NetPoint+GPM
CONFERENCE

May 8, 2020



Have You Identified Every Risk?

When assessing the likelihood of project completion…

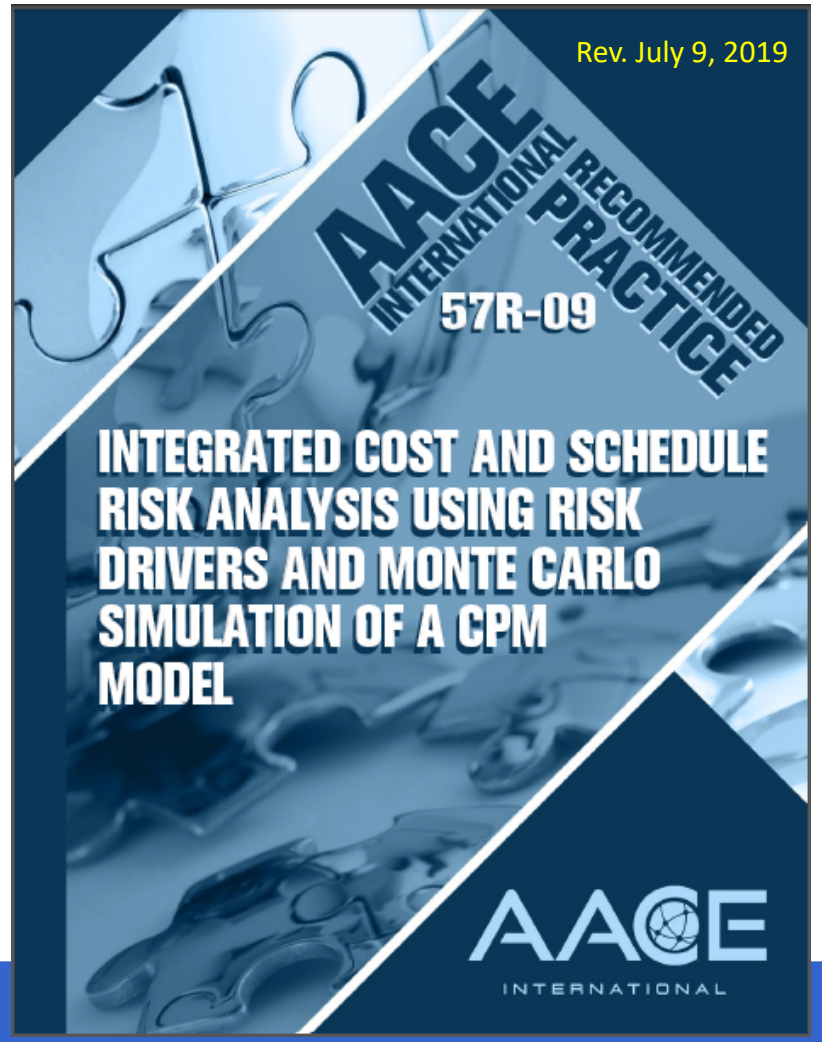
Gui Ponce de Leon, PhD, PE, PMP
Founder/Chief Executive Officer
PMA Consultants LLC

© 2020 PMA Consultants LLC

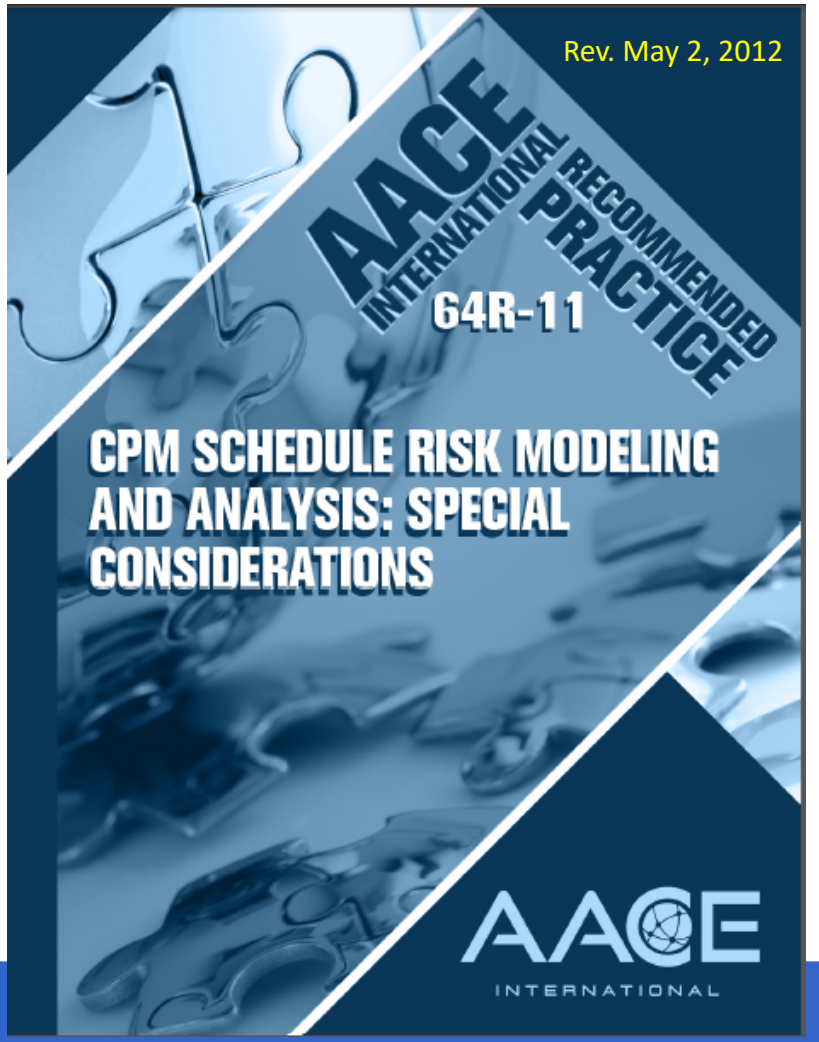
Modeling *Float-Use* Risk in Schedule Risk Analysis

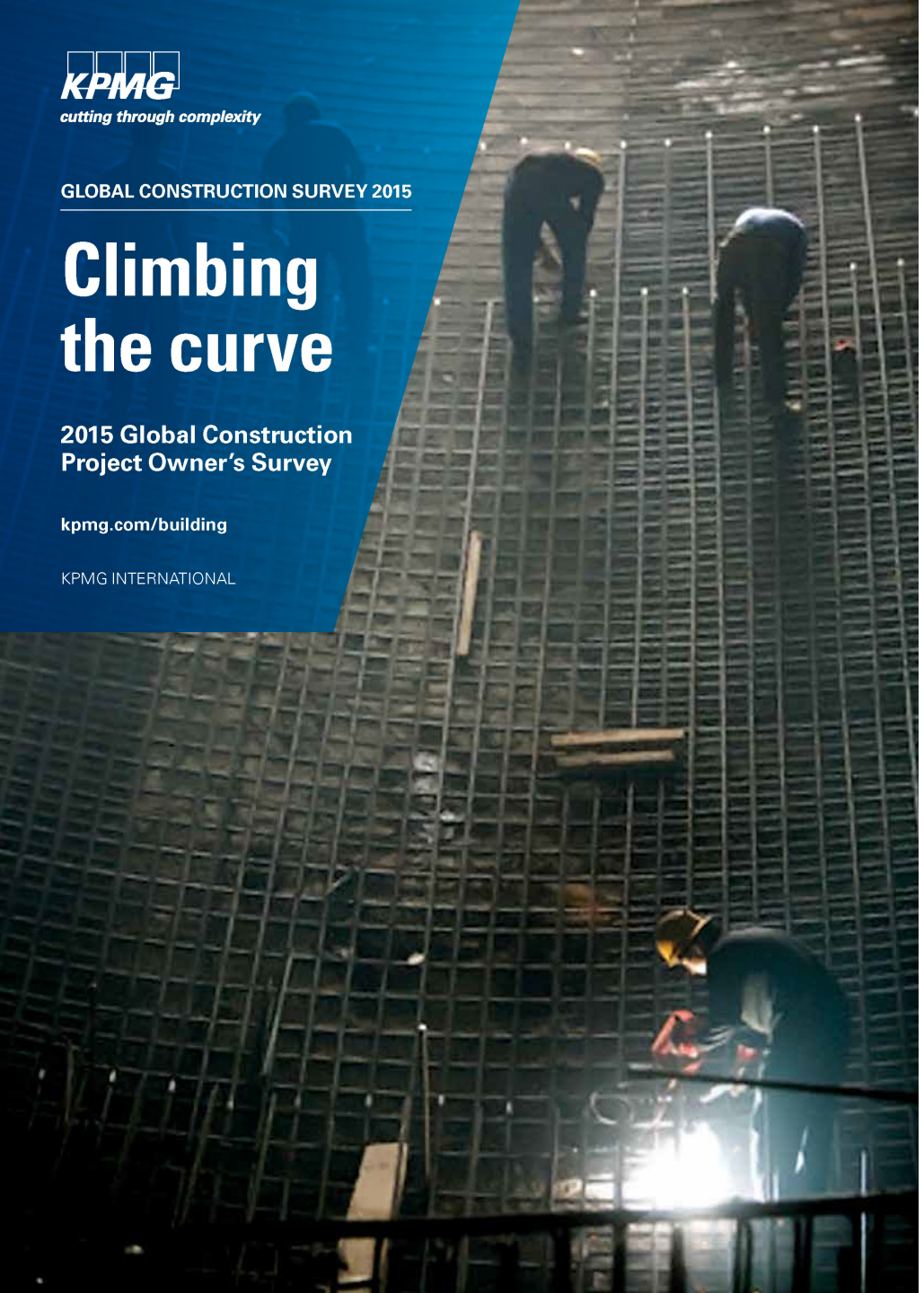
Use of float and its influence in the likelihood of completion has ***been overlooked*** in Monte Carlo schedule modeling, leading to exceedingly optimistic probabilities of completion. This Keynote illustrates how the Graphical Path Method (GPM), by **modeling the risk of *float use*** in schedule risk analysis, assists schedulers in more accurately predicting *probable* project finish dates.

© 2020 PMA Consultants LLC



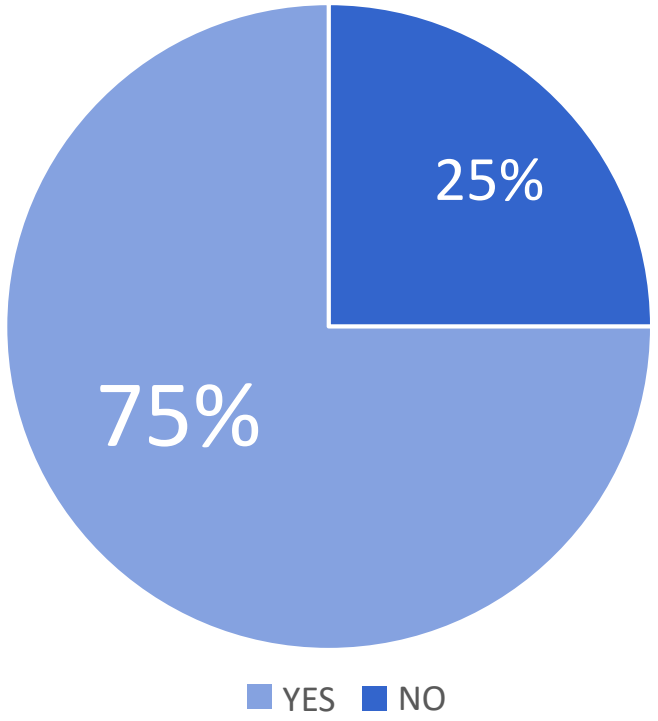
"[…]to estimate contingency and/or to understand the project's behavior in consideration of risk."





75% Of Projects Finished 10% Behind Schedule

Only one in ten public sector organizations hit this target



Source: KPMG International, 2015

© 2020 PMA Consultants LLC

PMI's PULSE of the PROFESSION®
8th Global Project Management Survey

2016

The High Cost of Low Performance

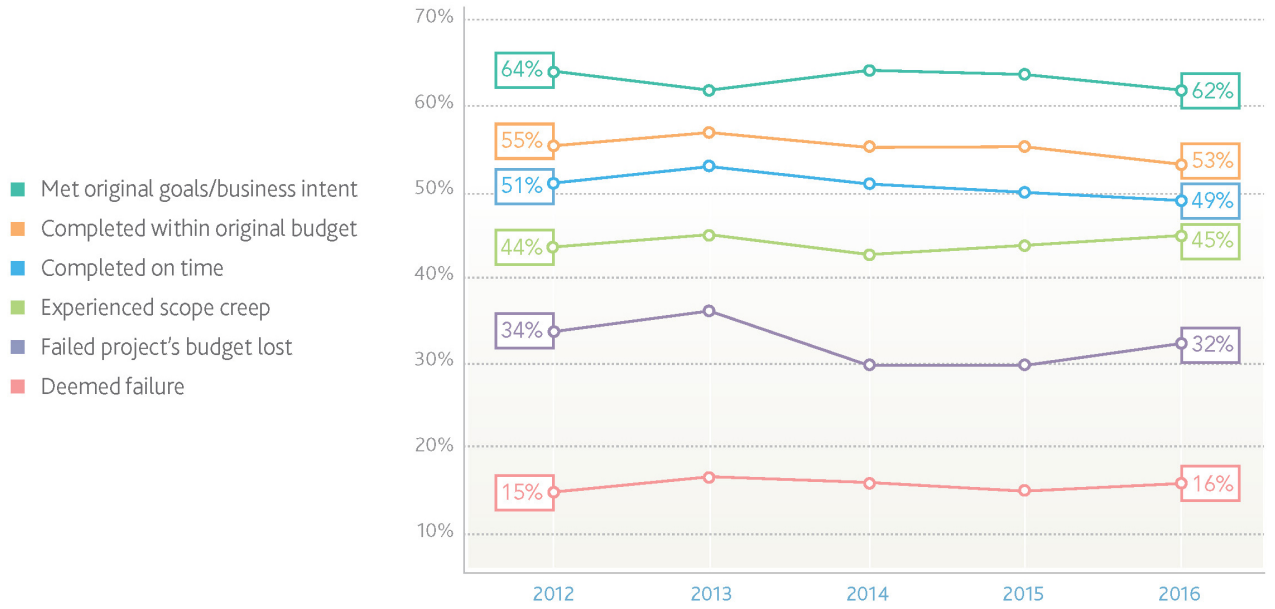
How will you improve business results?

