SYNOPSIS OF

CORE TRAITS OF A RELIABLE SCHEDULE

A Compendium of Best Practices for CPM and GPM Schedules

	1 SCHEDULE DELIVERABLE BEST PRACTICES	2 INDICATORS OF SCHEDULE RELIABILITY[1]	3 CONSEQUENCES OF NONCONFORMANCE[2]
A1 Aligned	The schedule portrays a viable plan that aligns with the planning basis, subcontractors' schedules, and the procurement approach	The schedule is supported by a narrative detailing the contractor planning basis; the contract schedule is appropriately signed off	A schedule not supported by a complete narrative justifies only conditional acceptance or withholding acceptance
A2 Complete	The entire work, including specified responsibilities of the owner and third parties, is captured by activities, logic ties, and events	Activities are developed using the WBS context inherent in the contract drawings and specifications and/or the BIM database	An incomplete schedule is susceptible to built-in delay and manipulation when corrected for the omitted scope
A3 Conforming	The schedule complies with contract dates, sequences, & other conditions; the initial schedule data date = contract start date	The schedule incorporates contractual constraints and activity & logic sequences, and the narrative lists the relevant documents	The schedule may anticipate a breach of contract and may contain false critical paths and latent negative total floats
A4 Formulaic	Physical work activity durations are largely formulaic, or are endorsed by activity owners, and align with the schedule level	At a minimum, critical/near-critical physical work activities have formulaic durations; over 80% of the activities last 2–6 weeks[3]	High durations may prove imprecise for remaining duration calculations; short durations may overburden the schedule
A5 Resourced	The schedule reflects the resources needed, their availability to support the rate of progress, and known availability limits	Crew loading is consistent with formulae used to derive durations; where suitable, activities are loaded with construction equipment	Trade congestion, density, and headcount over-demand may not be solved without extending project completion
B1 Predictive	The schedule establishes valid critical and near-critical paths; in the initial schedule, the critical path has total float ≥ 0	High-effort physical work and deliveries that drive physical work are portrayed; owner activities and soft & resource logic are justified	Negative total floats are incongruent with timely completion and render any initial schedule unacceptable as-is
B2 Risked	Using risk assessment, the schedule is established with schedule margin[4] sufficient to support the targeted probability threshold	Contingencies (if any) added to activity durations for uncertain contract risks are removed for the purpose of risk analysis	Durations, logic, and dates portray a schedule that features a low probability of completing by the required completion date
B3 Weather-Fit	The schedule correctly integrates normal adverse weather according to the controlling specifications and best practices	Weather planning is based on the most representative pre-contract record (e.g., 10-year) of weather conditions for the site	Schedule margin may be consumed and the completion of the project may be delayed by normal adverse weather
B4 Resource-Flowing	Resource-flow logic ties portray crew movements, equipment logistics/reuse workflow, and material reuse workflow	Resource-flow logic ties are devised by the planner vs. software generated; crew-flow charts are provided for repeating activities	The schedule completes unreasonably early because it uses unrealistic levels for resources that drive the activities
B5 Flexible	Level 3 schedule flexibility right of the data date is adequate for mitigating delay/floating and for resource leveling	Total float and mean total float (CPM schedules) or gap and float performance indices (GPM[5] schedules) are trended[6]	Unknown, lopsided gap and total float depletion undermine the credibility of the level 3 schedule right of the data date
C1 Hierarchical	The baseline is developed as a level 2 schedule that serves as the basis for, and remains traceable to, the level 3 schedule	Discretionary milestone + benchmark count: 1%-2% of the activity count; each level 3 activity is coded to its parent level 2 activity	Loss of vertical traceability undermines use of the schedule as a tool; unconnected milestones are not horizontally traceable
C2 Phased	Construction phases from sitework to closeout align with the planning basis; construction phase durations are benchmarked	Construction phase hammocks are established; critical path total float is allocated to construction phases through benchmarks	The schedule may not support the rate of progress that supervision envisions based on prior project experience

