Calculating Lost Labor Productivity: Is There a Better Way?

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One of the more significant elements of damages in a construction dispute, and one of the most controversial, is the calculation of lost labor productivity or, as it is also termed, labor inefficiencies. These damages are significant because, if proven, the monetary value of such a claim can be considerable. This is not surprising because “[l]abor costs generally make up 30 to 50% of overall project costs.”1 Indeed, “[w]hen projects lose money, the primary reason is often unanticipated labor costs resulting from less than anticipated productivity.”2 One commentator notes that “[d]isruption of labor productivity is the greatest risk to a construction project and contractors are increasingly careful to account for a multitude of potential variables when preparing their pre-contract labor estimates.”3

The calculation of lost labor productivity is controversial because of the widespread skepticism of those owners (or even general contractors) against whom such claims are asserted, as well as triers-of-fact, who may come to view the methodologies employed to calculate both the extent and value of the asserted damages as questionable, speculative, and illusory.

With Daubert4 fully entrenched in federal jurisprudence, and many states following suit in imposing on the trier-of-fact the role of “gatekeeper,” those parties seeking to pursue loss-of-productivity claims need to acquaint themselves with the requisites of a proper evidentiary basis as well as determine the best choice of an appropriate modality to calculate a loss-of-labor productivity claim in order to avoid the Daubert “shoals.” In doing so, they need to undertake a reality check of their claim during the process of its development.5

In this article, we will discuss how lost labor productivity claims are developed; the interplay of Daubert in the pursuit of, and defense against, such claims; and recent federal and state case law addressing loss productivity. We will then endeavor to discuss and analyze the current professional literature regarding techniques to improve the accuracy of determining the validity and value of such claims.

Inherent Difficulties in Ascertaining Lost Labor Productivity

Experts involved in the “science” of proving lost productivity damages recognize the inherent difficulties in such analyses:

This claim effort can be met with difficulty because proving lost productivity is one of the most contentious and controversial areas in construction claims and disputes, especially in international projects. This can be readily understood because productivity decline can occur in many circumstances on construction projects, which may be attributed to the owner, the contractor’s estimate, the ability to execute as estimated, or to a third party.6

As anyone knows who has been through the experience of either prosecuting or defending against a loss-of-productivity claim, this can be a very expensive undertaking. It normally involves retaining an experienced construction productivity expert, preferably one with direct experience in the type of construction involved and trades whose productivity is claimed to have been disrupted; depending upon

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the available project records, the expert may need to spend many hours analyzing the claimant’s original productivity on the project at hand and, potentially, may be required to examine records from other similar projects for the purpose of developing reasonable proof of the loss of productivity and causation as a result of impacts for which the contractor is not responsible. Correspondingly, in defending against such a claim, the opponent often must incur comparable costs in expert fees to not only refute such claims, but, very possibly, to persuade the trier-of-fact that the opponent’s expert is not qualified or his/her analysis fails to meet the Daubert threshold for admissibility.

That notwithstanding, the amounts of losses due to labor inefficiencies—not the fault of the contractor—in a given project may be so large as to justify the expenditure of time and money to fully develop such a claim. Moreover, if a claimant expects to be able to negotiate or to mediate a sizable settlement, he/she may need a well-developed loss-of-productivity claim as leverage.

No one can seriously question that there are many circumstances, not caused by a contractor, or not otherwise reimbursable, that may cause a loss of labor productivity, such as: (1) errors and omissions in design-bid-build contracts, (2) an owner refusing to recognize legitimate extensions of time that could result in unwarranted accelerations of work, (3) unforeseen changed conditions disrupting the planned work efficiencies, or (4) a combination of the above. Moreover, depending on the size and complexity of the project, the extent of the disruption(s), and the amount of labor involved, such claims can cause damages in the millions of dollars. As has been explained by those involved, the process of preparing such a claim is laborious and time-consuming; this is because:

[A] construction project is a very dynamic process where thousands of custom crafted pieces that make up the project are assembled by trade workers in an environment often exposed to changing weather conditions. Such an undertaking is subject to numerous factors that can affect productivity. Therefore, the challenge of quantifying the loss of productivity caused by a specific factor or factors, which is not within the contractor’s control, can be quite daunting.7

The possible causes of loss of labor efficiency are legion; among other causes, disruption can be the result of more difficult or crowded working conditions, extended overtime or second shift work (the worker fatigue factor), working out of sequence or with frequent interruptions, access problems, and working in less favorable weather or temperature conditions. All of these can be compensable when they are the result of disrupting actions or inactions of the government [or private owner, or general contractor] that entitle the contractor to an equitable adjustment.

However, there are just as many possible non-compensable causes of lower-than-anticipated labor efficiency including such factors as high labor turnover, poor supervision or planning, inadequate coordination of subcontractors, or simply an overly optimistic estimate. Additionally, all of the previously mentioned causes of inefficiency that may result from compensable actions can just as easily be the result of noncompensable root causes. This overlap, and the possibility that an observed manifestation of inefficiency may be due to multiple root causes, are two reasons why proving compensable loss of efficiency is particularly challenging.8

Challenging, indeed!

This same commentator notes:

The boards [of Contract Appeals] have acknowledged that determining the amount of compensation for disruption/labor inefficiency with exactitude is “essentially impossible,” and that some form of reliable methodology to arrive at an inexact approximation must be utilized, typically based on expert analysis and testimony. The reason is that loss of productivity cannot generally be directly observed, measured, or recorded as it occurs but, instead, can be seen only in the reduced units of completed work installed by the workforce over a period of time.9

Daubert and Its Impact on Proving Lost Productivity

The trier-of-fact as “gatekeeper” in connection with the preliminary review and acceptance/rejection of expert testimony is now clearly applicable to construction experts. In fact, the Daubert motion is, perhaps, the greatest threat to a proponent’s advancement of a loss-of-productivity
claim and, correspondingly, the greatest weapon in the arsenal of an opponent to such a claim. Numerous federal courts and boards of contract appeals have applied Daubert in construction cases since the Supreme Court issued its ruling 22 years ago. There have not been very many instances, however, where Daubert has been specifically leveled against tendered expert testimony in the context of supporting loss-of-productivity claims, though there is no reason to expect that such claims will escape the ravages of Daubert.\(^\text{10}\)

This should not be surprising, principally because, almost invariably, proof of loss of productivity is particularly dependent on expert witness opinions that are often based on a rather subjective and selective analysis of the documentation supporting labor inefficiencies and often the difficulty in ascertaining the necessary causal connection between the impact of disruptions and their adverse effect on productivity. This expert endeavor requires both the identification of and accounting for the noncompensable causes of disruption as well as the ability to quantify the compensable damages. Moreover, the facility to prove such claims is directly affected by the quantity and quality of documentation on a particular project. Because this varies widely, it is to be expected, as we discuss further below, that such damages claims result in Daubert challenges.

One relatively recent case from the Armed Services Board of Contract Appeals (ASBCA) is instructive.\(^\text{11}\) In that case, the prime contractor, Hensel Phelps Construction Company (Hensel Phelps), submitted a pass-through claim of its subcontractor, Steward Mechanical Enterprises, Inc. (SMEI), seeking to recover almost a million dollars in lost labor productivity damages, caused, so it claimed, by design deficiencies. From the language of the A.S.B.C.A.’s opinion, we can glean what might be required of an expert attempting to develop a factual basis for such a claim, reciting the perceived “deficiencies” in the expert’s preparation of his factual analysis. Using the government’s cross-examination of the expert as a basis for its criticism of the expert’s efforts, the board gives the reader a rather clear idea of what it believed needed to be done but was not:

The government’s cross-examination of Mr. Lucas established the following facts: Mr. Lucas did not think it was necessary to talk to anyone from Hensel Phelps (tr. 4/8–9); he did not think it was important to talk to Mr. King (Stewart’s project manager from September 1990 to May 1991) and did not do so (tr. 4/69–70); he relied upon his conversations with Mr. Nicholls (who replaced Mr. King and remained Stewart’s project manager through contract completion) about the change orders and modifications instead of reviewing the relevant documentation himself (tr. 4/7–25); he concluded that Stewart was not responsible for any major delays or inefficiencies based primarily upon his discussions with Mr. Nicholls (tr. 4/124–27) and did not conduct any other independent investigation of possible inefficiencies caused by Stewart (tr. 4/134–45); he was not interested in documents associated with Stewart’s subcontractors (tr. 4/52–53); he thought it was important to review the daily reports prepared by Stewart and not those prepared by Hensel Phelps and the government (tr. 4/10–11, 34, 49), but nevertheless reviewed only about 35 percent of Stewart’s reports, relying instead upon the summary of Stewart’s reports prepared by a law clerk to appellant’s counsel (tr. 4/35–37); he did not review documents in the Hensel Phelps files (tr. 4/21–22, 289–90); and he was not interested in correspondence between Hensel Phelps and the government or between Hensel Phelps and its other subcontractors (tr. 4/31–33, 67–68); he was not aware of the Field Trouble Reports and did not think the Non-Compliance Notices issued to Stewart were important to his analysis (tr. 4/38–41).

