THE PRACTITIONER

A monthly newsletter of the Energy Facility Contractors Group's Project Delivery Working Group

Issue 63 October 2024

Planning and Scheduling — Part 2

Happy Fiscal New Year, Fellow EFCOG PDWG Practitioners!!!

Fall is in the air and the autumn colors continue to be magnificent. Fall also brings closure to some of our Annual Work Plan (AWP) tasks. Many thanks to our Project Controls Subgroup for supporting development of PM-30's Supplemental Guidance to CAG 2.0 "Establishment and Usage of Management Reserve (Attributes C.10 and G.1)" and completing a white paper on "Master Program Schedule Integration Methodology". Below is a summary of each.

Preface

Management Reserve (MR) is a key element of the Earned Value Management System (EVMS) to manage unforeseen, in-scope work within a project. Despite its importance, MR is often misunderstood and misused, making it essential to understand its proper establishment and allowable uses. This document aims to identify the principles and expectations for EIA-748 compliant practices on the establishment and allowable and unallowable use of MR.

A healthy project environment, which includes both tangible and intangible factors, is paramount to ensure effective EVMS implementation. The project environment significantly influences the maturity and effectiveness of EVMS implementation, correlating with better project outcomes. To promote responsible MR management and align its usage with project goals, consider the following strategies:

- **Enhance Communication**: Clearly define MR's purpose and guidelines, and regularly communicate these to all stakeholders.
- **Provide Training**: Offer training sessions for managers on MR allocation to ensure understanding of best practices.
- **Cultivate Accountability**: Foster a culture that emphasizes responsibility and appropriate MR use.
- **Implement Strong Oversight**: Establish a governance framework to monitor MR usage, with regular reviews and audits to ensure compliance.
- **Improve Transparency**: Provide managers with real-time data and reporting tools for informed MR decisions.
- **Encourage Collaboration**: Facilitate cross-departmental discussions to align interests and ensure MR allocation supports organizational goals.
- **Establish Clear Policies**: Develop and disseminate clear policies on MR usage, including approval processes and reporting requirements.
- **Utilize Risk Management**: Implement risk assessment processes to determine appropriate MR use and mitigate misuse.
- **Solicit Feedback**: Regularly gather input from managers about MR usage challenges and adjust policies accordingly.

By embracing these strategies and understanding the environmental and human factors influencing EVMS implementation, organizations can foster a project environment that promotes trust, transparency, and shared values.

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This approach reduces the risk of failing to achieve schedule, budget, and performance goals, ensuring effective MR use in compliance with EIA-748 standards.

The EFCOG PDWG, through its support and collaboration, embraces the strategy and approach presented in this PM-30 Supplemental Guidance to CAG 2.0 for Establishment and Usage of Management Reserve (Attributes C.10 and G.1).

The PM document can be found at the following two locations:

- PM EVM Clearinghouse Topics - Dept of Energy-External - Community (connect.gov)
- EVMS Implementation Guidance | Department of Energy (Clearinghouse Topics table)

Master Program Schedule Integration Methodology

The purpose of this white paper is to demonstrate practices related to setting up and maintaining large project/program integrated master schedules (IMS) that include subprojects that are required to be individually submitted into the DOE Project Assessment and Reporting System (PARS). Even though there are subprojects in the IMS that do not report into PARS, it is recommended that those projects consider the outlined practices as they affect the reporting criteria of the PARS subprojects.

DOE is transitioning to a new format for data upload to PARS, using JavaScript Object Notation (JSON) dataset format. The new JSON format requirement, which will replace the existing MS Access file and CSV flat files, are documented within the DOE Contractor Project Performance (CPP) Data Item Description (DID). The new JSON dataset will be required for future PARS data uploads. The latest version of the DOE CPP DID is found at the PARS DOE website.

PARS emphasis is to improve/streamline management of the scope and integration of WBS, schedule, and costs. The focus in the outlined practices is to illustrate the necessary steps required when certain DOE offices/sites maintain an IMS (enterprise site/portfolio/program) that comprise multiple inter-related PARS projects. The individual capital asset projects, each having unique PARS IDs are required to be reported separately in PARS, with each project able to stand alone in the tenets of schedule health and critical path analysis, or identification of tasks with total float less than or equal to zero, within PARS when segregated from the Program IMS. This requires that the submitted schedules must match the same information in the IMS for critical path, date and float calculations, resources, and interproject dependencies (driving and non-driving) originating from external projects included in the site/portfolio/program IMS. To accomplish this, the separated schedules must include interface milestones representing predecessor activities of external projects that link to the activities in the submitted PARS project.

The separation of the schedules for accurate reporting of stand-alone schedule files is facilitated by implementation of a process and methodology for development and maintenance of interface milestones. The standard traditional practice requires manual creation of interface milestones within the submitted PARS project. The use of interface milestones, as discussed later in this document, is necessary to facilitate the ability to create native stand-alone P6 schedule backups (e.g. XER/XML) files for importing into external P6 systems for review and analysis.

In addition to the necessary standard practice of developing and maintaining interface milestones, DOE has commissioned Oracle to develop automated capabilities in P6 to support the DOE CPP JSON DID for reporting project data into PARS.