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C3 Logical	FS logic is favored; constraints, FS lags, FS leads, and zero-lag SS & FF logic are used judiciously and, when used, are justified	FS logic ≥ 80%; constraints ≤ 2% of total activities;[7] redundant links are identified; the network is largely clear of SF logic	Logic chains with confusing total floats render the schedule unreliable for what-if and delay/disruption analyses
C4 Connected	Every activity has at least one FS or SS predecessor and one FS or FF successor; paired SS/FF logic is used judiciously	Planned dates or SNE dates model external logic ties; open ends + dangling ends ≤ 1% of logic; level 3 schedule logic index is 1.5-2.5[8]	Open ends may corrupt total floats; a schedule that is not fully connected is unreliable for risk and delay/disruption analyses
C5 Calendar-Fit	Calendars used to calculate the schedule reflect the planning basis, the working schedule, and other limiting factors	Except for weather calendars and acceleration calendars, crew-loaded activities are substantially on the same calendar	Unnecessary calendar variations exacerbate total float breaks and may blur logic chain & critical path continuity
D1 Statused	The schedule is accurately statused using reliable, documented protocols; imminent level 3 schedule activities are resource leveled	Actual dates and remaining duration protocols are supported; out-of-sequence progress is repaired to reflect as-built logical flow	Unrealistic remaining durations cover up actual delay, or conversely, may predict delay that is unlikely to occur
D2 Weathered	The schedule is used to evaluate weather delay and/or gain originating from actual weather conditions in the prior month	Adverse weather schedule analysis considers work stoppages and production loss (in the latter case, when crews continue working)	A statused schedule that overlooks actual weather may be unreliable for prospective and retrospective delay analyses
D3 Re-baselined	To ensure a realistic forecast, the schedule is timely re-baselined to reflect replanning, time impacts, and schedule recovery	The schedule attaches a narrative; every non-progress revision is documented; the level 2 revised schedule is risk assessed	An obsolete baseline conveys an unreliable forecast; schedule margin may not reflect updated risk profiles
D4 Forensic	In a statused or revised GPM schedule, the critical path is identified left of the data date (from the project start event to the data date)	Each continuous critical path with zero-drift and least-total-float activities connects to a/the critical path right of the data date	Missing (continuous) critical path left of the data date impairs the reliability of the schedule for forensic schedule analysis
D5 Trended	Activity rate of completion is sufficient so the scope of remaining activities is congruent with an achievable rate of progress	Execution index, resource index, and other execution indices[9] are trended; actual & formulaic production rates are compared	More activities and work effort *than planned* remaining as of the data date may render the schedule unrealistic

This document serves as a synopsis of *Core Traits of a Reliable Schedule* aka 20-Trait Protocol or Protocol. The Protocol organizes established and emerging best practices for CPM and GPM schedules into 20 core traits. 'A' Traits correspond to comprehensive schedules, 'B' Traits correspond to credible schedules, 'C' Traits correspond to well-constructed schedules, and 'D' Traits correspond to controlled schedules. Related works include the GAO *Schedule Assessment Guide* and the NDIA *Planning & Scheduling Excellence Guide*. Certain aspects of Traits A4, B1, C3, C4, D1, and D5 are alternatives to the "14 Point Schedule Metrics" in the DCMA *Earned Value Management System (EVMS) Program Analysis Pamphlet*. The Endnotes in *Core Traits of a Reliable Schedule* present additional references. The Glossary in *Core Traits of a Reliable Schedule* interprets key terms. For additional scheduling terms, including forensic scheduling terms, refer to *Guide to the Forensic Scheduling Body of Knowledge Part I*.

1 While this Protocol is applicable to level 2 and level 3 schedules, metrics in Traits A4, C1, C3, and C4 are intended for level 3 schedules. The equivalent Trait C1 metric for level 2 schedules is 5%-10%.
2 Any nonconformance that sufficiently impairs the reliability of the schedule may be grounds for returning the schedule deliverable aka submittal as Revise & Resubmit, or Comments Noted, Resubmittal Not Required.
3 This level 3 normative duration range is for physical work activities and applies to major projects, defined as projects with construction phase normally spanning 27–40 months, including closeout, and with construction value between US$250M and $1B. The equivalent activity duration range for level 2 schedules is 6 weeks–6 months. The duration range for level 4 activities in level 3 schedules is ≤ 2 weeks.
4 Schedule margin is contingency that supports the targeted completion probability threshold, if determined through risk assessment, or that results from targeted early completion based on prior projects, like context. A targeted 70%-80% completion threshold normally entails 5%-15% schedule margin. Where determined using contingency heuristics, 4%-8% of the length of the critical path, no less than 1 week, is a norm.
5 See Ponce de Leon, G. (2009). "GPM®: A networking method anchored on objectbase principles." Also, Ponce de Leon, G. (2012). "Logic Gantt chart RIP."
6 Total float is trended via Float Trend Charts and/or mean total float or median/mean total float, with the latter measure excluding activities with total float above the 50th percentile. A Float Trend Chart portrays changes in the distribution of total float values by plotting the 0, 5th, 10th, & 50th total float percentiles (y-axis) for the baseline and for every update (x-axis). Gap index is the sum of link gaps (excluding redundant links) as a ratio to the sum of remaining durations. Float performance index is the gap index as a ratio to what the gap index should be according to a base case (e.g., the baseline, a prior update, or a revised baseline).
7 The discretionary constraint limit in GPM schedules is ≤ 1% of the number of activities. The 14 Point Schedule Metrics assessment suggests a 5% limit on *hard constraints* ('must-on' dates) in CPM schedules.
8 Logic index measures network complexity and is calculated as the number of valid activity-to-activity links as a ratio to the number of activities. Normative logic index for level 2 schedules is 1.25-1.75.
9 Execution index, schedule performance index, resource index, and duration index are trended for level 3 baseline early and late schedules and for the level 3 current early/planned schedule.