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A SunCam online continuing education course

# Lessons Learned in Project Management

by

Mark Ludwigson, PE, PMP

Course Outline:



## Managing an Engineering Project

Each engineering project is a unique adventure. Leading the way on such an adventure can be thrilling and fulfilling. Such projects usually result in building something that is useful and makes a positive difference in the world. But the journey to get there is wrought with potential pitfalls.

After managing several projects, it becomes clear that many of the same pitfalls keep appearing and most are easily avoided. This course shares lessons learned in avoiding such pitfalls and keeping to a more positive and successful path.

Project managers (PMs) and engineering leaders are held responsible for achieving project performance criteria, which typically include the following:

- High quality design
- Within schedule
- Within budget
- Low risk exposure
- Stakeholder/client satisfaction
- Internal team satisfaction

The advice provided in this course should help to achieve these performance criteria.

## Lesson 1: Invest in Planning

In my experience, the majority of a PM's time should be spent on various planning activities.

In overly simple terms:

*The project manager plans it; the team executes it*

Planning Activities

The following are common planning activities:

- Create project charter
- Define project goals
- Create project plan (aka work plan)
- Prepare proposals
- Create work breakdown structure
- Create and track project schedule
- Schedule resources
- Define team roles
- Develop and track project budget
- Plan project activities
- Prepare for project kick-off meeting
- Prepare for project meetings
- Create communication plan
- Create change plan
- Coordinate contracting and ordering
- Prepare change proposals
- Manage risks

In my experience, most issues that arise during execution of a project are preventable through proper planning. It helps for a PM to see their role as preparing the team to execute the work and preparing for potential issues. A project manager should plan to spend sufficient time early in the project to complete planning activities. And throughout the project, the PM should be preparing for meetings, updating planning documents for scope changes, and managing potential risks.

## Risk Management

One approach to preventing issues/problems is through risk management. Risks are potential events that would have a negative impact on the project. Risk management involves these activities:

1. Identifying risks
2. Preparing for risks
3. Responding to risks

The goal of risk management is to minimize the impact of risks in order to keep on track for meeting project goals.

## Risk Register

A risk register is a table with a list of identified risks. Normally, there are columns for risk description, probability (aka likelihood), severity (aka impact or consequence), ranking (aka priority), mitigation strategy, response, and status. See Figure 1 for examples.

| ID | Risk | Probability | Impact | Priority |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| | | | | |

| Identify | | Analyze | | | | Plan Response |
|---|---|---|---|---|---|---|
| ID | Description | Category | Probability | Estim. Impact | Add. Workload, days | Status |
| **1** | **Scope creep** | **Scope** | **0.25** | **5200** | **3** | **Response Planned** |
| 2 | Initial plan mistake | Schedule | 0.2 | 10000 | 1 | Occurred (Issue) |
| **3** | **The server with the project management software breaks down.** | **Operational** | **0.05** | **4700** | **0** | **Response Planned** |
| **4** | **Supplier increases the price** | **Financial** | **0.05** | **200** | **0** | **Response Planned** |
| 5 | Supplier delays the delivery of major components. | External | 0.1 | 0 | 5 | Not Treated |
| **6** | **Product quality does not correspond to the initial requirements.** | **Quality** | **0.15** | **4500** | **1** | **Response Planned** |
| **7** | **People receive other priorities from their line managers.** | **Resource** | **0.25** | **1100** | **1** | **Response Planned** |
| **8** | **Lack of management support** | **Resource** | **0.2** | **0** | **4** | **Response Planned** |
| 9 | Key people are unavailable | Resource | 0.2 | 0 | 5 | Not Treated |

Figure 1: Example risk registers.

Source: commons.wikimedia.org/wiki/File:Risk_Register_ID_and_Qual.png, Lapollard, CC-BY-SA-4.0
commons.wikimedia.org/wiki/File:SimulTrain12RiskRegister.JPG, Kokcharov, CC-BY-SA-4.0

Risk Ranking

One way to prioritize risks is to assess the severity (aka impact or consequence) and likelihood (aka probability) of each risk. See Figure 2 for a plot of severity versus likelihood with resulting risk scores from 1 to 12. This is called a risk matrix.

| RISK RATING KEY | LOW | MEDIUM | HIGH | EXTREME |
|---|---|---|---|---|
| | 0 – ACCEPTABLE | 1 – ALARP (as low as reasonably practicable) | 2 – GENERALLY UNACCEPTABLE | 3 – INTOLERABLE |
| | OK TO PROCEED | TAKE MITIGATION EFFORTS | SEEK SUPPORT | PLACE EVENT ON HOLD |

| LIKELIHOOD \ SEVERITY | ACCEPTABLE<br>LITTLE TO NO EFFECT ON EVENT | TOLERABLE<br>EFFECTS ARE FELT, BUT NOT CRITICAL TO OUTCOME | UNDESIRABLE<br>SERIOUS IMPACT TO THE COURSE OF ACTION AND OUTCOME | INTOLERABLE<br>COULD RESULT IN DISASTER |
|---|---|---|---|---|
| IMPROBABLE<br>RISK IS UNLIKELY TO OCCUR | LOW<br>– 1 – | MEDIUM<br>– 4 – | MEDIUM<br>– 6 – | HIGH<br>– 10 – |
| POSSIBLE<br>RISK WILL LIKELY OCCUR | LOW<br>– 2 – | MEDIUM<br>– 5 – | HIGH<br>– 8 – | EXTREME<br>– 11 – |
| PROBABLE<br>RISK WILL OCCUR | MEDIUM<br>– 3 – | HIGH<br>– 7 – | HIGH<br>– 9 – | EXTREME<br>– 12 – |

Figure 2: Risk assessment matrix with "severity" resulting in higher scoring.

Source: commons.wikimedia.org/wiki/File:IC-Risk-Assessment-Matrix-Template.jpg, U3115299, CC-BY-SA-4.0

Another approach for risk ranking is to sum the severity and likelihood values (each on the same scale), per this formula:

Total Risk = IF * Severity Score + Likelihood Score

IF = Importance factor (often 1.5 to 2.5)

## Lesson 2: Work Breakdown Structure

It is important to break down the scope of work into small tasks that can be easily managed. The task list can be in the form of a work breakdown structure (WBS), deliverable breakdown structure, or activity list. The term WBS is utilized in the Project Management Body of Knowledge (PMBOK) issued by the Project Management Institute, Inc. (PMI).

Although there are many ways to create a WBS, the “deliverable based” approach is most common for an engineering design project. With this approach, work is broken into deliverables, then by “work packages” for each deliverable. Work packages (WPs) are often tasks for individual staff members or discipline teams. WPs can be further broke down into subtasks

The following is an example WBS for a simple project with two deliverables: a report and a presentation:

<u>Project ACME WBS</u>

- Deliverable 1: Report
  - WP 1.1: Draft Report
    - Subtask 1.1.1: Civil Sections
    - Subtask 1.1.2: Structural Sections
    - Subtask 1.1.3: Electrical Sections
    - Subtask 1.1.4: General Sections
  - WP 1.2: Report Quality Review
  - WP 1.3: Submit Report
  - WP 1.4: Revise Report
  - WP 1.5: Resubmit Report
- Deliverable 2: Presentation
  - WP 2.1: Draft PowerPoint
  - WP 2.2: Presentation Quality Review
  - WP 2.3: Client Presentation

A WBS is often depicted graphically as shown in Figure 3.