Further, Mr. Lucas only reviewed a list of the RFIs, instead of the RFIs themselves, and did not know the content of all the RFIs (ex. A-3.1; tr. 3/236, 4/41–45, 74–75). He somehow concluded that 185 of the RFIs related to Stewart’s work and assumed that many of the rest of them indirectly affected Stewart’s labor productivity, although he could not identify how many (ex. A-330; tr. 4/100–02).\(^\text{12}\)

Clearly, the board was not happy with the lack of thoroughness of the expert’s review of the documentation available. This failure, as in Hensel Phelps, to conduct a thorough investigation clearly leaves the claimant at a substantial risk of a successful Daubert challenge, as occurred in Hensel Phelps, wherein the board stated:

Contrary to appellant’s view, the number of RFIs and changes alone is insufficient to establish the government’s liability for a contractor’s inefficiency. Santa Fe Engineers, Inc., A.S.B.C.A. Nos. 24578, 25838, 28687, 94-2 B.C.A. ¶ 26,872 at 133,754. Accordingly, we decline to adopt the opinion of appellant’s expert witness about the labor inefficiency Stewart experienced because it relies almost entirely upon the number of RFIs and changes issued to Stewart during contract performance.\(^\text{13}\)

The takeaway from this decision is that there are no shortcuts in reviewing available documentation and he/she who takes such shortcuts does so at his/her own peril and that of his/her client.

The Daubert Motion: It’s Coming Whether You Like It or Not

Not only are there no shortcuts when preparing a claim of damages for lost productivity, based on a reading of some recent Daubert cases, when someone makes a significant
claim for damages due to lost labor productivity, it is virtually inevitable that a Daubert challenge will occur, often both as to (a) the qualifications of the expert and (b) the findings of that expert.

For some, the extent of an expert’s evident qualifications poses no deterrent to opposing counsel’s effort to disqualify the expert.

Indeed, for some, the extent of an expert’s evident qualifications poses no deterrent to opposing counsel’s effort to disqualify the expert. Although it does not involve loss-of-productivity damages, the relatively recent case of John H. Banks v. United States demonstrates the lengths to which some counsel will go to object to the qualifications of a proffered expert. Banks involved claims by property owners on Lake Michigan who were contending that the US Army Corps of Engineers’ construction-maintenance of certain jetties caused erosion to the claimant’s shorelines, amounting to a compensable taking of their property rights. Although there was a significant and seemingly legitimate dispute between the parties regarding whether the expert had fully provided to opposing counsel a proper listing of what the expert had reviewed, counsel also argued that the expert was not qualified to give his opinion. Here is the court’s recitation of that expert’s qualifications:

With regard to education, Dr. Nairn holds three academic degrees, including a doctorate in Coastal Processes and Engineering from the Imperial College of Science, Technology and Medicine in London, England. JR 442. With regard to experience, he has practiced for twenty-four years in the fields of hydrodynamics, sediment transport and scour processes in rivers, estuaries, lakes, coasts, and oceans. Id.; Def.’s Resp. 20. Dr. Nairn has conducted a number of coastal engineering investigations, created numerical and physical modeling and design projects, and directed coastal zone management projects. JR 442–48. Dr. Nairn has worked throughout North, Central, and South America; Africa; the Middle East; Asia; and Europe. Id. Dr. Nairn has authored at least sixty-five articles published in peer-reviewed publications, “many of which relate to coastal processes involved in this litigation.” Def.’s Resp. 20. He has been qualified to offer and has provided expert testimony in one other federal trial in the past. JR 453. He has never failed to qualify as an expert. Id.

Based upon Dr. Nairn’s curriculum vitae, JR 442–53, the court concludes that defendant has made a showing that Dr. Nairn is an expert in coastal engineering sufficient to defeat a motion in limine.

Ask yourself: How many experts have you proffered with the kind of qualifications of Dr. Nairn? The court seems to have been the master of understatement in concluding that, based on this rather extraordinary resume, the government’s showing was merely “sufficient” to avoid a motion in limine calling for the expert’s disqualification. As such, if the qualifications of the expert in the Banks case are going to be challenged, it is a safe bet that your expert’s qualifications stand a good chance of facing a challenge.

Even where a lost labor productivity expert’s credentials are unchallenged, it is even more likely that the expert’s methodology, analysis, and conclusions will be challenged under Daubert. This is because, as noted earlier, the nature of such opinions requires that the expert determine the effect of myriad factors affecting productivity, thereby giving rise to almost as many opportunities to challenge. Because loss-of-productivity claims hinge on the acceptability of expert testimony, the attorney needs to view these claims through the prism of a Daubert lens in the preparation of both the expert and the claim.

The Banks case is also instructive as to how courts and boards must apply the Daubert factors before qualifying the expert and then accepting that expert’s opinion as evidence:

In Daubert v. Merrell Dow Pharmaceuticals Inc., 509 U.S. 579, 113 S. Ct. 2786, 125 L. Ed. 2d 469 (1993), the Supreme Court presented a two-prong test for the admissibility of expert evidence. The first prong assesses the reliability of the underlying principles and methodologies. Daubert, 509 U.S. at 592–93. Factors suggested by the Court to consider when making this assessment include: whether methodologies can be and have been tested; whether theories have been peer-reviewed and published; any known or potential rate of error; and acceptance of methodologies within the relevant scientific or technical community. Id. at 593–94. However, that list is not exhaustive, and the trial court may scrutinize the portions of an expert’s testimony that is [sic] based upon the expert’s skill or experience. Kumho Tire, 526 U.S. at 151. “[T]he trial judge must have considerable leeway in deciding in a particular case how to go about determining whether particular expert testimony is reliable.” Id. at 152. The second prong inquires whether the testimony is relevant to the facts at issue. Daubert, 509 U.S. at 591–92. According to the Court, “‘relevance’ requires that a ‘fit’ exists between the proffered testimony and the issue to be resolved by trial.
Thus, this is the framework within which, or the prism through which, a trial court is going to determine whether expert testimony on labor inefficiency is admissible.

While the trier-of-fact certainly has broad discretion to qualify an expert and admit that expert’s opinion (especially in cases that are tried to the court or board), this is really less than half the battle. The harder and ultimate test, of course, is persuading the trier-of-fact with such testimony.

The “Measured Mile”: The Gold Standard for Proving Lost Labor Productivity

The authors of the leading treatise on construction law state:

Loss of efficiency normally is proven by a “measured mile” analysis comparing current project before “disruption” and “after disruption” labor productivity, past and current project labor productivity, and antidotal evidence. Where specific job history is inconclusive, loss of efficiency may also be proven:

1. By comparison of productivity during a disruptive event with reasonable productivity assumptions (supported by historical data or detailed estimates) upon which the bid was based;
2. By comparison of productivity achieved on similar work;
3. By comparison with industry standards reflected in industry manuals and learning curve studies prepared on the basis of scientifically accepted methodologies; and
4. By expert testimony.

