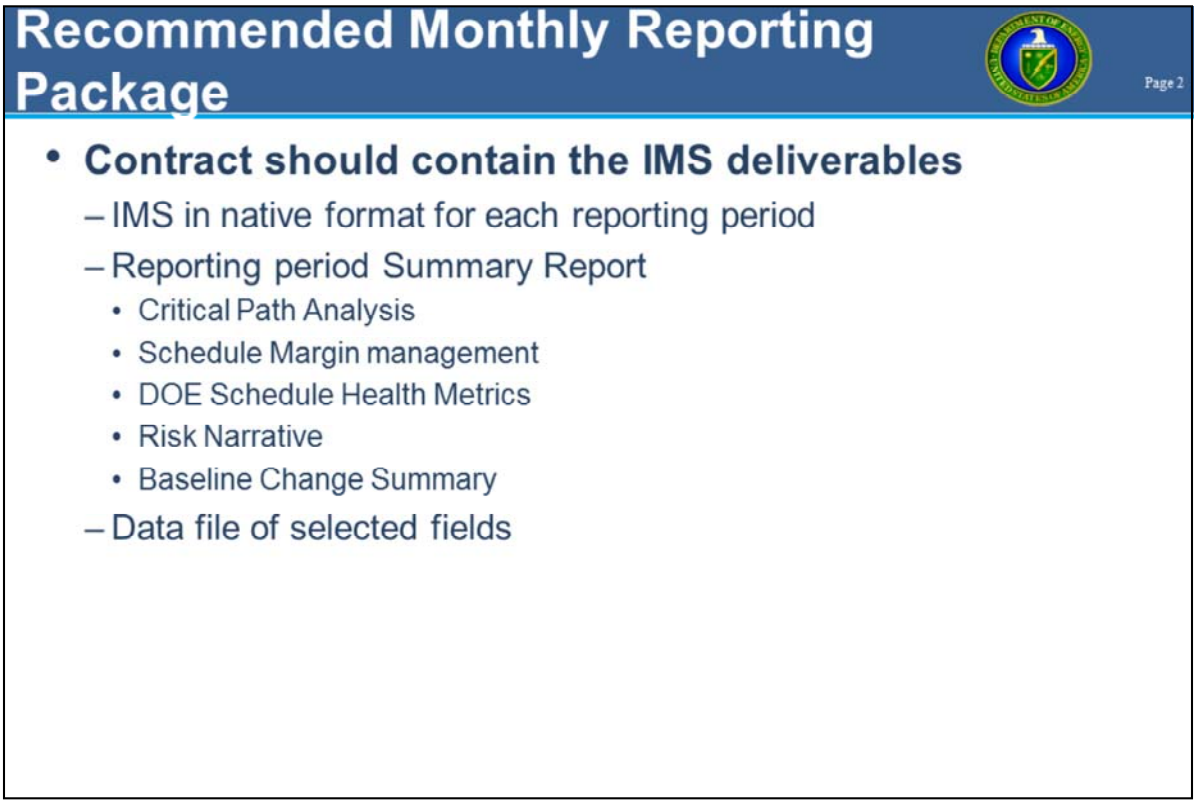
EVMS Training Snippet Library:

IMS Monthly Review

Office of Acquisition and Project Management (OAPM) MA-60
U. S. Department of Energy
July 2014

This EVMS Training Snippet sponsored by the Office of Acquisition and Project Management (OAPM) explores how to review monthly submittals of the integrated master schedule.

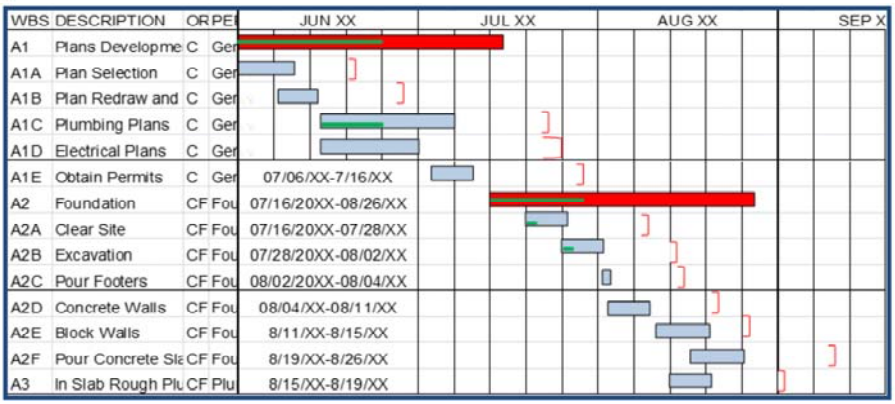


The contract will stipulate the monthly deliverables for the Integrated Master Schedule. At a minimum the native file should be requested to be delivered with the monthly submission of the cost data to PARSII. A narrative should also be requested that discusses the following items; 1) the Critical Path and any changes to the path's contents, dates, and float. 2) If schedule margin is planned on the project, the reduction or increase to schedule margin task durations with an explanation why the durations changed. 3) The DOE schedule health metrics results with any explanations regarding thresholds that have been breached. 4) Changes to risk items (mitigation plans) that have been incorporated into the IMS. This would include the completion of mitigation activities and the results. 5) A listing and summary of Baseline Changes that have been incorporated during the reporting month and the impact to any to major reporting milestones.

Periodically, it may be necessary to request a schedule risk assessment or SRA. This should be requested if there are significant changes to the schedule baseline as in a replan driven by: additional scope, stop work orders or scope reductions, realization of risk, or any other factors that can drive baseline changes that could impact negotiated project milestones. It should also be requested whenever a total project single point adjustment is performed. This SRA may be run only on the critical path or on the near critical paths, if any, depending on the possible impacts to the project deliveries.