See the entire white paper at the EFCOG PDWG Website.

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This month's *Practitioner* also continues with our exploration of DOE's "Planning and Scheduling" Guide DOE G 413.3-24. Hopefully you found the time to visit the Energy Facility Contractors Group (EFCOG) Project Delivery Working Group (PDWG) webpage for training material developed and provided for you and your staff's use FileaFrame-Project Delivery | EFCOG.org.

The information provided in DOE G 413.3-24 is important and timely because it will be used in support of a significant EFCOG PDWG AWP task to be worked in collaboration with the PM-30 site reviews. Recent history gathered through PM-30 site reviews identified repeat schedule issues that can be mitigated through advance project peer reviews conducted by an EFCOG PDWG Scheduling Subject Matter Expert (SME) Task Team. This effort will commence once the PM-30 Site Review schedule is finalized and received by the PDWG. So given the additional context, here is where we left off with the guide in the previous *Practitioner*.

This guide addresses **four schedule evolutions**:

- ✓ **Prior to CD-1**, a high-level Master Schedule
- ✓ **Post CD-1**, IMS for the selected alternative
- ✓ **Prior to CD-2**, baseline/forecast IMS
- ✓ **Post CD-2**, baseline/forecast IMS with the construction plan of execution

Prior to CD-1, High-level Master Schedule

The high-level Master Schedule prior to CD-1 addresses each viable alternative being analyzed. It is comprised of:

Scheduling Objective: Include milestones in the **schedule for commitments to stakeholders, contract deliverables, critical decisions and high-level activities to create a high-level longest path**.

Maturity: **This phase represents the submittal and approval of a CD-1 schedule to DOE**. It does not include the maturity of the CD-1 design as it approaches CD-2. Nonetheless, a common best practice prior to CD-1 is to further mature the preferred alternative's schedule in the form of a preliminary working IMS tailored to the conceptual approach outlined in CD-1. This enables better estimation of the cost range proposed at CD-1 while maintaining the high-level master schedule for the other alternatives considered in the Analysis of Alternatives (AoA).

Mechanics: Depicts relationships between Activities and milestones with a high-level longest path.

Risk: **Depicts schedule margin between the end of the PMB and the delivery date specified in the CD-0 approval**. Depicts schedule contingency between the delivery date and the high-end of the approved CD-4 date range.

Status: Prior to CD-1 approval, the schedule does not require forecasting.

Assessments: **No assessments on the pre-CD-1 milestone schedule will occur**.

Post CD-1, IMS for the Selected Alternative

Scheduling Objective: The project matures in this phase from the alternative selection to the detail design.

Maturity: **The schedule between CD-1 approval and CD-2 contains detailed activities as design scope is defined but may be immature with limited activities in the post CD-2 phase**. From CD-1 approval to CD-2 approval,

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preparation of a baseline schedule begins with enough remaining project life-cycle activities to generate a high-level realistic critical path for the period post CD-2 to CD-4 consistent with the high-end estimate approved at CD-1. As the baseline matures, add detail to the baseline schedule. [GAO 16-89G best practice #1 (GAO BP #1)].

Mechanics: Define relationships for all activities [GAO BP #2]. Load each activity with the resources required to complete the work [GAO BP #3]. **Load resources so that all resources tally to the high-end of the approved CD-1 cost range**. It is anticipated that some WBS elements may only have high-level or summary values for resource requirements at this phase. **Assign each activity a realistic duration**. This includes the scope scheduled between CD-2 and CD-4 [GAO BP #4]. Add logical relationships between associated activities or milestones, resources, and durations to generate a realistic critical path through project completion [GAO BP #6]. Determine the total float of each activity and of the overall project through consideration of activity durations coupled with the identified logical dependencies [GAO BP #7]. Demonstrate vertical traceability when subcontractor and summary schedules become available. Demonstrate horizontal traceability through schedule float and schedule logical relationships [GAO BP #5].

Risk: Maintain a risk register. **Complete a schedule risk analysis (SRA)**, the results of which form the basis for DOE schedule contingency and contractor schedule margin (SM) calculated prior to CD-2. [13] Per DOE Order 413.3B, analyze the risk at a confidence level between 70 and 90 percent.

Status: Show status of design accomplishments made during preliminary design in preparation for CD-2.

Assessments: **Complete the assessments in Table 4 to verify the soundness of the schedule post CD-1**. (The table shows GAO best practices in blue.) Find descriptions of each assessment in Appendix A.

