# Benchmarking of Scheduling Standards and Practices against GAO Best Practices for Project Schedules [1, 2]

**Tijo Kurian**

## ABSTRACT

In oil and gas industry projects, the problem is to produce a class schedule for measuring the performance of projects. The purpose of this paper is to select appropriate standards for future reference in adopting best practices in scheduling. In the analysis, various standards across the globe, company standards, and contractors scheduling practices benchmarked against GAO Schedule Assessment Guide. A scoring model developed by using Multi Attributes Decision Making (MADM) Non-compensatory and compensatory method on the basis of the GAO Schedule Assessment Guide. From the analysis it's found that GAO Schedule Assessment Guide is superior to the other standards and practices. The recommendation from this paper is that the practices from GAO Schedule Assessment Guide can be adopted to prepare and maintain a quality, reliable schedule in projects. Owners can ensure these practices were followed in their projects by adopting the standards as scheduling specifications in the contractual documents.

**Keywords:** Best practices in scheduling, GAO Schedule Assessment Guide, Project Schedule, Scoring Models, Multi-attribute Decision Making, activities

## INTRODUCTION

"Owners continue to experience project failures, 53% suffered one or more underperforming projects in the previous year. For energy and natural resources and public sector respondents, the figures were 71% and 90%, respectively. Only 31% of all respondents' projects came within 10% of the budget in the past 3 years. Just 25% of projects came within 10% of their original deadlines in the past 3 years"[3]. Developing a feasible project schedule is challenging due to many factors. In oil and gas, the projects are delaying due to various reasons and one of the major reasons that the contractor may not produce a feasible project schedule that should not comply with the best practices in scheduling. Hence the contractor loses the opportunity for forecasting and predictive manners. This happens due to a lack of awareness and usage of best practices in scheduling. The author in this paper tried to overcome such circumstances made

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[3] KPMG International. (2015). Climbing the curve. Retrieved from https://assets.kpmg/content/dam/kpmg/pdf/2015/04/global-construction-survey-2015.pdf


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by the contractors and give the awareness about the best practices which to be followed for the preparation and maintaining the schedule. There are many standards and references available for the standardization of project schedules in that the GAO Schedule Assessment Guide seems the best to compare the schedules with the best practices and adopt for the preparation of the schedules. To overcome such situations and make aware of the contractors the importance of implementing the best practices in scheduling for the schedule development. To substantiate the facts four project schedules have been selected for the assessment with the best practices in GAO Schedule Assessment Guide.

The GAO Schedule Assessment Guide provides ten best practices to develop and maintain a reliable and high-quality schedule for the smooth execution of projects. In appendix II, the guide has provided a detailed audit questionnaire that can exclusively use for the audit of the schedule, and thereby, the health of the schedule can be determined. GAO concluded with the "four characteristics required for a reliable and high-quality schedule that it should be comprehensive, well-constructed, credible and controlled." As per GAO;

**Comprehensive**

"A comprehensive schedule includes all activities for both the government and its contractors necessary to accomplish a program's objectives as defined in the program's WBS. The schedule includes the labor, materials, travel, facilities, equipment, and the like needed to do the work and depicts when those resources are needed and when they will be available. It realistically reflects how long each activity will take and allows for discrete progress measurement"[4].

**Well-constructed**

"A schedule is well-constructed if all its activities are logically sequenced with the most straightforward logic possible. Unusual or complicated logic techniques are used judiciously and justified in the schedule documentation. The schedule's critical path represents a true model of the activities that drive the program's earliest completion date, and total float accurately depicts schedule flexibility."

**Credible**

"A schedule is credible if it is horizontally traceable—that is, it reflects the order of events necessary to achieve aggregated products or outcomes. It is also vertically traceable: activities in varying levels of the schedule map to one another and key dates presented to management in periodic briefings are in sync with the schedule. Data about risks are used to predict a level of confidence in meeting the program's completion date. Necessary schedule contingency and high-priority risks are identified by conducting a robust schedule risk analysis."

[4] U.S. Government Accountability Office. (2015). GAO Schedule Assessment Guide Best Practices for Project Schedules (148). Author. FOUR CHARACTERISTICS OF A RELIABLE SCHEDULE


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**Controlled**

"Finally, a schedule is controlled if trained schedulers update it regularly using actual progress and logic—based on information provided by activity owners—to realistically forecast dates for program activities. Updates to the schedule are accompanied by a schedule narrative that describes salient changes to the network. The current schedule is compared against a designated baseline schedule to measure, monitor, and report the program's progress. The baseline schedule is accompanied by a basis document that explains the overall approach to the program, defines ground rules and assumptions, and describes the unique features of the schedule. The baseline schedule and current schedule are subjected to configuration management control ."[5]

In this paper, the author demonstrates the best practices that to be followed for the preparation of the project schedule by adopting the ten Best practices entailed in the four scheduling characteristics in the GAO Schedule Assessment Guide. A scoring model is to be developed by using Multi Attributes Decision Making non compensatory and compensatory model methodology for the benchmarking of the project schedules in order to assess the project schedules against the ten best practices thereby the health of the schedule can be determined and to provide proper feedback to the management about the importance of adopting the best practice for schedule development. And feedback to be provided to the contractor about the practices least used in the schedule and overcome such practices by incorporating the best practices for scheduling in future projects, and by adopting these practices, they can prepare a reliable and high-quality schedule. This research should find the answers for the below-mentioned questions;

- How can we rate the GAO standard for Best scheduling practices, among other standards?
- What are the best practices in scheduling to be followed for schedule development?

## PROBLEM STATEMENT

In the oil and gas industry, contractors need to improve the quality of the schedule as per the author's findings. The main reason behind this is the contractor's exposure to the best scheduling practices is limited; lack of schedule specification in contract documents. To negate this, a standard for the Best scheduling practices to be in place and to incorporate these practices as a specification in contract documents. There are some standards available with Government authorities and other professional organizations, which to be assessed as per the Multi Attributes Decision Making (MADM) and adopt for the purpose.

[5] U.S. Government Accountability Office. (2015). GAO Schedule Assessment Guide Best Practices for Project Schedules (148). Author. FOUR CHARACTERISTICS OF A RELIABLE SCHEDULE


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## FEASIBLE ALTERNATIVES

In standards, there are some alternatives selected for this research. The alternatives are GAO Schedule Assessment Guide, GPC Compendium and Reference, TCM from AACE, PMBOK from PMI, Owner Standards & Contractor Standards.

### GAO SCHEDULE ASSESSMENT GUIDE

"The U.S. Government Accountability Office is responsible for, among other things, assisting the Congress in its oversight of the federal government, including agencies' stewardship of public funds. To use public funds effectively, the government must employ effective management practices and processes, including the measurement of government program performance.

The GAO Schedule Assessment Guide develops the scheduling concepts introduced in the Cost Estimating and Assessment Guide and presents them as ten best practices associated with developing and maintaining a reliable, high-quality schedule. The GAO Schedule Assessment Guide also presents guiding principles for auditors to evaluate certain aspects of government programs."[6]

### GPC COMPENDIUM AND REFERENCE

"This document has been designed to be a compilation of "best tested" and "proven practices" along with references and sample templates purposed for Project Control Practitioners operating in a global and pan-industry environment.

This guide has been collated, organized, and proposed by an unparalleled array of experienced practitioners and comprises many pages of references. It serves as the Project Controls Compendium and Reference (CaR) with links to what Subject Matter Experts (SME) believe to be "best tested and proven" tools, techniques, and methodologies.

This Guild of Project Controls Compendium and Reference (GPCCaR) has been created to serve the following purposes:

1. To be used as a handy "Project Controls Reference"- a compendium of tools, techniques, methodologies, references, and templates developed by both owners and contractors, and;
2. As the basis to prepare for one or more of the Guild of Project Controls certification exams, and;
3. It provides standards to which practitioners are expected to adhere in order to be recognized by the Guild of Project Controls, and;
4. It also defines appropriate performance benchmarks and standards against which they would be measured and provides a tool for continued education and learning, and;

[6] United States. Government Accountability Office. Applied Research and Methods. (2015). Introduction. In *GAO schedule assessment guide: best practices for project schedules* (p. 1).


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5. To be used in relation to Project Controls operations within any industry sector or global location."[7]

**TOTAL COST MANAGEMENT (TCM) FROM AACE**

"Total cost management (TCM) is the effective application of professional and technical expertise to plan and control resources, costs, profitability, and risk. Simply stated, TCM is a systematic approach to managing cost throughout the life cycle of any enterprise, program, facility, project, product or service. The TCM Framework is a representation of that systematic approach.

The TCM Framework is a structured, annotated process map that explains each practice area of the cost engineering field in the context of its relationship to the other practice areas, including allied professions. It provides a process for applying the skills and knowledge of cost engineering. A key feature of the TCM Framework is that it highlights and differentiates the main cost management application areas: project control and strategic asset management.

The TCM Framework is a significant contribution to the cost management profession applicable to all industries. It is an AACE cornerstone technical document that joins the current body of knowledge for related fields such as project management, operations management, and management accounting. It is also consistent with organizational and portfolio thinking, which ties all practices and processes back to overall business strategies and objectives."[8]

**PMBOK FROM PMI**

"PMI defines the project management body of knowledge (PMBOK) as a term that describes the knowledge within the profession of project management. The project management body of knowledge includes proven traditional practices that are widely applied as well as innovative practices that are emerging in the profession.

The body of knowledge (BOK) includes both published and unpublished materials. This body of knowledge is constantly evolving. This PMBOK® Guide identifies a subset of the project management body of knowledge that is generally recognized as good practice.

The Standard for Project Management is a foundational reference for PMI's project management professional development programs and the practice of project management. Because project management needs to be tailored to fit the needs of the project, the standard and the guide are both based on descriptive practices, rather than prescriptive practices.

[7] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR). (2015, November 2). Retrieved from http://www.planningplanet.com/guild/gpccar/purpose

[8] Hollmann, J. K. (2006). *Total Cost Management Framework: An Integrated Approach to Portfolio, Program, and Project Management* (pp. 17-18). AACE International.


