
AACE INTERNATIONAL RECOMMENDED PRACTICE
55R-09
ANALYZING S-CURVES
SAMPLE
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ANALYZING S-CURVES

TCM Framework: 9.2 – Progress and Performance Measurement
10.1 – Project Performance Assessment
10.2 – Forecasting

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Any terms found in AACE Recommended Practice 10S-90, *Cost Engineering Terminology*, supersede terms defined in other AACE work products, including but not limited to, other recommended practices, the *Total Cost Management Framework*, and *Skills & Knowledge of Cost Engineering*.

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1. PURPOSE

This recommended practice (RP) for analyzing S-curves is intended to serve as a guideline, not to establish a standard. As a recommended practice of AACE International, analyzing S-curves provides guidelines for stakeholders of a project to evaluate the current status and trends of a project in a simple graphical format.

S-curves are often developed by a project scheduler or cost engineer to indicate costs, resource usage, or performance measures over time and can be applied on a variety of project types. They are often used as a project management and/or total cost management (TCM) tool for graphical representation of project plan and actual data.

S-curves are commonly generated to support earned value performance assessment. This RP is aligned with the *Total Cost Management Framework*, as well as the Electronics Industries Alliance (EIA) - 748 Earned Value Management Systems (EVMS) guidelines (Guidelines 27 entirely, and components of Guidelines 22-26).

The RP provides descriptions of S-curves with the intent to improve understanding and communication among project participants and stakeholders when preparing and analyzing graphics based upon project schedule information. The RP describes different types of S-curves that may be generated in a project, provided the proper information is loaded into the schedule and the status of the information is maintained throughout the duration of the project.

2. OVERVIEW

An S-curve is a graphical display of cumulative costs, labor hours, progress, or other quantities plotted against time. The term derives from the S-like shape of the curve, flatter at the beginning and end and steeper in the middle, which is typical of most complex projects. Most projects start slowly, ramp up to a steady state for a majority of the work, and then slow down again near the end as productivity declines and work completes.

The term S-curve can also be used to indicate an S-shaped chart resulting from a cumulative probability distribution. In this function, an S-curve is a tool of quantitative risk analysis (QNRA) which project management would use to determine the possible dangers of any given course of action.

S-curves are also called *cumulative distribution charts*, *velocity diagrams*, and *S-Plots* (SPLOTS).

3. RECOMMENDED PRACTICE

AACE recommends that schedulers and other project team members develop and use S-curves to plan, monitor, analyze, forecast and control project progress. Project managers should request that project controls personnel produce and use this graphical technique as a tool for briefing stakeholders on project status and trends in a quick and intuitive manner.

4. DEVELOPING BASELINE S-CURVES

Prior to developing an S-curve, a project baseline schedule needs to be developed. The baseline schedule should employ best scheduling practices (i.e., documentation of scheduling basis, start, finish, no open ends, minimal constraints, a defined critical path, etc.). The baseline schedule should also contain cost and/or resource information as required. The S-curve produced from the baseline early dates is often referred to as the *target S-curve* which reflects projected or planned progress on the project if all tasks are completed on their original early finish dates.

This curve represents the *best* progress or productivity that can be expected. It is important that the cost and/or quantity information loaded into the activities represents the appropriate time-scaled values for those activities.

For example, if electrical service equipment will be delivered in one large shipment and then installed over a three-month time period, the material cost of the equipment will be earned when delivered, so that cost should be loaded into the delivery activity, and the balance of the costs can be loaded into the installation activities). When loading costs into activities, the activities may reflect a straight-line consumption of those costs (a ten-day activity with a $10,000 cost should reflect installation of $1,000 per day), or a front- or back-loaded consumption profile. The selected methodology of loading costs into the schedule should result in reasonable and appropriate S-curves.

Generating S-curves starts well in advance of preparation of the baseline schedule. S-curves will be utilized during the schedule development process for the schedule health check, resource leveling, cash flow optimization etc.

4.1. Common S-Curves

A variety of S-curves exist for project control purposes, the most comm[on] being manhours, costs, and resources versus time. Quantity plan S-curves indicating planned versus actual quantit[ies] installed over time (e.g., volume of concrete installed) can be used to identify and support progress measurement. [Cost p]rofile S-curves indicating cost over time are often used to identify the project's cash flow profi[le]. Resource pro[file] S-curves are the outcome of resource assignment and leveling. The time unit used is typic[ally] mo[st]hly to co[in]cide with normal monthly project status updates for most projects. Weekly and even daily ti[me] units may a[lso] be used, depending on the circumstance or project need.