Table 4. Post CD-1 to Pre CD-2 Assessments

Number	Name
	1. Capturing All activities
1	WBS Dictionary Matches IMS—Baseline
10	Hours in IMS consistent with Cost Tool Hours—Baseline
11	Risk Mitigations Included—Forecast
28	Baseline IMS Includes HDV Material
29	Critical key milestones and deliverables in IMS—Baseline
60	Risk Mitigations Included—Baseline
	2. Sequencing All activities
2	Adequate Predecessors and Successors—Baseline
3	Limited SF Relationships—Baseline
4	Limited SS or FF Relationships—Baseline
5	Limited Leads—Baseline
6	Limited Lags Baseline
7	Minimize Merge Points—Baseline
8	Limit Hard Constraints—Baseline
9	Minimize Soft Constraints—Baseline
12	No LOE Discrete Successors—Baseline
30	Adequate Predecessors or Successors—Forecast
31	Limited SF Relationships—Forecast
32	Limited SS or FF Relationships—Forecast
33	Limited Leads—Forecast
34	Limited Lags—Forecast
35	Minimize Merge Points—Forecast
36	No LOE Discrete Successors—Forecast
37	Limit Hard Constraints—Forecast
38	Minimize Soft Constraints—Forecast
	3. Assigning Resources to All activities
13	Adequate Resource Loading—Baseline
14	No SVTs with Resources—Baseline
16	Reasonable Resource Profile—Baseline
17	No SM Resources—Baseline
39	Reasonable Resource Profile—Forecast
40	No SVTs with Resources—Forecast
41	Adequate Resource Loading—Forecast
42	No SM Resources—Forecast
	4. Establishing the Duration of All activities
15	Minimize Duration—Baseline
21	Minimize Work Packages—Baseline
	5. Verifying that the Schedule Can Be Traced Horizontally and Vertically
24	Vertical Traceability—Baseline
	6. Confirming That the Critical Path is Valid
18	Critical Path Push Assessment—Baseline
19	Critical Path Pull Assessment—Baseline
20	No LOE on Critical Path—Baseline
22	Critical Path Reasonably Defined—Baseline
23	Continuous Critical Path—Baseline
46	Continuous Critical Path—Forecast
47	Critical Path Reasonably Defined—Forecast
48	Critical Path Push Assessment—Forecast
49	Critical Path Pull Assessment—Forecast
50	No for LOE on Critical Path—Forecast
	7. Ensuring Reasonable Total Float
25	Reasonable Total Float—Baseline
51	Reasonable Total Float—Forecast
	8. Conducting a Schedule Risk Analysis
26	SM Linkage—Baseline
52	SM Duration Consistent with Risk—Forecast
53	SM Linkage—Forecast
	9. Updating the Schedule Using Actual Progress and Logic
54	Physical Complete with No Actual Finish Date—Forecast
55	Statused Out of Sequence—Forecast
56	Actual Start without Physical Percent Complete—Forecast
57	Status Reliability—Forecast
58	Baseline Versus Forecast—Activity Count
59	Forecast Versus Baseline—Activity Count
	10. Maintaining a Baseline Schedule
27	Negative Total Float—Baseline

[13] *Schedule contingency described in GAO 16-89G, current version, includes both DOE schedule contingency and contractor SM.*

Prior to CD-2, Baseline IMS and Forecast IMS

Scheduling Objective: The project matures in this phase, from the alternative selection to a detailed design. **Prepare for an independent cost estimate (ICE) or external independent review (EIR) prior to CD-2 by significantly maturing the IMS. Submit to the ICE and EIR review teams the forecast IMS in place of the proposed baseline IMS**. The ICE and EIR review teams will assess the realism of this forecast schedule.

Maturity: Develop an IMP. Include in the IMP events like critical decisions or other key milestones, deliverables, products, and acceptance criteria, any of which may appear in the Project Execution Plan. **Structure or reconcile the IMS against the integrated master plan (IMP)**.

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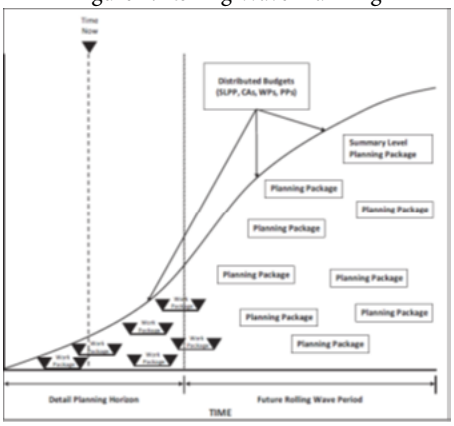
Figure 4. Rolling Wave Planning



- Include in the baseline IMS the entire scope the project will submit for approval prior to CD-2. **Align the baseline IMS to the basis of estimate (BOE) used to generate the contractor CD-2 cost estimate and the government ICE**. Ensure planning packages (PP) through the start of execution or construction have adequate maturity to support a realistic critical path through CD-4. Just like projects combining CD-2 and CD-3 should a design maturity near 100 percent, commensurately define execution and construction activities prior to a CD-2/3 [GAO BP #1]. If available, define subcontractor efforts based on subcontractor estimates received as part of planning for construction or execution.
- **Use rolling wave or block planning**, defined as cycles of detail planning, to develop work packages (WP), planning packages (PP), and Summary Level Planning Packages (SLPPs). Support the baseline with WPs through near-term detail planning periods and by PPs or SLPPs throughout the remainder of the IMS.
- **Include sufficient details in WPs and their associated activities to allow for execution**. Use PPs or SLPPs beyond the near-term rolling wave and block planning spans as shown in Figure 4. PPs have no duration limit. However, ensure WPs have shorter durations than PPs, generally less than two months. [14] Keep the scope, schedule, and budget of both WPs and PPs integrated.

