Paper to Project Controls Expo.

Primary Author.

Matthew Alan Brook.

Phone. 56975616706

Email. Donmateo1971@gmail.com

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Matthew Brook

Author Profile.

Matthew Brook is a Project Controls Professional who grew up in Brisbane Australia. Having graduated from QUT with a degree in construction management he has worked for 20 years in in Project Controls positions on resource projects throughout the world but primarily on the Owners side often in direct execution roles.

New Project Controls Tool - Combined Phase Curves

Abstract.

Modern project controls systems produce large amounts of data and curves which when presented in isolation provide progress tracking on individual phases of the project, ie engineering, procurement, construction. When combined they provide a global view of the project that is easier for senior management to understand.

The combination of engineering, procurement and construction with cash flow and commitment curves can be a useful tool for both forensic analysis or can be utilized as predictive tool with a high degree of accuracy.

Introduction.

The challenge of project controls is to make difficult and complex project interactions simple to non project controls management professionals. As part of the practice of Forensic schedule analysis on project delays the author was looking for a way to demonstrate the interactions between delays that occurred in the various phases of the project. The author was also looking for an early predictor of project delays that can be utilized for accurate forecasting of project outcomes, both schedule and accordingly project cost. The resulting system generates a high level of accuracy, 95% on a small sample of historical projects as well as a large sample of projects from a third party data base scan. This system utilizes combining the following curves on one chart and utilizing the graphical relationships as predictor of project schedule delays.

The progress graphs that were combined were the following:

- Engineering
- Procurement
- Construction
- Commitments
- Cashflow

The combination of commitment curves are important early on in a project as commitments are a leading indicator of project progress as well as providing a check for the accuracy of the engineering reporting early on in the project. The results of this system indicated that 95% of projects fail to recover the time lost during the engineering phase of the project. This lost delay is evident at the stage of 80% completion of engineering services. This delay can form the basis of predicting the schedule completion date and therefore the overrun in the project. This method provides an accurate predictor of project completion dates and therefore cost, early in the project. This method circumvents the natural tendency of projects to insist during the construction execution phase, to report that time lost during engineering completion will in fact be recovered during project execution. Historical information indicates only 5% of projects ever recover time lost during engineering execution.

Technique.

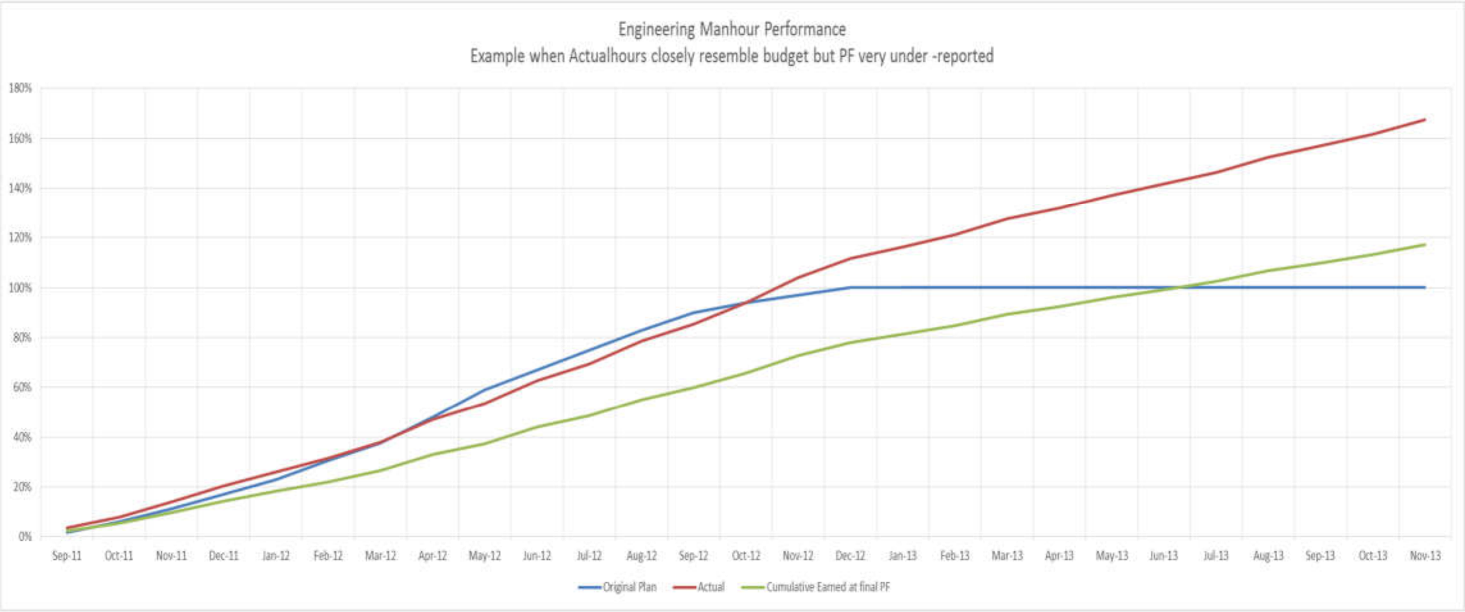
Typically project progress is reported by project progress curves which report the following baseline data :

- Cashflow and commitment curves.
- Engineering progress
- Procurement progress
- Construction progress.

