M-006

EARNED VALUE ANALYSIS

TARGET AUDIENCE & DESCRIPTION:

1.   INTRODUCTION

The petrochemical industry has been using the concept of earned value for at least 50 years, but only recently and infrequently has it been used in the construction industry. Earned Value Analysis is a way of monitoring, comparing and controlling budgets, programmes and productivity simultaneously. One of its most powerful features is the ability to combine performance measurement across activities that are quite different in nature.

## 2   CALCULATING AND USING EARNED VALUE

For example, if a gang of 2 bricklayers and a labourer lays $120 m^2$ of common brickwork and $30 m^2$ of engineering brickwork in a week, and if the tender price for labour for each of these activities is £20/m^2 and £30/m^2, then the value "earned" by the gang is:

$$120 \times £20 + 30 \times £30 = £3300$$

If the cost of the gang for the week is £2500, then the contractor knows that he has made a profit on his labour costs for these activities of £900 for the week. Clearly, the same technique can be used to combine the performance of gangs of different trades. For example, if in the same week a gang of four carpenters costing £4000 erects $100 m^2$ of vertical wall formwork and $20 m^2$ of column formwork, and the tender labour prices are £25/m^2 and £50/m^2 respectively, then the labour cost of formwork exceeds the tender price by:

$$£4000 - (100 \times £25 + 20 \times £50) = £500$$

Combining the information about the bricklaying and carpeting gang indicates that the total earned value £3300 + £3500 = £6800, and the actual labour cost is £2500 + £4000 = £6500, so overall, the labour on these activities made a loss of £300.
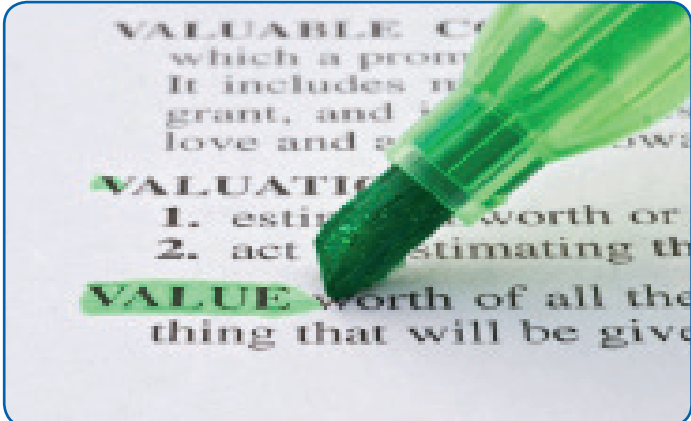
The same approach can be used to compare planned and actual productivity. If the planned (or tender) productivities were as shown in the table below, and if the site is working a 37½ hour week, then using the data above, the "earned" hours are:

$$(120 \times 1) + (30 \times 1.5) + (100 \times 1) + (20 \times 2) = 305$$

Activity	Planned or tender productivity
Common brickwork	1 m^2/mh
Engineering brickwork	1.5 m^2/mh
Vertical wall formwork	1 m^2/mh
Column formwork	2 m^2/mh

and the actual hours are (7 x 37½) = 262.5

The productivity index, which is defined as earned hours divided by actual hours is therefore 305/262.5 = 1.16. In other words, actual productivity is 16% higher than planned productivity

An example of how the concept can be used to analyse costs and productivity is shown below.

| Element	Quantity	Budget Cost/ Unit (£)	Budget Total Cost (£)	Quantity Complete	Earned Value (£)	Actual Cost (£)	Variance (£)	Remarks
Common Brickwork	1000m	4.00	4000	2000	800	1220	+420	Breakdown required
Vertical formwork	10000m	38.00	3800	10	380	280	-100	
etc								

3. USING EARNED VALUE TO CONTROL COST AND TIME

The concept of earned value has an even wider application in performance measurement. It can also be used to measure time and cost performance simultaneously. In the figure below, if the project runs exactly as planned, it follows the line labelled "Budgeted Cost of Work Scheduled". The line labelled "Budgeted Cost of Work Produced" is obtained by measuring the work actually completed at any point in time and multiplying the measure by the planned or "budgeted" cost. It is the earned value of work completed. The line labelled "Actual Cost of Work Produced" is self-explanatory.

