

The Measurement and Pricing of Inefficiencies on Construction Projects

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What is Productivity?

Productivity =

Work Performed/Resources Expended

Measuring Productivity

1. Units of work and resources should be expressed in terms of a measurable quantity (cubic yards of concrete, labor hours, etc.).

Measuring Productivity

2. Sometimes measured in terms of percent complete or cost per unit, though these measures are not preferred and are often erroneous. They can be very misleading as they are easily distorted by front-end loading, the cost of equipment and materials, and the mix of different types of work.

Measuring Productivity

3. Maintenance of good records is essential to evaluating inefficiencies.

What are “Good Records”

- Good records document both quantity and effort.
- Good records provide the facts.
- Good records support an accurate perspective on the project.

What is inefficiency?

- **Inefficiency** is based on a comparison of productivities

Potential Sources of Inefficiency

- Extended periods of overtime
- Weather
- Altered means and methods
- Learning (or experience) curve effects
- Equipment breakdowns
- Night-shift work
- Labor shortages
- Increased crew sizes
- Design problems

Methods of Measurement

Ask yourself to answer the question:

“What is the most persuasive way to convince somebody that inefficiency is linked to a problem they caused?”

Methods of Measurement

- Measured mile
- Comparison with other projects
- Comparison with bid, estimate, or plan
- Use of experts
- Use of published standards

Industry “Standards”

- Factors are often based on limited analysis.
- Factors are general and may not apply to a particular project.
- Factors apply only to the trade or industry that generated the factor.
- Because factors are often prepared by a particular industry or trade organization expressly for use in change order or claim situations, their objectivity may be questionable.

Some “Standards” to Avoid

- Factors published by the Mechanical Contractors Association of America (MCAA)
- Factors published by the National Electrical Contractors Association (NECA)
- The Leonard Study
- And many others

Expert Opinions

Measure of inefficiency based on opinion of expert familiar with the type of work that was inefficient. This is not an analytical approach and its accuracy depends upon the capabilities of the expert. The credibility of the expert is a factor in the evaluation.

Comparison to Bid

Involves the comparison of what was bid or anticipated to actual performance. Primary weakness is the assumption that the estimate was accurate or reasonable. Often presented as part of a total cost method for measuring damages.

Total Cost Assumptions

- Nature of the impact was such that costs could not be tracked to specific impacts.
- Owner responsible for all added costs.
- Contractor's costs were reasonable.
- Contractor's bid was reasonable.

Comparison with Other Projects

Comparison methodology where unimpacted period is taken from other projects.

Comparison may be distorted by differences in the scope, nature, character, magnitude, accessibility, contract requirements, management, staffing, equipment, and approach.

Measured Mile

Comparison of productivity of unimpacted (efficient) and impacted (inefficient) work on the same project. This method eliminates from consideration problems for which the contractor is responsible.

How is Inefficiency Calculated?

Inefficiency Factor =

Unimpacted Productivity minus

Impacted Productivity divided by

Unimpacted Productivity

Measured Mile

A measured mile approach may not be possible when there is no unimpacted period.

A Measured Mile Analysis

A project consists of the installation of a 5280-foot water line. The contractor has a crew of 5 workers that installed 2400 feet through week 8 of the project. Beginning week 9, it accelerates its operations to working six, 10-hour shifts per week as opposed to five, 8-hour shifts per week.

A Measured Mile Analysis

Day 1 Contractor mobilized
Day 2 Survey site
Day 3 Excavated 390' of trench for waterline.
Day 4 Excavated 410'
Day 5 Excavated 420'
Day 6 Excavated 390'
Day 7 Excavated 380'
Day 8 Excavated 410'
Day 9 Excavated 500'
Day 10 Excavated 490'
Day 11 Excavated 490'
Day 12 Excavated 480'
Day 13 Excavated 470'
Day 14 Excavated 450'

Unimpacted Period

Day 3 Excavated 390' of trench for waterline.

Day 4 Excavated 410'

Day 5 Excavated 420'

Day 6 Excavated 390'

Day 7 Excavated 380'

Day 8 Excavated 410'

Unimpacted Productivity

- Unimpacted: $5 \text{ days} \times 8 \text{ hours} \times 6 \text{ weeks} = 240$ crew hours
- $2400 \text{ feet} \div 240 \text{ crew hours} = 10 \text{ ft./crew hour}$

Impacted Period

Day 9 Excavated 500'

Day 10 Excavated 490'

Day 11 Excavated 490'

Day 12 Excavated 480'

Day 13 Excavated 470'

Day 14 Excavated 450'

Impacted Productivity

- 6 days x 10 hours x 6 weeks = 360 crew hours
- 2880 feet ÷ 360 crew hours = 8 ft./crew hour

Inefficiency Factor

Inefficiency Factor =

Unimpacted Productivity minus

Impacted Productivity divided by

Unimpacted Productivity

$$(10-8)/10 = 20\%$$

Cautions

- Note that in this example the first step is to identify the cause of the inefficiency and then to identify periods when the impact is not present and when it is.
- The Unimpacted period is NOT the most efficient period. It is the period when there is no impact.

Cost Calculation Methods

- **Contract**
- **Estimates**
- **Actual Cost**
- **Total Cost**
- **Modified Total Cost**

Inefficiency Cost Calculations

ODOT Standard Specifications

109.07 Inefficiency. Payment for efficiency losses is limited to 5 percent unless otherwise determined by the Director. The Department will compensate for all such costs according to 109.05.

Inefficiency Cost Calculations

NJDOT Standard Specifications

Inefficiencies. If the source of the loss of productivity cannot be isolated and priced separately, the Department will consider making payment for inefficiency costs based on a Measured Mile analysis comparing the productivity of work impacted by a change to the productivity of similar work under unimpacted conditions.

Inefficiency Cost Calculations

Essentially, cost is calculated by multiplying the actual hours expended during the impacted period by the inefficiency factor.

Example Calculation

- A contractor encounters a differing site condition that makes the installation of drainage pipe less efficient. The contractor was able to install 5000 feet of drainage pipe per week prior to encountering the differing site condition (unimpacted period). After encountering the differing site condition, the contractor was only able to install 4000 feet of drainage pipe per week (impacted period). The contractor had a total of 1250 labor hours at an hourly labor rate of \$20.00 during the impacted period.

Example Calculation

Inefficiency Factor:

$$(5000-4000)/5000 \times 100\% = 20\%$$

Inefficient Hours:

$$1250 \times 20\% = 250$$

Cost Calculation (IAW 109.05):

$$250 \times \$20 = \$5,000$$

Thank You

Questions?