

## CONSTRUCTION

### JOHN LIVENGOOD

Managing Director  
415.356.7137  
John.Livengood@Navigant.com

### [Navigant.com](http://Navigant.com)

#### About Navigant

Navigant Consulting, Inc. (NYSE: NCI) is a specialized, global professional services firm that helps clients take control of their future. Navigant's professionals apply deep industry knowledge, substantive technical expertise, and an enterprising approach to help clients build, manage and/or protect their business interests. With a focus on markets and clients facing transformational change and significant regulatory or legal pressures, the Firm primarily serves clients in the healthcare, energy and financial services industries. Across a range of advisory, consulting, outsourcing, and technology/analytics services, Navigant's practitioners bring sharp insight that pinpoints opportunities and delivers powerful results. More information about Navigant can be found at [Navigant.com](http://Navigant.com)

## THE FUTURE OF FORENSIC SCHEDULE DELAY ANALYSIS

It is safe to assume that contractors have been asserting delay claims or their effective equivalents on projects since before recorded history commenced. While we have no record of delay claims on the Pyramids, I am sure that King Djoser's architect Imhotep, hoped the funerary pyramid he designed would be completed prior to, or at least near to the time of death of the king in 2670 BCE, even though it took dozens of years to complete. Similarly, we do know that in medieval times the popes who built the Duomo in Florence and St. Peters Basilica in Rome complained to their master-builders Brunelleschi and Michelangelo about the very long time and the cost overruns these projects took to reach completion. Much more recently, U.S. Courts have reported delay claims for more than 100 years, with the proof of delay based on variations of the As-Planned vs As-Built methodology.

Since the mid-20<sup>th</sup> century and the advent of Critical Path Method (CPM) scheduling, that invention has not only revolutionized both the planning and execution of construction projects, but also the claims for delays asserted by contractors. These claims are different than their predecessors only in the potential for "scientific" proof of delay. CPM schedules came into existence in the late 1950s with the development of the UNIVAC computer and the work of J. Mauchly and J. Kelley on behalf of DuPont. Those initial trials of activity-on-arrow schedule systems proved almost immediately that CPM schedule development could save considerable time. Shortly thereafter, the Navy's Polaris Program developed PERT (activity-on-node) such that by the end of the 1960s, CPM scheduling fundamentals were essentially in place, albeit working on computers we would consider unbearably slow today.

In the mid-1960s some schedule experts started to identify and quantify delays through the use of "time-impact analysis" (TIA) and snapshots of time. As the Apollo Moon project advanced, experts working with the CPM schedules developed and implemented TIA methods to quantify and project time delays that occurred on the project. Since the advent of CPM, the number of different forensic schedule delay methodologies seems to have grown rapidly, with some commentators having identified up to 14 different methods,<sup>1</sup> while others aggregate the subtle differences into four major families.<sup>2</sup>

1. R. D'Onofrio and A. Meagher. "What is a Schedule Good For? A Study of Issues Posed by Schedules on Complex Projects," ABA Mid- Winter Meeting, Houston 2012  
2. J. Livengood and P. Kelly, "Forensic Schedule Analysis Methods: Reconciliation of Different Results," Cost Engineering, January 2015, AACE International Morgantown WV.

While delays occur on all projects, constructors and owners work diligently to avoid delays, and if they occur, to recover from them. Most of the time, their efforts are successful and therefore few projects have critical path schedule delays and even fewer have claims that result from requests for additional time.

Nevertheless, when such claims do occur, they can be complicated and ironically, time consuming. For this reason, time is an essential element of all construction projects, and construction professionals should all be aware of the principal issues associated with extensions of time and delay claims.

Virtually all large construction projects use techniques to evaluate entitlements to time extensions for changed work yet-to-be performed and occasionally to identify entitlement to time extensions for work already performed. Those techniques range from simple time estimates for simple change orders to sophisticated time-impact evaluations for more complicated changes or delays, and further, to full-blown forensic delay analyses for disputed time entitlement.

Advancements in CPM technology and analysis has continued since 1960. Even in the last decade, advancements in CPM software analytics and conceptual advancements in forensic schedule delay methodologies have enabled persons needing to perform delay estimates or analysis with more choices and better tools to perform this work.

