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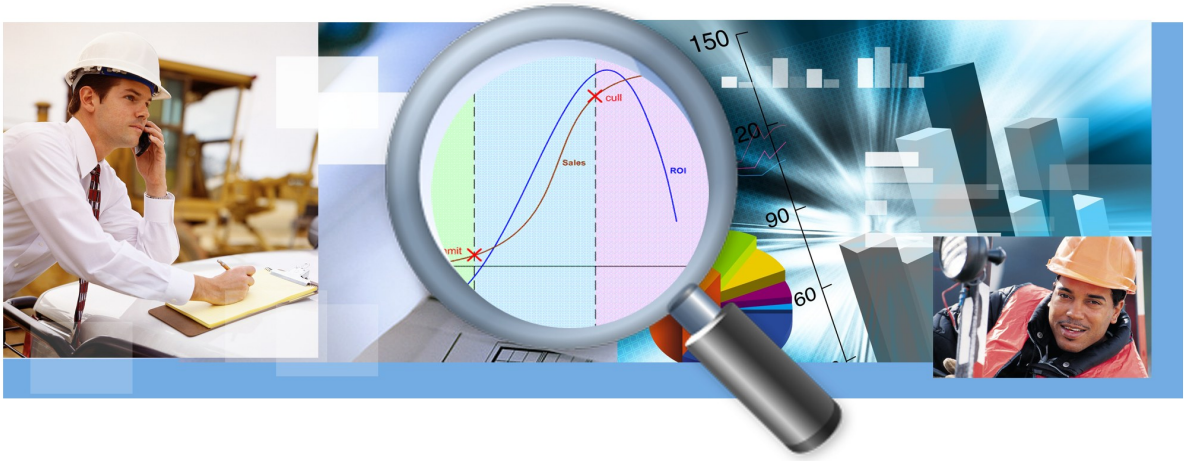


WHITE PAPER

'S-Curve' in project monitoring: an overview

Turnkey projects typically start slow and end slow, with a period of sustained acceleration in between. Measuring progress across this varied landscape is one of the biggest challenges in project management, although over the years several tools, technologies, and techniques have been tried - with varying degrees of success.

Here we consider the value of the 'S-Curve' as a logistic tool in project management.

1. Why use it?

To answer this, let's look at a standard project lifecycle. The startup phase involves planning and mobilization (with focus on resource allocation and schedule definition) and takes a great deal of skill and experience to 'set up' properly. The pace picks up rapidly after this and productivity peaks. Towards the end it decelerates again as multiple loose ends (some of them billable, like documentation) are hastily pulled together after being pushed aside for more pressing matters in the previous weeks/months. Many of these 'last-minute' tasks require huge amounts of time and attention to unravel, verify and in some cases, re-do.

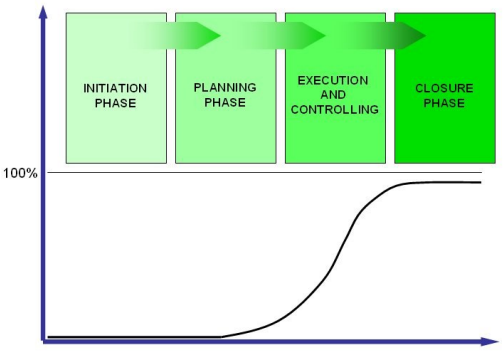
The S-Curve is a visual representation of the project path. Managers use it to assess progress against estimates (schedule and/or budget) and course-correct accordingly. At least, that's the idea on paper; in a global project it is extremely difficult to compile accurate reports of any kind, S-Curves included, during the process because there are so many parameters and so few ways to capture current data for each parameter. (See section 5: From paper to practice).

An S-Curve is the S-shaped graph produced by the Sigmoid formula which calculates the cumulative expenditure of certain parameters (manhours, output, cost) against time. The term 'sigmoid comes from the Greek letter 'sigma' (which is also shaped like an 'S').

Technically the S-Curve is just another report derived from mathematical formulae and therefore largely theoretical, but if compiled accurately and used intelligently it can be a boon to organisations whose business depends on project monitoring. In today's engineering organisation, S-Curves are widely used.

2. What does it show?

It is a snapshot of where you are, against where you ought to be. For example, last week you planned to complete 10% of work, but only 8% progress was actually completed which means a shortfall or 'lag' of 2%. The S-curve will help you identify what this 2% is in terms of activities or tasks so that you can resolve them before the cumulative delay becomes too great.

