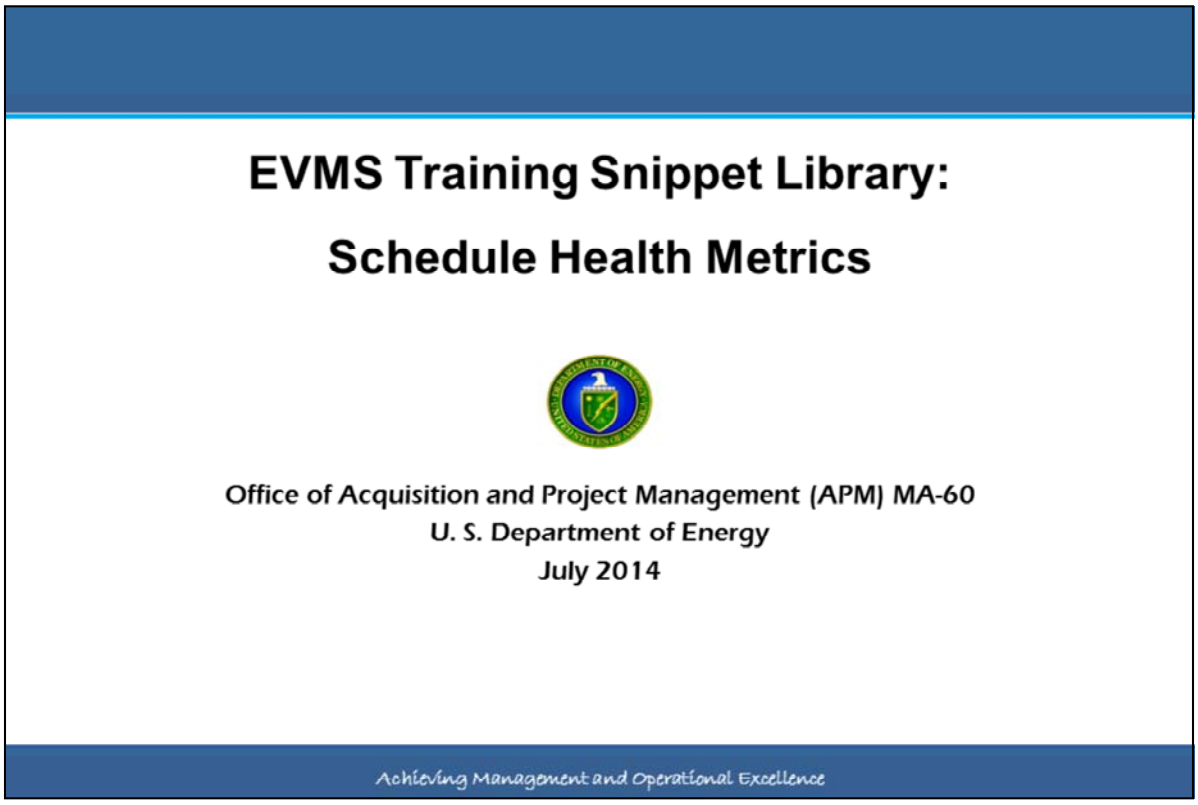
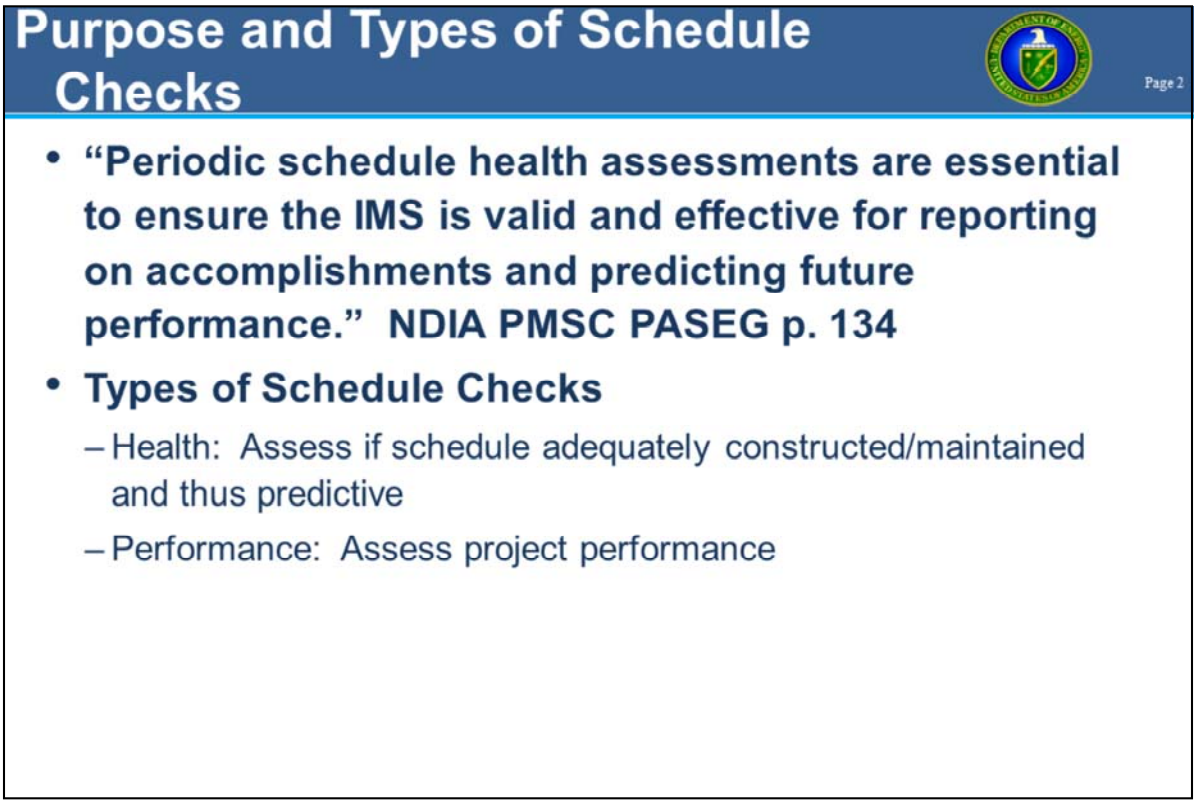


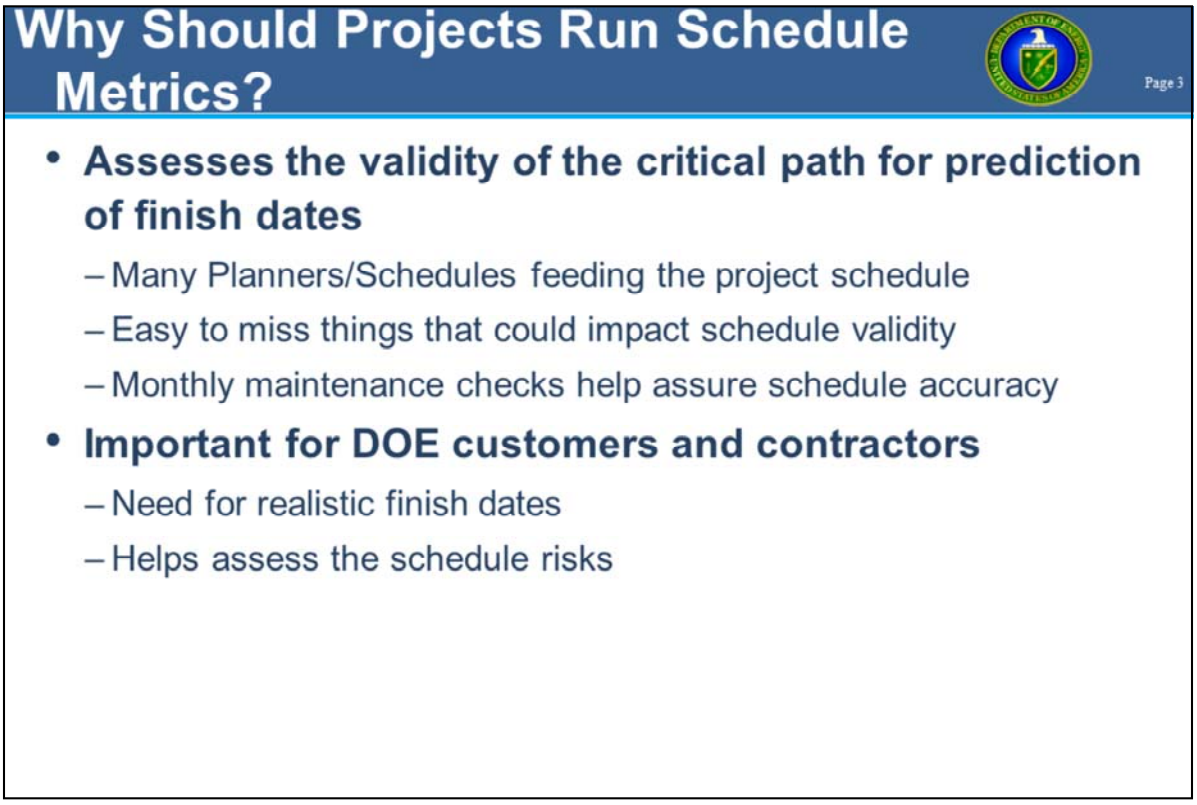
This EVMS Training Snippet sponsored by the Office of Acquisition and Project Management (OAPM) focuses on ‘what’ the metrics are, ‘why’ they are important, and what they tell us about the schedule health. This Snippet does not focus on the ‘how’ the metrics are calculated, other than to provide a basic understanding of what is being calculated.



As stated in the National Defense Industrial Association's Planning and Scheduling Excellence Guide (PASEG), "Periodic schedule health assessments are essential to ensure the IMS is valid and effective for reporting on accomplishments and predicting future performance."

There are several types of Schedule Checks:

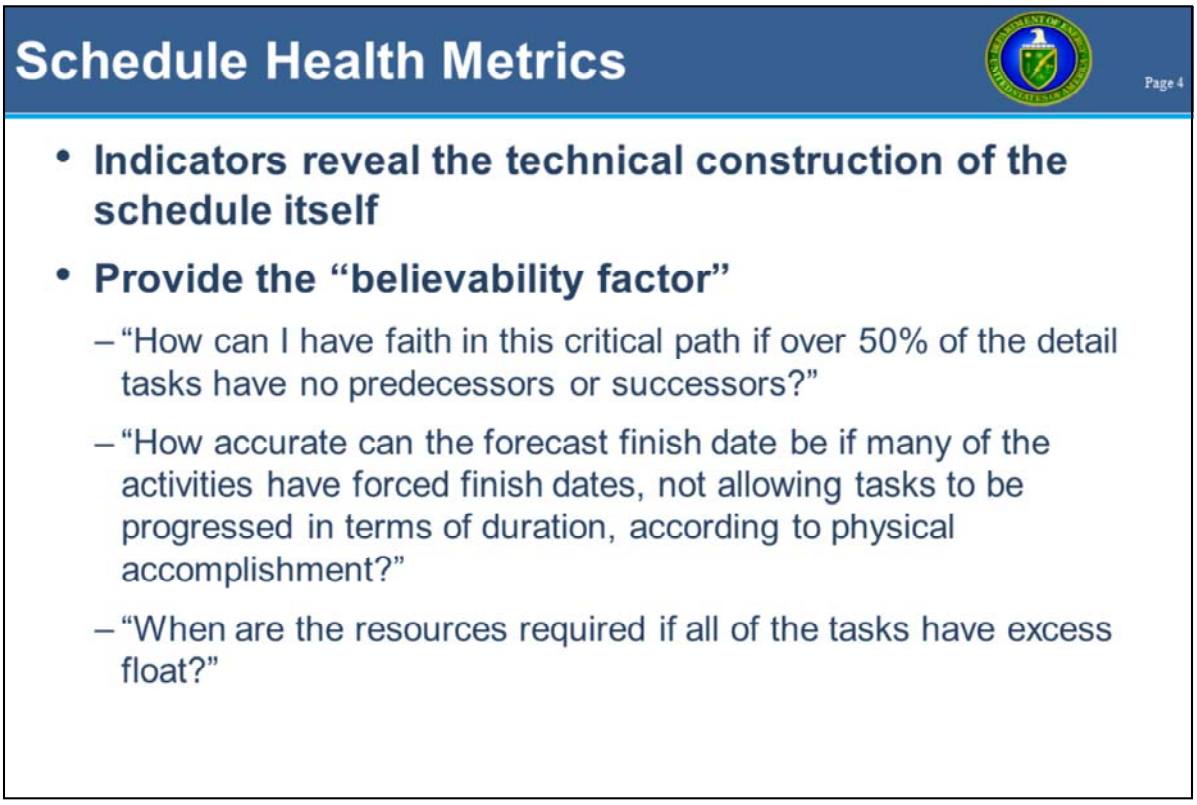
Basic Health checks, which assess if the schedule is adequately constructed and maintained, and therefore predictive, which is the topic of this Snippet and, Performance checks which assess project performance metrics. These are discussed in Snippet 3.1B IMS Monthly Review.



Before we get into the specifics, why should projects run schedule metrics? The answer is because these metrics assess the ability of the schedule to produce a realistic critical path for prediction of activity and project finish dates.

Typically there are many different Planners or Schedulers who input pieces of information into the schedule. It is easy to miss something that could affect the integrity of the schedule. Monthly maintenance checks help ensure that the schedule remains properly constructed and accurate.

Why is this important? Because the contractor and the DOE customer need realistic finish dates in order to accurately forecast project costs and operational status. It also helps everyone to assess schedule risks.



Next we will review several key Schedule Health Metrics. These indicators reveal the technical construction of the schedule itself and provide the "believability factor".

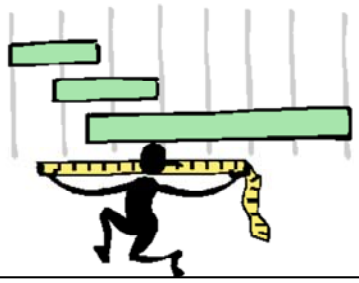
Questions commonly based upon unfavorable health metrics include:
"How can I have faith in this critical path if over 50% of the detail tasks have no predecessors or successors?"
"How accurate can the forecasted finish date be if many of the activities have imposed finish dates?
When are resources actually required if all of the tasks have excess float?

