CDR.05

The Measured Mile – a Better Way of Using an Old Tool

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The "measured mile" analysis is usually thought of as the industry's best approach for analyzing and quantifying productivity disruptions. Most productivity experts agree that the major obstacle in performing this kind of analysis is validating that the work analyzed, in both the baseline and impacted periods, is comparable. More often than not this is also the main obstacle in convincing a "trier of fact" that an analysis is valid. Surely, it would be unrealistic to compare the productivity of above ground large bore pipe work versus above ground small bore pipe work, using the traditional approach of comparing expended worker hours per linear foot (unit rate basis). This work is not comparable and would yield false productivity results if compared on a unit rate basis.

The second most important consideration in performing a measured mile analysis is the level of detail of which both worker hours and work progress are tracked. The productivity of above ground large bore pipe can only be evaluated if both the expended worker hours and installation progress are tracked at that level of detail or lower. If, for example, work progress for above ground large bore pipe is tracked but the expended worker hours for all above ground piping work is lumped together then that would make it invalid to perform a measured mile analysis at the above ground large bore pipe level of detail.

A CLOSER LOOK AT THE OBSTACLES

Comparable Work

Let's examine the comparable work issue using pipe installation work knowing that the measured mile is most accurate where the work in the baseline period is identical to the type of work being performed in the impacted period [1]. Figure 1 shows an example of a typical pipe installation program in a process plant. It is difficult, if not impossible to find two time periods where identical work taking place in each period.

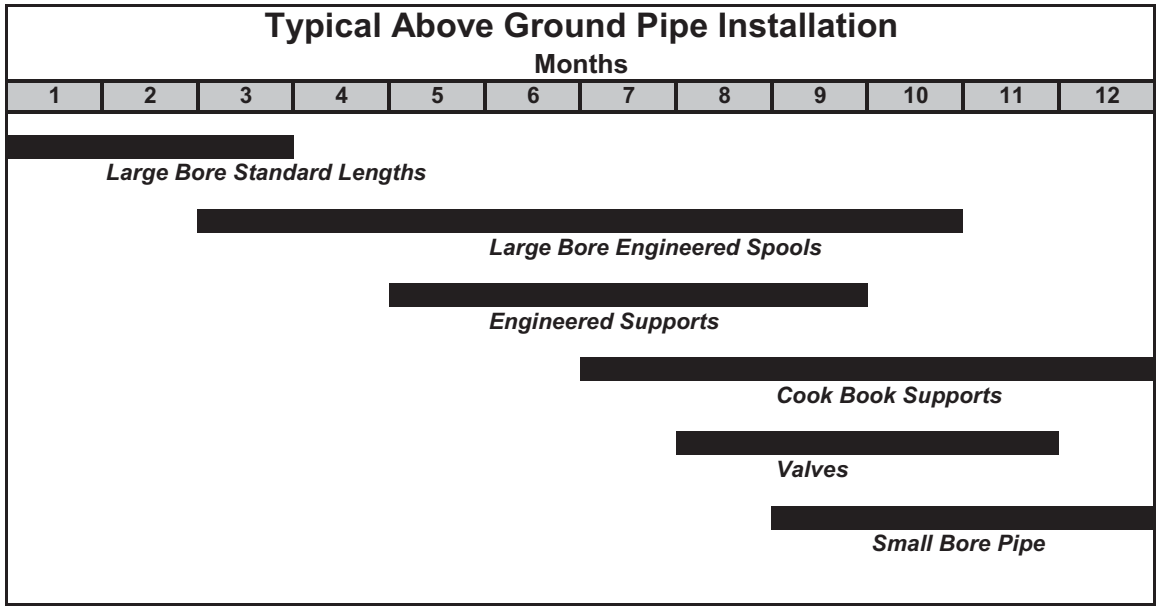

Figure 1

Figure 2 is the same graphic as Figure 1, except a couple of time periods have been singled out as the "baseline period" (the least impacted period) and the "impacted period" (the most impacted period).

