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Quantifying disruption — The measured mile

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MUCH HAS been written about quantifying and evaluating a claim for loss of productivity but it still remains an elusive and altogether nebulous process that is difficult to identify and evaluate. The quantification of productivity is often criticised as being a process steeped more in the arts of supposition and illusion rather than reality. This may or may not be the case but it is difficult to refute the common allegation that quantifying disruption has traditionally involved far too much subjective opinion and broad assumption.

There are methodologies for quantifying claims for loss of productivity but none of these can be said to have received any significant endorsement from either the courts in the UK or from legal and technical commentators alike. It would be fair to say that the judiciary remains largely unimpressed by any single method of evaluation that purports to provide a systematic approach to quantifying disruption and has instead tended to treat every set of facts and method of analysis on its own merits.

Some of the more common methodologies used to quantify disruption include; system dynamics modelling, total cost claim or a modified total cost claim, earned value analysis, time and motion studies and productivity comparison, otherwise known as 'the measured mile'. All these methods have their own particular strengths and weaknesses and, under a given set of circumstances, it may be more appropriate to use a particular method over another. However, it is the measured mile technique that has recently gained credibility and support as an acceptable method of identifying, quantifying and evaluating lost production, particularly in the US where its use has been approved by the courts.

In the UK, the Society of Construction Law's *Delay and Disruption Protocol* 2002 also lends support to the measured mile analysis. The protocol guidance puts the matter as follows:

> *"The most appropriate way to establish disruption is to apply a technique known as the measured mile. This compares the productivity achieved on an un-impacted* [undisrupted] *part of the contract with that achieved on the impacted* [disrupted] *part. Such a comparison factors out issues concerning unrealistic programmes and inefficient working. The comparison can be made on the man-hours expenses or the units of work performed. However care must be exercised to compare like with like. For example, it would not be correct to compare work carried out in the learning curve part of an operation with work executed after that period."*

Given the support of the courts in the US and the endorsement of the Society of Construction Law in the UK, we are likely to see a growing awareness and use of the measured mile as a recognised and acceptable method of quantative disruption analysis.

A measured mile analysis

The intention of the process is to compare productivity during a period of a project that has been disrupted by an excusable event, i.e. the impacted period, to productivity during a period that was has not been subject to disruption, i.e. the unimpacted period. The measure of productivity in the unimpacted period is referred to as the measured mile and is used as the baseline period to analyse what the labour productivity should have been had the excusable event not occurred. The difference between the resources expended per unit of work performed in the unimpacted period and the resources expended per unit of work performed in the impacted period gives rise to the consequential lost productivity, i.e. disruption.

Figure 1 sets out a basic measured mile analysis where the mile, or baseline period, (point A to point B) has been established as the control period and extrapolated to demonstrate what the labour productivity would have been but for the excusable disruptive event.

The concept of comparative production studies is simple and, from a documentary point of view, involves a relatively straightforward analysis of labour records and data. It goes without saying that the more detailed and accurate the labour record, the more relevant, reliable and persuasive the measured mile method will be. The further we move away from detailed contemporary records, the more unreliable and inaccurate the analysis will be. If there are insufficient labour records or insufficient detail on the labour records, then the analysis will inevitably move away from an analysis of direct labour performance into the realms of a global or total cost claim. Even the most accomplished of analysts will be unable to 'make a silk purse out of a sow's ear'.

The analyst needs to establish the scope of the disrupted work (this may be by reference to a trade such as concrete or steelwork, for example, or by reference to a