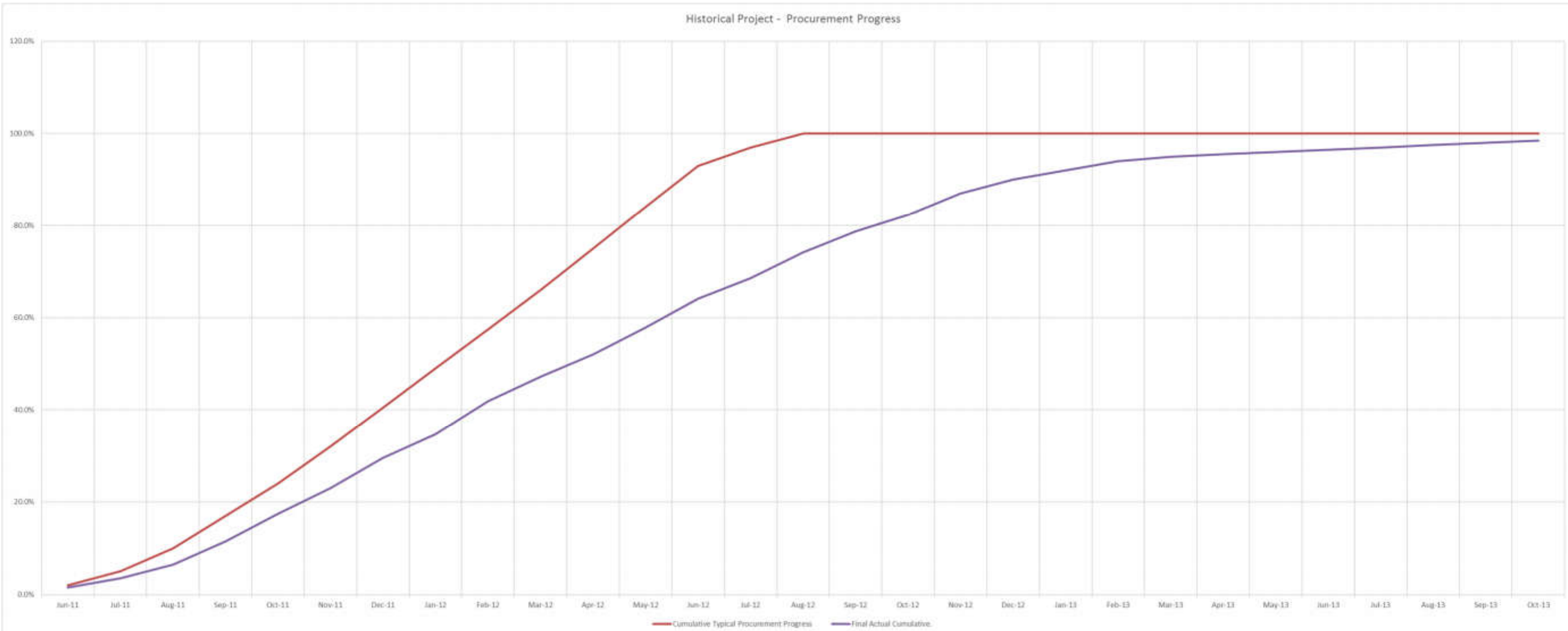
This technique involves place at a miniumum engineering, procurement and construction progress on the same graph. The addition of cashflow and commitment curves also provide additional data on accuracy of engineering progress reporting early on in a project. This technique was developed forensically but can be used in predictive capacity.

The following indicates the steps of preparing this technique. The following curves and examples are historical examples.

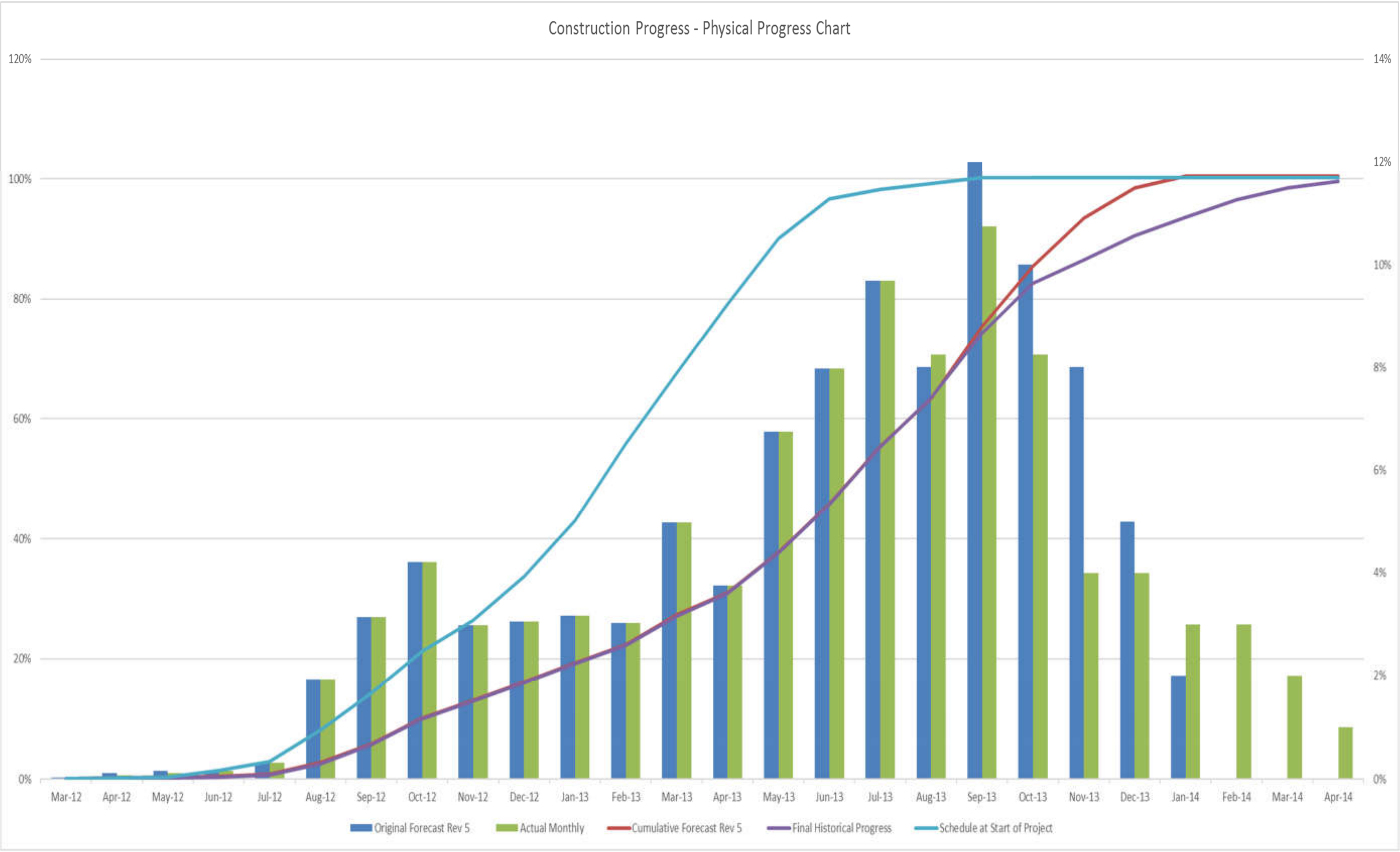
Step 1 Prepare Engineering curves.



