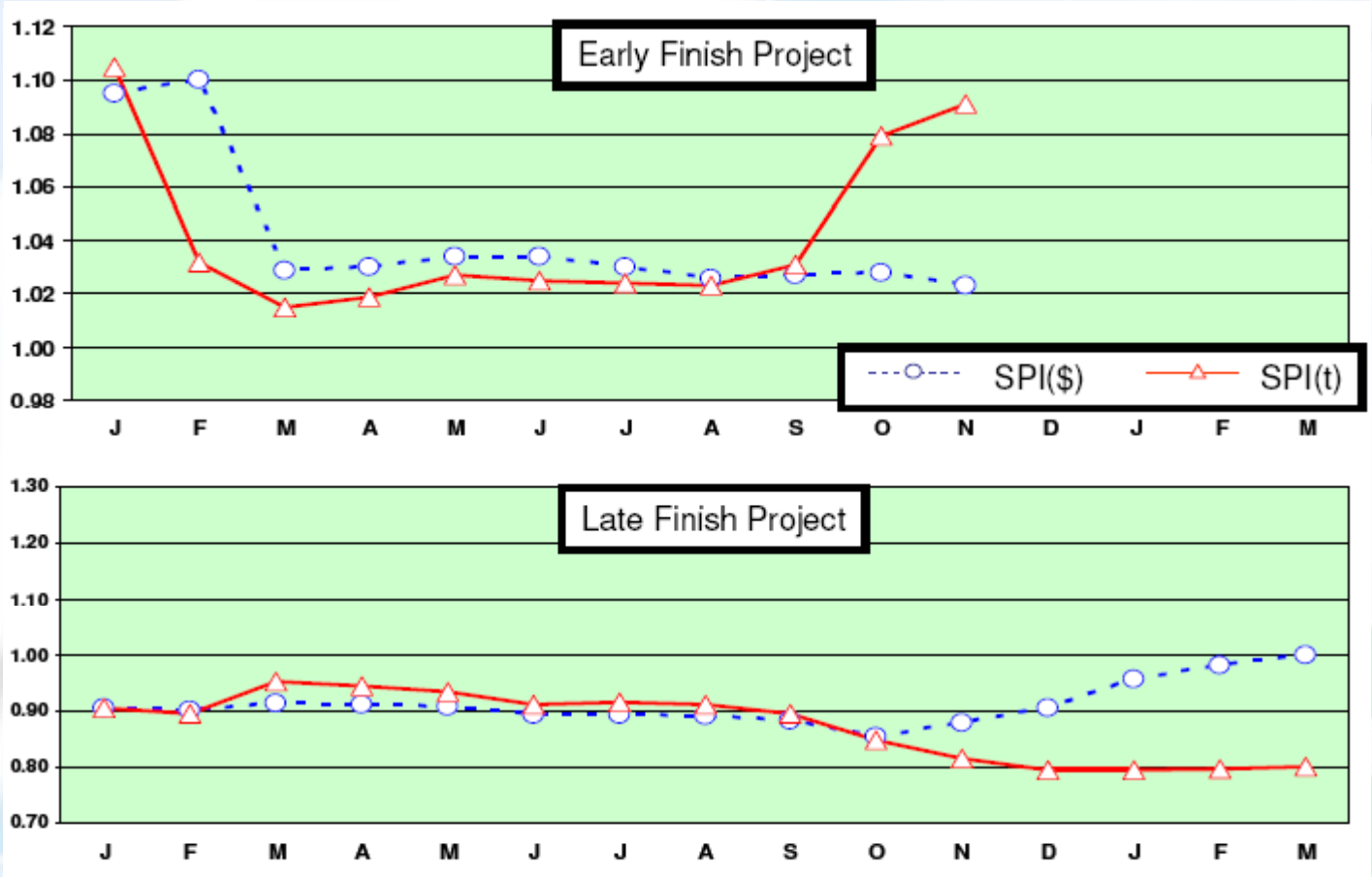
Earned Schedule Indicators

- Key Points:
  - ES Indicators constructed to behave in an analogous manner to the EVM Cost Indicators, CV and CPI
  - SV(t) and SPI(t) are not constrained by BCWS calculation reference
  - SV(t) and SPI(t) provide duration based measures of schedule performance

SV Comparison



SPI Comparison



Earned Schedule Predictors

- Can the project be completed as planned?
  - TSPI = Plan Remaining / Time Remaining
  - = (PD – ES) / (PD – AT)
    - where (PD – ES) = PDWR
    - PDWR = Planned Duration for Work Remaining
- …completed as estimated?
  - TSPI = (PD – ES) / (ED – AT)
  - where ED = Estimated Duration

TSPI Value	Predicted Outcome
≤1.00	Achievable
>1.10	Not Achievable

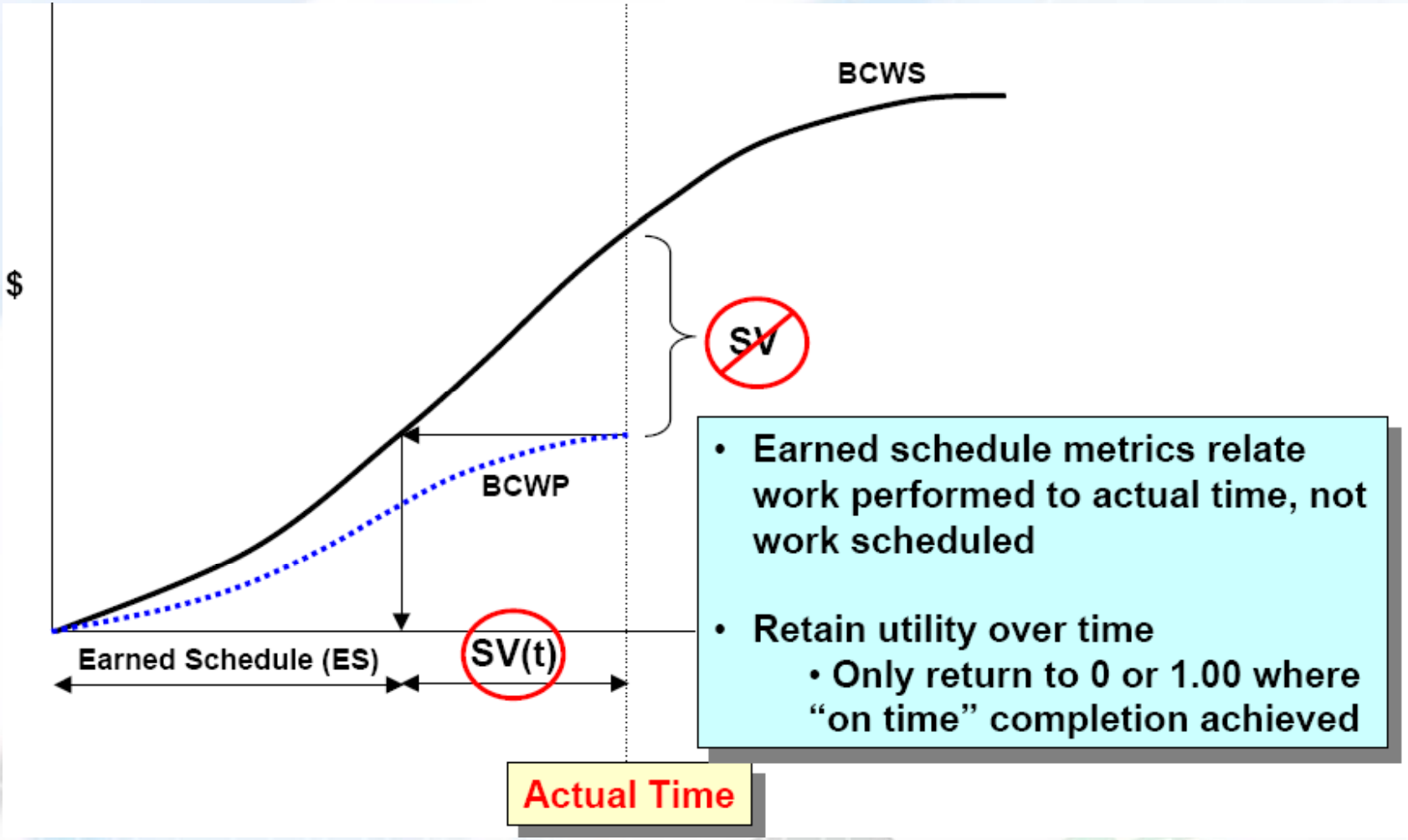
Earned Schedule Predictors

- Long time desire of EVM practitioners…
  - Prediction of total project duration from EVM data
- Independent Estimate at Completion (time)
  - IEAC(t) = PD / SPI(t)
  - IEAC(t) = AT + (PD – ES) / PF(t)
    - where PF(t) is the Performance Factor (time)
  - Analogous to IEAC used to predict final cost
- Independent Estimated Completion Date (IECD)
  - IECD = Start Date + IEAC(t)

Earned Schedule Key Points

- ES Indicators constructed to behave in an analogous manner to the EVM Cost Indicators, CV and CPI
- SV(t) and SPI(t)
  - Not constrained by PV calculation reference
  - Provide duration based measures of schedule performance
  - Valid for entire project, including early and late finish
- Facilitates integrated Cost/Schedule Management (using EVM with ES)

SV($) versus SV(t)



- Earned schedule metrics relate work performed to actual time, not work scheduled
- Retain utility over time
  - Only return to 0 or 1.00 where "on time" completion achieved

Earned schedule terminology

	EVM	Earned schedule
Status	Earned value (EV)	Earned schedule (ES)
	Actual cost (AC)	Actual time (AT)
	SV	SV(t)
	SPI	SPI(t)
Future work	Budgeted cost of work remaining (BCWR)	Planned duration for work complete (PDWR)
	Estimate to complete (ETC)	Estimate to complete (time) ETC(t)
Prediction	Variance at completion (VAC)	Variance at completion (time) VAC(t)
	Estimate at completion (EAC)	Estimate at completion (time) EAC(t)
	Independent EAC	Independent (time) IEAC(t)
	To complete performance index (TCPI)	To complete schedule performance index (TSPI)

Earned schedule terminology

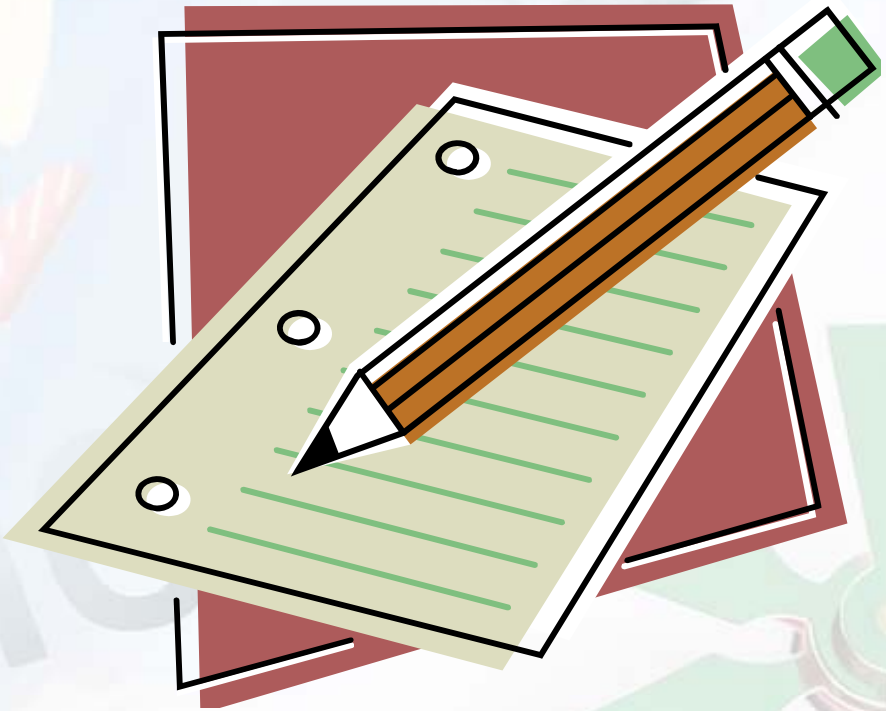
Metrics	Earned Schedule	ES_{cum}	ES = C + I number of complete periods (C) plus an incomplete portion (I)
	Actual Time	AT_{cum}	AT = number of periods executed
Indicators	Schedule Variance	SV(t)	SV(t) = ES - AT
	Schedule Performance Index	SPI(t)	SPI(t) = ES / AT
	To Complete Schedule Performance Index	TSPI(t)	TSPI(t) = (PD – ES) / (PD – AT)
			TSPI(t) = (PD – ES) / (ED – AT)
Predictors	Independent Estimate at Completion (time)	IEAC(t)	IEAC(t) = PD / SPI(t)
			IEAC(t) = AT + (PD – ES) / PF(t)

Case Study: USFDA project Dissertation: Sujit Jadhav, VJTI

- Client: RPG Life Science Limited
- Location: 25, M.I.D.C. Land, Thane-Belapur Road, Navi Mumbai 400 705
- Contractor: Conart Engineers Limited
- Total contract value- 245.00 laces.
- Client specified dates-
  - Date of commencement of work: 7 Aug 2006
  - Total job with finishing: 15 Feb 2007

Data collected

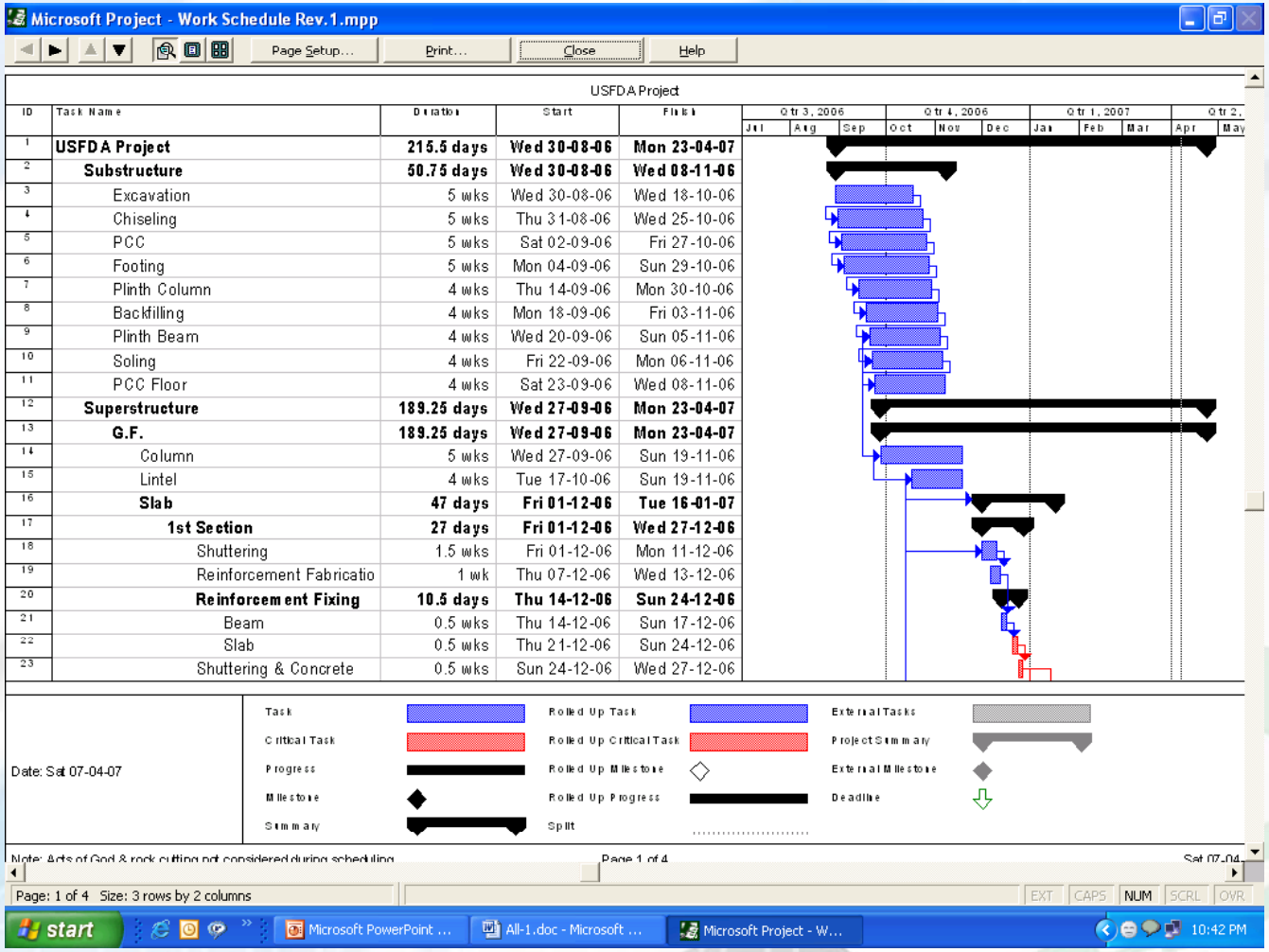
- Bill of Quantities
  BOQ
- Project schedule
- Architectural drawing
  of project
- Rate analysis
- Running account bills
- Project expenses