During EVM surveillance, the schedule health indicators are not necessarily findings by themselves. However, the team focuses on the items over the thresholds, with the CAMs, to understand the justification for the condition. If the CAMs cannot adequately explain the rationale for high float and use of leads, lags and/or constraints, then the concern stands and a Corrective Action Request (CAR) may be issued with a reference to the amount over the threshold. Thus the systemic nature of the concern is validated by the sampling of CAMs interviewed.

Useful for Both Contractor and DOE

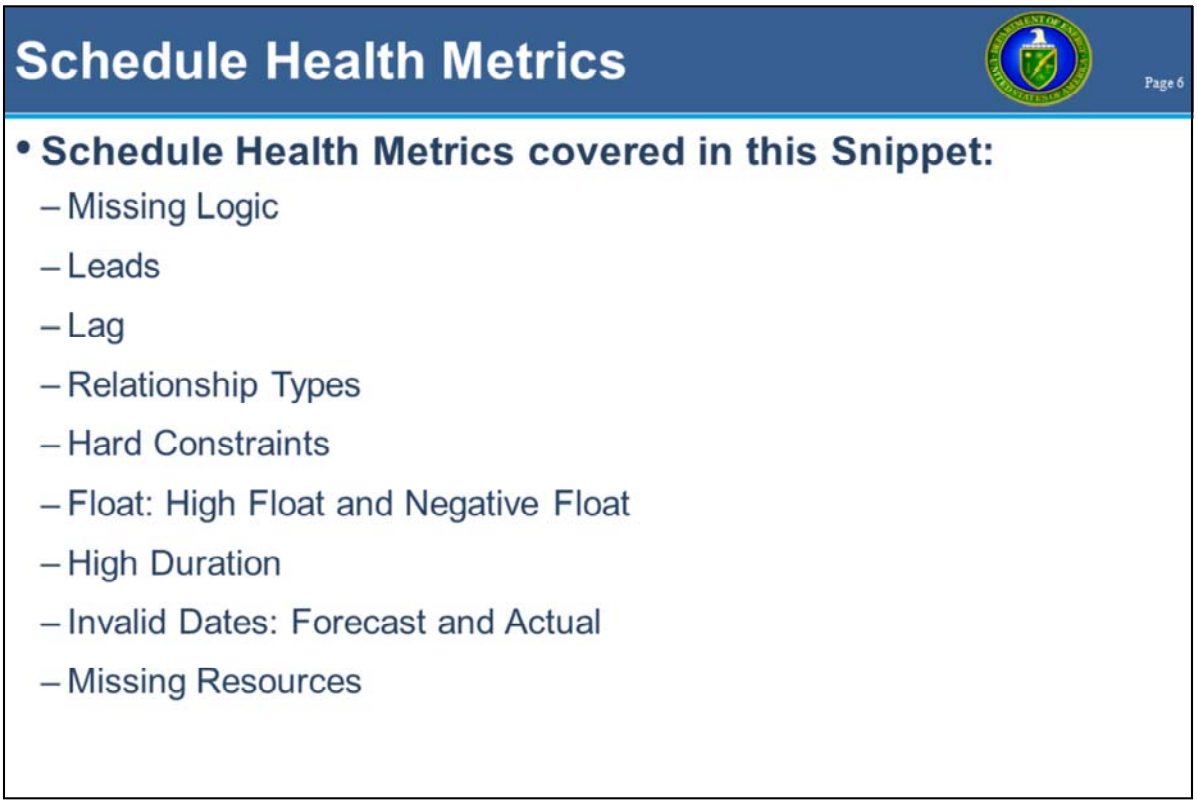
Page 5

- **Used to track progress and improvement of schedule health**
  - Contractors should be monitoring these health metrics to continuously improve fidelity of management tool
  - Internal scheduling processes should use these metrics as a guide to build and maintain the schedule
  - Useful to track maintenance in a growing/evolving schedule



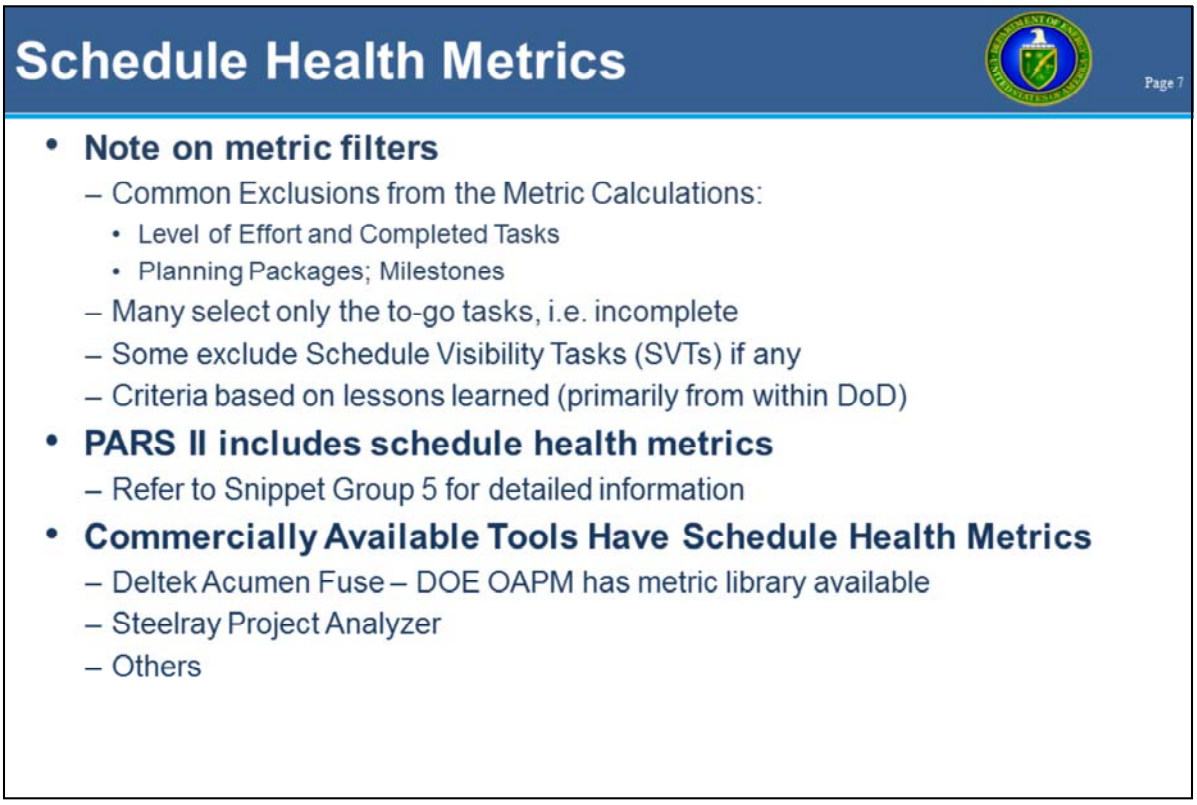
Schedule health metrics are used by both the contractor and the DOE. They are used to track progress and improvement of schedule health. Contractors should be monitoring these same health metrics to continuously improve the fidelity of the schedule. Internal scheduling processes should use these metrics as a guide to build and maintain the schedule. The metrics are useful to track maintenance in a growing/evolving schedule.

The schedule baseline and forecast frequently change with monthly status and the incorporation of approved baseline changes. Therefore the schedule metric results can change frequently. It is recommended that the metrics be run monthly to catch any anomalies that are created during the schedule status process. This ensures the continual validity of the critical path and can help prevent issues from developing.



The schedule health metrics covered in this snippet include:

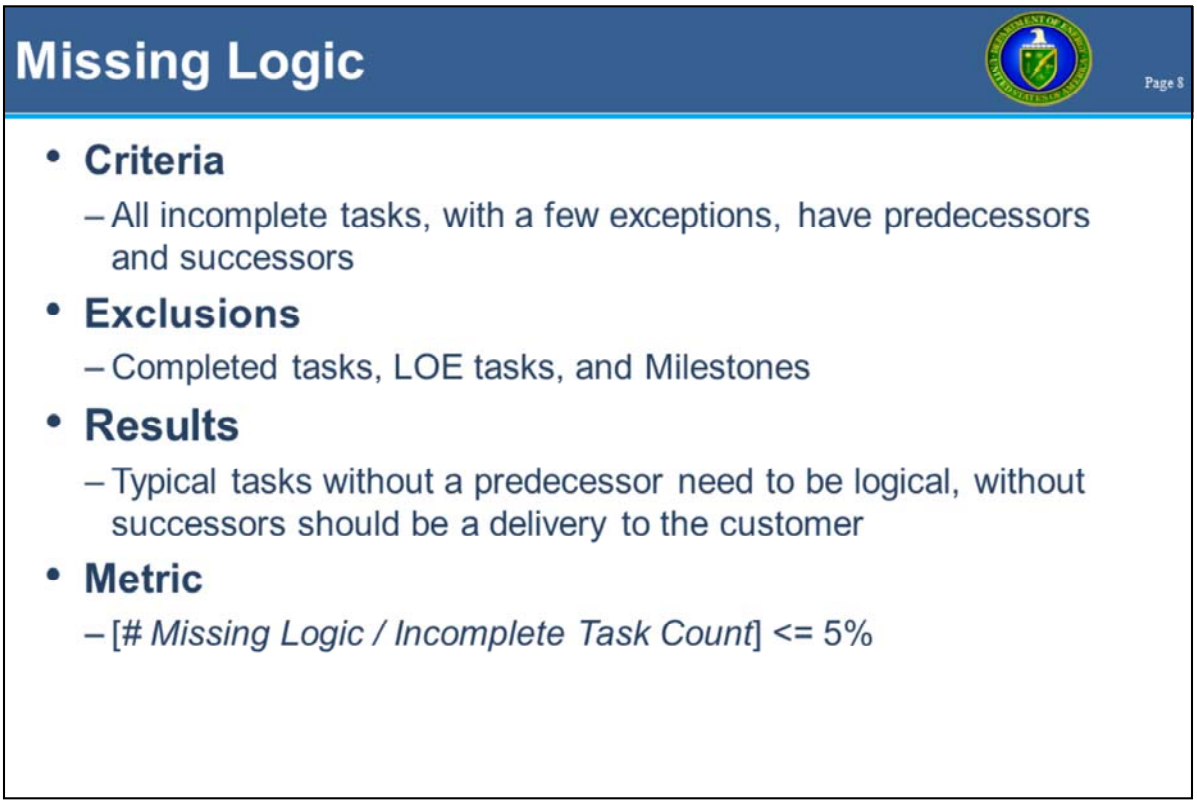
- Schedule Logic
- Leads
- Lags
- Relationship Types
- Hard Constraints
- Float: High Float and Negative Float
- High Duration
- Invalid Dates: Forecast and Actual
- Missing Resources



As we show the details behind the calculations, you will note many of the following terms. They refer to filters that are applied to each metric. Many of the metrics omit Level of Effort tasks, Planning Packages, and Milestones. Most of the metrics only include incomplete tasks. Some filter out Schedule Visibility Tasks (SVTs). The criteria for the metrics are based on lessons learned and followed by the Department of Energy and the Department of Defense.

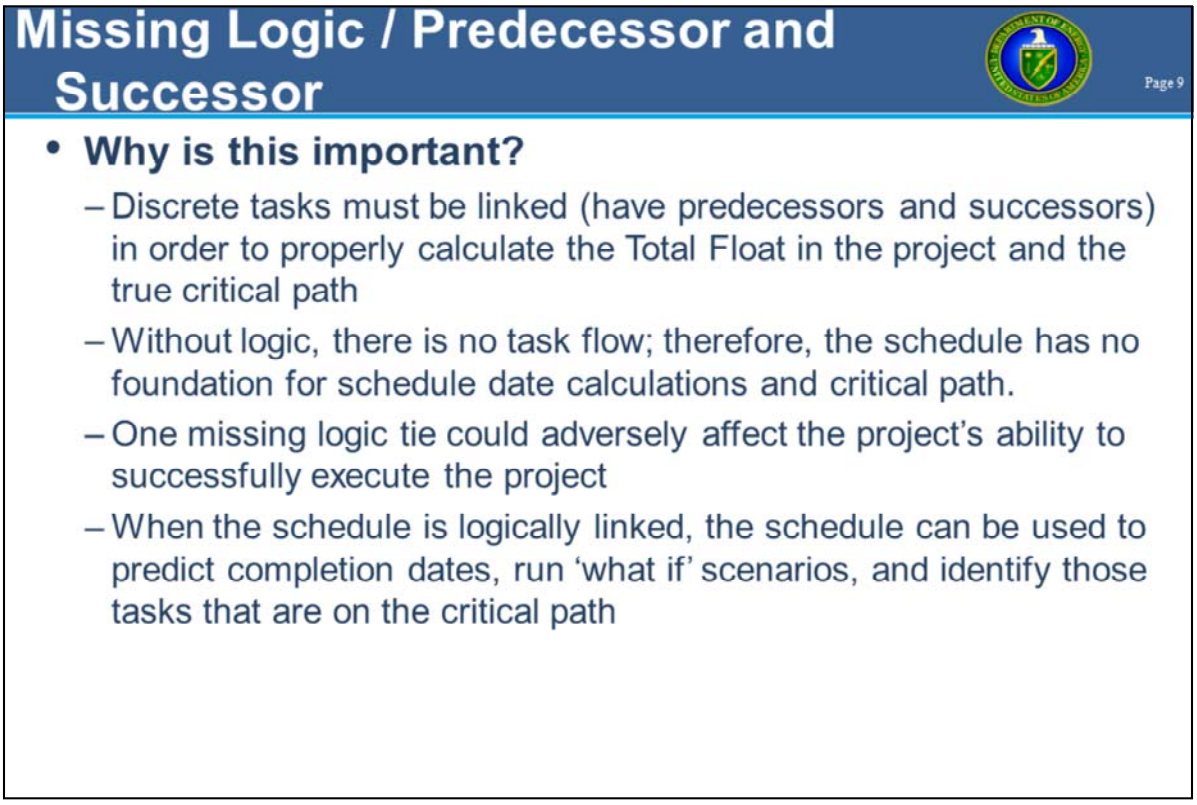
PARSII has many schedule health metric analysis reports. Refer to Snippet 5.3 PARSII Analysis: Schedule Health Assessment Reports for detailed information.