Project Management Institute

Habitual Late Completion

2012 - 2016, only 51% to 49% of Projects completed on time

Figure 1: CURRENT STATE OF PROJECT OUTCOMES

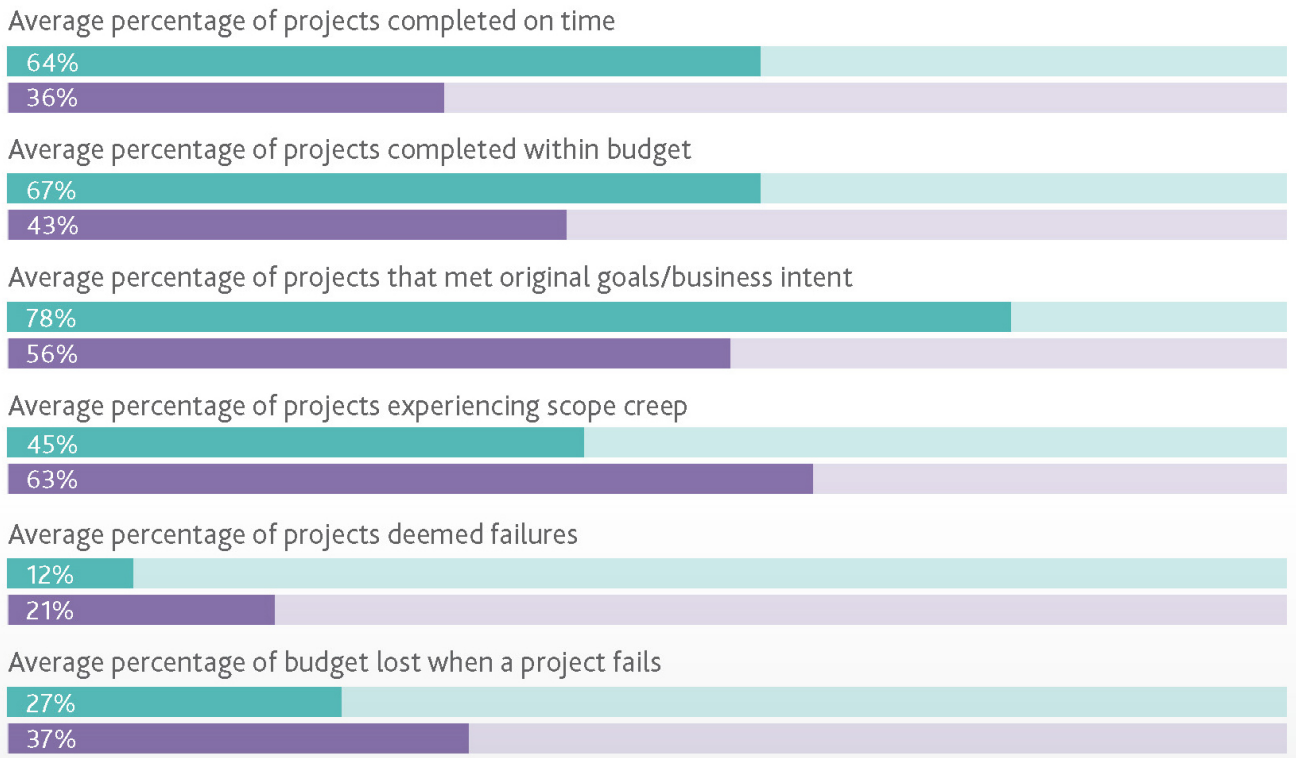


© 2020 PMA Consultants LLC



≈ Two-Thirds of Low Maturity Projects Late*

Figure 1: Value Delivery Capability Maturity Leads to Greater Project Performance



* 2016 *Pulse* 49% on-time performance increased to 52%

© 2020 PMA Consultants LLC

mosaic

Planning & Scheduling

The Scheduling Conundrum



The scheduling conundrum is simple:

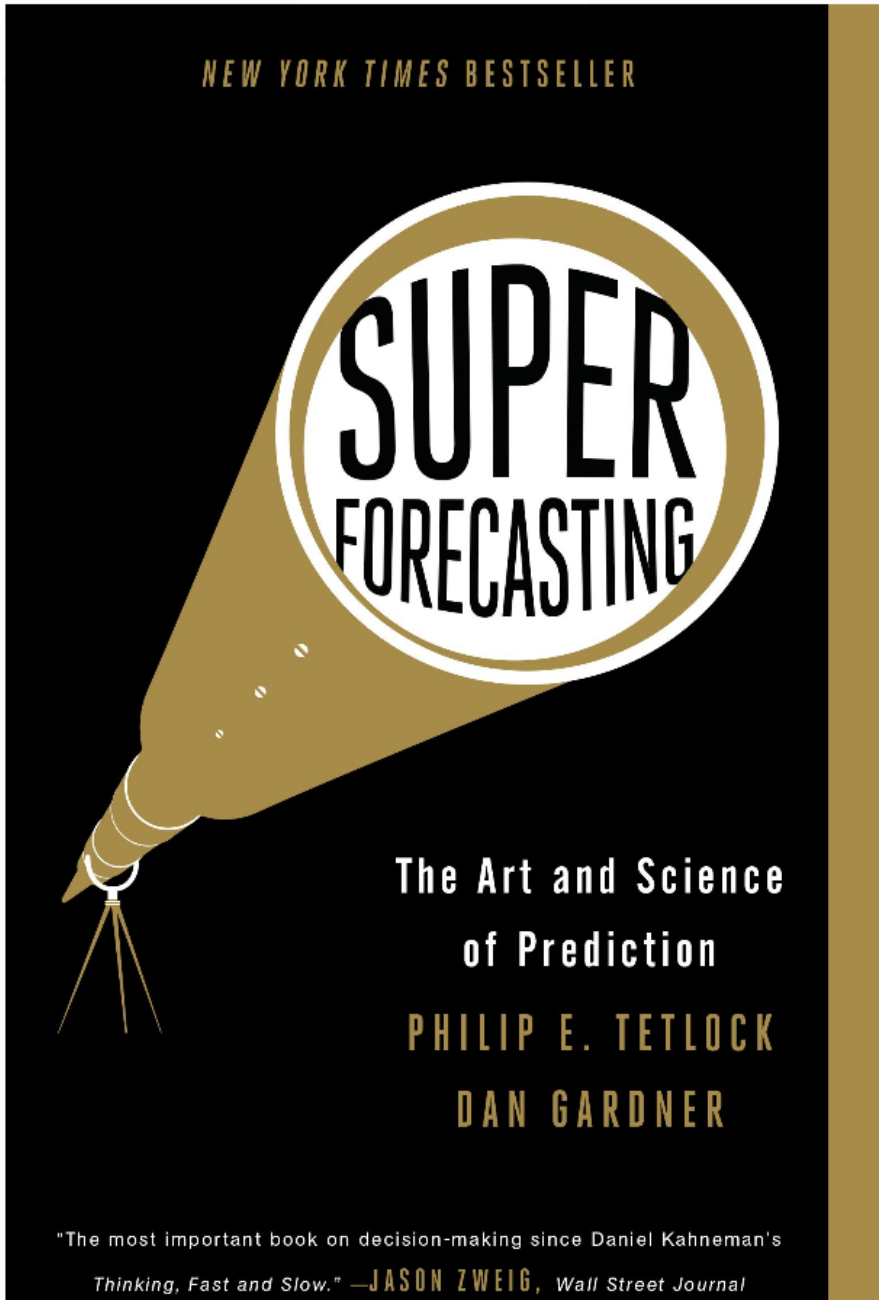
We know effective scheduling makes a significant difference to project success and we know what effective scheduling looks like but in most projects, the schedule is ignored, bad scheduling practice is the norm and most projects finish late.

The concepts and ideas outlined in this series of articles are drawn from many sources and an on-going dialogue with friends and colleagues around the world. These are indeed 'interesting times'; the business of scheduling and its underpinning concepts and theories underwent a revolution in the early 1960s with the introduction of critical path scheduling but since then all that really changed until recently is the scheduling tools and the

*"We know effective scheduling makes a significant difference to project success, and we know what effective scheduling looks like, but in most projects, the schedule is ignored, bad scheduling practice is the norm, and **most projects finish late**."*

…it can be solved through training and accreditation

© 2020 PMA Consultants LLC

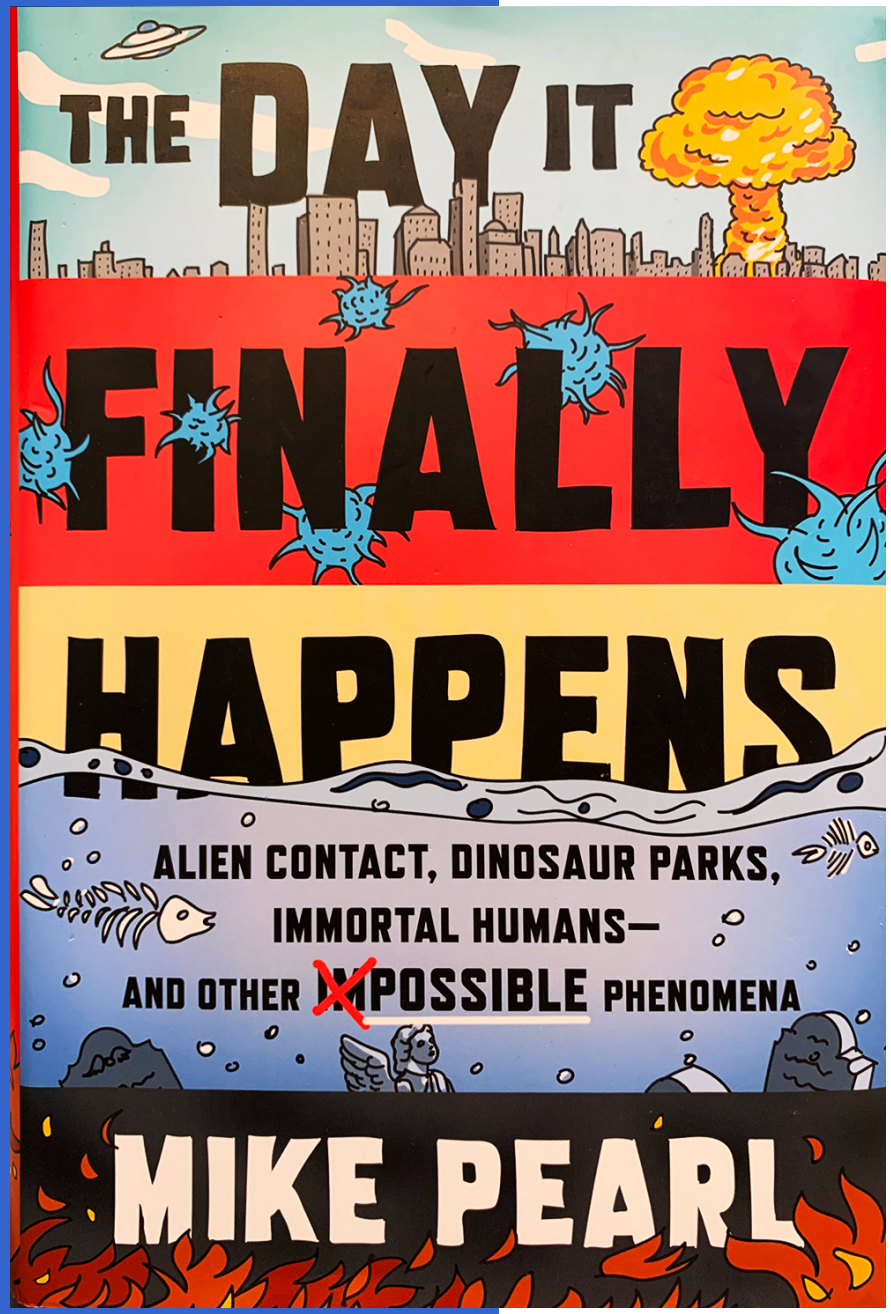




In fact, Pat Weaver's lament apart, ***deterministic schedules,*** even if built collaboratively and reliable, kept current, and followed (in and of itself, a rarity) without a probability attached to the finish date or the likelihood of on-time project completion *are hardly effective* project completion forecasting tools

