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Lost Productivity – Finding the Missing Puzzle Pieces and Contract Bars

Dr. Tong Zhao, PE PSP and J. Mark Dungan

Abstract—A contractor makes certain assumptions regarding the scope of work represented in a contract, specifications and drawings, construction sequence, and schedule. Should those conditions change, the contractor may suffer economic losses related to unplanned extra effort. However, in the case of lost productivity, identifying the cause and effect is often illusive and in some cases contracts even try to explicitly bar loss of productivity claims. This paper discusses loss of productivity, an important piece in the construction claim puzzle, and employing the measured-mile methodology to prove the damage. This paper also discusses potential methods of recovering extra labor when loss of productivity claims are explicitly denied in the contract.

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Introduction

There are a lot of uncertainties and risks in construction projects, which often lead to adversarial relationships among relevant parties. It is not uncommon that disputes and claims arise in a construction project, though all parties involved endeavor to successfully complete the project and benefit from the construction. In general, the contract documents define the primary relationship between or among the parties to a construction project and provide the basis for construction claims.

When submitting its bid or proposal, a contractor makes certain assumptions regarding the scope of work represented in a general and special conditions, specifications and drawings, construction sequence, and schedule, which mostly would become parts of the ultimate contract. Should those conditions change or events beyond the parties' control occur, the contractor may suffer economic losses related to unplanned extra effort, which may further lead to construction claims. This paper discusses construction claims from contractors' perspective, though at times the owner may claim against contractors to recover its loss.

In construction claims that contractors seek recovery of its economic loss, proving lost productivity is often one of the most intangible pieces of the puzzle. However, in the case of lost productivity, identifying the cause and effect is often illusive, though the measured mile method is the most accepted approach. In some cases contracts even try to explicitly bar loss of productivity claims. This issue will be addressed in later part of this paper.

Construction Claims from Contractors

Depending on the cause, contractor construction claims can be categorized as scope changes, delay, disruption, acceleration, payment, termination and pass through claims [1]. They can be caused by one or multiple factors listed as follows:

- Differing site conditions;
- Owner directed changes;
- Design omission, errors, ambiguity and conflicts;
- Insufficient plans and specifications;
- Force Majeure;
- Adverse weather;
- Owner interruptions and disruptions;
- Delays in the delivery and supply of owner provided materials and equipment;
- Delays in construction caused by one or more of the above reasons
- Construction acceleration
- Lost productivity caused by one or more of the above reasons
- Wrongful termination

Scope Changes

It is common to see minor changes in the scope of work in construction projects and virtually every construction contract contains provisions governing them. Design adjustments for omissions, errors, ambiguities and conflicts, owner requested changes, potential value engineering, and differing site conditions, among others, may result in scope change. Certain cost issues can be resolved via formal change orders under the usual provisions of a construction contract. If a contractor is not able to realize the impacts that a scope change has on other work, a formal change order may result in the contractor's releasing the owner from costs attributable to delay, disruptions or constructive acceleration resulting from those impacts.

A cardinal change occurs when a party makes an alteration in the work so drastic that it effectively requires the contractor to perform duties materially different from those originally bargained for. Usually a cardinal change is so profound that it cannot be re-addressable under the original contract, and the party contracting for the work is deemed to be in breach. Now many owners delineate additional work as an option under the contract to avoid a claim of cardinal change.

Delay

A delay claim on a construction project involves a change in the time anticipated for performance of the contract. Damages under a delay claim usually include extended home and field office overhead, additional costs of financing and other time related costs. There are excusable and inexcusable delays. Excusable delays are delays that are not the fault of the contractor and may be used as the basis to extend the time for contract performance. Owner responsible delays on the critical path are both excusable and compensable. When both the owner and contractor have contributed to a concurrent delay, each party then bears its own costs of the delay, and it is excusable.