There are also commercially available tools that run several of these metrics, such as Deltek Acumen Fuse and Steelray Project Analyzer, among others. DOE OAPM has a Deltek Acumen Metric Library available that contains all of the metrics discussed in this snippet.



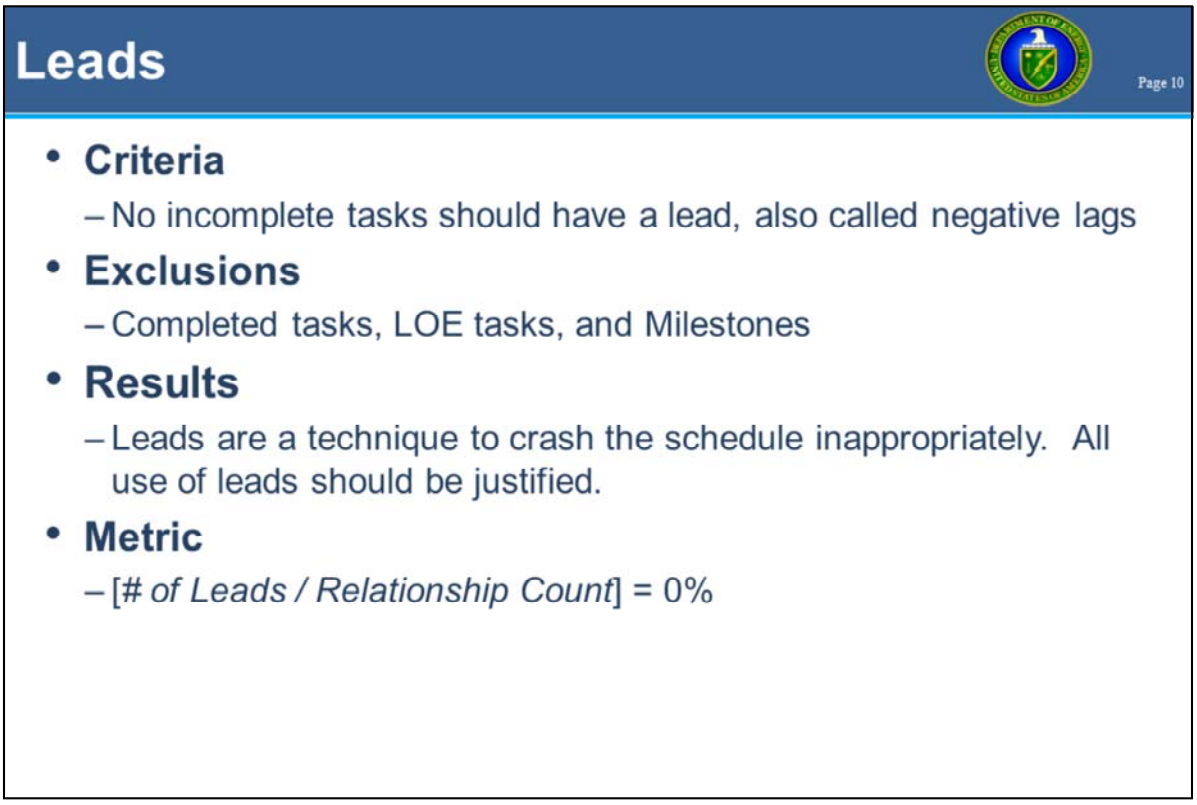
Let's begin with Missing Logic. This metric looks at all incomplete tasks, with a few exceptions, to see if they have predecessors and successors. Every discrete activity should have at least one predecessor and one successor with the exception of the first and last tasks on a project.

This metric excludes completed tasks, LOE tasks, and Milestones. The result is to identify tasks without predecessors and/or successors. Typical tasks without a predecessor need to have a valid, logical reason and those without successors should be a delivery to the customer. The metric counts the number of tasks without predecessors and/or successors and should not exceed 5%.

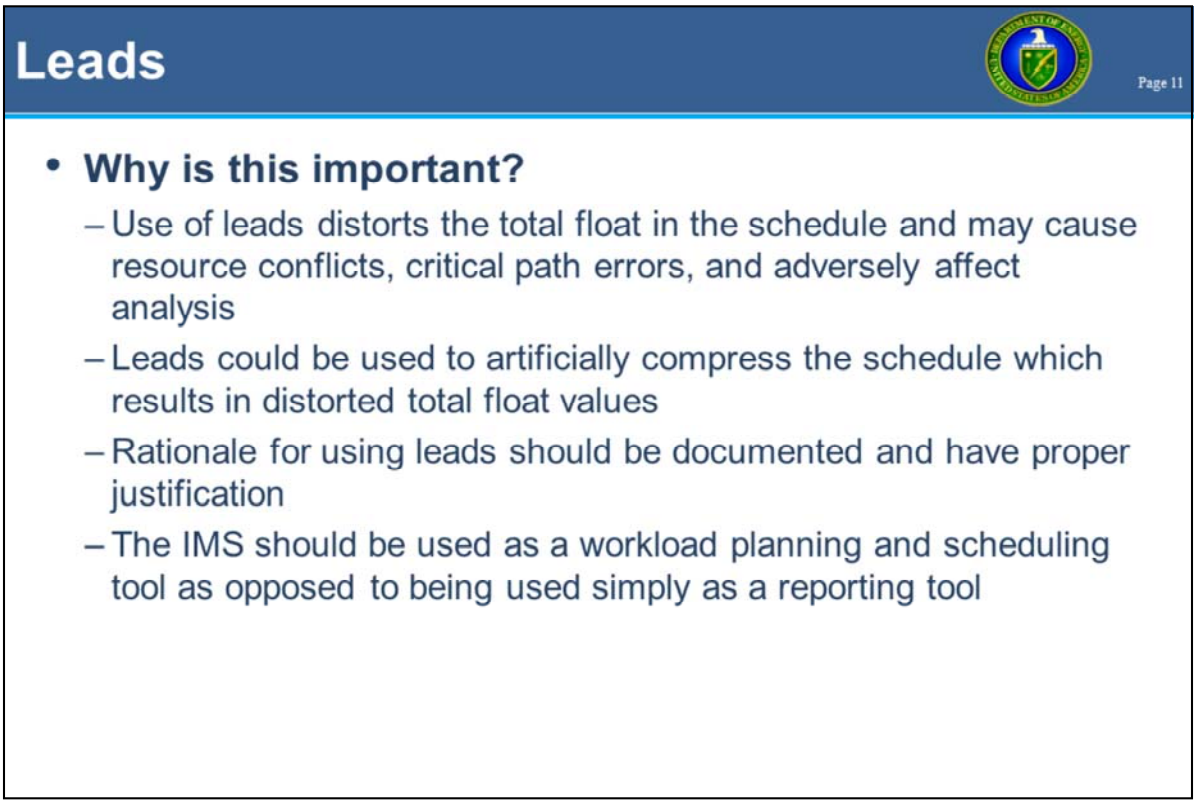


Why is schedule logic so important?

The logic dependencies define the interrelationships between tasks and link the schedule together from start to complete. Predecessor and successor tasks are linked to define the schedule sequence and to enable the calculation of total float. Without logic, there is no defined task flow and the schedule has no foundation for date calculations and determining a critical path. For example, a task without a logical near-term successor can slip indefinitely without impacting the critical path. This is not logical for discrete type work because one missing logic tie could adversely affect the ability to successfully execute the project. When the schedule is logically linked, the schedule can be used to predict completion dates, run 'what if' scenarios and identify those tasks that are on the critical path.

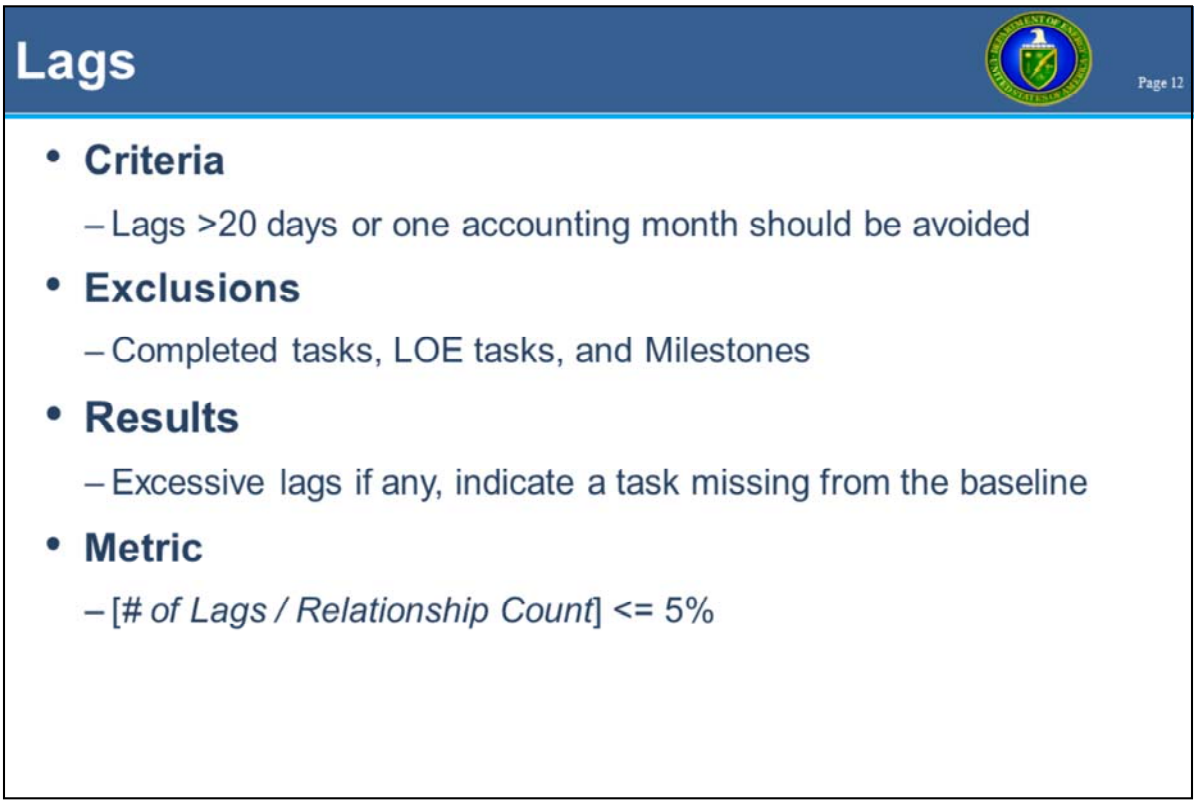


The next metric is for 'leads'. This metric looks at all incomplete tasks to identify leads or negative lags as they are sometimes called. A lead is a scheduling option that models an overlap between two logically linked IMS activities. This metric excludes completed tasks, LOE tasks, and Milestones. The result is to identify leads to ensure they are justified because they can be used as a technique to shorten the overall duration of the schedule inappropriately. The metric identifies all leads with a goal of 0% unless properly justified.

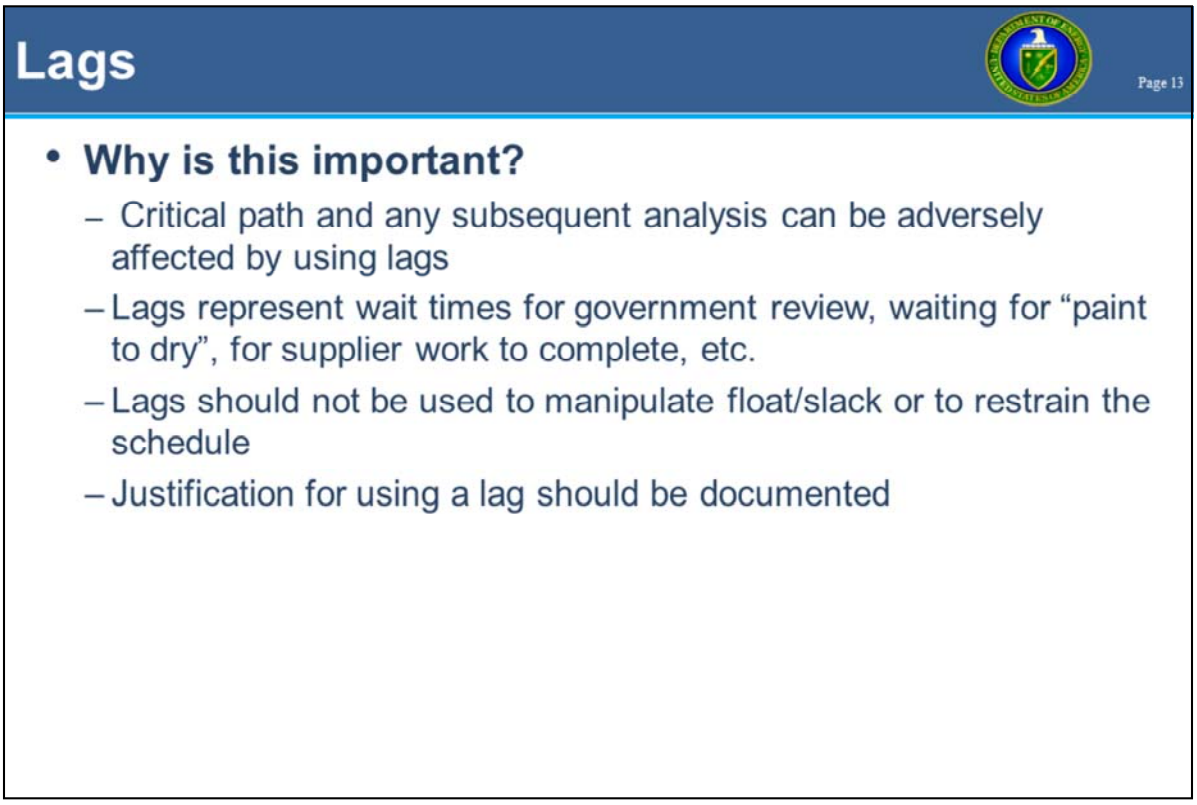


Why is identifying leads so important? The critical path and any subsequent analysis can be adversely affected by using leads. The use of leads distorts the total float in the schedule and may cause resource conflicts. In some cases, these leads are used to artificially compress the schedule which results in distorted total float values.