For example, many specifications with CPM schedule requirements mandate that requests for extensions of time be prepared in standardized formats—formats that help the contractor identify if a critical path delay occurred, and if so, how much time is involved. Those same submissions permit the owner to evaluate time requests fairly and quickly.

This maturation of schedule delay analyses is associated with two contravening trends: (1) fewer legal decisions on CPM issues; and, (2) more and better understanding of delay methodologies.

## LACK OF CPM LAW

Court decisions on construction issues, particularly the arcane issues associated with CPM and delay law, are becoming rare. The increased cost of litigation and the corresponding rise of less expensive alternative dispute resolution options, means that fewer court cases are decided and reported that address fundamental legal questions associated with schedule delays. No legal rulings = no precedents.

For example: contractors schedules that are “reasonable” form the basis of both a contractors planned work effort and can serve as a basis for a subsequent delay analysis. Yet courts have so far been unable to provide much guidance on what constitutes a “reasonable” schedule. This issue is particularly important since construction contracts often require contractors to mitigate both their own delay and that caused by owners. It is a nice question as to how much mitigation is required to correct for a schedule that was reasonable before work commenced, but quickly became unreasonable as actual work proceeded.

Another thorny legal question is who owns the float? While the U.S. legal decisions seem united in their rulings that float belongs to the project (whoever uses it first), unless stipulated otherwise in the contract, many commentators and contractors argue that since the schedule is created by the contractor, it describes the contractor’s work plan and is essentially the contractor’s “means and methods,” the contractor should be entitled to build in accordance with his schedule and float should be a contractor resource.<sup>3</sup> Yet many owners specify (unrealistically in my opinion) that float is an owner resource. Owners that include such provisions are kidding themselves – such provisions simply invite the contractor to manipulate the CPM schedule to eviscerate the provision. This topic of float ownership has also generated numerous academic articles on float sharing proposals<sup>4</sup> – most of which are useless in the real world.

Another CPM related issue not clearly defined by courts is the role of anti-concurrency clauses. In many ways these clauses, always inserted by institutional or governmental owners, are relatives of no-damages for delay clauses, which are legal in some states and prohibited in others. Anti-concurrency clauses seem never to have been addressed by a U.S. court, but concurrency itself is major issue, even if a complete muddle. As one recent decision observed “*The exact definition of concurrent delay is not readily apparent from its use in contract law.*”<sup>5</sup> The truth of the statement is underscored by the three separate methods U.S. courts seem to have developed in order to address concurrent delay.<sup>6</sup> The most common method, “apportionment” is highly dependent on a detailed CPM analysis. That would be good, but even within the technical arena of forensic schedule delay, there is less than technical unanimity as to what is “concurrent.” A

3. S. Hess, “Who Should Own the Float,” *Journal of the College of American Construction Lawyers*, Vol. 4, No. 1, Winter, 2010.

4. A. Prateapusanond, “A Comprehensive Practice of Total Float Pre-Allocation and Management for the Application of a CPM-Based Construction Contract,” Ph.D. Thesis, Virginia Polytechnic Institute and State University, 2003.

5. *George Sollitt Construction Co. v. U.S.*, 64 Fed. Cl. 229, n. 8, 241 (2005).

6. J. Livengood, “Comparison of English and US Law on Concurrent Delay”, *Construction Lawyer*, Vol 35, No. 3, Summer 2015

typical argument runs that a delay on a near-critical path should be concurrent because CPM schedules are simply too inaccurate to define day-for-day critical paths.<sup>7</sup> The other two approaches to concurrent delay in the U.S. courts are just as poorly developed. No wonder jurists find expert explanation of concurrent delay unhelpful in many situations.

Another and perhaps even more contentious area of unresolved CPM law concerns the role of the agency construction manager (not at-risk) as regards development and adherence to the CPM. While agency CM's attempt to write virtually all liability for the schedule out of their contracts, courts seem to be trying to hold them to a standard more akin to CM-at-Risk. This short list highlights but a few of the many areas that CPM law is not well defined by the courts. It is not likely to get better.<sup>8</sup>

While the important court cases decided in the late 20<sup>th</sup> century do occasionally get updated, the trend for resolving disputes points towards more arbitration and mediation. These forums have no public record of the reasons for a decision, thereby they fail to create precedents that can be the basis to resolve future disputes. The development and spread of this non-judicial trend has been carefully documented within the pages of the Navigant Construction Forum™.<sup>9</sup>