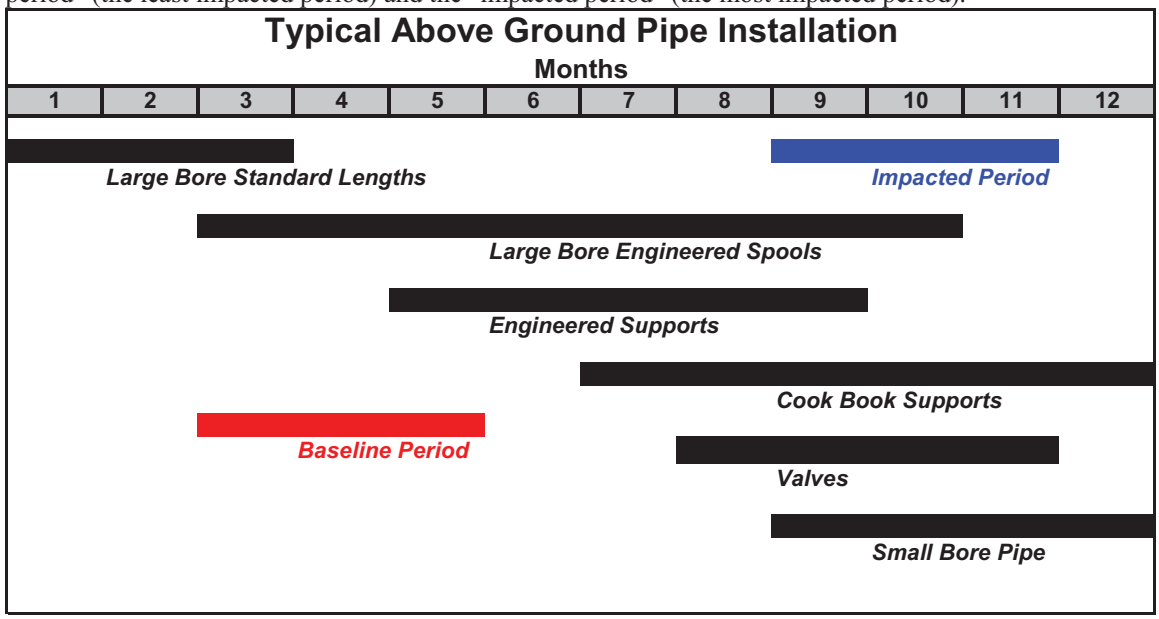

Figure 2

During the baseline period, the construction installation is comprised of:

- large bore standard pipe;
- large bore engineered spools; and
- large bore engineered supports.

During the impacted period, the construction installation is comprised of:

- large bore engineered spools;
- large bore engineered supports;
- cook book supports;
- valves; and
- small bore pipe.

It would be very difficult to make a case that the same work is going on in both of these specific periods of time if you were looking at the total piping effort. If we were just looking at the productivity of large bore pipe; it would be difficult to say that the work is the same in each period because the baseline period has all of the standard length installation, which is the easiest large bore pipe to install and the impacted period has the installation of all of the regular supports and all of the valves, which would be reasons for less productivity. Unless the cost system allows the segregation of only large bore engineered pipe installation then the work is different in each period.

Tracking of Worker Hours and Progress

Let's examine the tracking of worker hours and progress of the work issue knowing that every measured mile analysis is dependent on the level of detail for which this information is collected. For example, if a project situation calls for the productivity analysis of 8" alloy pipe installation. Let's assume that the quantities installed are tracked by size of pipe and line number. However, if within the project controls' worker hour collection system, the project lumps the expended worker hours for all large bore pipe installation into a single account, then obviously the desired analysis is not possible unless all 8'' alloy pipe was installed during a known timeframe when no other large bore piping work was being performed. Unless that is true, the lowest level of productivity that could be analyzed would be – large bore pipe installation.

It is not the least bit unusual, in this day where much of the construction industry is performed by subcontractors, for worker hours to be tracked at the following levels:

- civil/structural/buildings;
- piping/mechanical;
- electrical/instrumentation;
- insulation; and
- painting.

The traditional approach for a measured mile analysis (i.e. the comparison of identical pieces of work) simply does not work at this level of cost control. Since this level of control does not differentiate time spent on large bore pipe work versus small bore pipe work, it is impossible to compare identical pieces of work. Therefore, it is necessary to take a different approach.