The reason for using leads should be documented and have proper justification (preferably in a “notes” column of the schedule). Negative time is not demonstrable and should not be encouraged. The schedule should be used as a workload planning and scheduling tool as opposed to being used simply as a reporting tool. Contractors should not use leads to restrain the schedule in an effort to “manage the message.” Stakeholders cannot believe future forecasts put forth by the schedule if leads are being used to “manage the message”.

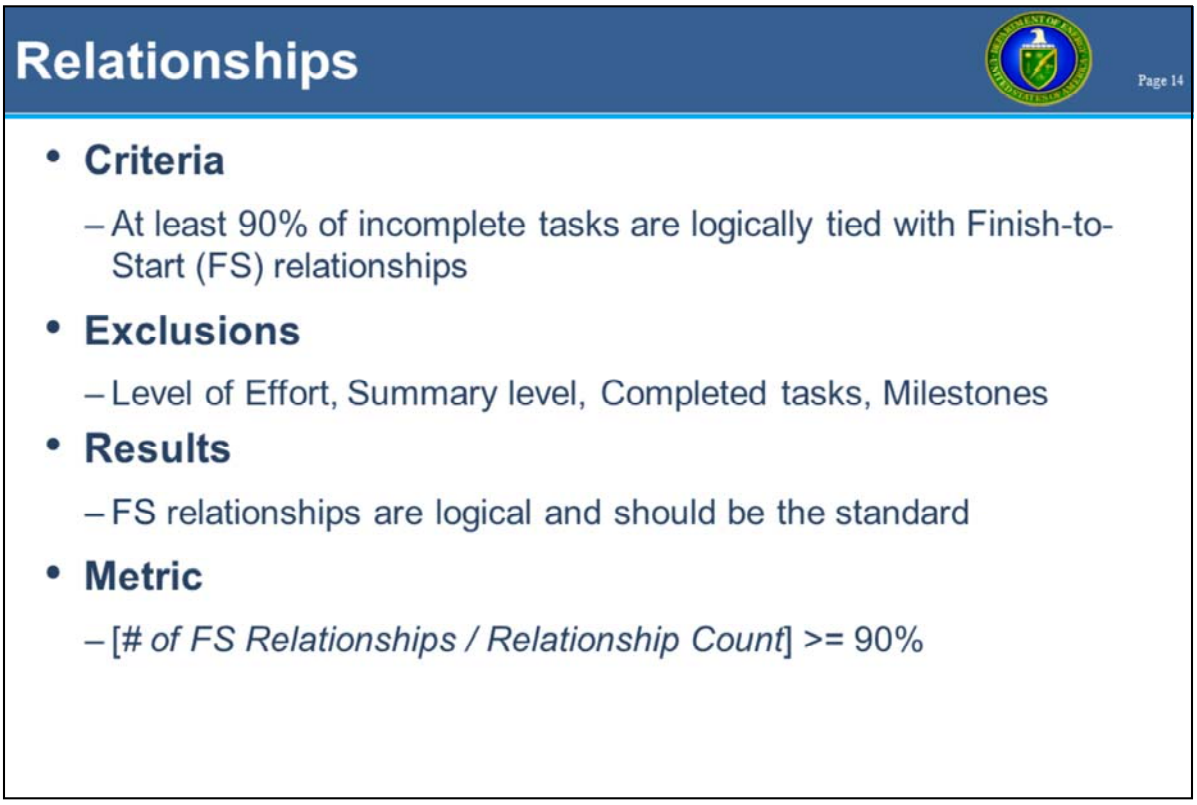


The next metric is 'lags'. The criteria identify lags greater than 20 days or approximately one accounting month. This metric excludes completed tasks, LOE tasks, and Milestones. The result is to identify excessive lags that may indicate a task is missing from the baseline. The metric identifies all lags with a goal of less than or equal to 5%.

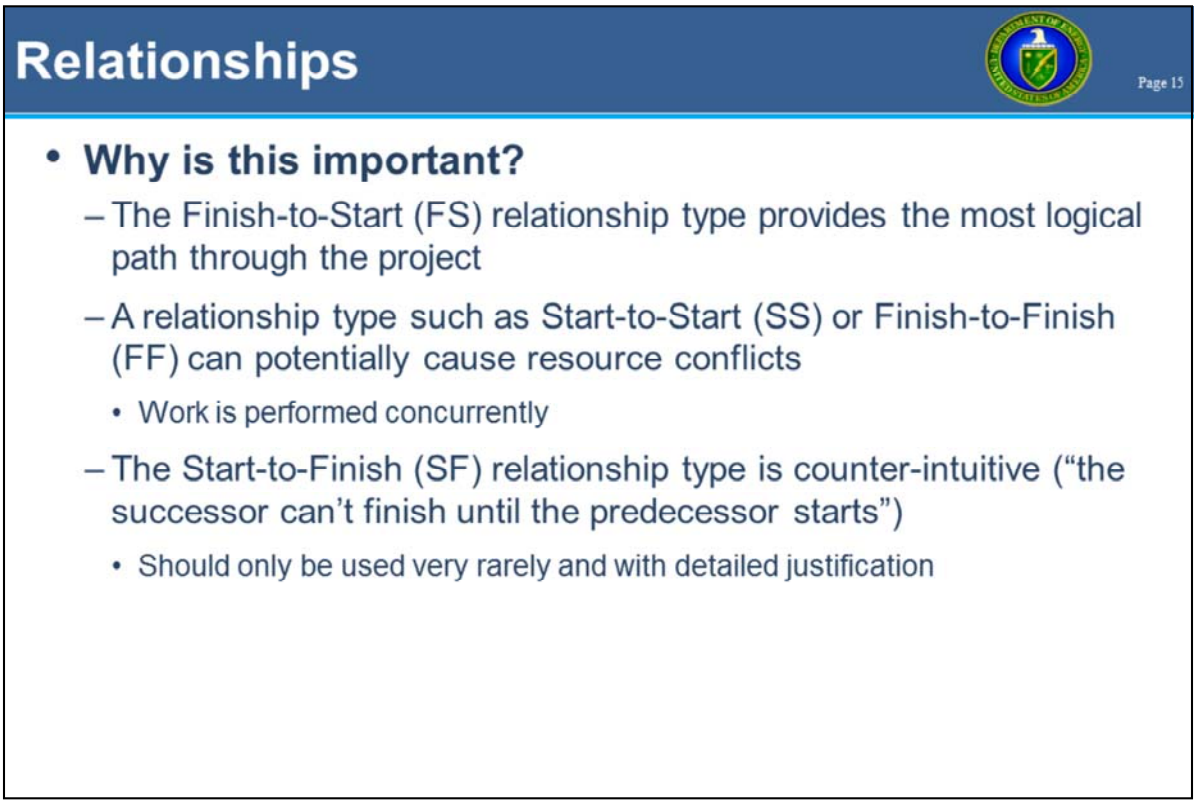


Why is identifying lags important? The critical path and any subsequent analysis can be adversely affected by using lags. In many cases, these lag values are appropriately used by the CAMs to represent wait times for government review, waiting for "paint to dry", for supplier work to complete, etc.

However, if lags are used to force a task to start or finish on a certain date, the schedule is being artificially restrained and this should be considered a finding. Lags should not be used to manipulate float or slack, or to restrain the schedule. Justification for using a lag should be documented (preferably in a "notes" column of the schedule) to discern whether or not the lag is being used in an appropriate manner.



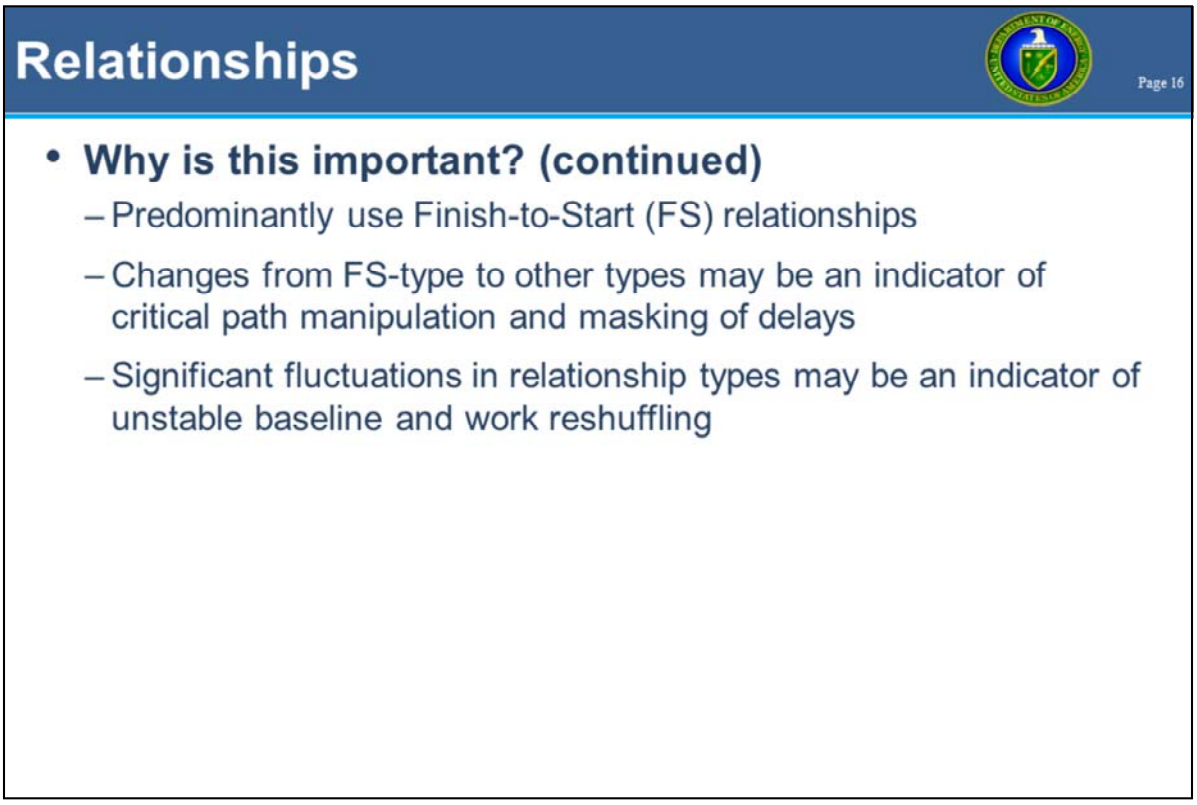
The next metric is 'relationships'. The criteria are that at least 90% of incomplete tasks should be logically tied with Finish-to-Start (FS) relationships. This metric excludes completed tasks, LOE tasks, and Milestones. Because Finish-to-Start relationships are logical, they should be the standard. Therefore, the metric measures them with a goal of greater than or equal to 90%.



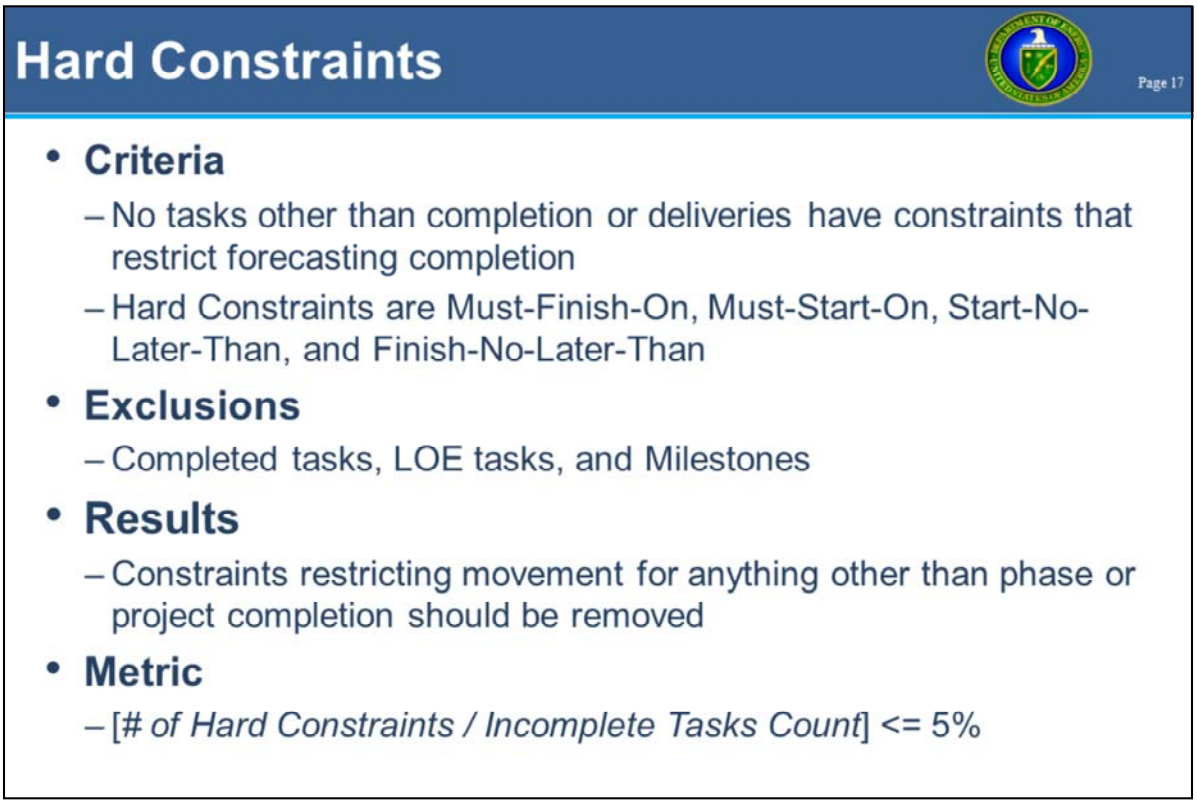
Why are Finish-to-Start relationships important? The Finish-to-Start (FS) relationship type, that is "once the predecessor is finished, the successor can start", provides the most logical path through the project.