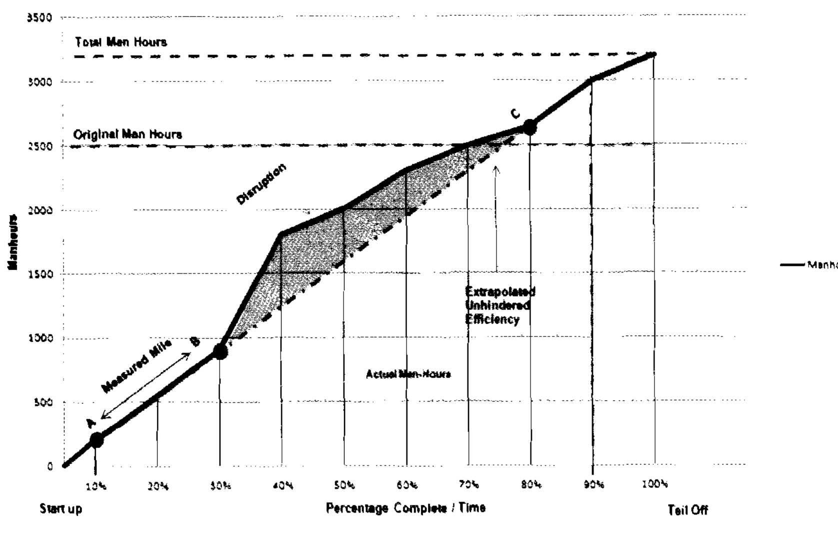

Figure 1: A basic measured mile analysis.

location like a particular floor, level or building), an unimpacted period (the measured mile), an impacted period (disrupted working), output during the measured mile (unimpacted productivity) and output during the impacted period (the disrupted productivity).

One of the arguments in favour of using a measured mile method is that it avoids reliance upon the productivity outputs laid down in the tender calculations. The measured mile method is concerned only with actual labour performance rather than theoretical outputs associated with the tender, and by utilising actual labour outputs, the analyst can overcome the often cited criticism, where tender calculations are used in the preparation of the claim, that the tender outputs were not achievable in any event.

However, whilst there are arguments in favour of using a measured mile method, there are equally a number of criticisms of the method.

A potential weakness in the measured mile method is that it tends to ignore the inherent variability in a contractor's performance. A contractor will rarely achieve a consistent level of productivity, even in the absence of any delaying and/or disruptive events, and, as such, the method will need to take due cognisance of these inexcusable inconsistencies when identifying the baseline period and quantifying the lost production. One factor that will influence inherent variability is the concept of the 'learning curve'. The learning curve is traditionally more an s-curve with reduced productivity at the beginning and end of an activity; referred to as start-up and tail-off.

With regards to start-up, it is normal to expect the workforce to become more competent at their assigned tasks as they become more familiar with both the process and the surroundings; in short, they become more efficient over time. Tail-off is the opposite; they become less efficient. This is probably due to the fact that the smaller, more labour intensive, tasks tend to take place at the end of an activity and also because as workers finish a particular task, they will start another one; meaning that time spent completing the first activity becomes more *ad-hoc* and not as time efficient as the previous work. In order to overcome this potential weakness, the first 10% and last 10% of the plotted productivity graph should not be used to establish the baseline period for the measured mile. To do so would create a false and non-representative mile.

A second inherent variable is overtime work. It is accepted that work carried out in overtime (work carried out after or outside normal working hours) will be executed less efficiently than work carried out in the normal working day. Some researchers estimate that the extent of this

...the overtime is worked as a consequence of the disruption itself and as such forms part of the claim.

inherent variable can be as much as 35% but in reality each variable needs to be considered on its own merits rather than by reference to any generic research. There may be many reasons for this inherent variability but a worker's productivity at the end of a day will (generally) not be as efficient as it was at the start of day. Therefore, the inclusion of overtime and overtime outputs in a measured mile analysis may create false and non-representative data and findings. However, it may of course be the case that the overtime is worked as a consequence of the disruption itself and, as such, forms part of the claim – but if this is not the case, then due cognisance should be given to overtime work.

Another inherent variable will often be the contractor's normal rate of productivity itself. As stated above, the contractor will rarely achieve a consistent level of productivity, even in the absence of any delaying and/or disruptive events, and it is important that this variability is recognised when identifying the baseline period. An analysis that seeks to maximise the claim by identifying an advantageous control period based purely on lowest resources expended per unit of work will be seen as opportunistic and subjective. The analyst should be looking to establish a baseline period that reflects the contractor's normal, rather than its best, productivity.