Methodology

- Project schedule
  - WBS & Activity List
  - Duration estimation considering resource
  - Activity Sequencing & Schedule Development
  - Microsoft Project 2003
- Pre-executed baseline
  - Start Date 7- Aug-06
  - Finish Date15-Feb-07
- At initial stage structural drawing wasn't available, hence dates revised
  - Start Date 30-Aug-06
  - Finish Date 23-Mar-07

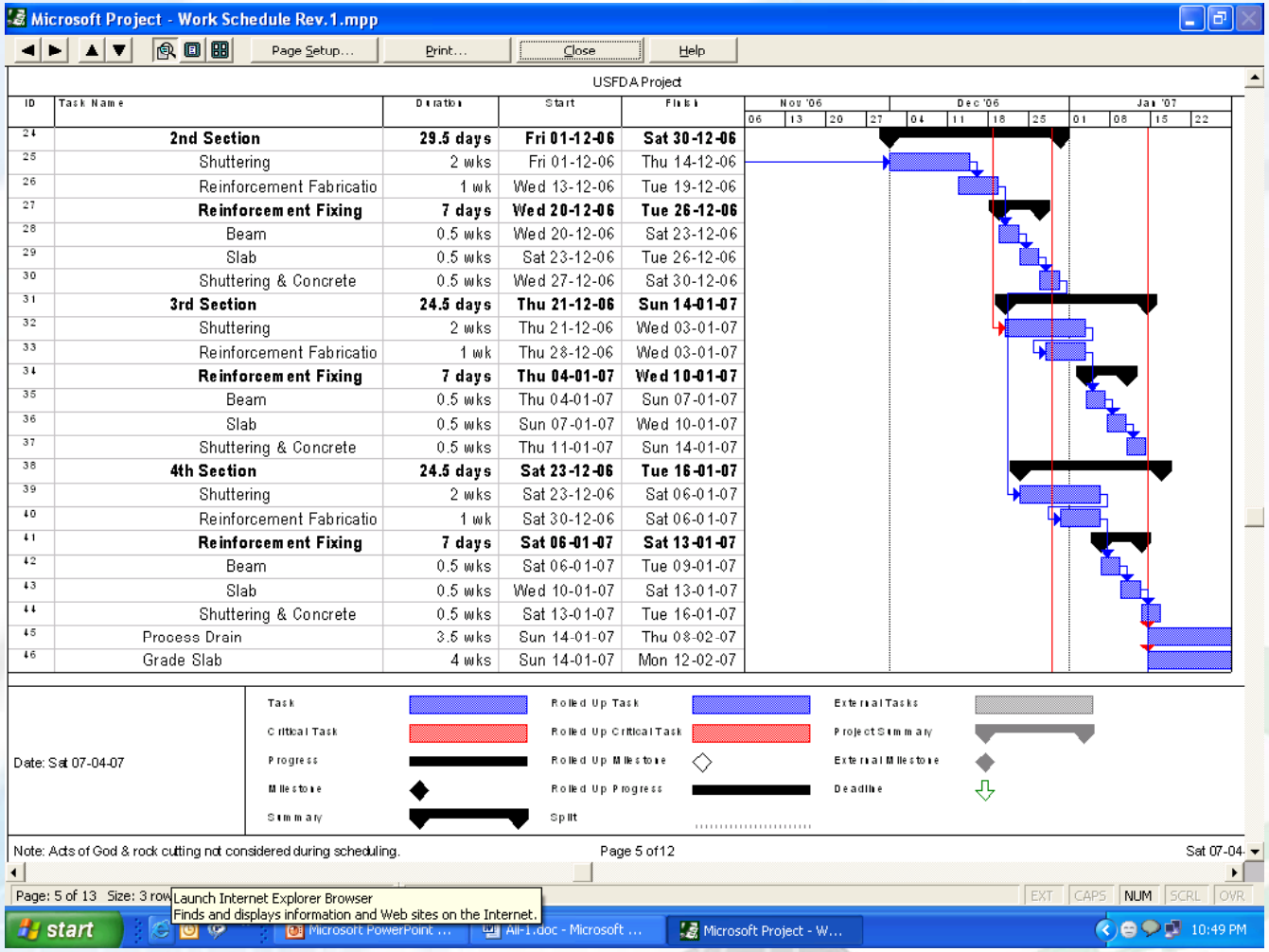
Project Schedule



ID	Task Name	Duration	Start	Finish
1	**USFDA Project**	**215.5 days**	**Wed 30-08-06**	**Mon 23-04-07**
2	**Substructure**	**50.75 days**	**Wed 30-08-06**	**Wed 08-11-06**
3	Excavation	5 wks	Wed 30-08-06	Wed 18-10-06
4	Chiseling	5 wks	Thu 31-08-06	Wed 25-10-06
5	PCC	5 wks	Sat 02-09-06	Fri 27-10-06
6	Footing	5 wks	Mon 04-09-06	Sun 29-10-06
7	Plinth Column	4 wks	Thu 14-09-06	Mon 30-10-06
8	Backfilling	4 wks	Mon 18-09-06	Fri 03-11-06
9	Plinth Beam	4 wks	Wed 20-09-06	Sun 05-11-06
10	Soling	4 wks	Fri 22-09-06	Mon 06-11-06
11	PCC Floor	4 wks	Sat 23-09-06	Wed 08-11-06
12	**Superstructure**	**189.25 days**	**Wed 27-09-06**	**Mon 23-04-07**
13	**G.F.**	**189.25 days**	**Wed 27-09-06**	**Mon 23-04-07**
14	Column	5 wks	Wed 27-09-06	Sun 19-11-06
15	Lintel	4 wks	Tue 17-10-06	Sun 19-11-06
16	**Slab**	**47 days**	**Fri 01-12-06**	**Tue 16-01-07**
17	**1st Section**	**27 days**	**Fri 01-12-06**	**Wed 27-12-06**
18	Shuttering	1.5 wks	Fri 01-12-06	Mon 11-12-06
19	Reinforcement Fabricatio	1 wk	Thu 07-12-06	Wed 13-12-06
20	**Reinforcement Fixing**	**10.5 days**	**Thu 14-12-06**	**Sun 24-12-06**
21	Beam	0.5 wks	Thu 14-12-06	Sun 17-12-06
22	Slab	0.5 wks	Thu 21-12-06	Sun 24-12-06
23	Shuttering & Concrete	0.5 wks	Sun 24-12-06	Wed 27-12-06

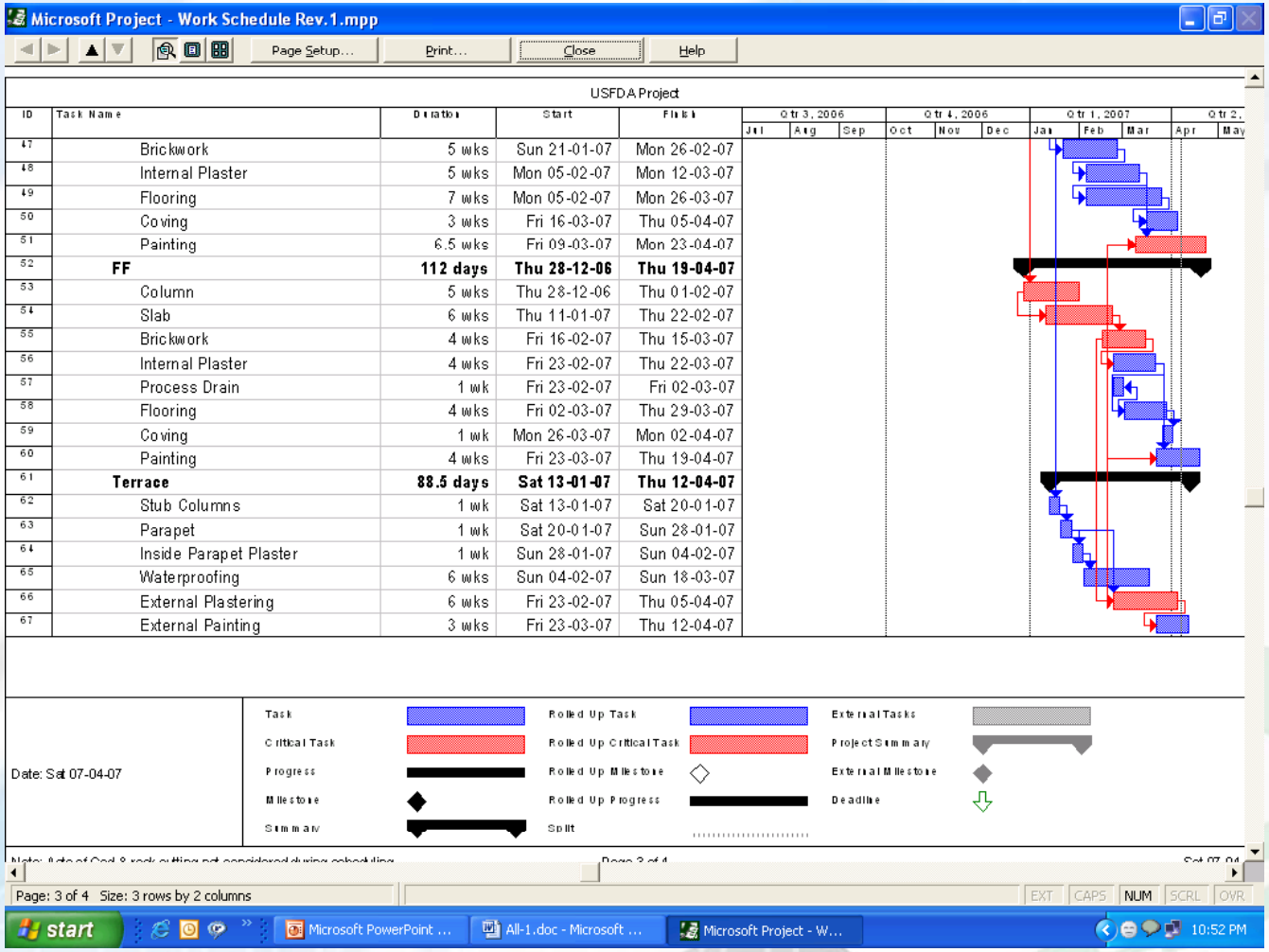
time management

Project Schedule



time management

Project Schedule



time management

Calculation of PV

- Price of work → Cost of work
- Cost of work = BOQ Items X cost of item in rate analysis sheet
- Cost of activity (As schedule prepared in MSP 2003)
- Schedule with cost Export to Microsoft Excel 2003.
- “Cost Usage Sheet”
- Cumulative of “Cost Usages Sheet” → Project Baseline

Calculation of EV

- Earned value project tracking → “RA Bills”
- Seven RA bills
  - First RA bill - 31-Oct-06
  - Last RA bill - 31-Apr-07
- Cost of RA Bills= quantities in RA bills x Cost in BOQ
- RA bills are not available at fix interval; all RA bill dates are irregular

Calculation of AC

- Actual cost → “Site expenses bill”
- Month wise Expenses (August to February)
- By interpolation actual cost is calculated according to RA bill dates

Project Data

Sr. No	Dates	PV(cu)	EV(cu)	AC(cu)
1	31-Oct-06	4050245.12	1,457,921.26	1558060
2	15-Nov-06	4955757.78	1,814,745.66	1986392.5
3	05-Dec-06	6019696.27	3,451,688.29	2718787.1
4	15-Jan-07	11911919.28	5,007,422.18	4953784.7
5	31-Jan-07	12678132.36	5,631,797.93	5651251
6	20-Feb-07	13656736.16	7,201,091.22	7223201.7
7	21-Mar-07	16175351.73	8,861,682.96	
8	23-Apr-07	17620118.84		

EVM Schedule parameters

Sr. No.	Dates	PVcu	EVcu	SV	%SV	SPI
1	31-Oct-06	4050245.12	1,457,921.26	-2592323.864	-64.00412	0.3599588
2	15-Nov-06	4955757.78	1,814,745.66	-3141012.12	-63.38107	0.3661893
3	05-Dec-06	6019696.27	3,451,688.29	-2568007.975	-42.66009	0.5733991
4	15-Jan-07	11911919.28	5,007,422.18	-6904497.098	-57.96293	0.4203707
5	31-Jan-07	12678132.36	5,631,797.93	-7046334.429	-55.57865	0.4442135
6	20-Feb-07	13656736.16	7,201,091.22	-6455644.938	-47.27077	0.5272923
7	21-Mar-07	16175351.73	8,861,682.96	-7313668.772	-45.2149	0.547851
8	23-Apr-07	17620118.84				

EVM Cost parameters

Sr. No	Dates	EVcu	AVcu	CV	%CV	CPI
1	31-Oct-06	1,457,921.26	1558060	-100138.7441	-6.868598	0.9357286
2	15-Nov-06	1,814,745.66	1986392.5	-171646.8402	-9.458452	0.9135887
3	05-Dec-06	3,451,688.29	2718787.1	732901.1981	21.233122	1.2695692
4	15-Jan-07	5,007,422.18	4953784.68	53637.5046	1.07116	1.0108276
5	31-Jan-07	5,631,797.93	5651251	-19453.06937	-0.345415	0.9965577
6	20-Feb-07	7,201,091.22	7223201.71	-22110.49198	-0.307044	0.996939
7	21-Mar-07	8,861,682.96				
8	23-Apr-07					

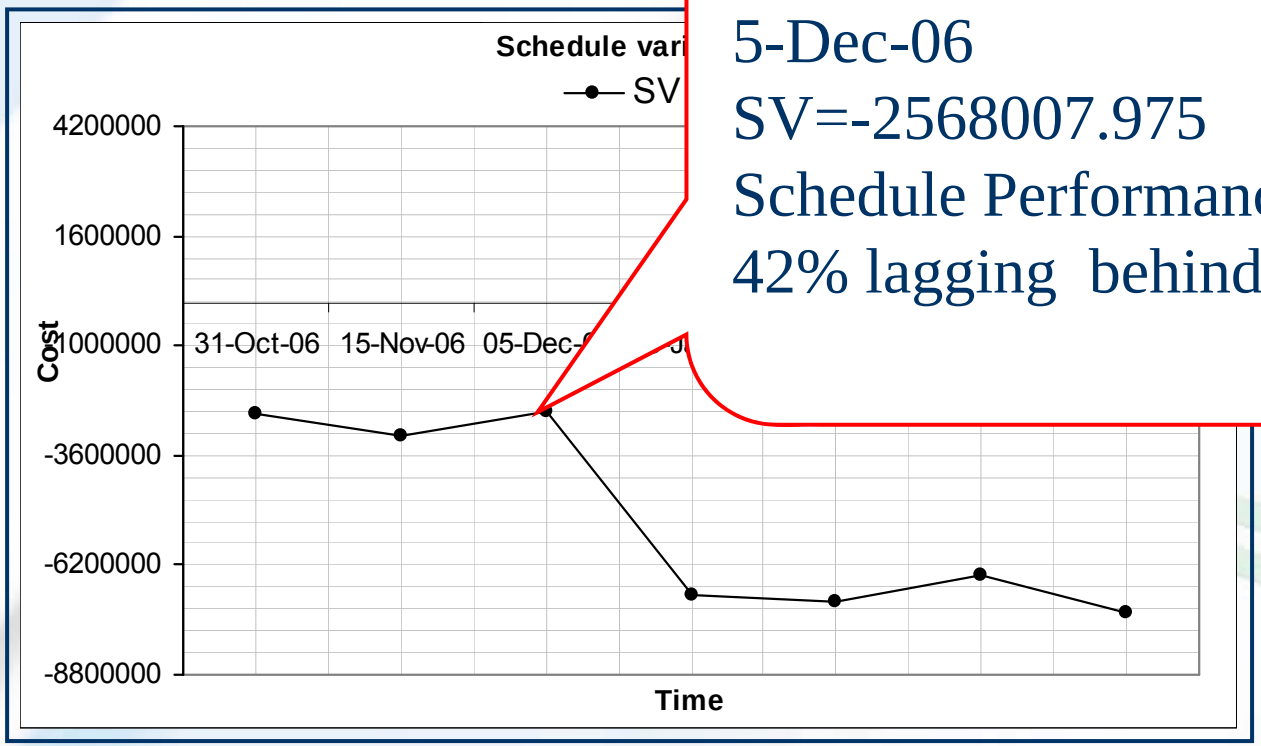
EVM Predictors

Sr. No	Dates	BAC	EAC1	EAC2	VAC1	VAC2
1	31-Oct-06	17620119.19	18830374	49542206	-1210255	-31922087
2	15-Nov-06	17620119.19	19286710	49230578	-1666590	-31610459
3	05-Dec-06	17620119.19	13878818	22181725	3741301.5	-4561605.8
4	15-Jan-07	17620119.19	17431380	34636144	188739.67	-17016024
5	31-Jan-07	17620119.19	17680982	32732215	-60862.52	-15112096
6	20-Feb-07	17620119.19	17674221	27043366	-54101.45	-9423246.4
7	21-Mar-07	17620119.19				
8	23-Apr-07	17620119.19				