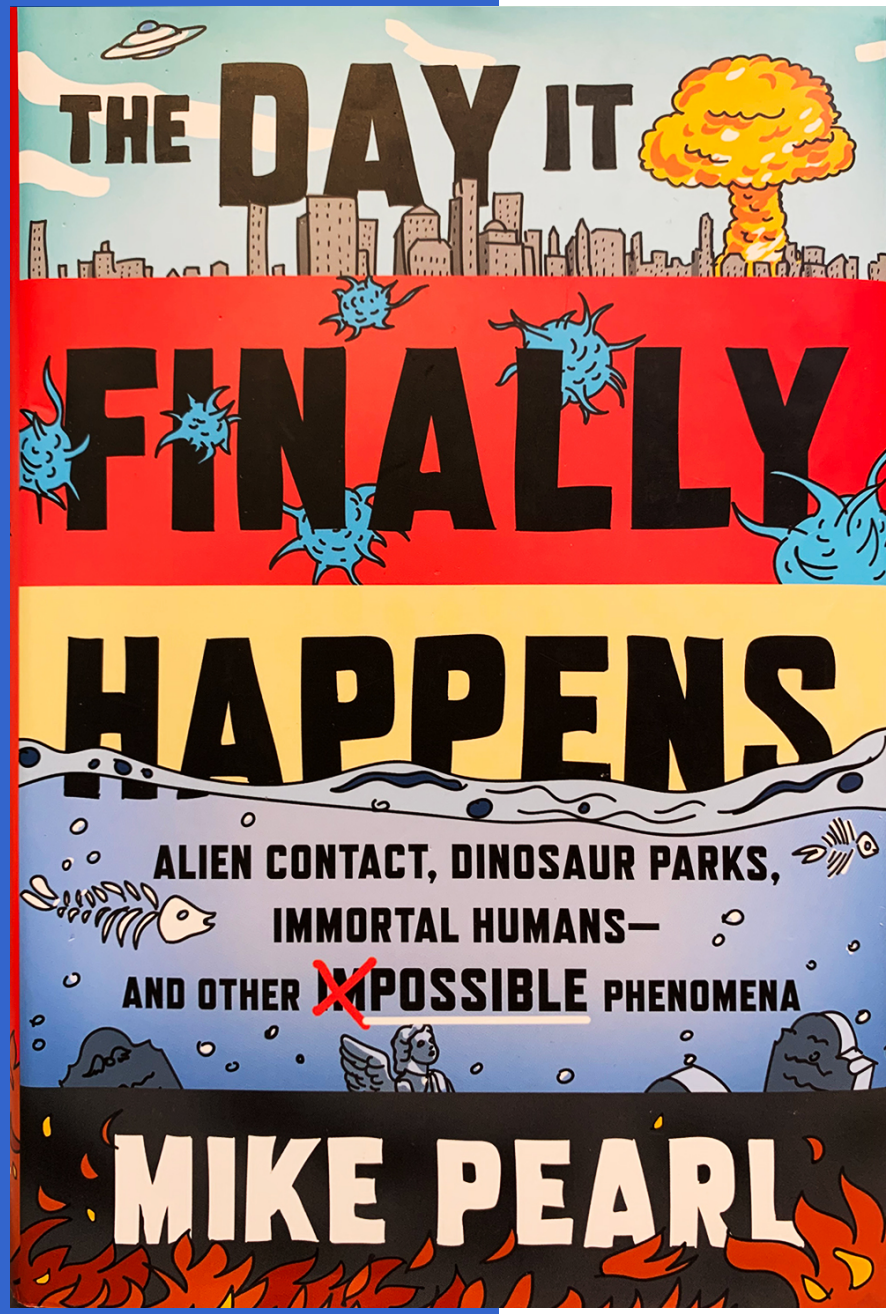
Training and accreditation is not going to cut it

© 2020 PMA Consultants LLC



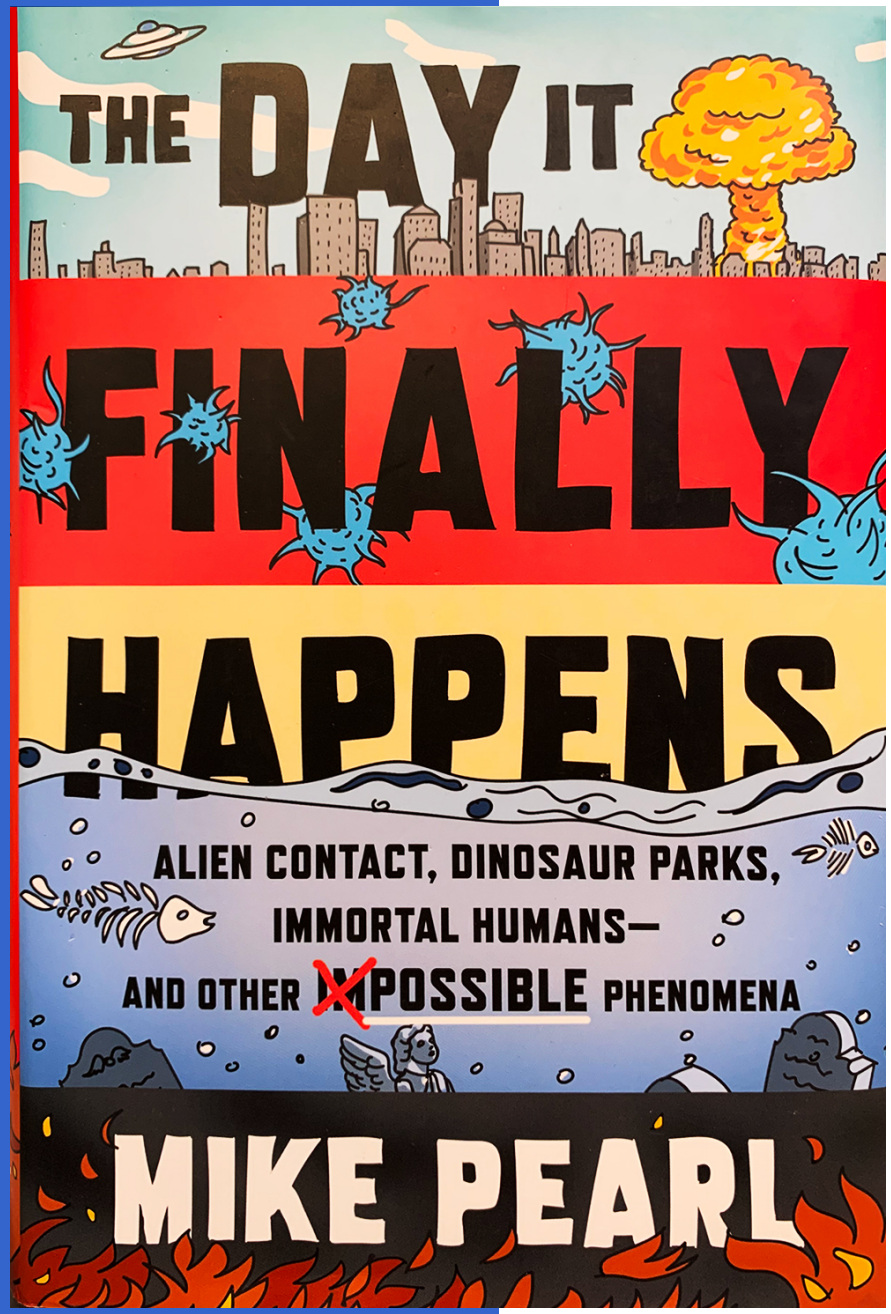
"Apparently, if you want to make a prediction about the future, you should base it on hard data, and that data should be completely divorced from any hunches or biases. **You should deal in probabilities—never certainties—and offer an unambiguous timeframe."**

© 2020 PMA Consultants LLC



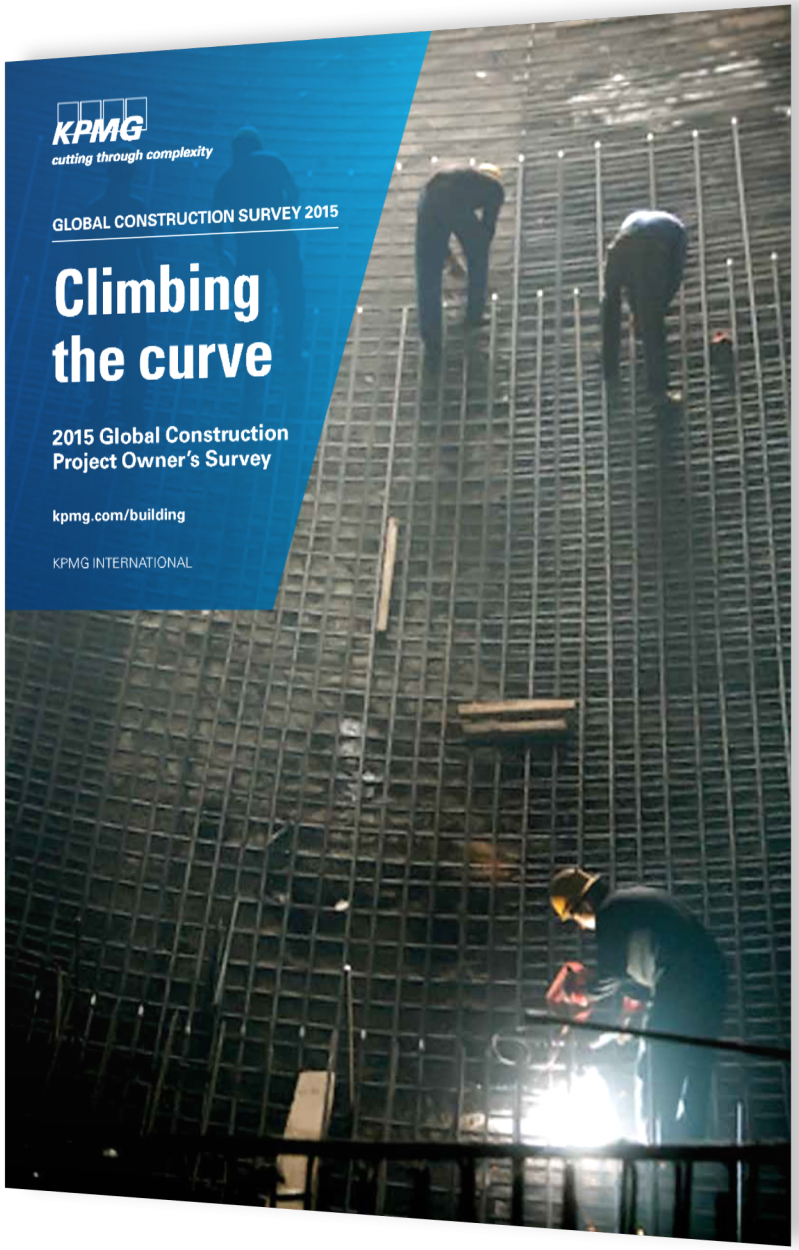
"[…] you should base it on hard data and that data should be completely divorced from any hunches or biases."

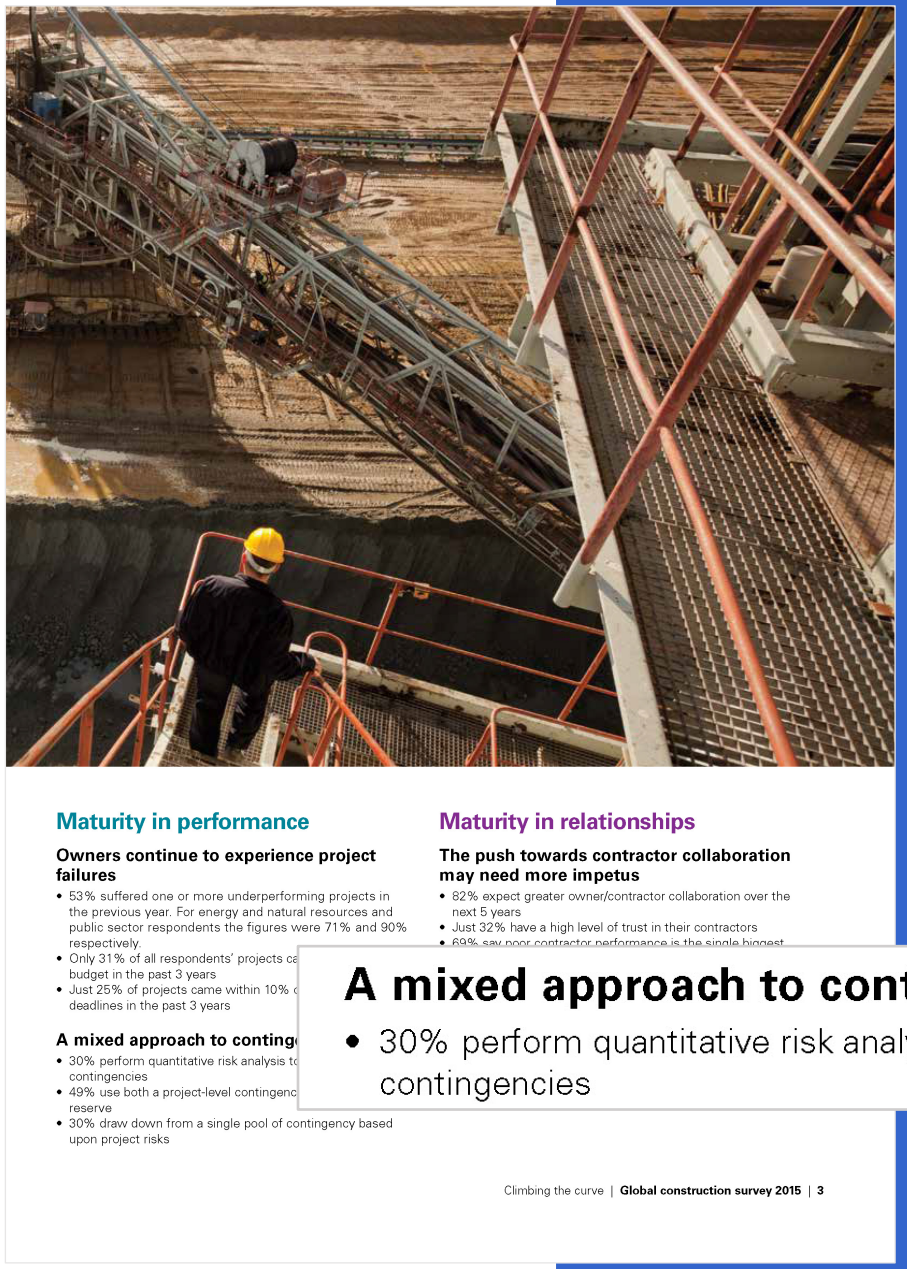
© 2020 PMA Consultants LLC



"You should deal in probabilities—never certainties—and offer an unambiguous timeframe."