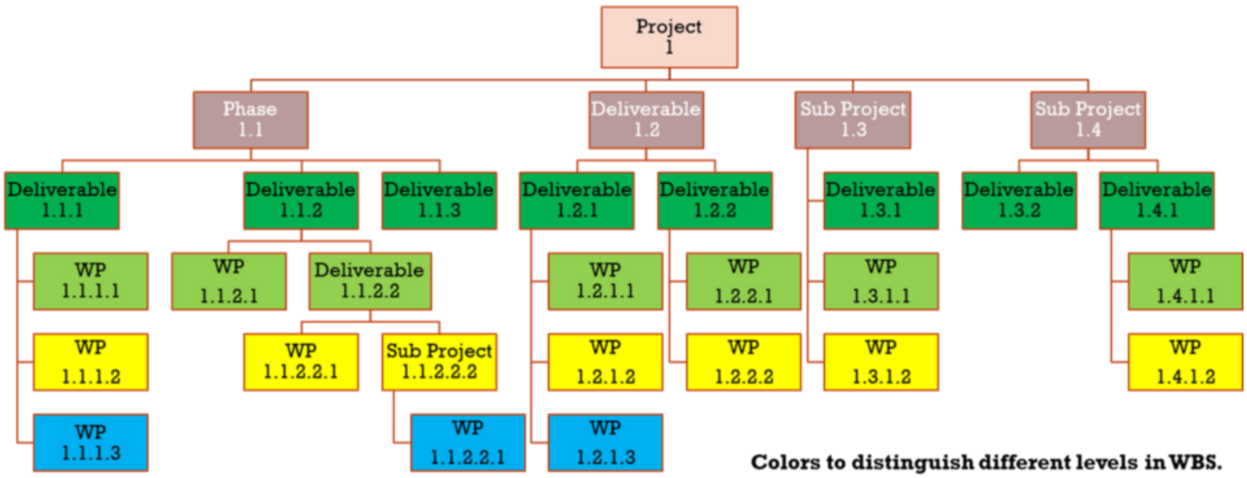



Figure 3: Generic WBS with Work Packages (WP)
Source: commons.wikimedia.org/wiki/File:Workbreadown_structure_sample.png

The benefits of creating a WBS (or similar breakdown) include:

- Helps ensure project proposal matches actual work required
- Basis for a project schedule
- Basis for a budget worksheet
- Facilitates tracking of budget and schedule (aka project controls)
- Allows identification of resources (staff, subconsultants, etc.)
- Helps ensure work elements are not missed
- Easier to identify risks

Often a basic WBS is created during the planning/proposal phase, which is used to create a budget and identify deliverable due dates. Then, when the project is awarded and kicked off, more details are added to the WBS and a detailed baseline schedule is developed.

## Lesson 3: Gain Commitments

A PM can accomplish very little without the help of a team. And odds are most team members will already be busy with other work. Thus, the success of the project depends on team members giving the project the time and attention required. Probably the most effective way to ensure this happens is by gaining commitments from each team member.

Examples of gaining commitments from team members:

- Email:
  - PM emails team members asking for number of hours (budget) and weeks (schedule) needed for each to complete their portion of the work.
  - Each team member responds with hours and weeks needed.
- Phone Calls:
  - PM calls each team member and asks for budget and schedule needs.
  - PM documents the responses and follows up with an email to each team member indicating the budget and schedule commitment.
- Individual Meetings:
  - PM meets with the lead engineer for each discipline and asks for budget and schedule needs.
  - PM documents the responses and follows up with an email to each lead engineer indicating the budget and schedule commitment.
- Group Meeting:
  - PM facilitates a group meeting and asks for budget and schedule needs from each member.
  - PM documents the responses and follows up with a group email indicating the budget and schedule commitments.

Gaining commitments is effective because staff:

- Want to keep their word
- Want a reputation as trustworthy
- Take ownership of their budget and schedule
- Are more likely to put in extra time as needed
- Are less likely to take on too much work from other projects
- Feel that their input is important
- Fear being blamed if the project goes over budget or beyond schedule

To foster commitment, project managers can:

- Clearly define goals and expectations for both the overall project and individual staff or discipline teams
- Involve team members in project planning activities
- Ask what is needed from others for them to meet their goals
- Ask what may hold them back from meeting goals
- Check-in with team members on project status, including budget and schedule
- Reiterate the importance of staying within budget and schedule