Identifying the appropriate mile is at the very heart of a persuasive and credible analysis. Get it right and the resultant findings will normally be reliable and representative of any consequential losses, but if you misapply the mile, you will severely weaken your analysis. A misapplied mile will not only allow the other party to undermine your method but will also lead the tribunal to conclude that your analysis has no substance and is unreliable.

The American experience

Identifying the appropriate mile has been considered in a number of judgements issued by the American courts and we need to understand what amounts to a misapplied mile so as to avoid the same mistakes.

In *Southern Comfort Builders Inc v US 67 Fed Cl 124* (2005) the plaintiff's expert claimed that it was impossible to identify a base line period (the measured mile) because the build period was too short to identify a suitable mile and that, in any event, the entire build period was subject to lost productivity caused by the employer's late change orders. In order to overcome these problems, the claimant identified a baseline derived from the production rates achieved by another contractor on the same project and applied these production rates for the duration of its own build period. The claimant then presented its ascertained losses as a modified total cost claim.

The court was clearly not impressed with the plaintiff's analysis:

> *"Based on the information presented, this court cannot adopt* [the plaintiff's] *measured mile analysis or modified total cost analysis to support* [its] *calculation of damages.* [The plaintiff's] *measured mile calculation is deficient in that it does not adequately represent a comparison between the plaintiff's unimpacted work with an impacted period. Instead the plaintiff's calculation compares its work with the work performed by another contractor."*

The court concluded that the expert's analysis had no evidential substance and, as such, was unreliable. In this instance, it is quite clear that the identified mile had little, if any, relevance to the disputed facts and absolutely no relevance in time to the excusable event(s) alleged to have caused the disruption. This is an example of a mile being identified out of subjective convenience rather than for any real evidential purposes. A measured mile should always be representative of the claimant's productivity on the project being analysed – any departure from this rule will undoubtedly weaken the measured mile analysis. The use of industry standards, or even productivity outputs from another project, as a baseline period will normally be seen as convenient, rather than analytical, and will often result in the claim failing. There may, of course, be circumstances where the use of industry standards or previous project outputs is acceptable but these are likely to be limited to situations where the work is standardised and the same specification is rolled out from project to project. Furthermore, by applying a measured mile to the entire build duration, the plaintiff's analysis was, for all intents and purposes, a global claim which tends to defeat the whole point of preparing a quantative measured mile analysis.

A similar decision was reached in *Daewoo Engineering and Construction Ltd v US 73 Fed Cl 547* (2006) where the expert calculated damages by comparing unimpacted periods of production with periods where production was alleged to have been impacted by excessive rainfall (an excusable delay event). From this data, the expert then developed a 'factor of efficiency' and applied this to the production throughout the project and applied a regular delay cost to calculate a total cost recovery.

In rejecting the expert's analysis, the court noted that the expert had made a presumption of efficiency with regards to the impacted period which it neither substantiated nor justified. In its judgement the court noted:

> *"We assume that a finder of fact faced with the measured mile method of estimating damages would want to have confidence in the expert's ability and objectivity. A court would be particularly concerned to know how the experts picked periods of productive and non-productive construction for comparison. We did not have such a level of confidence in the 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."*

The court's judgement is unequivocal to say the least but it should be noted that as with *Southern Comfort Builders Inc v US* (supra), the criticism is of the expert rather than the method.

The point to take from this particular decision is that the expert must be objective in its analysis and not use the analysis as a means to an end, as was clearly the case here. The point at which the measured mile is applied should be relevant to the facts and (preferably) relevant in time to the point at which the productivity was adversely affected. The measured mile is not suppose to circumvent the need to demonstrate cause and effect but rather it could be the means by which cause and effect is proven.

