The quantification of loss caused by disruption: How applicable is the measured mile method?

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This article examines the measured mile method to estimate loss caused by disruption to the progress of a construction project by providing an overview of the operation of the methodology, a literature and case law review, and provides guidance on how a measured mile analysis should be conducted.

INTRODUCTION

This article examines the measured mile method, which is used to estimate loss of productivity due to an impact on the progress of a construction project. Although the measured mile concept is relatively simple, it is arguably misunderstood.

Analysis of case law, texts and journal articles shows that, although the measured mile is not always used appropriately, a major issue may also be one of application, for example, a disruption analyst’s use of the measured mile is sometimes flawed, and/or the methodology is not being used as effectively as it could be.

What is the measured mile method?

The Society of Construction Law’s Delay and Disruption Protocol (SCL Protocol) states: 1

1.19.7 … The most appropriate way to establish disruption is to apply a technique known as the “measured mile”. This compares the productivity on an unimpacted part of the contract with that achieved on the impacted part. Such a comparison factors out issues concerning unrealistic schedules and inefficient working. The comparison can be made on the man-hours expended, or the units of work performed …

In Clark Concrete Contractors Inc v General Services Administration, 2 the court said that:

[A] measured mile analysis compares work performed in one period not impacted by events causing loss of productivity with the same, or comparable work performed in another period that was impacted by productivity-affected events.

The difference is taken “to be the loss associated with the disruption and is used to calculate loss of productivity”. 3 The loss of productivity is calculated in labour-hours, which in turn are multiplied by the labour rate to obtain the cost of the loss of productivity. 4

Delay and disruption: The distinction

Delay and disruption are often treated as being the same thing. 5 However, they are different 6 and should therefore be distinguished.

In Bell BCI Company v United States, 7 the court defined the terms:

1 FRICS, FCIArb, Chartered Arbitrator, Manager, Dispute Services, Aquenta Consulting, Brisbane, Australia. This article is adapted from an LLM dissertation undertaken at the University of Salford Law School, Manchester, England.

2 Clark Concrete Contractors Inc v General Services Administration 99-1 BCA P 30280 (1999).


4 Ibbs, n 3.


6 Society of Construction Law, n 1.

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There is a distinction between (1) a “delay” claim and (2) “disruption” or cumulative impact claim. Although the two claim types often arise together in the same project, a “delay” claim captures the time and cost of not being able to work, while a “disruption” claim captures the cost of working less efficiently than planned.

The SCL Protocol further distinguishes delay and disruption as follows:8

1.19.1 Disruption (as distinct from delay) is disturbance, hindrance or interruption to a contractor’s normal working methods, resulting in lower efficiency. If caused by the Employer, it may give rise to a right to compensation either under the contract or as a breach of contract.

1.19.2 Disruption is often treated by the construction industry as if it were the same thing as delay. It is commonly spoken of together with delay, as in “delay and disruption”. Delay and disruption are two separate things. They have their normal everyday meanings. Delay is lateness (eg delayed completion equals late completion). Disruption is loss of productivity, disturbance, hindrance or interruption of progress. In the construction context, disrupted work is often work that is carried out less efficiently than it would have been had it not been for the cause of disruption.

1.19.3 Disruption to construction work may lead to late completion of the work, but not necessarily so. It is possible for work to be disrupted and for the contract still to finish by the contract completion date. In this situation, [C] will not have a claim for an EOT, but it may have a claim for the cost of the reduced efficiency of its workforce.

In summary, therefore, delay is time-related and disruption is productivity-related. However, delay may cause disruption, disruption may cause delay, and both may occur at the same time.9

Causes of disruption

The SCL Protocol states that:

[T]he most common causes of disruption are loss of job rhythm (caused by, for example, premature moves between activities, out of sequence working and repeated learning cycles), work area congestion caused by stacking of trades, increase in size of gangs and increase in length or number of shifts. But these are also symptoms of poor site management.10

However, the AACE11 goes further and attempts to identify factors that cause and/or contribute to loss of productivity, as follows:

Absenteesism; Acceleration (directed, or constructive); Adverse, or unusually severe, weather; Availability of skilled labour; Variations, ripple impact, cumulative impact of multiple changes and rework; Competition for labour; Labour turnover; Crowding of labour, or trade stacking; Defective engineering, engineering recycle, or rework; Dilution of supervision; Excessive overtime; Failure to coordinate trade contractors, subcontractors, or vendors; Fatigue; Labour relations and labour management factors; Learning curve; Material, tools and equipment shortages; Over-manning; Poor morale of labour; Project management factors; Out-of-sequence work; Rework and errors; Schedule compression; Site, or work area access restrictions; Site conditions; and Untimely approvals or responses.

Entitlement to payment for “loss caused by disruption”

A contractor that has suffered loss caused by disruption may have an entitlement to claim payment for that loss either under the contract and/or as common law damages, sometimes referred to as general damages. A contractor must prove liability, causation and loss or expense suffered.

This article does not deal with issues of entitlement, but instead focuses on the quantification of financial loss due to loss of productivity, and whether and to what extent the measured mile method is appropriate to calculate such loss. In addition, as a result of the literature and case law reviewed, this article also covers the correct usage of the measured mile methodology.