EVM Predictors

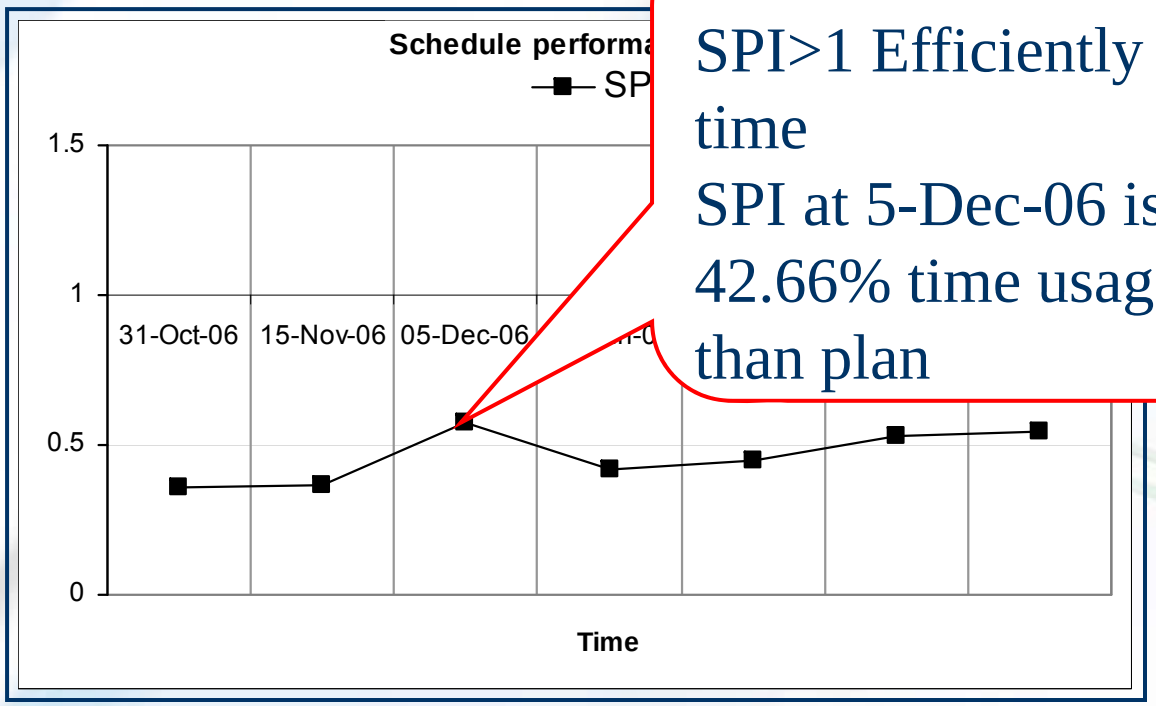
Sr. No	Dates	ECA1	ECA2	ISAC	TCPI	CR
1	31-Oct-06	17272314	47984146	48950381.56	1.0062345	0.336823706
2	15-Nov-06	17300317	47244186	48117510.18	1.0109793	0.334546426
3	05-Dec-06	11160031	19462938	30729242.24	0.9508164	0.727969796
4	15-Jan-07	12477595	29682359	41915666.36	0.9957653	0.424922326
5	31-Jan-07	12029731	27080964	39665876.87	1.0016253	0.442684432
6	20-Feb-07	10451019	19820164	33416229.77	1.0021266	0.525678195
7	21-Mar-07			32162245.79	0.4970702	
8	23-Apr-07					

Are we ahead or behind schedule..?



5-Dec-06
SV=-2568007.975
Schedule Performance is 42% lagging behind

How efficiently are we using time?

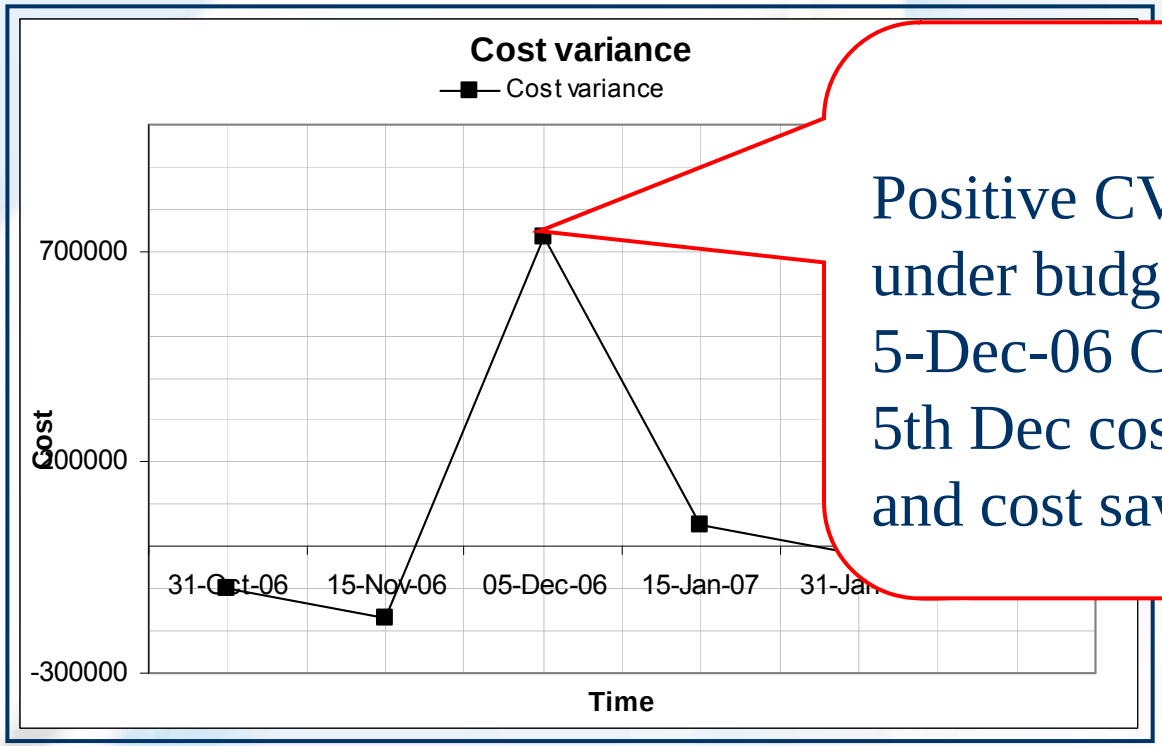


SPI>1 Efficiently using time

SPI at 5-Dec-06 is 0.550

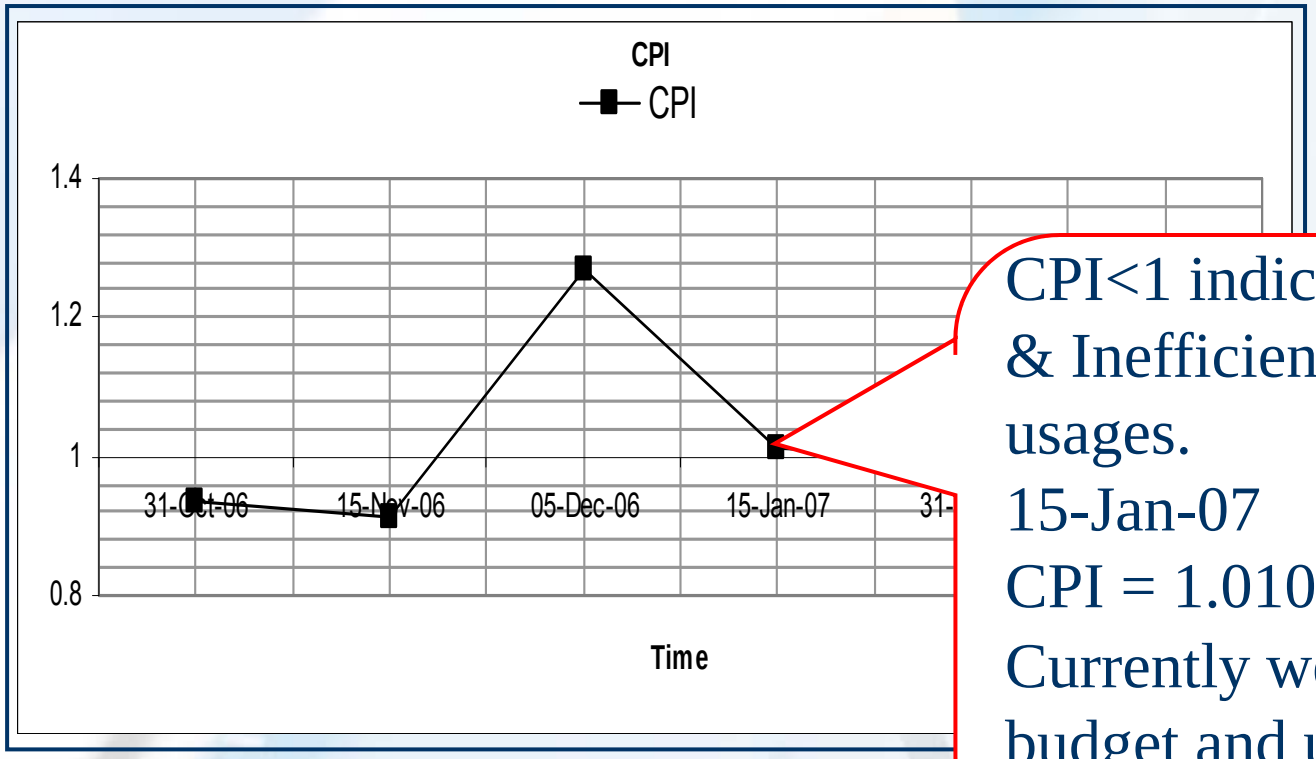
42.66% time usage is more than plan

Are we under or over our budget?



Positive CV- Task is currently under budget
5-Dec-06 CV is 732901.19
5th Dec cost is under budget and cost saving is 24%.

How efficiently are we using our resources?



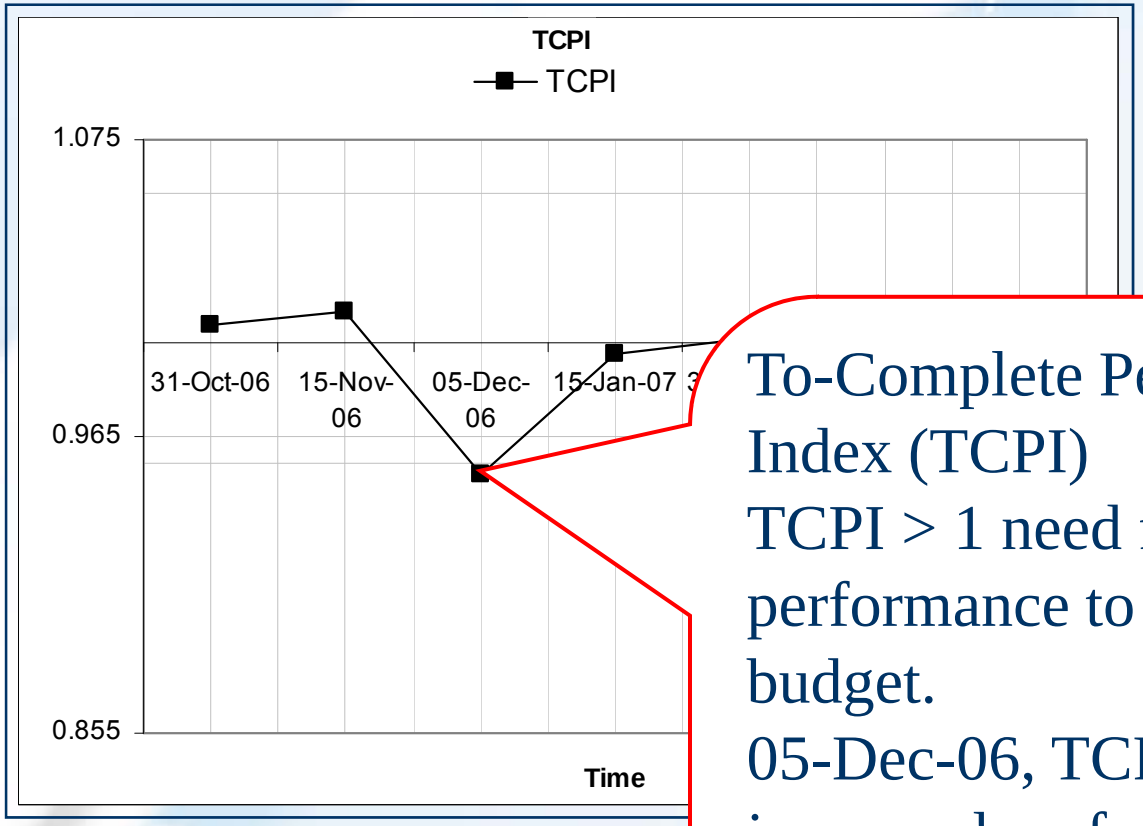
CPI<1 indicate over budget & Inefficient resources usages.

15-Jan-07

CPI = 1.0108

Currently we are under budget and using our resources efficiently.

How efficiently must we use our remaining resources?

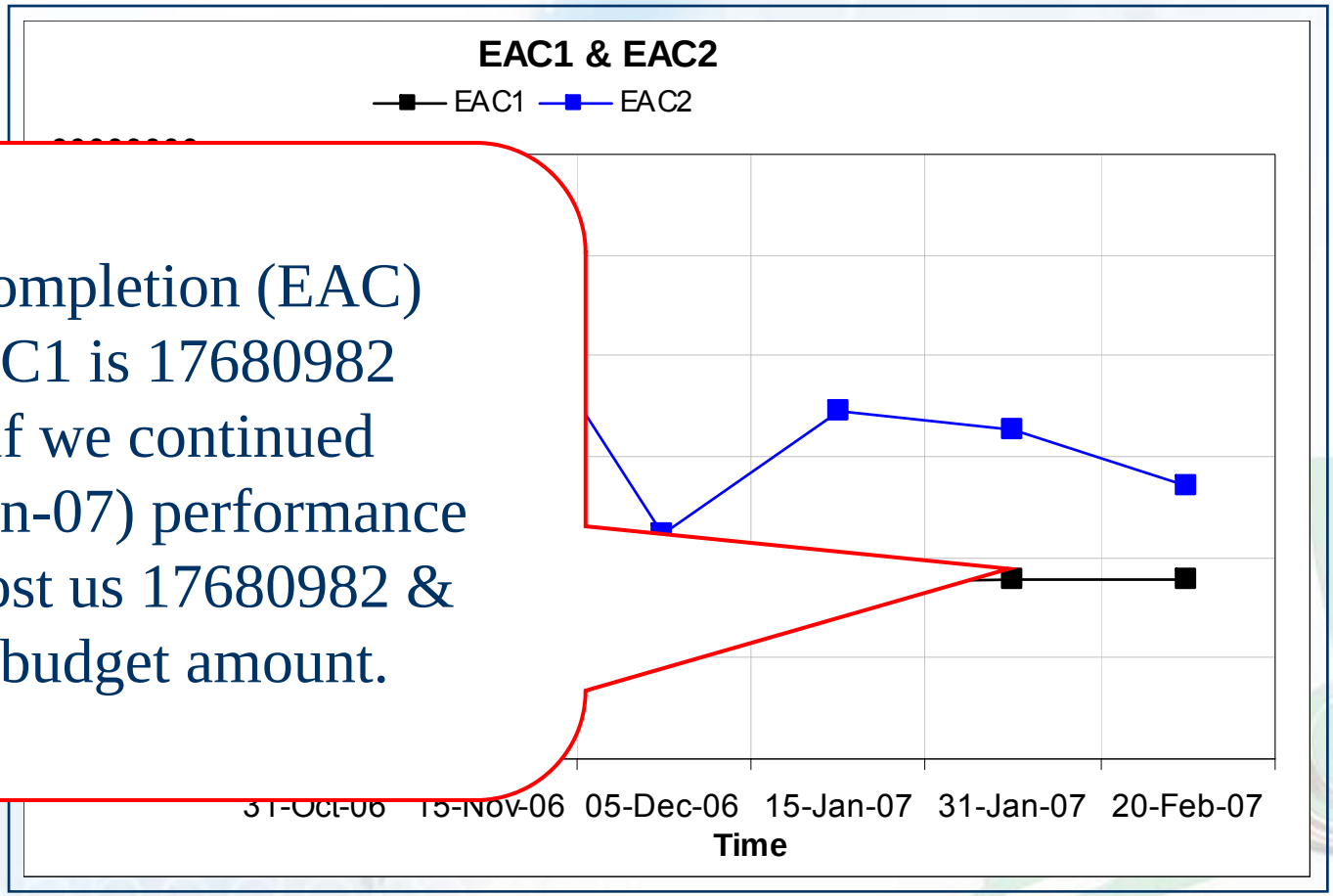


To-Complete Performance Index (TCPI)

TCPI > 1 need for increased performance to stay within budget.