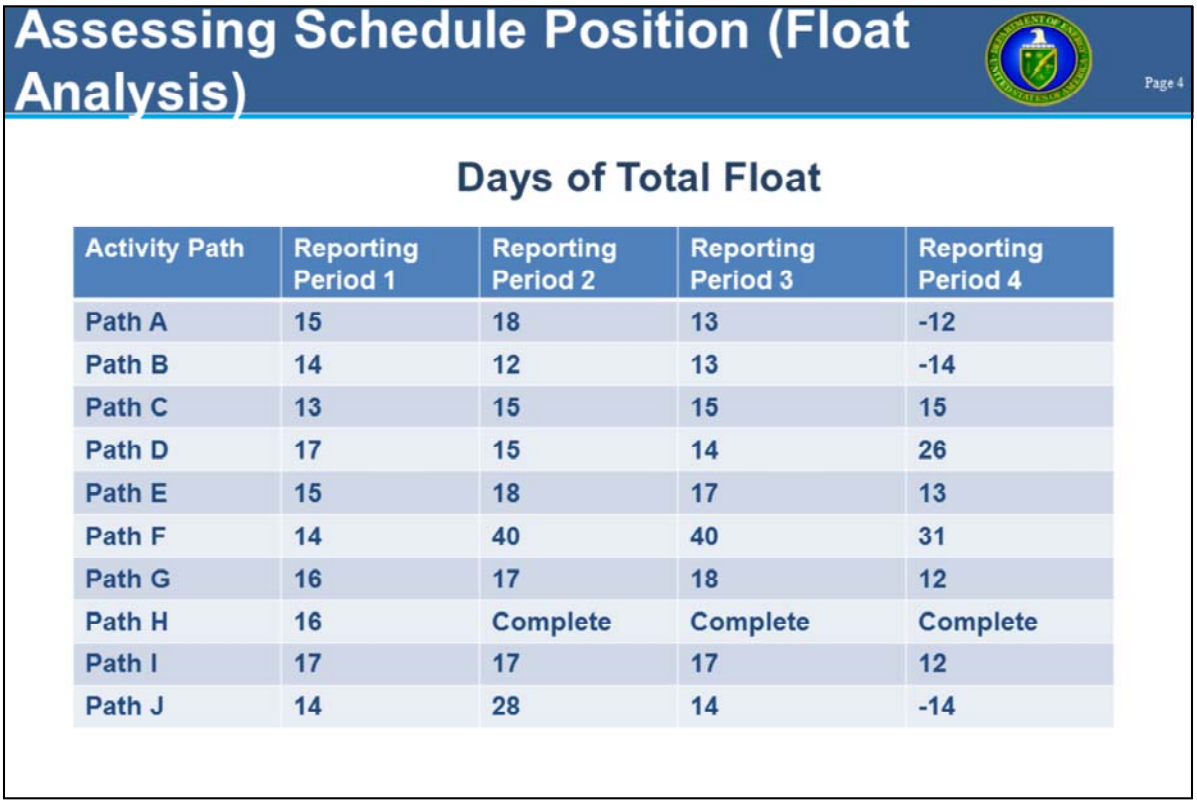
Reading the Schedule Reports

- Float Analysis
- Critical Path Analysis
- Validity Indicators
- Metrics



As we walk through this presentation, we will look at the various ways to review the IMS and understand what the data in the reports represent. The IMS is how the project reports status in terms of time. The current schedule changes every reporting period based on the progress of the project. If a solid and reliable baseline is established and maintained, it creates a basis for predictive assessment / analysis of the project's ability to the meet contractual obligations. It also gives us a basis for management by exception. In other words, we look at the areas in the IMS that require attention based on several factors. It is important to understand that the monthly data is a snapshot in time and as a result, is only a piece of the picture on how the project is actually progressing. Several factors are important to validate the data. These include, but are not limited to, the maintenance of the baseline, quality of the schedule, and the trends in the data that help us to understand the contractor's execution against the baseline.

During this snippet, we will look at several types of schedule data and discuss what they tell us as reviewers. We will look at Float Analysis, Critical Path Analysis and how interpreting Project Critical Path may differ from the secondary critical path(s). We will also look at some Validity indicators; these tell us if what the contractor is reporting passes certain common sense tests. Finally we will look at some Indices and other metrics that indicate when we should ask questions.



Activity Path	Reporting Period 1	Reporting Period 2	Reporting Period 3	Reporting Period 4
Path A	15	18	13	-12
Path B	14	12	13	-14
Path C	13	15	15	15
Path D	17	15	14	26
Path E	15	18	17	13
Path F	14	40	40	31
Path G	16	17	18	12
Path H	16	Complete	Complete	Complete
Path I	17	17	17	12
Path J	14	28	14	-14

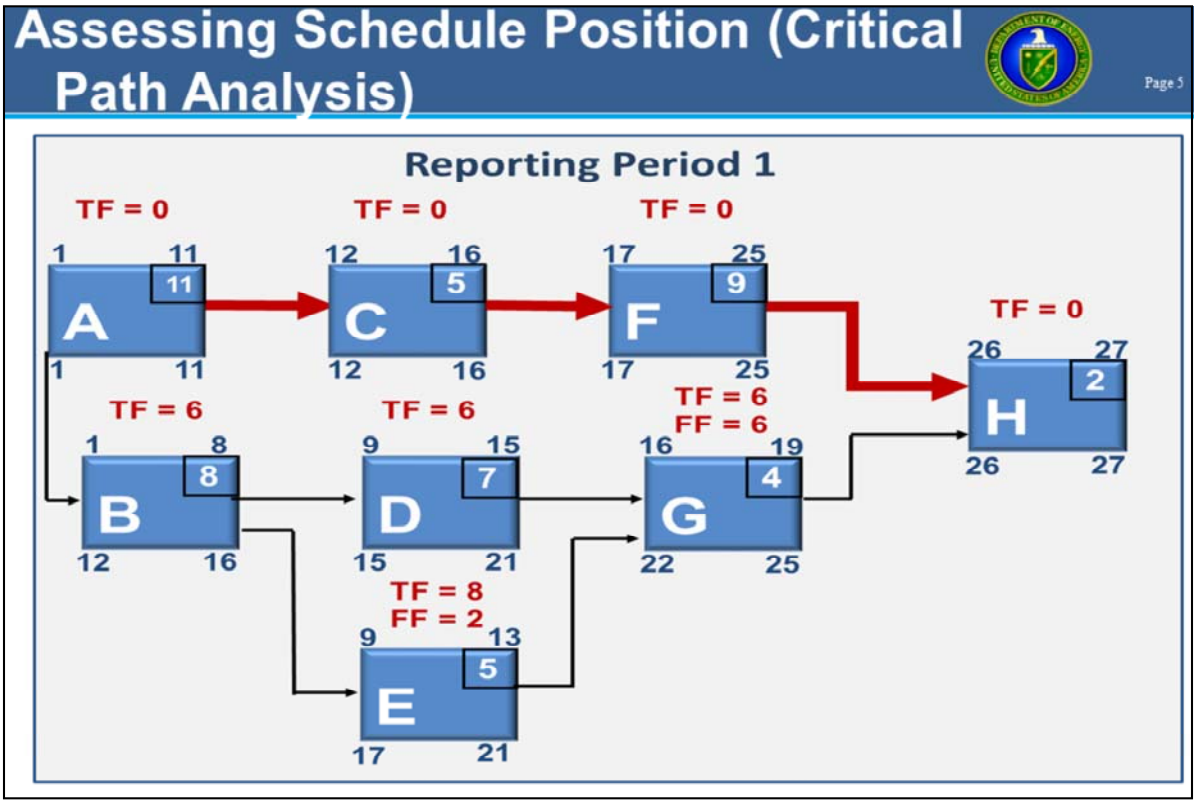
Float Analysis is one of the keys to understanding how the project is progressing and whether the schedule dates will be achieved. Float analysis can be done on 2 levels. First at the activity level where the float is monitored on an activity by activity basis, for large complex networks this can very time consuming with little benefit to our management by exception rule. As a result, the best method is to identify several paths through the network, or secondary critical paths. These should be identified and in most cases will terminate with an important project interim milestone or delivery. Monitoring only the project critical path does not provide the insight into what may be changing, and what deliverables may be late as these deliverables may not be on the project critical path. The most important paths, on which management should concentrate attention if the criterion of least Total Float is used, can vary from reporting period to reporting period. This is typical, since concentration on the most critical activities paths often results in their improvement while other activity paths lose float and become more critical. This is why it is important to monitor not only the paths with the least amount of float, but also those that show degradation in float.

In our example we are looking at 10 individual paths through the network. Each path represents milestones that have been identified as critical to the project, and as a result require close attention by management. As we walk through the reporting periods, we will see that the priorities can change based on project status.

In the first week of reporting, the path with the least amount of float is path C with 13 days of positive float. Based on the status of the project, in the second week we see there is a change in the path with the least amount of float, Path B with 12 days. In our third reporting period we see that paths A and B are now tied for criticality, but are they the only ones we should focus on? What about Path J? The float has degraded by half. This would indicate a need to focus on this path as well. There are probably major issues involved that require attention. Reporting period 4 indicates that Path J is still in trouble, it is tied with Path B and

