SPIRE
CONSULTING GROUP

EVALUATION OF BASELINE SCHEDULE METRICS

For Successful Project Schedule Performance

PROJECT CONTROLS

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ABSTRACT

The development of a reasonable baseline schedule is a challenge for some construction professionals. Some construction projects experience schedule impacts or delays as a result of fatally flawed baseline schedules that produce an unreasonable forecasted completion. Accordingly, some organizations, public entities, private firms, software companies and consultants have developed checklists or guidelines for evaluating the mechanics of baseline schedules to improve the likelihood of forecasting a reasonable completion date. However, these guidelines have yet to be substantiated. The purpose of this paper is to identify and evaluate a list of industry-recognized metrics to determine whether a schedule is fatally flawed or suggests a reasonable forecast. Accordingly, this paper addresses the correlation between current Industry Metrics and developing a reasonable schedule. The findings are addressed after evaluating 27 current Industry Metrics against eight completed case projects within the commercial and university building sectors. The case projects are divided into two groups based on amount of delay. The analysis results show that between two groups there exist significant baseline schedule quality differences.

INTRODUCTION

Schedules can be a great tool for tracking and forecasting the execution plan, completion date, progress, resources, activity durations, sequence and costs of a construction project. In order for a schedule to forecast a reasonable plan and completion date, it must contain a contractors' scope of work, be properly updated and maintained, and have the proper schedule mechanics (mechanics refers to the composition of a schedule network).

Although construction scheduling is a topic that has been well developed over several decades, many construction projects experience schedule impacts or delays as a result of fatally flawed baseline schedules that produce an unreasonable forecasted completion. Generally, a baseline schedule is considered fatally flawed when its mechanics or insufficient/incomplete scope of work prevent the scheduler from forecasting a reasonable date for completion. Schedulers often rely on the project contract, plans, specifications, personal/project experiences and education to develop the mechanics and scope of work to forecast a reasonable completion date within a baseline schedule. To improve the likelihood of forecasting a reasonable completion date, some organizations, public entities, private firms, software companies and consultants have developed checklists or guidelines for evaluating the mechanics of baseline schedules. These guidelines, though, have yet to be substantiated. The purpose of this paper then is to identify and evaluate a list of industry-recognized metrics to determine if a schedule is fatally flawed or offers a reasonable forecast.

METHODOLOGY

The following methodology was used to determine if current industry-recognized metrics could determine whether a schedule was fatally flawed or potentially depict a reasonable forecast. The methodology followed a seven (7) step process: 1) Literature Review; 2) Literature Analysis; 3) Metric Compilation; 4) Metric Selection; 5) Case Project Collection; 6) Case Project Screening and Classification; and 7) Industry Metric Analysis. Figure 1 depicts the seven (7) step process.

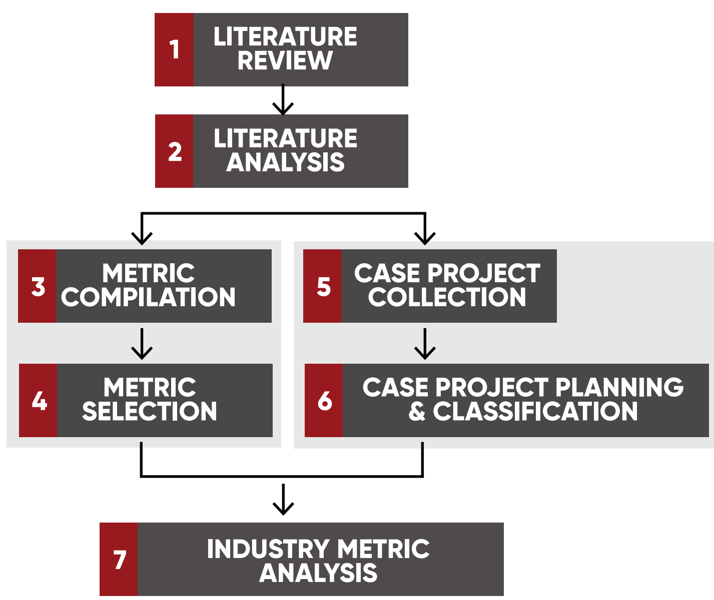

Figure 1. Research Methodology

1. LITERATURE REVIEW

Some readers may point out that metrics to check the quality of a schedule already exist. As such, an extensive interview process and literature review was performed. Industry professionals were interviewed to identify which schedule metrics, checklists, guidelines, best practices and publications currently exist to demonstrate the impact the metrics have on a schedule. Professors from the Department of Civil, Architectural and Environmental Engineering program at The University of Texas at Austin, project managers, schedule forensic consultants and owners' representatives were interviewed. In addition, the U.S. Department of Veterans Affairs (VA) and the U.K. Royal Institution of Chartered Surveyors (RICS) were researched to find standards or recommended practices related to schedule metrics.