05-Dec-06, TCPI is 0.95081 no increased performance of work to complete remaining work with remaining budget.

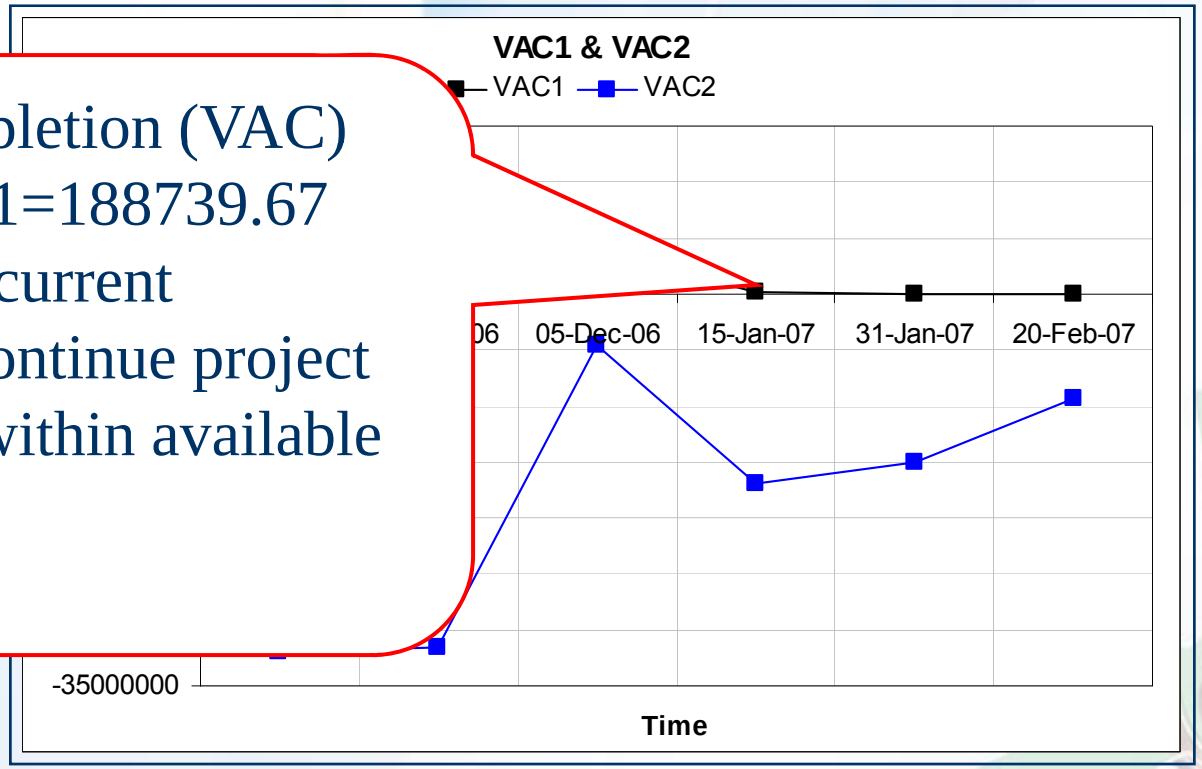
What is the project likely to cost?



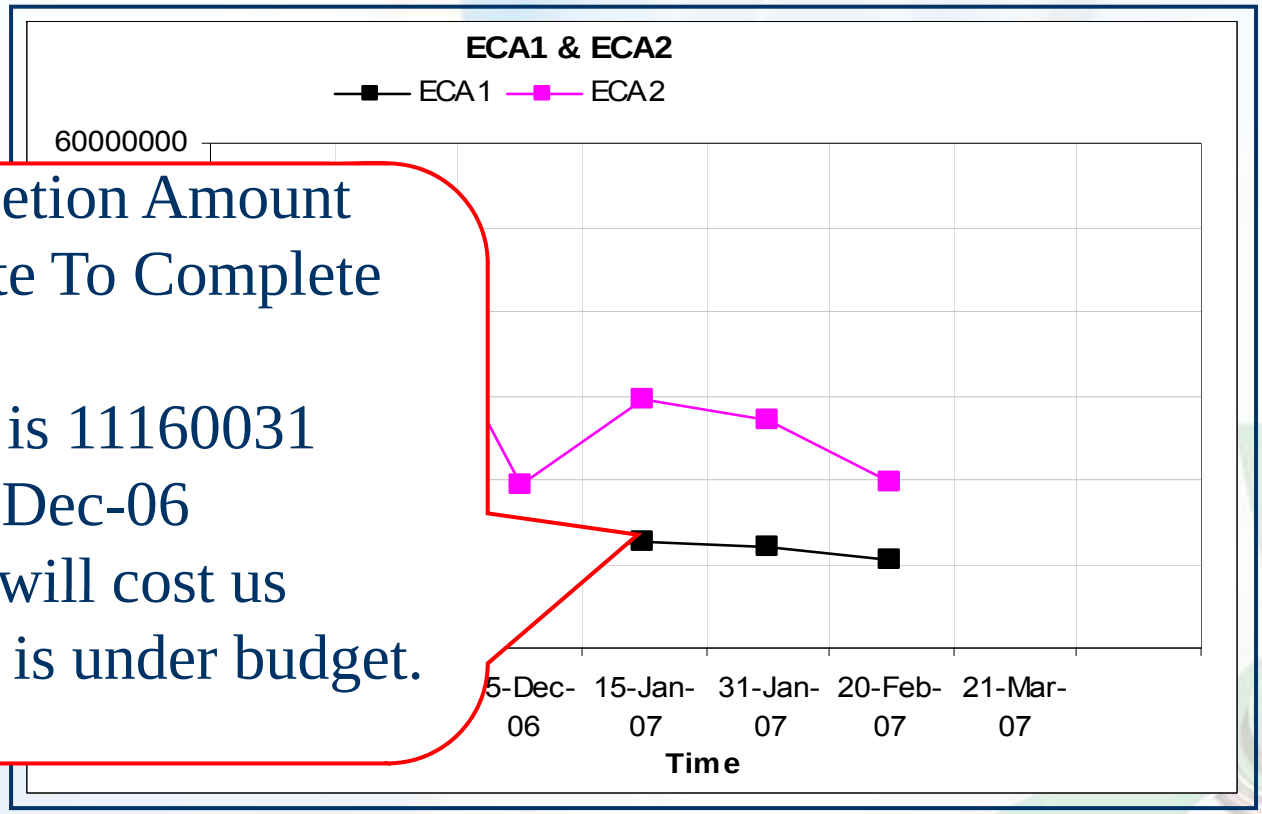
Estimate at Completion (EAC)
31-Jan-07 EAC1 is 17680982
it means that if we continued current (31-Jan-07) performance project will cost us 17680982 & will cross the budget amount.

Will we be under or over budget…?

Variance at Completion (VAC)
15-Jan-07, VAC1=188739.67
It means that, if current performance is continue project will be finished within available budget.



What will the remaining work cost….?

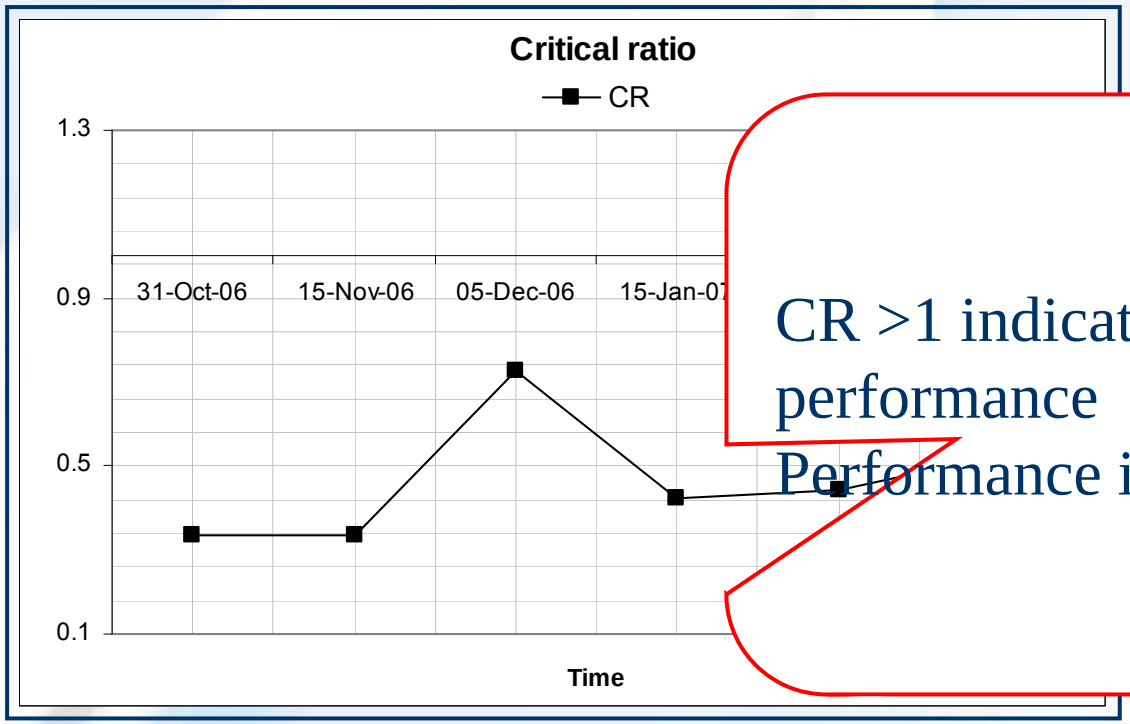


Expected Completion Amount (ECA) = Estimate To Complete (ETC)

5-Dec-06 ECA1 is 11160031

It means from 5-Dec-06 remaining work will cost us 11160031 which is under budget.

Overall performance……



CR >1 indicates overall excellent performance

Performance is poor

Any other way to show overall performance……?

EARNED VALUE GRAPHS

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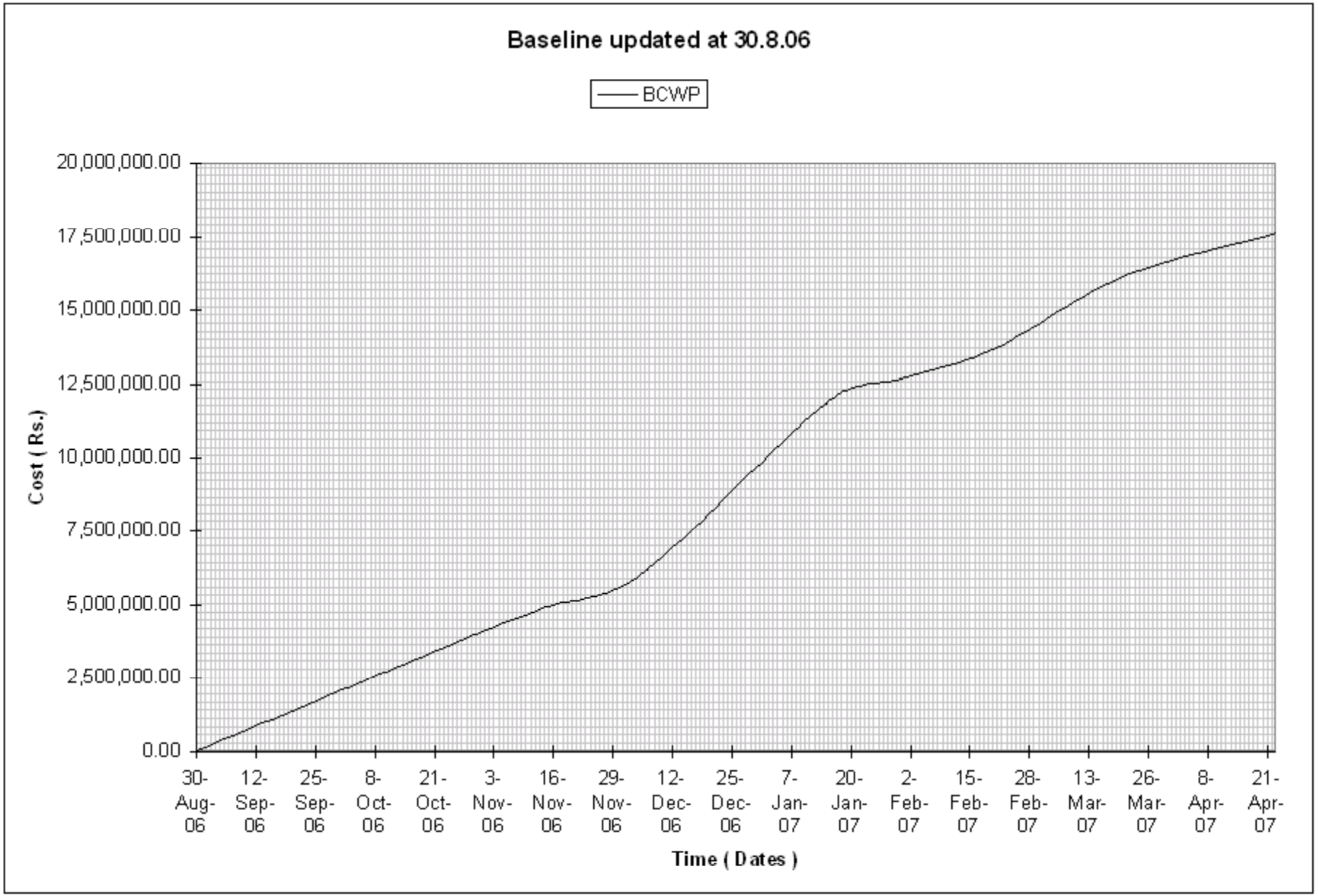

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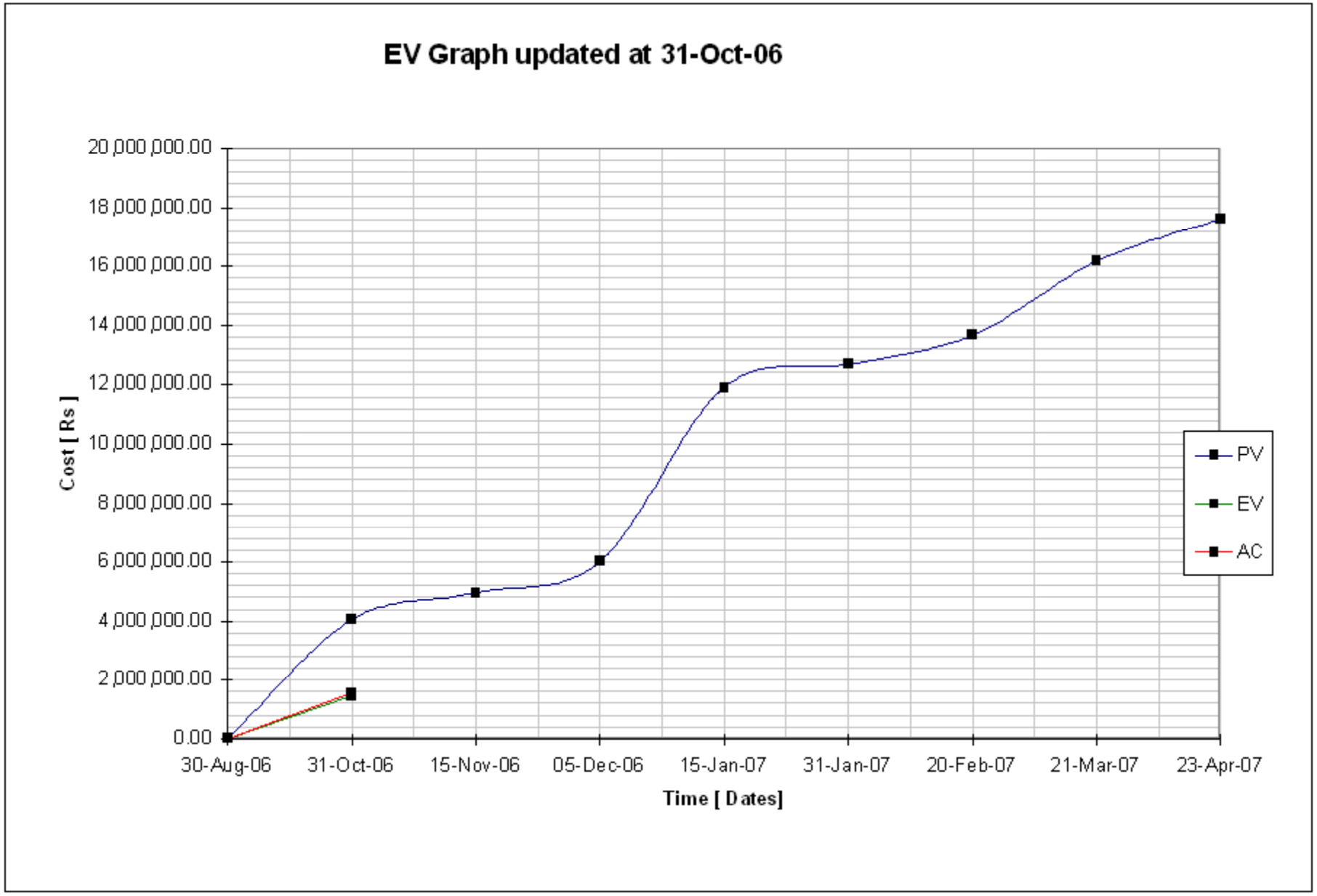