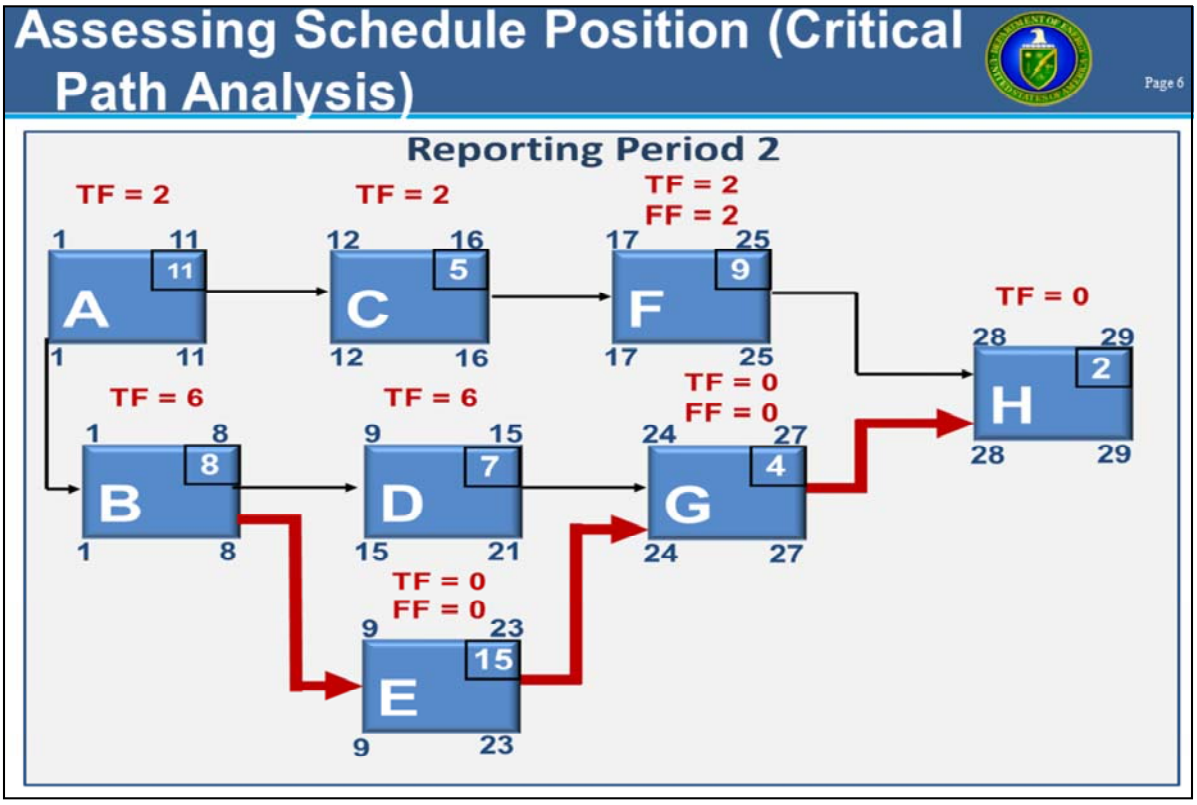
both seem to be falling behind at an equivalent rate. Path A, while not the path with the most negative float, will require attention as the trend shows it is losing progress almost as much as Paths B and J.

If the contractor does not report the top 10 paths, simply sort the schedule by minimum float and select the top 100 tasks. This will likely be several paths if the float varies. Then each month repeat this exercise. If a task leaves the top 100 it means the float has improved. New tasks in the top 100 are tasks increasing in risk. For the remainder, we will see changes in float from the previous period to the current period.

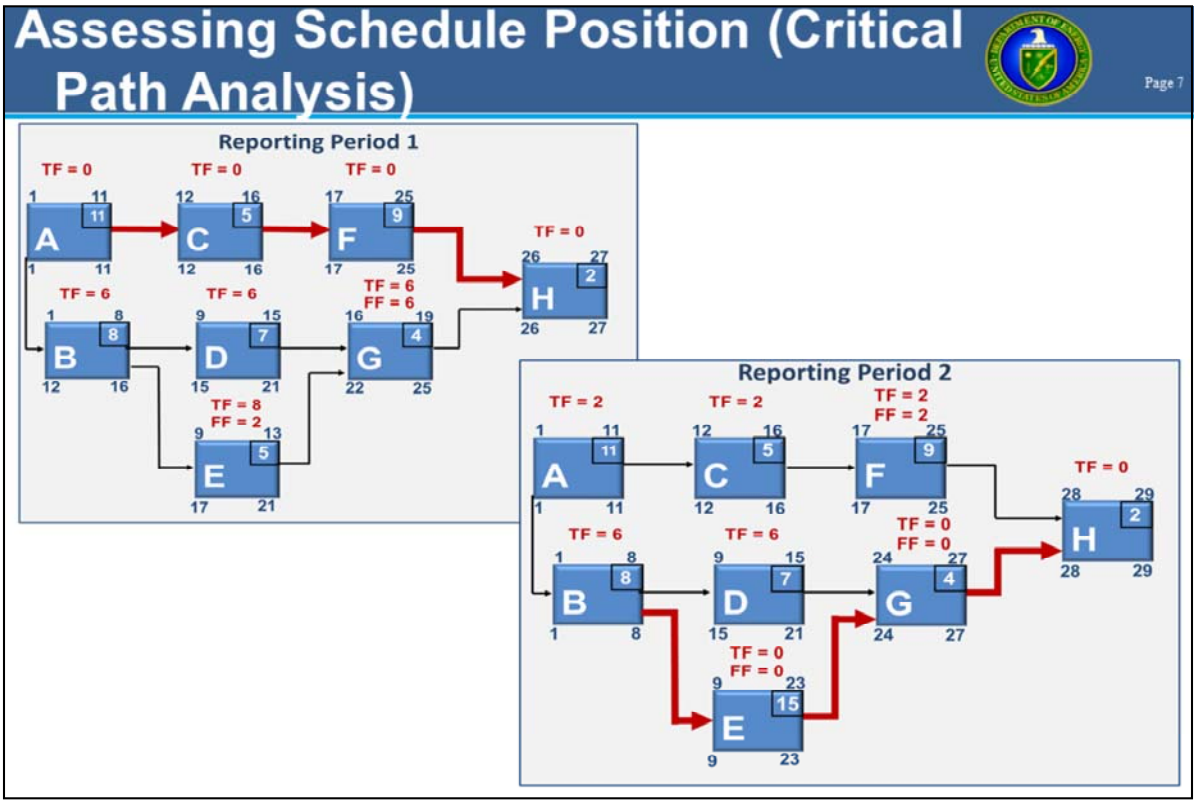


The Project critical path is defined as the longest contiguous path through the network or the shortest amount of time in which the project can be completed. At baseline establishment, the critical path is usually the path through the network with zero float. This analysis tells us when we can expect the project to complete and which activities in the schedule are driving the completion. This path should be monitored each reporting period and may change based on progress. Explanations of changes to the critical path content should be provided by the contractor in a summary report with the IMS submission. It should be noted that one of the DOE health metrics analyzes the validity of the critical path. This metric should be performed on each reporting period submission to ensure the critical path is maintained with solid logic and has not been distorted by use of lags or constraints.

In our example, in the first reporting period we see that path A-C-F-H has zero total float. This is the critical path in the first reporting period as designated by the red arrows. Our next longest path is B-D-G-H with 6 days of total float, and our 3rd path of B-E-G-H has total float of 8 days. The completion date of the project is day 27 as noted on activity H.