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8 Society of Construction Law, n 1, pp 31, 32.
9 Society of Construction Law, n 1.
10 Society of Construction Law, n 1, p 32.
Methods of calculating loss of productivity

There are several methods of calculating loss of productivity which include “actual costs, total and modified total cost, project comparison studies, specialty industry studies, general industry studies and the measured mile”. Ibbs says that system dynamic modelling and earned value analysis may also be used to calculate such loss.

However, the measured mile is considered to be the most robust and reliable method because, compared to the other methods, as well as being based on contemporaneous project documentation and knowledge from the project, it calculates loss of productivity due to the “actual effect of alleged impact and thereby eliminates disputes over the validity of cost estimates, or factors that may have impacted productivity due to no fault of the owner”.

LITERATURE AND CASE LAW REVIEW

This section is divided into the following:

• literature review;
• case law review; and
• how the measured mile analysis should be conducted.

Literature review

This literature review is concerned with ascertaining the extent to which the measured mile is appropriate and/or is being used correctly/most effectively in calculating loss caused by disruption – disruption being a reduction in productivity that results in an increase of cost in carrying out the work.

A type of damage often alleged on construction projects is loss of labour productivity. A method to assess that loss is by using the measured mile methodology. Ibbs says that “problems exist with the measured mile approach, however, because the guidelines for developing and applying it are unclear”. The guidelines provided by Ibbs have been followed and expanded on in the section below entitled “How the measured mile analysis should be conducted”.

Productivity

If productivity is impacted, labour costs in all probability will increase. Even though labour effort and project programme are related, the courts consider that loss of productivity damages is not the same as programme delay damages and therefore form a separate category of recoverable damages.

12 AACE International, n 11.
14 AACE International, n 11.
16 Pickavance K, Delay and Disruption in Construction (3rd ed, Sweet and Maxwell, 2005) at [1.25], [10].
17 Ibbs, n 3.
18 Ibid, n 3.
19 Ibid, n 3.
21 Ibid, n 3.
The problem

Even though legal precedent,22 writers23 and groups24 suggest that the measured mile is “the preferred method of calculating loss of productivity”, it is not always appropriate.25 Further, the success rate for loss of productivity claims is low as “there is no rigorous methodology” to calculate damages or for applying the measured mile.26

Measured mile analysis

In his paper in 1986, Zinc introduced the concept of a measured mile which compares productivity during an unimpacted period of work to productivity during an impacted period.27 Schwartzkopf and McNamara28 say that:

The most widely accepted method of calculating lost labor productivity is known throughout the industry as the “measured mile” calculation. This calculation compares identical activities on impacted and nonimpacted sections of the project in order to ascertain the loss of productivity resulting from the impact...

The SCL Protocol states: “The most appropriate way to establish disruption is to apply a technique known as the measured mile…”29 However, Schwartzkopf and McNamara30 also point out a weakness in the measured mile:

On highly troubled projects, however, it may be impossible to segregate one period of performance that was not impacted. Even if a nonimpacted period is available for comparison with the impacted period, it may be that wholly different types of work were performed during the two periods making the measured mile calculation impractical or inaccurate...

The dilemma, then, is to know when the measured mile is appropriate. By way of some guidance, in Re Lamb Engineering & Construction31 (Lamb Engineering) the board emphasised that the measured mile approach is most effective when the impacted and non-impacted periods being compared are similar, are part of the same contract/project and close in time so that like is compared with like. However, disruption very often does not occur like this.32

It therefore appears inappropriate to use a measured mile analysis if there is no unimpacted period, if the unimpacted period is too short, or for complex projects.33

Gulezian and Samelian34 also say that the measured mile may not show the actual productivity of a contractor because successive cumulative data has a “smoothing effect”. Professor Thomas argues, however, that cumulative data should not be used and that a “unit rate” should be used instead.35

23 Schwartzkopf and McNamara, n 15.
24 Society of Construction Law, n 1.
25 Schwartzkopf and McNamara, n 15.
28 Schwartzkopf and McNamara, n 15.
29 Society of Construction Law, n 1.
30 Schwartzkopf and McNamara, n 15.
32 Schwartzkopf and McNamara, n 15.
Partly, or totally, as a result of the above-mentioned problems, and other problems that are covered later in this section, some quantum experts are not using the measured mile methodology correctly. For example, in Daewoo Engineering & Construction Ltd v US, the court rejected the expert’s measured mile analysis and considered that the presumed efficiency regarding the impacted period was neither substantiated nor justified and that Daewoo’s expert was “less than truthful”.

In Appeal of JA Jones Construction, the tribunal also rejected the quantum expert’s evidence because the expert made “no attempt to isolate specific impacts allegedly caused by changes” and “the methodology used by the expert does not consider the nature of any specific changes or what locations/areas and work they directly affected on the project.”

The measured mile was also found to be inappropriate in Southern Comfort Builders Inc v US, in which a baseline, i.e., the measured mile, was calculated using the production rates of another contractor on the same project. The court said:

Based on the information presented, this court cannot adopt [the plaintiff’s] … analysis to support [its] calculation of damages. [The plaintiff’s] … calculation is deficient in that it does not adequately represent a comparison between the plaintiff’s unimpacted work with an impacted period.

The measured mile method is more appropriate in such cases if the projects being analysed are similar.

