Project Overview

This is a tool to measure changes to Earned Value Management (EVM) based on common changes that may impact the data by either changing the schedule or cost of a schedule. EVM is measured off a cost and schedule profile that is set as a baseline, and one that is updated as the current plan changes. In this example, we are going to assume it is for a pen shop that makes ballpoint pens in three sizes, fine, medium, and bold. The shop must manufacture a certain number of pens per month and to do so, all of the parts that are needed to assemble these pens must be bought and assembled in time to support the schedule. With many investors in the company, it is important that Pipa, the owner, can report on financial and schedule data as well as what the impacts will be for various changes. This tool will allow her to upload her data and then simulate various changes and the impacts it will have on the data she reports on.

User Interactions

Upload two files

one is the item details that will contain all the items used to manufacture each of the pens as demonstrated below:

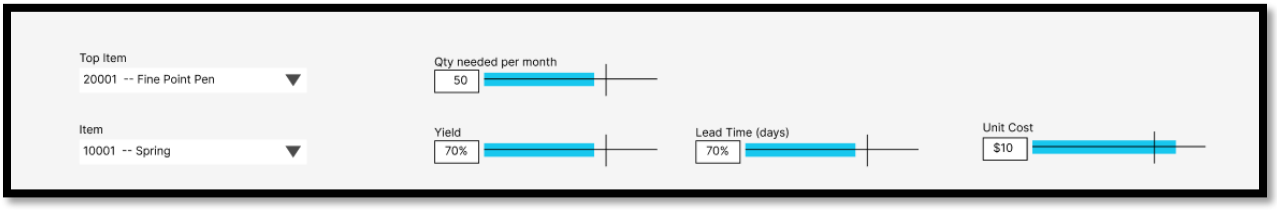
Item	Item Description	Cost ($)	Lead Time (d)	Total Lead Time (d)	Yield (%)	Assembly level
20001	Fine Point Pen	1	5	5	95	1
30001	Medium Point Pen	1.2	5	5	95	1
40001	Bold Point Pen	1.5	5	5	95	1
10001	Spring	0.5	7	7	90	2
20002	Fine Ballpoint Tip	0.75	6	6	90	3
30002	Medium Ballpoint Tip	0.9	6	6	90	3
40002	Bold Ballpoint Tip	1.2	6	6	90	3
10002	Clip	0.3	7	7	85	2
10003	Thrust Device	2.5	10	10	85	2
10004	Tip	0.6	7	7	90	2
10005	Ink Chamber	1.8	10	10	85	3

The other will be the cost and schedule profile. This would traditionally be created based on a demand schedule, the item details, and bill of material, but due to the complexity of the project we will assume that was done through a SQL database and will use a sample dataset as the output. An example of these datasets is below:

Item Description	Pen Type	Need Date	Needed Qty	Build Qty	Build Cost
Fine Point Pen	Fine Point Pen	1/1/2025	50	52.5	52.5
Medium Point Pen	Medium Point Pen	1/1/2025	150	157.5	189
Bold Point Pen	Bold Point Pen	1/1/2025	75	78.75	118.125
Spring	Fine Point Pen	12/27/2024	50	55	27.5
Spring	Fine Point Pen	1/27/2025	50	55	27.5
Spring	Medium Point Pen	12/27/2024	150	165	82.5
Spring	Medium Point Pen	1/27/2025	150	165	82.5
Spring	Bold Point Pen	12/27/2024	75	82.5	41.25
Spring	Bold Point Pen	1/27/2025	75	82.5	41.25
Clip	Fine Point Pen	12/27/2024	50	57.5	17.25
Clip	Fine Point Pen	1/27/2025	50	57.5	17.25
Clip	Medium Point Pen	12/27/2024	150	172.5	51.75
Clip	Medium Point Pen	1/27/2025	150	172.5	51.75
Clip	Bold Point Pen	12/27/2024	75	86.25	25.875
Clip	Bold Point Pen	1/27/2025	75	86.25	25.875
Tip	Fine Point Pen	12/27/2024	50	55	33

Modify Item Details

Users will have the option to make changes to the item details in the dashboard through slide bars.

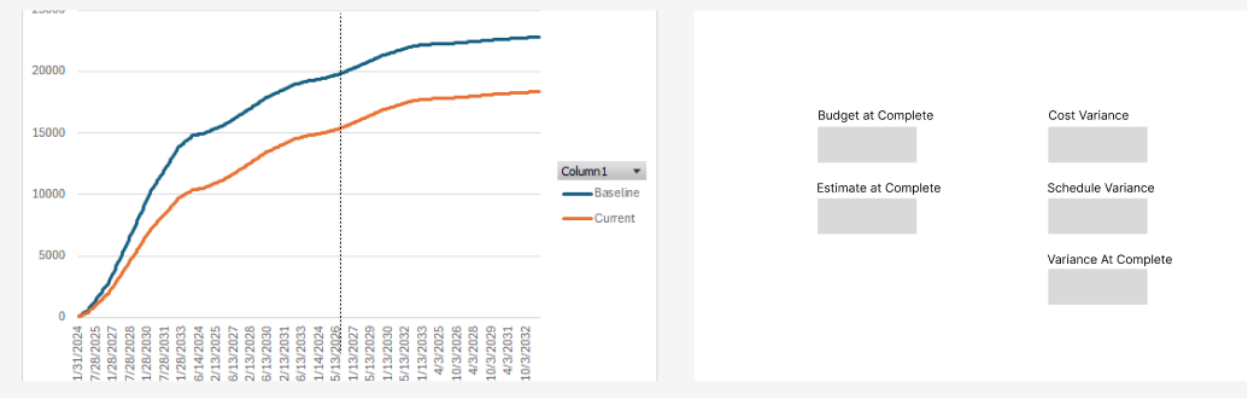


In our example, Pipa will have her data loaded into the tool at this point, and will be able to interact with the data. There is a drop down menu that allows her to select the item she would like to change, then after selecting it, the blue bars in the image depict slider bars and the default values will be shows by the vertical marker. Pipa can use the slider bars, or type in an exact number.