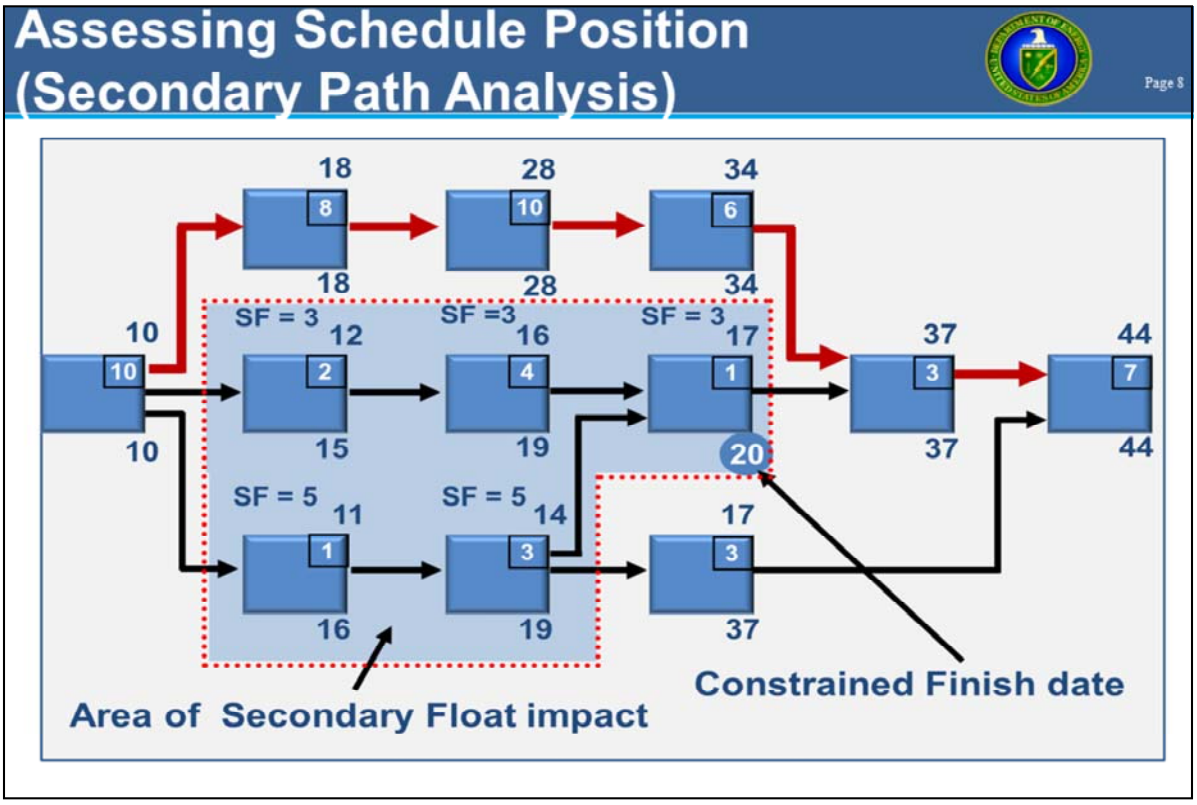


In the submission for our second reporting period, Activity E is now forecasted to have a duration of 15 days instead of the original 5. As a result, the critical path is now B-E-G-H as noted by the red arrows. Please note also that the completion date of the project is now day 29 instead of day 27. Had we constrained that date we would be showing negative float of 2 days. With activity E as our driving activity we should focus on this activity and it's successors in discussions with the contractor.



So what are the questions we should ask? First, what caused the forecast for activity E to increase to 15 days? Second, what are the possible mitigations that can be implemented to bring our project completion date back to 27 days? With the short durations of the successor activities it is unlikely the contractor will be able to make up the time by reducing these. Options for mitigation may include shortening the duration for activity E by adding resources, or running parallel with activity G although this might introduce technical risk.

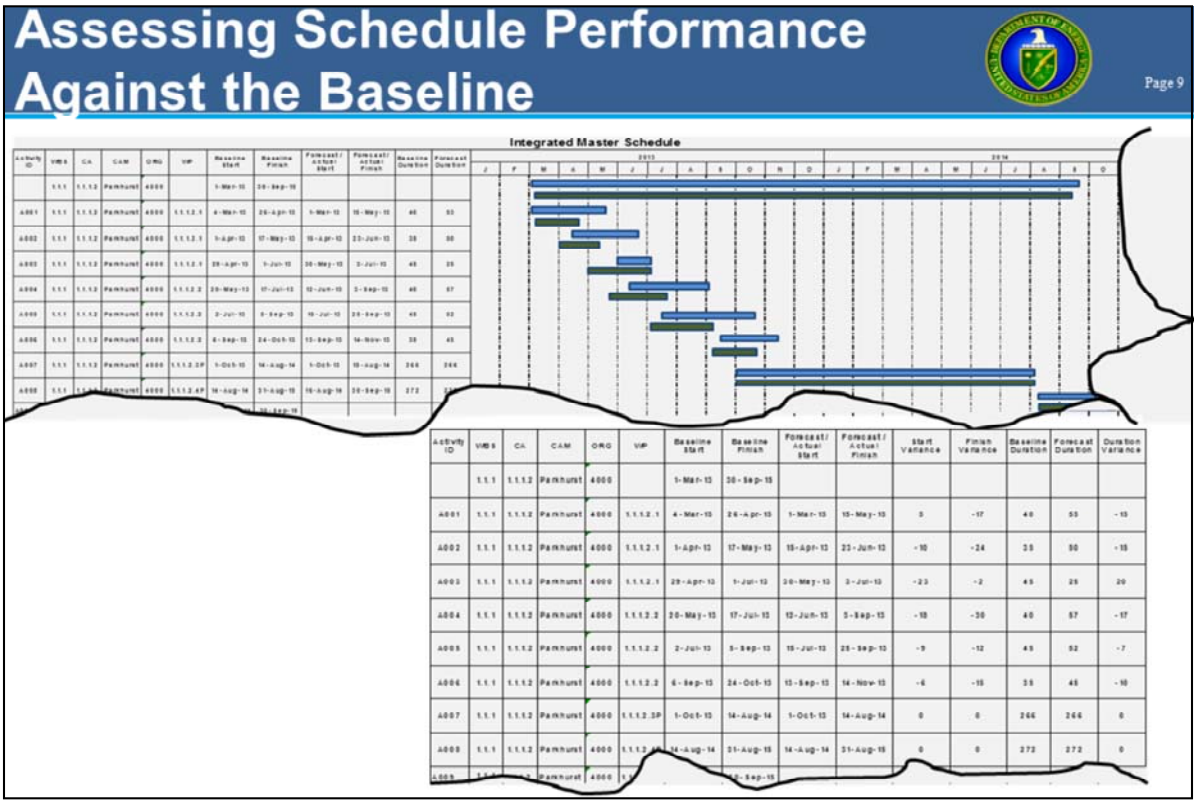
As our monthly analysis of the critical path example illustrates, we first need to determine if there has been a change. The change may be to the duration of our original path or a change to the activities that are now the critical path. Either way we should be aware of what has changed. Second, we need to understand what activity or activities are driving the critical path. And finally we need to understand what mitigation steps the contractor can take to get the critical path back on track. Breaking logic should not be permitted to “fix” the problem. If the original baseline established activity G as a successor to activity E, there was probably a reason for this logic and it should not be changed unless the contractor can establish a viable reason to do so. Nor should the reduction in duration of future activities be used as a solution.



As was demonstrated earlier in the float analysis, it is important to monitor not only the project critical path, but the secondary or near critical paths as well. This is accomplished by placing a constraint on the activity or milestone that represents a contract deliverable or important event that occurs at interim points in the project life cycle. In our example, we see a constrained date of day 20 has been placed on the last activity in our secondary path.

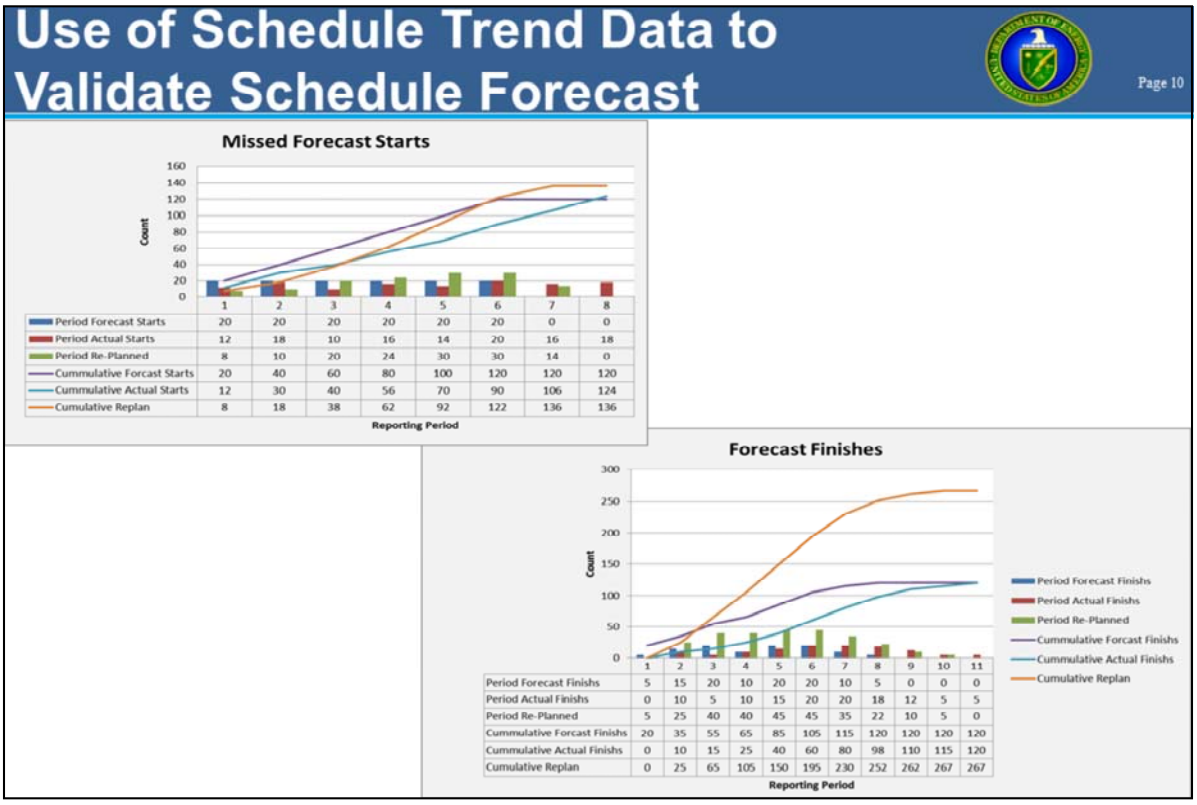
Since there are 2 converging paths to our constrained activity, the secondary float will have to be watched along both of the paths. It should also be noted that a slip of 3 or more days to the secondary path will only impact the deliverable we are monitoring but not the critical path of the project. The use of the secondary path constraints should be carefully applied. Soft constraints should be used for the calculation of secondary float.