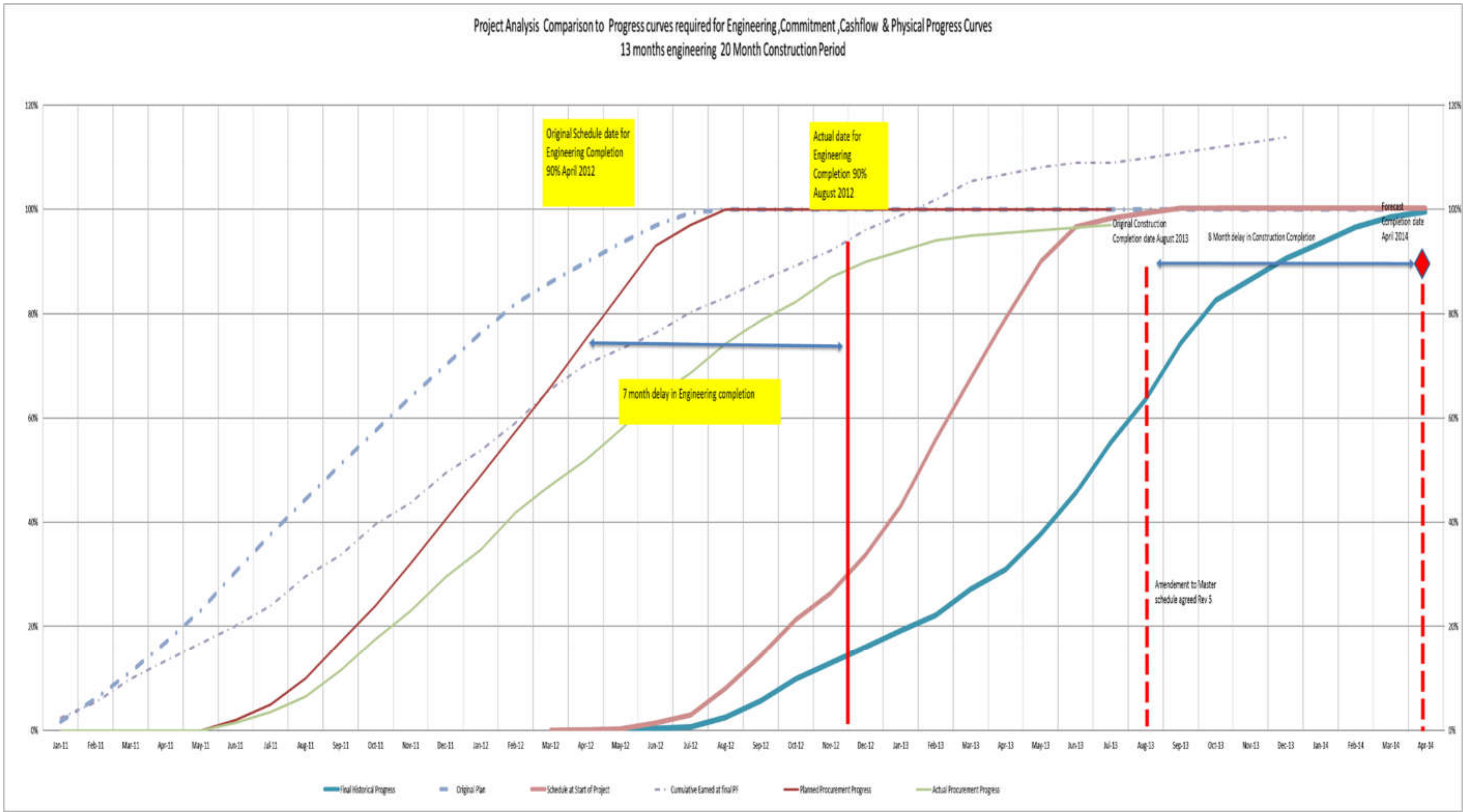
Step 2 Prepare Procurement Performance Curves



Step 3 – Construction Progress curves.