However, if used correctly, the measured mile method can be appropriate where similar work is carried out at different times, maybe even on a different project. The calculation remains the same but the impacted activity and the measured mile may not be on the same activity, close in time, or even not on the same project.

In summary, disruption analysts are using the measured mile method to quantify loss caused by disruption in a variety of ways with varying degrees of success in the courts. From the above literature review, the main reasons appear to be that the measured mile is not always appropriate for the circumstances in which it is being used, together with analysts not using the method in the most effective manner.

Case law review

In the following cases, the use of the measured mile method has been considered in some detail. Each case is worthy of separate review because of the issues dealt with, and the comments made in the judgment. Most of the case law considered below is from the US, simply because the US has by far the greatest amount of case law and also the majority of publications dealing with both productivity and more specifically the measured mile. Starting with the oldest case first:

Maryland Sanitary Manufacturing v US

In Maryland, the claim was for US$30,152.95 and the court awarded half the claimed amount. Although the words “measured mile method” were not specifically referred to in the judgment, the methodology used by the plaintiff was based on the measured mile principles. Maryland claimed for loss of productivity during a period in which its labour worked 12 hours per day, seven days per week. This unimpacted period was compared with a period immediately following the 12 hours per day, seven days per week period, i.e., the impacted period.

Maryland manufactured shells. The shells produced during the 12 hours per day, seven days per week period cost Maryland US$7.5534 each to produce. During the period thereafter, when

37 Appeal of JA Jones Construction 00-2 BCA P 31000 (2000).
39 Schwartzkopf and McNamara, n 15.
40 AACE International, n 11.
41 Maryland Sanitary Manufacturing v US 119 Ct Cl 100 (1951); Appeal of Clark Construction Group Inc 00-1 BCA P 30870 (2000).
42 Maryland Sanitary Manufacturing v US 119 Ct Cl 100 (1951).
Maryland’s labour worked 10 hours per day, six days per week, the production of each shell cost US$5.918 each, ie US$1.6354 less per shell. Maryland calculated its additional costs on a labour and material basis, and not just a labour basis. However, the cost of materials during the periods being compared was uncertain and the fact the work was being “closed out” during the lower cost period led to lower costs of production.

Notwithstanding these complications, the court acknowledged that efficiency would be impaired by working a 12 hour day, seven days per week. The court also considered a government study that was introduced in evidence. This showed that efficiency was reduced by about 20% as a result of extending the workday to 10 hours and the working week from five to six days.

In spite of the lack of certainty in Maryland’s evidence, the court was convinced that Maryland incurred increased costs of at least half the amount claimed owing to labour inefficiency because of the increased work day and work week. However, owing to the uncertainty in Maryland’s calculations, the court awarded half the amount claimed.

Therefore, notwithstanding that the evidence presented by Maryland was uncertain, it appears that the court was persuaded partly by a comparison of productivity during the impacted and unimpacted periods and partly by a government study, that Maryland suffered loss of productivity caused by the client. On the basis of Maryland’s uncertain calculations and the government study, the court was persuaded that Maryland had suffered at least half the loss that it claimed. The court therefore awarded half the amount claimed by Maryland.

Comment
Maryland was able to demonstrate that it was entitled to payment for loss of productivity. However, its calculations were uncertain, which in turn may have led the court to err on the side of caution and, even though Maryland was awarded some payment for its loss, if its calculations had been more “certain”, Maryland might have been able to demonstrate an entitlement to an amount in excess of that awarded by the court.

Luria Brothers v US
In Luria Brothers,43 the claimant, Luria Brothers, followed the measured mile principles and the court supported the use of adjusted productivity rates.

The court permitted an expert to adjust productivity rates to allow for differences between the impacted and unimpacted periods being compared. However, the court said that the adjustments made had to be reasoned and substantiated.

Luria Brothers’ expert did not reason or substantiate the adjustments he made to the productivity rates. As a result, the court reduced the productivity rates used by the expert to a level which was within the court’s knowledge and experience.

Comment
Although the expert’s lack of reasons or substantiation did not prove fatal to the claim, their absence probably proved to be detrimental to the amount recoverable. It is therefore necessary for an analyst making adjustments to productivity rates to reason and substantiate the adjustments made.

EC Ernst Inc v Koppers Inc
In EC Ernst,44 the court rejected the expert’s productivity analysis, which considered that the cause of the loss of productivity was a high number of drawing revisions. The expert calculated the number of drawing revisions in each year over a three-year period and then conducted a pro-rata exercise to determine the cost of loss of productivity.

The court said that the expert’s analysis was invalid because not all drawings required work to be carried out. The drawing revisions did not require an equal amount of work and the expert’s methodology was artificial and hypothetical and was “not a proper substitute for a calculation based on historical expenditure [on] labor”.

43 Luria Brothers v US 177 Ct Cl 676 (1966).
44 EC Ernst Inc v Koppers Inc 626 F2d 324 (1980).
Comment

An expert’s analysis may therefore be invalid if the methodology used to calculate loss of productivity is “artificial and hypothetical”, for example as in EC Ernst, using the number of drawing revisions each year and then conducting a pro-rata exercise based purely on the number of drawing revisions to determine loss of productivity.