As was shown in our critical path example, impacts to these secondary paths can be driven by changes to durations of the activities and some assessments should be made as we do with the critical path. The impact should be traced to the driving activity or activities and the contractor needs to explain why the impact occurred and what the mitigation strategy is for avoiding late delivery.



Assessing schedule performance against the baseline must look at several factors. These include a comparison of the actual and forecast start and finish dates against the baseline start and finish dates, the baseline duration against the actual and forecast durations, and current float values against baseline float values. There are 2 basic ways in which this information can be viewed: Graphically in a bar chart with columns and in a tabular format. Later in this snippet we will discuss 2 of the schedule performance metric indicators that look at this data in a different way. These are the Missed Tasks analysis and the Baseline Execution Index (BEI).

A general warning - Finish dates, Missed tasks, and BEI all look whether activities are being performed in accordance with the baseline schedule. They are not assessing if the right work is being done. Float changes are combined with these metrics to see if both the baseline is being accomplished and the right effort is being prioritized.



The IMS forecast is used as the basis for the project estimate to complete or ETC, which when combined with actual costs to-date will give us the Estimate at Completion or EAC. The time remaining on the project and the resources needed to complete the work as forecasted drives the accuracy of the EAC. The IMS is used not only to tell us where we are on the project but also where we will finish, in time and in required resources to execute the remaining effort. Therefore, there needs to be confidence in the contractor's ability to provide accurate estimates or forecasts on the remaining activities.

For this trend analysis we look at both the forecast start and finish dates and changes to those dates. Since this needs to be an apples-to-apples comparison, a total count of activities will not give us the data we need to determine the validity of the forecast; instead we need to look at the forecasts at the activity level. Once again in the interest of 'by exception' reporting, we should look at only those activities that fall into the 'current execution' window that are not being performed to the baseline. Let's look at our first chart, Missed forecast starts. In this chart we look at the activities that have missed the forecast start date. We also look at the activities that have been re-forecast in the reporting period with a new forecast start date. As we can see from our example, the contractor is continually missing the forecast start dates for the current reporting period.

A trend where we see the missed re-planned forecast start as later than the missed forecast start dates indicates the initial forecast start dates were not realistic. This means either the forecast finish of predecessor activities were inaccurate or the start dates of the activities were simply being moved to the data date with each advance of the effective date of the schedule. Notice how in the last 2 reporting periods we have no initial forecast start dates. This would seem to indicate that the schedule was not updated, we have missed the

forecast dates for those two reporting periods, or we are two reporting periods behind in our forecast start and the accuracy of the start forecasts is only 88%.

Our second chart, the Forecast Finishes looks at forecast finishes on the in-progress activities that are not meeting the forecast finish dates. This chart, more so than the start dates chart, shows the possible impact to the accuracy of the EAC. As with the start date, we track the initial forecast finish date against the actual finish dates. In our example, we see in the first reporting period we have 5 activities that missed the baseline completion dates and have required a re-planned forecast date. As with our missed forecast starts, we see the trend of required re-forecasting indicates the contractor is either inaccurate on forecasting completion dates or allowing the activity completion to be driven by the data date. Notice the last 3 reporting periods have no initial forecast finishes. This would indicate the project is 3 reporting periods behind schedule and with our final numbers we see the accuracy of the initial forecast finishes is only 45%.

Using this type of trend data helps us to determine the contractor's ability to accurately forecast the start and completion dates for activities that have missed baseline dates, and as a result, can affect the accuracy of the project EAC. When the missed forecast trend indicates missed forecast dates, the contractor's schedule status process should be reviewed.

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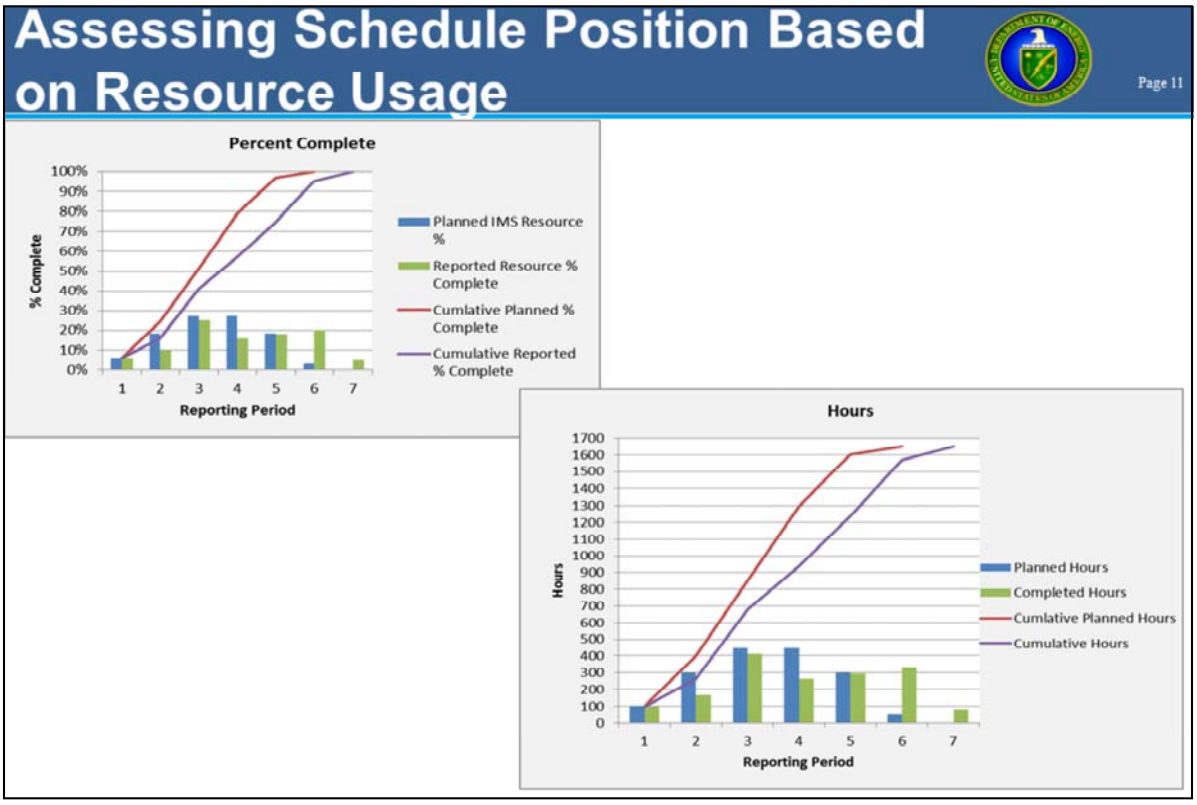

Assessing resource usage is a means of indicating the accuracy of the IMS reported progress and the accuracy of the ETC. This should be done no lower than the work package level. Often contractors will use the duration percent complete as the resource or earned value percent complete. This only works if the resources are leveled to have an exact amount for resources in each reporting period. This almost never occurs as the number of working days in each reporting period will vary based on fiscal months and holidays. Also if the contractor is using a resource percent complete, this should be compared against the planned resources to provide an indication of schedule slippage. In our example, we are looking at a labor work package in both a percent complete format and an hour format. The resource percent complete is falling behind the plan. This would indicate that either the contractor is going to add more resources to maintain schedule or the forecast for the work package activities should indicate a slip in the baseline schedule.