In the figure, SV measures how far the project is ahead of or behind programme, and CV measures the extent to which the project is over or under budget. The outcome of the project including final cost and time variances can be forecast by extrapolating the ACWP and BCWP lines.

4 CAVEAT

Whilst earned value analysis is potentially a powerful tool, its accuracy depends on the accuracy of the budgeted costs, and more particularly, the budgeted productivities. In the petrochem industry, these are called the "norms", which are reasonably well established, even though their accuracy y is open to question. In the construction industry, no such widely accepted norms exist, since very few companies collect unit costs and productivities, and there is an understandable reluctance to report the data that does exist in the public domain. As a result, there is relatively little robust data on which to base the budgeted costs and productivities, so the absolute values produced by earned value analysis should be viewed with caution.
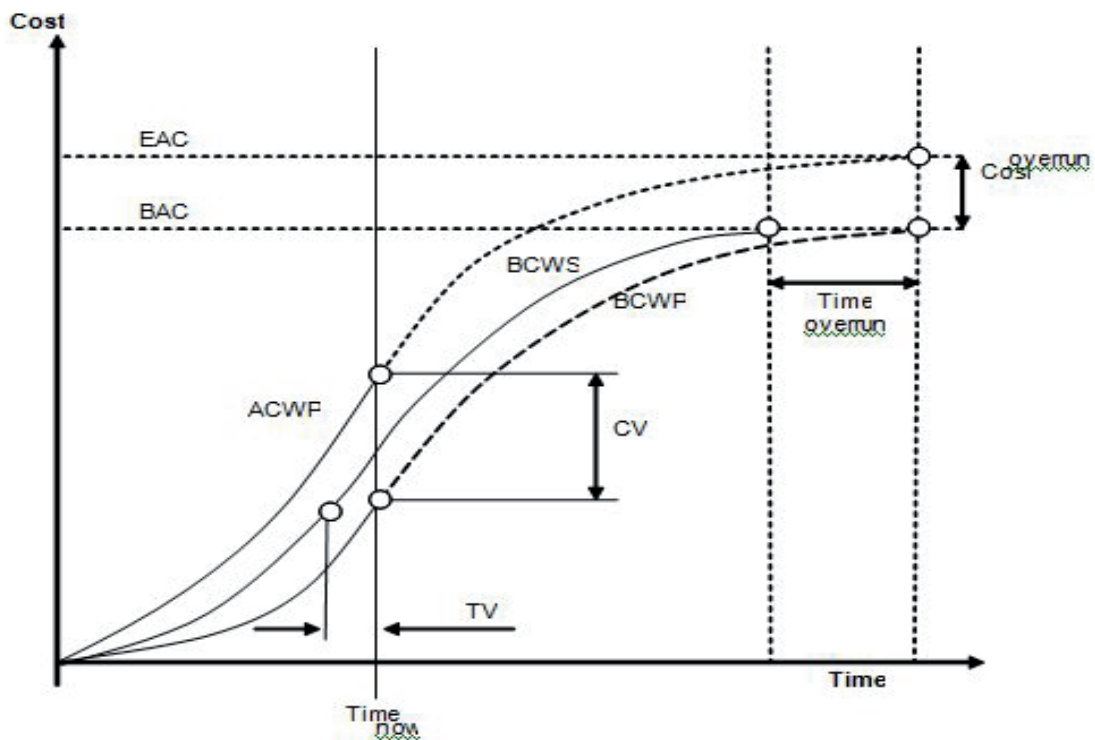
Legend
ACWP   Actual Cost of Work Produced
BCWP   Budgeted Cost of Work Produced
BCWS   Budgeted Cost of Work Scheduled
BAC   Budget at Completion
EAC   Estimate at Completion
SV   Schedule Variance
CV   Cost Variance

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SIGNPOSTING

TITLE/DESCRIPTION	LINKS
Earned value, clear and simple	http://www.projectsmart.co.uk/docs/earned-value.pdf
Earned Value Analysis overview	http://www.projectlearning.net/pdf/l2.1.pdf
Horner, R.M.W. (2006) Performance measurement. Invited chapter in Commercial Management of Complex Projects: Defining the Discipline	(eds Lowe, D. & Lehringer, R.), 263-297.

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