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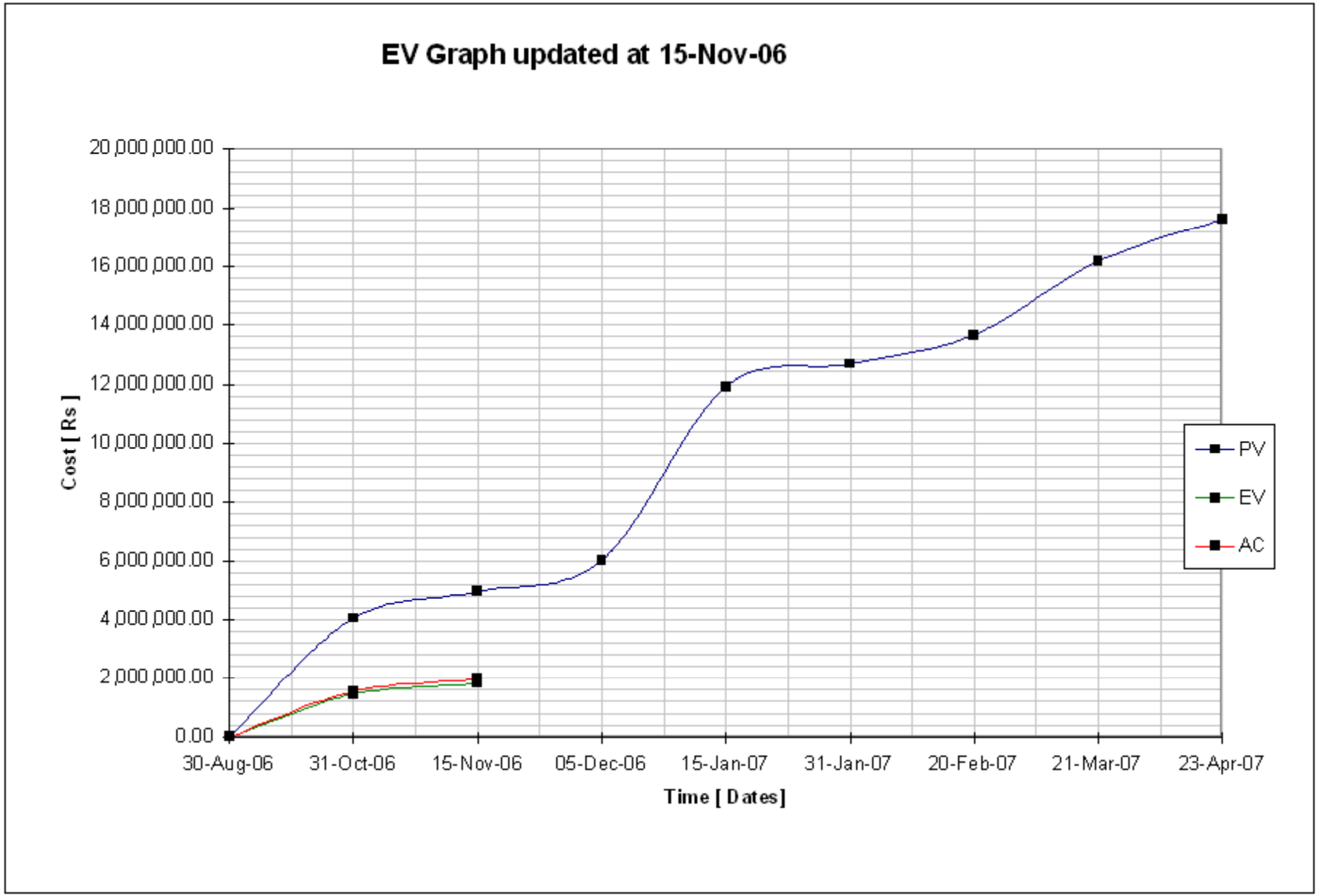

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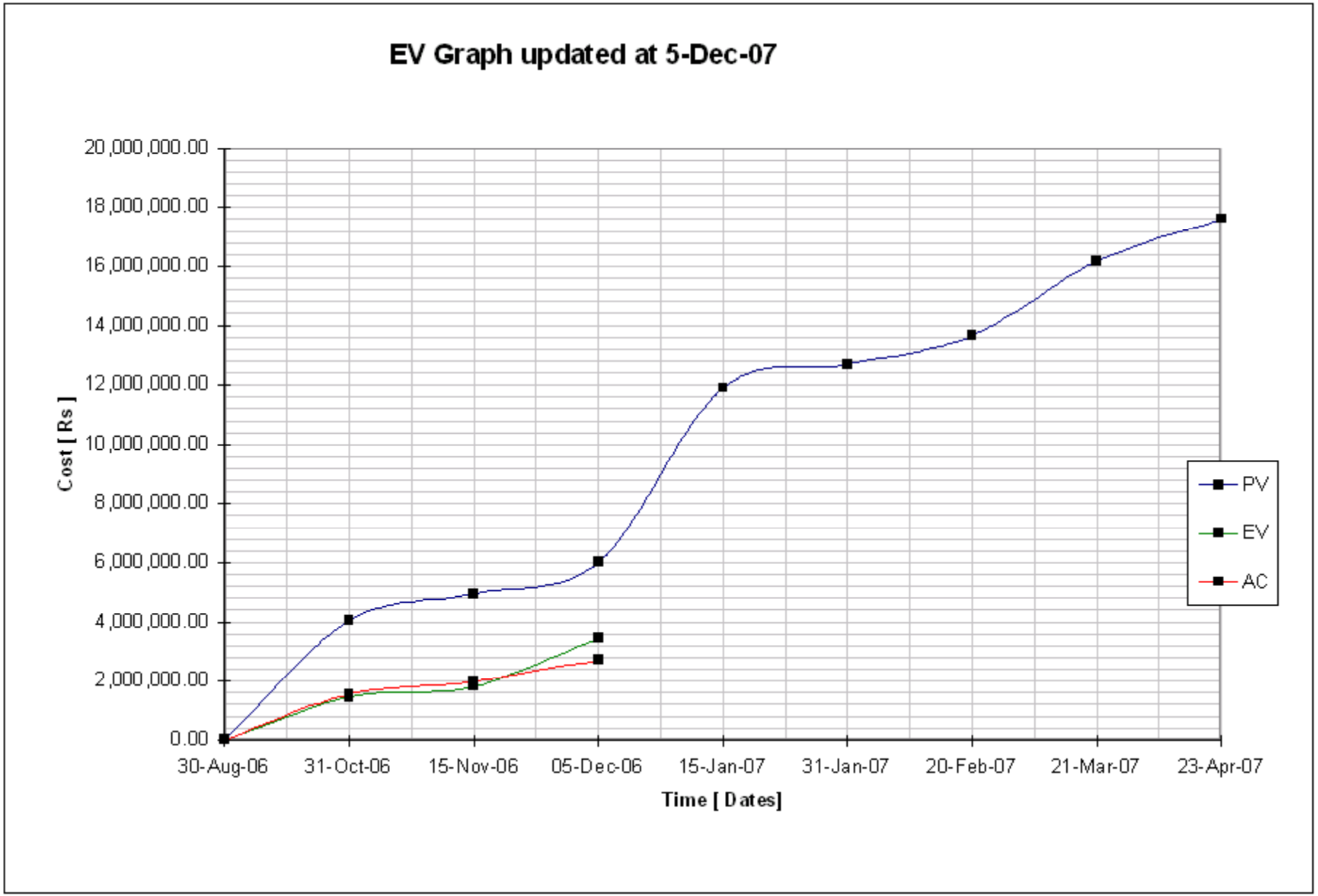

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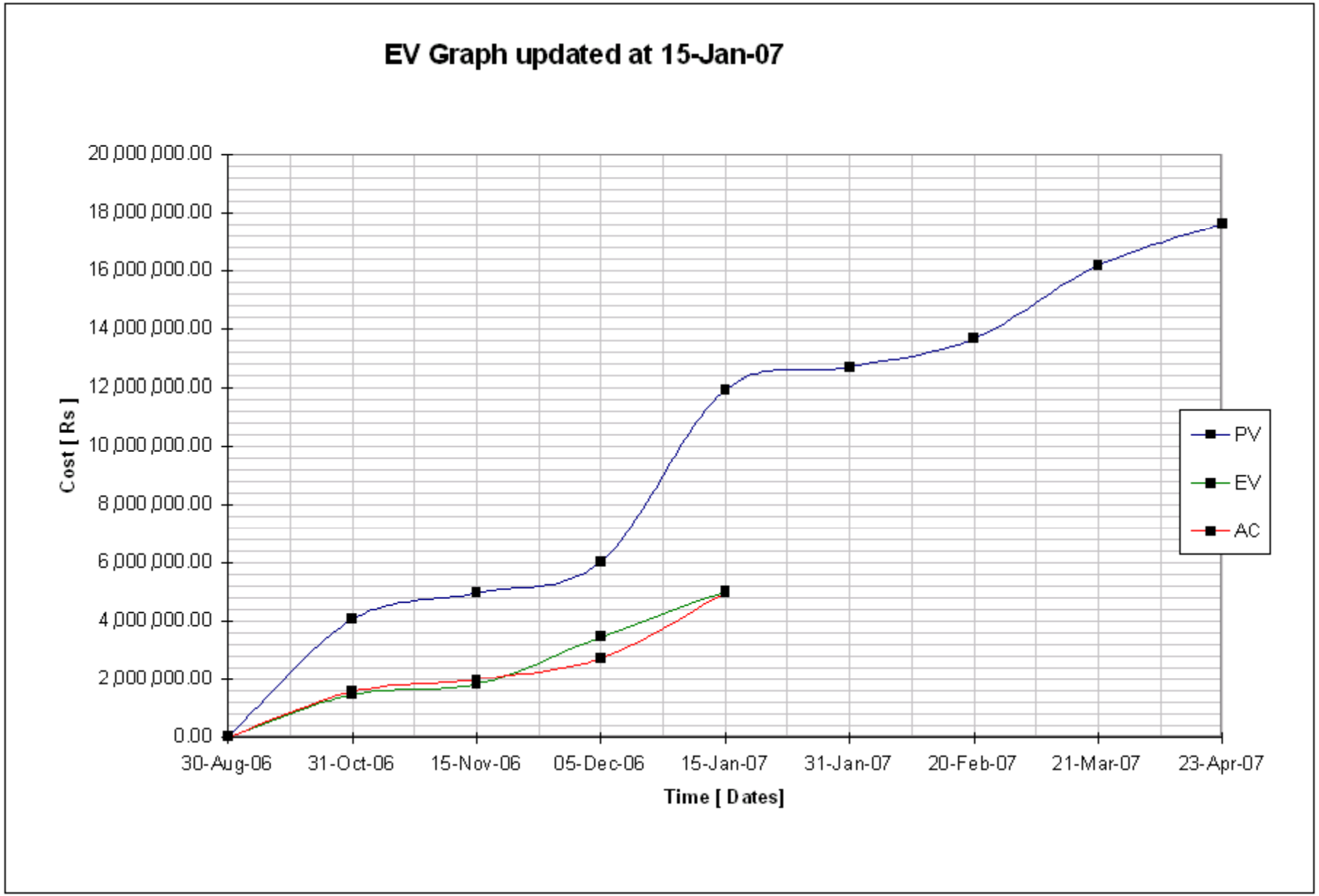

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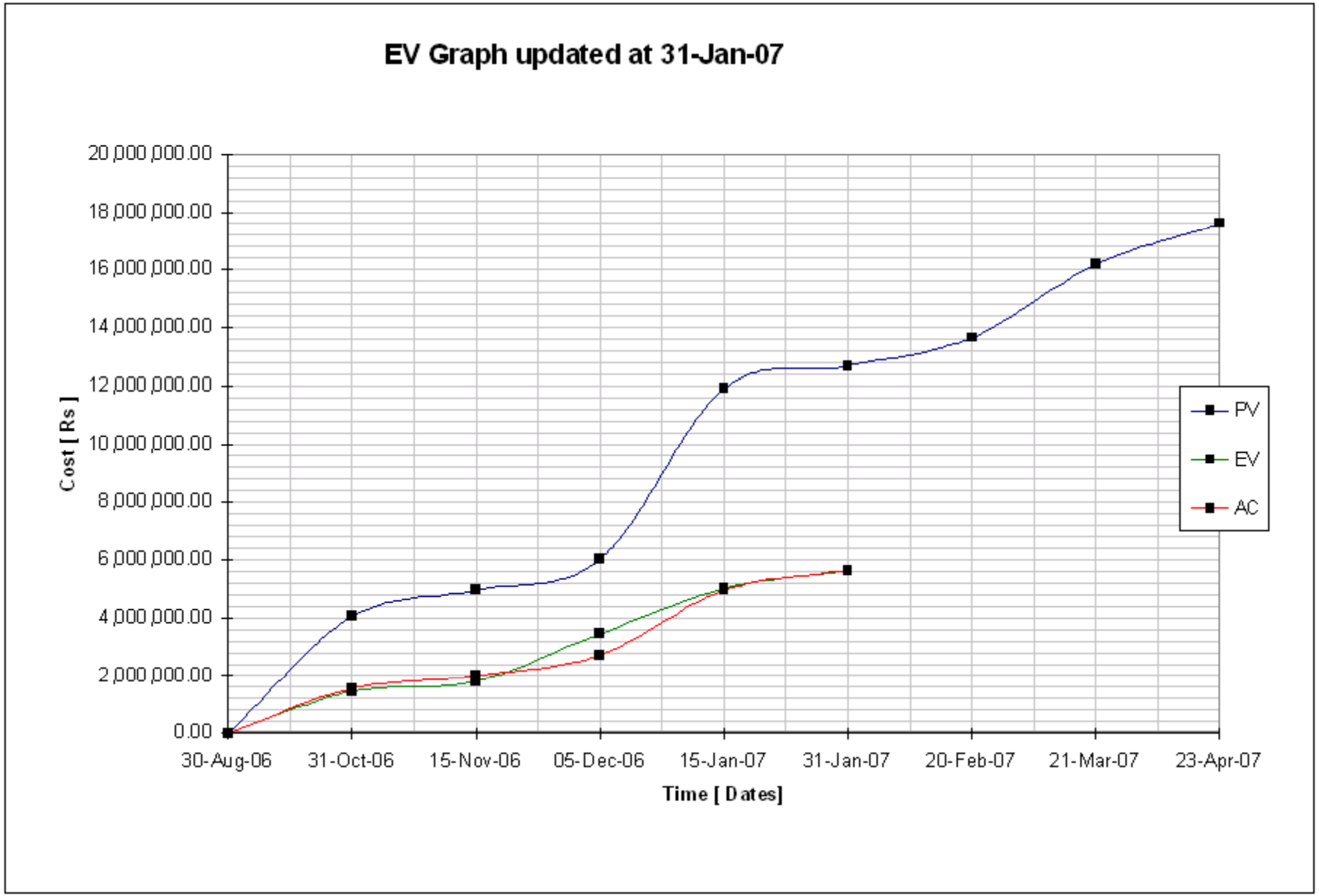