4.1.1. Progress S-Curves

After creating a baseline schedule, a baseline S-curve [sh]ould be generated. Baseline S-curves provide the basis on which to compare a project's actual status to its p[la]nned progress. There are two types of comparisons that can be developed (for simplicity's sake Figure 1 an[d 2] below r[e]ference hours, but just as easily could be replaced with costs):

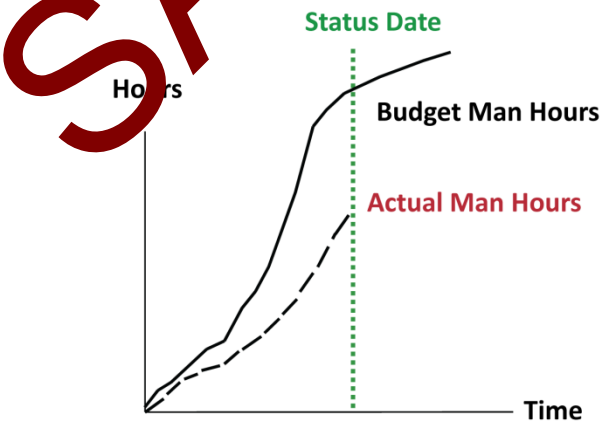

Figure 1 – Target Plan Manhours vs. Actual Manhours Expenditure

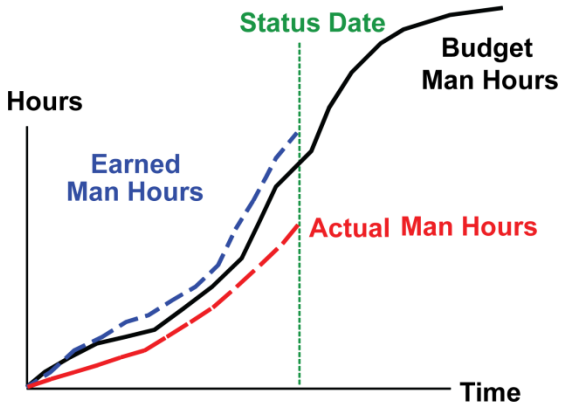

Figure 2 – Target Plan Man-Hours vs. Earned Man-Hours (Based on Plan)

The two comparisons can be combined with a target or earned vs. actual comparison which can provide insight as to manpower and financial resources required to complete the project.

Schedules with status applied to them are called updated schedules. One can produce the same type of S-curves as produced with the baseline schedule to track actual progress and to forecast upcoming progress. S-curves produced from update schedules are typically similar but different than those produced from the baseline schedule in that they also display curves derived from earned and actual data.

The baseline schedule provides target progress (plan curve), typically in costs or man-hours. The update schedule may provide three basic metrics: the value of the work that was planned to be achieved at the time of the update; the actual value of the work achieved at the time of the update; and the earned progress that typically shows earned costs or earned man-hours at the time of the update. Time-tracking system or other labor reports may generate the actual man-hours or expenditures.

Updated project schedules and payroll/time cards provide the actual data that is then compared to the baseline S-curves. This allows the progress of a project to be monitored and quickly reveals any divergence from the baseline schedule. S-curves may also be used to depict project growth, slippage, and progress.

The two values that are generated in updated schedules are different in that the earned value is derived from the accumulation of the percent complete of the individual activities, times their planned quantities or costs, and the actual value is derived from either manual entry of actual job costs or the calculations of the completed activities' values along with the calculation based on the estimates of remaining durations of those activities. Obviously, if the project management team can provide actual job values or quantities to be entered into the system, the actual curves will be more accurate and valuable. Without actual real-time job data, the software may default to its own algorithms for the calculations of completion in the schedule. If the remaining duration and the percent complete components of the schedule are linked, such that one calculates from the other, then the two available curves will be identical and offer no separate analysis ability. For this reason, it is recommended to calculate percent complete and remaining duration separately, allowing time and values to be represented in the curves. When discussing cost loaded schedules, the actual cost curves are generated from percent complete of activities (hopefully based on quantities or costs), and the earned value curves are generated from remaining duration calculations based on time.

4.1.2. S-Curves with Early and Late Dates

Most scheduling software can provide the information that calculates the cost, hours, and/or quantity data in the schedule over the both the early dates (forward pass of the schedule) and the late dates (backward pass of the