2. LITERATURE ANALYSIS

Recommended literature was obtained, reviewed, and analyzed. Literature was compiled and reviewed to identify referenced schedule metrics. Information obtained from the literature included but may not be limited to the following:

+ Focus/purpose of the literature
+ Intended audience of the literature
+ Contents
+ Methodology of the literature
+ Findings of the literature
+ Specified quantitative metrics

The referenced information was imported into a table for comparative purposes. Rows and/or columns were added when a new metric was found or literature was added. This facilitated the documentation of the metrics relative to the information source.

3. METRIC COMPILATION

The referenced schedule metrics from each publication was compiled, organized, and analyzed. Redundant metrics were evaluated and removed from the compilation. The remaining items were used to form a 'master list' of possible schedule metrics to consider. Accordingly, over 100 quantitative schedule metrics were documented, compiled, and analyzed.

4. METRIC SELECTION

Compiled schedule metrics were categorized and selected. Schedule metrics appearing within multiple publications/ sources and seemed reasonable for evaluating a baseline schedule were identified, selected, and labeled "Industry Metrics." Analyzing over 100 quantitative metrics would have been difficult and time consuming since there is no research regarding the impact of each metric. Accordingly, Industry Metrics were evaluated based on the recommended thresholds identified within the literature. Industry Metrics were considered for exclusion in one or more of the following scenarios

1. The metric did not have a recommended threshold in the literature researched.
2. A metric was not appropriate for analyzing a baseline schedule. For example, earned value, progress, and benchmarking metrics were not considered in the evaluation as they are typically involved in the evaluation of schedule updates.

It is reasonable for some of the metrics not to have recommended thresholds. Examples include the total number of tasks (activities), number of relationships, number of milestones, average duration, and so forth. These metrics are needed for the basis of other metrics analysis. However, these metrics were not included in Industry Metrics because these metrics are intended to understand a schedule rather than measure a schedule quality.

On the other hand, there were many metrics having no recommended thresholds even though one should have existed (e.g., the number of highest concurrent tasks, number of redundant links, path convergence/divergence, number of soft constraints, average total float, etc.). After proper (scientific) study by identifying threshold, these metrics may be appropriate to measure a schedule quality. These metrics were also excluded, as no recommended threshold existed within the researched literature.

5. CASE STUDY PROJECT COLLECTION

Case study projects were collected from multiple sources. The project information was obtained to analyze the characteristics. A questionnaire was developed and transmitted to several industry professionals to obtain project baseline schedules and information. The information consisted of the following:

- ☑ Approved Baseline Schedule
- ☑ Contract Value
- ☑ Description of Project (Project Type, Location, Owner, Contractor, etc.)
- ☑ Forecasted (from Baseline) and Actual Project Duration
- ☑ Forecasted (from Baseline) and Actual Project Start
- ☑ Date and Year
- ☑ Forecasted (from Baseline) and Actual Project Completion Date and Year
- ☑ Reported Project Delays & Delay Categories (Force Majeure, Weather Delays, Labor Strikes, Owner Delay, Scope Change/Change Order, etc.)

Afterward, the case study projects were sorted by their schedule performance and renamed by project number.

6. CASE STUDY PROJECT SCREENING AND CLASSIFICATION

The received project information was reviewed, organized, and classified. Projects with insufficient information were excluded from the analysis. In total, 8 case study projects were classified into two groups according to the following criteria:

1. Average percentage of delay relative to planned project duration;
2. A distribution of the average percentage of delay was checked for inflection points and extreme variation. It is assumed that each schedule should have a normal distribution of scores (delay amount) and equal or similar variances.

Ultimately, the threshold for dividing into one of the two groups was whether the average schedule delay for a case study project was more or less than 10%. Case study projects experiencing less than 10% were categorized as Group A. Group A projects had an average of 6% schedule delay. Case study projects experiencing greater than 10% schedule delay were categorized as Group B. Group B projects had an average of 50% schedule delay.