In *JA Jones Construction v US Corps ENG BCA* (2000), the tribunal again had to consider a misapplied measured mile. The plaintiff's expert gave evidence that labour inefficiency stemmed from the cumulative impact of client change orders on the contract works. The analysis measured the productivity of the contractor under two different conditions. Firstly, when they were working on both contract works and change order work (the impacted period) and, secondly, when they were carrying out contract works only (the unimpacted period). The expert concluded that the comparable element of contract works within the impacted period required 28% additional time per unit of work and as such extended the 28% uplift to contract works.

The tribunal rejected the analysis for two reasons. Firstly, the expert appears to have arrived at the 28% inefficient factor by a subjective and somewhat convoluted route that was not immediately apparent to anybody. The tribunal stated:

> *"Although the 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 or poor management) there is nothing in the macro-orientated nature of his analysis that eliminates these potential causes of increased hours related to performance of the unchanged work and he made no analysis of the weather sensitivity of specific work items. We consider that the contractor has failed to prove that other non-compensable factors and variables did not significantly contribute to any production inefficiency."*

The important point to note here is that if there are two competing and potential causes of the loss of productivity during an impacted period, one of which is compensable and other non compensable, then the analyst must take the non compensable events into account or demonstrate that that it did not affect the contractor's productivity. There is absolutely no point in persevering with an analysis that tries to avoid addressing non compensable events. If the non compensable element is active, then the appropriate adjustments needs to be made to the productivity outputs prior to evaluating any losses.

If the claimant fails to account for its own inefficiencies during the impacted period, then the court may be unwilling to make its own adjustment if it is later established that it is partly responsible for the lost productivity, thereby ensuring the claim fails. In the case of *US for Use and Benefit of Shields Inc v Citizens and Southern National bank of Atlanta* 367 473 4th cir (1966) the court, on appeal, held;

> *"...it appears that a not insubstantial part of the extra cost for which the plaintiffs sought reimbursement (in the impacted periods) could be attributed to factors for which (the contractor) was not responsible. As the evidence does not provide any reasonable basis for allocating the additional cost among these contributing factors, we conclude that the entire claim should have been rejected... this court has heretofore recognised and applied the principle that if there are actionable and non-actionable factors, the court, in the absence of a showing of some reasonable basis in the evidence, will not attempt to apportion the damages."*

The second reason that the tribunal rejected the measured mile analysis in JA Jones Construction is that the analysis failed to deal with cause and effect (a charge that could equally be aimed at the previous two cases). The court took issue with the fact that the measured mile analysis did not demonstrate that the alleged compensable event had an adverse effect on the contractor's productivity. The court stated:

> *"The expert did not perform a cause and effect analysis. He did not think such was feasible since he allegedly was attempting to measure the cumulative effect of changes on the project. He made no attempt to isolate specific impacts allegedly caused by changes. His analysis is not dependant on detailed knowledge of the project. 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. 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."*