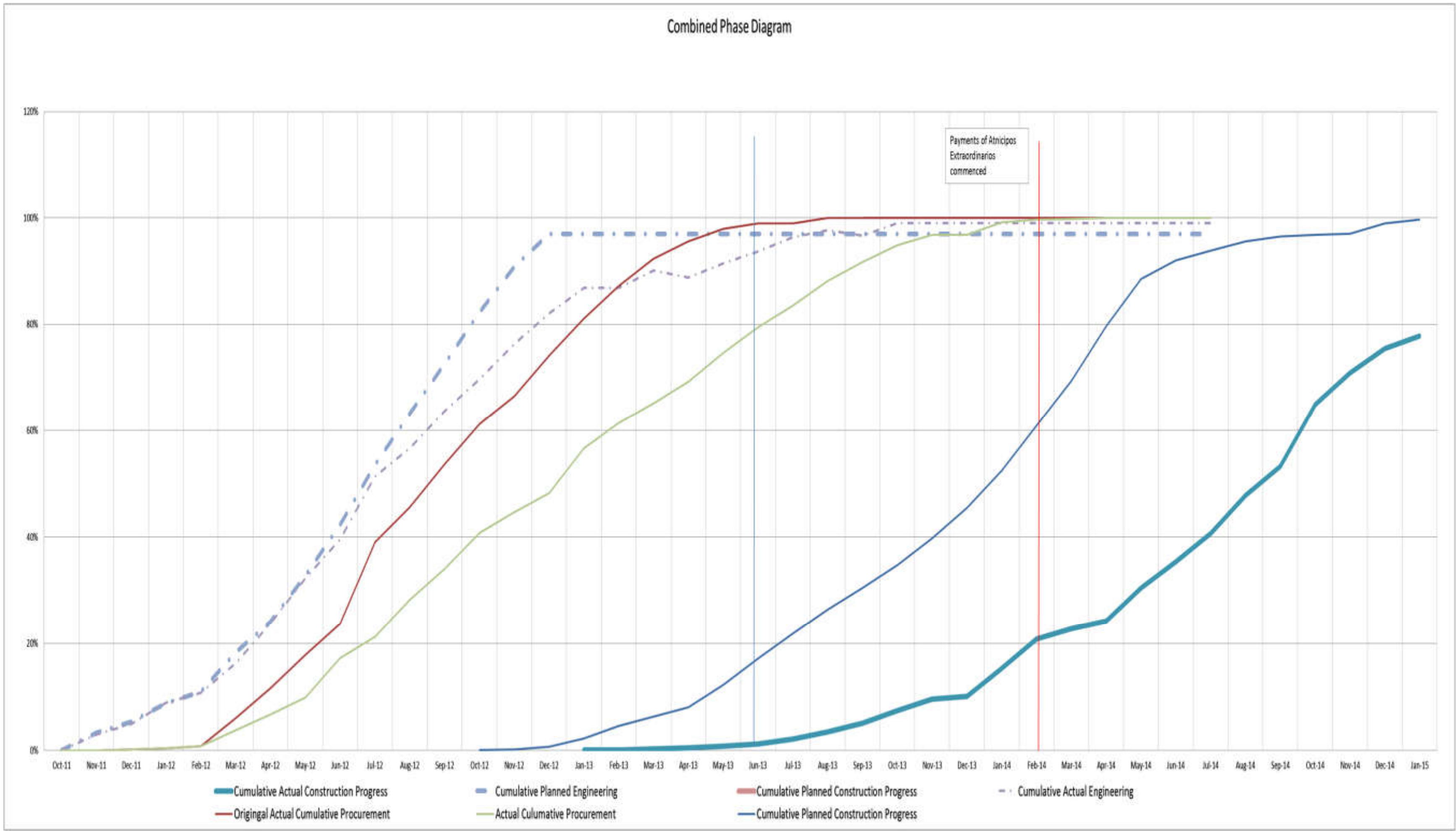


Step 4. Combination of Phases.



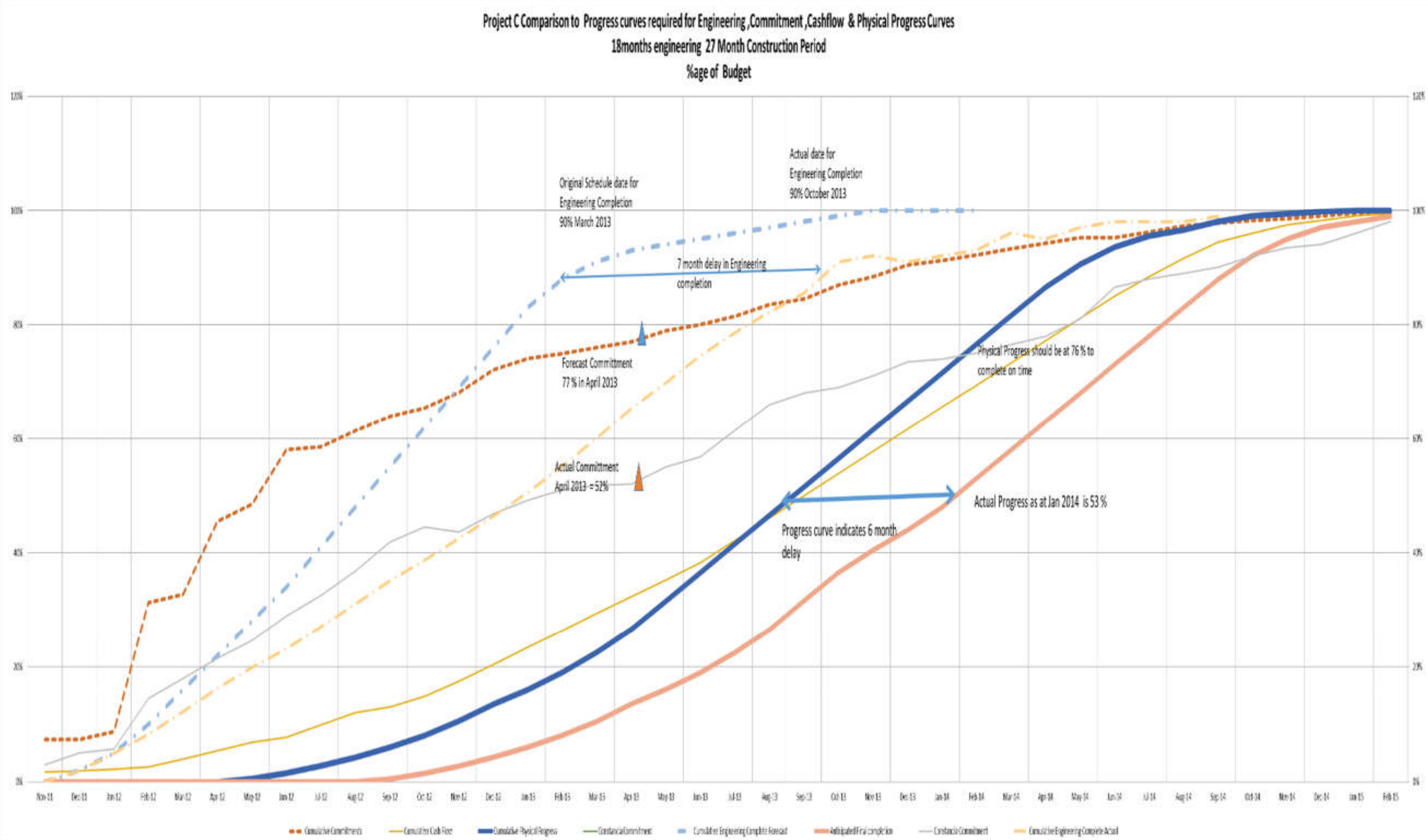
Practical examples.