If the delay is found to be the fault of the contractor and inexcusable, the contractor may be liable to the owner for damages. The damages may be calculated based on either the actual damages suffered by the owner as a result of the delay or liquidated damages specified in the contract. Construction contracts commonly include clauses that allow the owner to terminate the contractor for failure to complete the project in a timely manner.

Disruption

Disruption claims arise because of events that preclude the contractor from completing the work in the manner in which the work was bid. Disruption claims are also called loss of productivity or loss of efficiency claims. Disruptions can be caused by the owner, such as incomplete or incorrect contract drawings, changes, failure to provide information in a timely manner or failure to approve submittals in a timely manner; other disruptions may be not owner caused, such as weather and labor issues. Unlike the delay claims, claims for disruptions may not extend the completion date but may be based on labor inefficiencies due to factors, such as the effects of overtime, the stacking of trades, and out of sequence work. We'll further discuss the disruption claims in later sections.

Acceleration

Acceleration involves a speeding up of the work process seeking to complete the work with less time than originally anticipated. The contractor either works overtime, hires additional manpower, or both. It is common that equipment and supervision costs increase as well. Acceleration may also cause labor productivity to decline. There are two types of reimbursable acceleration: directed acceleration and constructive acceleration. Directed acceleration occurs when the owner orders the contractor to speed up the pace of the work. Constructive acceleration occurs when a contractor is forced to increase the pace of the work to meet a project schedule that has not been extended even with the presence of excusable delays that entitle the contractor a time extension. Courts have established that a contractor must prove five elements in order to recover under a theory of constructive acceleration:

- An excusable delay;
- Proper notice to the owner of the excusable delay and a request for an extension of time;
- Refusal by the owner to grant the time extension within a reasonable time;
- An order, either express or implied, to accelerate;
- Actual acceleration by the contractor

Payment Claims

The expected cash flow under the payment terms of the construction contract is essential to the contractor. If payment due from the owner per the payment terms is not made or is made untimely, the contractor's financial status, including its working capital, financing, ability to perform other projects, bonding capacity and obligations to employees, subcontractors and vendors would be all negatively impacted, and then a payment claim can be made. Prompt payment acts provide legal basis for the contractor to make prompt payment claims, if such laws are available in the jurisdiction.

Termination Claims

If the contractor did not have a breach that is material, but was terminated, it may have a termination claim against the owner. If the termination occurs before the notice to proceed, the contractor may be entitled to recover its anticipated profit on the project and preparatory costs, such as the cost of preparing the bid. If the termination occurs after the work has started, the contractor may be entitled to recover its unpaid direct and indirect cost of performance, and some portion of the contractor's expected profit on the project. In addition, the contractor may also be entitled to unabsorbed home office overhead.

Pass Through Claims

An increasing number of jurisdictions are allowing construction "pass through" claims, in which a subcontractor can assert a claim against an owner – even though the subcontractor and owner are not in contractual privity. In the pass through claims, the general contractors bring claims against owners on behalf of subcontractors.

General contractors typically enter into liquidation agreements with subcontractors or suppliers, in order to limit their exposure in the event that a pass through claim against an owner should fail. A general contractor may promise in a liquidation agreement to pursue a subcontractor's claims against the owner, with any recovery to be remitted to the subcontractor. In exchange, the subcontractor may agree to release all claims against the general contractor.

Loss of Productivity Claims and the Measured Mile Method

There are numerous circumstances and events on construction projects that impact productivity, and they may be attributed to the owner, the contractor itself, or a third party. Though loss of productivity claims are common in construction disputes, proving and quantifying lost productivity is one of the most challenging tasks in construction claims. AACE International Recommended Practice 25R-03: *Estimating Lost Labor Productivity in Construction Claims* lists common methods to quantify lost labor productivity claims, in which the measured mile method is ranked the most preferred approach.