© 2020 PMA Consultants LLC





Maturity in performance

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 ca
budget in the past 3 years
- Just 25% of projects came within 10%
deadlines in the past 3 years

A mixed approach to conting

- 30% perform quantitative risk analysis to
contingencies
- 49% use both a project-level contingenc
reserve
- 30% draw down from a single pool of contingency based upon project risks

Maturity in relationships

The push towards contractor collaboration may need more impetus

- 82% expect greater owner/contractor collaboration over the next 5 years
- Just 32% have a high level of trust in their contractors
- 69% say poor contractor performance is the single biggest

Climbing the curve | **Global construction survey 2015** | 3

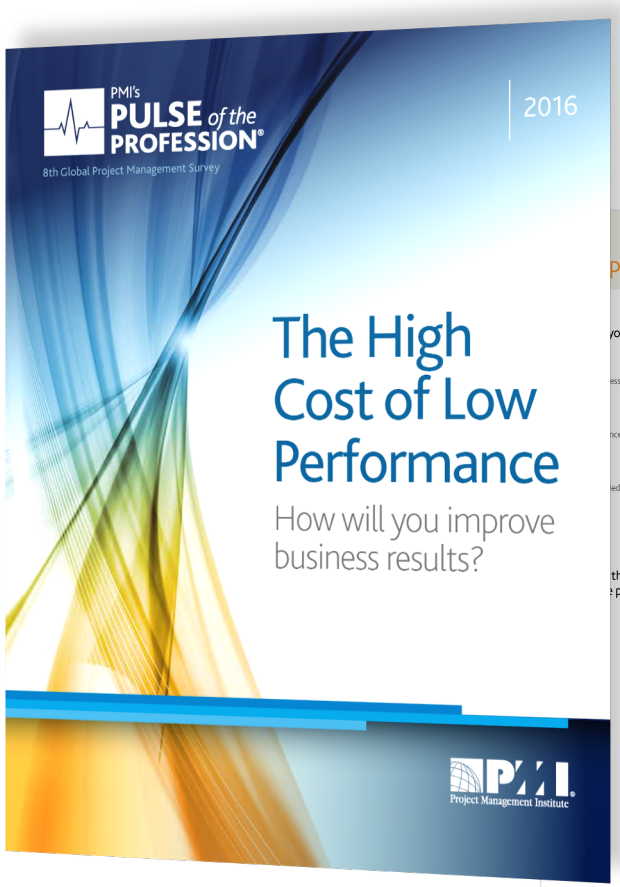
A mixed approach to contingency planning

- 30% perform quantitative risk analysis to calculate contingencies

AND, WHAT ABOUT PROBABILITIES?

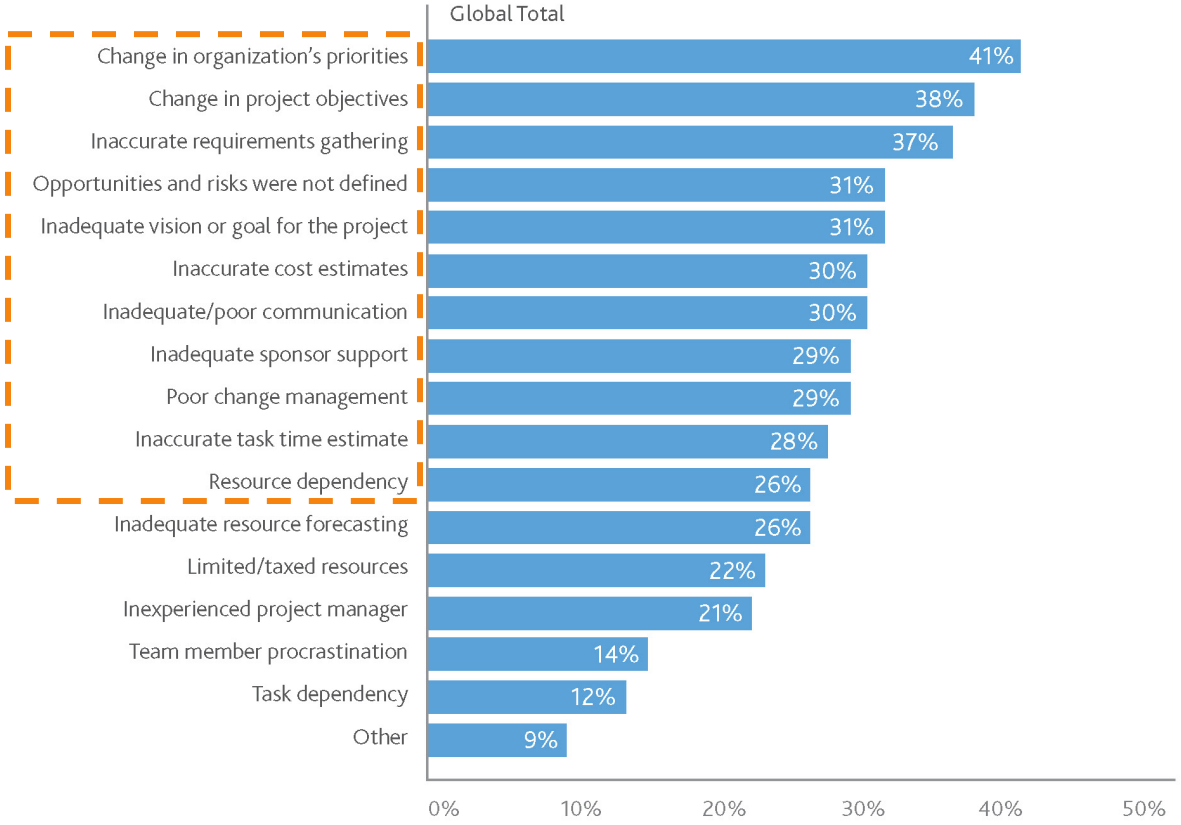
© 2020 PMA Consultants LLC

HAVE WE IDENTIFIED EVERY RISK?





Q: Of the projects started in your organization in the past 12 months that were deemed failures, what were the primary causes of those failures? (Select up to 3)



© 2020 PMA Consultants LLC

RISK TAXONOMY (Besides Inherent Risk*)

Project-Specific Risk Events

- Known, probable factors *specific to the project* resulting in non-random distribution of outcome and that can be potentially mitigated or removed
- Risks associated with permitting, fabrication/deliveries, site conditions, installation, weather
- Probability and impact informed by interviews with the project team
- Typically assumed to occur less than 100% of the time

Systemic Risks

- Anticipated, probable factors that result from project delivery risks and that can be potentially mitigated
- Inexperienced owner, new process technology, overly aggressive fast-tracking, estimate has not been confirmed with historical data, etc.
- Empirically validated parametric, or Monte Carlo modeling, informed by organizational assessments
- Occur 100% of the time with stated ranges of probability of impact

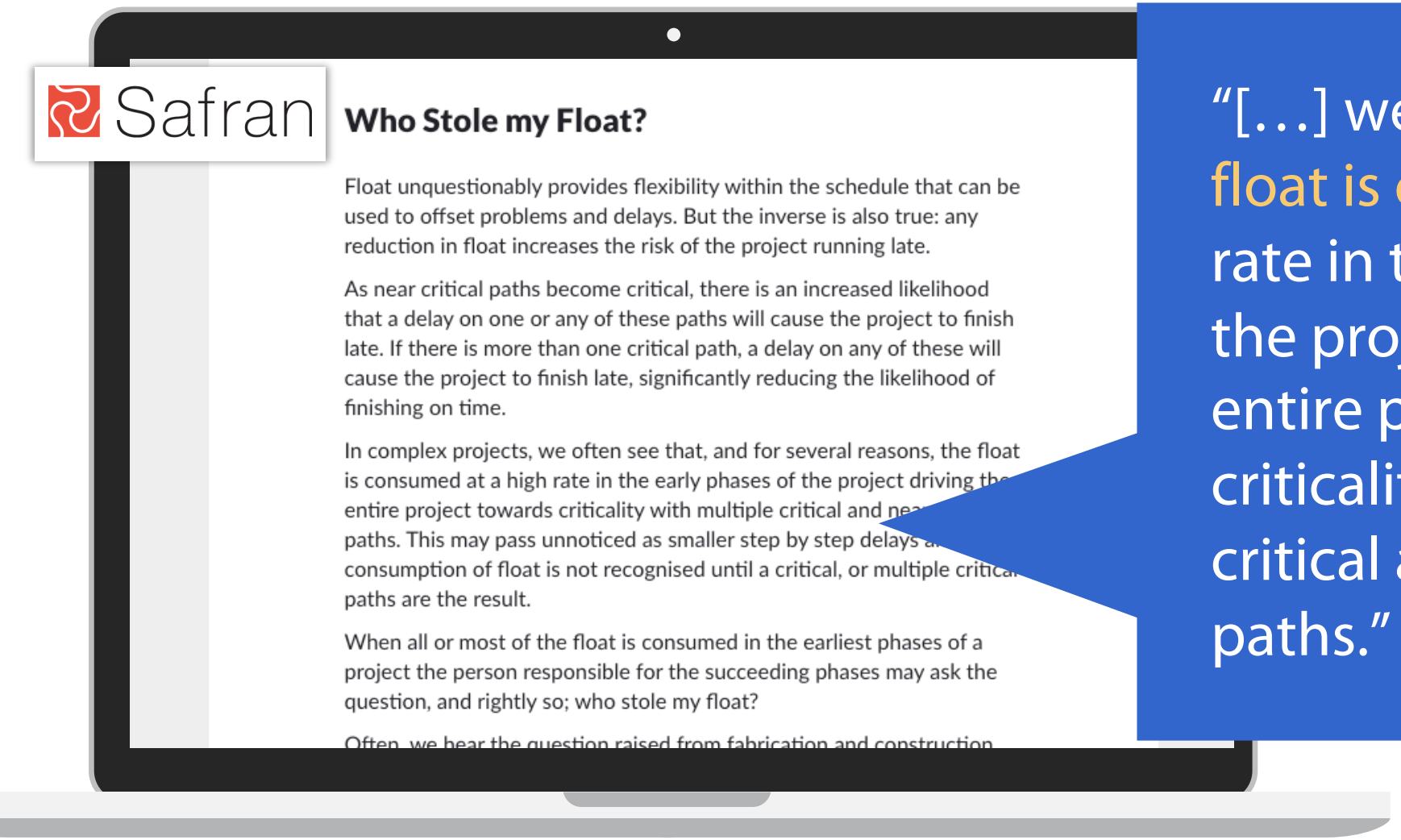
Inherent activity duration uncertainty risk

© 2020 PMA Consultants LLC

I'm here to tell you about a ***schedule risk*** we continue to disregard in schedule risk assessment at our own peril!