Either way, when there is a divergence in the reported percent complete of resources from the planned percent complete of resources, the contractor should be able to demonstrate an increase in resources (and an increase to the EAC) to recover schedule or a forecast finish equivalent to the resource variance, which will also increase the EAC.

It should be noted in this situation that when looking at materials there may not be an impact to successor activities if the material values are planned at receipt and not at consumption. As a result, materials may not have the same impact as labor.

Other Schedule Trend Data (Durations, Lags)

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Activity	Baseline Duration	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Baseline Lag	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
A0100	10	10	10	5	5	5	5	5	5	5	0	0	0	0
A0105	20	20	20	18	18	18	18	10	10	10	0	0	0	0
A0110	40	40	40	40	35	35	30	5	5	5	5	0	0	0
A0115	15	15	15	15	15	15	15	0	0	0	0	0	0	0
A0120	20	20	20	20	15	15	15	0	0	0	0	0	0	0
A0125	45	45	45	45	40	40	35	5	5	5	0	0	0	0
A0130	40	40	40	40	40	40	40	2	2	2	2	2	2	2
A0135	266	266	266	260	260	255	250	0	0	0	0	0	0	0
A0140	272	272	272	272	267	267	267	0	0	0	0	0	0	0
A0145	260	260	260	260	255	250	250	0	0	0	0	0	0	0

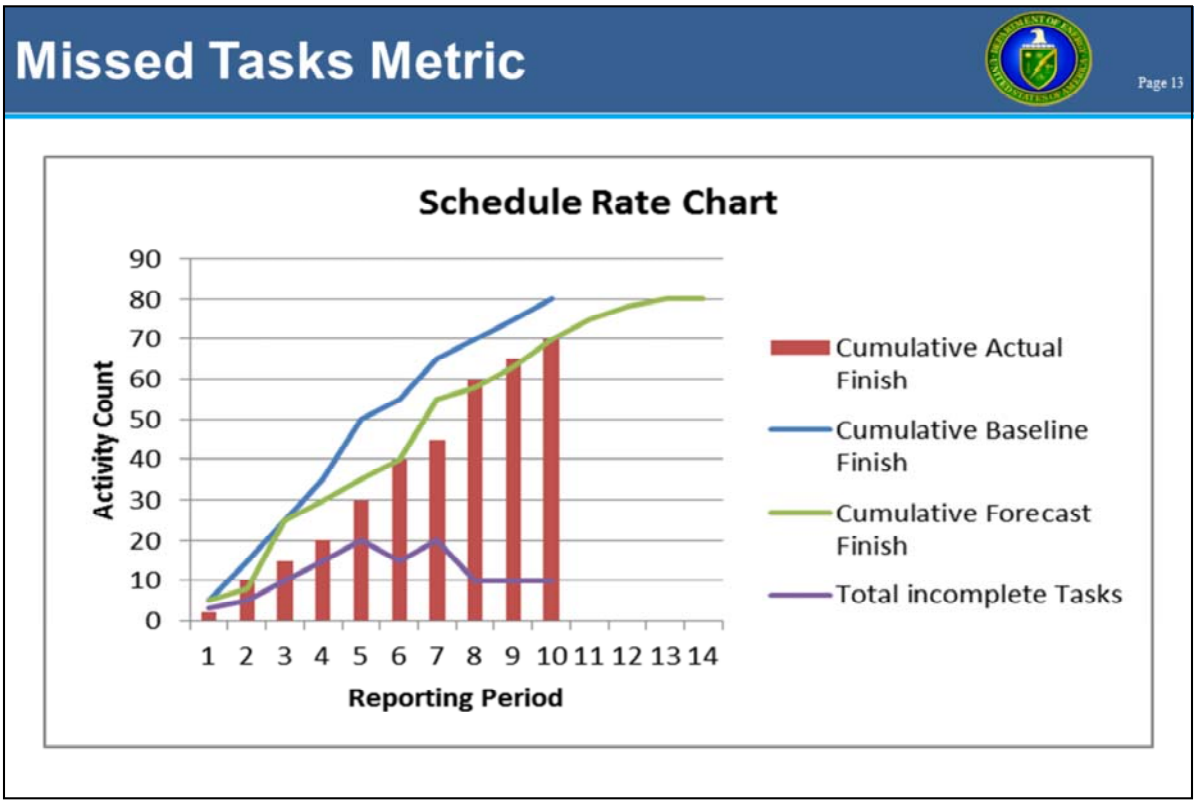
Indicates Change from Baseline Value

- **Analysis on future not started activities only**
  - Planning Packages in particular
- **Monitor Baseline Changes for Duration adjustments**
  - Without Scope Reduction
  - Resource Increases

Looking at the changes in durations and lags can help us understand if the contractor is decrementing either of these to report a better schedule position than is realistic. If a trend is noticed to duration changes in future activities, this could indicate the contractor is reducing the time it will take to complete future work scope in order to maintain an on schedule position. This will create a bow wave effect that will not indicate if the contractor is in trouble until it is too late to remedy the situation. Questions should be asked if there is an indication that the future activities are being shortened in duration.

Lags are often used as a means to build margin or schedule reserve into the schedule. If these lags start to decrement and go to zero, the chances of the future activity durations being adjusted to maintain schedule position will increase.

In our chart, the highlighted activities are those that have changed from the initial baseline values, and should be explained by the contractor.

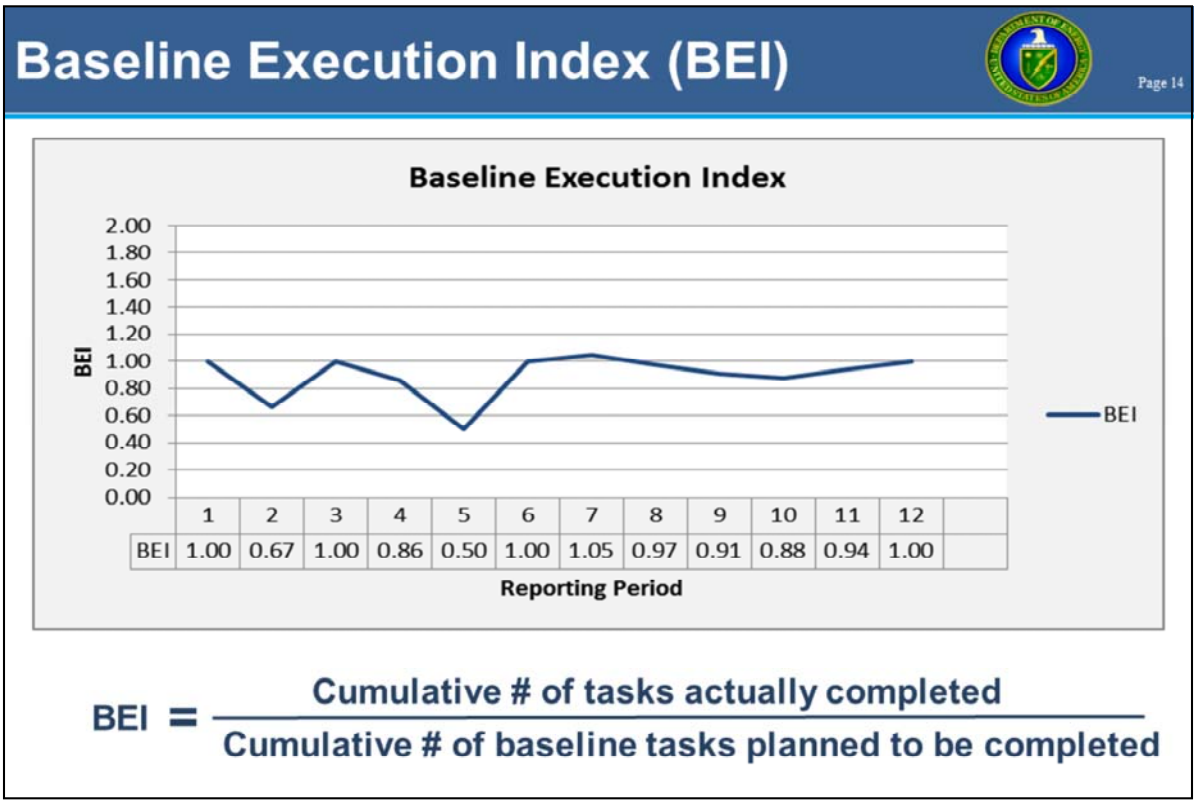


The baseline missed tasks can be reported in several ways. For this training we will use the Schedule Rate Chart as defined in the Planning and Scheduling Excellence Guide or PASEG created by the NDIA. This metric is graphically displayed and can monitor the entire project or if desired, secondary critical paths to important project milestones, control accounts, or any other meaningful areas of assessment in the IMS.