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Therefore, the standard identifies the processes that are considered good practices on most projects, most of the time."[9]

### OWNER STANDARDS FOR SCHEDULING

The specifications have been selected from the Companies which serve a guideline for the preparation and maintaining the schedule for the projects.

### CONTRACTORS PRACTICES FOR SCHEDULING

Based on the assessment of the project schedules from the contractors, the practices they followed for the preparation of the schedules also as an alternative here.

## DEVELOPMENT OF OUTCOMES

For further analysis, the scoring attributes selected from GAO Appendix VI to compare the alternative standards. The methodology used here for the analysis is the Multi Attributes Decision Making (MADM) Non-Compensatory Model Dominance method.

"Dominance is a useful screening method for eliminating inferior alternatives from the analysis. When one alternative is better than another with respect to all attributes, there is no problem in deciding between them. By comparing each possible pair of alternatives to determine whether the attribute values for one are at least as good as those for the other, it may be possible to eliminate one or more candidates from further consideration or even to select the single alternative that is clearly superior to all the others."[10]

| Sl No. | Attributes | Alternatives | | | | | |
|---|---|---|---|---|---|---|---|
| | | GAO | GPCCAR | AACE | PMI | COMPANY | CONTRACTOR |
| 1 | **Capturing all activities** | | | | | | |
| 1a | Total number of activities, including total summary, hammock, milestone, and detail activities | 5 | 5 | 3 | 3 | 3 | 3 |
| 1b | Total number of remaining activities, including total summary, hammock, milestone, and detail activities | 5 | 5 | 3 | 3 | 3 | 3 |
| 1c | If applicable, the number of activities marked as both a milestone and summary activity | 5 | 5 | 3 | 3 | 0 | 0 |
| 1d | Number of activities with no descriptive name | 5 | 5 | 0 | 0 | 0 | 0 |
| 1e | Ratio of detail activities to milestones | 5 | 0 | 0 | 0 | 0 | 0 |
| 1f | Number of activities not mapped to program or contractor work breakdown structure | 5 | 5 | 5 | 5 | 3 | 3 |
| 1g | Number of contractor activities not mapped to an SOW paragraph or similar information | 5 | 5 | 5 | 5 | 3 | 3 |
| 1h | Number of activities with duplicate names | 5 | 3 | 0 | 0 | 0 | 0 |

[9] Project Management Institute Project Management Institute. (2017). *A Guide to the Project Management Body of Knowledge (PMBOK® Guide) — Sixth Edition and Agile Practice Guide (ENGLISH)* (pp. 1-2). Newton Square, PA: Project Management Institute.

[10] Sullivan, W. G., Wicks, E. M., & Koelling, C. P. (2014). Decision Making Considering Multiattributes. In *Engineering Economy* (16th ed., p. 580). Harlow, England: Pearson.


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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Subtotal of Capturing all activities** | **40** | **33** | **19** | **19** | **12** | **12** |
| | **Percentage of Capturing all activities** | **10.81%** | **8.92%** | **5.14%** | **5.14%** | **3.24%** | **3.24%** |
| **2** | **Sequencing all activities** | | | | | | |
| 2a | Number of remaining detail activities and milestones missing predecessor links | 5 | 5 | 0 | 0 | 3 | 3 |
| 2b | Number of remaining detail activities and milestones missing successor links | 5 | 5 | 0 | 0 | 3 | 3 |
| 2c | Number of remaining detail activities and milestones missing both predecessor and successor links | 5 | 5 | 0 | 0 | 0 | 0 |
| 2d | Dangling activities: number of remaining detail activities and milestones with no predecessor on the start date | 5 | 5 | 0 | 0 | 0 | 0 |
| 2e | Dangling activities: number of remaining detail activities and milestones with no successor off finish date | 5 | 5 | 0 | 0 | 0 | 0 |
| 2f | Percentage of logic links that are finish to-start | 5 | 5 | 0 | 0 | 0 | 0 |
| 2g | Number of remaining detail activities and milestones with start-to-finish links | 5 | 5 | 0 | 0 | 0 | 0 |
| 2h | Number of remaining summary activities with logic links | 5 | 5 | 0 | 3 | 0 | 0 |
| 2i | Remaining detail activities and milestones with a great many predecessors | 5 | 5 | 0 | 0 | 0 | 0 |
| 2j | Remaining detail activities and milestones with soft date constraints | 5 | 5 | 3 | 0 | 0 | 0 |
| 2k | Remaining detail activities and milestones with hard date constraints | 5 | 5 | 3 | 0 | 0 | 0 |
| 2l | Remaining detail activities and milestones with active SNET date constraints | 5 | 5 | 0 | 0 | 0 | 0 |
| 2m | Remaining detail activities and milestones with active FNET date constraints | 5 | 5 | 0 | 0 | 0 | 0 |
| 2n | Remaining detail activities and milestones with lags | 5 | 5 | 0 | 0 | 0 | 0 |
| 2o | Number of lags on remaining detail activities and milestones | 5 | 5 | 0 | 0 | 0 | 0 |
| 2p | Remaining detail activities and milestones with leads | 5 | 5 | 0 | 0 | 0 | 0 |
| 2q | Number of leads on remaining detail activities and milestones | 5 | 5 | 0 | 0 | 0 | 0 |
| 2r | Remaining detail activities and milestones with an F–S predecessor lead greater than remaining duration | 5 | 5 | 0 | 0 | 0 | 0 |
| | **Subtotal of Sequencing all activities** | **90** | **90** | **6** | **3** | **6** | **6** |
| | **Percentage of Sequencing all activities** | **24.32%** | **24.32%** | **1.62%** | **0.81%** | **1.62%** | **1.62%** |
| **3** | **Assigning resources to all activities** | | | | | | |
| 3a | Total number of resources | 5 | 5 | 3 | 3 | 3 | 3 |
| 3b | Overallocated resources | 5 | 5 | 0 | 0 | 0 | 0 |
| 3c | Maximum units available per resource | 5 | 5 | 0 | 0 | 0 | 0 |
| 3d | Summary activities and milestones with assignments | 5 | 3 | 0 | 0 | 0 | 0 |
| 3e | Remaining detail activities with assignments | 5 | 3 | 0 | 0 | 0 | 0 |
| 3f | Remaining detail activities without assignments | 5 | 3 | 0 | 0 | 0 | 0 |
| 3g | Remaining detail activities with dissimilar time units | 5 | 3 | 0 | 0 | 0 | 0 |
| | **Subtotal of Assigning resources to all activities** | **35** | **27** | **3** | **3** | **3** | **3** |
| | **Percentage of Assigning resources to all activities** | **9.46%** | **7.30%** | **0.81%** | **0.81%** | **0.81%** | **0.81%** |
| **4** | **Establishing the duration of all activities** | | | | | | |
| 4a | Remaining detail activities or milestones starting or finishing on a weekend or holiday | 5 | 5 | 0 | 0 | 0 | 0 |
| 4b | Holidays and other exceptions by task calendar | 5 | 5 | 0 | 0 | 0 | 0 |
| 4c | Remaining detail activities with durations less than the reporting period | 5 | 5 | 0 | 0 | 0 | 0 |
| 4d | Remaining detail activities with durations | 5 | 5 | 0 | 0 | 0 | 0 |


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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | greater than the reporting period | | | | | | |
| 4e | Average duration of remaining detail activities | 5 | 3 | 0 | 0 | 0 | 0 |
| 4f | Median duration of remaining detail activities | 5 | 3 | 0 | 0 | 0 | 0 |
| | **Subtotal of Establishing the durations of all activities** | **30** | **26** | **0** | **0** | **0** | **0** |
| | **Percentage of Establishing the durations of all activities** | **8.11%** | **7.03%** | **0.00%** | **0.00%** | **0.00%** | **0.00%** |
| **5** | **Verifying that the schedule can be traced horizontally and vertically** | | | | | | |
| 5a | Assessment of how critical and noncritical planned dates dynamically react to dramatic increases in predecessor activity durations | 5 | 5 | 0 | 0 | 0 | 0 |
| | **Subtotal of Verifying that the schedule can be traced horizontally and vertically** | **5** | **5** | **0** | **0** | **0** | **0** |
| | **Percentage of Verifying that the schedule can be traced horizontally and vertically** | **1.35%** | **1.35%** | **0.00%** | **0.00%** | **0.00%** | **0.00%** |
| **6** | **Confirming that the critical path is valid** | | | | | | |
| 6a | Assessment of the driving paths to key milestones and comparison of those paths to activities marked as critical in the schedule | 5 | 5 | 3 | 3 | 3 | 3 |
| 6b | Number of critical activities | 5 | 5 | 5 | 5 | 3 | 3 |
| 6c | Number of critical LOE activities | 5 | 5 | 5 | 5 | 0 | 0 |
| 6d | Number of lags and leads on the critical path | 5 | 5 | 0 | 0 | 0 | 0 |
| 6e | Number of critical activities with hard date constraints | 5 | 5 | 0 | 0 | 0 | 0 |
| 6f | Number of in-progress critical activities | 5 | 5 | 0 | 0 | 0 | 0 |
| | **Subtotal of Confirming that the critical path is valid** | **30** | **30** | **13** | **13** | **6** | **6** |
| | **Percentage of Confirming that the critical path is valid** | **8.11%** | **8.11%** | **3.51%** | **3.51%** | **1.62%** | **1.62%** |
| **7** | **Ensuring reasonable total float** | | | | | | |
| 7a | Remaining detail activities and milestones with dissimilar total float time units | 5 | 5 | 3 | 3 | 0 | 0 |
| 7b | Remaining detail activities and milestones with a relatively high total float | 5 | 5 | 3 | 3 | 0 | 0 |
| 7c | Remaining detail activities with negative total float | 5 | 5 | 3 | 3 | 0 | 0 |
| 7d | Average total float value of remaining detail activities and milestones | 5 | 5 | 3 | 3 | 0 | 0 |
| 7e | Median total float value of remaining detail activities and milestones | 5 | 5 | 3 | 3 | 0 | 0 |
| | **Subtotal of Ensuring reasonable total float** | **25** | **25** | **15** | **15** | **0** | **0** |
| | **Percentage of Ensuring reasonable total float** | **6.76%** | **6.76%** | **4.05%** | **4.05%** | **0.00%** | **0.00%** |
| **8** | **Conducting a schedule risk analysis** | | | | | | |
| 8a | Fields within the schedule used for SRA | 5 | 5 | 3 | 0 | 0 | 0 |
| 8b | Correlation measures within the schedule | 5 | 5 | 0 | 0 | 0 | 0 |
| 8c | Contingency activities | 5 | 5 | 3 | 3 | 0 | 0 |
| | **Subtotal of Conducting a schedule risk analysis** | **15** | **15** | **6** | **3** | **0** | **0** |
| | **Percentage of Conducting a schedule risk analysis** | **4.05%** | **4.05%** | **1.62%** | **0.81%** | **0.00%** | **0.00%** |
| **9** | **Updating the schedule using actual progress and logic** | | | | | | |
| 9a | Number of in-progress activities | 5 | 5 | 0 | 0 | 0 | 0 |
| 9b | Number of remaining detail activities and milestones that have a forecasted start date in the past but no actual start date | 5 | 3 | 0 | 0 | 0 | 0 |
| 9c | Number of remaining detail activities and milestones that have a forecasted finish date in the past but no actual finish date | 5 | 3 | 0 | 0 | 0 | 0 |
| 9d | Number of remaining detail activities and milestones that have an actual start date in the future | 5 | 3 | 0 | 0 | 0 | 0 |
| 9e | Number of remaining detail activities and milestones that have an actual finish date in the | 5 | 3 | 0 | 0 | 0 | 0 |