© 2020 PMA Consultants LLC

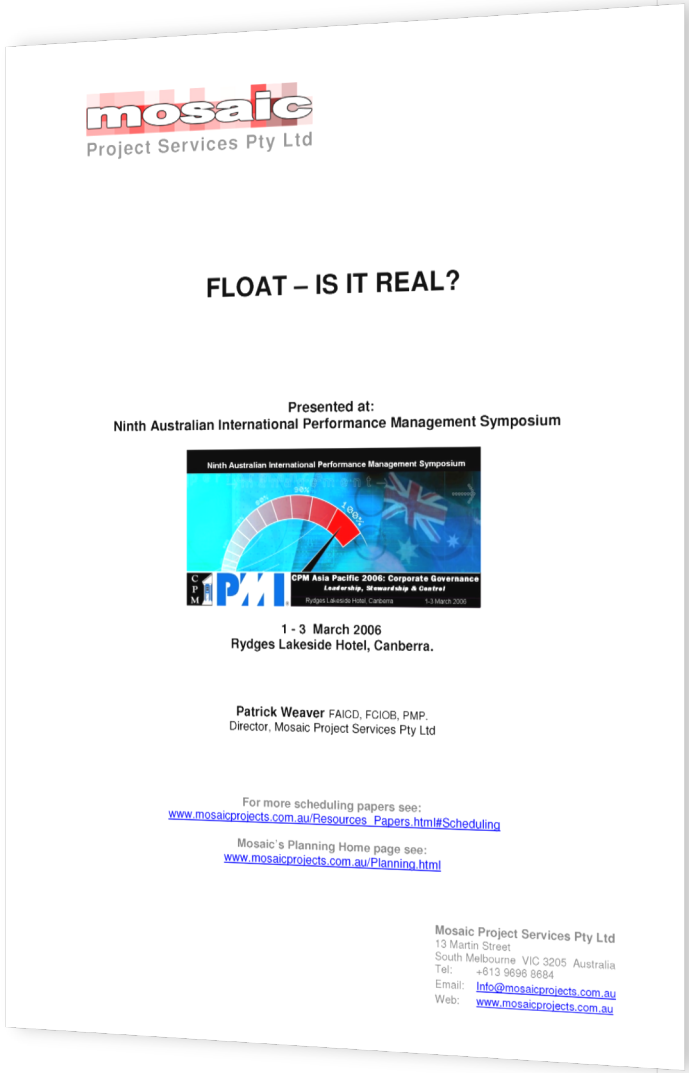
HAVE WE IDENTIFIED EVERY RISK?



"[…] we often see that […] float is consumed at a high rate in the early phases of the project driving the entire project towards criticality with multiple critical and near critical paths."

© 2020 PMA Consultants LLC

HAVE WE IDENTIFIED EVERY RISK?



mosaic
Project Services Pty Ltd

FLOAT – IS IT REAL?

Presented at:
Ninth Australian International Performance Management Symposium

1 - 3 March 2006
Rydges Lakeside Hotel, Canberra.

Patrick Weaver FAICD, FCIOB, PMP,
Director, Mosaic Project Services Pty Ltd

For more scheduling papers see:
www.mosaicprojects.com.au/Resources_Papers.html#Scheduling

Mosaic's Planning Home page see:
www.mosaicprojects.com.au/Planning.html

Mosaic Project Services Pty Ltd
13 Martin Street
South Melbourne VIC 3205 Australia
Tel: +613 9696 8684
Email: Info@mosaicprojects.com.au
Web: www.mosaicprojects.com.au

Under most contracts, if the first delay was caused by the client and the second by the contractor, the contractor would be liable for damages for the total extent of the delay shown in Figure 9, but if the situation was reversed, with the initial delay being caused by the contractor and the second delay by the client then the contractor would be entitled to an EOT and reimbursement of delay costs. A highly undesirable lottery!

Some authors are suggesting that float be apportioned in advance between the client and the contractor[9]. This solution has some merit (particularly at the theoretical level), but managing the schedule to know what float is available and how it should be allocated given the uncertainties and variability inherent in the CPM process would require a major expenditure of resources. However, this could offer a better solutions than float being consumed on a 'first in, best dressed' basis (ie float being treated as a 'resource' available to the project).

Concurrent Delays

The discussion thus far has only considered a single delay event. If there are parallel (or concurrent) delays impacting different parts of the schedule at the same time; understanding the consequences and apportioning liability becomes far more complex. For more on this topic, refer to the paper; 'Concurrent Delays in Contracts[10]'.

Resource Levelling

One of the primary uses of float in scheduling is to smooth or level resource demands. All resource levelling options cause float to change. Generally float is consumed to allow some work to be delayed to remove peaks in the resource demand curve, occasionally, additional float is created in some parts of a schedule by the resource levelling process shifting the overall completion date to a more realistic and achievable time. Effective resource levelling is a highly skilled process that requires far more than simply selecting an option in your scheduling software. Some aspects of the process required for effective resource levelling are discussed in the paper 'Five Steps to Project Success'[11].

One characteristic of a resource levelled schedule can be discontinuous critical paths as the control on schedule dates flows through resource movements controlled by the algorithms in the scheduling software rather than 'logical' connections in the schedule. Another key consideration is that any change in the scheduled dates for work can cause the levelling to fail and the overall schedule to be delayed. Arguably, there is no float in a resource levelled schedule, only the current scheduled dates for the activities that achieve a balanced resource demand.

The Consequences of Consuming Float

'Float' unquestionably provides a contingency within the schedule that can be used to absorb problems and delays, but any reduction in float increases the risk of the project overrunning! As demonstrated in the example shown in Figure 9, above, an 'inconsequential' delay to a non-critical activity (that only consumed some of the available float) was a direct cause of the project finishing late.

As more paths through a schedule approach 'criticality' there is an increased likelihood that a delay on any one of the near critical paths will cause the project to finish late. If there is more than one critical path, then **any** delay on **any** of the critical paths will cause the project to be late and the chance of completing on time will be significantly reduced.

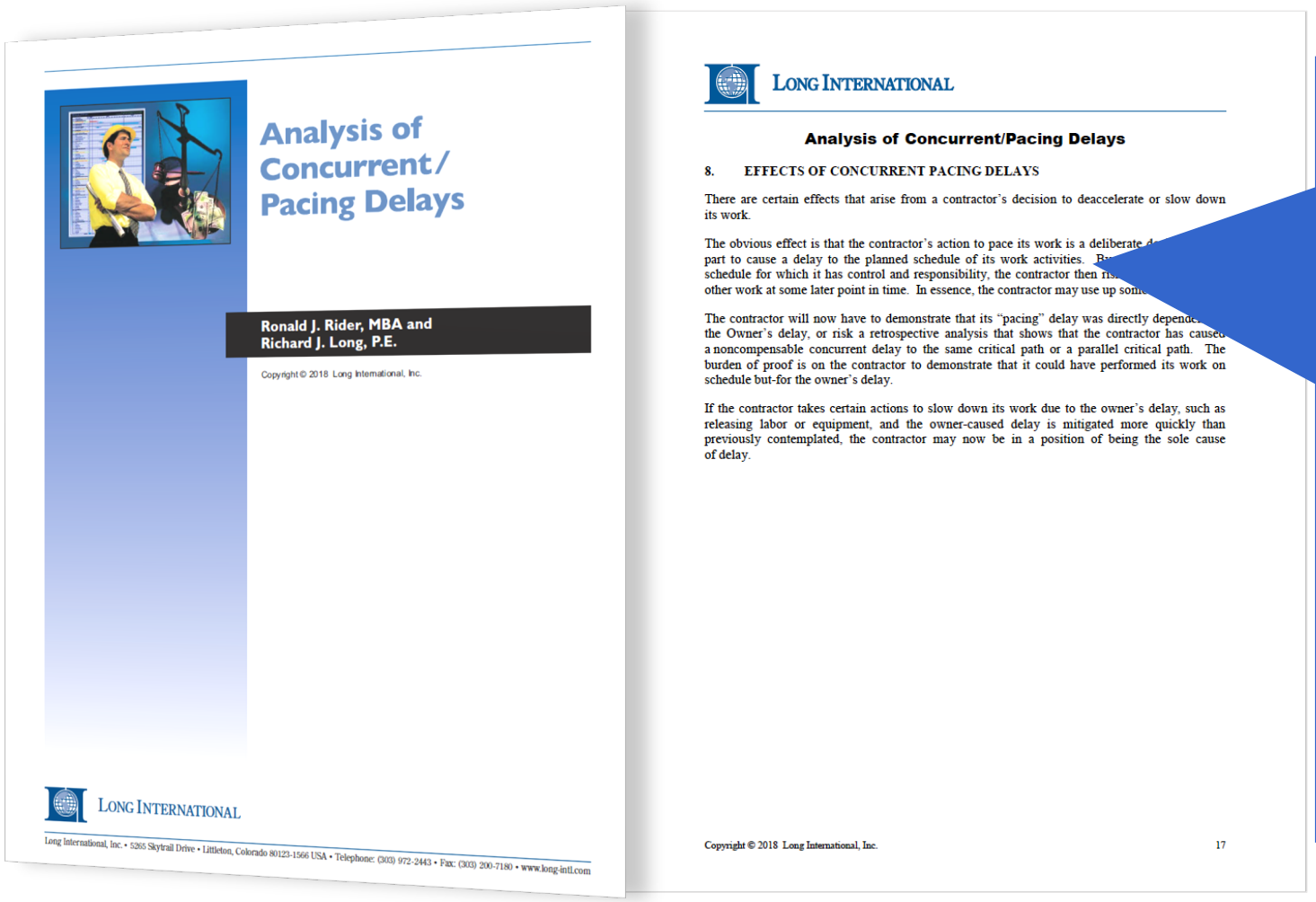
Using Float - Summary

© 2006 Practical PMP Pty Ltd & the Authors

"[…] but any reduction in float increases the risk of the project overrunning!"

© 2020 PMA Consultants LLC

HAVE WE IDENTIFIED EVERY RISK?

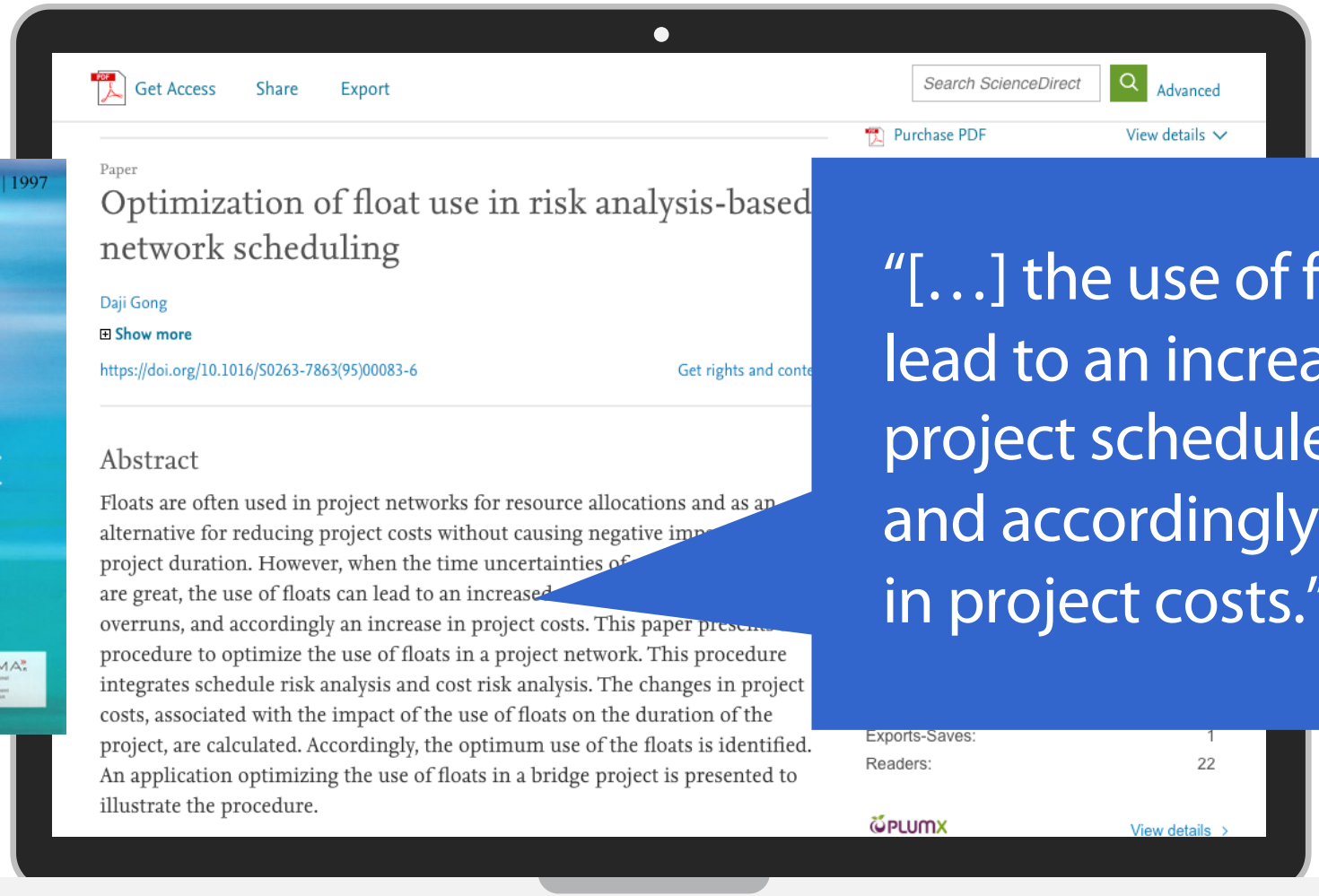


"By not maintaining the schedule for which it has control and responsibility, the contractor then risks being delayed on other work at some later point in time."