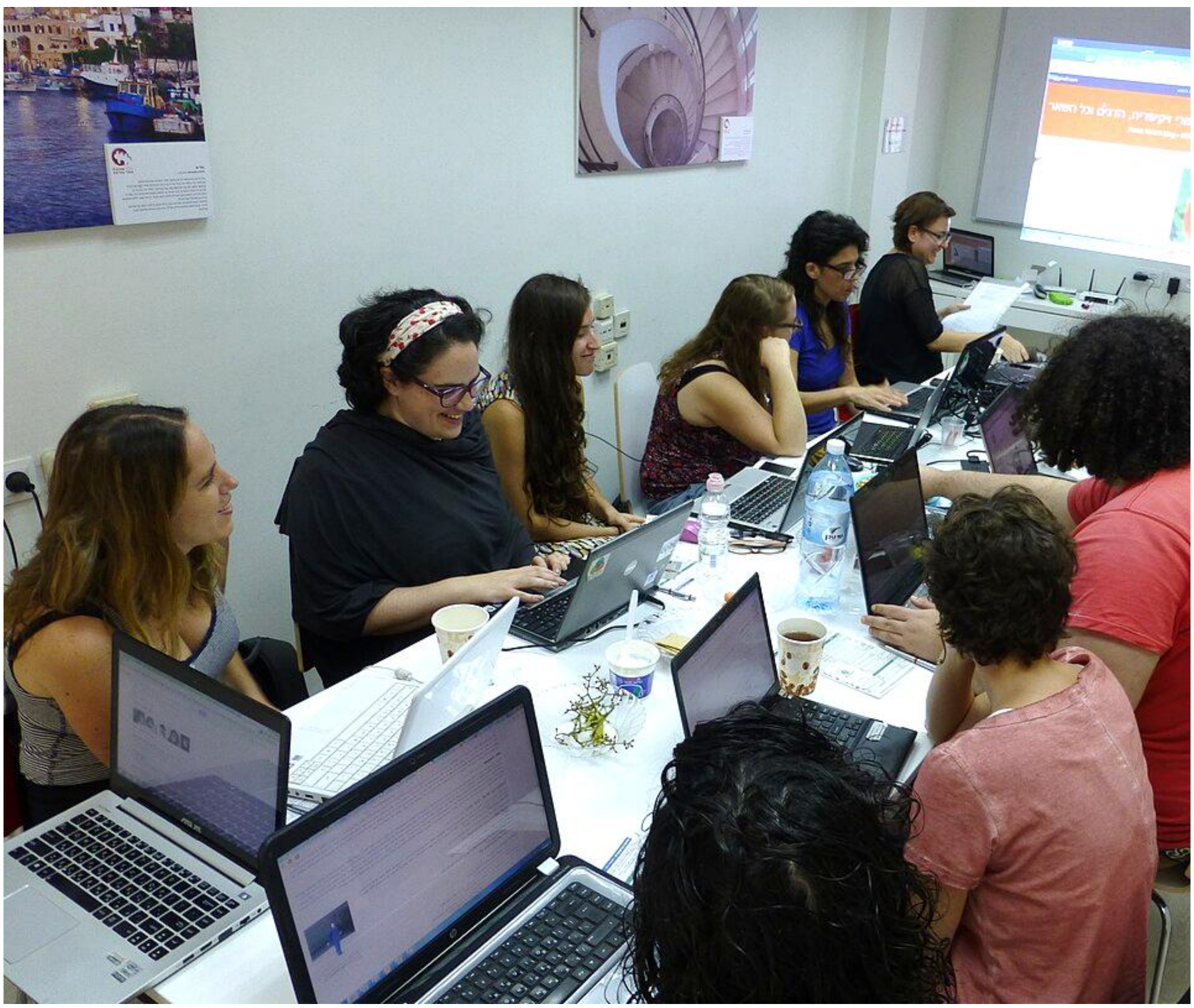


Figure 6: Internal project meetings are a good opportunity to review original commitments along with the status of the budget and schedule.
Source: commons.wikimedia.org/wiki/File:Wiki_Women_Editors_Project_-_Opening_Meeting_(9).JPG, Chenspec, CC-BY-SA-3.0

**Lesson 4: Define Everyone's Role**

A common project on projects is for staff to assume some aspect of the scope is someone else's responsibility. Also, it is common for staff to not know whom is doing activities that require collaboration. Both of these problems can be tackled by defining everyone's role and scope of work, and then conveying this to the team.

Org Chart

Staff organization charts (org charts) are commonly made in proposals for larger projects. Often these charts only include key team members that are highlighted for the purpose of securing the work. However, these org charts are also helpful for managing the execution of the project. They should include all known staff and subconsultants working on the project and be updated and distributed with any changes.

See Figure 7 for an example generic org chart. Staff names and assignments/roles should be included. Note that subconsultants should also be included and placed below the staff member they should primarily be reporting to, such as the project manager, design lead/manager, or a lead engineer.

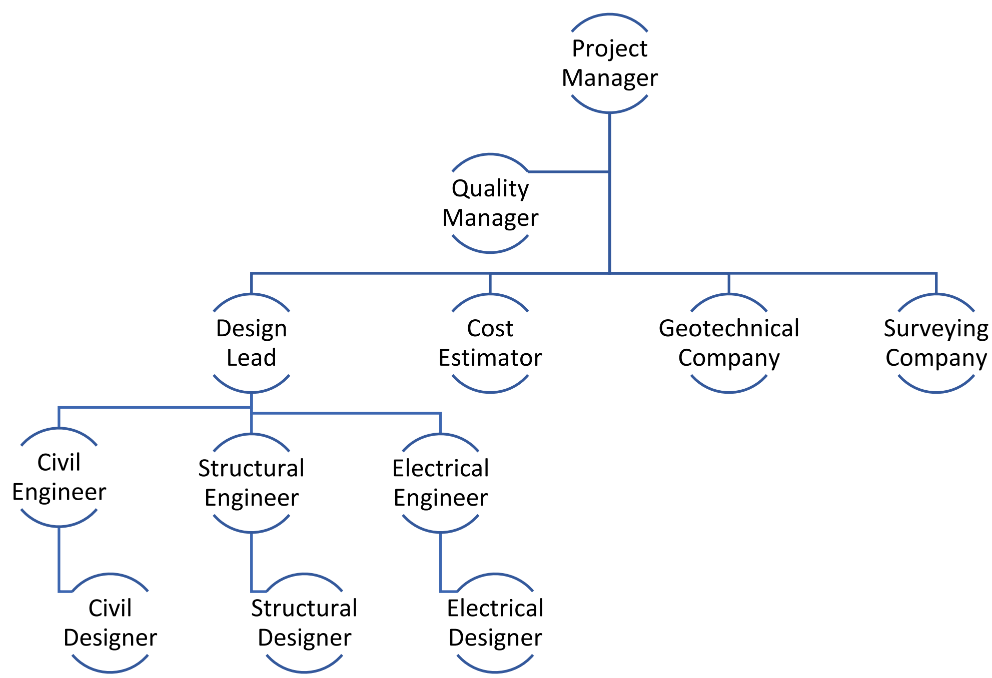



Figure 7: Example Staff Organization Chart. Names should be included.
Source: Author

For a project at the construction phase, it is helpful to have a stakeholder organization chart or hierarchy chart (in addition to a staff organization chart), as shown in Figure 8. It is important to know the roles of all the parties involved in construction. Creating a stakeholder chart can help keep everyone's role straight and help define communication paths.