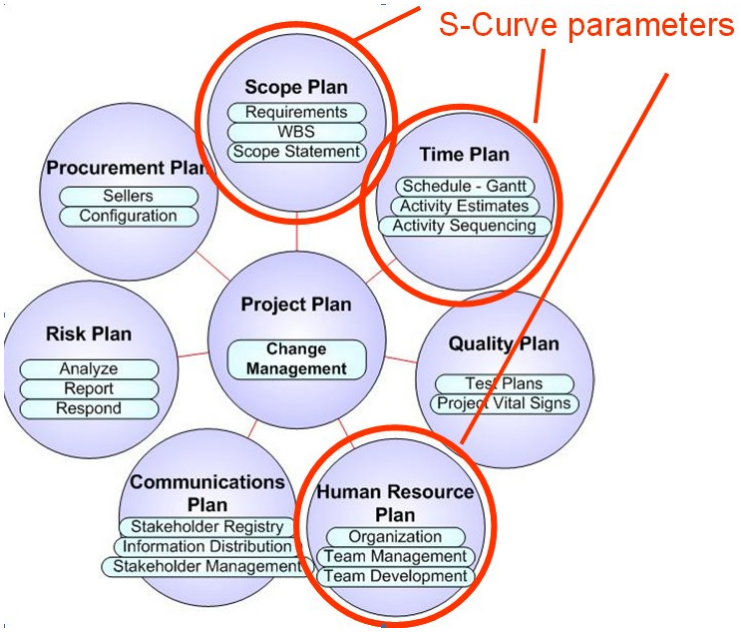


3. The foundation:

A project plan is the standard against which work is measured. A good plan starts with a detailed Work Breakdown Structure (which 'breaks down' the work into smaller components or tasks) and maps out every deliverable, activity, group, schedule, milestone, budget etc. The importance of a well-documented plan (and WBS) cannot be stressed enough.

Note: Until a few years ago project planning was a manually-documented and manually updated process which had managers relying on tools like Primavera/Microsoft Project, even Microsoft Excel to hammer out a task list or draw up a WBS, but now fortunately more intuitive and automated tools[1] are entering the market.

What goes into a project plan? It depends on the organisation's favoured methodology and the project manager in charge, but common elements include:



Estimated **manhours per deliverable**, and **weightage per deliverable:** Weightage refers to the importance of the deliverable within the project as a whole, manhours measure time-spend and money-spend (since manhours = $$) per deliverable. These affect budget-planning and hence are crucial parameters that impact decision making at senior levels. In most of the engineering projects the weightage is the manhours itself.

Project milestones: A milestone marks a significant point along the path of a project. A deliverable – or a set of deliverables – is part of the milestone (although sometimes a deliverable is a milestone in itself). Each deliverable is given 'rules of credit' which defines its % progress towards the milestone, and calendar dates are assigned to each milestone.

Examples of milestones are completion of drafting, submittal of the deliverable to client for review, incorporation of client comments, release for construction. Now rules of credit are assigned to these milestones, like release for construction is 100% achieved or completion of drafting, 10% progress is credited/ achieved.

Resource management: Tracking individual and group performance. Each organisation has its own method and procedure and tools, including but not limited to-do lists, tasklists, activity charts, time logs…these have evolved after years of experience, and although efficiency of this system is usually quite low, changing it would too complicated and the change may not be for the better. But using resources optimally is still a major challenge for a project manager in today's market.

4. How to monitor the plan?

Let's take a simple example: if deliverables are the building blocks of milestones which are linked to schedules which measure the overall progress of the project, two aspects of a deliverable need to be constantly monitored- the % actual completion and the

corresponding actual completion calendar dates. From this we can calculate 'actual progress' or 'earned progress'.

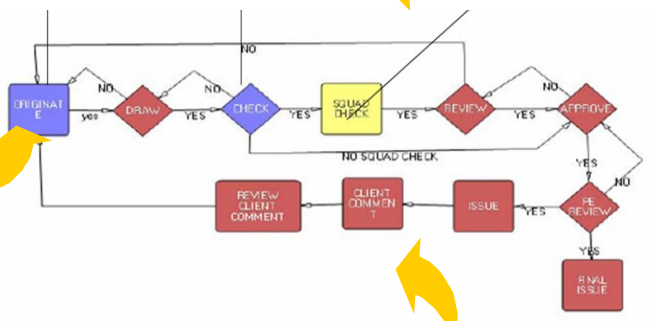
Note: Each organisation follows a slightly different project planning methodology to measure and monitor project progress, and this is reflected in the S-Curves and other reports/charts they use. Here we show a simplified and generic approach for illustrative purposes only.