One of the pioneers of the measured mile approach, Dwight A. Zink, provides the following definition:

The measured mile method is a technique whereby an unimpacted period or area or activity of construction work is compared with another period or area or activity of construction work that has been disrupted, the assumption being that the difference between the labor or equipment hours expended per unit of work performed in the unimpacted and impacted periods represents the loss to the contractor due to the impact or disruption for which another party is responsible.

As such, the measured mile is “[t]he method of proof generally recognized as the best available in most instances.”

As noted above and as we will develop below, there are other ways to attempt to prove loss of productivity, other than the so-called measured mile, including: (1) what has been called the “baseline” method; (2) comparison methods; (3) the use of construction industry-developed guidelines or studies, such as those published by the Business Roundtable, the Mechanical Contractors Association of America (MCAA), and the National Electrical Contractors Association (NECA); (4) that rarest of available methodologies, direct observation; and (5) generally, as a last resort, the so-called total cost or modified total cost methods. As students of construction law know, “total cost” and its cousin, “modified total cost,” analyses are the most criticized of methods of proving damages and will be accepted only when there is truly no other way to prove damages.

As with all of these methodologies, the old adage “the devil is in the details” applies, and it is to those details that we now turn.

Development of the Specialty of “Cost Engineering” and Methods for Determining How Best to Calculate Lost Labor Productivity

Importantly, and in light of Daubert’s “sword of Damocles” that hovers over every loss-of-labor-productivity analysis, a claimant and its attorney seeking to utilize either the measured mile approach and its variants, or others mentioned above, both need to become intimately familiar with how these methods are developed, their relative strengths and weaknesses, and what is necessary to ensure, initially, their admissibility and, ultimately, their effectiveness in persuading a trier-of-fact to award loss-of-productivity damages.

Fortunately, over almost the last 30 years, a number of scholarly articles, many of them peer reviewed, have been written by “cost engineers” describing the evolution of innovations in technique in developing and deriving the factual bases for their analyses. These articles have also provided improvements to this effort, shoring up perceived weaknesses in some of the methodologies. We will discuss these articles and their evolutionary development of the “science” of lost labor productivity further on in this article.

The understanding and quality of analysis of lost productivity/labor inefficiency claims’ analysis and preparations have been greatly enhanced as “cost engineering” has become a recognized specialty within the range of construction claims skills. With the advent of organizations such as the Association for the Advancement of Cost Engineering International (AACE International), this specialty has gained widespread recognition. Indeed, AACE International provides a certification procedure for those seeking to be recognized as having expertise in this field. Moreover, AACE International has developed a set of “Recommended Practices,” one of which is entitled “Estimating Lost Labor Productivity in Construction Claims,” known as Recommended Practice 25R-03. As might be expected, this recommended practice is relevant to our discussion here. We will discuss this recommended practice at greater length and in more detail later in this article.

By reviewing the literature and engaging certified, or
otherwise qualified, “cost engineers,” and following the “recommended practices” of organizations such as AACE International, the claimant and his/her attorney can go far in establishing the bona fides of a lost labor productivity claim. Correspondingly, the opponents of such claims also have a trove of information from which to draw to determine whether a claimant’s lost labor productivity claim will either avoid or be fatally injured by Daubert’s “sword of Damocles.”

In the ensuing pages, we will discuss these various and developing methodologies to familiarize the reader with them and to consider which method or methods are more appropriate in particular cases. As experts have noted:

the number of variables that can affect productivity at the specific project site can be extensive. As methods of analysis become less project specific and involve the comparison of separate projects, the number of potential variables that can affect the results increases and the certainty of the results decreases. As the methods of analyses become even less project specific, such as in empirical studies, the degree of certainty is even further diminished. In general, proofs of causation and lost productivity are most preferred if they are based on contemporaneous project specific documentation.22

Of course, what methodology to use may well be predicated on the nature and pervasiveness of the disturbances impacting efficiency and, very often, the amount of and detail contained in the particular project’s documentation. The fewer the particular impacts causing problems and the more detailed the information in documentation, the greater the ability to utilize the more project-specific methodologies to develop the claim and the more likely the acceptability of particular analyses. With that, we will discuss the various methods of lost productivity/labor inefficiency claim detection.

Classical Measured Mile: How It Is Determined
The traditional measured mile method relies upon a comparison of labor productivity of identical activities occurring in both unimpacted and impacted periods or segments of the same project in order to quantify the lost productivity resulting from the disrupting events for which the claimant bears no responsibility. The obvious advantage of the measured mile method over other approaches is that it relies on actual performance achieved on the same work from the same project, thereby eliminating most disputes over the validity of cost estimates, or productivity-impacting factors for which the claimant is not liable.

It makes sense that this classic measured mile approach has been considered as the preferred method of proving lost productivity as reflected in numerous professional articles and in the prioritization of most-to-least effective by AACE International’s Recommended Practice 25R-03, as well as in numerous cases in which lost productivity labor inefficiency damages are discussed.

In fact, this method received acceptance by courts even before the term measured mile became common parlance to describe the method to quantify lost labor productivity. Often, this method was referred to as the “differential method.” For example, the U.S. Court of Appeals for the D.C. Circuit accepted this so-called differential method in the seminal case of U.S. Industries, Inc. v. Blake Construction Co., Inc.23 wherein the court noted that it was a “well established” methodology for proving increased labor cost damages due to lost productivity, without ever using the term measured mile.

As noted above, the initial use of the term measured mile in connection with lost productivity quantification is generally ascribed to Dwight Zink, when he proposed his measured mile procedure in his 1986 article entitled The Measured Mile: Proving Construction Inefficiency Costs.24 Since then, of course, many courts and boards have both accepted and adopted the measured mile approach. For example, in DANAC, Inc.,25 the Armed Services Board of Contract Appeals (ASBCA) confirmed that a “good period vs. bad period” analysis of comparing the labor costs of work performed during unaffected periods with that performed during periods affected by disruptive events not caused by the claimant “is a well-established method of proving damages,” citing the D.C. Circuit’s Blake decision26 as supporting authority. In addition, the ASBCA, in W.G. Yates & Sons Construction Co.,27 not only endorsed the claimant’s measured mile analysis but, again, declared that the measured mile method was a “well established method of proving damages.”

Extension of the Measured Mile to Similar, but Not the Same, Work
We know from experience, however, that the literal requisites for a true measured mile, i.e., the ability to compare the same labor work occurring in unimpacted and impacted periods on the same project, are circumstances that on many, if not most, projects are the exception rather than the rule. As a result, a number of courts and boards began accepting the broadening of the measured mile concept to include comparisons of similar work activities as opposed to the rigidity of identical work, as well as permitting the comparison of lightly impacted periods, as opposed to unimpacted periods. In Clark Concrete Contractors, Inc.28 the General Services Administration (GSA) awarded a contract to Clark to construct a multi-story concrete building. During construction, GSA made significant design changes that Clark alleged caused the contractor to modify its planned work sequence, resulting in delays and labor congestion at the site that required rescheduling of work crews and the incurring of overtime expenses. The contractor contended that it had calculated its lost productivity based on similar work that was reasonably like the actual labor that had been impacted and for which Clark sought labor inefficiency damages.
In ruling for Clark, the General Services Board of Contract Appeals (GSBCA) stated that:

[the government] is correct in asserting that the work performed during the periods compared by [the contractor] was not identical in each period. We would be surprised to learn that work performed in periods being compared is ever identical on a construction project, however. And it need not be; the ascertainment of damages for labor inefficiency is not susceptible to absolute exactness. . . . We will accept a comparison if it is between kinds of work which are reasonably alike, such that the approximations it involves will be meaningful.29

Thus, according to the GSBCA, so long as work in the unaffected period was “reasonably alike,” it could be compared with different work in the affected period, provided that such “approximations” were “meaningful.”

Not surprisingly, no cases have been found that define precisely the extent to which work must be “reasonably alike” or when “approximations” are “meaningful.” Rather, because of the variety of circumstances presented by different construction cases, each one requires that it be viewed on its own merits, with the triers-of-fact carefully weighing the facts of each case. Suffice it to say, however, that for triers-of-fact to be expected to accept similar work comparisons, the following factors will be extremely relevant:

• The work performed in the measured mile and the impacted period should be substantially similar in type, nature, and complexity;
• The composition and skill level of crews should be comparable;
• The measured mile should represent a contractor’s reasonably attainable level of productivity; and
• The work environment should be similar.