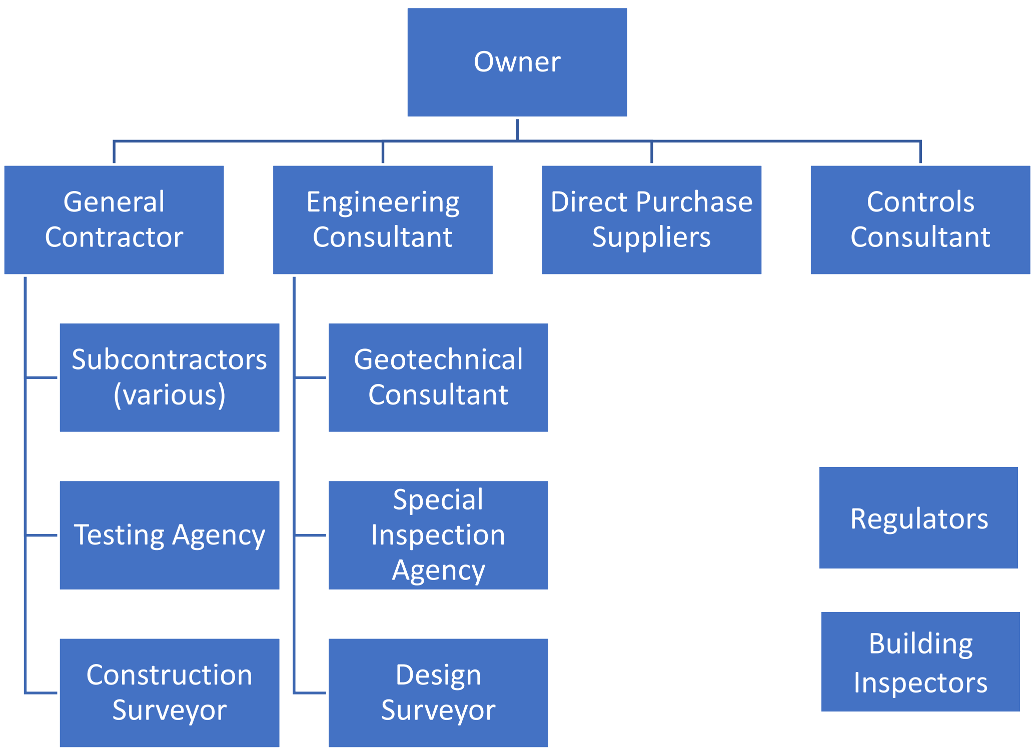



Figure 8: Example stakeholder organization chart.
Source: Author

WBS Assignments

To address staff not realizing which tasks are in their scope, utilize the work breakdown structure (WBS) since it should contain a list of all significant tasks within the scope of work. Staff names or roles can be added to each work package or task. Similarly, budget sheets and schedules can have resource names added next to each task. A project manager can do their best to make assignment, but should follow up with staff to confirm (commit) to the assigned tasks.

## Lesson 5: Prioritize Tasks

Project managers and engineers often experience extreme workload variations during the duration of a project. Typically, a project manager is very busy at the beginning of a project for project planning and kick-off activities. And near the end of a project can be busy as final deliverables are made, to complete close-out activities, and to finishing various loose ends to officially complete the scope to the client's satisfaction.

Often it is just not possible to do everything within a reasonable time period, even when working overtime. And bringing in a coworker with little to no knowledge of the project is either not possible or not helpful. This is where prioritization of tasks becomes essential. I recommend always keeping a list of tasks and prioritizing them at least once a week. Reviewing the list at the beginning of each day can really help make the day efficient and effective. A template for a "to do" list is provided with this course and snippet shown in Figure 9.

TO DO LIST

| CATEGORY | DESCRIPTION | DUE | PRIORITY | STATUS | NOTES |
|---|---|---|---|---|---|
| Sub | Review proposal for surveying | 6/28 | Medium | Completed | Move this to completed tab |
| Sub | Review change proposal from geotech | 6/30 | High | In progress | |
| Design Issue | Raise Elevation of Bldg 302 | 6/28 | High | In progress | Meet w/ Sarah |
| Client | Respond to question on ADA compliance. Check with architect. | 7/1 | Medium | In progress | |
| Invoicing | Review draft Invoice #2 | 6/30 | Medium | Pending | |
| Changes | Prepare change proposal for adding utility locates to scope | 7/3 | High | In progress | Incorporate civil comments |
| Civil | Schedule meeting to review base map with civil team | 7/5 | Medium | Pending | |
| Structural | Schedule meeting to review building layout and room sizes | 7/5 | Low | Pending | |
| Electrical | Assign internal reviewer for subconsultant electrical work | 6/29 | Medium | Pending | |
| Quality | Schedule meeting for quality review assignments | 7/5 | High | Pending | |
| Cost Estimate | Send estimator draft building layout for high level costing | 7/13 | Low | Pending | |

Figure 9: Example "to do" list. The yellow item should be done next.

Source: Author

## Lesson 6: Identify the Critical Path

Managing the design means being responsible for the work being completed **on time**. This is traditionally done by developing a schedule and focusing the team on completing critical path work. The critical path is the series of tasks leading to completion with the least float. To identify the critical path, a project schedule should be developed. An example is shown in Figure 9. The initial schedule is called the “baseline schedule”.

Here are steps to develop a baseline schedule:

1. List major tasks and deliverables
2. List activities required to complete each major task
3. Sequence activities
4. Estimate durations for activities
5. Create Gantt chart (MS Project, Excel, Primavera, etc.)
6. **Identify the critical path**
7. Allocate float (days for unexpected delays)
8. Assign resources (discipline or staff names) to each activity

The project manager and design lead should check-in regularly, perhaps daily, with staff working on a critical path item. Good questions to ask include:

- What is your progress on task ___?
- When do you estimate it will be complete?
- Is there anything I can do to help?
- Are you waiting on anything from anyone else?