The chart looks at the cumulative data for the Baseline Finishes, the Actual Finishes and Forecast finishes. It also looks at the current period unfinished tasks or missed tasks. As you can see from the forecast finish data, we are going to be 4 reporting periods behind schedule on the project. We can also see that our forecast finish dates are reasonable in the fact that the cumulative actual finishes for this reporting period, period 10, are not falling below the actual finish date as it appears to have happened in reporting periods 1 through 5 and reporting period 7.

The total incomplete tasks looks at the period tasks that were planned to be completed against the actual completed tasks. In this graph the trend indicates the contractor is working a recovery in period 6 and again in periods 8 through 10. If the recovery trend continues you should see a change to the cumulative forecast finish.

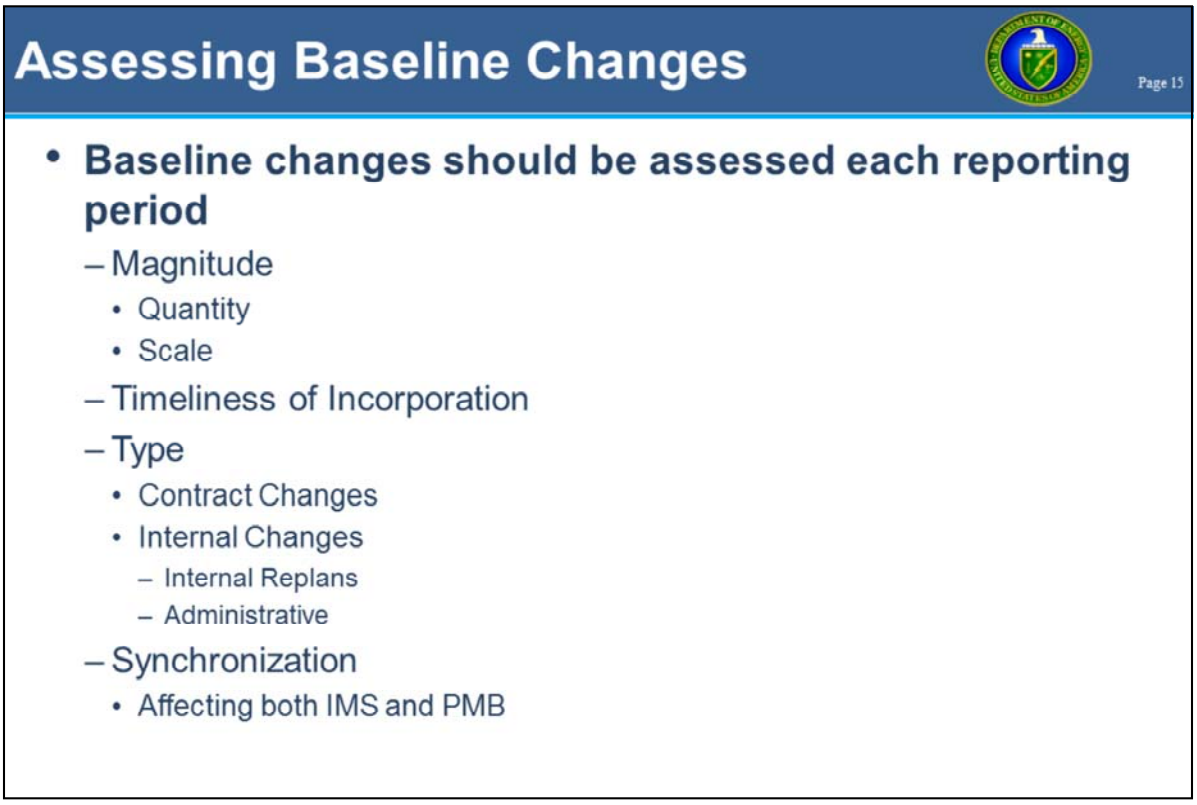
While charts like these are good for viewing statistical data of how program execution is progressing against the program baseline, it is important to remember they should only be used as indicators. A true analysis of schedule position can only be done by looking at the critical and near critical paths in the network.



The Baseline Execution Index looks at the ratio of actual completed tasks as compared to the baseline tasks. In this trend chart we see the contractor's BEI is erratic. In period 5 the BEI takes a noticeable drop to .50. When things like this happen it is advisable to ask the contractor what created this occurrence and if there were unidentified risks that caused a lack of progress. Also notice how in reporting period 6 the BEI makes a dramatic recovery. This could indicate the Contractor has done an internal replan, gone to an Over Target Schedule or has gotten contract relief. Whatever the cause it should be explained in the summary report or at project reviews.

As stated earlier, while charts like these are good for viewing statistical data and trends of how program execution is progressing against the program baseline, it is important to remember they should only be used as indicators. A true analysis of schedule position can only be done by looking at the critical and near critical paths in the network.

This metric is best in the first 75% of the project when sufficient remaining time exists for possible corrective actions. A variation is to calculate BEI on current period data. This metric is valid anytime in the project completion cycle.



Changes to the IMS baseline should be assessed on a monthly basis, and the magnitude of the changes assessed and understood. How many changes is the contractor processing? Is the number of changes appropriate for the current phase of the program? At program start up there are usually a significant number of baseline changes. These may be caused by more detailed planning, beyond the current window, as requirements become more clearly defined. While if the project is in a later phase, the change activity should decrease. The scale of the changes also needs to be taken into consideration. Are baseline changes confined to a few Control Accounts or do they impact the entire project? Baseline changes can impact the metric data that we reviewed earlier so it is important to understand how changes can affect the analysis.

Timely incorporation of baseline changes is imperative to maintaining a good reporting baseline. For example, if new approved work scope is not incorporated prior to starting the work, resources could be diverted from the already planned task which may cause a reported schedule slippage against the baseline that is not real. It is important to monitor the contractor's baseline change process to ensure reporting is accomplished against an up-to-date baseline.

There are two basic types of baseline changes: External / Contract changes and Internal / contractor driven changes. The main focus for review on a monthly basis is to monitor the internal changes initiated by the contractor. Internal replans should be closely reviewed to ensure the contractor is not changing the baseline to alleviate schedule performance issues. A majority of internal replans should be associated with rolling wave planning, or the conversion of planning packages to work packages. Administrative changes are those that correct clerical errors in coding structures or change assignments of responsibility.

Another important aspect to monitor is that the incorporation of changes to the PMB, or the cost baseline, and the IMS occur in the same reporting period. If these are not synchronized, the work scope cannot be properly managed in terms of time and cost. A mismatch of the period of performance in the two systems can invalidate the data from both.

Reviewing Alignment of Performance Reported in IMS and EV Cost Subsystem

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Activity ID	Period 1			Period 2			Period 3		
	Schedule Duration % complete	Schedule Physical % complete	EVM Cost Engine % Complete	Schedule Duration % complete	Schedule Physical % complete	EVM Cost Engine % Complete	Schedule Duration % complete	Schedule Physical % complete	EVM Cost Engine % Complete
A0100	10	10	10	30	20	20	50	40	40
A0105	0	0	0	0	0	25	25	25	50
A0110	50	45	30	75	60	50	100	100	75

- By activity compare IMS Physical % Complete to EV % complete
- By activity look for EV % complete with no IMS % complete
- By activity Look for IMS % completes with no EV % complete
- If there are differences, there are integration problems

A comparative look at the performance in the IMS in comparison to the performance in the PMB, or cost baseline, is required to ensure the two reporting systems are using the same status for reporting progress against the baseline plan. Since we need to make an apples-to-apples comparison, the period of performance, the resource types, and resource time phasing in both systems must be aligned. Looking at this comparison helps us to verify the basis for both the cost and schedule reporting as well as highlight potential problem areas where the two systems may not be synchronized. Or, where schedule status may be reported based on the passage of time rather than the actual accomplishment of work.