Example 1. Note the difference between the engineering progress early on in the project and the delays to the procurement. This indicates inaccurate reporting of earned value of engineering scope and poor performance.



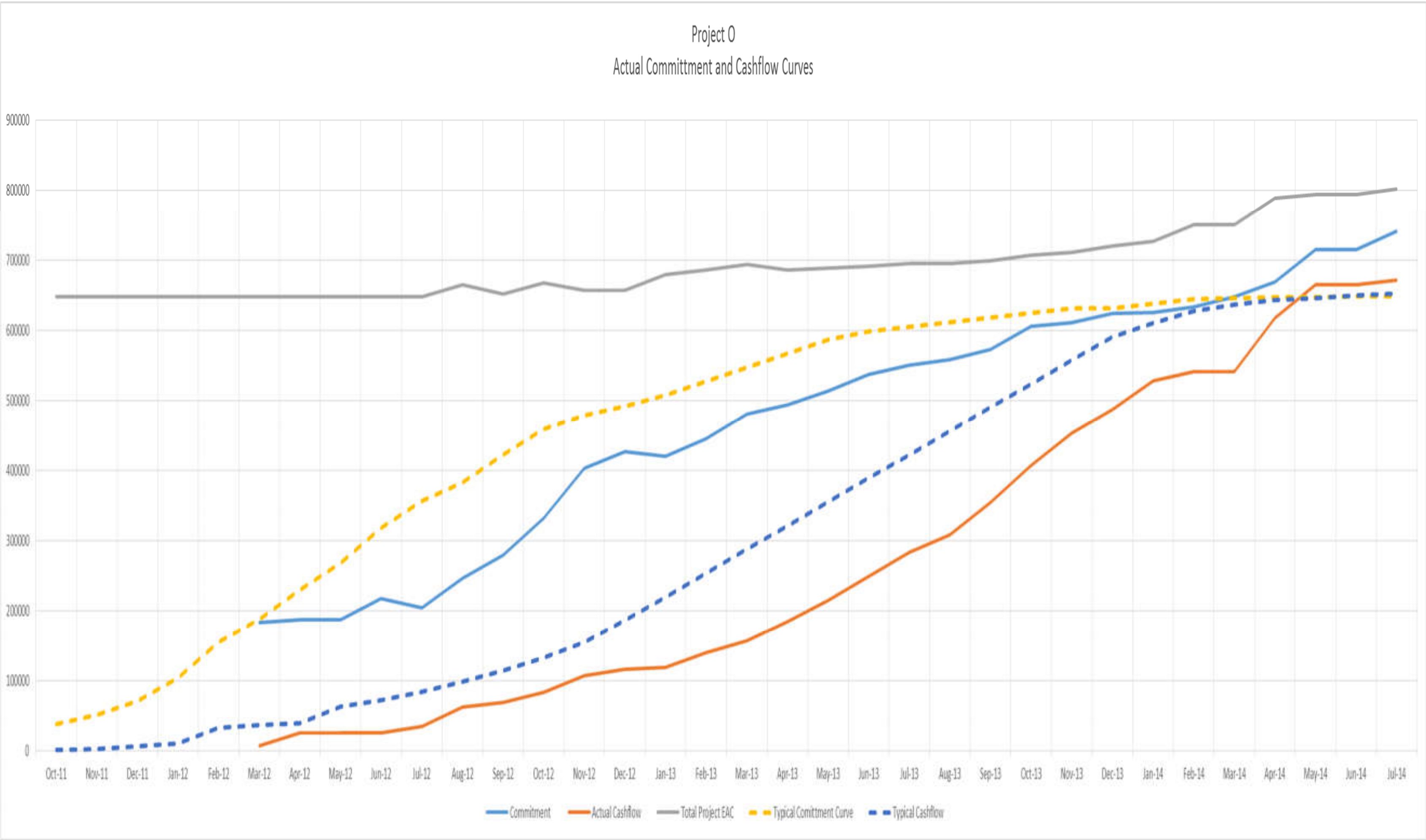
Example 2.

Historical example indicating the engineering completion, the commitment curves and actual progress curves. Procurement progress was not available on this project. Not the leading indicator of the commitment progress data. The final result was a seven-month delay in the completion of the project.