While some cynics in the construction industry may welcome the reduced number of court decisions, the absence of definitive legal explanations hinders management, administration, and resolution techniques for projects. Yet the very trend toward arbitration and expert mediation could empower informed and knowledgeable resolution because of the more expert arbitrator or mediator involved in the more complicated construction projects. One prominent observer has hypothesized that with the reduction in judicial decisions, the professional organizations might take up the slack (not float).<sup>10</sup>

## GUIDES TO FORENSIC DELAY ANALYSIS

In the decades that followed the invention of TIAs in the mid-1960s, there was an explosion of forensic delay CPM methodologies. This was the result of it being a new area for construction experts. A review of literature developed in the 1970s and into the 1980s reveals dozens of methodologies with different names. Some were genuinely different, most were variations on some basic models, and some may have been simply experts trying to stakeout a methodology to call their own.<sup>11</sup> At this same time, expert legal and technical articles started to appear that provided the conceptual framework for forensic schedule delay analysis.<sup>12</sup> A re-read of many of these pioneer articles shows the depth of understanding the authors had on the subject. Many of the common methodologies we know today were identified and discussed and form the four basic families of forensic delay methodologies: (1) As-planned v As-built; (2) Contemporaneous Period Analysis (aka "Windows"); (3) Time Impact Analysis (including Impacted As-Planned); and (4) Collapsed As-Built (aka "but-for").

This near-riot of different names for similar or identical methods were partially organized and given some form by works such as Jon Wickwire *et al.*'s book, Construction Scheduling: Preparation, Liability and Claims<sup>13</sup> and Barry Bramble and Michael Callahan's book, Construction Delay Claims.<sup>14</sup> The stage was therefore set for the first comprehensive peer-reviewed guide to delay methodology, which was published in 2002. The Society of Construction Law Delay and Disruption Protocol<sup>15</sup> provided a detailed framework for the management of a project and subsequent forensic analysis in England. While widely used in countries that generally follow U.K. law, it had only minimal impact in the U.S., and some commentators believed it was inappropriate for the U.S. legal system.<sup>16</sup>

7. M. Woolf, CPM Mechanics, ICS-Publications, Rochester, MI, (2012).

8. A. Ness, "Whither Construction Law? How Can Construction Law Continue to Grow and Evolve in the Era of 'The Vanishing Trial?'" The Construction Lawyer, Vol. 30, No. 3, Summer 2010.

9. See Trends in International Construction Claims (October, 2012); Trends in Construction Claims & Disputes (December 2012); Delivering Dispute Free Projects: Part III - Alternative Dispute Resolution (June 2014); Changing Landscape of Government Contract Claims (December 2015), Navigant Construction Forum™, Boulder, CO.

10. A. Ness, "Experts and Expertise in Construction: Black Letter Law and the Debate of Whether Scheduling /Programming Experts are Imposters - It's All Smoke and Mirrors. Conference of the International Bar Association, Dublin, 1-Oct-2012

11. For example: W. Ibbs and L. Nguyen, "FLORA: New Forensic Schedule Analysis Technique," Journal of Construction Engineering and Management, ASCE, Vol. 134, No. 7, July 2008, Page 483

12. J. Wickwire and R. Smith. "The Use of Critical Path Method Techniques in Contract Claims." Public Contract Law Journal, Vol.7, No.1 (1974), p 23.

13. J. Wickwire, T. Driscoll, R. Hurlbut and R. Hillman, Construction Scheduling: Preparation, Liability and Claims, 3rd edition (2010), § 9.08[E] at 408, Aspen Publishers.

14. B. Bramble and M. Callahan. "Construction Delay Claims." (2000), (3d Ed. Supp. 2010), Aspen Publishers, New York.

15. The Society of Construction Law Delay and Disruption Protocol (Oxford 2002).

16. E. Barba., G. Lare and R. Lowe. "View from Across the Pond: An American Perspective on the Society of Construction Law's Delay and Disruption Protocol." The Construction Lawyer, No. 27, Vol. 1, Winter 2007, Page 23.