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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | future | | | | | | |
| 9f | Number of detail activities performed out of sequence | 5 | 5 | 3 | 3 | 0 | 0 |
| | **Subtotal of Updating the schedule using actual progress and logic** | **30** | **22** | **3** | **3** | **0** | **0** |
| | **Percentage of Updating the schedule using actual progress and logic** | **8.11%** | **5.95%** | **0.81%** | **0.81%** | **0.00%** | **0.00%** |
| **10** | **Maintaining a baseline schedule** | | | | | | |
| 10a | Number of detail activities and milestones with baseline dates | 5 | 5 | 0 | 0 | 0 | 0 |
| 10b | Number of detail activities and milestones without baseline dates | 5 | 5 | 0 | 0 | 0 | 0 |
| 10c | Number of remaining detail activities and milestones that are forecast to start or finish before their baseline dates | 5 | 5 | 0 | 0 | 0 | 0 |
| 10d | Number of remaining detail activities and milestones that are forecast to start or finish on their baseline dates | 5 | 5 | 0 | 0 | 0 | 0 |
| 10e | Number of remaining detail activities and milestones that are forecast to start or finish after their baseline dates | 5 | 5 | 0 | 0 | 0 | 0 |
| 10f | Number of remaining detail activities that actually started before their baseline start date | 5 | 5 | 0 | 0 | 0 | 0 |
| 10g | Number of remaining detail activities that actually started on their baseline start date | 5 | 5 | 0 | 0 | 0 | 0 |
| 10h | Number of remaining detail activities that actually started after their baseline start date | 5 | 5 | 0 | 0 | 0 | 0 |
| 10i | Number of detail activities and milestones that actually finished before their baseline finish date | 5 | 5 | 0 | 0 | 0 | 0 |
| 10j | Number of detail activities and milestones that actually finished on their baseline finish date | 5 | 5 | 0 | 0 | 0 | 0 |
| 10k | Number of detail activities and milestones that actually finished after their baseline finish date | 5 | 5 | 0 | 0 | 0 | 0 |
| 10l | Average and median start variance | 5 | 0 | 0 | 0 | 0 | 0 |
| 10m | Average and median finish variance | 5 | 0 | 0 | 0 | 0 | 0 |
| 10n | Baseline execution index | 5 | 5 | 0 | 0 | 0 | 0 |
| | **Subtotal of Maintaining a baseline schedule** | **70** | **60** | **0** | **0** | **0** | **0** |
| | **Percentage of Maintaining a baseline schedule** | **18.92%** | **16.22%** | **0.00%** | **0.00%** | **0.00%** | **0.00%** |
| **Total Score (DOMINANCE )** | | **370** | **333** | **65** | **59** | **27** | **27** |
| **Total Percentage** | | **100.00%** | **90.00%** | **17.57%** | **15.95%** | **7.30%** | **7.30%** |

Figure 1: Non-Compensatory Model with scoring attributes from GAO Appendix VI[11]

[11] By Author


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| Sl No. | Attributes | Alternatives | | | | | |
|---|---|---|---|---|---|---|---|
| | | GAO | GPCCAR | AACE | PMI | COMPANY | CONTRACTOR |
| 1 | Capturing all activities | 10.81% | 8.92% | 5.14% | 5.14% | 3.24% | 3.24% |
| 2 | Sequencing all activities | 24.32% | 24.32% | 1.62% | 0.81% | 1.62% | 1.62% |
| 3 | Assigning resources to all activities | 9.46% | 7.30% | 0.81% | 0.81% | 0.81% | 0.81% |
| 4 | Establishing the durations of all activities | 8.11% | 7.03% | 0.00% | 0.00% | 0.00% | 0.00% |
| 5 | Verifying that the schedule can be traced horizontally and vertically | 1.35% | 1.35% | 0.00% | 0.00% | 0.00% | 0.00% |
| 6 | Confirming that the critical path is valid | 8.11% | 8.11% | 3.51% | 3.51% | 1.62% | 1.62% |
| 7 | Ensuring reasonable total float | 6.76% | 6.76% | 4.05% | 4.05% | 0.00% | 0.00% |
| 8 | Conducting a schedule risk analysis | 4.05% | 4.05% | 1.62% | 0.81% | 0.00% | 0.00% |
| 9 | Updating the schedule using actual progress and logic | 8.11% | 5.95% | 0.81% | 0.81% | 0.00% | 0.00% |
| 10 | Maintaining a baseline schedule | 18.92% | 16.22% | 0.00% | 0.00% | 0.00% | 0.00% |
| Total | | 100.00% | 90.00% | 17.57% | 15.95% | 7.30% | 7.30% |

Figure 2: Summary of Percentage obtained in each attribute for all alternatives [12]

The percentage at the attribute level is calculated by the ratio of subtotal at attribute level to Total score obtained for the alternative.

$$\text{Percentage of attributes} = \frac{\text{Subtotal to the attribute}}{\text{Total score of alternative}}$$

For Eg: Percentage of GAO "Capturing all activities = (40/370)*100 = 0.1081*100 = 10.81%

From the non-compensatory model analysis, it's clear that the GAO standard dominates all other selected as alternatives, and by this screening method, inferior alternatives shall be eliminated.

## SELECTION CRITERIA

The decision criterion is based on the scoring attributes against the scores in the alternative standards and selection to be made, which scores high in the alternatives lead to the selection of the best standard for scheduling practices. The criterion should serve to prepare a quality and reliable schedule which meets or exceeds the standard requirements. The selection of feasible alternatives shall be made according to scores obtained, and acceptance criteria for the selection of further analysis are greater than or equal to 15%. According to the scores obtained in the alternatives below, the acceptance criteria shall be rejected from further analysis. In fact, for further analysis, only four out of six will be selected.

## ANALYSIS AND COMPARISON OF ALTERNATIVES

Based on the selection criteria, the feasible alternatives shall be selected on the obtained scores. Hence four alternatives can be selected for further analysis and reject two alternatives scores below the criteria score. For further analysis, the technique used here is Adding weighting Method. "Attribute weights should be determined in two steps following the

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completion of ordinal ranking. First, relative weights are assigned to each attribute according to its ordinal ranking. The second step is to normalize the relative ranking numbers by dividing each ranking number by the sum of all the rankings. It's a single-dimensional method since it includes performance ratings and importance weights of each attribute when evaluating alternatives." [13]According to the top scores obtained from the alternatives can be selected as the best alternative.

| Sl No. | Attributes | Alternatives Non-Dimensional Data Table 14-09 | | | | Relative | Normalized | Scores for each alternatives | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | GAO | GPCCAR | AACE | PMI | Rank | Weight | GAO | GPCCAR | AACE | PMI |
| 2 | Sequencing all activities | 24.32% | 24.32% | 1.62% | 0.81% | 10.00 | 0.18 | 0.04 | 0.04 | 0.00 | 0.00 |
| 10 | Maintaining a baseline schedule | 18.92% | 16.22% | 0.00% | 0.00% | 9.00 | 0.16 | 0.03 | 0.03 | 0.00 | 0.00 |
| 1 | Capturing all activities | 10.81% | 8.92% | 5.14% | 5.14% | 8.00 | 0.15 | 0.02 | 0.01 | 0.01 | 0.01 |
| 3 | Assigning resources to all activities | 9.46% | 7.30% | 0.81% | 0.81% | 7.00 | 0.13 | 0.01 | 0.01 | 0.00 | 0.00 |
| 4 | Establishing the durations of all activities | 8.11% | 7.03% | 0.00% | 0.00% | 6.00 | 0.11 | 0.01 | 0.01 | 0.00 | 0.00 |
| 6 | Confirming that the critical path is valid | 8.11% | 8.11% | 3.51% | 3.51% | 5.00 | 0.09 | 0.01 | 0.01 | 0.00 | 0.00 |
| 9 | Updating the schedule using actual progress and logic | 8.11% | 5.95% | 0.81% | 0.81% | 4.00 | 0.07 | 0.01 | 0.00 | 0.00 | 0.00 |
| 7 | Ensuring reasonable total float | 6.76% | 6.76% | 4.05% | 4.05% | 3.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | Conducting a schedule risk analysis | 4.05% | 4.05% | 1.62% | 0.81% | 2.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | Verifying that the schedule can be traced | 1.35% | 1.35% | 0.00% | 0.00% | 1.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total | | 100% | 90% | 18% | 16% | 55.00 | 1.00 | 0.13 | 0.12 | 0.02 | 0.02 |
| | | ^Best Choice | | | | | | ^WINNER | | | |

Figure 3: Compensatory Single dimensional Method for analysis of the selected four alternatives[14]

By using Additive weighting technique steps as follows[15]

- Add up the total of relative ranking of all attributes and its 55
- Normalize the weighing of each attribute and give a perfect score 1.00
- Scores of each alternative obtained product of the percentage of attributes in alternatives and normalized weight.
- From this analysis, GAO scores 0.13, which scores first among the other alternatives, and GPCCAR scores 0.12 maintains the second position. The other two alternatives score 0.02 as the inferior option.