The item details can be modified, but the quantities of pens needed per month can also be modified. All changes will have an impact on her financial and schedule data.

Evaluate impacts of Changes

As the data is modified in the previous section, the dashboard will be visible and will update at the same time assuming this is not a limitation that is encountered.



Pipa will be able to see the impacts of her changes but will also be able to move the vertical line on the line chart in order to see how her metrics will change with time to predict what her reports will be to help address any questions before they come up with her investors.

Reset

It will be important that there is a way to reset the data after changes are made in case the user wants to restart.

Export

Users may want to export the data for deeper analysis, so it will be important to allow them to export the data when they are complete which will be exported in the same format as the import files.

Logic Flow

Import data files

Import Item Details

This will be the function that takes the item details in and ensures it is in the right format for the code to process it. Will need to check that the correct column headers are there, and the data is formatted correctly

Import Schedule and Cost Details

This will be a similar function but will take the schedule and cost details as input instead.

Create a copy of the schedule and cost details

This will be the data that is modified based on user inputs so the original data file can be used as a comparison in evaluating the changes

Update Dashboard

Plot Import Schedule and Cost Details

This will likely use the recommended Plotly Dash Open-Source code to help generate a line chart of the original data as well as the modified data set. Initially they will be the same data set

Add vertical line to the line chart

This will either be at today's date if that is a point within the dataset, otherwise it will start at a date 25% of the way into the dataset so it remains visible to the user

Calculate EVM Data

The Calculated fields to the right of the chart will be calculated based on the two comparison files. See the Formulas section for details on these formulas

Take in User Inputs

Acknowledge data was updated

Any time any of the values change the code needs to execute on calculating the impacts

Calculate changes

For each changed value it needs to determine the original value of the input file, and the new input and calculate a percent change. This percent change will determine the impacts to the schedule and cost data. These impacts are shown below and need to be made for each line of data in the modified dataset.

	Need Date	**Qty**	**Monthly Cost**
Yield	No Change	Qty * %Change	Cost * %Change
Cost	No Change	No Change	Cost * %Change
Lead Time	Date + LeadTime Change	No Change	No Change
Pen's needed	No Change	Qty * %Change	Cost * %Change

Update dashboard

Run the same functions to originally update the dashboard each time assuming this is not too slow. If it proves to be too slow, there may have to be a button included to execute the code when the user is ready to see the impacts.

Export Data

Once the user is happy with the changes, there will be an option to export the data. This function will create a zip file of the two data files in the same format as the inputs so they can be used in the future as the next baseline.

Assumptions:

- The system will assume backward planning meaning the tasks will start in time to meet need dates for simplicity
- This assumes there are resources available to complete the work based on the needed schedule
- Costs may not be realistic but are used to simulate the data for the dashboard

Formulas

The following formulas will be used in calculating the Earned Value Management (EVM) metrics. The following two formulas are summative and will not vary across time and will be impacted by changes in user inputs by either increasing and decreasing values or shifting the time phasing. These formulas represent the expected outcome for a project at the end once all costs are incurred and the schedule is completed.

$$BAC = \sum_{t=1}^{T} PV_t$$

Where:

- $BAC = Budget\ at\ Completion$
- $T =$ $the\ total\ time\ periodover\ which\ the\ project\ is\ planned$
- $PV_t = the\ planned\ value\ at\ time\ t, in\ this\ case\ it\ represents\ a\ month$

$$EAC = AC + \sum_{t=t_{current}+1}^{T} ETC_t$$

Where:

- $EAC = Estimate\ at\ Complete$
- $AC = Actual\ Cost\ incurred\ up\ to\ the\ current\ time\ (t_{current})$
- $ETC = Estimate\ to\ Complete = the\ remaining\ forecast\ for\ remaining\ work$
- $T =$ $the\ total\ time\ periodover\ which\ the\ project\ is\ planned$

$$VAC = BAC - EAC$$

Where:

- $VAC = Variance\ at\ Completion$
- $BAC = Budget\ at\ Completion$
- $EAC = Estimate\ at\ Complete$

The following formulas vary based on the current time which in this case will be by months that the user can select to understand how these metrics may change over time.

$$\%_{Completed\ work} = \frac{AC}{EAC}$$

Where:

- $\%_{Completed\ work} = the\ percent\ of\ work\ complete\ up\ to\ the\ current\ time\ (t_{current})$
- $EAC = Estimate\ at\ Complete$
- $AC = Actual\ Cost\ incurred\ up\ to\ the\ current\ time\ (t_{current})$

$$EV = \%_{Completed\ work} \times BAC$$

Where:

- $EV = Earned\ Value$
- $\%_{Completed\ work} = the\ percent\ of\ work\ complete\ up\ to\ the\ current\ time\ (t_{current})$
- $BAC = Budget\ at\ Completion$

$$CV = EV - AC$$

Where:

- $CV = Cost\ Variance$
- $AC = Actual\ Cost\ incurred\ up\ to\ the\ current\ time\ (t_{current})$
- $EV = Earned\ Value$

$$SV = EV - PV$$

Where:

- $SV = Schedule\ Variance$
- $PV = The\ planned\ value\ up\ to\ the\ current\ time\ (t_{current})$
- $EV = Earned\ Value$