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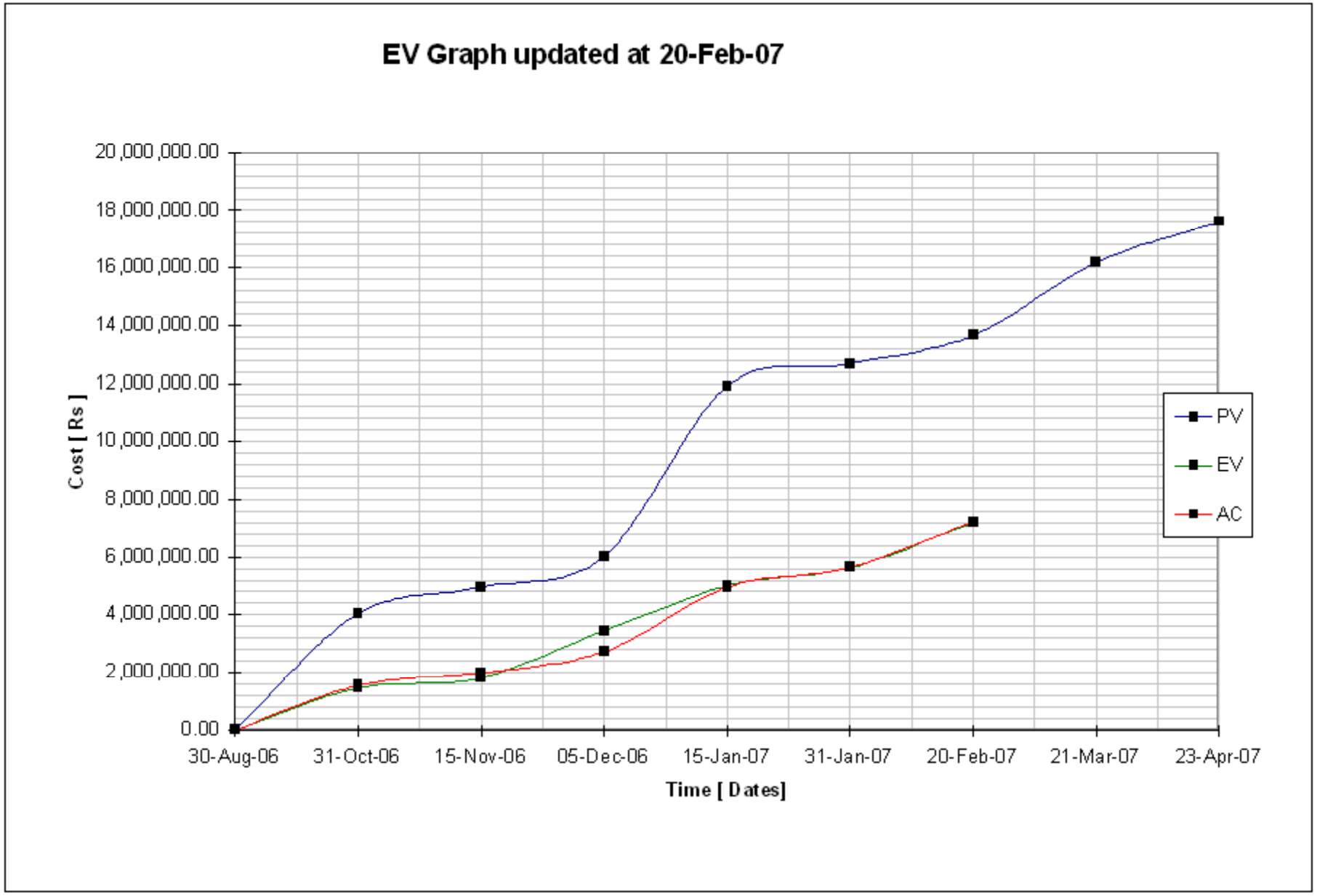

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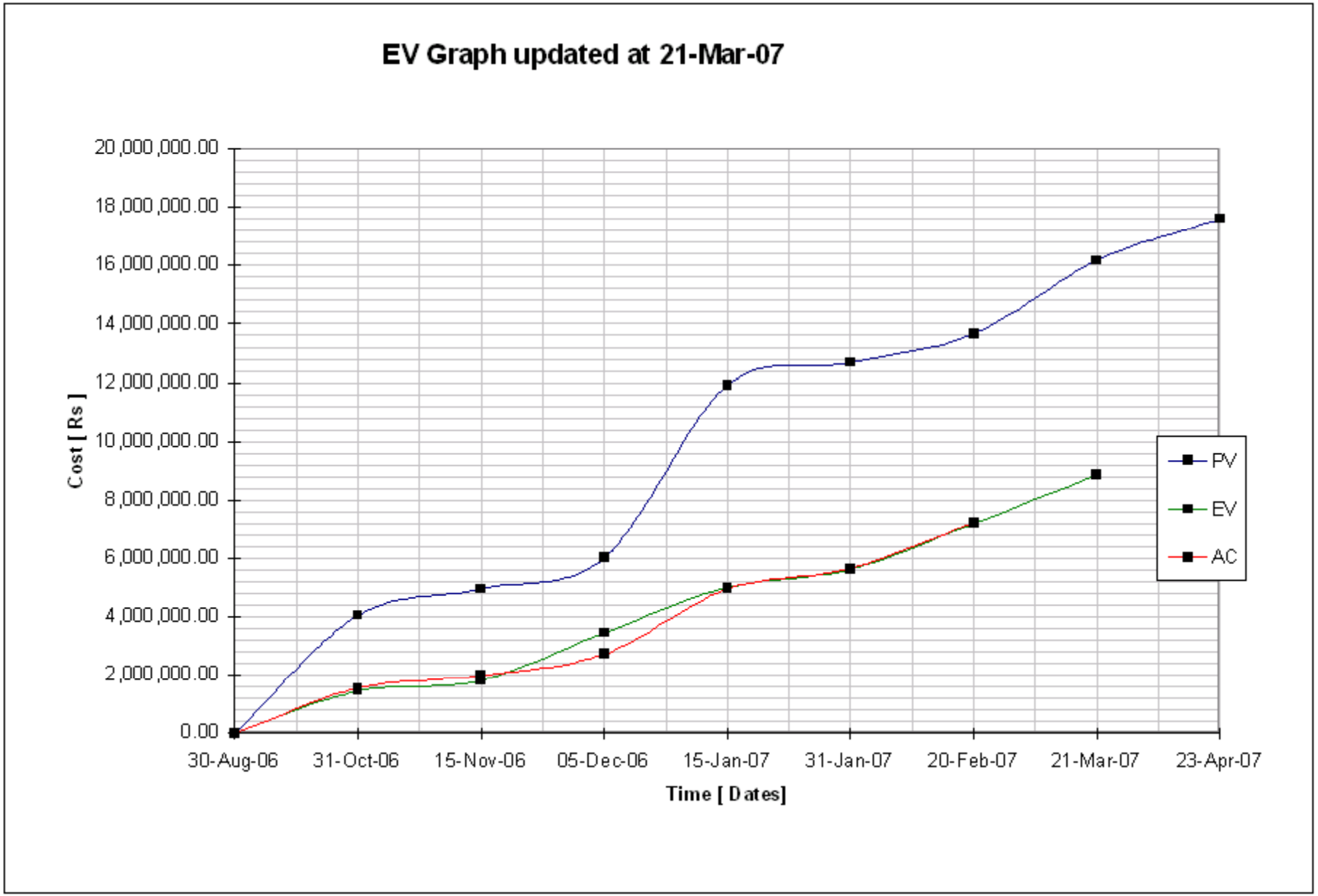


NUM

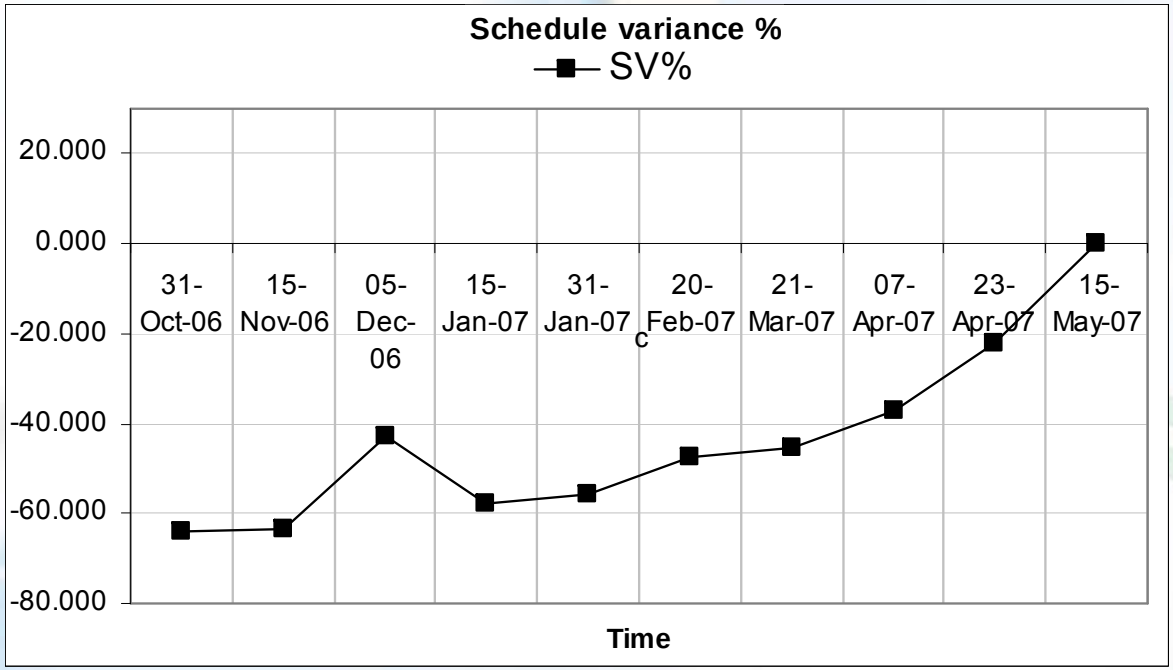
Earned Value limitation

- Evaluation of Problem

Sr. No.	Dates	PVcu	EVcu	SV	%SV	SPI
1	31-Oct-06	4050245.12	1,457,921.26	-2,592,323.86	-64.004	0.360
2	15-Nov-06	4955757.78	1,814,745.66	-3,141,012.12	-63.381	0.366
3	05-Dec-06	6019696.27	3,451,688.29	-2,568,007.98	-42.660	0.573
4	15-Jan-07	11911919.28	5,007,422.18	-6,904,497.10	-57.963	0.420
5	31-Jan-07	12678132.36	5,631,797.93	-7,046,334.43	-55.579	0.444
6	20-Feb-07	13656736.16	7,201,091.22	-6,455,644.94	-47.271	0.527
7	21-Mar-07	16175351.73	8,861,682.96	-7,313,668.77	-45.215	0.548
8	07-Apr-07	17510424.47	11,051,291.93	-6,459,132.54	-36.887	0.631
9	23-Apr-07	17620118.84	13,678,822.69	-3,941,296.15	-22.368	0.776
10	15-May-07	17,620,118.84	17,620,118.84	0.00	0.000	1.000