[14] *Neither GAO nor PASEG specify a maximum duration for activities. The related assessment counts activities with durations in excess of 44 working days.*

End the schedule with a CD-4 milestone and any closeout and commissioning activities necessary.

Mechanics: Define relationships for all activities [GAO BP #2]. Load each activity with the resources required to complete the associated scope [GAO BP #3]. Assign each activity a realistic duration. Buffer the schedule risk by adding SM. Limit discrete activity durations to less than two months in the absence of quantifiable backup data (QBD) [GAO BP #4]. **Plan future activities beyond the detail planning period with enough detail to accurately depict the relationships, resources and durations to generate a realistic critical path through project completion [GAO BP #6]**. Confirm a small percentage of incomplete activities comprise the critical path. Justify the duration and resources of activities with detailed BOEs. Calculate schedule float and determine the critical path by conducting a forward and backward pass through the schedule [GAO BP #7]. Identify subcontracted work and subcontractor schedules in the IMS to allow for horizontal and vertical traceability [GAO BP #5].

Risk: Maintain the risk register. Complete an SRA through CD-4. An SRA feeds optimistic, most likely, and pessimistic activity durations into a Monte Carlo simulation to determine the probability of completion by a specified date. **Base the CD-4 date on an SRA calculated without SM or DOE schedule contingency**. After analyzing the probability of achieving CD-4 at a confidence level between 70 and 90 percent, base the schedule margin and DOE contingency on the gap between the last activity and the risk adjusted CD-4 date. Baseline the schedule, deemed achievable through the risk assessment, with SM and DOE schedule contingency included to generate a CD-4 date [GAO BP #7, 8].

Status: **Summarize historical costs as "sunk costs" [GAO BP #10]**. Retain the baseline IMS that supported the CD-2 approval as the baseline IMS. Use a copy of this baseline IMS as the forecast IMS for recording future status.

Assessment: **Complete the assessments in Table 5 (next page) to verify the soundness of the schedule prior to CD-2**. (The table shows GAO best practices in blue.) Find descriptions of each assessment in Appendix A.

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Post CD-2, Baseline IMS with the Construction Plan of Execution

Document differences, if any, between schedule tools and algorithms used by subcontractors and the contractor in a manner consistent with the WBS.

Scheduling Objective: Manage the execution of the project, including long lead procurements, following the expectation for the baseline and forecast IMSs described in this section.

- **Confirm the baseline and forecast schedules contain the entire scope of the project**. The baselined scope, schedule, and budget remain under change control for the remaining duration of the project.
- As the project approaches the start of construction, update the IMS to reflect the details of the construction plans including authorized long lead procurements and executed construction contracts. **Use rolling wave techniques for planning**. Reflect the detailed field execution, or lower level, schedules used for near term planning in the IMS.

Maturity: Reconcile scope in the IMS with the most recent changes impacting scope. **Complete and reconcile work authorizations**. Ensure that both the baseline and forecast schedules fully comply with GAO 16-89G and PASEG.

- After CD-2, copy the baseline IMS and designate it as the forecast IMS. Progress and track activities and update plans and schedules reflecting work performed in the forecast IMS. Follow established configuration management and change control processes when maintaining the baseline IMS. Fully integrate, and keep consistent, schedule and cost between the baseline and forecast schedules.
- **Continue to use rolling wave or block planning to support the baseline with WPs through near-term planning periods and by PPs or SLPPs throughout the remainder of the IMS**.

Table 5. Pre CD-2 Assessment Principles

Number	Name
	1. Capturing All Activities
1	WBS Dictionary Matches IMS—Baseline
10	Hours in IMS consistent with Cost Tool Hours—Baseline
11	Risk Mitigations Included—Forecast
28	Baseline IMS Includes HDV Material
29	Critical key milestones and deliverables in IMS—Baseline
60	Risk Mitigations Included—Baseline
	2. Sequencing All Activities
2	Adequate Predecessors and Successors—Baseline
3	Limited SF Relationships—Baseline

Number	Name
4	Limited SS or FF Relationships—Baseline
5	Limited Leads—Baseline
6	Limited Lags Baseline
7	Minimize Merge Points—Baseline
8	Limit Hard Constraints—Baseline
9	Minimize Soft Constraints—Baseline
12	No LOE Discrete Successors—Baseline
30	Adequate Predecessors or Successors—Forecast
31	Limited SF Relationships—Forecast
32	Limited SS or FF Relationships—Forecast
33	Limited Leads—Forecast
34	Limited Lags—Forecast
35	Minimize Merge Points—Forecast
36	No LOE Discrete Successors—Forecast
37	Limit Hard Constraints—Forecast
38	Minimize Soft Constraints—Forecast
	3. Assigning Resources to All Activities
13	Adequate Resource Loading—Baseline
14	No SVTs with Resources—Baseline
16	Reasonable Resource Profile—Baseline
17	No SM Resources—Baseline
39	Reasonable Resource Profile—Forecast
40	No SVTs with Resources—Forecast
41	Adequate Resource Loading—Forecast
42	No SM Resources—Forecast
	4. Establishing the Duration of All Activities
15	Minimize Duration—Baseline
21	Minimize Work Packages—Baseline
	5. Verifying That the Schedule Can be Traced Horizontally and Vertically
18	Critical Path Push Assessment—Baseline
19	Critical Path Pull Assessment—Baseline
24	Vertical Traceability—Baseline
43	Vertical Traceability—Forecast
44	Supplemental Vertical Traceability—Forecast
45	Subcontractor Vertical Traceability—Baseline
48	Critical Path Push Assessment—Forecast
49	Critical Path Pull Assessment—Forecast