[13] Sullivan, W. G., Wicks, E. M., & Koelling, C. P. (2014). Decision Making Considering Multiattributes. In *Engineering Economy* (16th ed., p. 587). Harlow, England: Pearson

[14] Author formatted from SULLIVAN, W. G., Wicks, E. M., & Koelling, C. P. (2019). *Engineering Economy, Global Edition* (p. 588). TABLE 14-10 The Additive Weighting Technique Applied to Example 14.

[15] Guild of Project Controls. (2015, October 3). GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR). Retrieved from http://www.planningplanet.com/guild/gpccar/managing-change-the-owners-perspective


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## SELECTION OF PREFERRED ALTERNATIVE

From additive weighting technique analysis to select the best alternative among the four selected alternatives, GAO Standard for Best Scheduling practices can be selected as the best alternative standards. This selected standard shall be used for the preparation of quality and reliable schedules for measuring program performance against the approved plan. It can be used as a checklist for assessing the health of the schedule.

## PERFORMANCE MONITORING

The best practices in the GAO Schedule assessment guide provide the entities that need to be considered when preparing quality and reliable schedules. The qualitative and quantitative analysis of the schedule can be performed by using Appendix II and VI respectively from the GAO Schedule Assessment Guide for Best Practices. Hence these practices can be included as specifications for the development and maintaining of the schedule.

## CONCLUSION AND RECOMMENDATIONS

The original objective of this research was to find the answers for the below-mentioned questions;

- How can we rate the GAO standard for Best scheduling practices, among other standards?

Based on using both non-compensatory and compensatory Multi-attribute Decision Making (MADM) analysis, the GAO rank as clearly the "best tested and proven" standards when compared against other leading standards associated with scheduling.

- What are the best practices in scheduling to be followed for schedule development?

The GAO Schedule Assessment Guide comprises all relevant best practices for the development and follow-ups for the Project Schedule. The GAO standards as shown in Appendix II and VI as included in this paper as appendices that represent "best tested and proven" practices …

This paper gives a recommendation to the project owners where the "best tested and Proven "practices in GAO Schedule Assessment Guide shall be included in the contractual documents as scheduling specification and are to be followed by the fellow contractors without any hesitation.


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Other specific recommendations based on this analysis are:

1) GAO
For future updates, it would be helpful if the GAO was to create a scoring model comparable to Figure 1 shown above.

2) Guild
Based on the Multi-Attribute Decision-Making Model in Table 1 above-identified areas of weakness that the Guild's Compendium has not addressed. It is recommended that the Guild update their Compendium to address these areas of weakness or omissions.

3) AACE

Based on the Multi-Attribute Decision-Making Model in Table 1 above-identified areas of weakness that AACE has not addressed. It is recommended that AACE update their Recommended Practices (RP's) to address these areas of weakness or omissions.

4) PMI

Based on the Multi-Attribute Decision-Making Model in Table 1 above-identified areas of weakness that PMI has not addressed. It is recommended that PMI update their Standards of Practices to address these areas of weakness or omissions.

5) Company
It is recommended that the company START by adopting the GAO document as their Scheduling Manual of Practice and require in the contract documents that the contractors be required to submit their progress schedules that substantially comply with the GAO document, specifically Appendix II and Appendix VI.

It is also recommended that the Company establish a Project Management Office (PMO) or "Project Controls Office" to review the contractors schedules against the GAO checklists and then track and report progress against the approved performance measurement baseline.

6) Contractor

It is recommended that the contractors START by adopting the GAO document as their Scheduling Manual of Practice and require in the contract documents that payment be made not off milestones but off the activities shown on the CPM schedule, PROVIDED it substantially complies with the requirements in the GAO document, specifically Appendix II and Appendix VI.


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# APPENDIX II

## An Auditor's Key Questions and Documents

### Best Practice 1: Capturing All Activities

**Key Questions**

1. Is there an IMS for managing the entire program (not just a block, increment, or prime contractor)? Is the schedule defined at an appropriate level to ensure effective management?
2. Is the IMS maintained in scheduling software and linked to external, detailed proj-ect schedules?
3. How does management ensure the accuracy of reported schedule information? Do the government program management office and contractors have different sched-uling software systems? If so, how is integrity preserved and verified when convert-ing the schedule?
4. Does the IMS include government, contractor, and applicable subcontractor effort?
5. Does the schedule reflect the program WBS and does the WBS allow tracking key deliverables? Does every activity trace to an appropriate WBS element, and do the activities define how the deliverables will be produced? Does the schedule WBS map to the cost estimate WBS? Is there a WBS dictionary?
6. Are key milestones identified and are they consistent with the contract dates and other key dates management established in the baseline schedule?
7. Does the schedule have clear start and finish milestones? Are there too many mile-stones in relation to detail activities?
8. Are activities within the schedule easily traced to key documents and other infor-mation through activity or task codes? Are all contractor activities mapped to the contract statement of work (SOW) to ensure that all effort is accounted for in the schedule?
9. Are activity names unique and descriptive? Are activities phrased in verb-noun combinations (for example, "develop documentation")? Are milestones named with verb-noun or noun-verb combinations (for example, "start project" or "project finished")?
10. Are level-of-effort activities clearly marked?
11. Does the schedule include significant risk mitigation efforts as discrete activities? If not, how are they documented and tracked?

**Key Documentation**

1. Work breakdown structure (WBS) and dictionary

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2. Statement of work (SOW), integrated master plan (IMP) and mission require-ments, as applicable
3. SOW crosswalk to the WBS and schedule activities, as applicable
4. Contractor WBS to program WBS crosswalk
5. Schedule custom fields and activity codes dictionary and LOE field identification
6. Activity codes used to organize and filter the activities into categories as necessary to confirm a complete scope of work
7. Plans and documentation used for defining activities, such as the systems engineer-ing plan, software development plan, risk management plan, and master test plan.

**Likely Effects If Criteria Are Not Fully Met**

1. If activities are missing from the schedule, then other best practices will not be met. If all activities are not accounted for, it is uncertain whether all activities are sched-uled in the correct order, resources are properly allocated, missing activities will appear on the critical path, or a schedule risk analysis can account for all risk.
2. Failing to include all work for all deliverables, regardless of whether the deliverables are the responsibility of the government or contractor, can lead to program members' incomplete understanding of the plan and its progress toward a successful conclusion.
3. If the schedule does not fully and accurately reflect the program, it will not be an appropriate basis for analyzing or measuring technical work accomplished and may result in unreliable completion dates, time extension requests, and delays.
4. If government work is not captured in the IMS, the program manager will be less able to plan all the work and minimize the risk of government-caused delays.
5. Because the schedule is used for coordination, missing elements will hinder coordi-nation efforts, increasing the likelihood of disruption and delays.
6. If the schedule is not planned in sufficient detail, then opportunities for process improvement (for example, identifying redundant activities), what-if analysis, and risk mitigation will be missed.
7. A schedule that does not emanate from a single start milestone activity and ter-minate at a single finish milestone activity is not properly constructed and may produce an erroneous critical path.
8. LOE activities can interfere with the critical path unless they are clearly marked and represented as summary or hammock activities designed for the purpose.
9. Too many milestones in the schedule can mask the activities necessary to achieve key milestones and can prevent the proper recording of progress.
10. Schedules that are defined at too high a level may disguise risk that is inherent in lower-level activities. Conversely, schedules that have too much detail make it diffi-cult to manage progress.
11. Unless the schedule is aligned to the program WBS, management cannot ensure that the total scope of work is accounted for within the schedule.
12. Repetitive naming of activities makes communication difficult between teams, par-ticularly between team members who are responsible for updating and integrating multiple schedules.

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## Best Practice 2: Sequencing All Activities

**Key Questions**

1. Have the activities and logical relationships been determined by those executing the program?
2. Are the majority of the relationships within the detailed schedules finish-to-start?
3. Are predecessor links (with the exception of the start milestone) or successor links (with the exception of the finish milestone) missing?
4. Are any predecessors or successors dangling?
   a. Does each activity (except the start milestone) have an F–S or S–S predecessor that drives its start date?
   b. Does each activity (except the finish milestone and deliverables that leave the project without subsequent effect on the project) have an F–S or F–F successor that it drives?
5. Do summary activities have predecessor or successor links?
6. Do activities have start-to-finish links?
7. How much convergence (that is, several parallel activities converging at one major event) is there in the schedule? For activities that have many converging predeces-sors, do those predecessors have adequate float?
8. Does the schedule contain date constraints other than "as soon as possible"? Is each one justified in the schedule documentation?
9. Are lags or leads specified between the activities? Can these be more accurately characterized by improving logic or adding activity detail?

**Key Documentation**

1. Documentation justifies using hard and soft date constraints instead of activities' duration and logic.
2. Documentation justifies using lags and leads instead of activities' duration and logic.
3. Documentation justifies any activity that has no F–S or S–S predecessor or no F–S or F–F successor.