Developing the “Baseline” for the Measured Mile

One of the more difficult tasks in performing the measured mile analysis is in finding the “baseline” of unimpacted or lightly impacted work for purposes of comparison with the impacted period of work. As has been noted, there are many projects that simply do not have work periods that are unimpacted by some disturbance. In such instances, the productivity expert will have to find some lightly impacted periods/segments of sufficient duration to demonstrate the productivity that the contractor could have actually achieved when the work was only lightly impacted. This period or segment then becomes the “baseline.” As such, it is essentially a conservative assessment by the productivity expert because any baseline productivity so derived will not represent what the contractor was capable of achieving if completely unimpacted. Therefore, when compared to more heavily impacted productivity, the claimant is forgoing the damages it incurred from the “light impacts.”

Although utilization of such a conservative baseline necessarily prevents absolute exactitude, it should meet the minimal requirements, as described in Clark, in providing a “reasonable” and “meaningful” approximation of the damage via the measured mile comparison.

Efficiency Factors, Earned Value, and Comparison with Budget and Estimates to Derive Lost Productivity

Beyond the issue relating to establishing an appropriate baseline to make an appropriate comparison between unimpacted (or lightly impacted) periods with impacted periods is the question of the adequacy and specificity of the contractor’s records relating to labor costs incurred. It is quite common for contractors to only maintain records that simply reflect the number of labor hours incurred within a given period without accounting for the quantity of output achieved by those labor hours. While this is not, or should not be, fatal, the lack of such documentation makes the task of the claimant’s expert to prove labor inefficiencies, understandably, more difficult.

Front-end loading of bids may seriously and adversely impact the accuracy of these calculations.

In such cases, the cost engineer may be required to resort to an analysis of the contractor’s bid estimates with the calculated percentages of completion contained in its monthly pay requisitions showing percentages of completion of the various tasks performed. The percentage of completion of various tasks in the contractor’s periodic payment requests generally reflects the ratio of what portion of a particular task has been completed to the total value ascribed to the performance of such task as listed in the schedule of values accompanying the contractor’s bid or estimate. Because of the reliance on bid estimates or earnings based on the budget, this necessarily deviates—to a degree—from the traditional measured mile analysis, which, in the best of cases, should eliminate the need to rely on the contractor’s bid estimate and/or budget. Naturally, should the claimant have to resort to a reliance upon its bid and/or budget as the percentages of completion contained in its payment applications, these will also require proof of the reasonableness and appropriateness of these estimates and calculations. As such, so-called front-end loading of bids may seriously and adversely impact the accuracy of these calculations by suggesting an unattainably high rate of expected progress.
In *P.J. Dick,* a subcontractor sought to recover labor inefficiency damages on its pass-through disruption claim against the Veterans Administration (VA). The subcontractor predicated its claim upon claimed design defects and purported acceleration of its electrical work. Because of the lack of any unimpacted periods in the same work activity on the project from which to derive a measured mile, however, the subcontractor’s expert selected a baseline from similar work completed by the subcontractor on the same project. The VABCA accepted this analysis, despite the lack of an impact-free measured mile from identical work, finding the subcontractor’s approach to be legitimate and holding that there was “no basis to conclude that either the productivity of the same crew or that exactly the same work is a prerequisite for a valid measured mile analysis to establish the amount of loss of productivity.”

Essentially, the only difference was instead of using the term efficient factor, as in *P.J. Dick,* the board in *Bell* used the term reasonable productivity level, and the VABCA accepted this analysis. Interestingly, the government did not challenge the board’s award as it related to lost productivity in its later appeal.

**State Courts’ Experience With Labor Inefficiency Claims and the Measured Mile**

State courts have begun utilizing the federal courts’ and boards’ measured mile approach to calculate lost productivity as well. In *James Corporation d/b/a James Construction v. North Allegheny School District,* the contractor, performing renovations on an elementary school, claimed that it suffered damages due to lost productivity caused by the owner’s unreasonably refusing to extend the time for completion after the contractor experienced delays for which it was not responsible. The contractor’s expert employed a version of measured mile analysis to prove lost productivity because of constructive acceleration. The contractor’s expert compared the percentage of work performed to the number of labor hours used. Despite the school district’s characterization of the contractor’s analysis “as nothing more than the disfavored total cost approach, which subtracts the estimated costs under the contract from the actual costs incurred,” the court was persuaded that the contractor had suffered lost productivity damages, explaining:

Contractor’s witness, an expert in project controls and claims analysis (claim expert), explained his measured mile analysis included an earned value factor since the Project was delayed from the beginning and the work could not be easily compared. N.T. Vol. III at 157, 231. According to claim expert, this comports with industry standards. Id. at 158.

Claim expert then described his methodology. Dividing the Project into two time periods, claim expert compared the percentage of work completed in each period to the number of labor hours utilized. During the first period, Contractor expended 4,279 hours to complete 41.76% of the Project. Had Contractor been able to work at the same pace during the second period, it would have expended an additional 5,967 hours to complete the remainder of the Project. However, the Project’s total hours equaled 19,645 hours; therefore, Contractor used 15,366 hours to complete the second period (19,645 – 5,967 [sic: 4,279]). Thus, the inefficient labor hours amounted to 9,366 (15,366 – 5,967 = 9,366). To arrive at an earned value factor of 61%, claim expert divided the inefficient labor hours by the number of hours worked in the second period (9,366 / 15,366 = 61%).

Utilizing the earned value factor, claim expert then determined the number of inefficient labor hours Contractor and its subcontractor each
A Massachusetts court has also endorsed the measured mile as a proper means of proving lost productivity damages. In the case of *Central Ceilings, Inc. v. Suffolk Construction Company, Inc.*[^17] the trial court stated that “Suffolk [the prime contractor defendant] is correct that, generally, ‘[w]hen a contractor alleges a loss of productivity, the measured mile approach is the preferred method of computing damages.” *James Corp. v. North Allegheny Sch. Dist.*, 938 A.2d 474, 495 (Pa. Commw. Ct. 2007).” In this case, however, the Massachusetts court permitted the contractor to prove its claim of lost productivity using a modified total cost method; because the prime contractor’s “misconduct throughout the Project impacted all aspects of Central’s performance, [it] thereby preclud[ed] [Central’s expert] from identifying a baseline and, consequently, from applying the measured mile.”[^38]

Tennessee courts have also looked favorably upon the measured mile approach. In *Contract Management, Inc. v. Babcock & Wilson*,[^39] the federal district court noted:

> The measured mile approach has been upheld in Tennessee as a reasonable method to calculate loss of productivity damages. See *Lee Masonry, Inc. v. City of Franklin*, 2010 Tenn. App. LEXIS 301, 2010 WL 1713137 (Tenn. Ct. App. 2010). But B&W Y-12 objects that this method requires CMI to determine a base period when it was not impacted (here, the period from September 10 to October 15) and that this base period is subject to a good deal of subjectivity. The probative value of the measured mile analysis “necessarily depends upon the comparability of the circumstances surrounding the sample to the circumstances which would have prevailed for the work which could not be directly measured.” *Lamb Eng’g & Constr. Co., E.B.C.A. No. C-9304172, 97-2 B.C.A. (CCH) ¶ 29,207*, at 93–94 (1997).

The district court, hearing the matter without a jury and while acknowledging the appropriateness of the measured mile to determine lost productivity damages in Tennessee, nevertheless agreed with the party opposing the claim that the claimant’s expert’s measured mile was “flawed because its base period is not likely to be representative of the productivity that CMI could have achieved during the first few weeks of the Project, even if it had not been impacted.”[^40] Because of these flaws, the court revised the claimant’s calculation, reducing the amount claimed by 25 percent.