Number	Name
	6. Confirming That the Critical Path is Valid
20	No LOE on Critical Path—Baseline
22	Critical Path Reasonably Defined—Baseline
23	Continuous Critical Path—Baseline
46	Continuous Critical Path—Forecast
47	Critical Path Reasonably Defined—Forecast
50	No LOE on the Critical Path – Forecast
	7. Ensuring Reasonable Total Float
25	Reasonable Total Float—Baseline
51	Reasonable Total Float—Forecast
	8. Conducting a Schedule Risk Analysis
26	SM Linkage—Baseline
52	SM Duration Consistent with Risk—Forecast
53	SM Linkage—Forecast
	9. Updating the Schedule Using Actual Progress and Logic
54	Physical Complete with No Actual Finish Date—Forecast
55	Statused Out of Sequence—Forecast
56	Actual Start without Physical Percent Complete—Forecast
57	Status Reliability—Forecast
58	Baseline Versus Forecast Activity Count
59	Forecast Versus Baseline Activity Count
	10. Maintaining a Baseline Schedule
27	Negative Total Float—Baseline

Mechanics: Ensure activities reflect the most detailed level of planning completed. Load each activity with sufficient resources to complete the work [GAO BP #3]. Limit activity durations to two months or less [GAO BP #4]. Develop the schedule through CD-4 with enough detail to accurately depict the relationships, resources, and durations to generate a realistic critical path through project completion [GAO BP #6]. **Confirm the reasonableness of schedule float, all activities have logical ties, and that the earned value technique (EVT) assigned to each WP or activity reflects how project intends to accomplish the work [GAO BPs #2, 3, 4, 6,]**.

- Develop the schedule through a forward pass by identifying the successor to the current activity then determining those activities' logical successors until reaching CD-4. Review and validate the schedule through a backward pass by starting at the end of the schedule and continuing back to the beginning. **Confirm all activities required to complete the project appear in the IMS, each logically linked to completely defined predecessors**. Ensure each activity in the baseline and forecast schedule, except for start and finish milestones, has at least one predecessor and one successor. Justify and document exceptions.
- **Construct the schedule linking most activities with finish to start (FS) logic**. Use FS logic to connect at least one successor activity to predecessors with a start to start (SS) or finish to finish (FF) relationship to prevent

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dangling logic. Avoid using start to finish (SF) logic [GAO BP #2].15 Use lags sparingly. Lags delay the start of an activity. Document and justify all lags, typically those longer than 22 working days, in a user-defined field in P6.16 Do not use leads, also known as negative lags [GAO BP #2].

- **Limit, and justify in P6, the use of hard constraints** which override relationship logic and may make the results of float calculations difficult to understand [GAO BP #2].

Avoid using mandatory constraints in P6. Minimize the use of finish no earlier, finish no later, and start type constraints. Use a finish on or before constraint for CD-4.[17].

- **Assess the schedule for activities or milestones with a large number (typically 15) of predecessors** except for CD-3, CD-4, or the schedule margin activity [GAO BP #2].[18]
- Estimate resources using historical data [GAO BP #3]. Load labor, material, and equipment costs to include unit prices and quantities on activities, excluding milestones and schedule visibility tasks (SVTs). **Identify high dollar value (HDV) material with a code associated with the activity and plan the receipt dates**.
- Review availability constraints placed on resources loaded on activities. CAMs determine and justify the sequence, relationships, duration, and resources estimated for activities. Confirm that the available budget can sustain resource demand peaks. Model resource availability with soft constraints such as with a start-on-or-after constraint in P6.[19]
- **Include and clearly label all LOE activities in the IMS, do not link them as predecessors to discrete work nor Contract Budget Base (CBB) completion milestone**, but logically plan LOE without level loading. For discrete work, ensure CAMs estimate the loading without reserves or margin buffers [GAO BP #4].
- **Maintain vertical and horizontal integration**. After CD-3, align each activity to its assigned contractor. For more guidance, see section 7.3.5.3 [GAO BP #5]. Ensure that incomplete discrete and LOE WPs, PPs, and SLPPs found in the EVMS cost tool also appear in the baseline schedule and that the budget at completion (BAC) labor hours by WBS code, start dates, and end dates for incomplete WPs and PPs match. Use the IMS duration, relationships, and resources to calculate the forward and backward pass to identify the critical (longest) path with the following characteristics: continuous, non-constrained until the end, and with minimal lags [GAO BP #6].

[15] GAO "discourages" using this relationship. PASEG says to "avoid" its use.
[16] Neither GAO nor PASEG specify an acceptable maximum number of days per lag.
[17] Neither GAO nor PASEG supports including hard constraints in the schedule.
[18] Neither GAO nor PASEG specify an acceptable maximum number of predecessors.
[19] PASEG addresses the availability of resources.