**Lamb Engineering**

In *Lamb Engineering*, the Board of Appeals emphasised that the measured mile method “is most effective when” the unimpacted and impacted periods being compared “are close in time, involve similar types of work, and occur in the same contract”. So that like could be compared with like, the board allowed the measured mile, ie the unimpacted period, to be corrected. Documents were used to substantiate corrections to scraper cycle times to reflect different site conditions encountered during the impacted and unimpacted periods.

The measured mile used by the expert was based on actual records of the productivity of one scraper for six days. The scraper operator kept records of the number of hours of operation and the number of cycles (cut and fill) completed by the scraper each day. The scraper carried out between 8.35 and 12.91 cycles per day at an average of 5.44 minutes per cycle. The site conditions varied between the impacted and unimpacted periods being compared, the site conditions during the impacted period being more difficult. The expert adjusted the cycle times during the unimpacted period down by one minute per cycle. This had the effect of increasing productivity by 20%, which made the difference between the impacted and unimpacted periods greater. The expert then used the topographic and grading drawings to calculate the amount of material “stripped” and “cut and filled” to arrive at a number of hours for each phase as anticipated, ie the number of hours the work should have taken.

The expert then prepared a separate composite hourly rate for each of the operations as planned, drawing from actual cost records, and multiplied the calculated number of hours for each phase by the relevant composite rate to arrive at a “but for” cost for each. He testified that the “but for” cost for the cut and fill operations was $94,795.

The board in this case said that the expert appeared to have been thorough in gathering and allocating data necessary for his calculations and concluded that the measured mile process followed was “essentially sound”.

**Comment**

On the basis of the decision in *Lamb Engineering*, which follows *Luria Brothers*, it is appropriate for the analyst to adjust the data to ensure that like is being compared with like – in *Lamb Engineering*, this being adjustments made to reflect differing ground conditions impacting on scraper cycle times. Unlike the expert in *Luria Brothers*, the expert in *Lamb Engineering* reasoned and substantiated the adjustments made.

**Appeal of Centex Bateson Construction**

In this case, it was necessary for the Board of Contract Appeals to abstract the likely effect of other causes of loss of productivity. It then accepted that the expert’s analysis of productivity was representative of the impact of events for which it claimed.

**Comment**

Following *Centex Bateson*, the analyst carrying out the measured mile analysis must take out the causes of loss of productivity to which the contractor is not entitled. If not, the analysis will be flawed.

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Clark Concrete Contractors Inc v General Services Administration

In this case 48 a subcontractor’s progress of work was disrupted because of additional concrete work, failure to respond to requests for information on time, and an inexperienced engineer.

The board considered that the government was correct in that the work carried out by Clark during the impacted and unimpacted periods was not identical. However, the court stated that it would be “surprised to learn that work performed in periods being compared is ever identical on a construction project”. The board considered that the works being compared do not need to be identical because the calculation of damages for labour inefficiency is “not susceptible to absolute correctness”. The board said that it would accept a comparison if it were “between kinds of work which are reasonably alike, such that the approximations it involves will be meaningful”.

The board therefore accepted the disruption analyst’s use of the impacted periods. One was “severely” impacted and the other was “moderately” impacted. However, the court did not accept the expert’s calculation of the adjusted unimpacted productivity rate as he did not sufficiently corroborate the adjustment made.

Comment

Following Luria Brothers and Lamb Engineering, the analyst should explain and corroborate any adjustments made, but does not need to ensure that the periods being compared are identical.

Appeal of Clark Construction Group Inc

In this case, 49 Clark Construction, also acting on behalf of its subcontractor PKC, claimed loss of labour productivity on a complex plumbing and mechanical installation in a hospital. As a result of an instruction, the work had to be re-sequenced from a horizontal to a vertical construction methodology. PKC used three methods to calculate loss of labour productivity: the measured mile analysis, MCAA method and modified total cost. The disruption analysis applies only to the PKC portion of the claim.

The analyses compared productivity rates for installation of four piping systems (domestic water, interstitial heating hot water, medical gas cast iron drain, waste and vent) on the first floor with the installation productivity rates for sixth or seventh floors of the main hospital structure.

PKC also compared the underground piping work for the hospital with the underground work for the adjacent nursing home on which PKC was the mechanical subcontractor for the project. The underslab utility work for the nursing home was similar to, although less complicated or extensive than, the work on the project on which disruption loss was claimed.

The underground piping analysis compared productivity rates for installation of such work with rates for installation of underground piping in the nursing home, immediately adjacent to the main hospital building. This comparison was made because of the proximity of the buildings and also because the nursing home underground piping installation was not impacted. Overall, however, there was no unimpacted area or time on the disrupted project to establish a baseline for the measured mile analysis; therefore, PKC used a lesser-impacted area (sixth and seventh floors) as the baseline.

For the heating hot water piping system, PKC’s expert compared the first and sixth floors because he found that PKC had improperly coded its seventh floor work, thus preventing him from determining the number of man-hours actually expended to install the heating hot water system on that floor. PKC’s expert also “adjusted” the first floor actual man-day per lineal foot rates. The adjustment was made because the installations on the first floor involved more and larger pipes and fittings and the adjustment was necessary, in his view, for accurate comparison of productivity rates between the floors. PKC’s expert determined a percentage inefficiency factor for the first floor installations by dividing the difference of the lineal feet/man-day productivity rate between the first and sixth or seventh floor by the sixth or seventh floor productivity rate. The underslab utility inefficiency factor was determined by applying the same methodology as that used for arriving at the inefficiency factor

49 Appeal of Clark Construction Group Inc 00-1 BCA P 30870 (2000).
in the main hospital and comparing this to the rates for the nursing home. Adjustments to the nursing home productivity rate were made in reaching the underground piping inefficiency factor.

