

## Incremental Milestone Works in Earned Value Analysis

Works with earned values associated with distinct points of time have cost functions of the form

$$V = V_z \text{ at } t_z \text{ less than } t \text{ less than } t_{z+1}$$

are called **Incremental works**. The TCM Framework of AACE calls this type of measurement as **Incremental Milestone**. Definition of incremental works is not amenable to PDCA analysis because resources do not appear on cost function. Cost function is identical to measurement function and hence the advantage of measuring work from two directions viz. deliverables as well as performable is lost.

For PDCA analysis, incremental works need to be homogenized by defining distinct homogeneous work packages with constant cost functions and extremely short fixed durations at instances of increment. The interval between increments is covered by **trivial works** that cannot be measured or paid.

An example of increment work previously discussed was installation of an equipment. Work was defined with values as -

- Delivery of materials (7th day, 20% value)
- Assembly (14th day, 60% value)
- Installation (17th day, 15%)
- Testing (20th day, 5%)

The cost (or value) function in this instance is

$V = 0\%$  at  $0 \text{ less than } t \text{ less than } 7$ ,  $20\%$  at  $7 \text{ less than } t \text{ less than } 14$ ,  $80\%$  at  $14 \text{ less than } t \text{ less than } 17$ ,  $95\%$  at  $17 \text{ less than } t \text{ less than } 20$ ,  $100\%$  at  $t \text{ greater than } 20$ .

In the above example, supply of materials is a work of duration one day and value 20%, scheduled on 7th day. Similarly, assembly is a work of duration 1 day, value 60% and zero cost. This work is scheduled on 14th day. A work called *assembly-in-progress* may be defined as a trivial work with zero value but non-zero cost function scheduled from 7th to 14th day. If the trivial work is homogeneous, percentage work completed on each day can be tracked and rectification applied whenever necessary. Since, trivial works have zero values; it cannot be measured and paid. From the contractors' perspective, trivial works have non-zero cost

function, to keep track of resources needed to complete work and control over cost of such resources. Sum of the work package at increment and trivial work in between equates the cost and value functions without altering the mode and method of measurement.

Fabrication and erection of steel buildings usually falls under incremental milestone works. Fabrication of a girder beam from a rolled section may involve:

- Receipt of rolled section at yard
- Straightening of section
- Cutting to length
- Grinding edges
- Jointing to length
- Drilling holes to catch mating members
- Placement of end plates and reinforcement plates
- Positioning of intermediate stiffeners
- Positioning of cleats
- Continuous welding,
- Providing priming coat
- Pre-erection painting.

Each of these tasks is in-turn distinct activity consuming different resources at different proportions and associated with different costs. However, value is attached generally only at the beginning and end, say 40% at receipt of materials and 25% upon completion of fabrication.

If a managerial interference is extended on the scheduled day of completion of the fabrication, it is likely that project delays and cost over run might remain unnoticed for corrective action. Hence, a suitable reporting system is needed to track the progress of this fabrication.

In order to homogenize the fabrication work, trivial works are defined for straightening, jointing, drilling, welding, painting etc in WBS. During detailed planning, each of these trivial works also should be scheduled assigning resources. The number of beams completing each stage can be reported as tracking parameter every day. Thus, completion of works can be compared against performance of resources in PDCA analysis and corrective measures can be taken whenever these are warranted.

Trivial works are not associated with physical measures of completion. For example, there is no percent value complete associated with fixing of end plates on the girder. That is, trivial works accrue cost but do not accrue value. During physical measurement and payment, trivial works shall not be measured or paid, unless all the trivial works leading to the incremental work is completed.

Incremental works also justify the necessity of separating planned value curves from planned cost curves. Although, value is accrued at completion of work, cost is continuously accrued during the work. Comparison of earned value against planned value is of least administrative significance in this case, since it does not enlighten about delay or cost increase during the work. On the other hand, comparison of actual cost against planned cost provides insight about these deviations.

Definition of incremental works is common in software development projects, design projects and film industry because intermediate deliverables do not possess stand-alone value. In software industry and in design projects, person-hours are the most significant resources. Planned value and cost is defined in terms of the person-hours. Earned value is defined by the completion of work on hand. It is hence necessary to define intermediate deliverables to be tracked albeit without value, so that corrective actions may be taken when such deliverables do not meet targets. After final delivery, the work is valued by physical measurement and earned value curve is updated.

If the accrual of value is associated only with financial transactions such as billing to client or payment to vendors, trivial works can be associated with earned value and flagged off for payment at later stages of work.

Staggering of financial transactions can be seen in many incremental works. For instance, in the steel building example, client is unlikely to be billed or contractor to be paid for completion of fabrication of every girder. Such transactions may occur for instance after completion of say fabrication of columns, braces, purlins, runners, base plates etc that is after entire lot of fabrication is completed. In such cases, it needs to be specified that transactions are staggered until another incremental work is completed.

Source: <http://indiancivilengineer.blogspot.in/2010/02/incremental-milestone-works-in-earned.html>