Challenge activities with negative or high total float. Total float is the amount of time that a schedule activity can be delayed from its early start date without delaying the project finish date or impacting a schedule constraint. Negative total float implies an infeasibility in the schedule. An excessive amount of float may challenge the validity of the schedule. Where total float is considered high the resource profile curve can be affected possibly skewing resource-leveling scenario analyses. Review such high total float changes monthly for reasonableness and adequate justification. Conversely, investigate any negative total float which may indicate a performance issue requiring workarounds or additional management priority. [GAO BP #7].

Risk: Maintain the Risk Register. Complete an SRA [GAO BP #8] prior to a long lead procurement, executing a construction contract, annually calculating a comprehensive estimate at complete (EAC), and changing the PB. **Assess the likelihood of achieving the established CD-4 date based on an SRA calculated without SM or DOE schedule contingency using a confidence level between 70 and 90 percent**. Find more detailed guidance on SRAs in both GAO-16-89G and PASEG.

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Status: Maintain the forecast schedule with actual start and finish dates, percent complete, and forecasted remaining durations. **Ensure supplemental or detailed schedules developed by contractors remain consistent with the forecast schedule**. Status the schedule and recalculate the critical path at least monthly. Review new activities for logic and completeness. **For earned value, ensure that CAMs status activities consistent with the identified EVTs**. Do not calculate earned value (EV) for discrete work based on the passage of time.

- **Review free and total float**, which communicate schedule priorities, changes, and impacts, for significant changes. Use free float to de-conflict resources or activities as its use does not impact successor activities [GAO BP#9].
- Performing activities out of sequence, or changing logic, may increase total float. Prior to executing, have the integrated project team review and validate these changes while verifying that all activities have proper predecessor and successor relationships.
- **If problems arise, incorporate workarounds in the forecast schedule as soon as possible**. Ensure the CAMs, with assistance from project controls, update the schedule in P6. Assign the schedule a unique identification number and archive it monthly [GAO BP #9].
- **Calculate the IMS via the retained logic option in P6 and not the progress override**. Reconcile or correct circular errors monthly [GAO BP #9]. Hold IMS management reviews monthly. Document significant variations and workarounds. [GAO BP #9]
- **Keep the baseline schedule, including original durations, relationships, resources, and EVTs, under configuration control and use it for earned value calculations**. Maintain the baseline to demonstrate an executable plan and sequence for future activities [GAO BP #10].

Table 6. Post CD-2 Assessment Principles

Number	Name
	1. Capturing All Activities
1	WBS Dictionary Matches IMS—Baseline
10	Hours in IMS consistent with Cost Tool Hours—Baseline
11	Risk Mitigations Included—Forecast
28	Baseline IMS Includes HDV Material
29	Critical key milestones and deliverables in IMS—Baseline
60	Risk Mitigations Included— Baseline
	2. Sequencing All Activities
2	Adequate Predecessors and Successors—Baseline
3	Limited SF Relationships—Baseline
4	Limited SS or FF Relationships—Baseline
5	Limited Leads—Baseline
6	Limited Lags Baseline
7	Minimize Merge Points—Baseline
8	Limit Hard Constraints—Baseline
9	Minimize Soft Constraints—Baseline
12	No LOE Discrete Successors—Baseline
30	Adequate Predecessors or Successors—Forecast
31	Limited SF Relationships—Forecast
32	Limited SS or FF Relationships—Forecast
33	Limited Leads—Forecast
34	Limited Lags—Forecast
35	Minimize Merge Points—Forecast
36	No LOE Discrete Successors—Forecast
37	Limit Hard Constraints—Forecast
38	Minimize Soft Constraints—Forecast
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17	No SM Resources—Baseline
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	5. Verifying That the Schedule Can Be Traced Horizontally and Vertically
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24	Vertical Traceability—Baseline
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44	Supplemental Vertical Traceability—Forecast
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22	Critical Path Reasonably Defined—Baseline
23	Continuous Critical Path—Baseline
46	Continuous Critical Path—Forecast
47	Critical Path Reasonably Defined—Forecast
50	No LOE on Critical Path—Forecast
	7. Ensuring Reasonable Total Float
25	Reasonable Total Float—Baseline
51	Reasonable Total Float—Forecast
	8. Conducting a Schedule Risk Analysis
26	SM Linkage—Baseline
52	SM Duration Consistent with Risk—Forecast
53	SM Linkage—Forecast
	9. Updating the Schedule Using Actual Progress and Logic
54	Physical Complete with No Actual Finish Date—Forecast
55	Statused Out of Sequence—Forecast
56	Actual Start without Physical Percent Complete—Forecast
57	Status Reliability—Forecast
58	Baseline Versus Forecast Activity Count
59	Forecast Versus Baseline Activity Count.
	10. Maintaining a Baseline Schedule
27	Negative Total Float—Baseline

Assessment: **Complete the assessments in Table 6** to verify the soundness of the schedule post CD-2. (The table shows GAO best practices in blue.) Find descriptions of each assessment in Appendix A.