© 2020 PMA Consultants LLC

HAVE WE IDENTIFIED EVERY RISK?

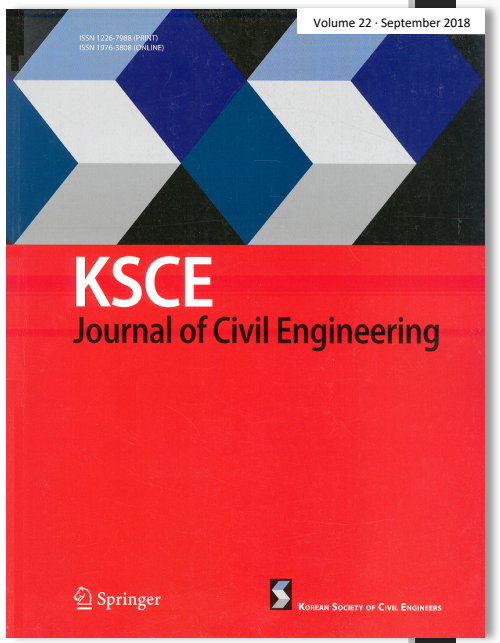




"[…] the use of floats can lead to an increased risk of project schedule overruns, and accordingly an increase in project costs."

© 2020 PMA Consultants LLC

HAVE WE IDENTIFIED EVERY RISK?



Construction Management | Published: 14 September 2018

A Multi Criteria Decision Making Model for Prioritizing the Non-Critical Activities in Construction Projects

Gholamreza Heravi & Nima Gerami Seresht

KSCE Journal of Civil Engineering **22**, 3753–3763(2018) | Cite this article

102 Accesses

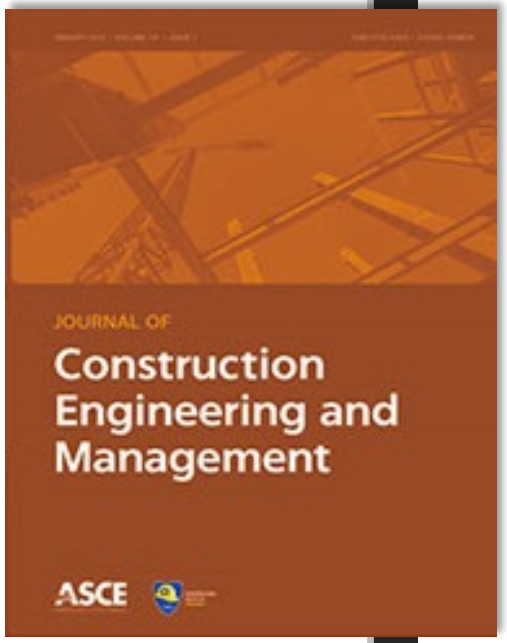
Abstract

The common approaches for project scheduling in the construction projects mainly focus on the critical activities and their delay risks. In contrast, delay risks of non-critical activities are commonly ignored. Although, using float time of the non-critical activities give the project managers the flexibility for project execution, improper planning of these activities may turn them into critical activities or even cause delays in projects. In this paper, the delay risk factors of the non-critical activities are identified and a new methodology is proposed for prioritizing the non-critical activities to improve the planning process of the construction projects. Prioritization of the non-critical activities enhances the project manager's vision toward the risks incorporated with using the float time of each individual activity. Moreover, due to the fact that multiple criteria need to be considered for prioritizing the non-critical activities, an MCDM method is used for this purpose. Finally, an algorithm is developed for application of the proposed methodology in the construction projects. The proposed method is evaluated through a case study and based on the prioritization results a discussion is provided to illustrate the practical application of the method.

"[…] delay risks of the non-critical activities are commonly ignored."

© 2020 PMA Consultants LLC

HAVE WE IDENTIFIED EVERY RISK?



"Float loss impact in noncritical activities is one of the complicated delays to assess on a project's duration and cost."

© 2020 PMA Consultants LLC

HAVE WE IDENTIFIED EVERY RISK?





Calculation of safe float use in risk-analysis-oriented network scheduling

Duji Gong and James E Rowings Jr

"The use of float is not considered as a factor in influencing project duration in risk-analysis-oriented scheduling techniques."

© 2020 PMA Consultants LLC

UPGRADED RISK TAXONOMY*

Project Specific

- Known, probable factors *specific to the project* resulting in non-random distribution of outcome and that can be potentially mitigated or removed
- Risks associated with permitting, fabrication/deliveries, site conditions, installation, weather
- Probability and impact informed by interviews with the project team
- Typically assumed to occur less than 100% of the time

Systemic

- Anticipated, probable factors that result from project delivery risks and that can be potentially mitigated
- Inexperienced owner, new process technology, overly aggressive fast-tracking, estimate has not been confirmed with historical data, etc.
- Empirically validated parametric, or Monte Carlo modeling, informed by organizational assessments
- Occur 100% of the time with stated ranges of probability of impact

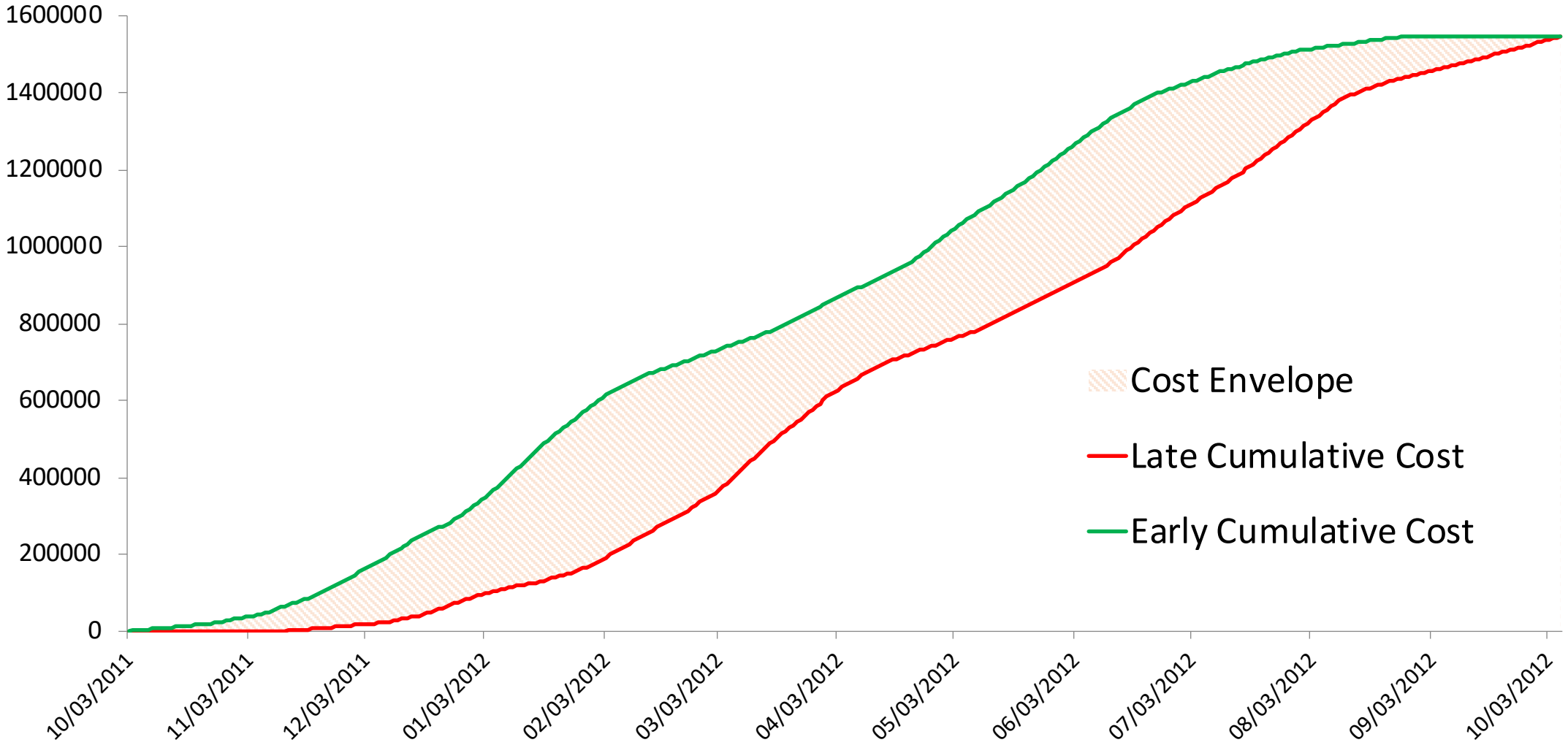
Speculative

- Anticipating use of total float, an expiring resource, and/or slowing down or accelerating activities
- Level resources, pace progress to other delay, shift in priorities, run into design holds, shift crews to competing projects, and so on
- Probability/impact are linked to activities with *then-existing* float when scheduled to start
- Likelihood of occurrence is selected by the analyst