Example 3

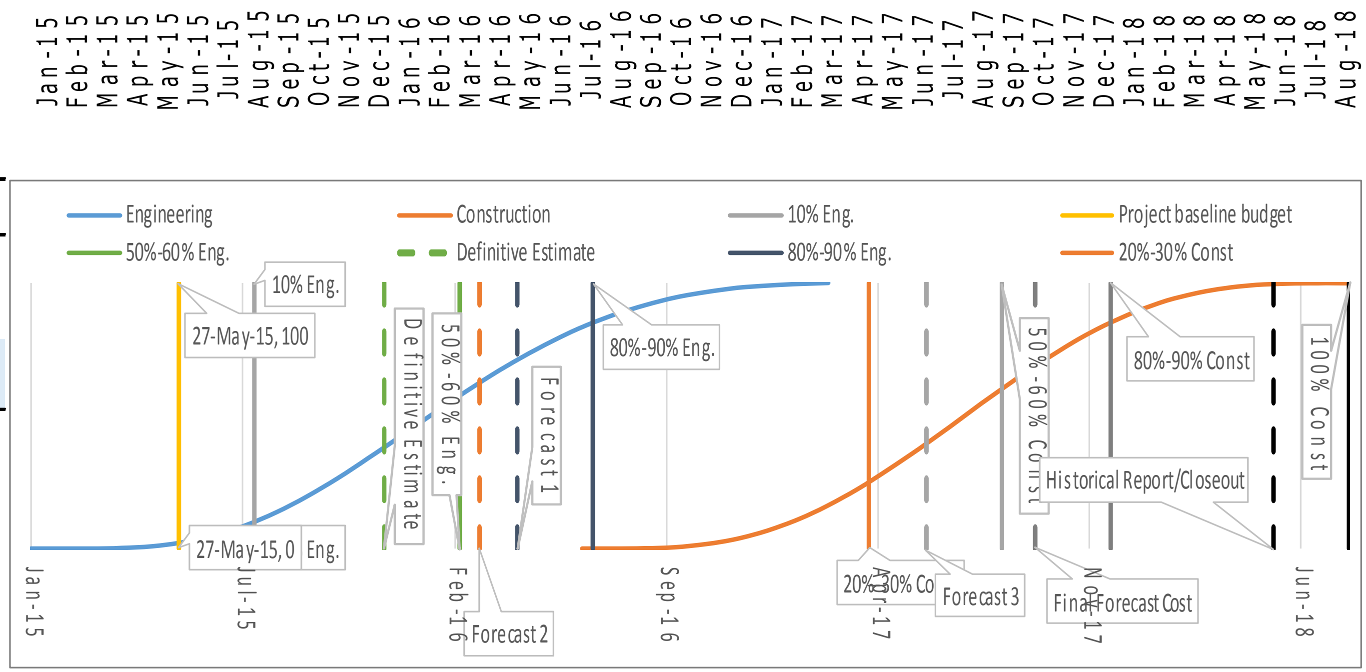
Example of Commitment and Cashflow curves.



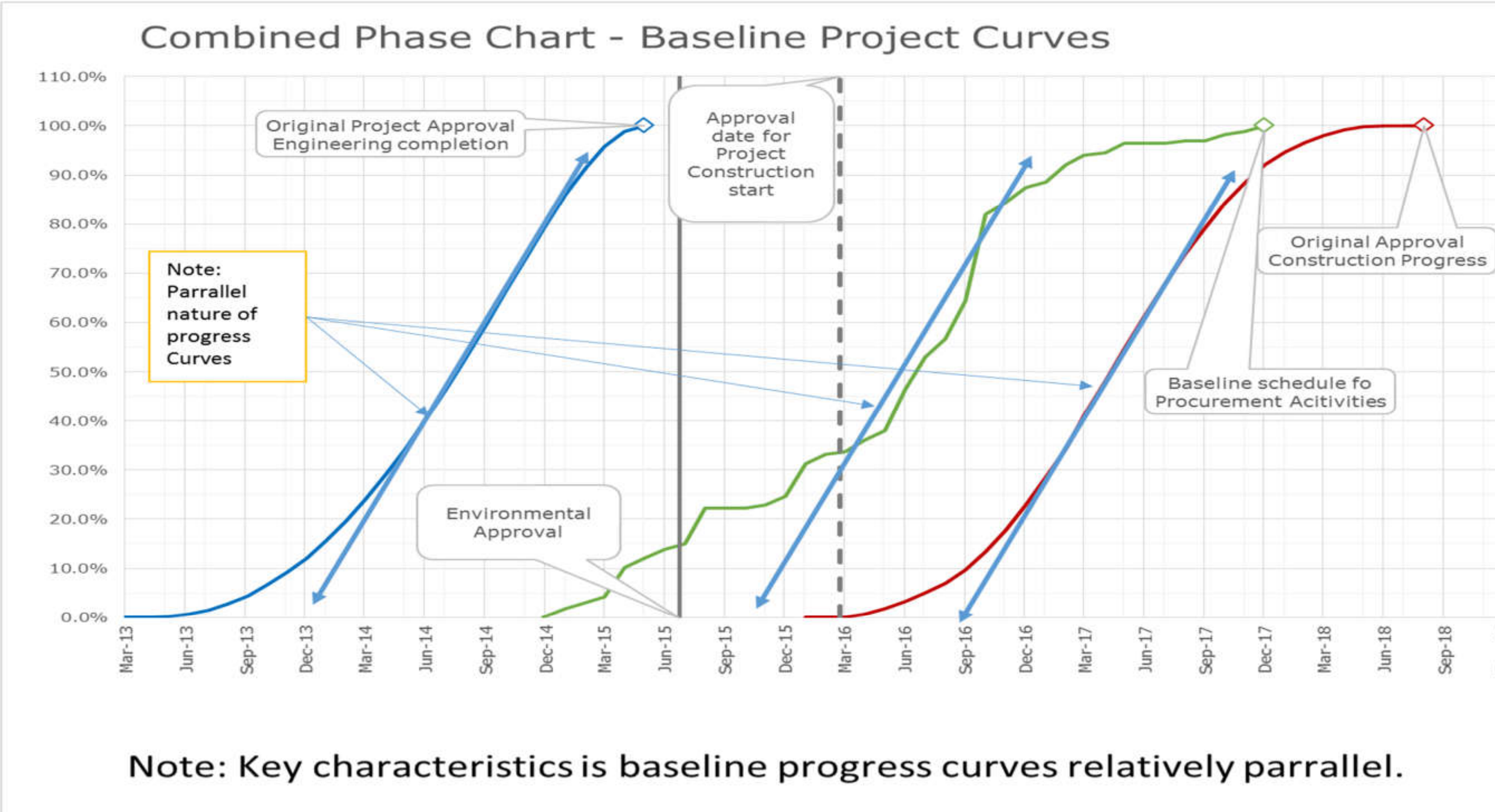
This example for a project clearly shows the effect that the effect that commitments are a leading indicator of project performance and cashflow is a lagging indicator, at least in the first 18 months of the project. In this case the engineering progress was reported as being excellent and on track, when the commitment curves were indicating no progress for 5 months.