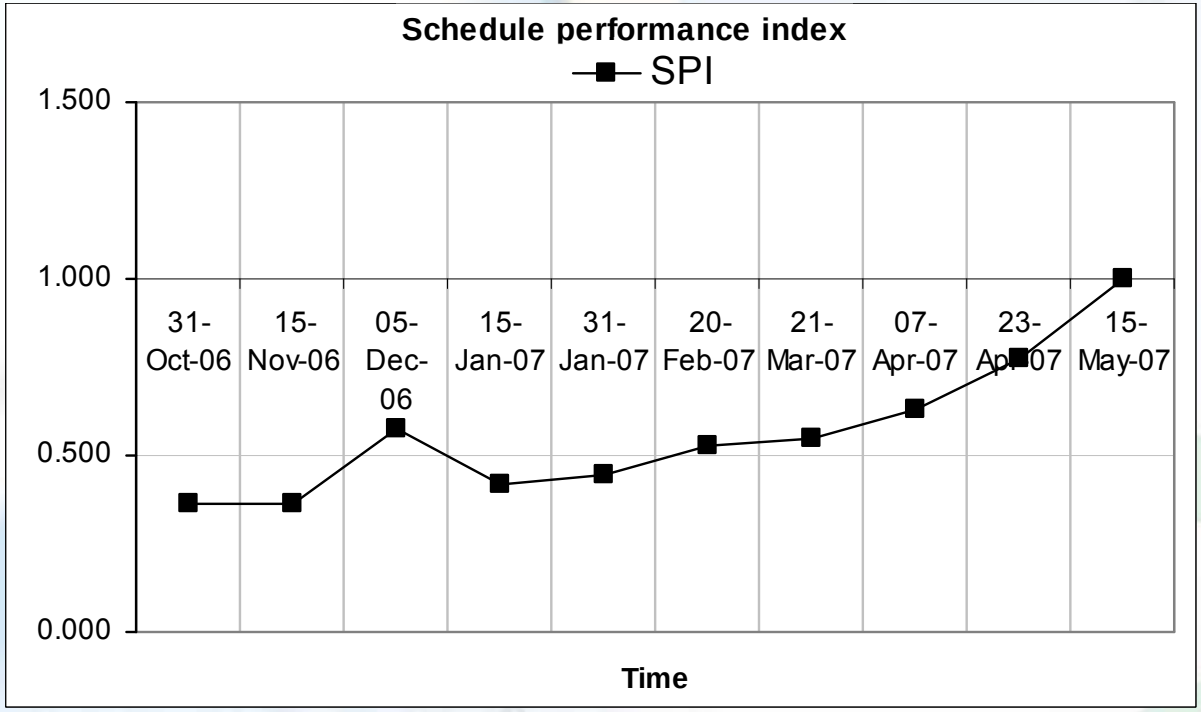
Late Finish Project

- Schedule Variance = 0



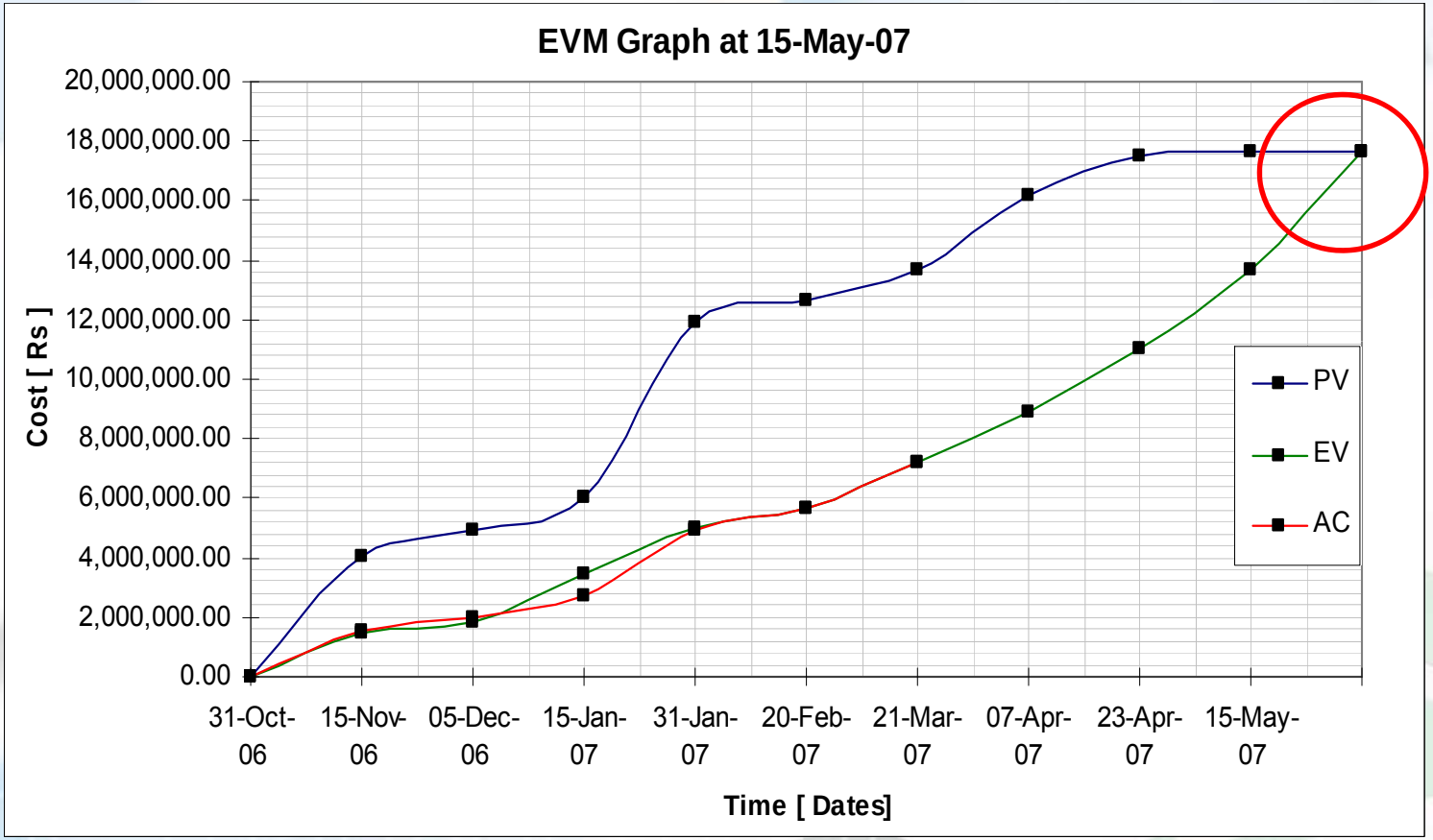
Late Finish Project

- Schedule performance index= 1.0



EVM Graph for late finish project

- Their should be certain variance at end for late finish project



Earned Schedule Parameters

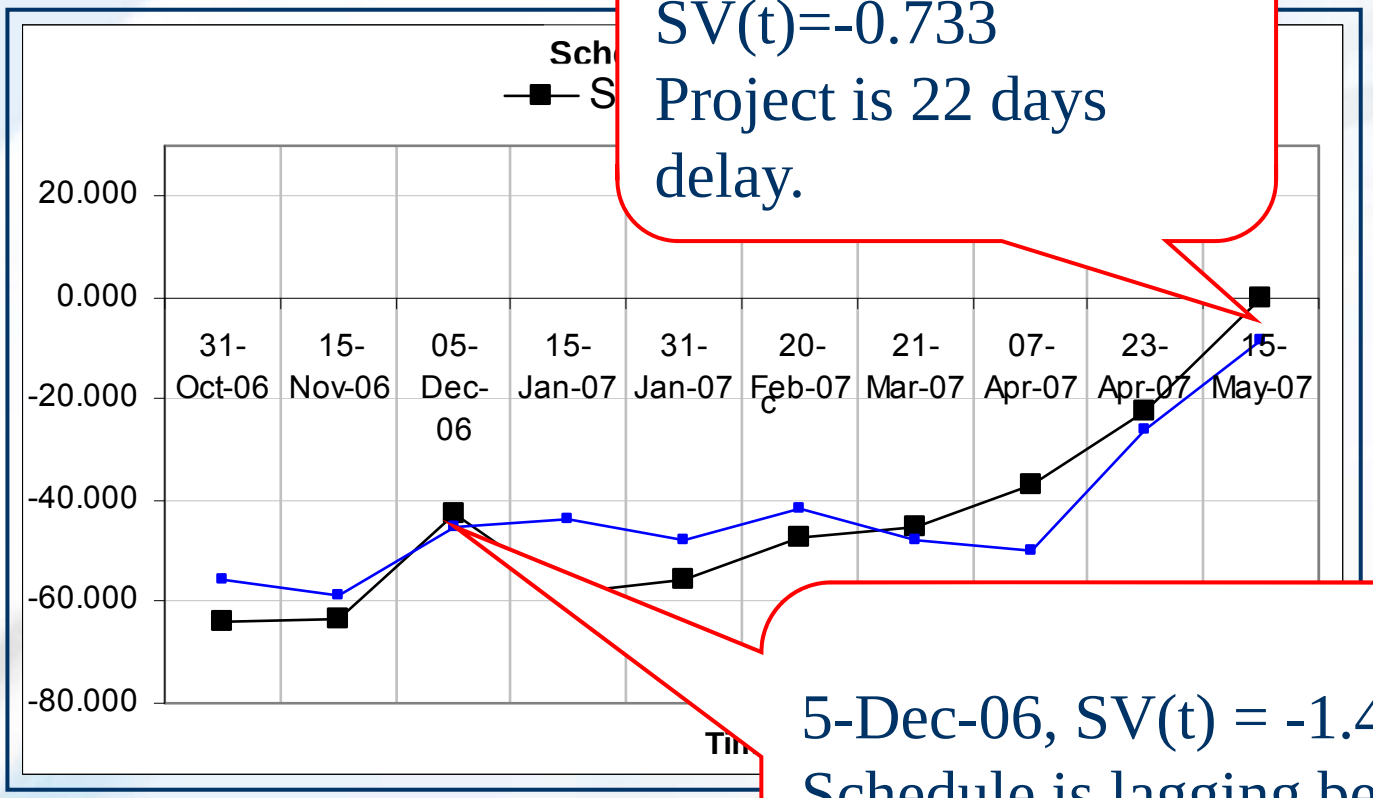
Sr. No.	Dates	PV(cu)	EV(cu)	Mo. count.	ES(mo)	SV(t)
1	31-Oct-06	4050245.12	1,457,921.26	2.100	0.937	-1.163
2	15-Nov-06	4955757.78	1,814,745.66	2.600	1.079	-1.521
3	05-Dec-06	6019696.27	3,451,688.29	3.267	1.796	-1.471
4	15-Jan-07	11911919.28	5,007,422.18	4.633	07	-2.026
5	31-Jan-07	12678132.36				179
6	20-Feb-07	13656736.16				2
7	21-Mar-07	16175351.73				53
8	07-Apr-07	17510424.47				62
9	23-Apr-07	17620118.84				61
10	15-May-07	17620118.84				33

Project start – 30-Aug-06
First RA – 31-Oct-06
Month count- 2.1

Earned Schedule Parameters

Sr. No.	Dates	SV(t)%	SPI(t)	TSPI(t)	IEAC(t)	PDWR	VAC(t)
1	31-Oct-06	-55.400	0.446	1.183	18.991	7.533	-10.521
2	15-Nov-06	-58.488	0.415	1.259	20.404	7.391	-11.934
3	05-Dec-06	-45.018	0.550	1.283	15.405	6.674	-6.935
4	15-Jan-07	-43.725	0.563	1.528	15.051	5.863	-6.581
5	31-Jan-07	-47.983	0.520	1.750	16.283	5.782	-7.813
6	20-Feb-07	-41.348	0.587	1.915	14.441	5.049	-5.971
7	21-Mar-07	-47.845	0.522	2.948	16.240	4.923	-7.770
8	07-Apr-07	-49.712	0.503	4.319	16.843	4.765	-8.373
9	23-Apr-07	-26.090	0.739	4.616	11.460	2.631	-2.990
10	15-May-07	-8.494	0.915	-3.490	9.256	0.570	-0.786

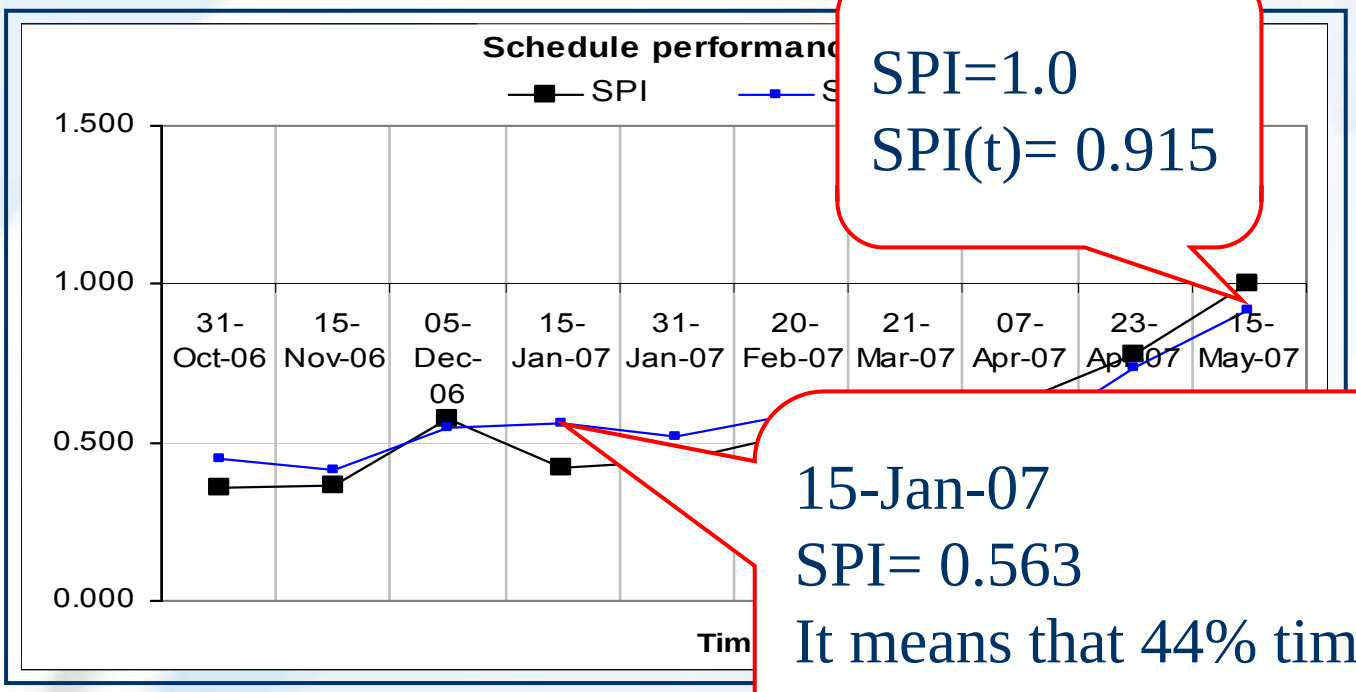
Is my task ahead of Planned Duration……?



SV=0
SV(t)=-0.733
Project is 22 days delay.

5-Dec-06, SV(t) = -1.471
Schedule is lagging behind by 44 days than planned duration

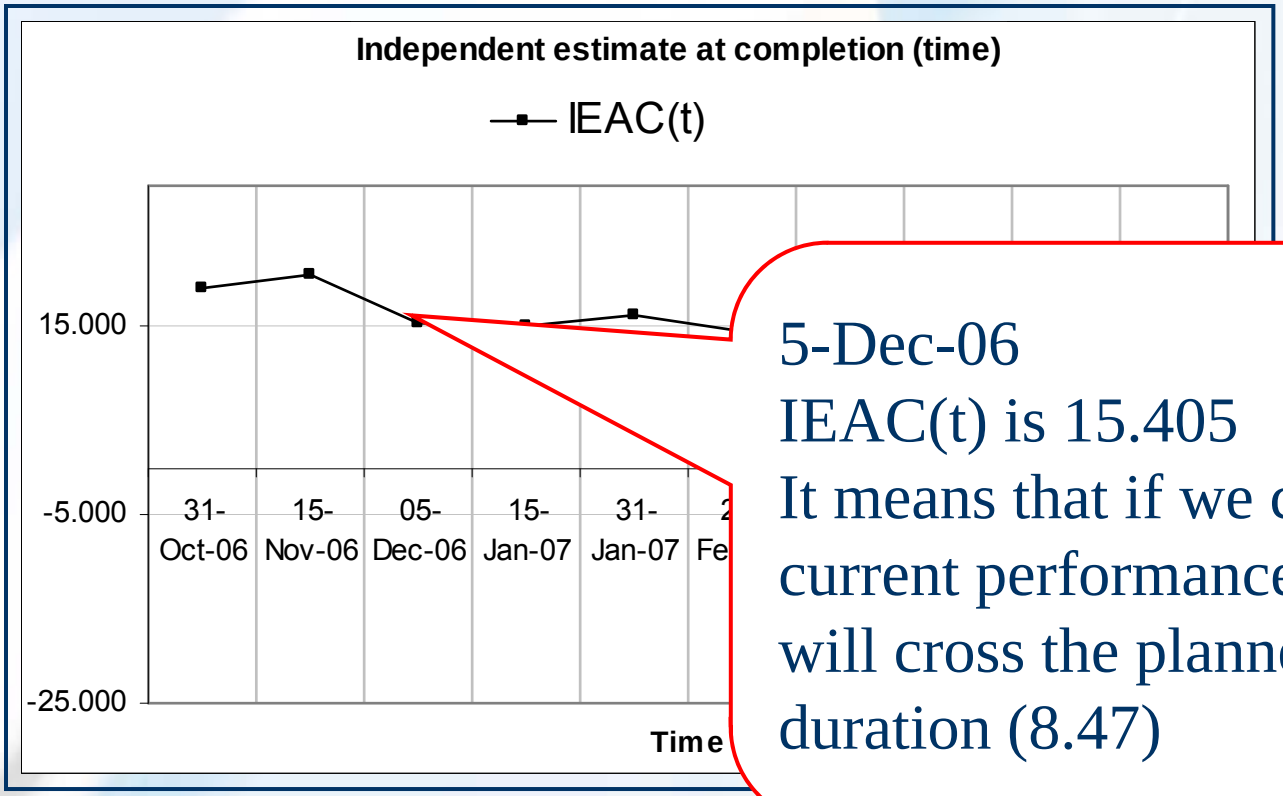
Am I using Time Efficiently……?



SPI=1.0
SPI(t)= 0.915

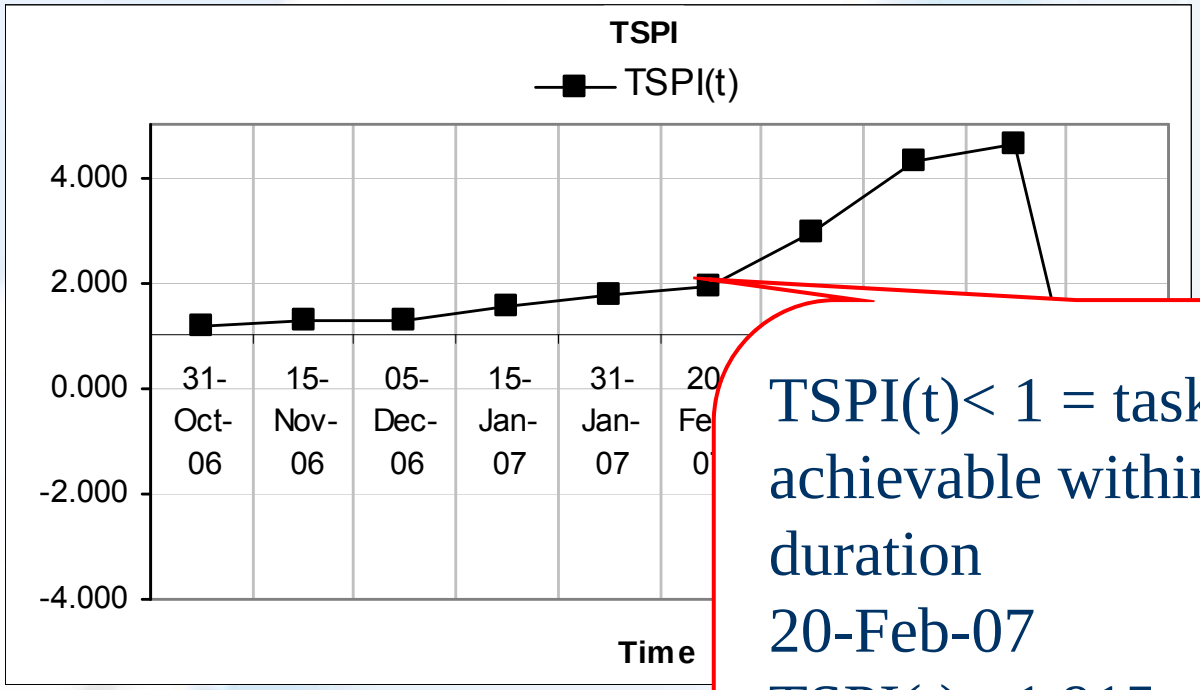
15-Jan-07
SPI= 0.563
It means that 44% time usage is more than planned duration.

How much time it will take to finish……?



5-Dec-06
IEAC(t) is 15.405
It means that if we continued current performance project will cross the planned duration (8.47)

Can I achieve it within planned duration…….?