7. INDUSTRY METRIC ANALYSIS

Industry metrics were analyzed by evaluated case projects through the following process:

1. Collected baseline or initial stage schedules were selected for the export.
2. Data types were identified and selected for the export (activities, activity relationships, resources, and resource assignments).
3. Template was created to export data.
4. Metric values were calculated by their calculation method as addressed in Table 1.
5. Schedule data was exported and compiled into a Spreadsheet format (XLS).
6. Most of the metrics analysis values were calculated easily by excel features such as pivot table, excel function (sum, average, lookup, countif, if, etc.), and finding feature.
7. Each returned metric analysis value was reviewed and compared to the recommended Industry Metric thresholds identified in the literature.
8. Metric analysis values that were within the Industry Metric thresholds were identified and labeled as “Pass.” Similarly, metric analysis values that were NOT within the Industry Metric thresholds were identified and labeled as “Fail.”
9. The number of “Pass” and “Fail” metrics were tabulated and analyzed.

ANALYSIS RESULTS AND FINDINGS

In total, 27 quantitative Industry Metrics were selected along with the published recommended thresholds. Table 1 provides a list of the 27 quantitative Industry Metrics with the corresponding literature referenced, a brief description of the metric, and how to calculate or identify the metric within a schedule.

TABLE 1 SELECTED QUANTITATIVE INDUSTRY METRICS

NO	INDUSTRY METRIC	REFERENCED LITERATURE [NUMBER] – ORGANIZATION	INDUSTRY METRIC DESCRIPTION SUMMARY	HOW TO IDENTIFY/CALCULATE?
1	Activity ID	A. [6] – GAO B. [10] – Naval Air C. [14] – PMI D. [15] – UT OFPC	Every activity should have a unique identification number.	Percentage of activities with unique Activity ID
2	Activity Name (Unique)	A. [6] – GAO B. [10] – Naval Air C. [11] – NDIA	Every activity should have a unique name.	Percentage of activities with unique Activity Name
3	Activity Codes / WBS / Reference Code	A. [10] – Naval Air B. [14] – PMI	Every activity should have an activity code which include a WBS by location, floor, phase, etc.	Percentage of activities with activity code
4	Responsibility / Organizational / Functional Directory	A. [10] – Naval Air B. [15] – UT OFPC	A schedule should have a Responsibility, Organizational or Functional Directory.	Find Responsibility / Organizational / Functional Directory
5	Responsibility / Organizational / Functional Codes	A. [10] – Naval Air B. [15] – UT OFPC	Every activity should assigned by Responsibility / Organizational / Functional code.	Percentage of activities with Responsibility / Organizational / Functional Code
6	Ratio of Detail Activities to Milestones	A. [6] – GAO	A rough indicator of the level of planning detail.	Divide Number of Detail Activities by Number of Milestones
7	Milestones Missing Predecessor or Successor	A. [11] – NDIA	Every Milestone should have at least one predecessor and one successor.	Percentage of milestone missing predecessor or successor
8	Milestones with Resources	A. [6] – GAO B. [11] – NDIA C. [14] – PMI	Milestone must have no resource	Percentage of milestone with resource assigned
9	Milestones with Duration	A. [2] – DCMA B. [6] - GAO C. [9] - NASA D. [11] - NDIA E. [14] - PMI	Milestone must have no duration	Percentage of milestone with duration assigned
10	Start and Finish Milestones	A. [6] - GAO B. [11] - NDIA C. [14] - PMI	A project start milestone and a project finish milestone should be present in the schedule.	Find project start milestone; find project finish milestone
11	High Duration	A. [2] - DCMA B. [4] - DOD C. [6] - GAO D. [10] – Naval Air E. [11] - NDIA F. [14] - PMI	An activity greater than 44 working days (2 months) needs intention.	Percentage of activities greater than 44 working days