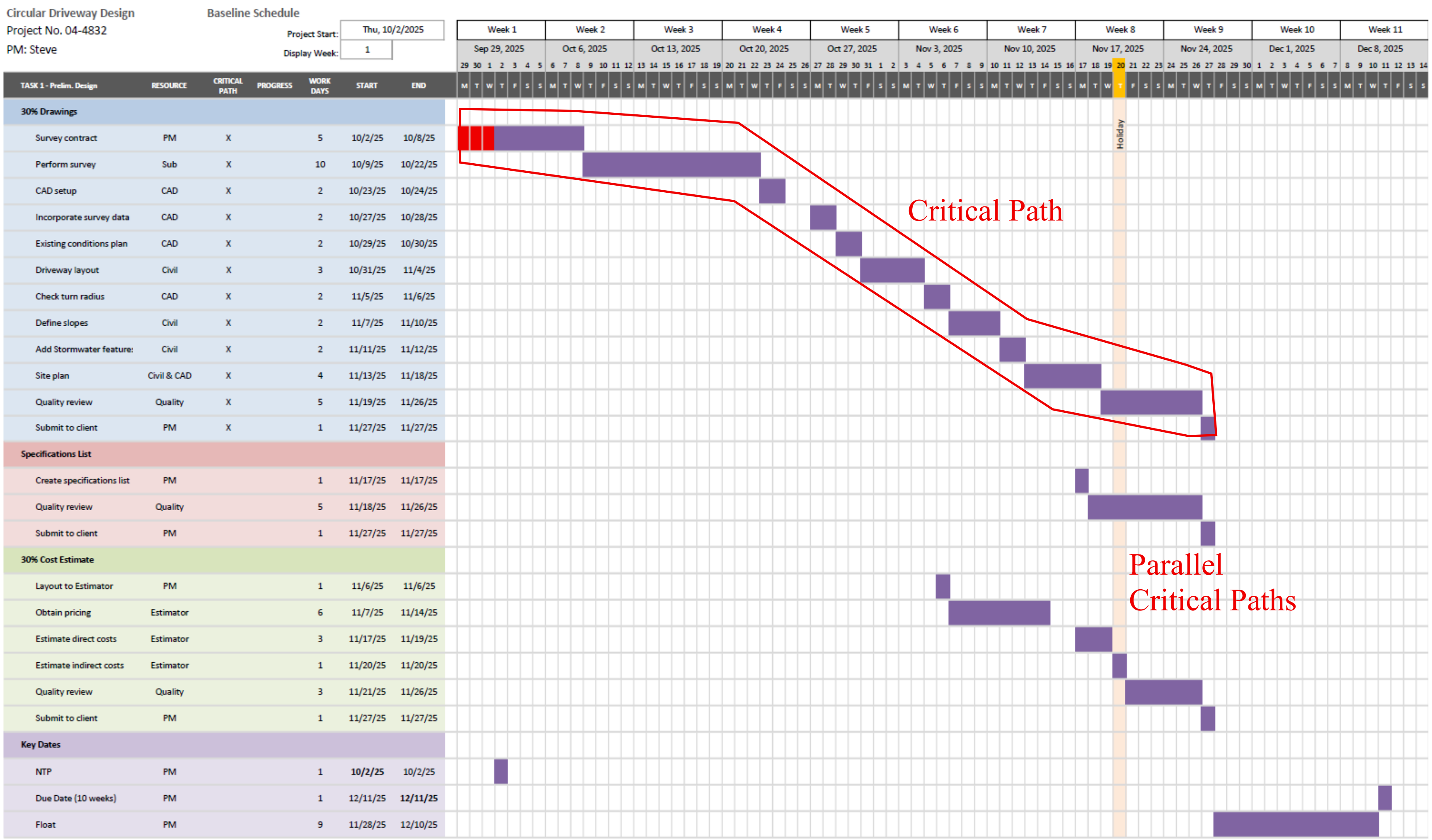
Example Problem 1

Given the baseline schedule in Figure 10, help PM Steve to identify the critical path. See excel document provided with this course.

Solution:

The project requires the following deliverables: 30% drawings (tasks in blue), specifications list (tasks in pink) and a 30% cost estimate (tasks in green). The drawings tasks form a continuous series with no gaps/float so they are the critical path. The quality reviews for all three deliverables can be considered parallel critical paths as they occur at the same time with no float.




| TASK 1 - Prelim. Design | RESOURCE | CRITICAL PATH | PROGRESS | WORK DAYS | START | END |
|---|---|---|---|---|---|---|
| **30% Drawings** | | | | | | |
| Survey contract | PM | X | | 5 | 10/2/25 | 10/8/25 |
| Perform survey | Sub | X | | 10 | 10/9/25 | 10/22/25 |
| CAD setup | CAD | X | | 2 | 10/23/25 | 10/24/25 |
| Incorporate survey data | CAD | X | | 2 | 10/27/25 | 10/28/25 |
| Existing conditions plan | CAD | X | | 2 | 10/29/25 | 10/30/25 |
| Driveway layout | Civil | X | | 3 | 10/31/25 | 11/4/25 |
| Check turn radius | CAD | X | | 2 | 11/5/25 | 11/6/25 |
| Define slopes | Civil | X | | 2 | 11/7/25 | 11/10/25 |
| Add Stormwater feature: | Civil | X | | 2 | 11/11/25 | 11/12/25 |
| Site plan | Civil & CAD | X | | 4 | 11/13/25 | 11/18/25 |
| Quality review | Quality | X | | 5 | 11/19/25 | 11/26/25 |
| Submit to client | PM | X | | 1 | 11/27/25 | 11/27/25 |
| **Specifications List** | | | | | | |
| Create specifications list | PM | | | 1 | 11/17/25 | 11/17/25 |
| Quality review | Quality | | | 5 | 11/18/25 | 11/26/25 |
| Submit to client | PM | | | 1 | 11/27/25 | 11/27/25 |
| **30% Cost Estimate** | | | | | | |
| Layout to Estimator | PM | | | 1 | 11/6/25 | 11/6/25 |
| Obtain pricing | Estimator | | | 6 | 11/7/25 | 11/14/25 |
| Estimate direct costs | Estimator | | | 3 | 11/17/25 | 11/19/25 |
| Estimate indirect costs | Estimator | | | 1 | 11/20/25 | 11/20/25 |
| Quality review | Quality | | | 3 | 11/21/25 | 11/26/25 |
| Submit to client | PM | | | 1 | 11/27/25 | 11/27/25 |
| **Key Dates** | | | | | | |
| NTP | PM | | | 1 | **10/2/25** | 10/2/25 |
| Due Date (10 weeks) | PM | | | 1 | 12/11/25 | **12/11/25** |
| Float | PM | | | 9 | 11/28/25 | 12/10/25 |

Figure 10: Example project baseline schedule with critical path in red.
Source: Author

## Lesson 7: Customize Tools for Tracking Budget

It is a given that project management involves budget tracking. There are a variety of tools for tracking a budget. The key is to use a tracking tool that makes sense to you. If the company standard software doesn't seem to apply to the project, or doesn't give a clear budget status, you should customize it for your needs or also use a secondary tool.

### Earned Value

An approach for determining budget status is by calculating the "earned value" of the work completed to date. If spending (actual cost) is greater than the earned value, the project is overbudget. If spending is less than the earned value, the project is underbudget. The earned value assessment can be applied to the overall project and to individual activities by using a spending breakdown and percent complete for each activity.

On a project with many unfinished tasks at the same time, the earned value can be difficult to calculate and may involve engineering judgement to estimate the percent complete. Even if you chose not to perform earned value calculations, the principle can be applied more roughly by looking at the percent spent and asking yourself if that percent of the work has really been completed.

### Example Problem 2

Continuing from Example Problem 1, help PM Steve to assess the budget status on Oct 30 given the progress schedule in Figure 11 (included in the free software with this course).

Solution:
Steve reviews the data in the green "% Complete" column in Figure 11, which when multiplied by the budget gives the "Earned to Date" values. In the table in Figure 12, Steve inputs the green "Spent to Date" fields. The difference between the two is the amount over or (under) budget for each task.

The sums at the bottom represent the overall project "Earned to Date" of $10,260, "Spent to Date" of $10,100, for a difference of $160. Since spent is less than earned, the project is $160 underbudget.