Well, that's it for this month, but there is more to come in the next edition of the Practitioner when we continue to with the Planning and Scheduling Special Topics Section where we will look at:

- Integration of Risk Management into the Schedule
- Level of Effort
- Schedule Margin and DOE Schedule Contingency in an IMS

And more…see you next month!

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Just for Fun: October's Notable Events and Famous Birthdays

Notable Events

1 — Yosemite National Park was established (1890), the first World Series game was played (1903), the first Ford Model T was introduced (1908), the People's Republic of China was established (1949), American Express issued the first credit card in the U.S. (1958), Roger Maris broke Babe Ruth's single-season home run record with his 61st (1961), and 58 people were killed in a mass shooting in Las Vegas (2017).

2 — The Texas Revolution began (1835), Thurgood Marshall was sworn in as the first African-American Supreme Court justice (1967), Bob Gibson set the World Series single-game strikeout record with 17 (1968), and actor Rock Hudson died of AIDS (1985).

3 — Thanksgiving became an official holiday (1863), Iraq became an independent nation (1932), Britain successfully tested an atomic bomb (1952), the "Guinness Book of World Records" made its debut (1955), East and West Germany were reunited (1990), and O.J. Simpson was acquitted of murder (1995).

4 — Construction of Mount Rushmore began (1927), the Brooklyn Dodgers won their first and only World Series title (1955), the Soviet Union launched *Sputnik*, the first artificial satellite, into orbit (1957), and Pope Paul VI became the first pope to visit the U.S. (1965).

5 — **President Harry Truman delivered the first televised presidential speech** (1947), the New York Yankees won a record fifth consecutive World Series title (1953), the first NC-17 film rating was given for *Henry & June* (1990), and Apple founder Steve Jobs died (2011).

6 — The first train robbery in the U.S. was staged (1866), and the Yom Kippur War between Israel and Egypt/Syria began (1973).

7 — The assembly line made its debut in a Ford factory (1913), East Germany was established (1949), and Operation Enduring Freedom began in Afghanistan (2001).

8 — The Great Chicago Fire began (1871), Don Larsen pitched the only perfect game in World Series history (1956), and impeachment proceedings against President Bill Clinton began (1998).

9 — Hoover Dam began transmitting electricity (1936).

10 — The U.S. Naval Academy was established (1845), and the first major operation of the Vietnam War began (1965).

11 — The first manned Apollo mission launched (1968), and *Saturday Night Live* debuted (1975).

12 — Christopher Columbus reached the New World (1492).

13 — The Continental Navy was established (1775), the cornerstone of the White House was laid (1792), and Bill Mazeroski hit the first ever World Series-winning walkoff home run (1960).

14 — USAF Capt. Chuck Yeager broke the sound barrier (1947), and the Cuban Missile Crisis began (1962).

15 — **Wayne Gretzky broke the NHL career scoring record with 1,851 points** (1989).

16 — China successfully tested its first nuclear bomb (1964), "Baby Jessica" was rescued from a well on live TV (1987), and 84 people died in a stampede at a World Cup match in Guatemala (1996).

17 — OPEC enacted an oil embargo on the U.S. and other nations (1973), and a 7.1 magnitude earthquake hit the Bay Area, postponing Game 3 of the World Series for 10 days (1989).

18 — The Mason-Dixon Line was established (1767), and the U.S. took possession of Alaska (1867) and Puerto Rico (1898).

19 — The American Revolutionary War ended with the British surrender at Yorktown, Va. (1781), and Maurice Richard became the first NHL player to score 500 goals (1957).

20 — The Louisiana Purchase was ratified (1803), and three members of the rock band Lynyrd Skynyrd died in a plane crash (1977).

21 — About 100,000 antiwar protesters marched on the Pentagon (1967).

22 — The U.S. suffered its first casualties in Vietnam (1957), President John F. Kennedy ordered a blockade of Cuba (1962), and Lance Armstrong was stripped of his 7 Tour de France titles (2012).

23 — A car bomb exploded at the U.S. Marines barracks in Beirut, Lebanon, killing 241 (1983).

24 — The first transcontinental telegraph line was completed (1861), the United Nations was formally established (1945), Toronto won Canada its first World Series title (1992), and the supersonic Concorde jet made its last flight (2003).

25 — Artist Pablo Picasso was born (1881), and the U.S. invaded Grenada (1983).

26 — The Erie Canal opened (1825), the Shootout at the OK Corral occurred (1881), and President George W. Bush signed the Patriot Act (2001).

27 — **New York's subway system began operation** (1904), the Cuban Missile Crisis ended (1962), and the Boston Red Sox won their first World Series title in 86 years (2004).

28 — The Statue of Liberty was dedicated (1886), Congress overruled President Wilson's veto and enacted Prohibition (1919), and the Digital Millennium Copyright Act was signed (1998).

29 — The stock market crashed, touching off the Great Depression (1929), the Suez Crisis began when Israel invaded Egypt (1956), and guitarist Duane Allman died in a motorcycle crash (1971),

30 — "The War of the Worlds" was broadcast, causing a nationwide panic (1938), and Muhammad Ali beat George Foreman for the heavyweight title in the "Rumble in the Jungle" (1974).