12	Extreme Duration	A. [10] – Naval Air B. [11] - NDIA	An activity greater than 120 (125 – Naval Air) working days needs high intention.	Percentage of activities greater than 120 working days
13	Project Calendar	A. [6] - GAO B. [10] – Naval Air C. [11] - NDIA D. [14] - PMI	At the project level, project calendar must constitute the primary or default calendar for the project.	Find Project Calendar; Project Calendar is assigned?
14	Holidays	A. [6] - GAO B. [10] – Naval Air C. [11] - NDIA D. [15] – UT OFPC	Holidays and other exceptions are assigned in the calendar.	Is there Holidays? Or other Exceptions?
15	Basic Relationship (Open Ends)	A. [2] - DCMA B. [4] - DOD C. [5] - DOD D. [6] - GAO E. [10] - Naval Air F. [11] - NDIA G. [14] - PMI H. [15] - OFPC	Every activity should have a predecessor and a successor.	Percentage of activities missing predecessor or successor
16	Relationship Type (Finish to Start)	A. [2] - DCMA B. [4] – DOD C. [6] - GAO D. [10] - Naval Air E. [11] - NDIA F. [14] - PMI	Finish to Start relationship should be majority of relationship	Percentage of F-to-S relationships
17	Critical Path Test (Horizontal Traceability)	A. [2] - DCMA B. [4] - DOD C. [5] - DOD D. [6] - GAO E. [10] - Naval Air F. [11] - NDIA G. [14] - PMI H. [15] - OFPC	A schedule should react by increasing Activities' durations by improbable amounts (500 or 1,000 days)	Increase several activities durations by 500 or 1000 days
18	Activities on Critical Path	A. [4] - DOD	A schedule should not overly simplified - adequate # of activities should be on the critical path.	Percentage of Activities on Critical Path
19	Link in Summary Activity / Hammock / Level of effort	A. [6] - GAO B. [9] - NASA C. [11] - NDIA D. [10] - Naval Air	Every summary activities/hammock should not have relationship.	Percentage of summary activities / hammock predecessor or successor
20	Hard Constraints	A. [2] - DCMA B. [4] - DOD C. [6] - GAO D. [10] - Naval Air E. [11] - NDIA F. [14] - PMI G. [15] - OFPC	Hard Constraints (Must start on, must finish on, finish no later than, start no later) should be used carefully.	Percentage of hard constraints
21	Constraints %	A. [5] - DOD B. [9] - NASA	Significant number of constraints in the schedule is one of schedule indicator.	Percentage of constraints
22	Resources Rate/Prices Assigned	A. [2] - DCMA B. [6] – GAO C. [9] - NASA D. [10] - Naval Air E. [11] - NDIA F. [14] - PMI	All activities with durations greater than zero should have dollars or hours assigned.	Percentage of activities with resource assigned

23	Resource Library/Dictionary	A. [14] - PMI	A resource library or dictionary should be organized into some meaningful structure.	Find a resource library or dictionary
24	High Float	A. [2] - DCMA B. [4] - DOD C. [6] - GAO D. [10] - Naval Air E. [11] - NDIA	An activity with total float greater than 44 working days needs intention.	Percentage of activities with total float greater than 44 working days
25	Extreme Float	A. [11] - NDIA	An activity with total float greater than 120 working days needs high intention.	Percentage of activities with total float greater than 120 working days
26	Lags	A. [2] - DCMA B. [4] – DOD C. [6] - GAO D. [10] - Naval Air E. [14] - PMI	A lag shall not be used or used rarely.	Percentage of lag in predecessor logic relationships
27	Lead	A. [2] - DCMA B. [4] – DOD C. [6] - GAO D. [10] - Naval Air E. [14] - PMI	A lead shall not be used or used rarely.	Percentage of lead in predecessor logic relationships

Industry Metrics were derived from reviewed publications and were not tested or substantiated prior to selection. From the extensive literature review, currently identified metrics appear to be not based on substantiated evidence but somewhat subjective, rule-of-thumb, or based on the experience of the authors. The referenced metrics did not assess the impact of the metrics on the quality of the schedule mechanics and no research or data was found to support the publications recommended metrics. Accordingly, analysts should use caution when relying on these Industry Metrics and the published corresponding thresholds.

Ultimately, projects within the commercial or higher education sector of construction were selected to analyze. The case study projects consisted of the following general characteristics:

+ Commercial or university project schedule
+ Medium size project (range of estimated duration: between approximately 300 to 1,200 calendar days)
+ Developed by different contractors or schedulers
+ Developed in primavera p3 or p6 versions
+ Schedules were developed between 2004 to 2011
+ Projects were completed between 2008 to 2013
+ Baseline or initial stage schedules were collected

All of the case study projects had delays. It would have been more advantageous if the comparison could have been made between case projects with and without delays. However, the amount of delay variance between the two groups was significant enough to identify their schedule quality differences.