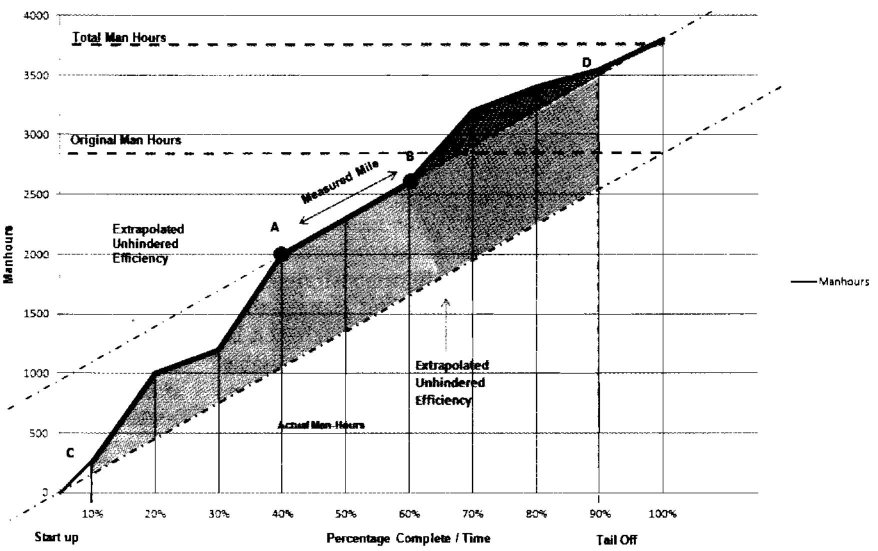

Figure 2: A measured mile analysis plotting varying degrees of productivity over the duration of the works. Note that the start-up and tail-off fluctuations in labour have been disregarded.

The tribunal's judgement is telling insofar as it sets out exactly what is expected of a measured mile analysis. The measured mile analysis is seen by many as a quantative exercise but we should not lose sight of the fact that demonstrating cause and effect should also be one of the main aims of the method. If cause and effect is not dealt with in the measured mile analysis itself then it must still be dealt with as part of the wider claim submission. A claim for a loss of productivity does not prove anything in itself!

In JA Jones Construction, the tribunal pointedly stated that the analysis 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."* These two statements highlight the importance of establishing a causal link between the event and the impact. In any claim for disruption, the tribunal will be looking for factual evidence that the regular progress of the works was interrupted by a causal compensable event which caused the rate of the progress of the works to be adversely affected.

Identifying the mile — At what point in time should the mile begin?

The American experience shows us that identifying an appropriate measured mile will be paramount in preparing a persuasive and credible analysis. If we identify a reasonable, logical and objective baseline period, the resultant findings will, more often than not, be representative of the consequential losses. More importantly, the analysis is likely to gain credibility with the tribunal.

Figure 2 deals with some of the more common issues that arise with a measured mile analysis; plotting varying degrees of productivity over the duration of the works. The first and last 10% of the duration of the activity (see points C and D above) is disregarded for the purposes of quantifying disruption because of the start-up and tail-off fluctuations in labour at the start and completion of any activity, which would normally follow a standard s-curve output.

The baseline has been identified as between points A and B. The reason that the measured mile has been identified between these points is not because it is the only unimpacted or maybe the least impacted period of work carried out by the contractor, i.e. where the contractor's productivity was at its most efficient and therefore any subsequent calculation of lost productivity will yield the highest return. If maximising the amount of the claim is the sole criteria for establishing the baseline period, the analysis becomes subjective and weak – and will normally fail.

In this analysis, the baseline period (between points A and B) has been identified because it represents the contractor's demonstrably rate of progress immediately prior to the occurrence of an excusable event (at point B) which causes the contractor's rate of productivity to be adversely affected. By objectively considering the data in this manner, the contractor can demonstrate that its actual rate of output was adversely affected by an excusable event and triggered a decrease in output. By extending the baseline period (extrapolated unhindered efficiency), we then identify and isolate the effect of the excusable event (i.e. the additional resources as shown in green). The quantification of that disruption can then be ascertained by reference to the data used in the analysis.

By establishing a rate of extrapolated unhindered efficiency from the baseline period, the argument exists that this in turn could be applied from the 0,0 axis on the graph to quantify all unproductive working throughout the duration of the activity. The argument goes that if the baseline period productivity was achievable at a particular point in time, it should have been achievable from the beginning of the activity. This argument is normally flawed because it ignores the need to demonstrate cause and effect. By misapplying the measured mile in this manner, the analyst is creating nothing more than a global claim whereby it is sweeping up all the vagaries of variable site production (excusable and non-excusable) and presenting the same as a total cost claim. These types of analysis will usually fail.

There may, of course, be circumstances where it is entirely appropriate to apply extrapolated unhindered efficiency through the 0,0 axis on the graph (normally where it is difficult or impossible to identify a suitable measured mile prior to or near the impacted period of work) but, as stated above, this will not negate the need for the contractor to prove cause and effect which must be dealt with and established elsewhere in its analysis. Remember, a claim for a loss of productivity does not prove anything in itself!

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