In 1951, the measured mile comparison was successfully used in Maryland Sanitary Mfg. Co. v. US [2], although the systematic procedures for measured mile calculation appeared much later. Measured mile calculation compares identical or similar work in impacted and unimpacted segments of the project to quantify the productivity loss resulting from the impact of known events for which the claimee is responsible. The original measured mile method requires the measured mile to be impact free, which limits its applicability. The concept of measured mile was then broaden to allow lightly impacted areas or periods to be considered as the baseline [3] [4]. The baseline method is also a kind of the measured mile method from a broader perspective.

Although many professionals assert that the measured mile approach is a concept, not a procedure, quantifying lost productivity using this approach involves steps of processing and reconciling data for input (usually measured in labor hours) and output (usually measured in the quantity of completed work), calculating productivity, identifying the productivity benchmark, analyzing the cause and effect relationships, and measuring labor inefficiencies. Each step can be considered as an indispensable piece to solve a puzzle. Improperly implementing a step in a measured mile approach may lead to an unjustifiable result, and compromise the chance of success for the loss of productivity claim [5].

<u>Data Processing</u>

It is not uncommon that data from contemporaneous documentation and cost control system may not be directly usable for a measured mile analysis without processing and reconciliation. A plot of productivity may help reveal errors or anomalies in the data where reconciliation is needed, such as the periods with quantity but no manhours, or manhours with no quantities reported. The errors or inconsistencies in contractor records sometimes can be significant.

Reviewing the original records, such as daily reports from all the relevant parties, may also help correct clerical errors and the issues of data updating delays.

Productivity Measurement

Productivity is a measure of the rate of output per unit of time or effort usually measured in labor hours. Input is normally measured using manhours, but there are two primary methods for output measuring, percentage complete or physical units of work completed. The percentage complete method relies on periodic estimates of the percentage of work completed. This information is commonly seen in the pay applications and progress reports. The physical units of work completed method is more detailed and may be more precise, however the data needed for that method is not as commonly available.

Proper productivity measurement is important to the measured mile analysis. Inappropriate selection of productivity measurement may make certain comparable work lose similarity. For example, linear footage may be a better measurement than weight whencomparing the productivity among similar ductwork.

Identical or Similar Work

A measured mile analysis for labor productivity requires that [4]:

- 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 reasonably attainable levels of productivity;
- The work environment should be similar.

Measured Mile/Baseline Identification

It is common to see that people identify the measure mile or baseline based on their visual observation on the productivity data, which sometimes may face the critique of cherry picking, if a solid cause and effect analysis is not available. In order to provide aid in determining the measured mile, Mr. Zink proposed a procedure, in which the curve of actual labor hours versus percentage of completion for the work is plotted. The linear or near linear portion of the chart with the most efficient rate of progress excluding the buildup and tailout sections is identified to be the measured mile, which must be free or essentially free of disruptions and continuous in time [6].

Dr. Thomas and his collaborators introduced the concept of baseline, which does not have to be impact fee and continuous in time [3] [4]. But Dr. Thomas proposed a procedure that selects the 10% of the total reporting periods with the highest production or output as the baseline productivity period, which does not work very well when the reporting periods with high production happen to be heavily impacted. Dr. Thomas's procedure has also been noted for the subjective 10% for the size of the baseline set [7] [8].

Messrs. Gulezian and Samelian used a process control chart for establishing a productivity baseline that reflects a contractor's normal operating performance [9]. When the majority of the data points are in disruption sections, Mr. Gulezian and Samelian's method is likely to fail in determining the baseline, as all the data point may fall in the control limits [8].

Drs. Ibbs and Liu proposed a K-means clustering based method to separate the productivity data into different groups. The average value for the group with the best productivity would serve as the measured mile or baseline [7]. One issue with K-means clustering technique is that it does not guarantee a unique solution [8].

Dr. Zhao and Mr. Dungan (the authors) proposed an improved method to help determine the productivity baseline. Using this method, the productivity data is first segregated into the good productivity group and the bad productivity group using the overall average productivity; then the baseline subset is refined from the good productivity group using statistical techniques, such as a process control chart, and then the baseline productivity is then calculated as the average productivity of the baseline subset. Since productivity is negatively impacted by disruptions, it is straightforward that the productivity for the unimpacted measured mile or even lightly impacted baseline must be better than the overall average productivity, thus only exist in the good productivity group [8].