Before the schedule analysis, the 8 schedules were divided into two groups by their schedule performance. (Originally, the authors collected 12 schedules. However, four schedules failed to qualify for this analysis due to a lack of background data such as actual duration, delay amount caused by change order, weather, etc.) The threshold for dividing the groups was a 10% schedule delay. Group A projects had an average of 6% and Group B projects had an average of 50% schedule delay. Projects were sorted by their schedule performance and named accordingly as Project 1 to 8. The individual “PASS” or “FAIL” results and schedule performance of Project 1, 2, and 3 (Group A) are presented in Table 2. The “PASS” or “FAIL” results and schedule performance of Projects 4, 5, 6, 7 and 8 (Group B) are addressed in Table 3.

TABLE 2 SCHEDULE QUALITY ANALYSIS RESULT (GROUP A)

NO	INDUSTRY METRIC	THRESHOLD	PROJECT 1		PROJECT 2		PROJECT 3	
	Performance (% Delay & Rank)		1.04%	1	1.06%	2	1.08%	3
1	Activity ID	100.00%	100.00%	PASS	100.00%	PASS	100.00%	PASS
2	Activity Name (Unique)	100.00%	95.10%	FAIL	100.00%	PASS	96.23%	FAIL
3	Activity Codes/WBS/Reference Code	100.00%	100.00%	PASS	100.00%	PASS	100.00%	PASS
4	Responsibility/Organizational/Functional Directory	Y	N	FAIL	N	FAIL	N	FAIL
5	Responsibility/Organizational/Functional Codes	100.00%	81.21%	FAIL	94.56%	FAIL	79.72%	FAIL
6	Ratio of Detail Activities to Milestones	LOW<=2, 10<=HIGH	5.070175	PASS	17.375	FAIL	3.97619	PASS
7	Milestones Missing Predecessor or Successor	95.00%	98.21%	PASS	71.43%	FAIL	97.62%	PASS
8	Milestones with Resources	0.00%	0.00%	PASS	0.00%	PASS	0.00%	PASS
9	Milestones with Duration	0.00%	0.00%	PASS	0.00%	PASS	0.00%	PASS
10	Start and Finish Milestones	2	1	FAIL	1	FAIL	2	PASS
11	High Duration	5.00%	2.02%	PASS	4.08%	PASS	3.32%	PASS
12	Extreme Duration	0.00%	0.29%	FAIL	0.00%	PASS	0.95%	FAIL
13	Project Calendar	Y	Y	PASS	Y	PASS	Y	PASS
14	Holidays	Y	Y	PASS	Y	PASS	Y	PASS

15	Basic Relationship (Open Ends)	5.00%	0.00%	PASS	0.00%	PASS	0.00%	PASS
16	Relationship Type (Finish to Start)	90.00%	95.06%	PASS	93.62%	PASS	98.04%	PASS
17	Critical Path Test (Horizontal Traceability)	Y	Y	PASS	Y	PASS	Y	PASS
18	Activities on Critical Path	15~20%	8.48%	FAIL	19.23%	PASS	24.88%	FAIL
19	Link in Summary Activity/Hammock/Level of effort	3.00%	0.29%	PASS	0.00%	PASS	0.95%	PASS
20	Hard Constraints	5.00%	0.00%	PASS	0.00%	PASS	0.00%	PASS
21	Constraints %	10%, 15%	0.00%	PASS	0.00%	PASS	0.00%	PASS
22	Resources Rate/Prices Assigned	100.00%	0.00%	FAIL	0.00%	FAIL	0.00%	FAIL
23	Resource Library/Dictionary	Y	Y	PASS	Y	PASS	Y	PASS
24	High Float	5.00%	36.99%	FAIL	9.52%	FAIL	16.10%	FAIL
25	Extreme Float	0.00%	4.91%	FAIL	2.04%	FAIL	0.00%	PASS
26	Lags	5.00%	4.94%	PASS	7.23%	FAIL	3.59%	PASS
27	Lead	0.00%	0.00%	PASS	0.00%	PASS	0.00%	PASS
			PASS	18	PASS	18	PASS	20
			FAIL	9	FAIL	9	FAIL	7