Florida courts have implicitly also endorsed the measured mile approach in *In re Electric Machinery Enterprises, Inc. v. The Hunt Construction Group,*[^41] in which the opponent to a lost efficiency damages claim argued that the court should not have permitted a modified total cost claim because the claimant could and should have utilized the measured mile approach. The court, however, rejected this argument, holding that, because of the prime’s handling of the job, the claimant could not perform a measured mile analysis but had no other way than the modified total cost method to quantify its damages. It did not help that the prime contractor’s expert, who opined that measured mile was achievable, did not perform one himself.

Although the state case law in particular is not extensive, it appears clear that state courts and federal district courts, when presented with the measured mile as a means of proving lost labor productivity, will embrace it, provided the expert’s qualifications and conclusions meet the requirements for admissibility.

### Misapplying the Measured Mile

To reiterate, at bottom, the measured mile method is a tool to calculate lost labor productivity by (1) comparing (a) identical or (b) similar work to (2) quantify the claimant’s productivity loss, (3) provided that the claimant is not responsible for the causes of the losses of productivity. Clearly, however, the measured mile approach cannot be universally mechanically applied, nor should it be, to every case of lost labor productivity. Without the requisites of (1) relevant and available cost data, (2) the existence of either identical or sufficiently identical work to compare, and (3) the existence of unimpacted or lightly impacted “baseline” periods (4) on the same or similar projects and (5) the ability to demonstrate that the claimant was not the cause of the loss of labor productivity being claimed, (6) where noncompensable impacts are accounted for, efforts to prove loss of productivity damages via measured mile may, and probably will, fail. The mere employment of the nomenclature of a measured mile without a strong underlying factual basis will likely result in a very substantial expenditure of funds in the attempt to collect damages, with the result coming to naught.

Because, like snowflakes, each construction project is different, no courts or boards have devised either a foolproof or fail-safe procedure for comparing similar work, or clear and foolproof guidelines to eliminate the often-fuzzy boundaries between “similar” and “dissimilar” work. The following is a list of the “shoals” upon which many measured mile analyses have founded:

- flawed, erroneous, or inadequate data;
- calculation mistakes;
- incompatible or dissimilar work periods, i.e., comparing apples with oranges;
- failure to provide either an adequate (or any) analysis of a cause-and-effect relationship; and
- failure to exclude noncompensable impacts, such as weather, from the calculation of lost productivity.

For instance, in *J.A. Jones Construction Co.*,[^42] the Corps of Engineers hired the contractor to provide flood

[^17]: Central Ceilings, Inc. v. Suffolk Construction Company, Inc.
[^19]: Contract Management, Inc. v. Babcock & Wilson
[^20]: Lee Masonry, Inc. v. City of Franklin
[^21]: In re Electric Machinery Enterprises, Inc. v. The Hunt Construction Group
[^22]: J.A. Jones Construction Co.
In later litigation before the Corps of Engineers Board of Contract Appeals (ENGBCA), the contractor’s expert, seeking to show lost productivity damages, presented a measured mile analysis purporting to have resulted from the “disruptive ‘cumulative impact’ of change orders.” The board rejected this analysis for a number of reasons, including what it viewed as the arbitrary differentiation between the claimed impacted and unimpacted periods, perceived data errors, the failure to provide an adequate cause-and-effect analysis of the disruptions upon the work of the contractor, and failure to take into account any contemporaneous noncompensable disruptions.

The board pointed out that J.A. Jones’s expert had “created the specific formula he used for his ‘Measured Mile’ Analysis. It has not been tested or reviewed by his peers.” The board explained that the expert apparently applied subjective filters to identify its “Base Period” when only contract work was performed versus the “impacted periods” when both base contract work and change order work were performed. The board refused to accept the expert’s analysis that:

if one member of a crew worked on [change order] work during any given day for more than 6 hours and also worked on base contract work (a cost-coded item), that would be classified by [the contractor’s expert] as an impacted day and the cost-coded item (hours and quantities) would be placed in the impacted period for that day.

Additionally, the board also found likely inaccuracies in the expert’s calculations. The expert heavily relied upon J.A. Jones’s crew foremen’s reports, in which the board noted that “the number of JO hours reported by the foremen was materially overstated.”

The ENGBCA also criticized what it found to be a fundamental flaw in J.A. Jones’s measured mile analysis, i.e., the lack of a cause-and-effect analysis, elaborating as follows:

[T]he contractor’s expert] did not perform a cause-and-effect analysis. . . . He made no attempt to isolate specific impacts allegedly caused by changes. His analysis is not dependent on detailed knowledge of the project. The methodology used by [the contractor’s expert] does not consider the nature of any specific changes, or what locations/areas and work they directly affected on the project. Nor does it take into consideration the timing of the changes and whether the contractor had adequate notice in advance to implement and sequence the work in an orderly fashion.

The board also found fault with the contractor’s expert for failing to “analyze base contract cost-coded items to provide convincing evidence demonstrating how those base contract work items were adversely affected by the changes.”

Furthermore, the board determined that the expert’s analysis was additionally undermined because he failed to take into account any contemporaneous, noncompensable disruptions. Expanding on this point, the board explained:

Although [the contractor’s expert] maintains that the subjective results of his methodology in this case takes into consideration some other factors that might cause inefficiency, (such as weather and poor management) there is nothing in the macro-oriented nature of his analysis that eliminates these other potential causes of any increased hours related to performance of the unchanged work and that he made no analysis of the “weather sensitivity” of specific work items. We consider that the contractor has failed to prove that other [noncompensable] factors and variables did not significantly contribute to any production inefficiency.

As the board in J.A. Jones makes clear, analyses by experts of labor inefficiency cannot be based on a mere mechanistic application of perceived principles of the measured mile method, but the expert must convey a real knowledge of the project, based on an examination of the actual and adequate project documents and discussions with relevant and available actual participants in what happened on the job.

In Southern Comfort Builders, Inc. v. United States, the National Air and Space Agency (NASA) engaged contractor Southern Comfort Builders, Inc. (SCBI) to install heating, ventilation, and air conditioning (HVAC) equipment, along with the associated ductwork, wiring, and piping, in its mobile launch platforms (MLPs) for its Kennedy Space Center space shuttles. SCBI claimed a loss of productivity due to defective specifications, differing site conditions, and failure to properly administer the contract.

In attempting to develop its labor inefficiency claim, the contractor acknowledged it was unable to establish an acceptable measured mile using contemporaneous project documentation because:

1) SCBI’s entire performance period while installing the HVAC modification on MLP 1 was impacted due to the many conflicts encountered and the slow response time by NASA, and 2) due to the short duration of the installation of the HVAC modifications to MLP 1 (June to October), contemporaneous data segregating productivity impacts is simply not available.

Despite these impediments, SCBI’s expert created what he coined a modified measured mile method analysis by using a productivity baseline derived from the work of a different contractor on the project. The court rejected SCBI’s self-described modified measured mile calculation as fatally inadequate, as follows:
SCBI’s measured mile calculation is deficient in that it does not adequately represent a comparison between SCBI’s unimpacted work with SCBI’s impacted work. Instead, SCBI’s calculation compares SCBI’s work with the work performed by another contractor, Merritt. Although the two companies conducted similar work, even SCBI’s own expert . . . indicated that, under a measured mile analysis, comparing two separate companies is fundamentally flawed. Also, since SCBI did not provide a basis of its work unimpacted by government actions, the court cannot properly conclude what SCBI’s unimpacted work would have been.52

Although it is the nature of a measured mile analysis that “one size cannot fit all,” due to the variability of factors affecting each construction project, unless the project provides certain essential elements required by the measured mile method, there are certain measured mile analyses that “fit none.”