**Likely Effects If Criteria Are Not Fully Met**

1. The logical sequencing of events is directly related to float calculations and the criti-cal path. If the schedule is missing dependencies or if activities are linked incorrect-ly, float estimates will be miscalculated. Incorrect float estimates may result in an invalid critical path and, thus, will not be reliable indicators of where resources can be shifted to support delayed critical activities.
2. That all interdependencies between activities are identified is necessary for the schedule to properly calculate dates and predict changes in the future. Without the right links, activities that slip early in the schedule do not transmit delays to activ-ities that should depend on them. When this happens, the schedule will not allow a sufficient understanding of the program as a whole, and users of the schedule will

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lack confidence in the dates and the critical path. Finally, when activities are not correctly linked, the program cannot use the IMS to identify disconnects or hidden opportunities and cannot otherwise promote efficiency and accuracy or control the program by comparing actual to planned progress.

3. Logical sequencing promotes a realistic workflow. If logic between activities is miss-ing, program team members can misunderstand one another, especially regarding receivables and deliverables.
4. For scheduling software packages that include the option, summary activities should not have logic relationships because their start and finish dates are derived from lower-level activities. Summary logic hinders vertical traceability by obstruct-ing the logic of lower-level activities.
5. A start-to-finish (S–F) link has the bizarre effect of directing a successor activity not to finish until its predecessor activity starts, in effect reversing the expected flow of sequence logic. The use of S–F logic is counterintuitive and overcomplicates sched-ule network logic.
6. The presence of "dangling activities" reduces the credibility of the calculated activity start and finish dates and the identity of the critical paths. The slip or elongation of an activity that has no logical successor will not reflect its effect on the scheduled start dates of successor activities.
   a. If an activity—other than the start milestone—does not have an F–S or S–S predecessor that drives its start date, the activity will start earlier if its duration is projected to be longer than originally believed. An earlier start may be illogical.
   b. If an activity—other than the finish milestone or deliverable that leaves the project—does not drive a successor by an F–S or F–F link, the implications of its running late or long are not passed on to any successor activity.
7. The ability of a schedule to forecast start and finish dates of activities and key events is directly related to the complexity and completeness of the schedule network. Unless complete network logic is established, the schedule cannot predict the effects on the program's planned finish date from, among other things, misallocated resources, delayed activities, external events, and unrealistic deadlines.
8. Because a logic relationship dictates the effect of an on-time, delayed, or accelerated activity on following activities, any missing logic relationship is potentially damag-ing to the entire network.
9. Path convergence issues can represent an unrealistic plan by implying that a large number of activities must be finished at the same time before a major event can occur as planned. An excess number of parallel relationships can indicate an overly aggressive or unrealistic schedule.
10. Hard date constraints that restrict activities to starting or finishing on a specific date must be justified by referring to some controlling event outside the schedule. Date constraints prevent activities from responding dynamically to network logic, including actual progress and availability of resources. They can seriously affect float calculations and the identification or continuity of the critical path and can mask both progress and delays in the schedule.



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11. Hard and soft constraints interfere with the results of a schedule risk analysis because they prevent activity dates within the schedule from dynamically responding to changes in predecessor dates.
12. A customer-mandated date is not a legitimate reason to constrain an activity. A schedule is intended to be a dynamic, pro-active planning and risk mitigation tool that models the program and can be used to track progress toward important program milestones. Schedules with constrained dates can portray an artificial or unrealistic view of the program plan.
13. Constraints should be used only when necessary and only if their justification is documented because they override network logic and restrict how planned dates re-spond to accomplished effort or resource availability. The presence of a large number of activities with constraints is typically a substitute for logic and can mean that the schedule is not well planned and may not be feasible.
14. SNLT and FNLT constraints prevent activities from starting or finishing later than planned, essentially restricting the ability of any predecessor delays to affect their start and finish dates.
15. Applying constraints to represent the availability of resources requires constant man-ual upkeep of the schedule.
16. Mandatory start and finish constraints are the most rigid of all constraints because they do not allow the activity either to take advantage of time savings by predeces-sor activities or to slip in response to delayed predecessors or longer-than-scheduled durations.
17. The time to produce an external product should be represented by a reference or schedule visibility activity rather than a constrained milestone representing receipt of the product. By modeling vendor or contractor production as an activity, the program office can track the contractor's high-level progress and apply risk to the external production activity.
18. Lags must be justified because they may represent work or delay that may be vari-able while the lag is static. Lags should not be used to represent activities because they cannot be easily monitored or included in the risk assessment and do not take resources. Activities represented by lags are not, in fact, risk free.
19. Constantly updating lags manually defeats the purpose of a dynamic schedule and makes it particularly prone to error.
20. Using a lag with F–S logic is generally not good practice because it is generally not necessary. When it is, every effort should be made to break activities into small-er tasks and to identify realistic predecessors and successors so that logic interface points are clearly available for needed dependency assignments.
21. Leads are generally not valid. As negative lags, leads imply the unusual measurement of negative time and exact foresight about future events.
22. Using lags as buffers or margin for risk between two activities should be discouraged because the lags persist even as the actual intended margin is used up.

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## Best Practice 3: Assigning Resources to All Activities

**Key Questions**

1. What resources are specified and assigned to the activities? At what level of detail are resources specified (for example, as labor categories, organizations, or individual names)?
2. Are significant material and equipment resources described in the schedule?
3. Do summary activities or milestones have resource assignments?
4. How were resource estimates developed for each activity?
5. Has analysis ensured that resources are sufficient and available in each work period when needed?
   a. Is obtaining scarce resources to accomplish the work potentially difficult?
   b. Are more resources required than are available for some work periods? What is the plan for resolving resource deficiencies?
6. Has resource leveling been performed?
7. To what extent are the resource estimates in the schedule consistent with those in the program cost estimate?

**Key Documentation**

1. Basis of estimates for resource assumptions that align with resource estimates within the cost estimates.
2. A resource allocation planning document that defines resource profiles and tables for unique resources derived from the schedule.
3. Resource output from scheduling software across all project schedules.

**Likely Effects If Criteria Are Not Fully Met**

1. Information on resource needs and availability in each work period assists the pro-gram office in forecasting the likelihood that activities will be completed as scheduled. If the current schedule does not allow insight into the current or projected allocation of resources, then the risk of the program's slipping is significantly increased. Overal-located resources result in inefficiency (for example, staff are less productive because of extended overtime) or program delay from unavailable resources.
2. Resources must be considered in the creation of a schedule because their availability directly affects an activity's duration.
3. A schedule without resources implies an unlimited number of resources and their unlimited availability.
4. If there is no justification for allocating and assigning resources, the schedule will convey accuracy falsely.
5. Unrealistic peaks in forecasts of resource assignments represent the need for large amounts of resources near the end of work streams to finish deferred or delayed work on time. Often the quantity of resources and funding required at the peak is unrealistic.

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6. If resource leveling causes enormous delays in the program finish date—for exam-ple, by many months or years—then the original resource assumptions, network logic, or activity durations must be examined for pragmatism.
7. Automatic resource leveling can lead to inefficient output by delaying activities if only partial resources are available and preventing activities from being partially ac-complished while waiting for the full complement of resources to become available.
8. Incorrect resource assumptions (usually in the form of unwarranted optimism) will lend unreasonable credence to a resource-leveled schedule, and the resulting sched-ule will convey a false sense of precision and confidence to senior decision makers.
9. A schedule that has not reviewed and resolved resource use issues is not reliable.
10. If the baseline schedule does not identify the planned resources, it cannot be used to make important management decisions, such as reallocating resources from activities with significant float to critical activities that are behind schedule.
11. If the schedule does not have resource assignments, management's ability to mon-itor crew productivity, allocate idle resources, monitor resource-constrained activi-ties, and level resources across activities is severely limited.

## Best Practice 4: Establishing Durations for All Activities

**Key Questions**

1. Were durations determined from work to be done and realistic assumptions about available resources, productivity, normal interferences and distractions, and reliance on others?
2. For a detailed schedule, are durations short enough to be consistent with the needs of effective planning and program execution?
3. Are activities long in duration because of LOE or rolling wave planning?
4. Are LOE activity durations determined by the activities they support?
5. Did the person responsible for the activities estimate their durations?
6. Was the program duration determined by some target or mandated date?
7. Are durations based on appropriate calendars? Do any specific conditions neces-sitate special calendars, and are they addressed (for example, religious holidays, nonwork periods for climate, shift work, unavailability of resources)?
8. Are activity durations assigned inconsistent time units?

**Key Documentation**

1. How durations of work activities were estimated is documented at the appropriate level of detail. For instance, the basis of estimate includes the assumptions made to justify the durations assumed for the cost. These should be consistent with the durations at the same level of detail.
2. Documentation justifies nonstandard working calendars.
3. Documentation justifies excessively long durations, including the identification of LOE activities and how they were scheduled.




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**Likely Effects If Criteria Are Not Fully Met**

1. If activities are too long, the schedule may not have enough detail for effective progress measurement and reporting.
2. If activities are too short, the schedule may be too detailed. This may lead to exces-sive work in maintaining the logic, updating the status of activities, and managing the many short-duration activities.
3. When durations are not based on the effort required to complete an activity, the re-sources available, resource efficiency, and other factors such as previous experience on similar activities, then there is little confidence in meeting the target deliverable date.
4. Schedules determined by imposed target completion dates rather than work and logic are often infeasible.
5. Durations estimated under optimal or "success-oriented" conditions will produce unrealistic program delivery dates and unreliable critical paths and could mask program risks.
6. Proper use of resource and task calendars usually precludes the need for soft con-straints in schedules. But improperly defined task or resource calendars incorrectly represent the forecasted start, finish, and durations of planned activities. Ensuring realistic calendars provides for more accurate dates and may reveal opportunities to advance the work.
7. The default calendar in a schedule software package rarely has appropriate national holidays defined as exceptions and will not have specific blackout periods or other project-specific exceptions defined.

## Best Practice 5: Verifying That the Schedule Is Traceable Horizontally and Vertically

**Key Questions**

1. Is all logic in place and has the technical content of the schedule been validated?
2. Are major hand-offs and deliverables easily identified in the schedule? How are major hand-offs and deliverables negotiated and monitored?
3. Has horizontal traceability been demonstrated by observing the effects of delaying an activity by many days within the schedule or a similar shock to the network?
4. Are the key dates consistent between lower-level detailed working schedules and high-er-level summary schedules? Do all lower-level activities roll up into higher WBS levels?
5. Do major milestones map between the schedule and management documents and presentations?