TABLE 3 SCHEDULE QUALITY ANALYSIS RESULT (GROUP B)

NO	INDUSTRY METRIC	THRESHOLD	PROJECT 4		PROJECT 4		PROJECT 5		PROJECT 6		PROJECT 5	
	Performance (% Delay & Rank)		1.16%	4	1.21%	5	1.23%	6	1.93	7	1.99%	8
1	Activity ID	100.00%	100.00%	PASS	100.00%	PASS	100.00%	PASS	100.00%	PASS	100.00%	PASS
2	Activity Name (Unique)	100.00%	100.00%	PASS	100.00%	PASS	95.74%	FAIL	76.62%	FAIL	53.64%	FAIL
3	Activity Codes/WBS/Reference Code	100.00%	0.00%	FAIL	100.00%	PASS	100.00%	PASS	92.51%	FAIL	100.00%	PASS
4	Responsibility/Organizational/ Functional Directory	Y	n	FAIL	n	FAIL	N	FAIL	n	FAIL	y	PASS

5	Responsibility/Organizational/ Functional Codes	100.00%	0.00%	FAIL	0.00%	FAIL	0.00%	FAIL	0.00%	FAIL	57.82%	FAIL
6	Ratio of Detail Activities to Milestones	Low<=2, 10<=High	40.967742	FAIL	10.26	FAIL	*	FAIL	101.33333	FAIL	4.55	PASS
7	Milestones Missing Predecessor or Successor	95.00%	80.65%	FAIL	90.24	FAIL	*	FAIL	66.66%	FAIL	98.30%	PASS
8	Milestones with Resources	0.00%	*	FAIL	0%	PASS	*	FAIL	*	FAIL	*	FAIL
9	Milestones with Duration	0.00%	0.00%	PASS	0.00%	PASS	*	FAIL	0.00%	PASS	0.00%	PASS
10	Start and Finish Milestones	2	1	FAIL	2	PASS	2	PASS	2	PASS	2	PASS
11	High Duration	5.00%	4.53%	PASS	2.00%	PASS	1.43%	PASS	2.93%	PASS	0.36%	PASS
12	Extreme Duration	0.00%	0.61%	FAIL	1.08%	FAIL	0.00%	PASS	0.00%	PASS	0.00%	PASS
13	Project Calendar	Y	y	PASS	Y	PASS	Y	PASS	y	PASS	y	PASS
14	Holidays	Y	y	PASS	Y	PASS	Y	PASS	y	PASS	y	PASS
15	Basic Relationship (Open Ends)	5.00%	0.71%	PASS	4.01%	PASS	16.43%	FAIL	3.29%	PASS	6.00%	FAIL
16	Relationship Type (Finish to Start)	90.00%	92.81%	PASS	94.68%	PASS	85.09%	FAIL	91.11%	PASS	79.59%	FAIL
17	Critical Path Test (Horizontal Traceability)	Y	y	PASS	n	FAIL	Y	PASS	y	PASS	y	PASS
18	Activities on Critical Path	15~20%	32.87%	FAIL	4.03%	FAIL	45.00%	FAIL	5.88%	FAIL	0.00%	FAIL
19	Link in Summary Activity/Hammock/Level of effort	3.00%	0.08%	PASS	1.60%	PASS	0.00%	PASS	0.00%	PASS	0.00%	PASS
20	Hard Constraints	5.00%	0.00%	PASS	0.03%	PASS	0.00%	PASS	0.00%	PASS	0.18%	PASS
21	Constraints %	10%, 15%	0.46%	PASS	1.25%	PASS	0.71%	PASS	0.98%	PASS	2.00%	PASS
22	Resources Rate/Prices Assigned	100.00%	0.00%	FAIL	0.00%	FAIL	0.00%	FAIL	0.00%	FAIL	0.00%	FAIL
23	Resource Library/Dictionary	Y	n	FAIL	n	FAIL	N	FAIL	n	FAIL	0.00%	FAIL
24	High Float	5.00%	31.16%	FAIL	10.83%	FAIL	14.29%	FAIL	33.88%	FAIL	21.17%	FAIL
25	Extreme Float	0.00%	11.13%	FAIL	4.56%	FAIL	11.43%	FAIL	0.00%	PASS	7.66%	FAIL
26	Lags	5.00%	7.03%	FAIL	5.88%	FAIL	0.00%	PASS	5.11%	FAIL	15.11%	FAIL
27	Lead	0.00%	0.08%	FAIL	0.03%	FAIL	0.00%	PASS	2.44%	FAIL	12.90%	FAIL
			PASS	12	PASS	14	PASS	13	PASS	14	PASS	15
			FAIL	15	FAIL	13	FAIL	14	FAIL	13	FAIL	12