The project plan can be monitored milestone-wise,

Milestone	Planned Dates	Progress	Planned Cumulative Progress	Planned Manhour consumed	Planned Cumulative manhours consumed
Start	12/01/2010	5%	5%	15	15
Checking	31/01/2010	25%	40%	95	110
Inter departmental check	05-02-2010	20%	60%	85	195
Submission for Review	06-02-2010	20%	80%	160	255
Receive Client Comments	15-02-2010	5%	85%	115	370
Submission for Approval	20-02-2010	5%	90%	15	385
Submission for Construction	01-03-2010	10%	100%	30	415

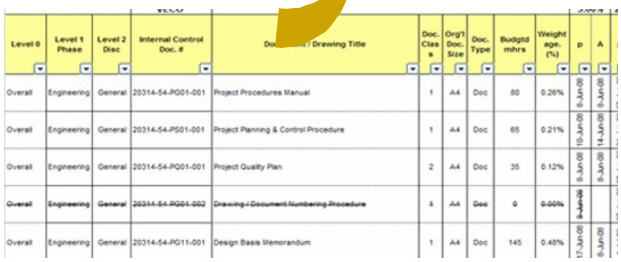
… Schedule-wise

Sl .no	Week No	Incremental Planned Percentage progress	Cumulative Planned Percentage progress
1	Week 1	5%	5%
2	Week2	0%	5%
3	Week3	35%	40%
4	Week4	0%	40%
5	Week 5	0%	40%
6	Week6	0%	40%
7	Week 7	25%	60%
8	Week 8	0%	60%
9	Week9	20%	80%
10	Week 10	10%	90%
11	Week 12	0%	90%
12	Week 13	0%	90%
13	Week14	10%	100%



…and **document-wise.**

(All deliverables are in some way linked to documents, and often the document itself is the deliverable. An engineering document/drawing register



The register has the list of deliverables or the documents with the plan(plan dates) for each milestone and also the planned progress achieved by reaching the milestone. The plan needs updates with the actual dates when the deliverable reaches the milestone. Based on this the actual vs planned progress can be compared.

The plan is monitored comparing the actual progress vs planned progress for each deliverable, cumulating to the project.

Putting it all together: Overall project progress is the weighted average of the progress of all deliverables. The Fig 1.1 scheduled, forecast, and actuals against time.

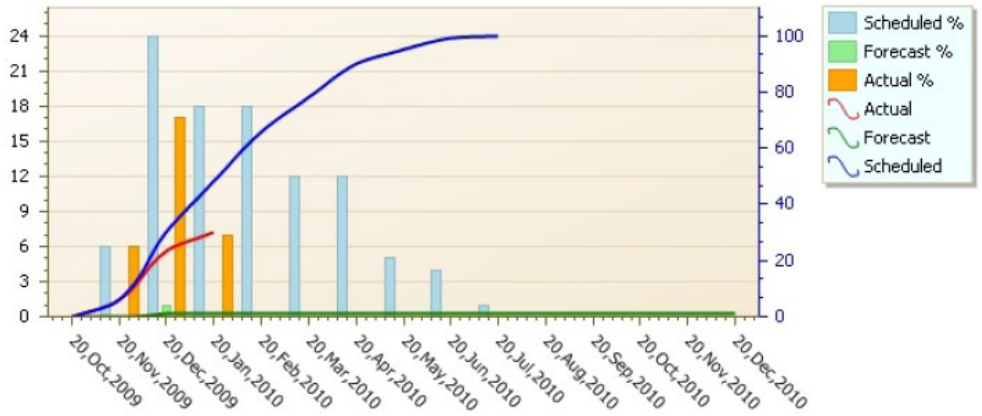


Fig 1.1

5. From paper to practice.

In theory, monitoring processes via S-curves or any other tool should be simple enough once the formulae have been worked out and tested. But applying formulae in the complex and competitive world of engineering design is challenging because:

A) Up-to-date data is almost impossible to source consistently

B) The various project elements don't dove-tail so neatly in real life (recurrent changes in engineering projects are a fact of life, as are human error, obsolete data/documents, and rework).