**Key Documentation**

1. All representations of the schedule are given as of a specific time. These may include different levels of the same schedule used in presentations as well as schedule representation using different platforms (scheduling or presentation packages) for different audiences.

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2. The integration between summary, intermediate, and detailed schedules is demon-strated.

**Likely Effects If Criteria Are Not Fully Met**

1. If the schedule is not horizontally traceable, there may be little confidence in the calculated dates or critical paths.
2. Unless the schedule is horizontally traceable, activities whose durations are greatly extended will have no effect on key milestones.
3. Schedules that are not horizontally integrated may not depict relationships between different program elements and product hand-offs. When this happens, hand-offs of project subcomponents cannot be fully traced to the end product, leading to less effective program management.
4. Vertical traceability provides assurance that the representation of the schedule to different audiences is consistent and accurate. Without vertical traceability, there may be little confidence that all consumers of the schedule are getting the same correct schedule information.
5. Any logic errors between summary, intermediate, and detailed schedules will cause inconsistent dates between schedules and will cause different expectations between management and activity owners.
6. Unless the schedule is vertically traceable, lower-level schedules will not be con-sistent with upper-level schedule milestones, affecting the integrity of the entire schedule and the ability of different teams to work to the same schedule expecta-tions.

## Best Practice 6: Confirming That the Critical Path Is Valid

**Key Questions**

1. Is the critical path, or longest path (in the presence of date constraints), calculated by the scheduling software valid?
   a. Are any activities in the schedule missing logic or constrained without justifi-cation? Are these issues resulting in an unreliable critical path?
   b. Is the critical path a continuous path from the status date to the major com-pletion milestones?
   c. Does the critical path start with a constraint so that other activities are un-important in driving the milestone date? If so, is there justification for that constraint?
   d. Does the critical path include LOE activities? Is the critical path driven by ac-tivities of unusually long duration that are not considered planning packages?
   e. Is the critical path driven in any way by lags or leads?
2. Does management use the critical path to focus on activities that will detrimentally affect key program milestones and deliveries if they slip?




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**Key Documentation**

1. Important program deliverables or milestones for which critical paths should be established are identified.
2. Printouts of the logic diagram indicate the longest paths to the important mile-stones, as well as critical paths based on total float to all major milestones.
3. Near-critical paths are identified.

**Likely Effects If Criteria Are Not Fully Met**

1. Without a valid critical path, management cannot focus on activities that will detri-mentally affect the key program milestones and deliveries if they slip.
2. Unless the schedule can produce a true critical path, the program office will not be able to provide reliable timeline estimates or identify when problems or changes may occur and their effects on downstream work.
3. Successfully identifying the critical path relies on capturing all activities (Best Prac-tice 1), properly sequencing activities (Best Practice 2), horizontal traceability (Best Practice 5), the reasonableness of float (Best Practice 7), accurate status updates (Best Practice 9), and—if there are resource limitations —assigning resources (Best Practice 3).
4. Unless the schedule is fully horizontally traceable, the effects of slipped activities on successor activities cannot be determined. If the schedule is missing dependencies or if activities are not linked correctly, float estimates will be miscalculated. Incorrect float estimates will result in an invalid critical path and will hinder management's ability to allocate resources from noncritical activities to those that must be completed on time.
5. LOE activities should not drive the schedule. If LOE is critical, management has no indication of which activities can slip and which will respond positively to addition-al resources to reduce the risk of finishing late.
6. The review and analysis of near-critical paths is important because their activities are likely to overtake the existing critical path and drive the schedule.

## Best Practice 7: Ensuring Reasonable Total Float

**Key Questions**

1. Are the total float values that the scheduling software calculates reasonable and do they accurately reflect true schedule flexibility?
2. Are excessive values of total float being driven by activities that are missing logic?
3. Is total float monitored? Does management have a plan to mitigate negative total float?
4. Does management rely on free float to level resources or reassign resources to assist critical activities?

**Key Documentation**

The program team can use a list of activities sorted by their total float values to deter-mine whether the total float values correctly reflect flexibility in the program schedule.



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**Likely Effects If Criteria Are Not Fully Met**

1. If the schedule is missing activities or dependencies or if it links activities incor-rectly, float estimates will not be accurate. Incorrect float estimates may result in an invalid critical path and an inaccurate assessment of program completion dates. In addition, inaccurate values of total float falsely depict true program status, which could lead to decisions that may jeopardize the program. For example, if activities are not linked correctly to successors, total float will be greater than it should be.
2. Without accurate values of total float, it cannot be used to identify activities that could be permitted to slip and thus release and reallocate resources to activities that require more resources to be completed on time.
3. Negative float indicates that not enough time has been scheduled for the activity and is usually caused by activities taking longer or starting later than planned, mak-ing target dates infeasible. The program may have to take some corrective action or the negative float may act as a threat to the program end date.
4. Too little float built into the schedule may indicate insufficient time to recover from delay without the program's completion date slipping.

## Best Practice 8: Conducting a Schedule Risk Analysis

**Key Questions**

1. Was an SRA performed to determine the confidence level in achieving the program schedule and other key dates?
   a. Was the schedule checked to ensure that it meets best practices before the simulation was conducted?
   b. Are there data fields within the schedule for risk analysis such as optimistic, most likely, and pessimistic durations?
   c. Were uncertainties in activity durations statistically correlated to one another?
   d. How much schedule contingency was selected and what is the probability of meeting the completion date?
   e. Did the SRA identify activities during the simulation that most often ended up on the critical path, so that near-critical path activities can be closely monitored?
2. Was a risk register used as an input to schedule development?
   a. Was the risk register used in identifying the risk factors potentially driving the schedule before the SRA was conducted?
   b. Once the SRA was conducted, were risks prioritized by probability and magni-tude of effect?
3. Are the SRA data, assumptions, and methodology available and documented?
4. Are the probabilities and impact ranges reasonable and based on information gath-ered from knowledgeable sources? Is there evidence of bias in the risk data?
5. How is the use of schedule contingency controlled and authorized?
6. Is an SRA performed periodically to reflect actual progress and changes in risks?




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**Key Documentation**

1. A risk register with prioritized risks.
2. SRA documentation that includes assumptions, methodology, data, data normaliza-tion techniques, and findings.
3. A listing of people interviewed or included in risk interviews along with their orga-nizations, positions, and expertise.
4. The schedule risk analysis file.

**Likely Effects If Criteria Are Not Fully Met**

1. If a schedule risk analysis is not conducted, the following cannot be determined:
   a. the likelihood of the program's completion date,
   b. how much schedule risk contingency is needed to provide an acceptable level of certainty for completion by a specific date,
   c. risks most likely to delay the program,
   d. the paths or activities that are most likely to delay the program.
2. Because activity durations are uncertain, the identity of the true critical path is unknown unless a schedule risk analysis has been performed. An SRA can identify the paths that are most likely to become critical as the program progresses so that risk mitigation can lessen the effect of any delays.
3. Unless a statistical simulation is run, calculating the completion date from sched-ule logic and the most likely duration distributions will tend to underestimate the program's overall critical path duration.
4. If the schedule risk analysis is to be valid, the program's schedule must reflect reli-able logic and clearly identify the critical path. If the schedule does not follow best practices, confidence in the SRA results will be lacking.
5. If the program does not have sufficient schedule reserve, then risk mitigation actions and schedule issues from unforeseen events may not be managed without a schedule delay.
6. If the task durations are not correlated to one another, the uncertainty on the criti-cal path duration may be underestimated.

## Best Practice 9: Updating the Schedule Using Logic and Progress

**Key Questions**

1. Is progress recorded regularly? Has the schedule been updated recently as planned? Is the status date recorded?
2. Is at least one in-progress activity critical?
3. Do any activities have start or finish dates in the past without actual start or finish dates? Do any activities have actual start or finish dates in the future?
4. Is responsibility for changing or statusing the schedule assigned to someone who has the proper training and experience in CPM scheduling?



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5. Were any activities started or completed out of sequence? If so, was the logic re-tained, or did the scheduler use progress override?
6. Does a schedule narrative accompany each status update and include the following?
   a. the status of key milestone dates, including the program finish date;
   b. the status of key hand-offs or giver/receiver dates;
   c. explanations for any changes in key dates;
   d. changes in network logic, including lags, date constraints, and relationship logic and their effect on the schedule time;
   e. a description of the critical paths, near-critical paths, and longest paths along with a comparison to the previous period's paths; and
   f. a description of any significant scheduling software options that changed be-tween update periods, such as the criticality threshold for total float, progress override versus retained logic and whether resource assignments are progressed along with duration.
7. Is the schedule structure examined after each update to ensure that no logic is miss-ing, constraints are necessary, and no activities impede the ability of the schedule to dynamically forecast dates?

**Key Documentation**

1. The schedule narrative.
2. The schedule shows actual and planned dates, remaining duration for in-process activities, and the status date.
3. Copies of program management review (PMR) briefings are available to verify whether schedule status is discussed and consistent with the schedule.

**Likely Effects If Criteria Are Not Fully Met**

1. If the schedule is not continually monitored to determine when forecasted comple-tion dates differ from planned dates, then it cannot be used to determine whether schedule variances will affect downstream work.
2. Maintaining the integrity of the schedule logic is not only necessary to reflect true status but also required before conducting a schedule risk analysis. If the schedule has not been updated, then it is impossible to tell what activities have been com-pleted, are in progress, are late, and are planned to start on time.
3. A schedule that has not been updated will not reflect what is actually occurring on the program and hence may have inaccurate completion dates and critical paths. When this is the case, management cannot use the schedule to monitor progress and make decisions regarding risk mitigation, resource allocations, and so on.
4. Unless a status date is provided, the schedule cannot be used to reliably convey effort spent and remaining.
5. An out-of-sequence activity causes degradation of the schedule and requires ad-dressing. A schedule with progress remaining out of sequence may have the wrong logic in place and, hence, inaccurate critical paths and completion dates.
6. If unfinished work remains in the past, the schedule no longer represents a realis-




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tic plan to complete the program, and team members will lose confidence in the model.