Circular Driveway Design
Project No. 04-4832
PM: Steve

Progress Schedule - Oct 30
Project Start: Thu, 10/2/2025
Display Week: 1

| TASK 1 - Prelim. Design | RESOURCE | CRITICAL PATH | PROGRESS | WORK DAYS | START | END |
|---|---|---|---|---|---|---|
| **30% Drawings** | | | | | | |
| Survey contract | PM | X | 100% | 5 | 10/2/25 | 10/8/25 |
| Perform survey | Sub | X | 100% | 10 | 10/9/25 | 10/22/25 |
| CAD setup | CAD | X | 100% | 2 | 10/23/25 | 10/24/25 |
| Incorporate survey data | CAD | X | 50% | 2 | 10/27/25 | 10/28/25 |
| Existing conditions plan | CAD | X | 50% | 2 | 10/29/25 | 10/30/25 |
| Driveway layout | Civil | X | 67% | 3 | 10/31/25 | 11/4/25 |
| Check turn radius | CAD | X | 50% | 2 | 11/5/25 | 11/6/25 |
| Define slopes | Civil | X | | 2 | 11/7/25 | 11/10/25 |
| Add Stormwater feature: | Civil | X | | 2 | 11/11/25 | 11/12/25 |
| Site plan | Civil & CAD | X | | 4 | 11/13/25 | 11/18/25 |
| Quality review | Quality | X | | 5 | 11/19/25 | 11/26/25 |
| Submit to client | PM | X | | 1 | 11/27/25 | 11/27/25 |
| **Specifications List** | | | | | | |
| Create specifications list | PM | | | 1 | 11/17/25 | 11/17/25 |
| Quality review | Quality | | | 5 | 11/18/25 | 11/26/25 |
| Submit to client | PM | | | 1 | 11/27/25 | 11/27/25 |
| **30% Cost Estimate** | | | | | | |
| After "driveway layout" | PM | | 80% | 1 | 11/6/25 | 11/6/25 |
| Obtain pricing | Estimator | | | 6 | 11/7/25 | 11/14/25 |
| Estimate direct costs | Estimator | | | 3 | 11/17/25 | 11/19/25 |
| Estimate indirect costs | Estimator | | | 1 | 11/20/25 | 11/20/25 |
| Quality review | Quality | | | 3 | 11/21/25 | 11/26/25 |
| Submit to client | PM | | | 1 | 11/27/25 | 11/27/25 |
| **Key Dates** | | | | | | |
| NTP | PM | | 100% | 1 | **10/2/25** | 10/2/25 |
| Due Date (10 weeks) | PM | | | 1 | 12/11/25 | **12/11/25** |
| Float | PM | | | 9 | 11/28/25 | 12/10/25 |

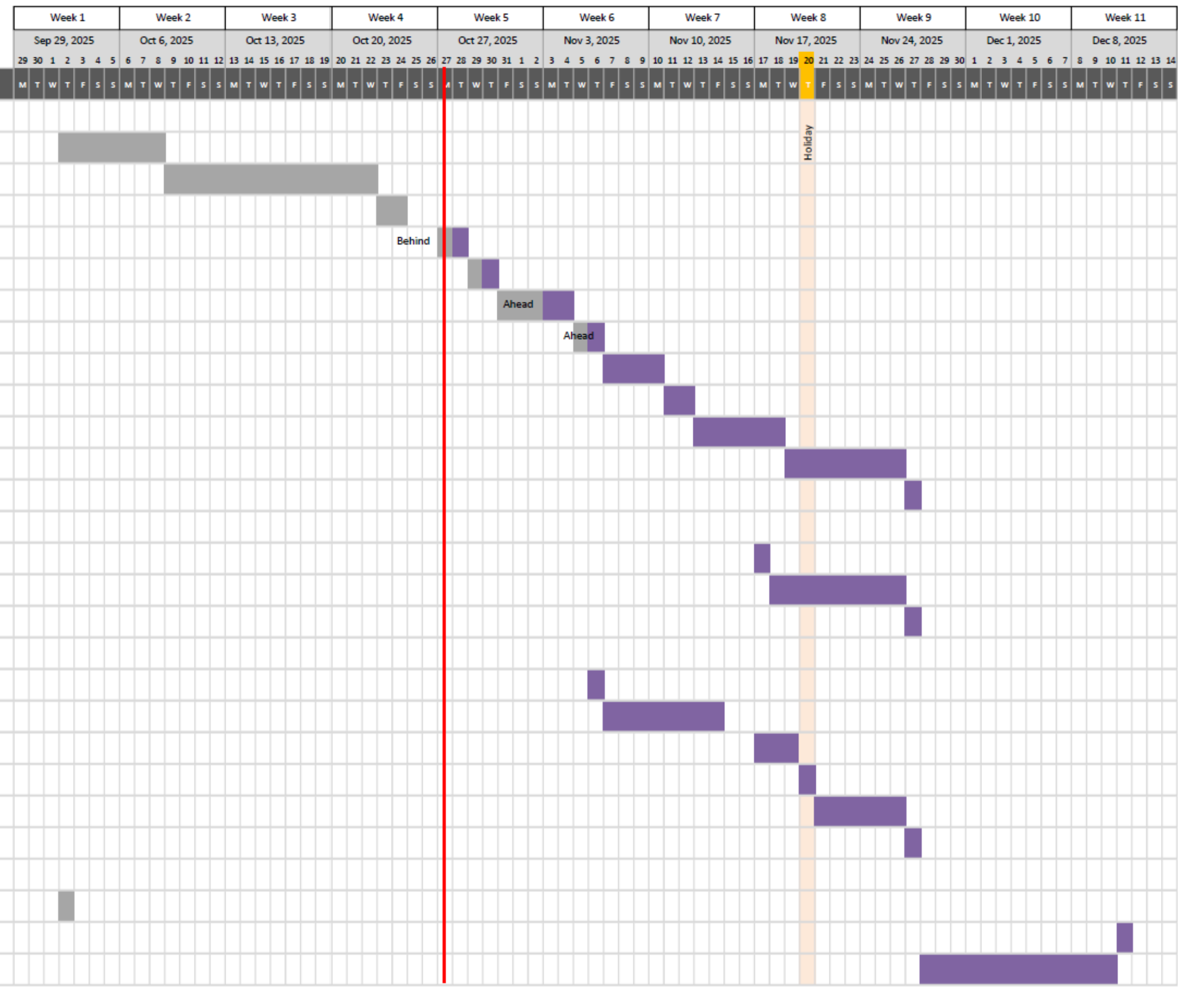



Figure 11: Progress schedule for Example Problem 2, with status as of date October 30.
Source: Author

**Circular Driveway Design** | **Budget Status**

Project No. 04-4832

PM: Steve

| | | |
|---|---|---|
| Assessment Date: | 10/30/2025 | |
| Overall Budget Status: | UNDER | -$160 |

| TASK 1 - Prelim. Design | RESOURCE | INITIAL BUDGET | % COMPLETE | EARNED TO DATE | SPENT TO DATE | % SPENT | BUDGET STATUS | AMOUNT OVER (UNDER) |
|---|---|---|---|---|---|---|---|---|
| **30% Drawings** | | | INPUT | | INPUT | | | |
| Survey contract | PM | $ 500 | 100% | $ 500 | $ 400 | 80% | UNDER | $ (100) |
| Perform survey | Sub | $ 3,000 | 100% | $ 3,000 | $ 3,000 | 100% | ON BUDGET | $ - |
| CAD setup | CAD | $ 2,000 | 100% | $ 2,000 | $ 1,800 | 90% | UNDER | $ (200) |
| Incorporate survey data | CAD | $ 2,000 | 50% | $ 1,000 | $ 1,200 | 60% | OVER | $ 200 |
| Existing conditions plan | CAD | $ 3,000 | 50% | $ 1,500 | $ 1,000 | 33% | UNDER | $ (500) |
| Driveway layout | Civil | $ 3,000 | 67% | $ 2,010 | $ 2,500 | 83% | OVER | $ 490 |
| Check turn radius | CAD | $ 500 | 50% | $ 250 | $ 200 | 40% | UNDER | $ (50) |
| Define slopes | Civil | $ 500 | | $ - | $ - | 0% | N/A | $ - |
| Add Stormwater features | Civil | $ 1,000 | | $ - | $ - | 0% | N/A | $ - |
| Site plan | Civil & CAD | $ 5,000 | | $ - | $ - | 0% | N/A | $ - |
| Quality review | Quality | $ 1,000 | | $ - | $ - | 0% | N/A | $ - |
| Submit to client | PM | $ 500 | | $ - | $ - | 0% | N/A | $ - |
| . | | | | | | | | |
| . | | | | | | | | |
| . | | | | | | | | |
| Contingency | Other | $ 3,000 | | $ - | $ - | 0% | N/A | $ - |
| **TOTALS** | | | | | | | | $ - |
| Total to Date | | $ 40,000 | 40% | $ 10,260 | $ 10,100 | 25% | UNDER | $ (160) |