The overall estimated productivity loss was 44,500 man-hours.

Clark Construction’s expert considered that the systems and the floors included in PKC’s measured mile analysis presented a “representative slice” of the disputed project and that it was valid to apply the analysis to ascertain an overall project loss of productivity.

The government’s expert considered however, among other things, that Clark Construction’s use of average estimated productivity rates for a particular piping system where there were wide differences indicated for various parts of each floor would not provide an accurate result because of the variance in planned productivity rates for the same work. He also found that acknowledged coding errors brought into question the validity of the analysis since accurate reporting by PKC of the actual expended labour hours was essential for a valid report.

The court said that PKC approached the three analyses using total incurred labour hours or costs as the starting point and that to some degree, each of the three methodologies was a variant on a total cost claim.

The court decided against PKC’s use of the measured mile and preferred to use the productivity factors from the MCAA Manual instead, ie a speciality industry study.

Comment
There was sufficient evidence to persuade the court that there had been loss of labour productivity. However, owing to PKC’s total cost approach to using the measured mile analysis, the court preferred PKC’s use of productivity rates from the MCAA Manual. The total cost approach to the use of the measured mile method made the analysis unreliable and it was therefore rejected.

Appeals of JA Jones Construction
In this case, JA Jones claimed that its total labour costs were increased by about 28-29% because of the “cumulative impact” of disruptive changes on the contract work. To prove entitlement, JA Jones’ expert prepared a computerised measured mile analysis.

The court said that JA Jones’ expert did not conduct a cause and effect analysis and did not try to identify and separate out the specific disruptive effects caused by the changes. The court also said that the expert’s approach made no attempt to rely on a detailed knowledge of the project and that he failed to consider specific changes, and what locations or work activities they affected. Further, the court said that the expert’s analysis failed to consider when the changes were ordered or whether the contractor had sufficient notice and was able to carry out the changes effectively.

The court agreed with the government’s expert that JA Jones’ expert should have made a comprehensive attempt, on the basis of a careful examination of the project records, to relate alleged labour inefficiency impacts to the causes of the impacts. The court considered that it was not enough to casually dismiss the need for an analysis of causation as unfeasible and simply assign any productivity losses to “cumulative impact”.

With regard to causation, the court did not consider that JA Jones’ expert’s methodology proved that other non-compensable causes did not contribute to productivity losses. In this regard, in a document entitled “Matewan Postmortem”, JA Jones had placed most of the blame for cost overruns on the project itself. In that document, JA Jones admitted that increased costs and inefficiencies were caused, among other reasons, by the high turnover of supervisory personnel, a bid that underestimated key work items and failed to consider fully the nature of the work site, as well as unreasonable, “overly aggressive” productivity estimates. In fact, the court emphasised that the “Postmortem” even noted that key productivity rates on the project were better than those achieved on a similar but much less complex job.

The court agreed with the government expert’s observations that JA Jones’ expert’s methodology “produced patently illogical results”. For example, JA Jones’ expert allowed a single impacted day for

50 Appeal of JA Jones Construction 00-2 BCA P 31000 (2000).
a single worker to be the determining factor in whether an entire month of productivity data for an entire crew was considered to be impacted or unimpacted. Moreover, the court considered that the method of apportioning the data resulted in the work of many crews being placed in the impacted category, even though those crews did not have even one recorded impacted day. The court said that “we consider that the Appellant’s sterile, formulaic approach has failed to isolate a realistic, normal/base period or identify impacted periods for comparison” and that JA Jones “has failed to prove that it is entitled to additional compensation in excess of the ‘direct’ costs it has already been paid for compensable changes”.

Comment
Following the judgment in JA Jones, it is necessary for the analyst to ensure that the analysis is not subjective and is clearly explained. The analyst should account for factors which contribute to loss of productivity for which the contractor does not have an entitlement to payment for loss. Further, it is necessary to carry out a cause-and-effect analysis and correct the contractor’s cost accounts if they overstate the costs incurred. The analyst should not rely on a one-day, and possibly non-representative, impact to conclude that the entire month was or was not impacted, especially if other documents demonstrate that cost overrun was caused by the contractor, high turnover of staff and optimistic productivity estimates.

PW Construction Inc v US
In PW Construction, the evidence showed that butt-welding on polyethylene pipes took between 15 seconds and two minutes per weld, and steel welding took up to 2.69 hours per weld. PW Construction’s expert omitted both sets of welding, plus trenching work from the period prior to disruption, but left them in for the “post-disruption” period.

As a result of the deletion of the welding work from the “pre-disruption” period, the measured mile was rejected by the court because the impacted and unimpacted periods were not comparable.

Comment
It is therefore necessary, when comparing the impacted and unimpacted periods, that like is compared with like, ie that the comparison periods are the same or substantially similar, and that adjustments made to one period are reflected in the other period.