A relationship type such as Start-to-Start (SS) or Finish-to-Finish (FF) can potentially cause resource conflicts because the work is being performed concurrently.

The Start-to-Finish (SF) relationship type is counter-intuitive as it is based on "the successor can't finish until the predecessor starts. It should only be used very rarely and with detailed justification.

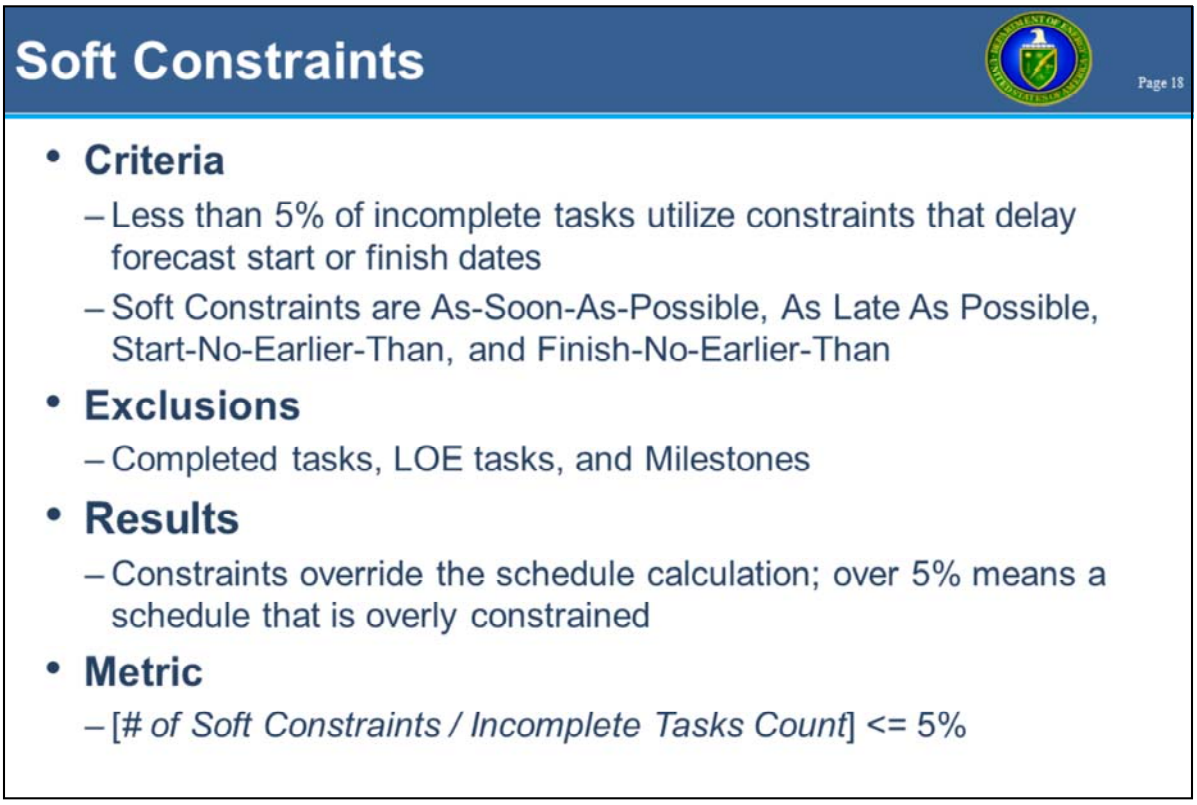


Projects should structure the IMS with predominantly Finish-to-Start (FS) relationships. Consistently decreasing the number of Finish-to-Start type relationships coupled with continuously increasing the number of Start-to-Start and/or Finish-to-Finish type relationships may be an indicator of activity relationships that are used to manipulate the critical path and mask schedule delays. Significant fluctuations in relationship types may be an indicator of unstable baseline and work reshuffling.



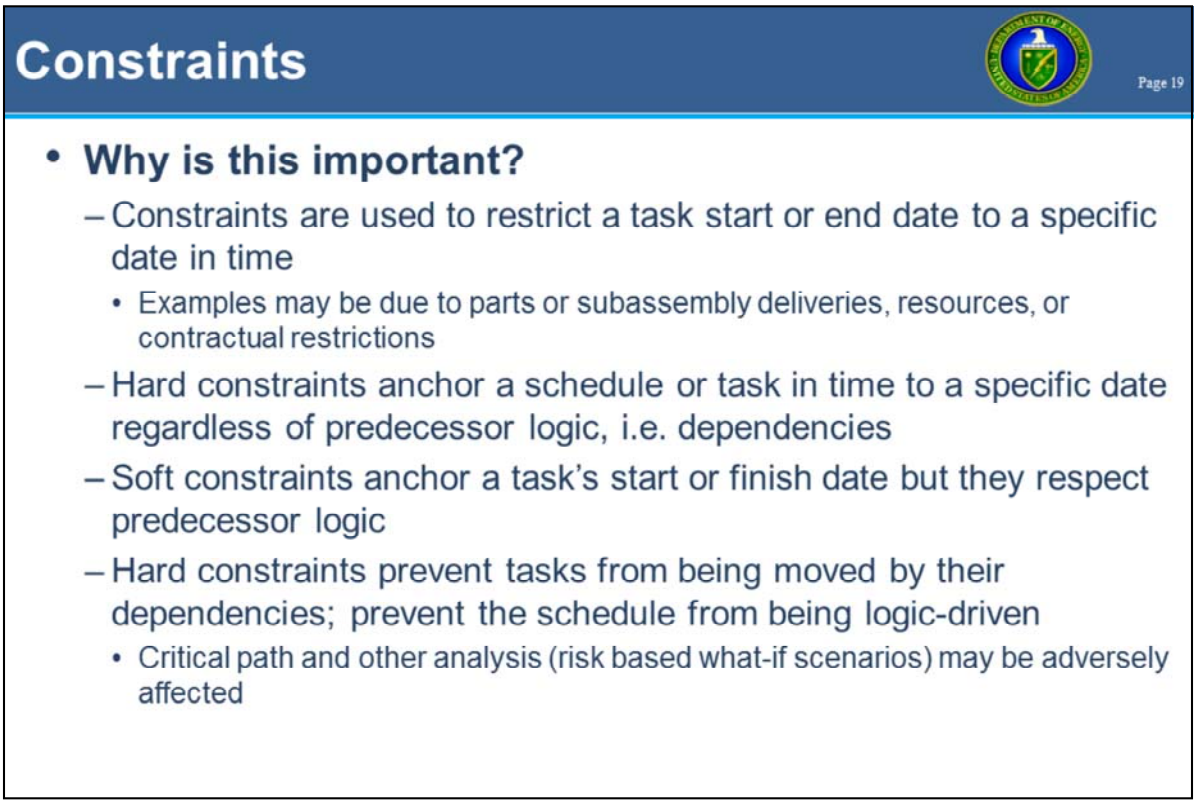
Another Schedule Health Metric is based on constraints. The criteria are that no tasks other than completion or deliveries have constraints that restrict forecasting completion dates. Hard Constraints are Must-Finish-On, Must-Start-On, Start-No-Later-Than, and Finish-No-Later-Than.

This metric excludes completed tasks, LOE tasks, and Milestones. A constraint restricting movement is common at the end of the project, or at the end of a phase, to calculate the network float. Any others should be removed. The metric states the number of tasks with hard constraints should not exceed 5%.

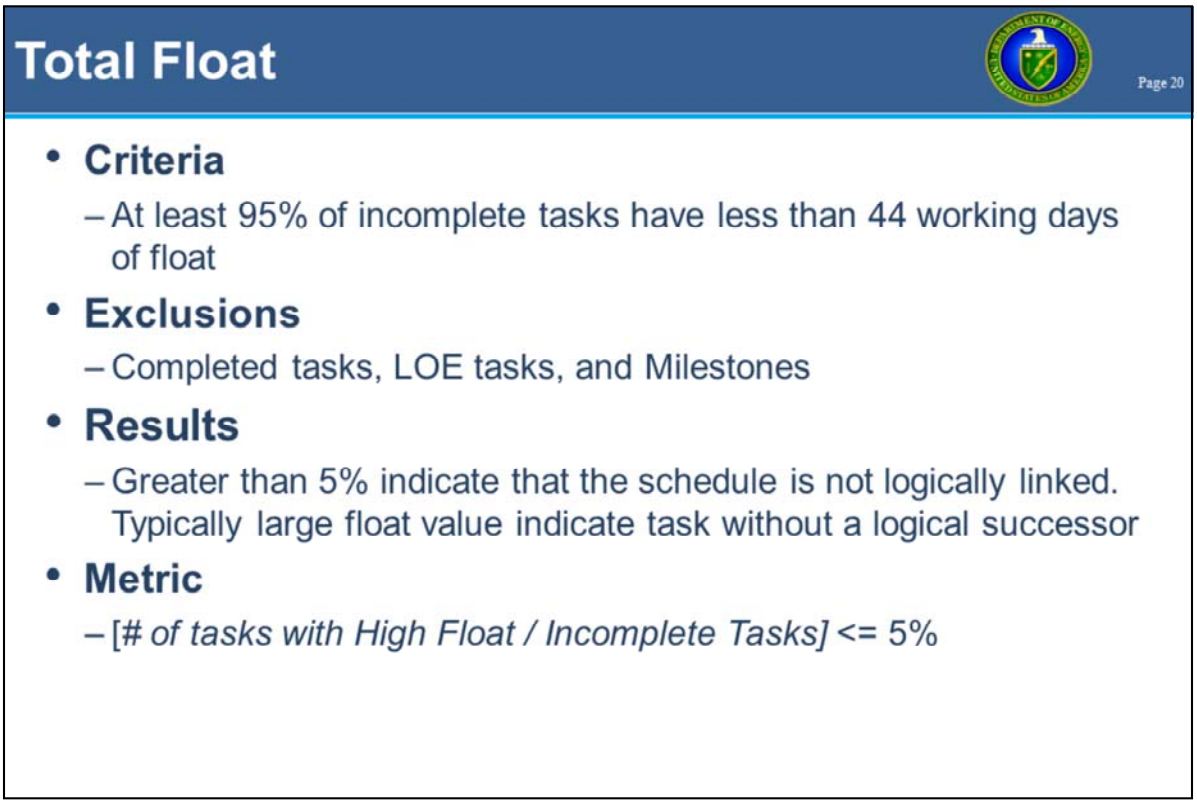


Another type of constraint is soft constraints. The criteria are less than 5% of incomplete tasks should use constraints that delay forecast start or finish dates. Soft Constraints are As-Soon-As-Possible, As Late As Possible, Start-No-Earlier-Than, and Finish-No-Earlier-Than.

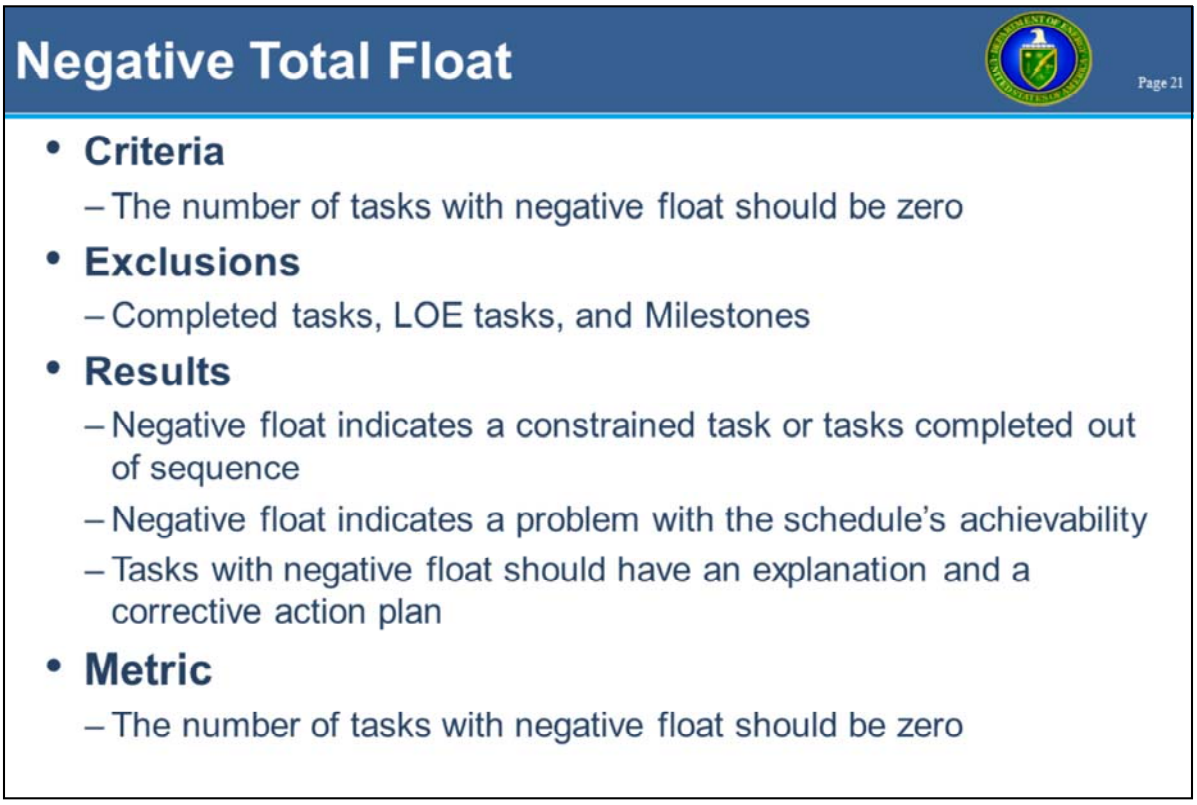
This metric excludes completed tasks, LOE tasks, and Milestones. Constraints override the schedule calculation algorithms. Over 5% means a schedule that is overly constrained. The metric states the number of tasks with soft constraints should not exceed 5%.