The average schedule performance (% delay) of Group A was 6%. On average, among all 27 measurements, Group A passed 18.7 thresholds (69.2%); Group B passed 13.6 (50.4%). The average schedule performance (% delay) of Group B was 50%. Unfortunately, it is difficult to claim statistical significance due to the small number of schedules. However, the authors were able to identify a relationship between a baseline schedule quality and the metrics identified in the referenced literature. From threshold screening analysis by group, the authors identified that Group A (better schedule performance group) had higher baseline schedule quality compared to Group B (poor schedule performance group).

As presented in Tables 2 and 3, there were several industry metrics that were within and outside the published thresholds for Group A and B. The following industry metrics were within the published thresholds (passed) for both Group A and Group B:

+ Unique activity ID
+ Project calendar
+ Holiday list
+ Link in summary activity / hammock / level of effort

+ Number of hard constraints
+ Number of general constraints.

Although these metrics were within the published thresholds for Groups A & B, they may not definitively determine schedule quality. Adjustments to the thresholds may be required to determine if a metric has an impact on schedule quality.

In addition, the following industry metrics were outside the published thresholds for both Group A and B:

+ Responsibility / organizational / functional codes
+ Activities assigned with resource rate or price
+ Activities with total float greater than 44 working days

Similarly, the thresholds for the above metrics may need to be adjusted. Failure to fall within the threshold for these metrics may not determine schedule performance.

From this analysis, the authors were able to develop a framework for reviewing and analyzing schedule-quality metrics. The existence of a lead in the baseline schedule, utilization of resource library/dictionary, ratio of activities with basic relationships (a predecessor and a successor -no open ends), and ratio of relationship type were good indicators of the quality of baseline schedules.

NEEDS FOR FUTURE RESEARCH

Additional research and analysis is recommended for the future. Here are a few considerations based on the current research and analysis performed to date:

1. Additional case study projects are required. A substantial effort is needed to initiate research through analyzing a large number of baseline schedules to develop effective quantitative schedule quality metrics and thresholds.

2. Research is needed on setting the proper threshold for each metric. Based on the literature review, Industry Metrics appear to be somewhat subjective, rule-of-thumb, or based on the experience of the organizations/authors; the metrics are not based on substantiated evidence. Furthermore, the referenced metrics did not assess the impact of the metrics on the quality of the schedule mechanics. Furthermore, no research or data was found from the literature review to support the publication's recommended metrics.

CONCLUSIONS

The purpose of this paper was to identify and evaluate a list of industry-recognized metrics to determine if a schedule is fatally flawed or represents a reasonable forecast. Current Industry Metrics were analyzed, filtered, and compared for different case study projects. While additional projects are needed to improve the statistical size, the following observations were noted based on the findings:

1. The case study projects with higher baseline schedule quality had less of a schedule delay (Group A). Group A had approximately 19% more Industry Metrics within the thresholds (passed) and experienced 44% less delay.

2. Schedules with milestones that had an adequate ratio of detailed activities, proper relationships ties, and contained no resource assignments experienced better schedule performance.

3. Existence of "leads" in the baseline schedule, utilization of resource library/dictionary, ratio of activities with basic relationships (a predecessor and a successor - no open ends), and ratio of relationship type were good

indicators for checking the quality of baseline schedules.

4. All the case study projects were successful in Industry Metrics such as Unique activity ID, Project calendar, Holiday list, Link in Summary Activity / Hammock / Level of effort, Number of hard constraints, and Number of general constraints. In addition, all the case study projects were unsuccessful in the metrics of Responsibility / organizational / functional codes, Activities assigned with resource rate or price, and Activities with total float greater than 44 working days. These metrics, which most of schedules passed/failed, might not be an outstanding tool to determine schedule quality. To improve a metric's measurability of schedule quality, adjustments to the recommended thresholds are needed.

The content included in this article is for informational purposes only and does not reflect the opinions or recommendations expressed by any individual unless otherwise stated.

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