PJ Dick Inc v Principi
In this case there were design deficiencies during the entire electrical installation. As a result, there was irregular work-flow, constructive acceleration and impacted labour productivity.

PJ Dick was contracted to build an extension to a medical facility. The electrical work was subcontracted to KES. PJ Dick said that the client’s electrical design was incorrect and not complete, and as a result caused delays and inefficient working. The client ordered PJ Dick to accelerate, and, as a result, KES had to add resources and accelerate its work. PJ Dick paid KES and then made a claim to the client for the additional costs. PJ Dick’s expert adopted the measured mile method to calculate loss of productivity. He considered that the branch circuit installations had been impacted by design issues and accelerated work. He then reviewed other electrical installations and considered that the feeder circuit was sufficiently similar to the branch circuit, both installed using conduit and wire and installed by union electricians. However, the feeder circuits being analysed for productivity were longer vertical runs of larger diameter conduit which had no device installed.

PJ Dick’s expert compared the branch circuit installation with productivity on the feeder circuit installation before acceleration. The client’s expert objected to this comparison of work on the basis that the feeder circuit work was not the same as the branch work. However, the board held that a contractor could compare current work with similar work carried out by another crew. The board said

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 the loss of productivity”.

Comment

PJ Dick therefore followed the board decision in Clark Concrete Contractors in that, when comparing impacted and unimpacted periods, it is acceptable in principle for the disruption analyst to compare similar work carried out by another crew with the impacted period. It is not necessary for the work being compared to be identical.

Southern Comfort Builders Inc v US

In Southern Comfort Builders,53 the expert said that, because of the change orders, the measured mile method could not be used because the entire project was impacted due to late changes, acceleration and out-of-sequence working. The expert therefore prepared a measured mile using another contractor’s productivity rates. However, the court rejected the analysis and said that the expert’s analyses were flawed, in that the measured mile was not a proper comparison between the contractor’s impacted and unimpacted work.

Further, the expert’s measured mile approach calculated productivity loss using the measured mile at a higher amount than a total cost calculation and the expert said that a total cost calculation should be the “maximum amount a contractor could possibly receive”. The court considered the expert’s calculation to be a result of a flawed comparison with the subcontractor’s productivity rates.

Comment

It may therefore be inappropriate to conduct a measured mile analysis based on the productivity rate of a different contractor. However, it did not help that the expert undermined his own analysis by admitting that his measured mile analysis should not be more than a total cost calculation. The expert’s admission may not be entirely correct in this regard. It is possible for a contractor to legitimately claim more than it could in a total cost claim if the tender price, and assumed resources, are found to be in excess of that required to complete the work. However, this is not normally the case.

Daewoo Engineering and Construction Ltd v US

This case54 is a good example of a claim failing primarily owing to the incorrect use of methodology and unreliable evidence given by a less than truthful expert.

In Daewoo Engineering, the court rejected the expert’s view because his opinion was not substantiated or justified. The court said that it did not have confidence in the expert’s evidence because, during cross examination, it became apparent that the choice of impacted and unimpacted periods was “arbitrary at best. More likely they were chosen to achieve a pre-determined result.”

In this case, rain days for which the government was liable were, for the most part, used by Daewoo’s expert to determine government-caused delay. The expert then compared periods impacted by rain with periods not impacted by rain and calculated a factor of inefficiency. This factor was applied to the project to calculate total delay costs through completion of the contract.

However, the court said that it would “be particularly concerned to know how the experts picked periods of productive and non-productive construction for comparison” and that it:

[D]id not have such a level of confidence in plaintiff’s experts. Cross examination showed their choices of productive and non-productive periods to be arbitrary at best. More likely, they were chosen to achieve a pre-determined result. Mr Cotton testified that Exponent’s approach to this assignment bordered on the unprofessional. We agree for reasons that appear throughout this Opinion.

The court said that:

Daewoo’s case against the United States is wholly without merit; its claims are fraudulent. The Corps of
Engineers has been as conscientious, patient, and fair in its administration of this contract as Daewoo
has been demanding, unreasonable, and inept…

In its judgment, the court also said that:

Daewoo violated the False Claims Act by knowingly submitting false or fraudulent claims; Daewoo
violated the Contract Disputes Act through its submission of false or fraudulent claims with an intent to
deceive or mislead the government; and it attempted to practise fraud against the United States “in the
proof, statement, establishment, or allowance” of its claims.

Comment

In summary, it is necessary for the disruption analyst to substantiate and justify his opinions and not
just reach unsupported arbitrary opinions. This case also reinforces the need for the analyst to be
truthful when calculating and presenting a loss of productivity claim, or in fact, for any claim.

Summary

The main findings and the principles revealed from the above case law analysis have been used to
prepare the following section on how a measured mile analysis should be conducted. It is uncertain
whether these examples are typical of the industry as a whole; this article does not attempt to address
this issue. However, on the basis of the case law and literature reviewed, they are typical.

How the measured mile analysis should be conducted

This section identifies the appropriate use of the measured mile method to calculate loss caused by
disruption. Ibbs sets out four main headings by which he considers a measured mile analysis should be
conducted. These are:

1. Selecting the impacted period;
2. Selecting the measured mile/the unimpacted period;
3. Calculation of lost productivity; and
4. Presentation of analysis.