AACE International Recommended Practice 25R-03 and Discussion of the Professional Literature on Loss of Productivity

As noted above, there is a developing, and now extensive, body of professional literature, often peer-reviewed, around the topic of loss of labor productivity with which both claimants for and opponents against and their attorneys need to become familiar—the claimants, to ensure that their claims are compliant with what cost engineers recognize as valid analyses, and the opponents, to develop arguments to attack the validity of such claims. The AACE International, mentioned earlier in this article, was founded in 1956 by cost estimators and cost engineers. In its current Constitution and Bylaws, the AACE states:

The Association is dedicated to the tenets of furthering the concepts of total cost management and cost engineering. Total cost management is the effective application of professional and technical expertise to plan and control resources, costs, profitability and risk. Simply stated, it is a systematic approach to managing cost throughout the life cycle of any enterprise, program, facility, project, product, or service. This is accomplished through the application of cost engineering and cost management principles, proven methodologies, and the latest technology in support of the management process.53

Clearly, such efforts by the ACCE International have more easily enabled experts presenting claims to meet the requirements discussed in Daubert.54 Arguably, their efforts should bring some consistency and credibility in endeavoring to derive measured miles and to quantify lost labor productivity—eliminating contentions that such claims are speculative, elusive, and too malleable to be relied upon.

The important and relevant recommended practice developed by AACE International, briefly referenced above, is in its “RP 25R-03: Estimating Lost Labor Productivity in Construction Claim.” This recommended practice attempts to define and summarize the commonly used methods of quantifying lost labor productivity claims and to rank them from the most reliable to the least reliable, based on a review of professional (or peer-reviewed) literature, existing case law, as well as other professional articles discussing such construction claims. We have discussed a number of these methods already.

AACE International divides these various methods into five categories, in descending order of reliability:

• project-specific studies,
• project-comparison studies,
• specialty-industry studies,
• general-industry studies, and
• cost-based methods.

Project-specific studies, i.e., those limited to a review of and reliance upon the actual records of a particular project, are, quite naturally, generally preferred to project-comparison studies, which attempt to compare similar projects. In turn, project-comparison studies are likely to be given greater weight than specialty-industry studies. Specialty-industry studies, correspondingly, are generally considered more reliable than general-industry studies, and last among the five categories are cost-based methods, more commonly known as total cost or modified total cost, which are the least preferred form of analysis.

In AACE International’s analysis of the case law, and as some of the cases discussed herein reveal, the term measured mile has been used rather loosely in lost productivity quantification. Those accepted by courts and boards fall into two general categories: those that are based on the measurement of labor productivity using the physical quantity of work completed per unit of time or effort, as in Clark Concrete Contractors, Inc.55 and those based essentially on earned value, as in P.J. Dick and James Corporation.56

AACE International’s RP 25R-03 accepts the former as the true measured mile method but categorizes the latter as an “earned value analysis,” though acknowledging that both belong to the generally more reliable and acceptable project-specific studies. RP 25R-03 also adopts the “baseline method” of using lightly impacted periods/
segments to derive the baseline when a totally unimpacted period/segment of the project simply does not exist for a particular activity, as a way of providing an alternative measured mile method.

Some other project-specific studies are based on sampling of the work performed during the course of construction. When we look at the professional literature, these sampling methods, which we will discuss below, often appear to be simple and inexpensive to perform. The real challenge, however, is in providing truly representative samples of the work because, not surprisingly, their reliability is usually challenged on the basis that the samples chosen are neither large enough nor representative of the overall work.

The lack of applicability to many projects has spawned the necessity of other methods of calculation.

RP No. 25R-03 discusses the less reliable “project comparison studies,” including “comparable work studies” and “comparable project studies,” as efforts to derive what is the should-have-been productivity. These are used in lieu of project-specific studies when the more conventional and acceptable modalities of deriving a baseline in an unimpacted or lightly impacted portion or segment of the work to compare with the same work in an impacted portion or segment of the same work on the same project are, by dint of circumstance, simply not available.

In performing a comparable work study, the analyst may use information from the same project to either:

1. Estimate the lost productivity on the impacted period, and then locate an analogous (but not the same) work activity on the same project that was either nonimpacted or lightly impacted and could involve a different trade, and calculate that trade’s productivity; or
2. Compare productivities during the impacted period and of similar but nonimpacted work performed by another contractor on the same project.

Southern Comfort Builders, Inc. v. United States, discussed above, involved what was termed a measured mile analysis but was more appropriately categorized as a “comparable work study” because it involved the comparison of work performed by two different contractors. It was largely for this reason that the court in that case would not accept this methodology as a properly implemented measured mile analysis. This does not mean that such analyses will invariably be rejected but just that they are more subject to attack.

Comparable-project studies are used to compare the productivities of similar work activities on the project in question with that of work on a similar but different project in order to derive a possible loss of productivity. While “necessity is the mother of invention,” as Plato has said in his Dialogues, this does not mean that courts or boards are required to recognize these “inventive” efforts to derive lost efficiency damages. As such, tribunals are less likely to accept either comparable work studies or comparable project studies as sufficiently persuasive to support a claimant’s effort to recover lost productivity damages. The inherent weaknesses and difficulties are: (1) proving a rational similarity between (a) different trades, (b) contractors, and (c) projects; (2) attempting to derive a causal connection between the disruption(s) and lost labor productivity; and (3) failing because courts and boards deem the added variables involved simply so speculative and assailable as to be rejected under Daubert or, if admitted, simply not persuasive. Moreover, they pale in comparison to stand-alone project-specific methods to quantify lost labor productivity. As such, where more conventional methods of proof of the measured mile are available, these should always be used. Where the amounts of damages involved are high enough, however, the cost in performing comparable project studies may be justified in order to corroborate the more conventional methods, thereby significantly bolstering the main thrust of a lost labor liability claim.

Specialty trade or industry studies refer to numerous specific studies and papers performed and produced by organizations such as Mechanical Contractors’ Association of America (MCAA), National Electrical Contractors of America (NECA), and U.S. Army Corps of Engineers in an attempt to develop, generically, the impact on labor productivity of various commonly experienced factors occurring on projects, such as numerous design defects, constructive acceleration, change orders, cumulative impacts (the so-called death by a thousand cuts) and rework, the effect on the learning curve, increased overtime and shift work, project characteristics, project management, and unusual weather.

These general industry studies attempt to aid in the quantification of lost labor productivity based on particular types of impacts, solely or in combination, and adherents attempt to apply the results of these studies to a particular project experiencing these various categories of impacts with rather mixed results.

Because these studies do not deal either directly or indirectly with the particular project at hand and make no pretense in doing so, AACE International views these methods, along with the so-called total cost method and its cousin, the modified total cost method, as the least effective means of proving lost productivity damages.

Again, these studies may serve a helpful role in corroborating the analyses derived from the more conventional
<table>
<thead>
<tr>
<th>Measured Mile</th>
<th>Baseline Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>The negative impacts are limited to those caused solely by the contractor.</td>
<td>The baseline period need not be free from owner impacts.</td>
</tr>
<tr>
<td>The measured mile time frame is several or more consecutive reporting periods.</td>
<td>The baseline time frame need not be consecutive reporting periods.</td>
</tr>
<tr>
<td>The focus is on finding periods of time when there are no owner-caused impacts.</td>
<td>The focus is on finding the best performance the contractor could achieve.</td>
</tr>
</tbody>
</table>

modalities of proving lost productivity damages. Because they already exist, there is little additional expense in using them to support conclusions based on analyses that are on firmer factual ground.

**Techniques to Determine the Measured Mile as Found in the Professional Literature**

Often, it is extremely difficult to identify a measured mile merely through a cause-and-effect analysis. Numerous construction researchers and professionals—including Zink; Gulezian and Samelian; Thomas, Horn; Minchin, and Chen; Thomas and Sanvido; Riley, Sanvido; Ibbs and Liu; and the coauthors of this article—have developed varying procedures to assist their efforts to identify and establish a measured mile or baseline. These techniques generally rely on the productivity measurements based on physical units completed. Each of the different methods has its own underlying premises and assumptions. Naturally, applying these different procedures without accounting for and adequately explaining the relevant underlying premises and assumptions will likely lead to erroneous measured mile calculations.

**Zink’s Measured Mile Procedure**

The procedures championed by the “pioneer,” Zink, require the following:

- Plot the actual labor man-hours expended versus the corresponding percentage of completion for the work;
- Exclude the first and last 10 percent from the analysis because the productivity during these periods may be impacted by “build-up” and “tail-out” effects, thereby skewing correct results;
- Identify a linear or near linear portion of the work performed to arrive at the most efficient rate of progress in the 80 percent of the curve as the measured mile.