31 — Nevada became a state (1864), magician/escape artist Harry Houdini died (1926), Earl Lloyd broke the color line in the NBA (1950), and Indian prime minister Indira Gandhi was assassinated (1984).

Birthdays

1 — Actor Walter Matthau (1920), **39th U.S. President Jimmy Carter** (1924), actress/singer Julie Andrews (1935), and actors Randy Quaid (1950) and Zach Galifianakis (1969)

2 — Civil rights leader Mahatma Gandhi (1869), entertainer Groucho Marx (1890), rock star Sting (1951), and TV personality Kelly Ripa (1970)

3 — Singer Chubby Checker (1941), civil rights leader Rev. Al Sharpton and guitar ace Stevie Ray Vaughan (1954), and singer Gwen Stefani (1969)

4 — 19th U.S. President Rutherford B. Hayes (1822), actor Charlton Heston (1924), author Anne Rice (1941), and actresses Susan Sarandon (1946) and Alicia Silverstone (1976)

5 — 21st U.S. President Chester Arthur (1829), **fast food entrepreneur Ray Kroc** (1902), astronomer Neil deGrasse Tyson and actor/comedian Bernie Mac (1958), and actress Kate Winslet (1975)

6 — Actresses Carole Lombard (1942) and Elisabeth Shue (1963)

7 — Rock singer John Mellencamp (1951), Russian president Vladimir Putin (1952), cellist Yo-Yo Ma (1955), music judge Simon Cowell (1959), and actress Rachel McAdams (1976)

8 — Automobile inventor Frank Duryea (1869), civil rights leader Rev. Jesse Jackson (1941), actor Chevy Chase (1943), actress Sigourney Weaver (1949), and actor Matt Damon (1970)

9 — Musician John Lennon (1940), and actors Scott Bakula and John O'Hurley (1954)

10 — Rock singer David Lee Roth (1955), football hall of famer Brett Favre (1969), and stock car racer Dale Earnhardt Jr. (1974)

11 — First lady Eleanor Roosevelt (1884), singer Daryl Hall (1946), **football hall of famer Steve Young** (1961), and actress Joan Cusack (1962)

12 — Opera singer Luciano Pavarotti (1935), and actors Hugh Jackman (1968) and Kirk Cameron (1970)

13 — Jazz pianist Art Tatum (1909), comedian Lenny Bruce and British prime minister Margaret Thatcher (1925), singer/songwriter Paul Simon (1941), rocker Sammy Hagar (1949), singer Marie Osmond (1959), football hall of famer Jerry Rice (1962), and actor/comedian Sacha Baron Cohen (1971)

14 — General and 34th U.S. President Dwight Eisenhower (1890), actor Roger Moore (1927), fashion designer Ralph Lauren (1934), and rapper/singer Usher (1979)

15 — Philosopher Nietzche (1844), and British royal Sarah Ferguson and TV chef Emeril Lagasse (1959)

16 — Dictionary author Noah Webster (1758), playwright Oscar Wilde (1854), and actresses Angela Lansbury (1925) and Suzanne Somers (1946)

17 — Actress Rita Hayworth (1918), motorcycle daredevil Evel Knievel (1938), actor George Wendt (1948), country singer Alan Jackson (1958), **comedian Norm MacDonald** (1963), and rapper Eminem (1972)

18 — Rocker Chuck Berry (1926), football hall of famer Mike Ditka and JFK assassin Lee Harvey Oswald (1939), tennis legend Martina Navratilova (1956), Olympic skier Lindsey Vonn (1984), and actor Zac Efron (1987)

19 — Actors John Lithgow (1945) and Jon Favreau (1966)

20 — Actor Bela Lugosi (1882), baseball Hall of Famer Mickey Mantle (1931), rocker Tom Petty (1953), and rapper Snoop Dogg (1972)

21 — Jazz trumpeter Dizzy Gillespie (1917), Israeli prime minister Benjamin Netanyahu (1949), actress Carrie Fisher (1956), and celebrity Kim Kardashian (1980)

22 — Actors Christopher Lloyd (1938) and Jeff Goldblum (1952)

23 — TV personality Johnny Carson (1925), soccer legend Pele (1940), **singer Dwight Yoakam** (1956), musical parodist Weird Al Yankovic (1959), and actor Ryan Reynolds (1976)

24 — Author Stephen Covey (1932)

25 — Artist Pablo Picasso (1881), hall of fame basketball coach Bobby Knight (1940), and singers Jon Anderson (1944) and Katy Perry (1984)

26 — TV game show host Pat Sajak and politician Hillary Clinton (1947), and actor Dylan McDermott (1962)

27 — 26th U.S. President Theodore Roosevelt (1858)

28 — Musician Charlie Daniels (1936), Microsoft co-founder Bill Gates (1955), and actress Julia Roberts (1967)

29 — Actor Richard Dreyfuss (1947) , actress Winona Ryder (1971)

30 — 2nd U.S. President John Adams (1735), singer Grace Slick (1939), and **actor Henry Winkler** (1945)

31 — Actor Michael Landon (1936), actor John Candy (1950), football coach Nick Saban (1951), actor Rob Schneider (1963), and rapper Vanilla Ice (1967)