Besides inherent activity duration uncertainty Risk

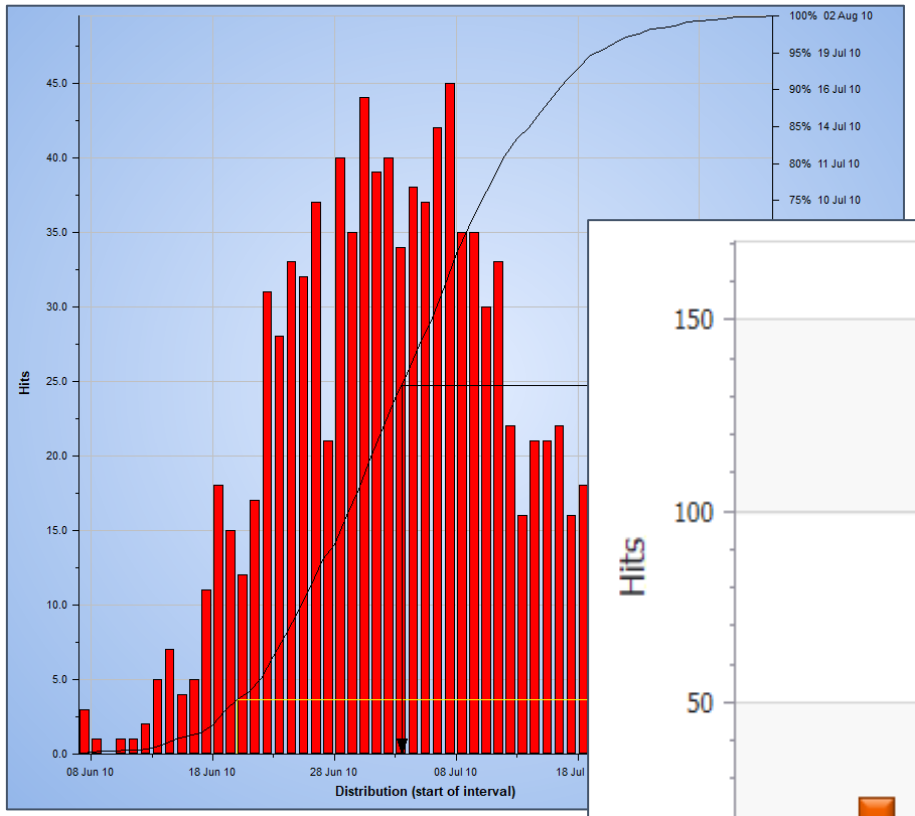
© 2020 PMA Consultants LLC

Float Use Is Commonly Modeled in CPM Conventional (Deterministic) Scheduling…

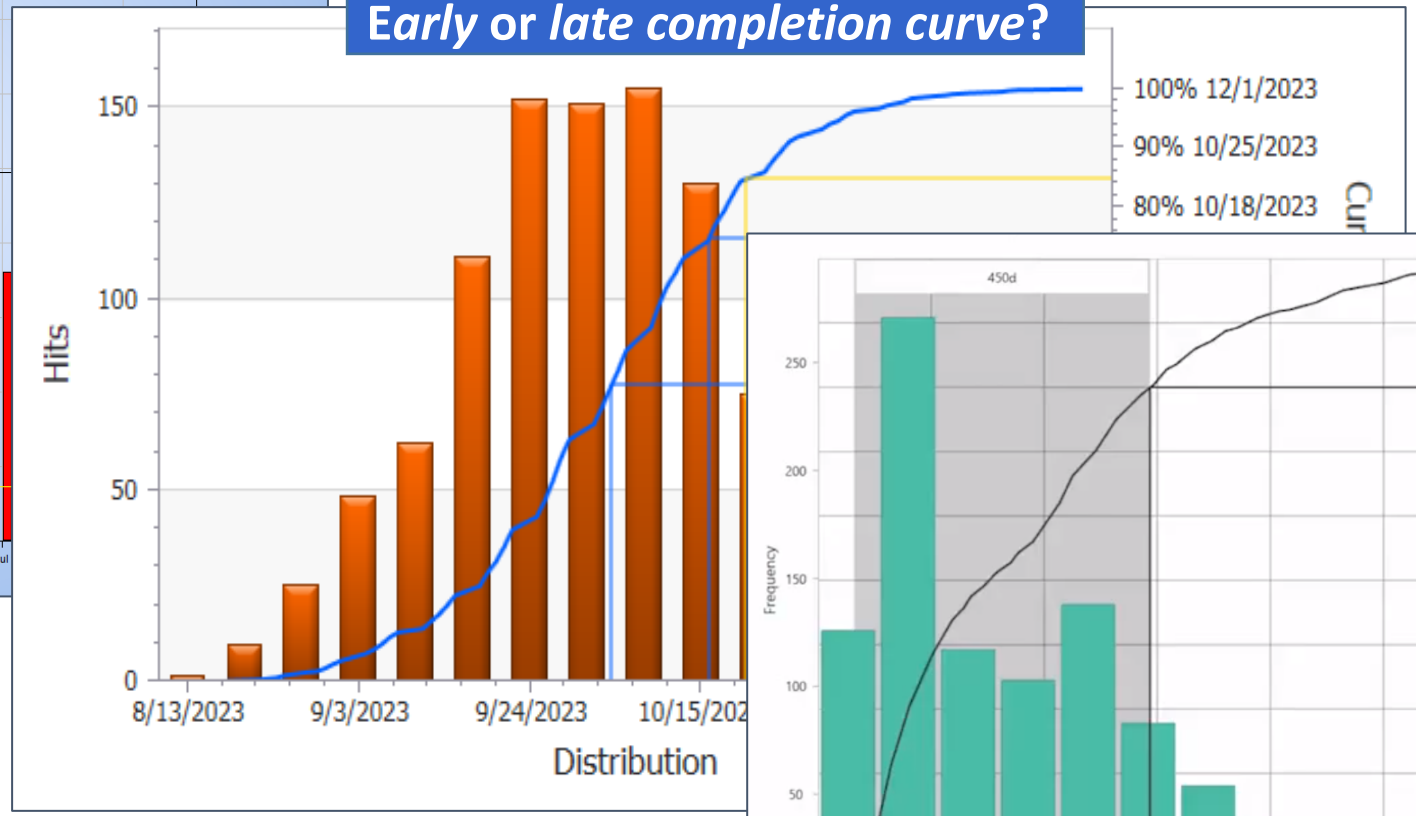


© 2020 PMA Consultants LLC

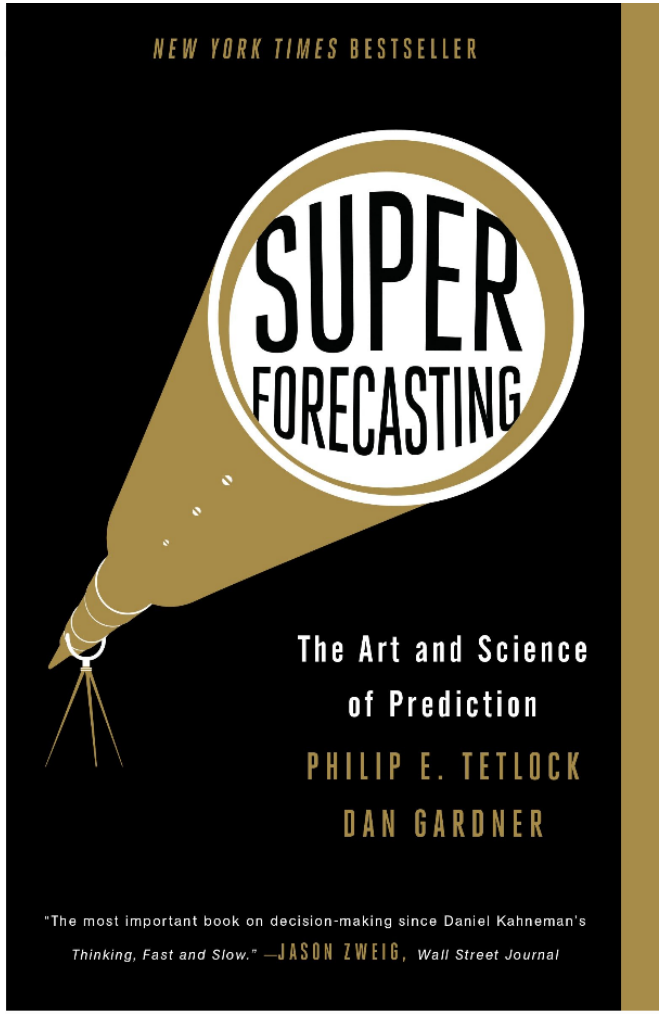
…but *NOT* in CPM Schedule Risk Analysis!!



Only one curve, no envelope!
E*arly* or *late completion curve*?



© 2020 PMA Consultants LLC





"In most cases statistical algorithms beat human judgment…The point is now indisputable: when you have a well-validated statistical algorithm, use it."

© 2020 PMA Consultants LLC



So, Let's Consider the **Graphical Path Method**

Intuitive graphical interface that avoids water-fall handicap

Activities may *float* which allows speculative float use in risk assessment

Network-based schedules that all stakeholders can grasp

Boosts stakeholder timely interaction (**hands on**)

Immediate visual impact and results of revisions (**No F9!**)

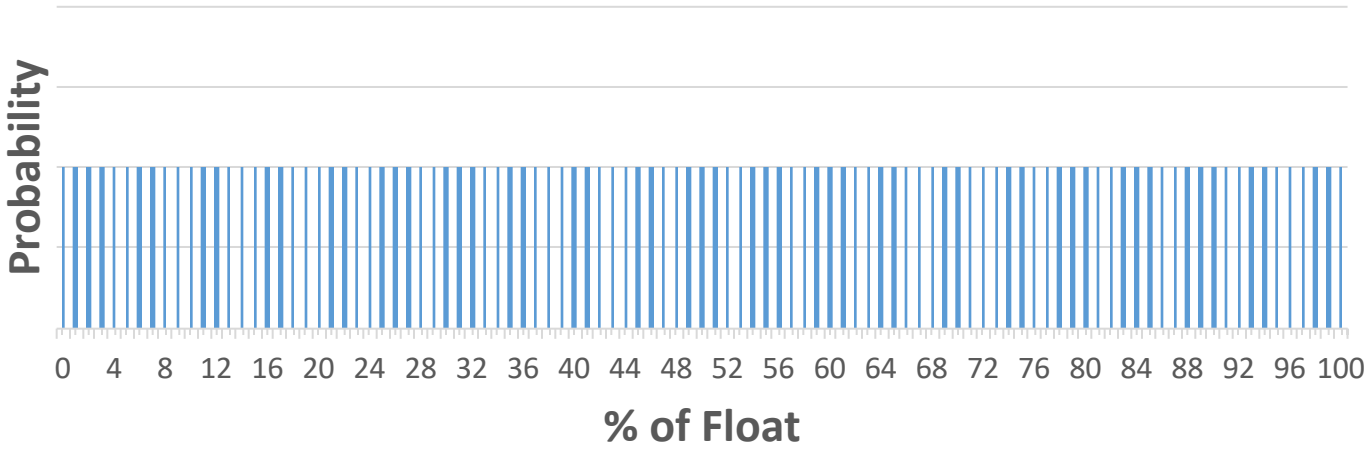
Total floats and the critical path/s exist *left of the data date*

© 2020 PMA Consultants LLC

Activities may *float* which allows modeling speculative float use in risk assessment

© 2020 PMA Consultants LLC

Modeling the Risk of *Speculative* Float Use



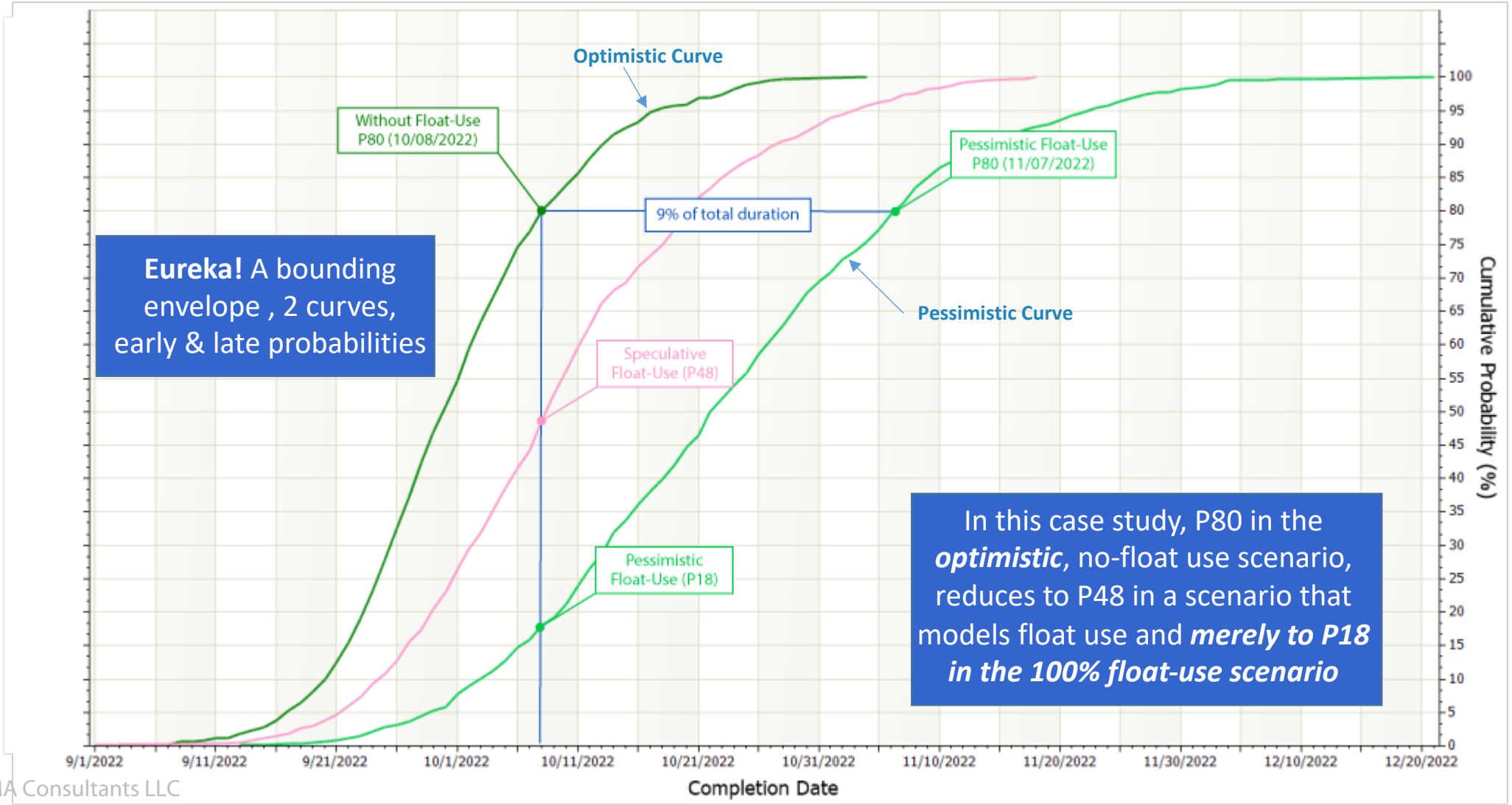
- (A) Use a uniform distribution: use from 0% to 100% on every activity with a likelihood of 100%
- (B) Pace the likelihood of float use: use free float in the first 20% of project duration, use 50% total float up to 67% of project duration, and use free float in the last 33% of project duration*
- (C) 100% total-float use for every activity yields the ***pessimistic*** completion risk curve
- (D) Limiting total float use in Monte Carlo modeling to *safe float* yields the SAFE project finish risk curve and a more reliable forecast of probable project finish dates*

*https://www.academia.edu/19371183/Calculation_of_safe_float_use_in_risk-analysis-oriented_network_scheduling

https://pmaconsultants.com/publication/RISK-2196%20Removing%20the%20Early-Dates%20Bias%20in%20CPM%20Risk%20Analysis%2023%20May%2016.pdf

© 2020 PMA Consultants LLC

A *Well-Validated* Monte Carlo Scheduling Algorithm Considers the Risk of *Float Use*



© 2020 PMA Consultants LLC

Which *P Date* To Select as Your Forecast?