In the U.S., which has been the leader in world-wide development of forensic schedule delay, just as it is in CPM technology, AACE International first published its peer-reviewed guide to forensic schedule delay methodologies, the *Recommended Practice of Forensic Delay RP29R-03* (FSA 29R-03) in 2007.<sup>17</sup> This document created a minor storm within the small industry of forensic schedule delay experts,<sup>18</sup> but by the release of version three in 2011, much of the legitimate and illegitimate criticism of the FSA 29R-03 had been resolved.

The successful organization of the various FSA methodologies (there are nine identified in the FSA 29R-03) has generated some additional development of “standards” as reflected by the recent publication of *Forensic Analysis Standards of Practice*” by The Guild of Project Controls in 2014<sup>19</sup>, ASCE’s forthcoming *Standard Guidelines for Schedule Delay Analysis*,” and SOCL planned revisions to the “Delay and Disruption Protocol.”

## RECENT METHODOLOGICAL ADVANCES

Just as there are more and better definitions of methodologies, there continues to be advances in the underlying theory relevant to forensic schedule delay analysis. For example, the concept “contemporaneous understanding of criticality” seems to have important, yet not fully understood implications on delay methodology.<sup>20</sup> This concept, first reflected in Wickwire’s book<sup>21</sup> notes that criticality is often related to what the project managers running a project think is critical at any given moment.

Another area ripe for development is how different delay methodologies might be integrated into the same analysis.<sup>22</sup> This issue is made more complicated by the generally unrecognized aspect of FSA methodologies that different methodologies measure different characteristics of delay: similar to Metric and English systems that can both measure distance but do so using different units. Below are an explanation of the different types of “days” the four major families of FSA methodology measure delay:

- **As-Planned v As-Built (APAB).** This methodology measures delays that actually occur on the day(s) they occur. It does not evaluate the projected delay at the end of the project, but rather measures the delay that has actually accrued at a specific point in the work compared to planned status at the same point in the work.
- **Contemporary Period Analysis (CPA or Windows).** This measures a combination of actually accrued delay to the start of the evaluation period, and anticipated delays projected to the end of the project after the start of the evaluation period. For example, the methodology measures actual delay through the start of the evaluation period based on earlier periodic evaluations. It then measures delays projected through the end of the project by comparing the plan at the evaluation period with the projected delay at the end of the evaluation period. Thus it measures two types of delay: actual delays to start of the evaluation period and projected delays thereafter.
- **Retrospective Time Impact Analysis (RTIA).** This methodology measures delay in two groups also. First it measures projected delays at the start of the evaluation period as reflected in the contemporaneous schedule updates. If those updates are inaccurate, then the delay measurement will not be correct. If the contractor has manipulated the go-forward logic and changes in scope to accentuate owner-responsible events, the periodic updates may bear little relevance to the actual needed sequences. Second, the methodology calculates an additional delay at the end of the project through the insertion of a RTIA fragnet into the evaluation period update. This additional delay is based on a mixture of actual activity durations (the TIA fragnet) and planned activity durations (the remaining CPM schedule into which the fragnet is inserted). For example, if the updates are inaccurate as described above, then the delay brought into the start of the TIA analysis is a mixture of actual delays and contractor anticipated delays. This is then merged through the RTIA process with forecast delays calculated through a mixture of projected activity durations and actual activity durations.
- **Collapsed As-Built Analysis (CAB).** This methodology measures delay that “actually” occurred by comparing actual dates and events with an expert’s after-the-fact assumption as to the should-have-planned sequence of activities. Therefore these days of delay are completely hypothetical because they measure delays against a plan that was never developed or executed.

17. K. Hoshino, J. Livengood, and C. Carson, RP 29R-03 Forensic Schedule Analysis, AACE International, Morgantown, WV. (2011)

18. E. Barba, J. Lifschitz and A. Lockshin. “A Critical Review of AACEI Recommended Practice for Forensic Schedule Analysis.” The Construction Lawyer, Fall 2009, Page 15; K. Hoshino and J. Livengood. “A Defense of AACE Recommended Practice for Forensic Schedule Analysis,” ABA Construction Lawyer, No. 30, Vol 1, Winter 2010. Page 32

19. [www.planningplannet.com](http://www.planningplannet.com)

20. P. Kelly, “Contemporaneous Understanding of Criticality,” Transactions 2016, AACE International Morgantown WV.

21. J. Wickwire, T. Driscoll, R. Hurlbut and R. Hillman, Construction Scheduling: Preparation, Liability and Claims, 3rd edition (2010), § 9.08[E] at 408, Aspen Publishers.