Example of utilizing these combined graphics for planning project review timing and events. .

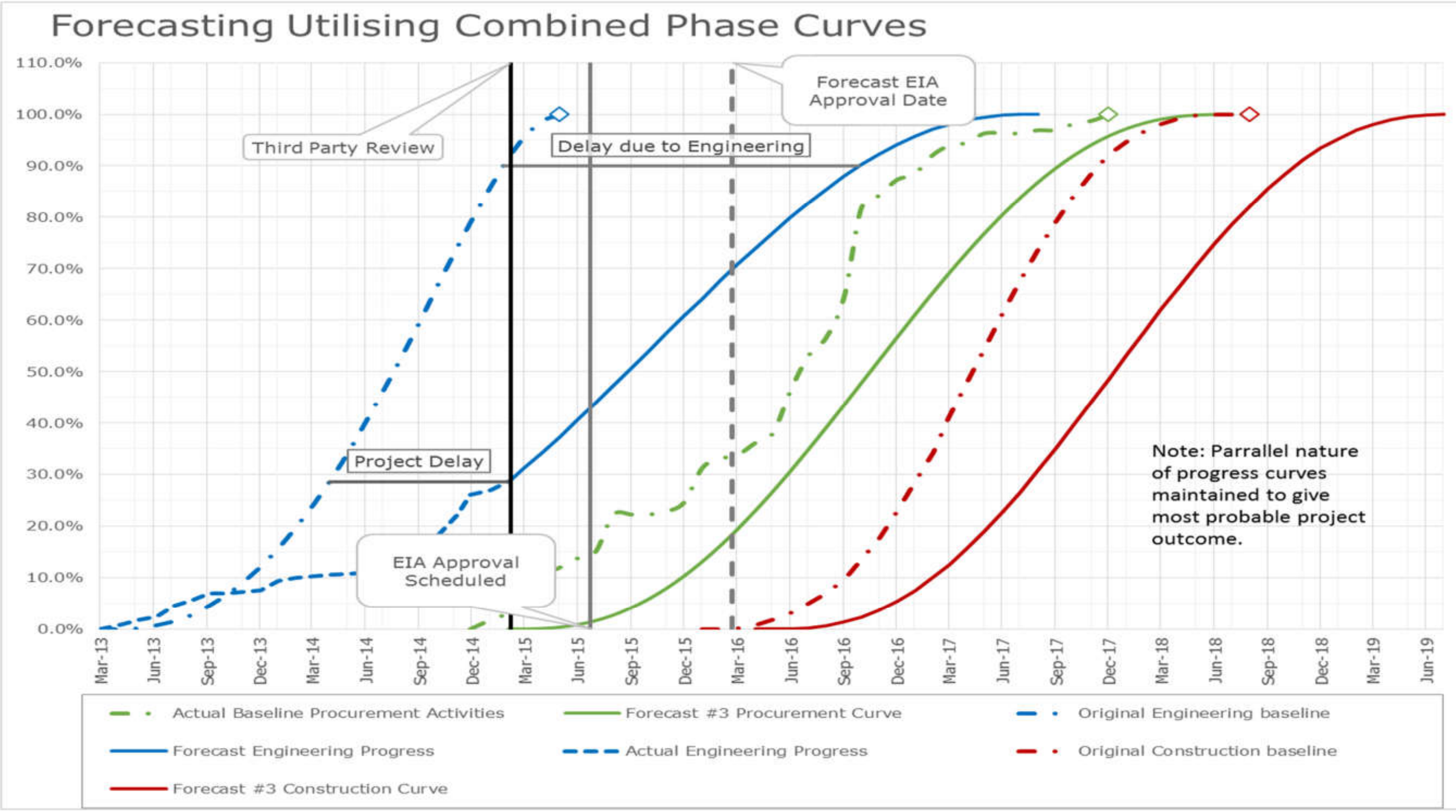
Key Project Events.	Project Review	Critical Milestones
Project A		
Prefeasibilty	01-Sep-14	30-Nov-14
Feasibility	01-Dec-14	01-Mar-15
Project Approval	02-Mar-15	01-Apr-15
Engineering	15-Jan-15	03-Jul-17
Construction	11-Jul-16	01-Aug-18
Project baseline budget	27-May-15	10-Aug-15
Definitive Estimate	17-Dec-15	01-Mar-16
Forecast 1	27-Apr-16	11-Jul-16
Forecast 2	21-Mar-16	11-Apr-17
Forecast 3	06-Jun-17	20-Aug-17
Final Forecast Cost	22-Sep-17	06-Dec-17
Historical Report/Closeout	18-May-18	01-Aug-18