Sherman Kent's Table to Equate Mathematical Odds to Words and Phrases of Estimative Probability*

Certainty	The General Area of Possibility
100%	Certain
93% (give or take about 6%)	**Almost Certain**
75% (give or take about 12%)	**Probable**
50% (give or take about 10%)	**Chances about even**
30% (give or take about 10%)	Probably not
7% (give or take about 5%)	Almost certainly not
0%	Impossible

* https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/books-and-monographs/sherman-kent-and-the-board-of-national-estimates-collected-essays/6words.html

© 2020 PMA Consultants LLC

P value depends on whether the schedule modeled is high-level, mid-level, or detailed, and on the extent of float use risked

P Value Options for Detailed Schedules

Certainty	The General Area of Possibility	No Float Use Risk	Modeled Float Use	100% Float Use
P100	Certain			
P93 +/-6%	Almost Certain	90%		
P75 +/- 12%	Probable		80%	
P75 +/- 12%	Probable			70%

In construction, commonly, a multi-thousand activity level 3/4 network subdividing physical work into repeating and non-repeating activities ranging from 5 to 15 working days (10 to 30 working days in the case of mega projects) at the building/area/elevation/trade/crew level

© 2020 PMA Consultants LLC

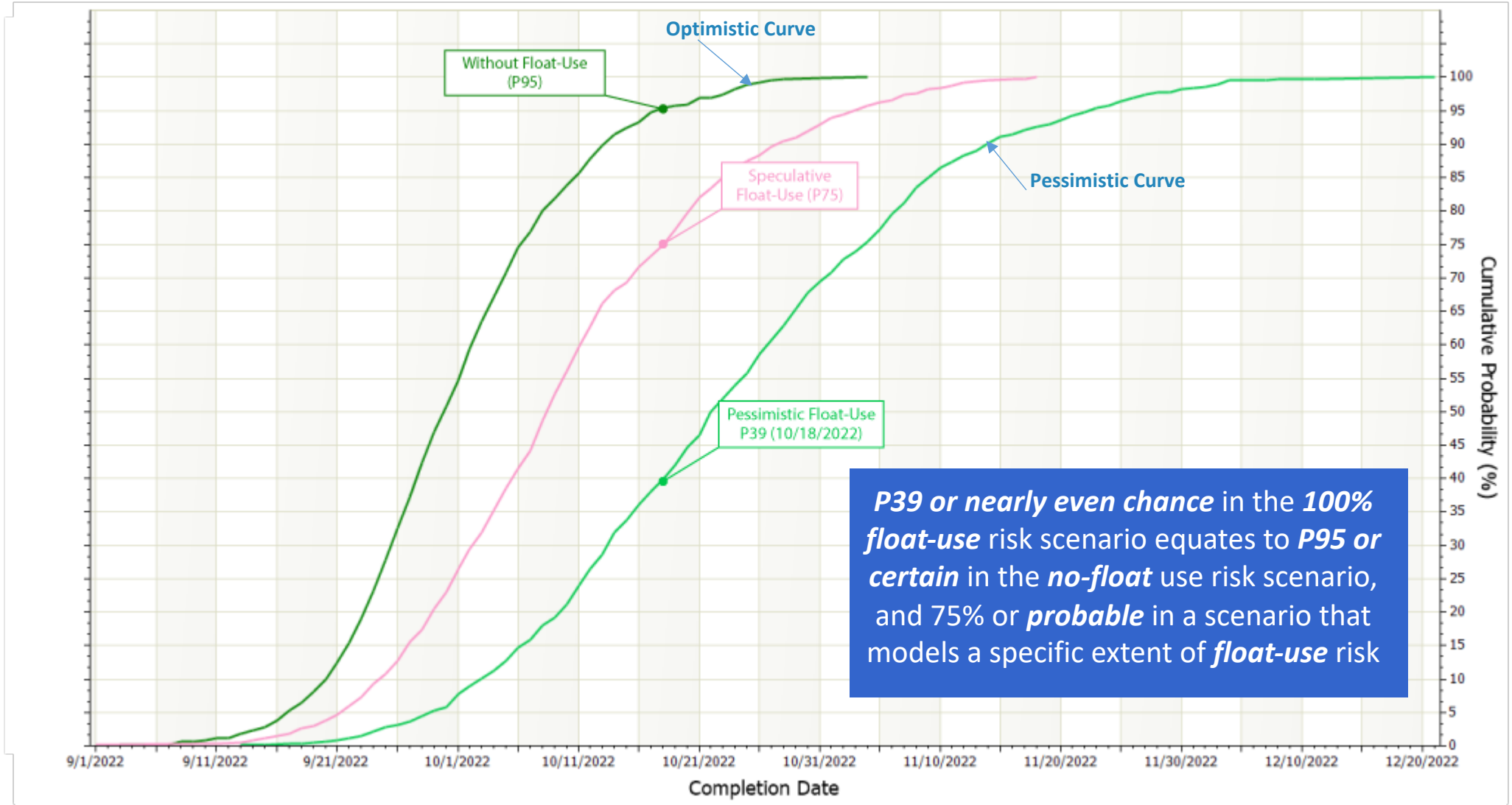
P Value Options for High-Level Schedules

Certainty	The General Area of Possibility	No Float Use Risk	Modeled Float Use	100% Float Use
P100	Certain			
P75 +/- 12%	Probable	80%		
P75 +/- 12%	Probable		70%	
P50 +/- 10%	Chances about even			60%

Commonly, one-sheet, high-level network (scale in weeks or months) the risk analyst develops by condensing critical, near-critical, and otherwise crucial, high-risk, or wide-duration-ranged activities in a contemporaneous, detailed schedule into summary activities and milestones

© 2020 PMA Consultants LLC

P39 on the 100% *Float-Use* Curve = P75 on Modeled Float Use = P95 on the CPM Risk Curve



P39 or nearly even chance in the ***100% float-use*** risk scenario equates to ***P95 or certain*** in the ***no-float*** use risk scenario, and 75% or ***probable*** in a scenario that models a specific extent of ***float-use*** risk

© 2020 PMA Consultants LLC

This innovative *GPM scheduling principle* allows schedulers to model the *risk of float use* in schedule risk assessment, leading to a more reliable forecast of *probable* project finish dates.

TAKE-AWAY

© 2020 PMA Consultants LLC



GUI PONCE DE LEON, PhD, PE, PMP

Inventor & CEO, PMA Consultants LLC
gui@pmaconsultants.com

Dr. Gui started his career in 1969 facilitating scheduling sessions on a drawing board with Townsend & Bottum, Inc. project managers and superintendents. Dr. Gui has served as contractor chief scheduler, scheduling consultant, program manager, construction manager, forensic scheduler, and expert witness, and has pioneered innovations in project management throughout his 50-year career. He holds five US patents and has numerous patents pending on his graphical path method/GPM. Dr. Gui pursued MS studies at Vanderbilt University and obtained his PhD in civil engineering from Michigan in 1972. From 1973-1989, he taught two graduate courses in network-based project scheduling in the College of Engineering, Civil & Environmental Department, at Michigan.

© 2020 PMA Consultants LLC

BIBLIOGRAPHY

AACE International. "AACE International Recommended Practice No. 57R-09: Integrated Cost and Schedule Risk Analysis Using Monte Carlo Simulation of a CPM Model." Morgantown: Author, 2011.

AACE International. "AACE International Recommended Practice No. 64R-11: CPM Schedule Risk Modeling and Analysis: Special Considerations." Morgantown: Author, 2012.

Buehler, Roger, Dale Griffin, and Michael Ross. "Exploring the 'Planning Fallacy:' Why People Underestimate Their Task Completion Times." *Journal of Personality and Social Psychology* 67, no. 3. 366-381, 1994.

Buehler, Roger, Dale Griffin and Michael Ross. "Inside the Planning Fallacy: The Causes and Consequences of Optimistic Time Predictions." In T. Gilovich, D. Griffin and D. Kahneman (eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment*. New York: Cambridge University Press, 2002.

Cropley, C. "Combining Parametric and CPM-Based Integrated Cost-Schedule risk Analysis." *AACE International Transactions,* 2019.

.

© 2020 PMA Consultants LLC

BIBLIOGRAPHY *(cont'd)*

Flyvbjerg, Bent. "What You Should Know About Mega-Projects and Why: an Overview." Project Management Journal., April 1, 2014.

Gong D. "Optimization of Float Use in Risk Analysis-Based Network Scheduling." *Int J Proj Manag* 15, no. 3, (1997): 187–192.

Gong D, Rowings J. E. Jr. "Calculation of Safe Float Use in Risk-Analysis-Oriented Network Scheduling." *Int J Proj Manag* 13, no. 3, (1995): 187–194.

Heravi, G. and Seresht, N. "A Multi Criteria Decision Making Model for Prioritizing the Non-Critical Activities in Construction Projects." *KSCE J Civil Eng* 22, no. 10 (2018): 3753-3763.

Hollman, J. *Project Risk Quantification: A Practitioner's Guide to Realistic Cost and Schedule Risk Management.* Sugarland, TX: Probabilistic Publishing, 2016.

Hulett, D. & Whitehead, W. "The Monte Carlo Method for Modeling & Mitigating Systemic Risk." *AACE International Transactions*, 2016.

Hulett, D. & Whitehead, W. "Cost and Schedule Risks Interact in Mega Projects." *AACE International Transactions*, 2019.

© 2020 PMA Consultants LLC

BIBLIOGRAPHY *(cont'd)*

Kahneman, Daniel. ***Thinking, Fast and Slow***. New York: Farrar, Straus and Giroux, 2011.

Kelley Jr., J. E. "Critical-Path Planning and Scheduling: Mathematical Basis." *Ops Res* 9, no. 3 (1961): 296-320.

Kent, S. "Words of Estimative Probability." Central Intelligence Agency, Center for the Study of Intelligence (March 2007). Last updated: July 7, 2008. https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/books-and-monographs/sherman-kent-and-the-board-of-national-estimates-collected-essays/6words.html

KPMG International. *Climbing the Curve: 2015 Global Construction Project Owner's Survey*. Geneva, Switzerland: Author, 2015.

Locatelli, Giorgio. "Why are Megaprojects, Including Nuclear Power Plants, Delivered Overbudget and Late? Reasons and Remedies." ***Report MIT-ANP-TR-172, Center for Advanced Nuclear Energy Systems (CANES)***. Cambridge, MA: Massachusetts Institute of Technology, 2018.

© 2020 PMA Consultants LLC

BIBLIOGRAPHY *(cont'd)*

Malcolm, D. G., Rosebloom, J. H., Clark, C. E., and Fazar, W. "Application of a Technique for Research and Development Program Evaluation." *Ops Res* 7, no. 5 (1959): 646-669.

O'Brien, J. *CPM in Construction Management*. New York: McGraw-Hill, 1965.

Pearl, M. *The Day It Finally Happens*. New York: Scribner, 2019.

Ponce de Leon, G. "Graphical Planning Method (A New Network-Based Planning/Scheduling Paradigm)." Presented at PMI College of Scheduling 5th Annual Conference, Chicago, IL, May 2008.

Ponce de Leon, G. "Project Planning Using the Logic Diagramming Method." *AACE International Transactions*. Atlanta, GA, May 2008.

Ponce de Leon, G. "GPM®: An Objectbase Project Networking Method." Presented at PMI College of Scheduling 6th Annual Conference, Boston, MA, May 2009.

Ponce de Leon, G. "GPM® and Forensic Total Float." Presented at PMI College of Scheduling 7th Annual Conference, Calgary, CAN, May 2010.

© 2020 PMA Consultants LLC

BIBLIOGRAPHY *(cont'd)*

Ponce de Leon, G. and Puri, V. "Removing the Early-Dates Bias in CPM Risk Analysis." *AACE International Transactions*, 2016.

Ponce de Leon, G. "Early and Late 'P-80' Dates." Presented at Ninth Annual NetPoint® & GPM® Conference, Denver, CO, April 2019.

Ponce de Leon, G., Field, D,. Spittler, P., Zann, J. et al. "*Core Traits of a Reliable Schedule*." Ann Arbor: PMA Consultants LLC, 2014.

Project Management Institute. *Pulse of the Profession*. *The High Cost of Low Performance.* 2016.

Project Management Institute. *Pulse of the Profession. Success in Disruptive Times: Expanding the Value Delivery Landscape to Address the High Cost of Low Performance*. 2018.

Rider, R.J. and Long, R.J. *Analysis of Concurrent/Pacing Delays*. Littleton, CO: Long International, Inc., 2018.

Raydugin, Y. "Non-Linear Probabilistic (Monte Carlo) Modeling of Systemic Risks." *AACE International Transactions*, 2018.

© 2020 PMA Consultants LLC

BIBLIOGRAPHY *(cont'd)*

Roberg, Oyvind. "Who Stole My Float? Distributing Slack with Safran Project." *Safran* (blog). June 23, 2017.

Sakka, Z.I. and El-Sayegh, S.M. "Float Consumption Impact on Cost and Schedule in the Construction Industry." *J Eng Const Mgmt ASCE* 133, no. 2 (2007): 122-133.

Sharot, T. The Optimism Bias: A Tour of the Irrationally Positive Brain. New York: Random House, 2011.

Sharot, T. "The Optimism Bias." Current Biology 21(23), R941-R945, 2011. Retrieved from https://doi.org/10.1016/j.cub.2011.10.030 on July 8, 2011.

Tetlock, P. and Gardner, D. *SUPER FORECASTING: THE ART AND SCIENCE OF PREDICTION.* New York: Random House LLC, 2015.

Van Slyke, R. M. "Monte Carlo Methods and the PERT Problem." *Operations Research* 11, no. 5 (1963): 839-860.

Van Slyke, R. M. *Uses of Monte Carlo in PERT*. Memorandum RM-3367-PR. Santa Monica: RAND Corporation, 1963.

© 2020 PMA Consultants LLC

BIBLIOGRAPHY *(cont'd)*

Weaver, P. "Why Critical Path Scheduling Is Wildly Optimistic!" Presented at PMI College of Scheduling 8th Annual Conference, San Francisco, CA, May 2011.

Weaver, P. "Float: Is It Real?" Presented at the Ninth Australian Performance Management Symposium, Canberra, Australia, March 2006.

Weaver, P. "The Scheduling Conundrum." Mosaic. https://www.mosaicprojects.com.au/Mag_Articles/P001_The_Scheduling_Conundrum.pdf (accessed July 17, 2019).

© 2020 PMA Consultants LLC