7. At least one in-progress activity is critical. If not, it is most likely that date con-straints or external dependencies are separating successor activities from in-progress activities. Such breaks in the critical or longest path represent weak or incomplete logic, causing a lack of credibility in the identity of the path and the schedule dates.
8. Without a documented, consistently applied schedule change control process, program staff might continually revise the schedule to match performance, hindering the program manager's insight into the true performance of the program. Good documentation helps with analyzing changes in the program schedule and identifying the reasons for variances between estimates and actual results, thereby contributing to the collection of cost, schedule, and technical data that can be used to support future estimates.
9. Unless the schedule is kept updated, trend reports and analyses that highlight prob-lems will not be useful in mitigating future delays.
10. Unless progress records are archived, historical data necessary for resource, work, and productivity assumptions for future analogous programs will not be available. If sufficient attention is paid to recording the way work is performed, the resulting archived data will help improve the accuracy and quality control of future similar programs.

## Best Practice 10: Maintaining a Baseline Schedule

**Key Questions**

1. Is the baseline schedule the basis for measuring performance?
2. Does a schedule basis document exist? Does the document
   a. describe the general approach to the program?
   b. describe the overall structure of the IMS, including the scope and purpose of projects, staff responsible for each project, the relationship between projects, a WBS dictionary, the status delivery dates for each project, and a list of key hand-off products and their estimated dates?
   c. describe the settings for key options for the scheduling software?
   d. provide an overview of the assumptions and ground rules, including justification for calendars and any lags, constraints, or long activity durations?
   e. Provide an appropriately detailed rationale for the basic approach to estimating key activity durations and justification of the estimating relationship between duration, effort, and assigned resource units?
   f. contain a dictionary of abbreviations, acronyms, and custom fields?
   g. describe the use of resources within the schedule?
   h. describe the critical risks prioritized in a schedule risk analysis as well as sched-ule contingency?
   i. discuss the derivation of the critical paths and longest path and justify excessive total float?



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3. Are changes to the baseline schedule reviewed and approved according to the sched-ule change control process?
4. Is trend analysis performed, such as monitoring start and finish dates, available float, and available schedule contingency?

**Key Documentation**

1. The designated baseline schedule.
2. A description of the schedule change control process.
3. The current schedule change control log.
4. The schedule basis document.

**Likely Effects If Criteria Are Not Fully Met**

1. Without a formally established baseline schedule to measure performance against, management cannot identify or mitigate the effect of unfavorable performance.
2. Good documentation helps with analyzing changes in the program schedule and identifying the reasons for variances between estimates and results, thereby con-tributing to the collection of cost, schedule, and technical data that can be used to support future estimates.
3. Thorough documentation is essential for validating and defending a baseline sched-ule. A well-documented schedule can convincingly argue for a schedule's validity and can help answer decision makers' and oversight groups' probing questions. A well-documented schedule is essential if an effective independent review is to ensure that it is reliable.
4. If changes are not controlled and fully documented, performance cannot be accu-rately measured against the original plan. Undocumented or unapproved changes will hamper performance measurement and may result in inaccurate variance re-porting, inconsistent stakeholder versions of the plan, and unreliable schedule data.
5. Without a schedule change control process, traceability for all status updates will be unreliable, and there will be no guarantee that stakeholders are using the same version of the schedule.
6. Unless schedule variances are monitored, management will not be able to reliably determine whether forecasted completion dates differ from the planned dates.
7. Without trend analysis, management will lack valuable information about how a program is performing. Knowing what has caused problems in the past can help determine whether they will continue in the future.

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# APPENDIX VI

## Standard Quantitative Measurements for Assessing Schedule Health

An assessment of schedule best practices encompasses both qualitative and quantitative information. Qualitative information is provided by program questions such as those detailed in appendix II. These questions are related to the general policies in place and procedures undertaken to create and maintain the schedule. The quantitative assessment involves a detailed analysis of the schedule data to determine the overall health of the network. While the questions addressed by the data analysis are also covered in appendix II, the quantitative assessment often involves filters and detailed data metric definitions. These filters and definitions are in table 11 for each best practice.

No "pass-or-fail" thresholds or tripwires are associated with the measures. Measures are evaluated in context with qualitative program information and any documented justification. Moreover, severity of the errors or anomalies takes precedence over quantity because any error can potentially affect the reliability of the entire schedule network.

**Table 11: Standard Data Measures for Schedule Best Practices**

| Best practice | Measure | Note |
|---|---|---|
| **1. Capturing all activities** | Measures in Best Practice 1 provide basic information on the scope of the schedule, such as number and types of activities and level of detail | |
| | Total number of activities, including total summary, hammock, milestone, and detail activities | Summary activities may or may not be present in the scheduling software |
| | Total number of remaining activities, including total summary, hammock, milestone, and detail activities | A remaining activity is any activity that is not complete. "Remaining" may be defined as (1) an activity with an actual start or no actual start and no actual finish or (2) any activity that is not 100 percent complete. Issues may arise with either definition. For instance, an activity may be noted as 100 percent complete and not have an actual finish date, or it may have actual start and finish dates but be less than 100 percent complete. Summary activities may or may not be present in the scheduling software |


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|---|---|
| If applicable, number of activities marked as both a milestone and summary activity | An activity cannot be both a summary and a milestone |
| Number of activities with no descriptive name | May or may not be valid activities |
| Ratio of detail activities to milestones | Provides a rough indicator of the level of planning detail in the schedule. While there is no specific threshold, one or two detailed activities per milestone is probably a very low level of detail, while 10 is probably highly detailed |

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| Best practice | Measure | Note |
|---|---|---|
| | Number of activities not mapped to program or contractor work breakdown structure | |
| | Number of contractor activities not mapped to a SOW paragraph or similar information | Depending on the nature of the effort, an activity may not be mapped to the statement of work |
| | Number of activities with duplicate names | Activity names should be unique and descriptive |
| **2. Sequencing all activities** | Best Practice 2 includes more advanced measurements to assess the reliability of the network logic. Thresholds for measures are not provided because, in theory, any missing or inappropriate logic may disrupt the entire network. The assessment of this best practice is related to the assessment of Best Practices 5, 6, and 7. If major deficiencies are identified in Best Practice 2, then a valid critical path, total float, and horizontal traceability are not possible. For minor deficiencies, an assessment of the schedule's critical path, total float, and response to tests of horizontal traceability are essential to understanding the implications of constraints and incorrect or missing logic. All activities in a schedule, regardless of detail or planning period, are subjected to this best practice | |
| | Number of remaining detail activities and milestones missing predecessor links | Does not include the start milestone; missing links to external activities (activities outside the scope of the current schedule file) may be excluded when a schedule is evaluated outside the IMS network |


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| | |
|---|---|
| Number of remaining detail activities and milestones missing successor links | Does not include the finish milestone; missing links to external activities (activities outside the scope of the current schedule file) may be excluded when a schedule is evaluated outside the IMS network |
| Number of remaining detail activities and milestones missing both predecessor and successor links | |
| Dangling activities: number of remaining detail activities and milestones with no predecessor on start date | Milestone activities may be excluded because their start and finish dates are the same; missing links to external activities (activities outside the scope of the current schedule file) may be excluded when a schedule is evaluated outside the IMS network; activities that have actually started may be excluded because their start dates have been determined |
| Dangling activities: number of remaining detail activities and milestones with no successor off finish date | Milestone activities may be excluded because their start and finish dates are the same; missing links to external activities (activities outside the scope of the current schedule file) may be excluded when a schedule is evaluated outside the IMS network |


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| | |
|---|---|
| Percentage of logic links that are finish-to-start | The majority of relationships within a detailed schedule should be finish-to-start |
| Number of remaining detail activities and milestones with start-to-finish links | Count either successor or predecessor links but do not count both. An S–F link is between two activities but represents only one link |
| Number of remaining summary activities with logic links | May also be measured as "logic links to and from remaining summary activities," although this may be a different number |
| Remaining detail activities and milestones with a great many predecessors | Assesses the schedule for path convergence. A relatively high number of predecessors may indicate a high-risk area. Note that not all predecessors are driving; only predecessors that have zero or low float have the ability to delay the successor when they are delayed |
| Remaining detail activities and milestones with soft date constraints | |

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| Best practice | Measure | Note |
|---|---|---|
| | Remaining detail activities and milestones with hard date constraints | |
| | Remaining detail activities and milestones with active SNET date constraints | If an activity's scheduled start date is the same as the SNET date, then the SNET constraint is more than likely preventing the activity from starting early. This is considered an active constraint. If an SNET constraint is earlier than the activity's start date, then the activity is not affected by the constraint date |
| | Remaining detail activities and milestones with active FNET date constraints | If an activity's scheduled finish date is the same as the FNET date, then the FNET constraint is more than likely preventing the activity from finishing early. This is considered an active constraint. If an FNET constraint is earlier than the activity's finish date, then the activity is not affected by the constraint date |
| | Remaining detail activities and milestones with lags | Count either successor or predecessor lags but not both. A lag is between two activities but represents only one lag. This number is different from the number of lags |
| | Number of lags on remaining detail activities and milestones | Count either successor or predecessor lags but not both. A lag is between two activities but represents only one lag. This number is different from the number of activities with lags |
| | Remaining detail activities and milestones with leads | Count either successor or predecessor leads but not both. A lead is between two activities but represents only one lead. This number is different from the number of leads |