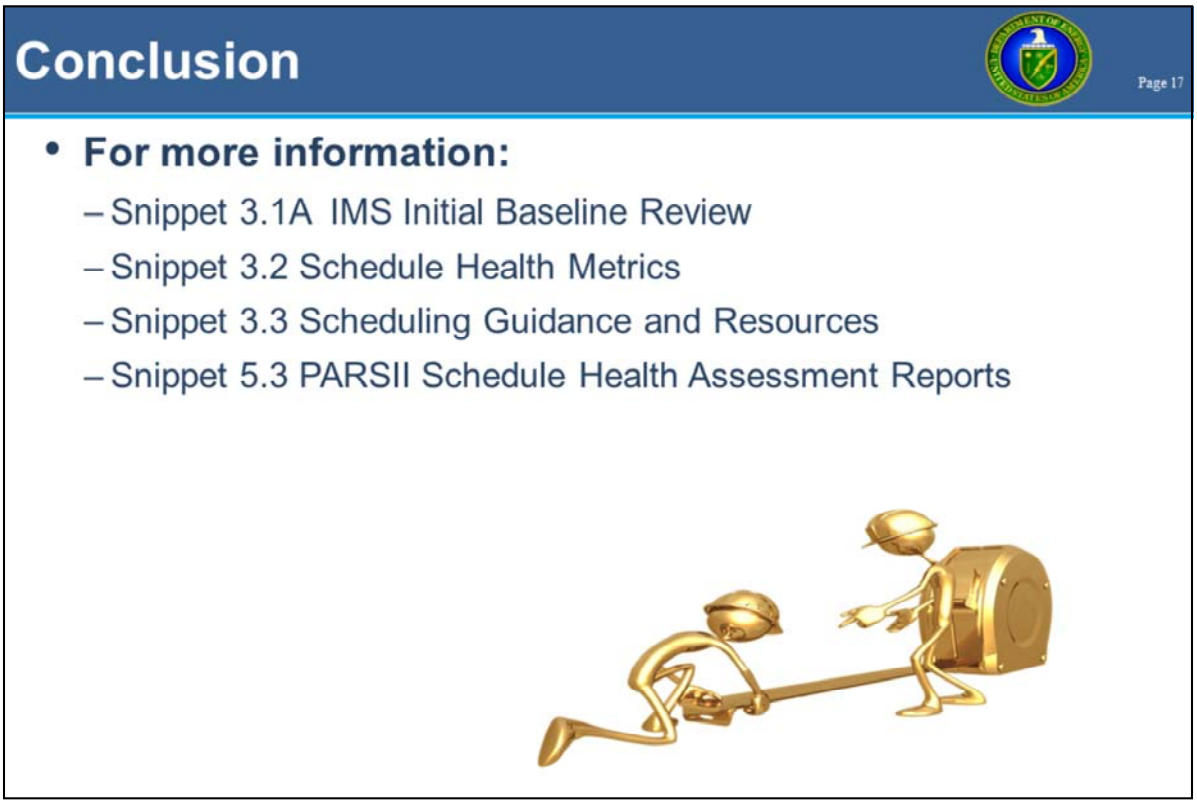
This comparison should be done at the work package level. Let's look at some examples of how anomalies in the comparative data from the 2 systems may lead us to identifying problems.

Our first activity A0100 shows a difference in the duration percent complete and the physical percent complete taken from the IMS. Is this an error? Probably not, since the physical percent may differ based on the resource spread. So as long as there is activity in both systems and the physical percent complete matches the EV percent complete for the work package, we can be pretty confident the resources are aligned in both systems.

Activity A0105 shows that in the second period we have taken earned value of 25% in the cost system and 0% in the IMS duration and physical percent complete. This often indicates an alignment error with period of performance and should be researched and corrected by the contractor. The reverse may also occur when an IMS duration percent complete and physical percent complete values are reported and 0% complete is reported in the EV Cost engine. Regardless of the cause, this situation indicates that there are integration problems

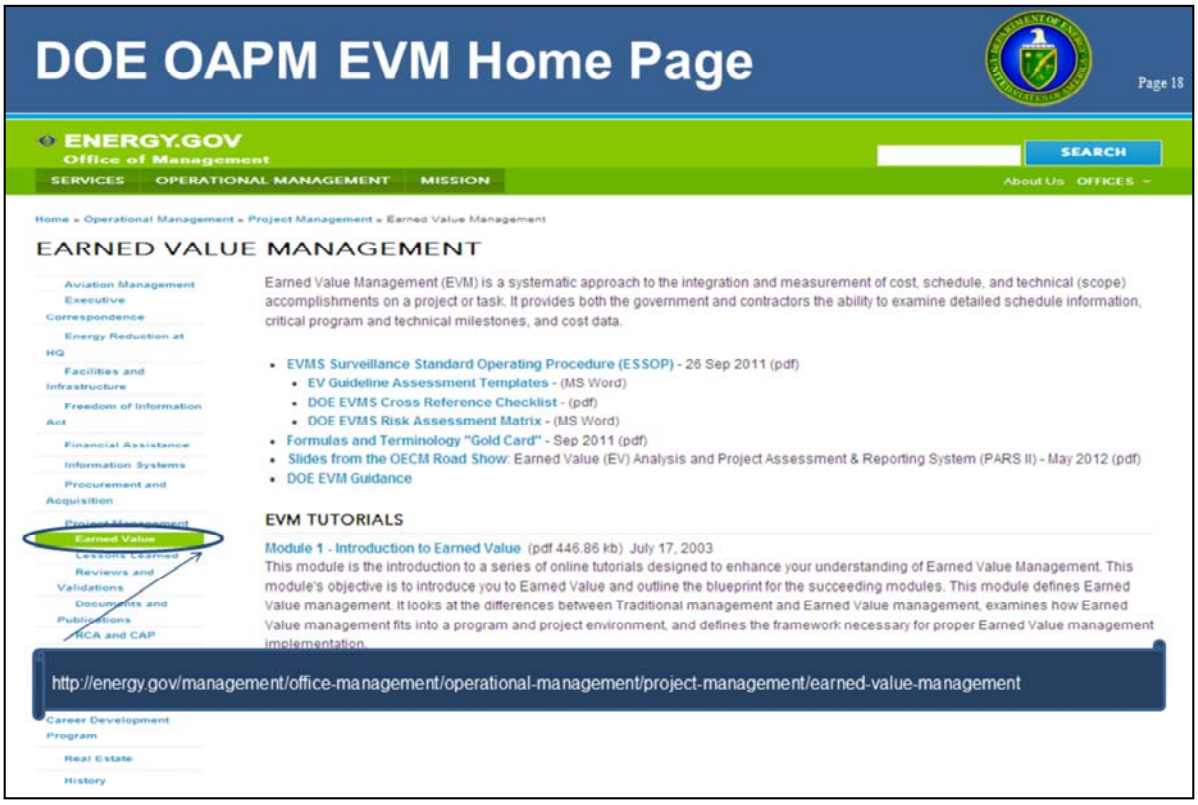
between the schedule and cost systems.

With activity A0110, our last example, we see that the duration percent complete is different from the physical percent complete. As discussed in the first example, this is probably okay as resources are not evenly loaded. However, when we look at the IMS physical percent complete compared to the EV system percent complete, they are different. This should not be the case and indicates the baseline resource spread in the IMS is different from the baseline resource spread in the EV system. Is this important? It can be as the contractor is overstating schedule position or understating EV position. This often occurs when the IMS activities “ride” the data date or show progress based on time instead of true physical performance. It may also indicate the baseline resources in the IMS are not being maintained through the change control process, if the IMS is used for staffing plans, this can cause reporting issues in other areas of project management. Again, this situation indicates an integration problem between the schedule and cost systems.



A monthly schedule review is vital to ensuring the schedule is properly maintained and will provide predictive insights into future performance. For additional schedule information, please refer to the following Snippets:

- Snippet 3.1A – IMS Initial Baseline Review
- Snippet 3.2 – Schedule Health Metrics
- Snippet 3.3 – Schedule Guidance and Resources
- Snippet 5.3 – PARSII Analysis Schedule Health Assessment



For information relative to EVMS procedures, templates, helpful references, and training materials; please refer to OAPM's EVM Home page. Check back periodically for updated or new information.

Thank you