Because there is no presentation of the analysis in the manner which Ibbs envisages in his paper,
the first three headings are applicable to this article and will be used in the discussion of the use of
measured mile analysis.

Selecting the impacted period

The measured mile method compares actual labour performance during an impacted and unimpacted
period. Both these periods therefore need to be identified.

Productivity graph(s)

A measured mile analysis should associate loss of productivity with the cause of loss – there must be
a correlation. To achieve this, the analyst, having to identify the impacted periods, should prepare
graph(s) of productivity to identify the periods of disruption. A graph of the labour productivity for
each phase of the project should be plotted, which will show both the unimpacted and impacted
periods.

If there are no production records, it may be possible to estimate the percent complete of a project
to estimate the quantities in the unimpacted parts of the analysis. However, the percent complete
approach is unreliable because it is based on an estimate, or a guess.

65 Ibbs, n 3.
66 Thomas and Barnard, n 35, p 20.
67 Thomas and Barnard, n 35.
1249.
69 Thomas and Barnard, n 35, p 31.
70 Thomas and Barnard, n 35.

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However, to plot the productivity graph, if possible, the quantity of work per labour-hours as a measure of productivity should be used, or, if this is not possible, work per percent project complete.61

**Productivity calculation**

Once the impacted periods have been identified from the productivity graphs, the analyst should calculate productivity for periods in which there has been high production.62 This is because the calculation of productivity must be representative of what the contractor was able to achieve.

**Cause-and-effect analysis**

It is necessary to conduct a cause-and-effect analysis to establish a correlation between the loss of productivity and the alleged impact.63 When the productivity graph indicates a loss of productivity, the cause must be determined. There must be a correlation between the loss of productivity and the alleged cause.64 Thomas says that to conduct a cause-and-effect analysis one “will likely have to resort to many information sources, including interviews with managers, project engineers, and foremen, diaries, production records, and a review of photographs and other documents.”65

One of the biggest deficiencies typically identified in a measured mile analysis is a lack of a cause-and-effect analysis. Without a cause-and-effect analysis the measured mile analysis remains a largely unsubstantiated “global” analysis and will fail to demonstrate the most probable cause of the loss of productivity.

This task may be difficult where the measured mile analysis is being used. Essentially, a measured mile analysis is used where direct proof of loss is not available. In this situation the dispute decider is being asked to infer from the measured mile analysis that it is more probable than not that the contractor’s loss of productivity was caused by the client, or by an event for which the client is liable under the contract. However, if an inadequate cause-and-effect analysis is conducted so that the analysis gives rise to conflicting inferences of an equal degree of probability so that the choice between the inferences becomes a matter of conjecture, then the analysis will most probably fail. The measured mile analysis must give rise to a reasonable and definite inference.66

**Adjustments for non-compensable causes**

The analyst should make appropriate adjustments for non-compensable causes of loss of productivity and for the contractor’s own inefficiencies.67

**Selecting the measured mile/the unimpacted period**

**Continuous period of time**

Thomas defines the unimpacted/measured mile period as “a continuous period of time when labour productivity is unimpacted.”68 Even though there may be inefficiencies for which the contractor is responsible in the continuous unimpacted period, all client-caused impacts should not be included.69
Selection of similar work to impacted period

It will be necessary to identify an unimpacted period that is the same as or similar to the impacted disrupted period. It is important when comparing labour productivity that the tasks being compared are substantially similar. It is also necessary to ensure that workers in the unimpacted period have comparable skill levels to the workers in the impacted period; the work carried out should represent an attainable level of productivity; and the work should have been carried out in an environment similar to the work carried out in the impacted period.

Use of productivity graphs

To identify the unimpacted period, productivity graph(s) for the entire project period prepared to identify the impacted period(s) should be used, and the quantities of work installed during the unimpacted period (and impacted period) should be recorded. However, this data is rarely reported.

Adjustments/corrections

The analyst should consider and adjust productivity calculations as necessary to account for discrepancies between the impacted and unimpacted management and supervision, work hours, project programme, site logistics, weather conditions, and trades to carry out the work. These factors can change over time, i.e., from the unimpacted to the impacted period. The analyst should therefore also note and take into account that the work environment of a project changes as the project progresses and early phases can be very different from the later phases. The environment will change with more congestion, changes, subcontractors, etc. Therefore, using an unimpacted period at the start of a project to calculate loss of productivity at the end of a project is inappropriate.

Identification of workers

Workers with a similar level of skill and knowledge as those in the impacted period should be identified. The same or similar labour pool is desirable. Thomas gives the example that “if one crew is composed of five journeymen and five apprentices, it may not be comparable to a crew of two journeymen and eight apprentices even though the crew size of both is ten craftsmen”.

Separation of labour trades

If possible, the analyst should separate the loss of productivity by labour trade. This will provide a more accurate picture of which labour resources have and have not been impacted.

Owner-collected data

The analyst should use owner-collected data if it is available as it will be more difficult for the owner to rebut the contractor’s evidence if it is taken from owner-collected sources. Inevitably, however, much of the data will have to come from the contractor’s own records.