Zink’s measured mile procedure shows a continuous period of time in which the most efficient productivity is uniform or nearly uniform. As noted above, the circumstances of many projects will not permit the use of Zink’s, perhaps, too simplistic methodology. This is because, in many projects, due to pervasive disruptions, a sufficiently long period or segment may just not exist from which an acceptable measure mile with uniform or nearly uniform productivity can be demonstrated. Indeed, Zink recognized this when he stated:

> The “measured mile” approach to isolating the disruption costs of acceleration is generally accepted by the courts as being a reasonable way of determining the damages incurred over and above those which should have been expected. However, the size of the sample must also be reasonable—i.e., extrapolating two percent of progress into 80 percent of expected costs would hardly be reasonable.

The lack of applicability to many projects has spawned the necessity of other methods of calculation.

**Thomas’s Baseline Method**

In order to address this lack of a sufficiently long period of uninterrupted or lightly interrupted segment or period of activity required by the original measured mile method, Professor Thomas and his collaborators introduced the so-called baseline concept. These researchers have taken the position that a baseline period is a period of time when the contractor performs at its best, but the period involved does not have to be a continuous, nonimpacted time frame. The differences between the measured mile and the baseline period, according to Thomas et al., are set forth in the above table.

The baseline is, therefore, a relatively conservative benchmark because it may include certain disruption events. In order to determine a baseline, based on Thomas’s analysis, the following steps must be taken:

- Ascertain the total number of contractor reporting periods;
- Create a baseline subset consisting of 10 percent of the total number of reporting periods but, in no event, less than 5 periods;
- This baseline subset should be for the reporting periods that have the highest production or output;
- The baseline is then assumed to be median of productivity value per period or the productivity average in the baseline subset.

It is important to note that Thomas’s procedure employs

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“production” instead of “productivity” to identify the baseline. Moreover, when the baseline is intermittent, a regression analysis (defined by statisticians as “a statistical process for estimating the relationships among variables”) may be necessary to quantify the influence of multiple disruptions.

Thomas’s procedure is, naturally, more accurate when the input contained within each reporting period is either uniform or almost uniform and when the reporting periods with the highest production are also among the ones reflecting the best productivity. When the input in each reporting period is not uniform, however, or when the reporting periods with the highest production happen to be heavily impacted, Thomas’s approach may be unable to determine a viable baseline, or may generate a baseline that includes significant productivity loss. This could create too conservative results from the claimant’s perspective, resulting in the failure to capture the true amount of lost labor productivity. In addition, Professor Thomas’s procedure has also been criticized for the subjectivity of selecting only a 10 percent size for the baseline set, which may be considered too small a sample.

### Gulezian and Samelian’s Control Chart–Based Method

Gulezian and Samelian have proposed another statistical approach based on a “process control chart” for establishing a productivity baseline that reflects a contractor’s normal operating performance. Such a process control chart, using fairly standard statistical jargon, consists of:

1. Points representing a statistic of measurement in samples taken from the process at different times;
2. The statistical mean is then calculated using all the samples taken;
3. A center line is drawn at the value of the statistical mean;
4. Using all the samples, the standard deviation of the statistical mean is then calculated;
5. The upper control limit (UCL) and lower control limit (LCL) are drawn, typically, at three standard deviations from the center line.

To use the process control chart to determine the productivity baseline, the metric on the vertical axis is called the “productivity value,” whereas the metric on the horizontal axis is called “time.” The individual productivity values in corresponding reporting periods are plotted on the chart to create a time-series plot of productivity values for corresponding reporting periods. Because a portion of the data points may fall outside of the control limits, they are eliminated and the process control chart is reapplied to reflect these removals, with a recalculated center line and control limits. This process repeats itself until no points fall above or below the control limits. This allows the mean productivity of the points falling within the control limits, after the last iteration is used, to define the baseline productivity level.

This method also may result, however, in a very conservative baseline that may not reflect the attainable sustained productivity, especially when the disruptions are pervasive, significantly diminishing the value of productivity loss claim. When the majority of the data points occur in periods of disruption, this method will not likely determine the baseline because all the data points may fall within the control limits.

### Ibbs and Liu’s K-Means Clustering Technique-Based Procedure

“K-means clustering,” adopted by Ibbs and Liu, is a method of cluster analysis that seeks to group observations into “K clusters” in which each observation belongs to the cluster with the nearest statistical mean. The avowed purpose of their technique was “to determine the reference period [of the measured mile and a variant, the baseline method] using objective criteria.” In other words, this method seeks to take the subjectivity out of the cost engineer’s analysis. According to the authors, “[i]ntroducing more objectivity into the claims resolution process will, in turn, help stem the rising costs of such [construction labor inefficiency] disputes because the litigating parties will have a more rational tool for evaluating the merits of their respective position in the dispute.” This article describes in detail both Zink’s measured mile approach and Thomas’s baseline method, going on to explain their new methodology of “statistical clustering.”

Succinctly put, their procedure contains the following steps:

1. Two cluster centers are established to reflect the highest and lowest productivity among all the reporting periods.
2. The distances to the two cluster centers are then calculated for each reporting period, and the reporting period is assigned to the cluster to which it is closer.
3. The statistical mean for each of the two cluster centers is calculated. If it is different from the cluster center, the cluster center is updated by it, and then go back to step 2; otherwise, go to step 4.
4. The cluster with the higher productivity is then the baseline set, and its cluster center is determined to be the baseline productivity.

By employing the K-means clustering technique, the productivity data can be divided into two clusters, highest and lowest, or good and bad. The good productivity cluster, which may not be continuous in time, is the baseline subset as determined by Ibbs and Liu’s method, and the statistical mean of the baseline subset is then selected as the baseline productivity. This method will always include the best reported productivity.
to Calculate Lost Construction Productivity.\(^{80}\)

The proposed approach for determining baseline productivity comprises the following general steps:

1. **Step 1: Segregate the data into the good productivity group (GPG) and the bad productivity group (BPG)** using the overall average productivity. In lost productivity claims, the establishment of the cause-and-effect relationship is one of the most important steps. The causal relationship between disruption and productivity governs the extent that lost productivity can be proven. It is generally accepted that with other conditions kept the same, the more severe the disruptions, the worse the productivity would be. The data points with good productivity are normally encountered when no disruptions or light disruptions are experienced. Therefore, it is reasonable to infer that the productivity observed in the periods without any assignable disruptions or with light disruptions should be better than the overall average productivity, the impacted and unimpacted combined.

2. **Step 2: Determine the baseline subset from the good productivity group using statistical techniques**, such as a modified control chart. The control chart technique is revised to use the average productivity as the center line instead of the arithmetic mean of the individual productivity values from different reporting periods, thus addressing the production differences among reporting periods. Concomitantly, project information is useful to refine the selection of the productivity baseline.\(^{81}\)

Zhao and Dungan’s IBM not only combines the advantages of the earlier methods, but also avoids their weaknesses. IBM does not require a continuous, unimpacted period for the baseline subset. The sample size of the baseline subset generated by the IBM is defined by the characteristics of the productivity data themselves, which is an improvement on the arbitrary percentage used in Thomas’s method. Further, the IBM eliminates extreme data points of the Ibb and Liu methodology that do not represent the contractor’s normal operating performance. Therefore, IBM provides a unique baseline productivity more reflective of the contractor’s normal operating performance without the need to subjectively eliminate data.

**Conclusion**

There is no question that a major component of construction damage claims involves the loss of labor productivity. Acceptance by courts and boards of a contractor’s right to recover for lost labor productivity/labor inefficiency is now well established. That being said, claimants seeking to recover damages for such claims should expect strong Daubert challenges to both the credentials and the results of their cost engineers’ analyses. There are no shortcuts available in coming up with factually sound, acceptable, and persuasive evaluations and quantifications of labor inefficiency claims. Contractors involved in large projects should review the way that they document labor productivity on their jobs to ensure that they will have accurate and detailed information at the disposal of cost engineers that they engage to prove lost labor productivity.