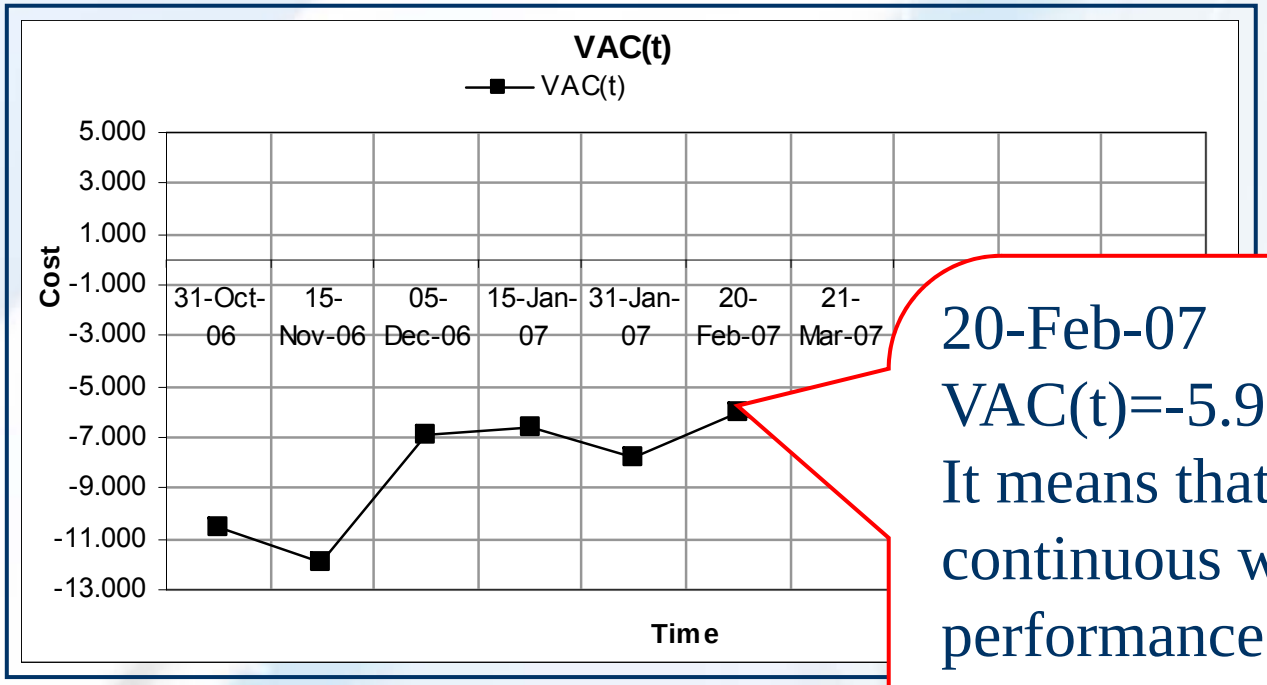
TSPI(t)< 1 = task is achievable within planned duration

20-Feb-07

TSPI(t)= 1.915

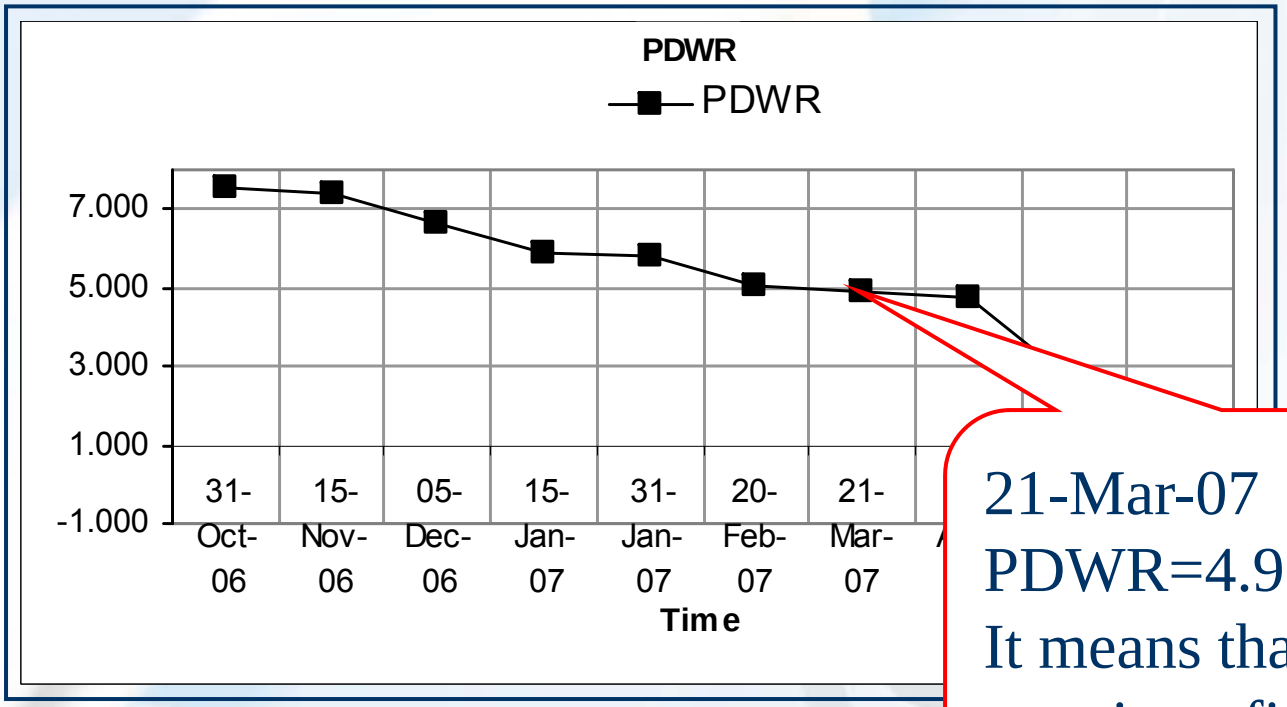
It means that particular task cannot be achieve within planned duration, if current performance is continue.

Will be my project delayed…….?



20-Feb-07
VAC(t)=-5.971
It means that if we continuous with current performance project will cross planned duration & project will delayed by 179 days.

How Much Time I Have To Finish Task……..?



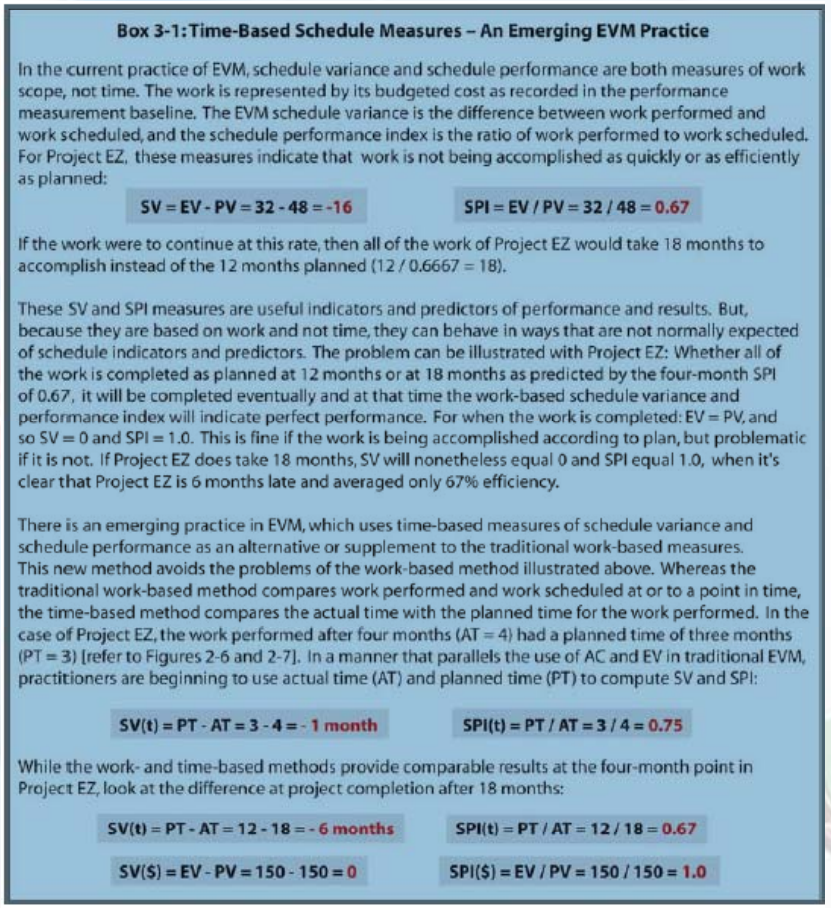
21-Mar-07
PDWR=4.923
It means that 146 days remain to finish work.

ES vs. EVM Comparison

Earned Schedule	Earned Value
SV(t) and SPI(t) valid for entire project, including early and late finish	SV($) and SPI($) validity limited to early finish projects
Duration based predictive capability analogous to EVM's cost based indicators	Limited prediction capability No predictive capability after planned completion date exceeded
Facilitates Cost – Schedule Management (using EVM and ES)	EVM Management focused to Cost

Time-Based Schedule Measures – – An Emerging EVM Practice

- Inclusion of Emerging Practice Insert into PMI -EVM Practice Standard
  - Dr. John Singley, VP of CPM
- Included in Box 3-1 of EVM Practice Standard
  - Describes basic principles of "Earned Schedule"
  - Provides foundation for further development of and research intended to result in Earned Schedule acceptance as a valid extension to EVM
- EVM Practice Standard released at 2004 IPMC Conference



Box 3-1: Time-Based Schedule Measures – An Emerging EVM Practice

In the current practice of EVM, schedule variance and schedule performance are both measures of work scope, not time. The work is represented by its budgeted cost as recorded in the performance measurement baseline. The EVM schedule variance is the difference between work performed and work scheduled, and the schedule performance index is the ratio of work performed to work scheduled. For Project EZ, these measures indicate that work is not being accomplished as quickly or as efficiently as planned:

SV = EV - PV = 32 - 48 = -16 **SPI = EV / PV = 32 / 48 = 0.67**

If the work were to continue at this rate, then all of the work of Project EZ would take 18 months to accomplish instead of the 12 months planned (12 / 0.6667 = 18).

These SV and SPI measures are useful indicators and predictors of performance and results. But, because they are based on work and not time, they can behave in ways that are not normally expected of schedule indicators and predictors. The problem can be illustrated with Project EZ: Whether all of the work is completed as planned at 12 months or at 18 months as predicted by the four-month SPI of 0.67, it will be completed eventually and at that time the work-based schedule variance and performance index will indicate perfect performance. For when the work is completed: EV = PV, and so SV = 0 and SPI = 1.0. This is fine if the work is being accomplished according to plan, but problematic if it is not. If Project EZ does take 18 months, SV will nonetheless equal 0 and SPI equal 1.0, when it's clear that Project EZ is 6 months late and averaged only 67% efficiency.

There is an emerging practice in EVM, which uses time-based measures of schedule variance and schedule performance as an alternative or supplement to the traditional work-based measures. This new method avoids the problems of the work-based method illustrated above. Whereas the traditional work-based method compares work performed and work scheduled at or to a point in time, the time-based method compares the actual time with the planned time for the work performed. In the case of Project EZ, the work performed after four months (AT = 4) had a planned time of three months (PT = 3) [refer to Figures 2-6 and 2-7]. In a manner that parallels the use of AC and EV in traditional EVM, practitioners are beginning to use actual time (AT) and planned time (PT) to compute SV and SPI:

SV(t) = PT - AT = 3 - 4 = - 1 month **SPI(t) = PT / AT = 3 / 4 = 0.75**

While the work- and time-based methods provide comparable results at the four-month point in Project EZ, look at the difference at project completion after 18 months:

SV(t) = PT - AT = 12 - 18 = - 6 months **SPI(t) = PT / AT = 12 / 18 = 0.67**

SV($) = EV - PV = 150 - 150 = 0 **SPI($) = EV / PV = 150 / 150 = 1.0**

time management

Foreseen Uses of Earned Schedule

- Enables independent evaluation of schedule estimates: ETC(t), IEAC(t)
  - Client, Contractor, Program and Project Manager ….
- Facilitates insight into network schedule performance
  - Duration based Schedule indicators
  - Identification of impediments/constraints and potential future rework
  - Evaluation of adherence to plan
- Improvement to Schedule and Cost prediction
  - Client, Contractor, Program and Project Manager ….
- Application of direct statistical analysis of schedule performance

Summary

- Derived from EVM data … only
- Provides time-based schedule indicators
- Indicators do not fail for late finish projects
- Application is scalable up/down, just as is EVM
- Schedule prediction is better than any other EVM method presently used
  - SPI(t) behaves similarly to CPI
  - IEAC(t) = PD / SPI(t) behaves similarly to IEAC = BAC / CPI

Summary

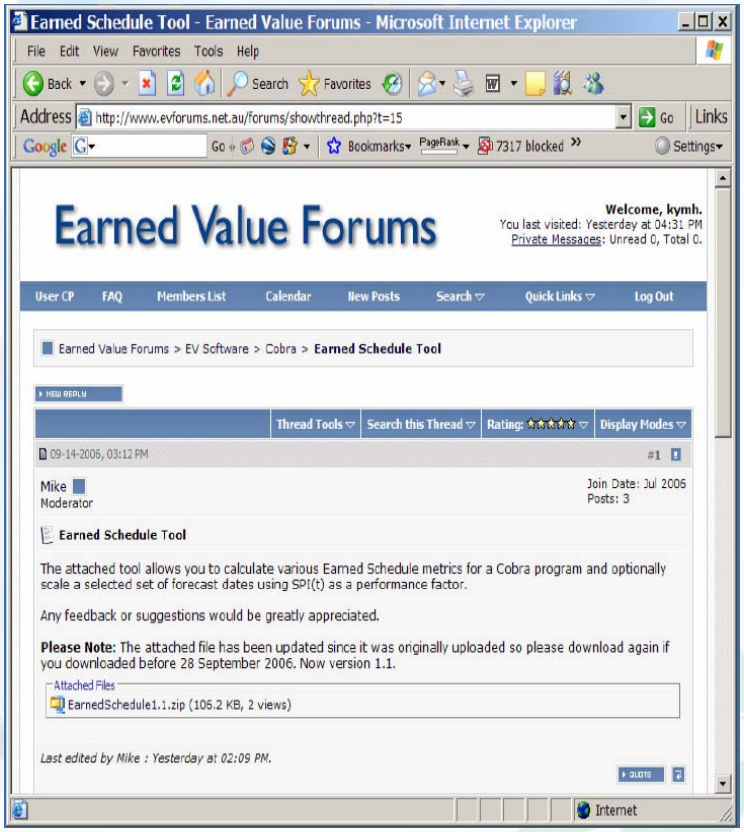
- Schedule prediction – much easier and possibly better than “bottoms-up” schedule analysis
- Application is growing in both small and large projects
- Practice recognized as “Emerging Practice”
- Resource availability enhanced with ES website and Wikipedia

Available Resources Papers and Presentations

- PMI-Sydney Chapter
  - http://sydney.pmichapters-australia.org.au/
  - Repository for ES Papers and Presentations
- Earned Schedule Website
  - http://www.earnedschedule.com/
  - Established February 2006
  - Contains News, Papers, Presentations
  - ES Terminology
  - Identifies Contacts to assist with application
- Wikipedia references Earned Schedule
  - http://en.wikipedia.org/wiki/Earned_Schedule

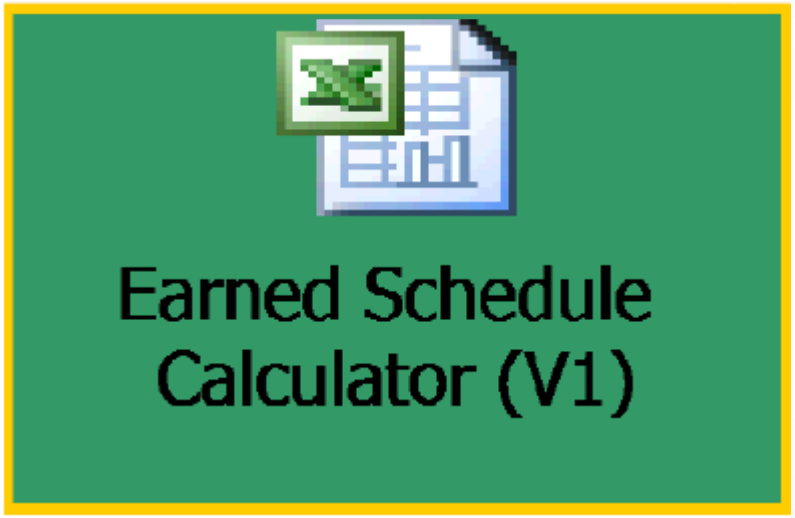
Available Resources Tools

- Freely available add on tool for the Deltek Cobra product
- Available from:
- http://www.evforums.net.au/forums/showthread.php?t=15
- (Requires registration to Earned Value Forums)
- Contact:
  - Mike Boulton
  - WST Pacific
  - mboulton@wstpacific.com.au
  - +61 8 8150 5500



Available Resources Calculators

- Excel based Earned Schedule calculators available from http://www.earnedschedule.com



Conclusion

- "Whatever can be done using EVM for Cost Analysis can also be done using Earned Schedule for Schedule Analysis"
- Earned Schedule
  - A powerful new dimension to Integrated Project Performance Management (IPPM)
  - A breakthrough in theory and application

Thank You!

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