Cause and Effect Analysis

Once the periods or sections with declined productivity have been identified, it is necessary to ascertain the causes. This task is usually time consuming and may be tedious because it involves the extensive review of project records, including daily reports, meeting minutes, cost reports and numerous other records.

The determination of causation can be aided by examining the graph of productivity depicting the productivity evolution over time on the project along with a time line of potential impact events. The timing between productivity decline and potential impact events can help the experts identify the causation. Similar to time dependency, it is possible to establish the relationship between the productivity and impact events experienced in different sections/locations of the project. For example, the demonstration that the productivity at an impacted section/location is worse than the productivity of similar work at an umimpacted section/location shows the particular impact caused the productivity loss.

Loss of Productivity Calculation and Responsibility Allocation

After the above steps have been completed, lost productivity can be calculated as the difference between the actual manhours and the manhours that should have been expended based on the measured mile/baseline productivity. The calculated productivity loss is apportioned to each assignable cause and then allocated to the responsible party.

Contract Bars

Although they may not be commonly seen, some construction contracts expressly bar the recovery on lost productivity, or "No Damage on Lost Productivity." It is a legal issue whether this provision is considered to be fair and enforceable by court, and beyond the scope of this paper. The discussion below is made on the premise that the clause is enforceable.

Before we further discuss the issue, let's take a look at a case study. A mechanical subcontractor, SUB, was engaged by a prime contractor, PRIME, to provide labor to install water heaters procured directly by the prime contractor to a townhouse complex under development. In the first 50 townhouses, no disruptions were encountered, and SUB's manhours were close to plan with a slight underrun. But the remaining 100 townhouses, the manufacture and delivery of water heaters could not keep up with the construction and water heater installation. Later, the water heaters were delivered with certain parts, such as pressure relief valves, changed from factory installation to field installation. As a result, SUB experienced manhours overrun for the last 100 townhouses.

This case may be very suitable for a measured mile comparison, because there is an apparent unimpacted section with normal productivity and an impacted section with declined productivity. However, it becomes infeasible because of the clause of "No Damage on Lost Productivity." Despite that, SUB's scope of work can be considered to be changed for the added work to field install parts, such as pressure relief valves, and additional demobilization and remobilization, and idle time because of untimely delivery of water heaters. If it has enough contemporaneous documentation to prove the additional manhours due to added field work, demobilization and remobilization, and idle time related to the scope change, SUB would have very good chance to recover corresponding manhours. But the lost manhours attributable to the re-learning due to demobilization and remobilization, and the cumulative effects of the changes and disruptions, may not be recoverable under the clause of "No Damage on Lost Productivity."

The case study also highlights the importance of maintaining detailed contemporaneous project documentation. A contractor's recordkeeping system should document all important events, when they occur. Special care should be taken to record the progress of construction and problems that are encountered. Well maintained contemporaneous documentation may help the contractor to recover its loss using an alternative justification, when a common entitlement is barred by the contract.

Conclusion

If a contractor has suffered losses because of changes, interference and other actions by an owner or the architect/engineer that it hires or a third party, it can develop a claim for scope changes, delay, disruption, acceleration, termination, untimely payment, etc. The loss of productivity claim is a challenge, because the contractor has the burden to not only establish

the causal link between the causes and their effects, but justify that the claimed loss is a reasonable approximation of what actually incurred. The measured mile method is so far the most preferred approach to prove lost labor productivity. This paper discussed the general steps to perform a measured mile analysis, and highlighted the guidelines that should be followed. This paper also discussed the potential methods to recover certain labor costs when loss of productivity claims are explicitly denied in the contract.

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Dr. Tong Zhao, PE PSP
Delta Consulting Group, Inc.
tzhao@delta-cgi.com

J. Mark Dungan
Delta Consulting Group, Inc.
mdungan@delta-cgi.com