Cost experts, in turn, should use, where available, project-specific analyses. Only when either the circumstances of the particular construction project and/or the lack of appropriate documentation are at issue should they employ the less-reliable methodologies. Those other less-reliable methods might, however, be employed to corroborate the more-acceptable methodologies.

Over the last 30 years, a welter of peer-reviewed articles have been published describing various techniques and showing the evolution of these techniques with which any cost engineer who is engaged as an expert should be familiar. It is to be expected that this body of knowledge will continue to grow and that techniques will become more refined, and, potentially, more objective and reliable. Claimants and opponents of such claims and their counsel will need to keep abreast of these developments.\(^{34}\)

**Endnotes**


\(^{34}\)
Eng’g, no. 4, 1992, at 11 (1992). It is also important to note that, while damages on a project may often be caused by delays, damages for delay and for lost efficiency are not the same, and, where the contract language permits, both types of damages may be recoverable. U.S. Indus., Inc. v. Blake Constr. Co., 671 F.2d 539 (D.C. Cir. 1982) (specifically holding that the two were distinguishable and there could be a recovery for both, provided that there was no double recovery.) See also Bell BCI Co. v. United States, 72 Fed. Cl. 164, 165 (2006), aff’d in part and rev’d in part, 570 F.3d 1337 (Fed. Cir. 2009). As such, no damages for delay (“No D for D”) clauses do not ordinarily apply to lost productivity claims.


5. Id.


7. Id. at 12.


10. See, e.g., Parson-UXB Joint Venture, A.S.B.C.A. No. 56481, 12-1 B.C.A. (CCH) ¶ 34,919 (granting a Daubert motion to strike the testimony of the government’s expert); Reflectone, A.S.B.C.A. No. 42363, 98-2 B.C.A. (CCH) ¶ 29,869 (casting aspersions on both the government’s and the claimant’s experts on Daubert grounds, though, nevertheless, considering the testimony of the experts on their merits).


12. Id. (emphasis added; language in brackets added).

13. Id. (emphasis added).


15. Id. at 300 (emphasis added).

16. Id. at 591.


18. Dwight Zink, The Measured Mile: Proving Construction Inefficiency Costs, 28 Cost Eng’t, no. 4, Apr. 1986, at 19. At the time of this article, Mr. Zink, a civil engineering graduate of Villanova University, was a vice president for management services at Hill International.


20. In this connection, see In re Electric Machinery Enterprises, Inc. v. The Hunt Construction Group et al., 416 B.R. 801 (S.D. Fla. 2009), to be discussed infra.


22. Zhao & Dungan, supra note 6, at 12.

23. 671 F.2d 539 (D.C. Cir. 1982).

24. Zink, supra note 18.


26. 671 F.2d 539.


29. Id. (emphasis added; bracketed language added).


31. Id.

32. 81 Fed. Cl. 617 (2008), aff’d in part, rev’d in part on other grounds, 570 F.3d 1337 (2009).

33. Id.

34. 938 A.2d 474 (Pa. Commw. 2007).

35. Id. at 495.

36. See also United States ex rel. Greenmooor, Inc. v. Travelers Cas. & Sur. Co. of Am., 2009 U.S. Dist. LEXIS 113153 (W.D. Pa. Dec. 4, 2009) (wherein a subcontractor sought to recover lost labor productivity damages). The magistrate judge from the Western District of Pennsylvania stated: As this Court previously explained in connection with its ruling on the admissibility of [the] expert testimony relative to Burchick’s administrative cost claim, the “measured mile” approach is a method for calculating decreased productivity, or a loss of labor productivity, on a given project by comparing “identical activities on impacted and non-impacted sections of the project in order to ascertain the loss of productivity resulting from the impact.” W. Schwartzkopf & J. McNamara, Calculating Construction Damages 64 (2001). Fundamental to the application of this methodology is the calculation of “labor productivity ratios,” which is derived by dividing the actual amount of hours on the activity being compared and the actual quantities of work performed on that activity. Id. at *192–93.

After a careful review of the expert’s analysis, however, the Greenmooor court found the measured mile wanting for failing to do the proper comparison of the unimpacted and impacted periods, to link up the purported cause and effect of the impacts, and to account for the subcontractor’s own inefficiencies.


38. Id.


40. Id.

41. 416 B.R. 801 (S.D. Fla. 2009).

42. E.N.G.B.C.A. Nos. 6348, 6386–6391, 00-2 B.C.A. (CCH) ¶ 31,000.

43. Id.

44. Id.

45. Id.

46. Id.

47. Id.

48. Id. (emphasis added; bracketed language added).

49. Id.


51. Id. at 147–48.

52. Id. at 150.


54. As the U.S. Court of Federal Claims stated in Alost v. United States, 73 Fed. Cl. 480, 504 (2006): Rule 702 provides that an expert may testify in the form of an opinion if: (1) the testimony is based on sufficient facts or data; (2) the testimony is the product of reliable principles and methods; and (3) the expert applied the principles and methods reliably to the facts of the case. Daubert also provides several factors to determine whether expert testimony is admissible: (1) whether the expert’s theory or technique can be tested; (2) whether the expert’s theory or technique has been subjected to peer review; (3) the rate of error for the theory or technique; and (4) whether the theory or technique is generally accepted in the scientific community. *505 509 U.S. at 593–595, 113...
Interestingly, though the court in this instance found the expert’s analysis wanting, it admitted the testimony anyway for its “weight.”


57. 67 Fed. Cl. 124.

58. As noted in In re Electric Machinery Enterprises, Inc. v. The Hunt Construction Group, 416 B.R. 801 (S.D. Fla. 2009), the prime contractor sought unsuccessfully to undermine a subcontractor’s modified total cost claim by asserting that the contractor could and should have done a measured mile analysis in lieu thereof.


60. See Zink, supra note 18.

61. Ronald Gulezian & Frederic Samelian, Baseline Determination in Construction Labor Productivity-Loss Claims, 19 J. MGMT. EN’G 160 (2003). At the time, Mr. Gulezian was a lecturer in statistics at the Wharton School of the University of Pennsylvania and Mr. Samelian was a senior vice president of Hill International, Inc.

62. H. Randolph Thomas, R. Edward Minchin Jr. & Dong Chen, The Role of Workforce Management in Bridge Superstructure Labor Productivity, 19 J. MGMT. EN’G’G 9 (2003). At the time, Professor Thomas was a professor of civil engineering at Penn State University, Professor Minchin was an assistant professor of engineering at the University of Florida, and Mr. Chen was a graduate research assistant at Iowa State University.

63. H. Randolph Thomas & Victor E. Sanvido, Role of the Fabricator in Labor Productivity, 126 J. CONSTR. ENG’G & MGMT. 358 (2000). See supra note 61 for the credentials of Professor Thomas. Professor Sanvido was a professor of architectural engineering at Penn State University at the time of this article.

64. H. Randolph Thomas, David R. Riley & Victor E. Sanvido, Loss of Labor Productivity Due to Delivery Methods and Weather, 125 J. CONSTR. ENG’G & MGMT. 39 (1999).

65. William Ibbs & Min Liu, Improved Measured Mile Analysis Technique, 131 J. CONSTR. ENG’G & MGMT. 1249 (May 2005). At the time, Professor Ibbs was a professor of construction management at the University of California at Berkeley and Mr. Liu was a doctoral student at the University of California at Berkeley.

66. Tong Zhao & J. Mark Dungan, Improved Baseline Method to Calculate Lost Construction Productivity, 140 J. Constr. Eng’g & Mgmt. (Feb. 2014) [hereinafter Zhao & Dungan, IBM].

67. Zink, supra note 18.

68. Id. at 21–22.

69. See supra notes 61–66.


71. See Gulezian & Samelian, supra note 61.

72. See Ibbs & Liu, supra note 65.

73. Id. at 1251–52.

74. Id. at 1249–50.

75. Id.

76. Id. at 1250–52.

77. Id. at 1255.

78. See Zhao & Dungan, IBM, supra note 66, at 06013006-3.

79. Id.

80. Id.

81. Id. at 06013006-2.