Why are constraints that prevent activity movement important? Constraints are used to restrict a task start or finish date to a specific date. Examples may be because of parts or subassembly deliveries, resources, or contractual restrictions. Hard constraints anchor a schedule or task in time to a specific date regardless of predecessor logic, i.e. dependencies. Soft constraints anchor a task's start or finish date but they respect predecessor logic, thus allowing the schedule end date to move to the right should a slip occur. Hard constraints prevent tasks from being moved by their dependencies and, therefore, prevent the schedule from being logic-driven. As a result, the critical path and other analyses such as risk based what-if scenarios may be adversely affected.

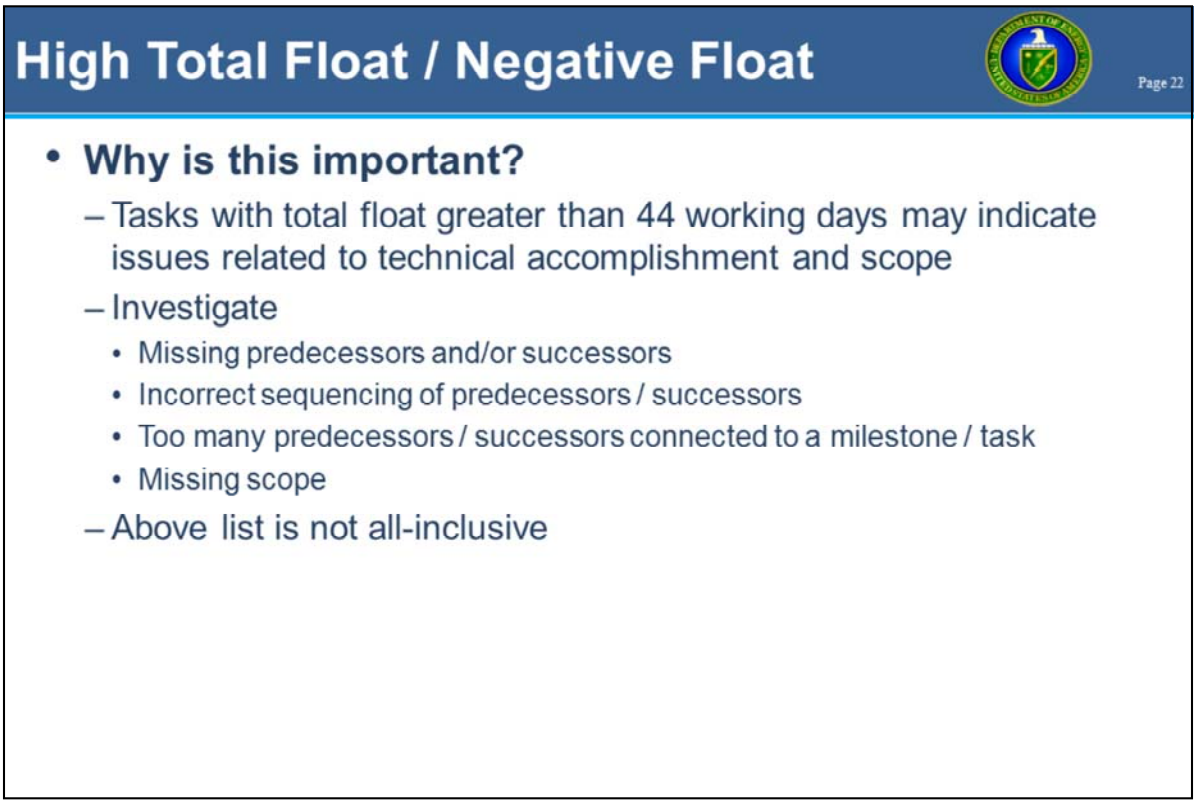


The next schedule health metric is total float. Total float is the amount of time a task finish date can slip before affecting the critical path. The criteria state that at least 95% of incomplete tasks should have less than 44 working days of float. This metric excludes completed tasks, LOE tasks, and Milestones. Greater than 5% indicate that the schedule may not be logically linked. Typically large float value indicates tasks without a logical successor. The metric states the number of tasks with high float should not exceed 5%.



We also measure negative total float. Negative float indicates an unachievable schedule; the work cannot support either intermediate delivery goals and/or the project completion date. The criteria states that no incomplete tasks have less than zero working days of float, that is to say no negative float should be in the schedule. This metric excludes completed tasks, LOE tasks, and Milestones.

Negative float may be caused by a constrained deliverable requirement that cannot be met based upon the activities remaining and amount of time required for their completion. Therefore where negative total float exists, there should be action to evaluate what must be done to help bring delivery projections back to the desired delivery requirement dates, or failing this, what slippage of delivery dates may be appropriate. The metric states there should be zero tasks with negative float.

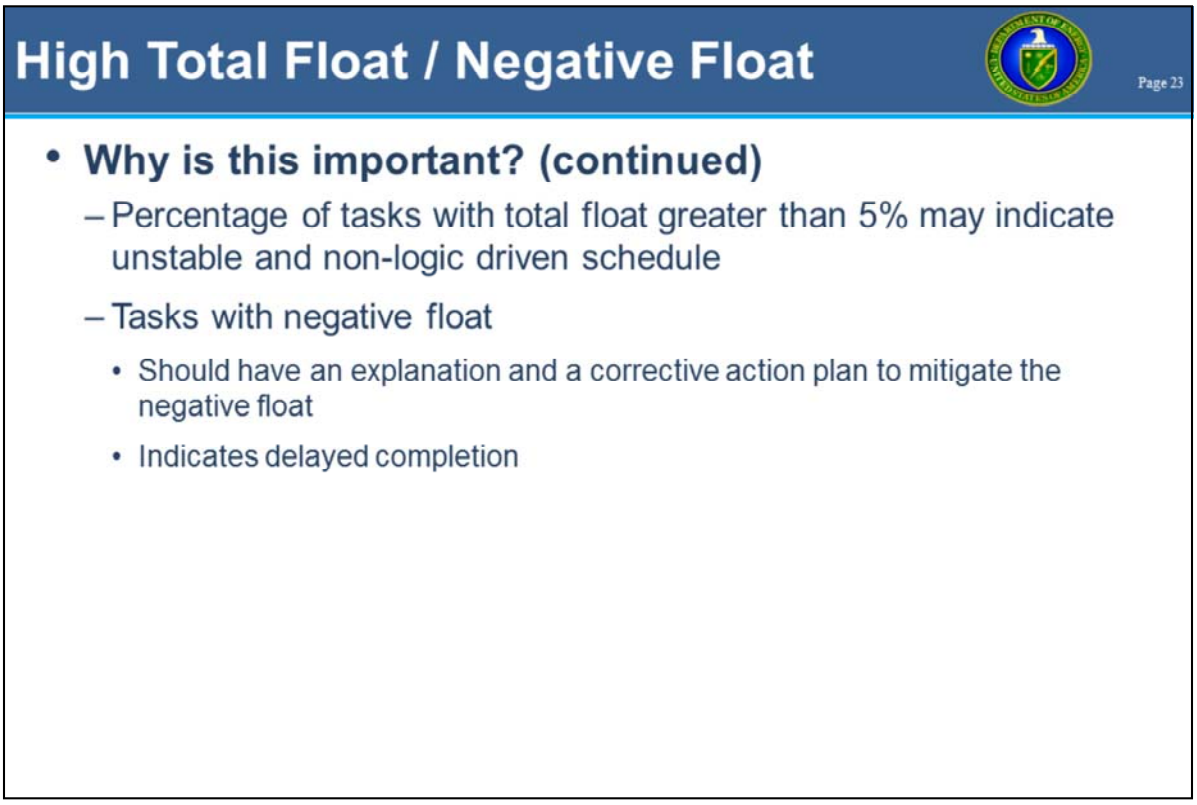


Why is this metric important? A task with total float greater than 44 working days may indicate several issues in the schedule related to technical accomplishment and scope.

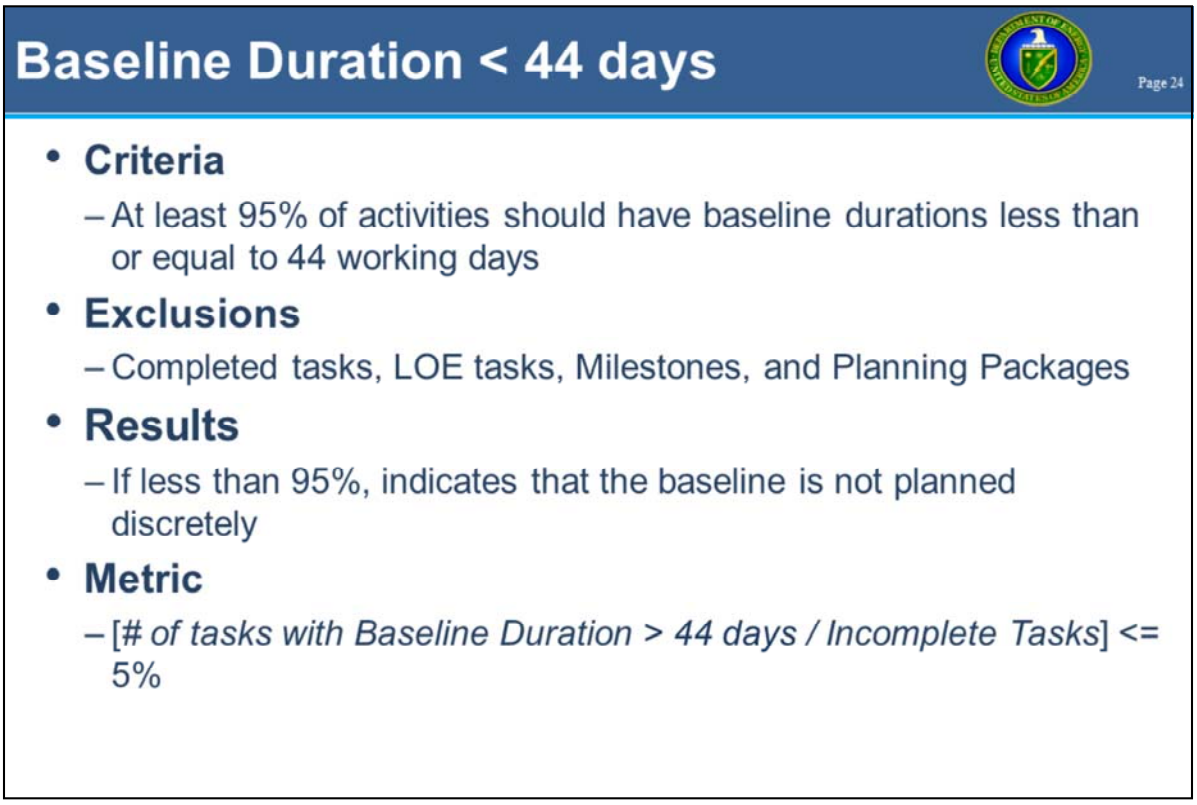
Any of the following are good places to begin investigation:

Missing predecessors and/or successors.
Incorrect sequencing of predecessors and/or successors.
Too many predecessors and/or successors connected to a milestone and/or task.
Missing scope

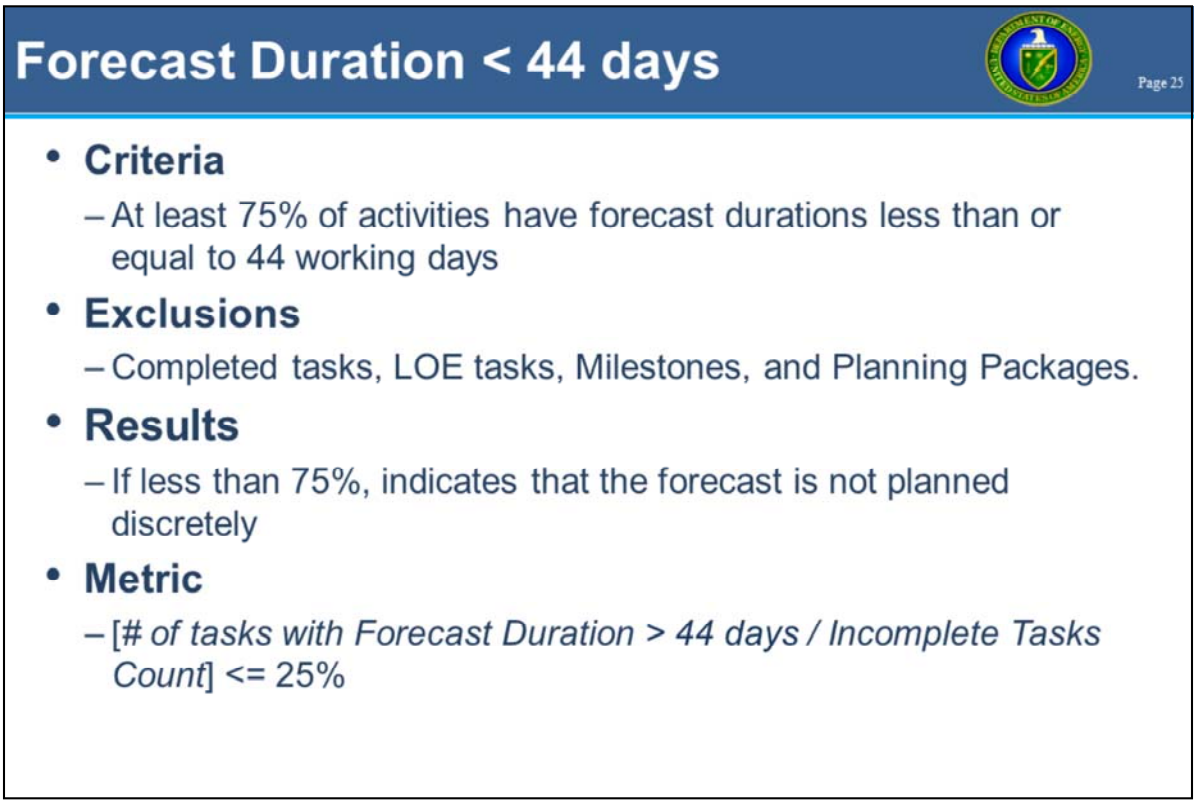
The list is not all-inclusive. Investigation generally proves that one or a combination of these items needs improvement.