C) The time required of data collection very high.

For managers and client alike there is always the question of data integrity – is this really the latest update? Has it been properly verified? Who verified it and how long ago? Should I double-check? How can I be sure that it is accurate? And so on.

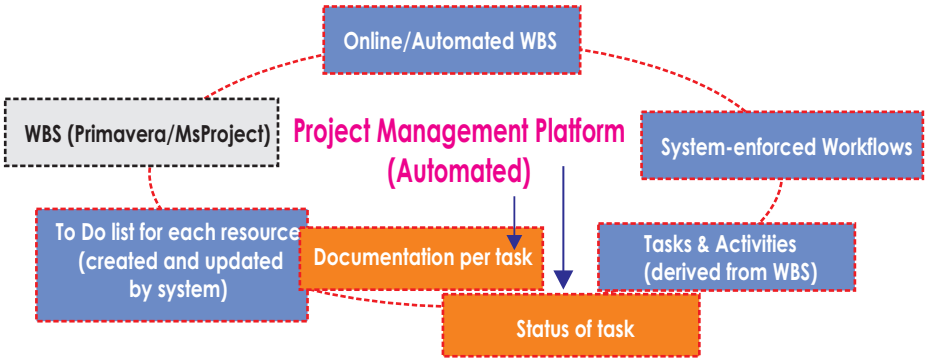
Milestones measure visible progress but don't necessarily show mission-critical tasks. If a milestone seems to be falling short the manger will quickly re-allocate resources to pick up the slack, but what goes unnoticed is that low-key but vital items are being neglected or back-shelved, and the resulting damage will then come unexpectedly. Sometimes, the long-term implications of short-term solutions can be disastrous.

But the main problem is that there is no foolproof way to capture data as often and as quickly as needed. There are significant bottlenecks in both Information Gathering and Information Updating. The typical method is to approach department heads (or the users themselves) and MANUALLY compile and record progress, and obviously this is both slow and error-prone because it relies on human effort.

6. An alternative

Automated project process, automatically captured data.
Automation in the project cycle is nothing new. It began with engineering (CAD) and business processes/communication (ERP and email), then planning and 'administrative' functions started getting digitized (partially via software like MSProject/Primavera/MsOffice), then came electronic document management (EDMS, also partial), and now recently there are systems that (claim to) integrate all

project processes – planning, execution, monitoring, communication and documentation – into one platform. Such a platform[2] (if it exists and lives up to its claims) would ensure that data is updated automatically which in turn would ensure



100% accuracy in all reports and documents and require little or no dependency on human intervention. Here is an example of an automated system that is designed to capture data used in S-Curve calculations:

The benefits of automated data capture are many. To start with, you are sure of complete accuracy in all progress data. Efficiency in all aspects of monitoring increases exponentially. Desktop access to real-time data is advantageous from any perspective, be it tracking deliverables, deploying resources, or calculating costs.

Project meeting would be conducted to resolve problems, bottlenecks identified rather than getting status of the project. Project controls would be achieved with document management & process management being incidental. Planners and expeditors would work towards resolving issues rather than collect data

Automated workflows are an effective time-management device; not only do they free up time for managers to concentrate on tasks other than chasing down information but they also offer a system for early 'warnings' on preset conditions that might lead to delay.

System-driven processes increase team morale and instil accountability. With each individual resources having his own automatically-updated ToDo list on his desktop (and transparent to his team/managers) the main 'pressure' comes from the bottom up and not just top down, which means that managers can know exactly what productivity ratings are for each employee, group and department.

To sum up, the S-Curve is a graphic representation of cumulative costs, manhours, time (and other parameters as required) measured against the overall project plan. It is an ideal tool for managers to quickly assess where the project stands in terms of completion, deadlines, and budget. If the organisation relies on manually-updated workflows/schedules, then it can require huge amounts of effort and time, perhaps even to the point of counter-productivity, but when supported by robust planning and intuitive automation, it can be one of the most powerful weapons in a project manager's arsenal.

[1] PLM or Product Lifecycle Management has been around for a while but now similar solutions are available for the project process which integrate engineering, planning, monitoring and handover functionality via the Web.

[2] Visit www.wrenchepc.com for details.