Figure 12: Budget Assessment Table for Example Problems 2 and 3.
Tasks in Specifications List and Cost Estimate deliverables are not shown,
but are all 0% complete.
Source: Author

Example Problem 3

Continuing with Example Problem 2, help Steve identify which disciplines are overbudget.

Solution:

Looking at Figure 12, the two disciplines with overbudget activities are CAD and Civil:

- CAD has one task overbudget, three tasks underbudget (1 completed), and a net amount underbudget. Overall, no reason to complain.
- Civil only has the one task started, "Driveway Layout," which is $490 overbudget. Not a good start.

Therefore, only the Civil discipline is overbudget.

S-Curve

The total “Earned to Date” and “Spent to Date” values can be recorded on a regular basis, typically once a month, and then plotted along with the original budget values to form what is called an “S-Curve”. Time is the X-axis and the budget/spent is the Y-axis (in dollars or percent). See Figure 13 for an example.

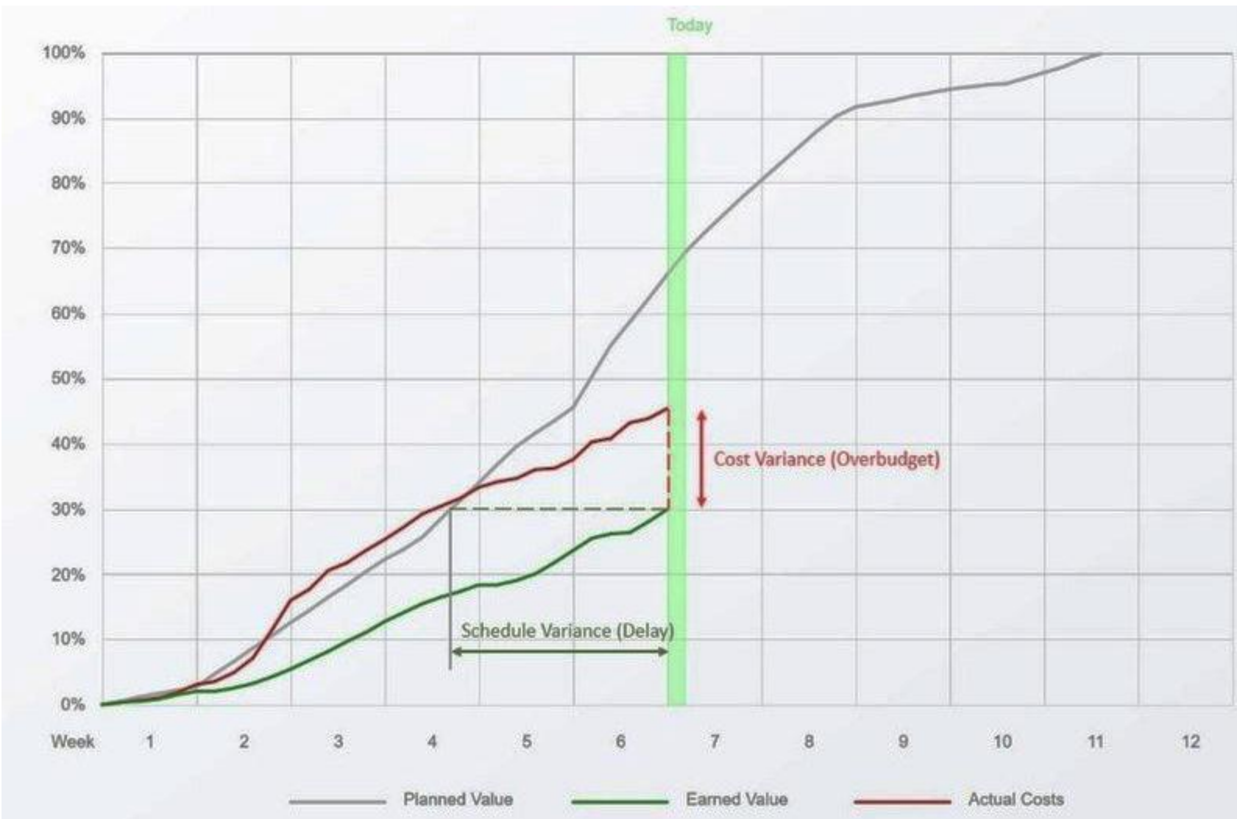



Figure 13: Earned value “S-Curve” for a project that is overbudget and delayed based on total spent (actual cost) and earned value at the end of week 6 of 12. The gray “Planned Value” line represents spending according to the baseline schedule.

Source: commons.wikimedia.org/wiki/File:EarnedValueChartNormalized.jpg, Kokcharov, CC-BY-SA-4.0

It is called an S-Curve because spending is usually greatest in the middle period of the project which makes the curve steeper in the middle and ends up shaped like a stretched out letter “S”.

Earned Value Parameters

Earned value data can be used to calculate other parameters to assess the state of the project and help direct actions to keep the project within schedule and budget. Common parameter formulas are in Table 1.

Table 1: Earned Value Parameters

| Parameter | Abbr. | Formula |
|---|---|---|
| Total Budget | TB | from Contract |
| Activity Budget | AB | from budget breakdown |
| Planned Value (Baseline Budget to Date) | PV | ∑ AB (to Date) |
| Actual Cost (Spent to Date) | AC | from accounting |
| Earned Value (Earned to Date) | EV | ∑ AB x % Complete |
| Cost Variance | CV | CV = EV – AC |
| Schedule Variance | SV | SV = EV – PV |
| Cost Performance Index | CPI | CPI = EV/AC |
| Schedule Performance Index | SPI | SPI = EV/PV |
| Estimated Cost at Completion | EAC | EAC = TB + CV |

Example Problem 4

Continuing with Example Problem 3, after week 7 is complete, help Steve identify the schedule variance, cost variance, and contingency remaining based on Figure 14.