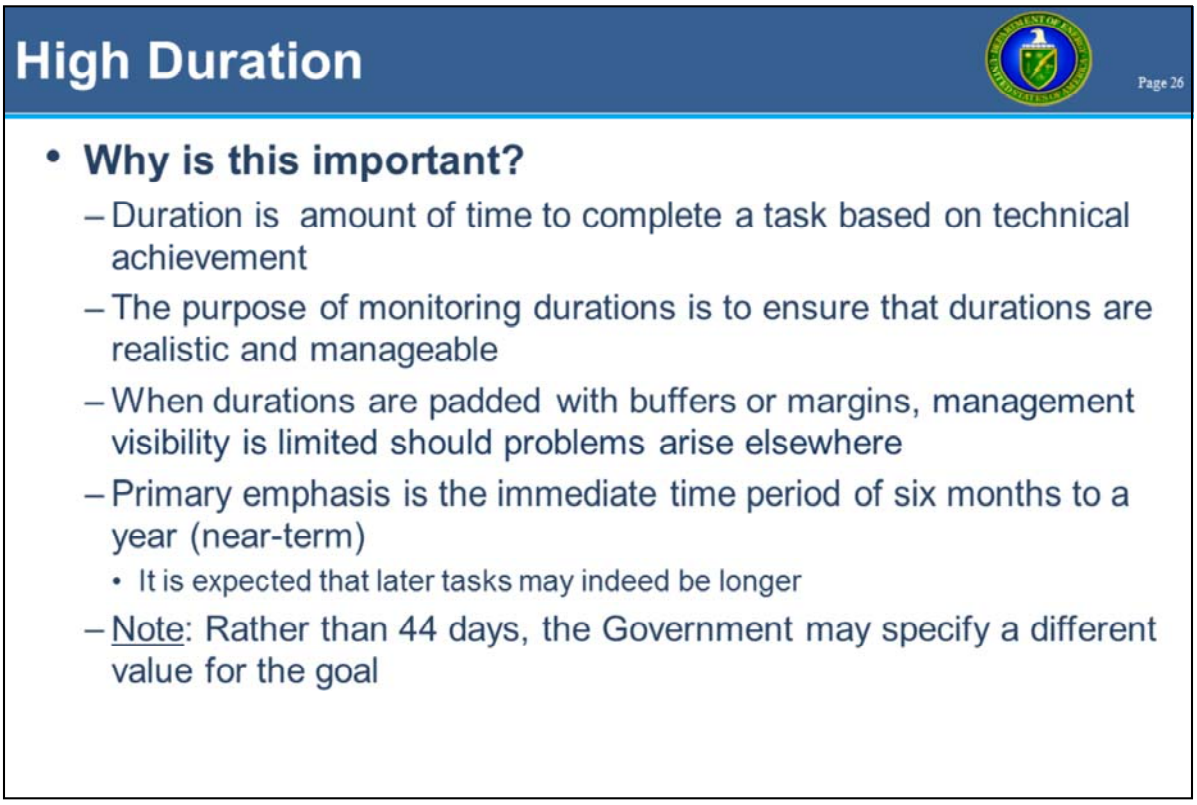
If the percentage of tasks with high total float exceeds 5%, the network may be unstable and is not being logic-driven. Tasks with negative float should have an explanation and a corrective action plan to mitigate the negative float – since it is an indicator of delayed completion.



The baseline duration criteria state that at least 95% of activities should have baseline durations less than or equal to 44 working days. This metric excludes completed tasks, LOE tasks, milestones, and planning packages. If less than 95%, the metric indicates that the baseline may not be planned in sufficient detail to allow accurate performance assessment. The metric measures high baseline duration tasks, those with durations greater than 44 days, to identify if the percentage is less than or equal to 5%.



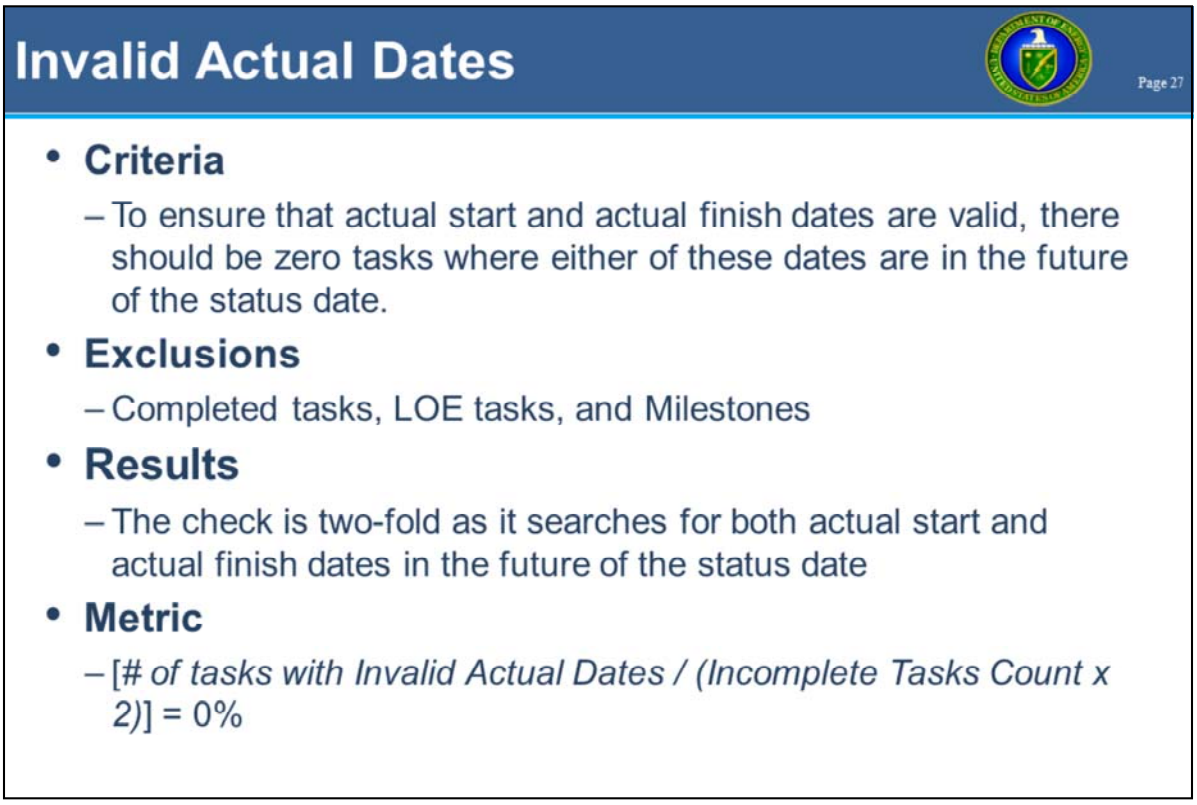
Similar to baseline duration, the forecast duration metric states that at least 75% of activities should have forecast durations less than or equal to 44 working days. This metric excludes completed tasks, LOE tasks, milestones, and planning packages. If less than 75%, the metric indicates that the forecasted effort may not be defined in sufficient detail. The metric measures high forecast duration tasks, those with durations greater than 44 days, to identify if the percentage is less than or equal to 25%.



Why is high duration important? Duration is the amount of time to complete a task based on technical achievement. The purpose of monitoring durations is to ensure that they are realistic and manageable. When durations are padded with buffers or margins, they can limit management visibility should problems arise elsewhere.

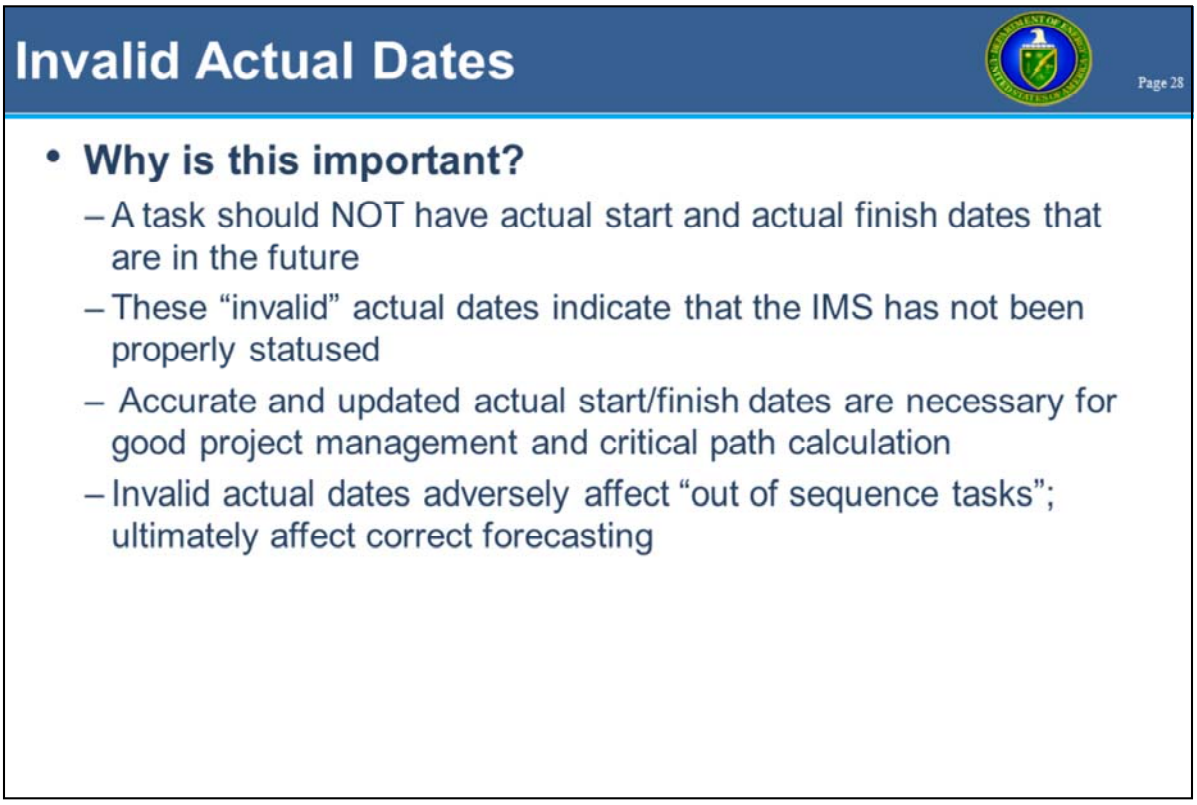
Emphasis on the baseline duration analysis is the period that is detail planned, typically the next six months to a year. Beyond this and in planning packages, it is typical that durations may be longer.

Note: rather than 44 days, the customer may specify a different value. Therefore, the goal may vary from project to project. In the absence of detailed guidance regarding durations of work correlating with EVM techniques, the default is 44 days.



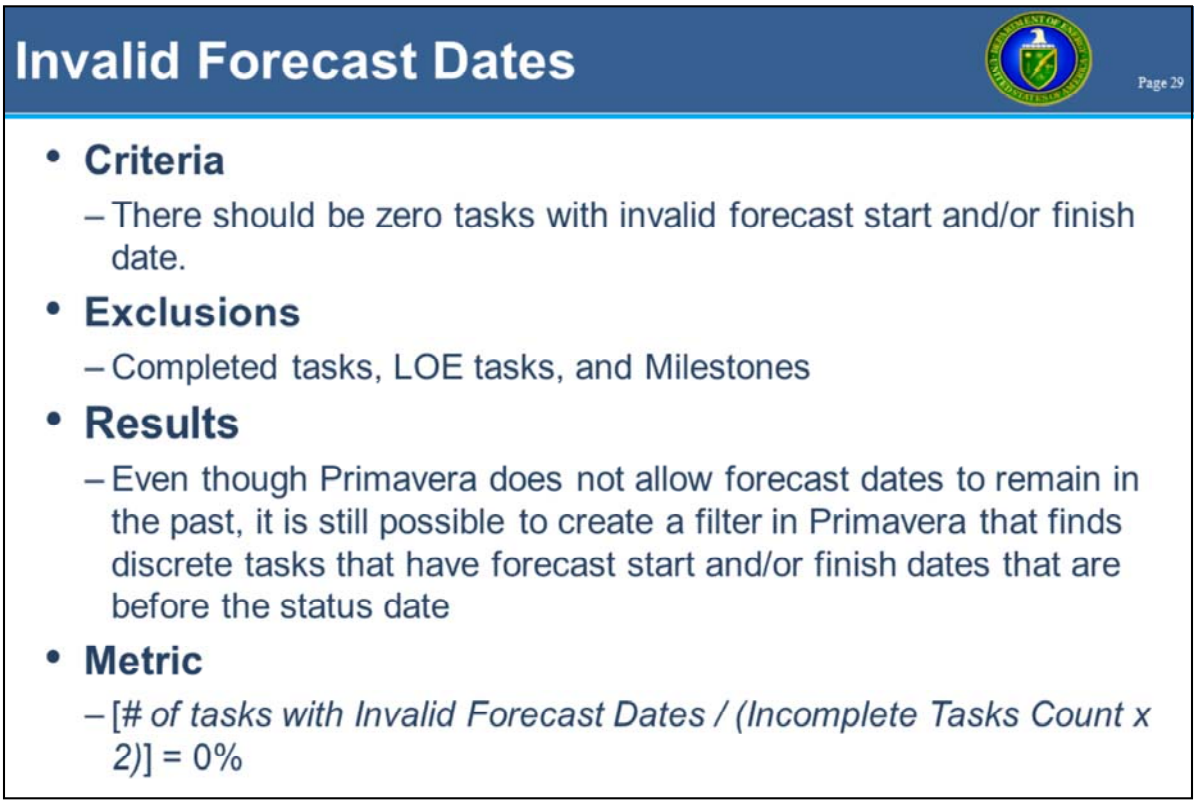
The next metric is Invalid Actual Dates. To ensure that actual start and actual finish dates are valid, there should be zero tasks where either of these dates are in the future of the status date.

This metric excludes completed tasks, LOE tasks, and milestones. The metric identifies the number of tasks with invalid actual finish and start dates should be 0%.