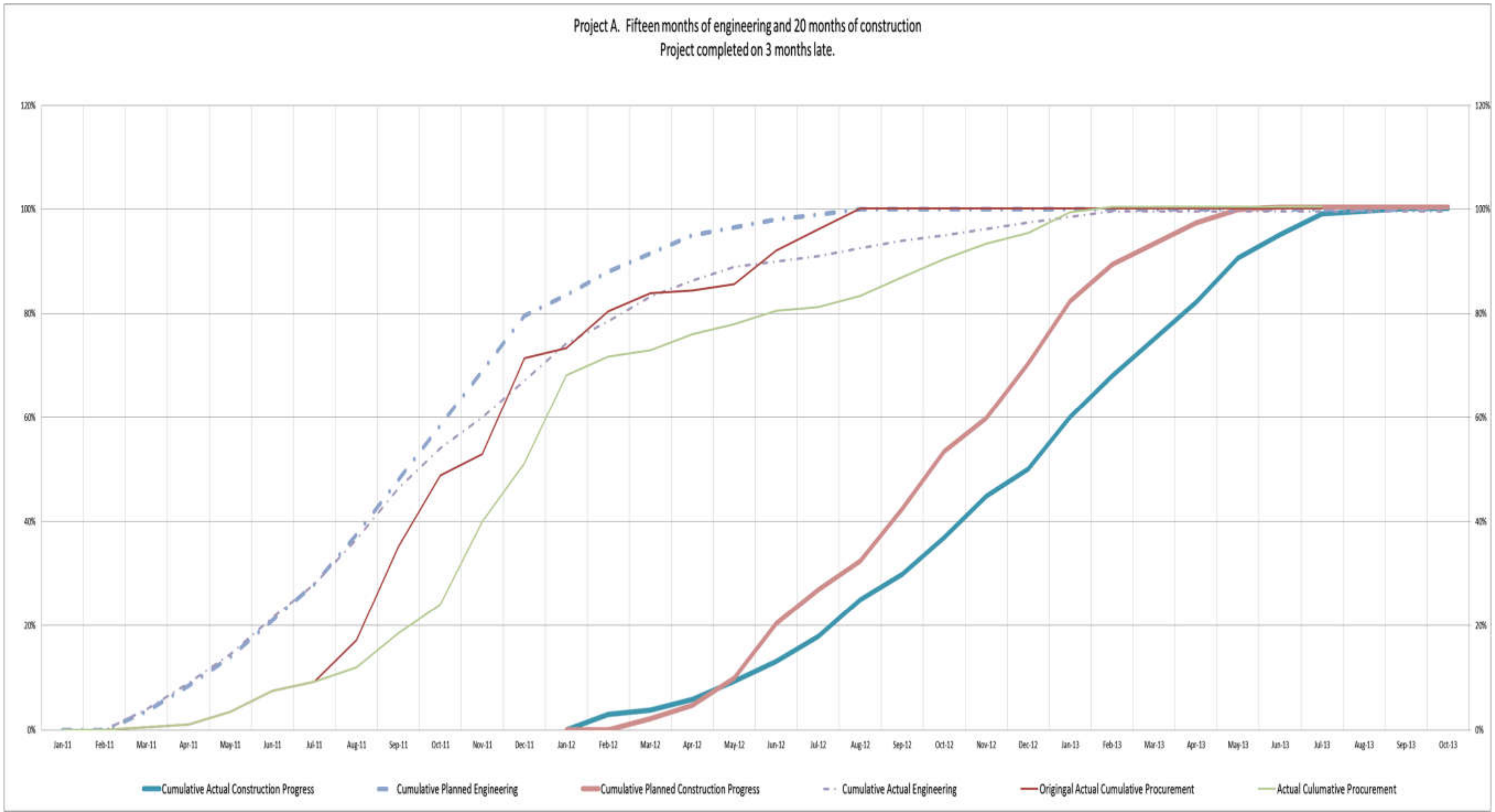
Example of Combined phase curves demonstrating the parallel effect of these curves on project plans.



Actual example of utilizing this data early on in a project to predict probable project outcome.



Example of good project execution with nominal delays in the project and timely execution of engineering progress.



This example indicates in accurate reporting of engineering progress early on in the project, due to the delays in the procurement curves, however these delays were recovered by the time the project was at 60% of Engineering completion which was just as construction was commencing. Note early engineering progress was probably over reported but not significantly so. Furthermore not the rough parallel nature of the progress curves.

Conclusion.

Project controls systems in the current age generate large amounts of data that often overwhelm project controls professionals who work with the data but also their project managers to whom the project control information must be explained. Often the interaction between various phases is a complex issue that is difficult to simply as within a critical path network, which contains engineering and procurement and construction activities, the overall impact of delays can be obscured by the individual issues. This system seeks to give the project controls professional a macro tool for prediction of project delays and project outcomes. This tool was tested on a limited and a large dataset has a high degree of accuracy.

The key criteria for a project delay prediction due to delays in project engineering and procurement is as follows:

- Engineering progress must be over 30% behind the original schedule, once this delay occurs it is very difficult to recover. This sounds like a lot but its only 1 month in 3 months of progress.
- The engineering delay in 95% of project cases, at engineering completion ie 90% of engineering hours, is the minimum delay to the project.
- The minimum delay to the project can be subsequently used in predicting both the contractor's additional costs and the additional indirects for the time related indirect costs. This projected delay date can then be utilized by the owner for owner related management decisions, i.e. mobilization of operations work force.
- This technique can be used in either forensic analysis or as a predictive management tool early in the project.
- This technique when utilized early on gives an accurate indication of the engineering contractor is providing high optimistic reporting on early engineering progress.