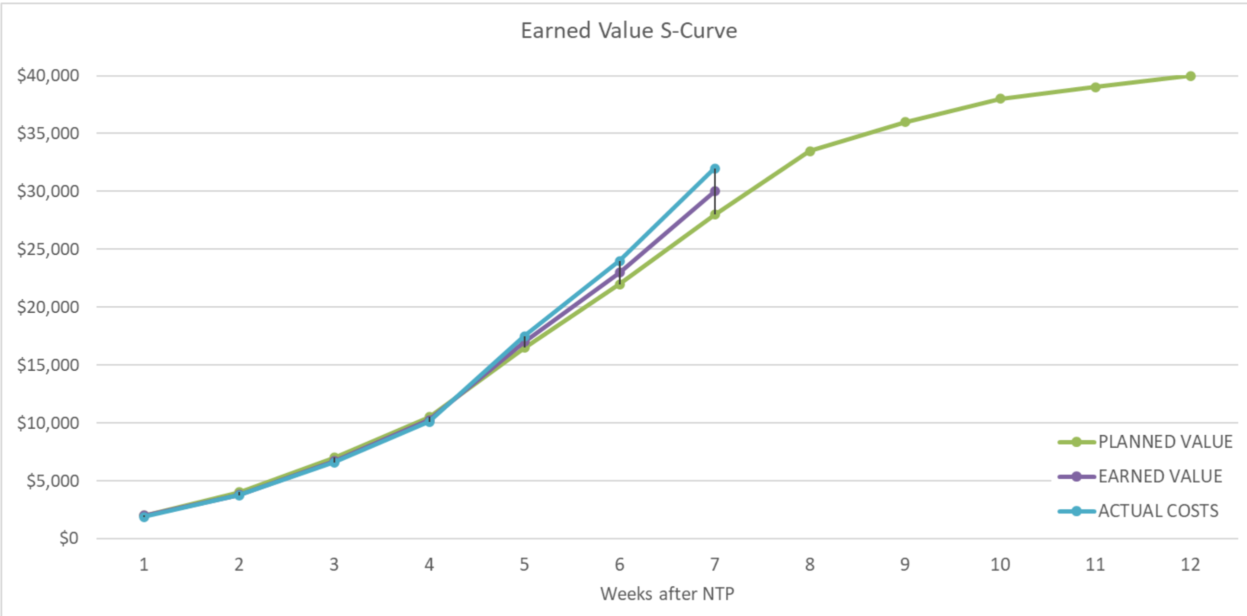



Figure 14: S-Curve for Example Problem 4 (included with free software).
Source: Author

Solution:
Based on Table 1 definitions and Figure 14 values (rounded):

- Schedule variance (SV) = EV – PV = $30,000 - $28,000 = $2,000
  SV is positive so project is ahead of schedule.
- Cost variance (CV) = EV – AC = $30,000 - $32,000 = ($2,000)
  CV is negative so project is overbudget.
- Contingency remaining = Cont. + CV = $3,000 + ($2000) = $1,000
  There is still contingency remaining, although it has been reduced (no reason to panic yet).

**Lesson 8: Overcommunicate**

It is frustrating to look back at a project failure and realize it could have been prevented by simply discussing the issue or sharing the information I had with the right people. Why hadn't I reached out?

Excuses for lack of adequate communication include:

- I mentioned it in a meeting and assumed everyone was listening attentively
- I assigned someone to handle the issue and never followed up
- I assumed everyone could find the information since it was saved in the project folder
- I was too busy
- The meeting was cancelled, or the right people did not attend
- I thought I could handle it myself
- I was overly optimistic that it would resolve itself
- I didn't want my manager to know my project had a problem
- I put it in the risk register with a mitigation plan, but never informed the team
- I put it on a change log but never obtained the needed approvals

The following forms of communication can make a big difference in leading the team to success:

- Regular team meetings and status emails:
    - Team members will be more engaged if they know the project status
    - Consider weekly status meetings which can be cancelled if work is slow, holidays, etc.
    - Updates should include budget status, schedule status, and any changes
    - Listen to the needs of team members
    - Help resolve conflicts and mitigate personality clashes
- One-on-one meetings:
    - With design manager or design lead(s)
    - With any staff having performance problems
    - With anyone that cant attend a team meeting
- Recognize outstanding work:
    - Find ways to recognize individuals who are performing well or have achieved something exciting
    - Options include words of gratitude, public recognition, bonus payment, award plaque or certificate, group celebration, and informing their supervisor

- Distribute Information
  - Ensure team members have access to project documents
  - Periodically review and organize the network folder structure, file names, and contents
  - Point out key document locations to team members in meetings and with follow-up emails
  - Ask team members if they are missing any information
- Motivate and Empower the Team
  - Be engaging and encourage the team to achieve great things
  - Put in the effort to ensure everyone is clear on upcoming tasks and have the information they need
  - Overcommunicate when needed as a precaution
  - Be a transformational leader, as shown in Figure 15


Figure 15: The Full Range Leadership Model. The goal is for a leader to put regular effort into motivating and empowering the team in order to maximum engagement and achieve project goals.
Source: Public Domain

**Lesson 9: Prepare for Meetings**

Often engineers spend most of the work day in meetings and making phone calls. Although meetings can be tedious, they are critical for a successful project. The best way to make sure the meetings are effective is to prepare for them.

Figure 16: In-person meeting with Owner, Contractor, and Engineer.
Source: https://www.flickr.com/photos/arizonadot/6881676937/in/photostream/

It is very important to prepare for each meeting, regardless of the agenda. Evan a short preparation of 5 to 10 minutes can make a difference. When leading the meeting, additional preparation is needed, including sending out an agenda in advance.

Although each project and meeting is unique, here are some general meeting preparation guidelines:

- Understand the overall purpose and goals of the meeting. If unsure, inquire from the organizer.
- State these goals in the invite and at the beginning of the meeting.
- Ensure you understand the role of each person invited to the meeting.
- If there is a new person invited, inquire about their role or introduce yourself before the meeting if possible.

- Decide on two or three specific goals for your contribution to the meeting. For example, to highlight a recent success, push for a solution to a design issue, introduce a new team member, or talk through an upcoming task requiring collaboration.
- Review pre-meeting documents such as the agenda, schedule, budget, draft design documents, quality review comments, recent emails, etc.
- Make a list of questions to ask during the meeting.
- For meetings with external clients, regulators, contractors, or other stakeholders, consider any known engineering issues that are likely to be brought up. Decide if the team is prepared to give a response and technical direction. If not, prepare an answer that includes an estimated number of days to get back with a response.
- Make sure your calendar is cleared for the meeting. If you have back-to-back meetings and believe the previous meeting may go long, inform others that you may be late for the meeting and chose someone to start the meeting, if possible.

*Meeting Notes*
For meeting notes, avoid transcribing everything that is said, which can be done by recording the audio of the meeting and/or using transcription software. Instead, focus on these two items:

1) Decisions made
2) Action items

These two items are the most useful for those who missed the meeting and attendees interested in recalling what occurred in the meeting.

*Other Notes*
Making notes after an important phone call or in-person discussion is also helpful. This can be done as an internal note (digitally saved) or with an email. Even an email to yourself can create a written record of information exchanged and decisions made. This also helps to later create a timeline of events.

## Helpful References

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