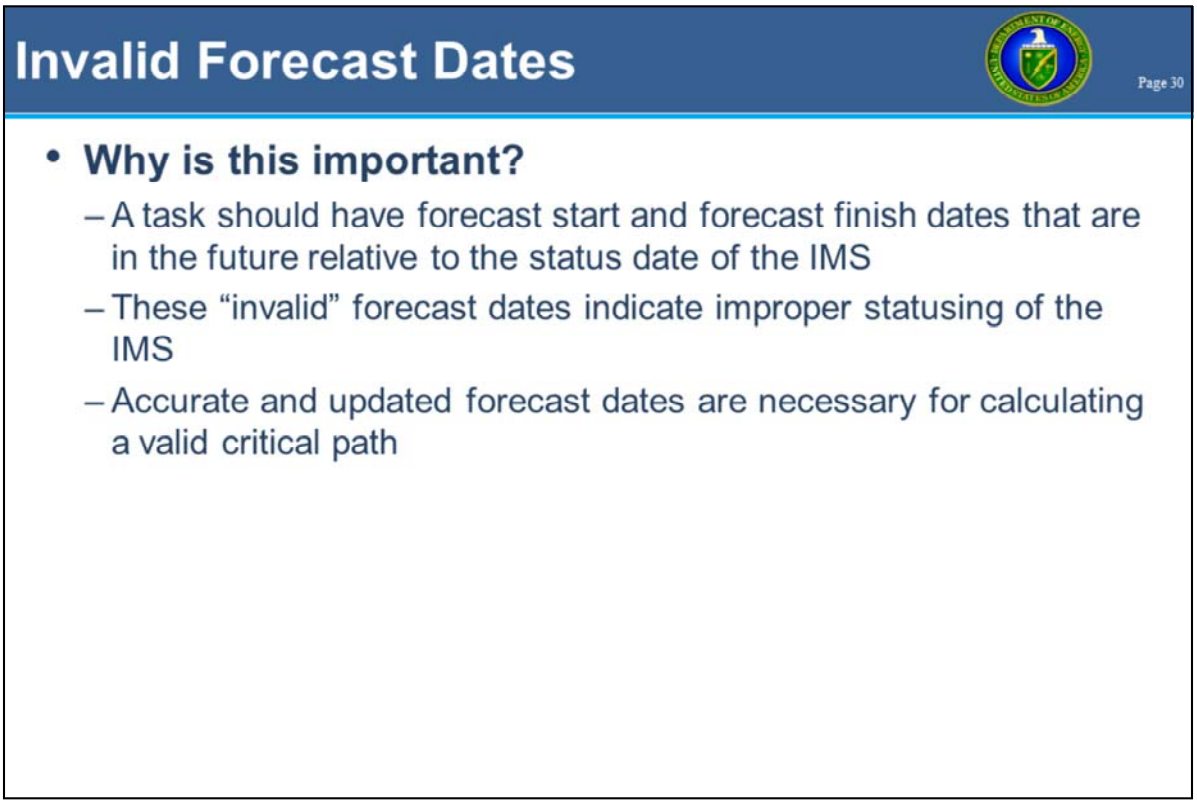
Why is this metric important? A task should NOT have actual start and actual finish dates that are in the future relative to the status date of the IMS. Tasks that have actual start and/or actual finish dates that do not meet the criteria are invalid and indicate that the IMS has not been properly statused.

Accurate and updated actual start and actual finish dates are necessary for good project management and for calculating a valid critical path. Additionally, invalid actual dates adversely affect "out of sequence tasks" and ultimately affect meeting the correct forecasting required to be EVMS compliant.

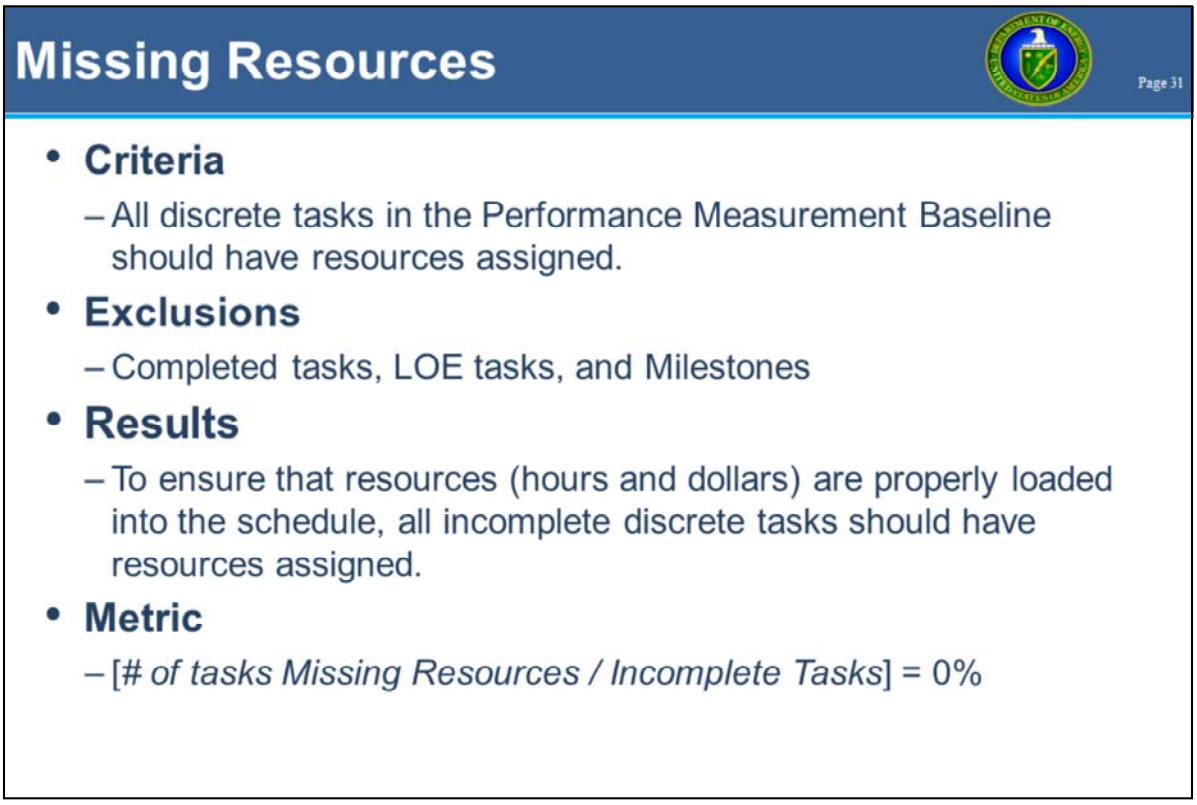


The invalid forecast date metric states that there should be zero tasks with forecast start and/or finish dates in the past. The metric filters out LOE, completed tasks and milestones through the schedule status date. Even though Primavera does not allow forecast dates to remain in the past, it is still possible to create a filter in Primavera that finds discrete tasks that have forecast start and/or finish dates that are before the status date.

The metric identifies the number of tasks with invalid forecast finish and start dates should be 0%.

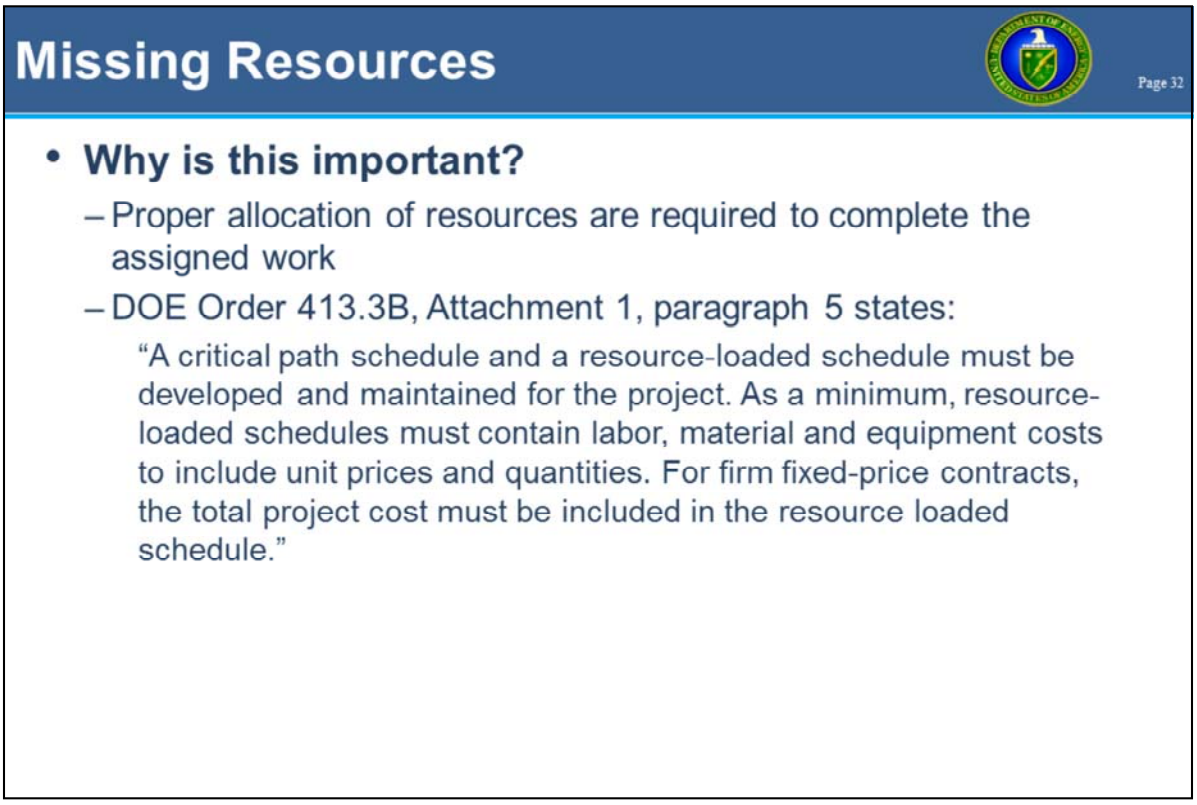


Why is this important? A task should have forecast start and forecast finish dates that are in the future relative to the status date of the IMS. Tasks that have forecast start and/or finish dates that do not meet these criteria are invalid and indicate that the IMS has not been properly statused. Accurate and updated forecast dates are necessary for good project management, for calculating a valid critical path, and for EVMS compliance in general.



The last metric is the missing resources metric. All discrete tasks in the Performance Measurement Baseline should have resources (hours and/or dollars) assigned.

This metric excludes completed tasks, LOE tasks, and milestones. The metric identifies the number of tasks with missing resources should be 0%.



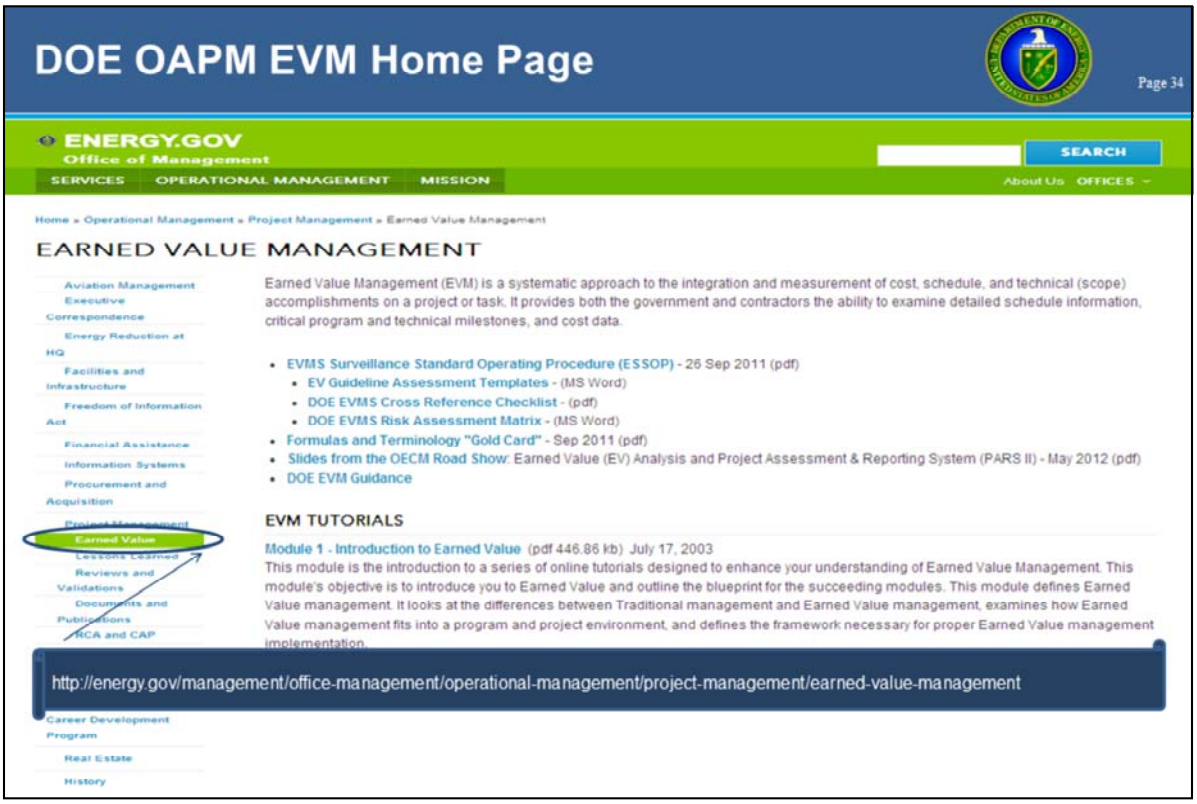
Why is this important? Tasks require the proper allocation of resources (hours and/or dollars) in order to complete the assigned work. DOE Order 413.3B, Attachment 1, paragraph 5 states:

"A critical path schedule and a resource-loaded schedule must be developed and maintained for the project. As a minimum, resource-loaded schedules must contain labor, material and equipment costs to include unit prices and quantities. For firm fixed-price contracts, the total project cost must be included in the resource loaded schedule."

Conclusion

- Review schedule metrics monthly to see if there are schedule health risks on your project.
- It may save you from experiencing unexpected surprises . . .

In conclusion, these schedule health metrics can be easily obtained and reviewed, either in PARSII or by use of commercially available software. These metrics can be quickly reviewed each month to identify any schedule health risks on your project, whether you are the contractor or the customer. It just may save you from experiencing unexpected surprises!



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