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| | | |
|---|---|---|
| | Number of leads on remaining detail activities and milestones | Count either successor or predecessor leads but not both. A lead is between two activities but represents only one lead. This number is different from the number of activities with leads |
| | Remaining detail activities and milestones with an F–S predecessor lead greater than remaining duration | |
| **3. Assigning to all activities** | Best Practice 3 is more programmatic than quantitative, although measures and trends may be **resources** investigated for fully resource loaded schedules. If possible, resource assignments over time may be evaluated to identify potential unrealistic peaks. In general, the measures assess the number of activities within the detail planning period that are assigned resources and the reasonableness of work hours. Overallocated resources and unrealistic resource units should be a cause for concern. Care should be taken to assess only the appropriate detailed activities | |
| | Total number of resources | |
| | Overallocated resources | |
| | Maximum units available per resource | Individuals should be available between 0 and 100 percent of full time, and resource groups should have a realistic number of individuals available to perform the work. |
| | Summary activities and milestones with assignments | Summary activity durations depend on the activities contained within them. Milestones should never be assigned resources because they have no duration |


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| | | |
|---|---|---|
| | Remaining detail activities with assignments | Exclude nonapplicable activities such as planning packages and reference activities |
| | Remaining detail activities without assignments | |




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| Best practice | Measure | Note |
|---|---|---|
| **4. Establishing** Measures for Best Practice 4 are generally straightforward, providing an overall assessment of the detail **the durations** available to management, as well as the appropriateness of the schedule calendars. Care should be **of all activities** taken to assess only the appropriate detailed activities | | |
| | Remaining detail activities with dissimilar time units | All durations should be in the same unit, preferably days |
| | Remaining detail activities or milestones starting or finishing on a weekend or holiday | May be legitimate but may stem from incorrect calendar assignments or specifications. Milestones on weekends or holidays should be questioned |
| | Holidays and other exceptions by task calendar | |
| | Remaining detail activities with durations less than the reporting period | Exclude nonapplicable activities such as planning packages and LOE and reference activities. The analyst should take into account baseline durations if available. That is, if the baseline duration is 35 days but the actual plus remaining duration is 60, the original baseline meets the intent of the best practice |
| | Remaining detail activities with durations greater than the reporting period | |
| | Average duration of remaining detail activities | |
| | Median duration of remaining detail activities | |
| **5. Verifying that the schedule can be traced horizontally and vertically** | Best Practice 5 has no standard measurements. Vertical traceability is assessed by determining whether lower-level activities fall within the same time as higher-level activities and whether detailed schedule dates fall within the same time as summary schedule dates. An essential check of vertical traceability is determining whether forecasted milestone dates in detailed schedules match those quoted in management documents. Horizontal traceability depends on Best Practice 2, although not entirely as noted in that best practice. It is assessed by increasing activities' durations by improbable amounts (500 or 1,000 days) and by observing how the schedule reacts. In the absence of constraints and assuming logic has been properly identified, key milestones should move and the critical path should change | |
| | Assessment of how critical and noncritical planned dates dynamically react to dramatic increases in predecessor activity durations | Horizontal traceability implies that the network responds dynamically to delayed activities. Severely delayed activities should become critical and previously critical paths should become noncritical. Delays of this magnitude should cause the finish date to slip relative to the activity delay and reasonable available float |
| **6. Confirming that the critical path is valid** | Best Practice 6 has several standard measurements for assessing the validity of a critical path. Beginning at the program finish milestone, the sequence of driving activities is traced back to the status date. This sequence of activities should be straightforward, continuous, and the same as the critical path—defined by zero total float—in the absence of date constraints. Critical paths to interim key milestones may also be assessed as applicable | |
| | Assessment of the driving paths to key milestones and comparison of those paths to activities marked as critical in the schedule | Ideally the longest path and critical path are the same to the key milestone. The path should be continuous from the status date to the key milestone |


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|---|---|
| Number of critical activities | In general, if the ratio of critical path activities to the total remaining activity count is nearly 100 percent, then the schedule may be overly serial and resource limited |
| Number of critical LOE activities | A critical path cannot include LOE activities because they do not represent discrete effort |
| Number of lags and leads on the critical path | Lags cannot represent work and cannot be assigned resources |
| Number of critical activities with hard date constraints | Using hard constraints to fix activity dates at certain points in time immediately convolutes critical path calculations and defeats the purpose of CPM scheduling |

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| Best practice | Measure | Note |
|---|---|---|
| | Number of in-progress critical activities | Given that the critical path is a continuous sequence of activities from the status date, at least one in-progress activity is critical |
| **7. Ensuring reasonable total float** | Best Practice 7 includes basic measurements of total float to assess overall program flexibility as reported by the schedule. It is closely related to assessments of Best Practices 2, 5, and 6, because a properly sequenced network produces reasonable estimates of float and a valid critical path. Reasonableness is assessed in combination with program length and activity type. In addition, because one logic error can cause an entire sequence of activities to report unreasonable amounts of float, the breadth of deficiencies reported in Best Practice 2 should be taken into account here. Negative float should always be questioned | |
| | Remaining detail activities and milestones with dissimilar total float time units | All float should be in the same units, preferably days |
| | Remaining detail activities and milestones with relatively high total float | High float is relative to the scope, length, and complexity of the schedule. Float should be reasonable and should realistically reflect the flexibility of the schedule |
| | Remaining detail activities with negative total float | Negative total float indicates that the activity's constraint date is earlier than its calculated late finish. Negative float may occur when activities are performed out of sequence |
| | Average total float value of remaining detail activities and milestones | |
| | Median total float value of remaining detail activities and milestones | |
| **8. Conducting a schedule risk analysis** | Many quantitative measurements are related to Best Practice 8, and a proper schedule risk analysis typically deserves a much more complex quantitative assessment than that given here. GAO's assessment of Best Practice 8 is more programmatic, and these questions are provided in appendix II. The measures for Best Practice 8 are limited to determining the existence of risk data within the schedule risk file | |
| | Fields within the schedule used for SRA | Fields that store optimistic, most likely, and pessimistic durations |
| | Correlation measures within the schedule | |
| | Contingency activities | |
| **9. Updating the schedule using actual progress and logic** | Best Practice 9 is assessed by determining the validity of the dates reported in the schedule. The assessment of this best practice depends on the status date reported in the schedule. It also depends on the scheduling software used: some software packages allow date anomalies that other software packages prevent | |
| | Number of in-progress activities | An activity is in progress when it has started but is not yet complete |
| | Number of remaining detail activities and milestones that have a forecasted start date in the past but no actual start date | Forecasted start dates should not occur in the past—i.e., any time preceding the status date |
| | Number of remaining detail activities and milestones that have a forecasted finish date in the past but no actual finish date | Forecasted finish dates should not occur in the past—i.e., any time preceding the status date |
| | Number of remaining detail activities and milestones that have an actual start date in the future | Actual start dates should not occur in the future—i.e., any time following the status date |


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| | | |
|---|---|---|
| | Number of remaining detail activities and milestones that have an actual finish date in the future | Actual finish dates should not occur in the future—i.e., any time following the status date |
| | Number of detail activities performed out of sequence | |

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| Best practice | Measure | Note |
|---|---|---|
| **10. Maintaining a baseline schedule** | Many data measures can be used to assess Best Practice 10; some are provided here. All baseline measures ultimately depend on the existence of a controlled baseline and a properly statused current schedule. Baseline measures are typically calculated by reporting period: for example, number of activities forecast to start early over the next 60 days or activities that have actually finished late over the past 6 months. They may also be useful when applied to specific products within the WBS, resource groups, or criticality: for example, the number of late activities during product integration, the average start variance of activities executed in one production plant, or the baseline execution index of activities with less than 10 days of total float | |
| | Number of detail activities and milestones with baseline dates | Counts should accord with rolling wave planning periods |
| | Number of detail activities and milestones without baseline dates | |
| | Number of remaining detail activities and milestones that are forecast to start or finish before their baseline dates | Represents activities and milestones forecast to begin or end early |
| | Number of remaining detail activities and milestones that are forecast to start or finish on their baseline dates | Represents activities and milestones forecast to begin or end on time |
| | Number of remaining detail activities and milestones that are forecast to start or finish after their baseline dates | Represents activities and milestones forecast to begin or end late |
| | Number of remaining detail activities that actually started before their baseline start date | Represents activities and milestones that actually started early |


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| | |
|---|---|
| Number of remaining detail activities that actually started on their baseline start date | Represents activities and milestones that actually started on time |
| Number of remaining detail activities that actually started after their baseline start date | Represents activities and milestones that actually started late |
| Number of detail activities and milestones that actually finished before their baseline finish date | Represents activities and milestones that actually finished early |
| Number of detail activities and milestones that actually finished on their baseline finish date | Represents activities and milestones that actually finished on time |
| Number of detail activities and milestones that actually finished after their baseline finish date | Represents activities and milestones that have actually finished late |


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| | |
|---|---|
| Average and median start variance | Start variance may be the difference between actual start and baseline start or forecast start and baseline start |
| Average and median finish variance | Finish variance may be the difference between actual finish and baseline finish or forecast finish and baseline finish |
| Baseline execution index | The ratio of actual completed detail activities to detail activities that were planned to finish. A BEI of 1 indicates that the project is performing according to plan. A BEI less than 1 indicates that, in general, fewer activities are being completed than planned; a BEI greater than 1 indicates that, in general, more activities are being completed than planned |

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**Tijo Kurian** is a project management professional with over 14 years of experience in upstream and downstream oil and gas projects. He is currently working as a Senior Project Engineer at Waha Oil Company in Libya. He previously worked with Samsung Engineering Co. Ltd, Bilfinger Berger Germany, as Project Control Engineer in various oil and gas projects. He holds a Degree in Mechanical Engineering from MG University, Kottayam and Diploma in Mechanical Engineering from DOTE, Tamil Nadu, India. He is a certified Project Management Professional (PMP) from PMI, USA. He is pursuing some other project management/project control credentials from AACE, Guild of Project Controls, and PMI under the tutorage of Dr. Paul D. Giammalvo, CDT, CCE, MScPM, MRICS, GPM-m Senior Technical Advisor, PT Mitrata Citragaha. Tijo Kurian can be contacted at tijokurien007@gmail.com .


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