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71 Thomas and Barnard, n 35, p 18.
72 Thomas and Barnard, n 35.
73 Thomas and Barnard, n 35.
74 Zink, n 27; AACE International, n 11; Thomas, n 69; Re Bay Construction VABCA No 5594 (2002).
75 Thomas, n 69
76 Thomas and Barnard, n 35.
77 Thomas and Barnard, n 35, p 18.
78 Thomas and Barnard, n 35, p 18.
79 Appeal of Bay West 07-1 BCA P 33569 (2007).
The unimpacted period, the measured mile period, and unhindered productivity

The analyst should ensure that the unimpacted period used contains contractor-unhindered productivity. To do this, the analyst should identify and adjust as necessary for contractor-caused hindrances and will need to explain the adjustments.

However, the analyst may need to use conversion factors to allow for differences that may exist between impacted and unimpacted periods.

If measured mile productivity actual project data is not available – other sources

If it is not possible to calculate a measured mile using actual project data, it may be possible to use other sources of information, for example, to supplement the analysis using published industry estimating guides, productivity data from different projects constructed by the same contractor or by similar contractors, and/or cost as a percentage of completed work and/or earned value rates.

Calculation of lost productivity

Data testing

Data for productivity, change, progress etc must be tested. The accuracy of the data being used is critical to a reliable analysis. The analyst must therefore ensure that the data reported is correct, and if it is not, it should be corrected.

Productivity factors

Loss of productivity factors should be applied to just the disrupted labour. It may be necessary to combine tasks rather than just analysing each task individually. However, a primary reason for the measured mile analysis being rejected is that too many tasks are combined or that the combination is inappropriate.

Adjustments to be made

It is necessary to consider and if necessary make adjustments, for example, for the learning period in the early phases of the work, any labour-hours included in variations, and any loss not recoverable under the contract and the contractor’s own inefficiencies etc.

Actual costs vs “unit rate”

Actual costs on their own should not be used to calculate labour productivity. This is because costs can be affected by several factors, for example, labour costs may not be recorded in the correct cost
code, labour rates change, crew sizes fluctuate and crew functions may also change. Thomas advocates the use of the “unit rate” which he describes as “commodity items”, for example, square metres of partition wall, cubic metres of concrete and linear metres of pipe. The unit rate is contrasted with say square metres or cubic metres of floor, this being composed of several “commodity items”, therefore leading to a less reliable analysis than using the unit rate for the applicable items only.

Summary

A literature review and case law critical review has been presented and, on this basis, an assessment made of how a measured mile analysis should be conducted.

The measured mile method is one of various methods that can be used to calculate loss caused by disruption and is the method that is preferred by the courts. However, the measured mile is clearly not always appropriate. Further, as the literature review and case law analysis reveal, analysts/experts using the measured mile method are not always using the method in the most appropriate way.

Survey

Introduction

A questionnaire survey was conducted to gather information about the use of the measured mile method. Questionnaires were sent to the following professional groups:

1. experts;
2. judges, arbitrators and adjudicators;
3. lawyers, both solicitors and barristers;
4. those who work in the contract/legal department of contractor organisations; and
5. those who work in the legal/contract department of client organisations.

Responses to the questionnaire were collected from 16 June 2015 to 19 August 2015. The questions asked were:

- Question 1: What is your primary profession?
- Question 2: Have you dealt with claims that concern the quantification of loss caused by disruption to the progress of a construction project?
- Question 3: In respect of the matters in which you were involved, has the measured mile method been used to calculate loss caused by disruption?
- Question 4: In approximately what percentage of cases was the measured mile method used successfully?
- Question 5: If the measured mile has not been used successfully, why?
- Question 6: Would you like a copy of the results of this survey?

Summary of survey findings

There were 228 responses to the questionnaire. Of the 228 responses, 92% of the respondents said that they had dealt with loss caused by disruption.

Of those respondents who said they have dealt with, or have decided, issues in relation to disruption, 66% said that the measured mile has been used. However, the overall “success” rate is low, with 74% of the respondents saying that the measured mile was “successful” less than 50% of the time (43% citing success between 0-25% of the time and 31% citing success between 26-50% of the time).

The main cause of the low “success” rate is a lack of records (71% of the respondents). However, 52% said there was no unimpacted period to use as a baseline, 40% said the unimpacted period was too short and therefore not representative and 45% said the comparison periods were not comparable. Thirteen percent gave other reasons, which in most cases were an elaboration of their previous responses to the questionnaire. Further, a few of the additional reasons given tend to reinforce the

96 Thomas and Barnard, n 35, p 18.
97 Thomas and Barnard, n 35.
findings in the qualitative analysis section of this article, for example, the analyst was not qualified to use the measured mile method, which is a recurring theme in the case law analysis.

Based on the 228 responses received, the measured mile method is inappropriate more often than not. This finding forms the basis for recommended further research, which is set out earlier in this article.

It is not possible to determine from the survey responses whether the analyst used the measured mile methodology correctly, and/or in the most effective way. However, the survey questionnaire was not designed to obtain that information. If the measured mile is being used incorrectly, as the case law reflects, then this would suggest that the measured mile may be appropriate more often than this research suggests. However, there is no data on this point.

**CONCLUSION**

In general, because the measured mile method is the most accurate method to estimate loss of productivity, it is the preferred method. However, it is clear from the above analysis of court judgments and from the responses to the questionnaire survey, that the measured mile is inappropriate more often than not and/or is often being used less effectively than it could be. It is hoped that the above guidance will help.

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98 Ibbs, n 3.