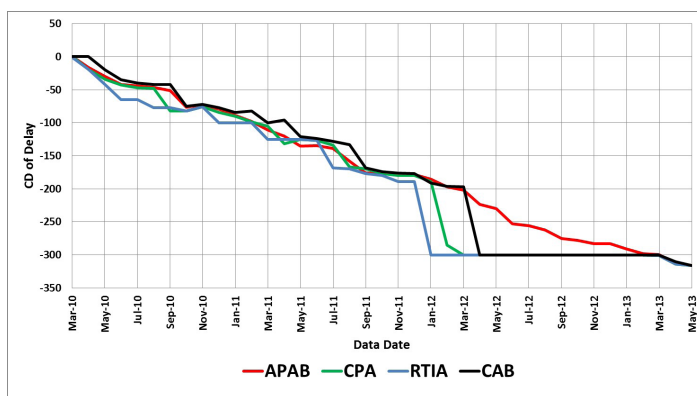
22. J. Livengood and R. Nelson, “Mixed FSA Methodologies - Proceed With Caution,” CDR.2236, Transactions 2016, AACE International Morgantown WV.

Thus it is clear that “combined” delay methodologies is problematic since the different methodologies, while each measuring “days,” actually measure different types of delay days.

A final, yet to resolved, issue is why different methodologies often arrive at different days of delays and allocations of delay responsibility. While partially addressed above, the studies to date seem to indicate that it is the timing of the delay methodology itself that accounts for the differences of delay.<sup>23</sup> Generally, the As-Planned vs. As-Built method identifies the delay earliest, and the Collapsed As-Built method identifies the delay latest. Such timing variances can significantly impact the allocation of delay responsibility.

## TREND CHART OF METHODOLOGIES

This chart plots the timing of recognition of delays for a model analysis of the four methodological families. Essentially, the APAB methodology identifies the delay occurring on the date it actually occurs, while the RTIA methodology identifies the delay up to two months earlier, the CPA methodology identifies the delay one month earlier and the CAB identifies the delay one month after. Source: J. Livengood and P. Kelly, “Forensic Schedule Analysis Methods: Reconciliation of Different Results,” Cost Engineering, January 2015, AACE International Morgantown WV.



## CONCLUSION

Experts have made tremendous progress to demystify and better explain the process of quantifying delay and allocate responsibility. In support of this, methodological best practices, techniques, and training in CPM schedules and forensic methodologies are readily available through leading professional organizations such as AACE International, ASCE, and CMAA.

Since 2005, there has been a steady development of cogent methodologies, explanation of underlying considerations, and training techniques to systematize forensic schedule delay analysis. Work by AACE International, ASCE, The Guild of Project Controls, and SOCL have all advanced the understanding of forensic schedule delay analysis.

The result of these two trends—less law and more guidance—have not fully staunched the tide of poorly conceived, voodoo analysis.<sup>24</sup> But there is hope. More arbitrations and mediations led by construction attorneys and construction experts, coupled with a better understanding of delay analysis methodologies by construction professionals, generally means a continuation of the long-term trend toward better analysis and fairer resolution of delay claims.

## ABOUT THE AUTHOR:

John Livengood is an architect and attorney as well as a Managing Director in the Global Construction Practice at Navigant. He is President-Elect of AACE International and has more than 41 years of experience in construction, design, delay analysis, and litigation support. He can be reached at 415-356-7137 or [John.Livengood@Navigant.com](mailto:John.Livengood@Navigant.com)

23. J. Livengood and P. Kelly, “Forensic Schedule Analysis Methods: Reconciliation of Different Results,” Cost Engineering, January 2015, AACE International Morgantown WV.

24. This may perhaps be too harsh a term. The non-CPM forensic methodology called “As-Built Critical Path” is where the expert looks at all that happened on the job in segments, perhaps as frequently as daily, and identifies the delays the expert concludes were on the As-Built Critical Path. While such a methodology is non-duplicable and therefore may not survive a “Daubert” challenge as to its legitimacy as a methodology, it can, in the hands of a well-experienced construction expert, be remarkable accurate.