A NEW APPROACH

Another approach to performing a measured mile analysis is by comparing the effort required to achieve one percent of the total discipline work effort or the worker hours expended to achieve one percent of a discipline's scope of work. Analyzing a discipline's total scope of work "normalizes" or averages the analysis and does not require the work being analyzed to be identical.

Let's Do the Math

If we prepare a small estimate for a small piping project, it might look like Table 1:

Element	Quantity	Unit Rate	Manhours
LB Pipe (LF)	9000	3.5	31,500
SB Pipe (LF)	1000	1.5	1,500
Pipe Supports (EA)	1000	25	25,000
Valves & Specialities (EA)	100	40	4,000
Total			**62,000**

Table 1—Small Estimate for a Small Piping Project

The estimated worker hour per one percent complete for this piping work is 62,000 worker hours divided by 100 (percent) or 620 worker hours per one percent complete.

Based on the above table, if during last month 1000 linear feet (LF) of large bore pipe and 10 valves were installed, the earned worker hours for that piping installation work would be as Shown in Table 2:

Element	Installed Quantity	Unit Rate	Earned Manhours
LB Pipe (LF)	1000	3.5	3,500
SB Pipe (LF)	0	1.5	0
Pipe Supports (EA)	0	25	0
Valves & Specialities (EA)	10	40	400
Total			**3,900**

Table 2—The Earned Worker Hours for Pipe Installation Work

The calculated percentage of the total piping scope of work (or the percent complete for 100 percent of the Project) for those quantities installed would be as reflected in Table 3:

Element	Earned Manhours	Total Project Earnable Manhours	Percent Complete
LB Pipe (LF)	3500	62,000	5.65%
SB Pipe (LF)	0	62,000	0.00%
Pipe Supports (EA)	0	62,000	0.00%
Valves & Specialities (EA)	400	62,000	0.65%

Table 3—Calculated Percentage of the Total Piping Scope of Work

Now, let's assume for the purpose for making a calculation for worker hours per one percent complete for this work accomplished, that the work was performed for the budgeted worker hour figure or that it took 3500 worker hours to install the piping and 400 worker hours to install the valves. The calculated worker hours per one percent complete would be as shown in Table 4.

Element	Expended Manhours	Percent Complete (for 100 %)	Divided By 100	Manhours Per One Percent Complete
LB Pipe (LF)	3500	5.65%	100	620
SB Pipe (LF)	0	0.00%	100	0
Pipe Supports (EA)	0	0.00%	100	0
Valves & Specialities (EA)	400	0.65%	100	620

Table 4—Calculated Worker Hours Per One Percent Complete

The result of our analysis shows that large bore pipe installation and valve installation, which are two completely different pieces of piping work, have the same value for the calculated worker hour per one percent complete when installed for the budgeted worker hour rate. Actual installation rates may vary higher or lower that the estimated 620 worker hours per one percent complete, but the analysis illustrates that the methodology does "normalize" the comparison of two different types of work.

APPLICATION OF METHODOLOGY

The application of this methodology is very similar to the traditional approach to performing the measured mile analysis.

Step 1

Generate a curve showing expended worker hours per one percent of the piping scope of work. See Figure 3:

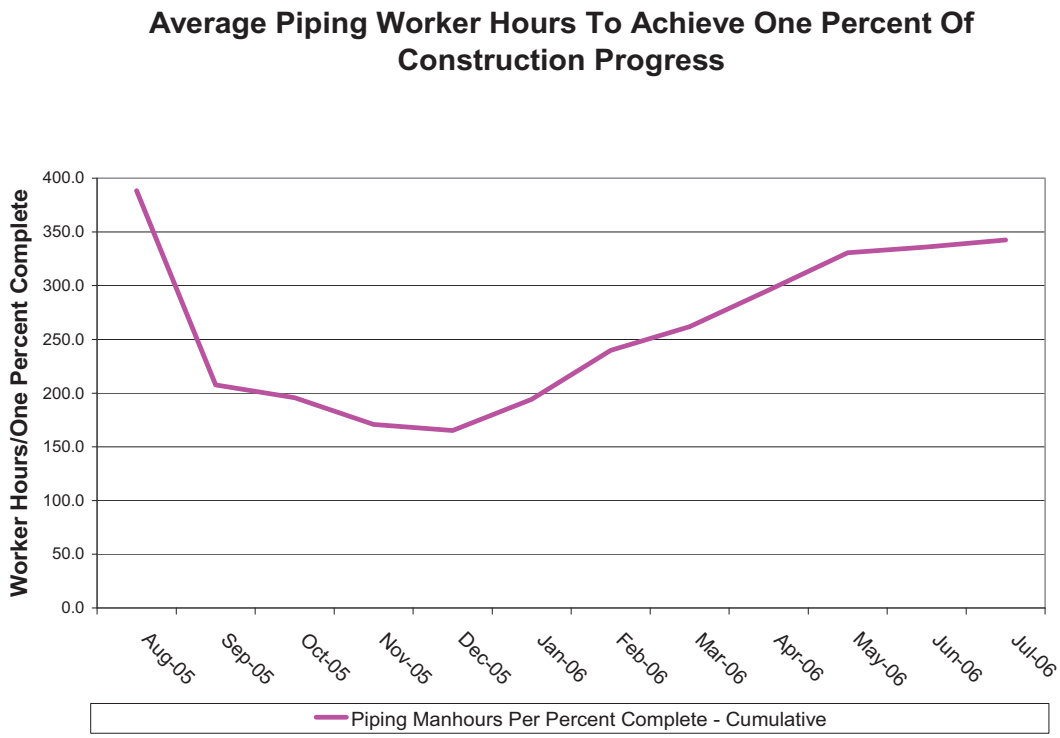

Figure 3

Step 2

The second step that I recommend is to eliminate the first and last 10 percent complete of progress from the analysis, which eliminates the typical inefficiencies in the early and late periods of work. This approach allows the analyst to focus on only those inefficiencies that occur during the time when the execution of the work should be most efficient. See Figure 4:

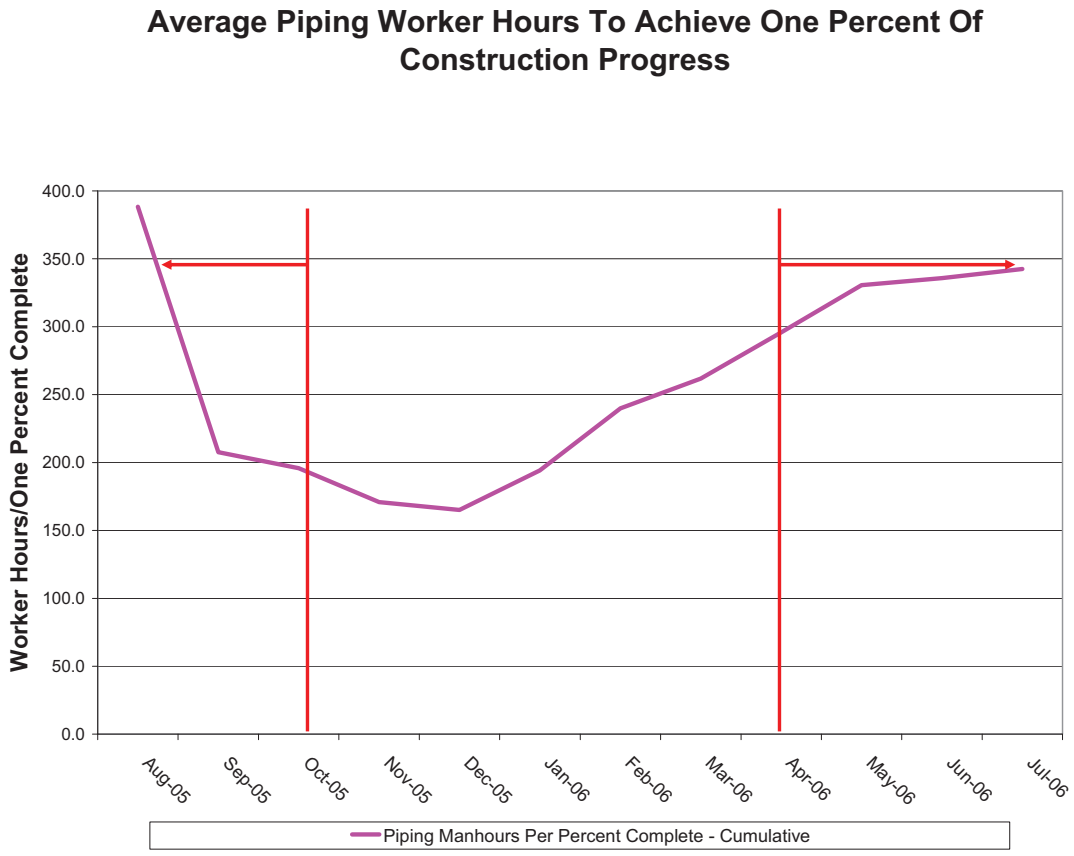

Figure 4

Step 3

The next step is to determine, through a review of the contemporaneous documentation, the time periods for the baseline and impacted periods. In other words, when did the least impacted periods and the most impacted periods occur in time? See Figure 5:

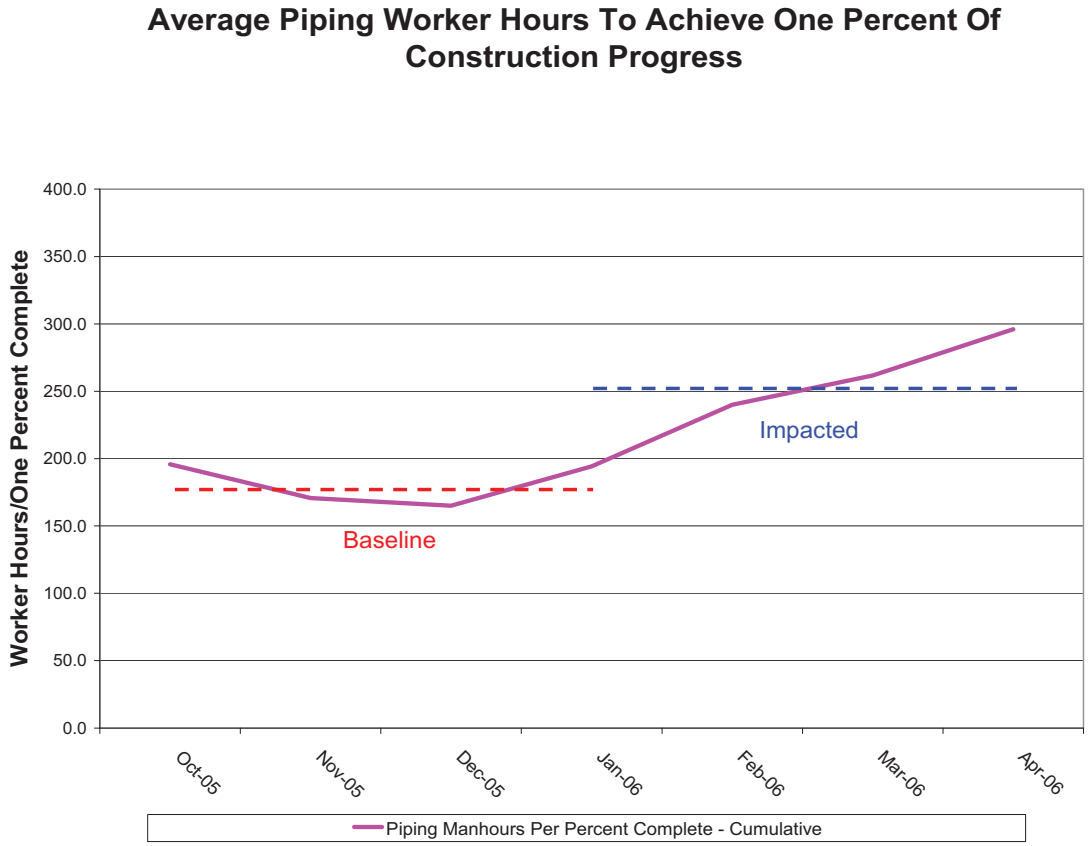

Figure 5

Step 4

The final step is to determine the number of inefficient worker hours by taking the difference between the average baseline value and the average impacted worker hour per one percent complete value. See Figure 6:

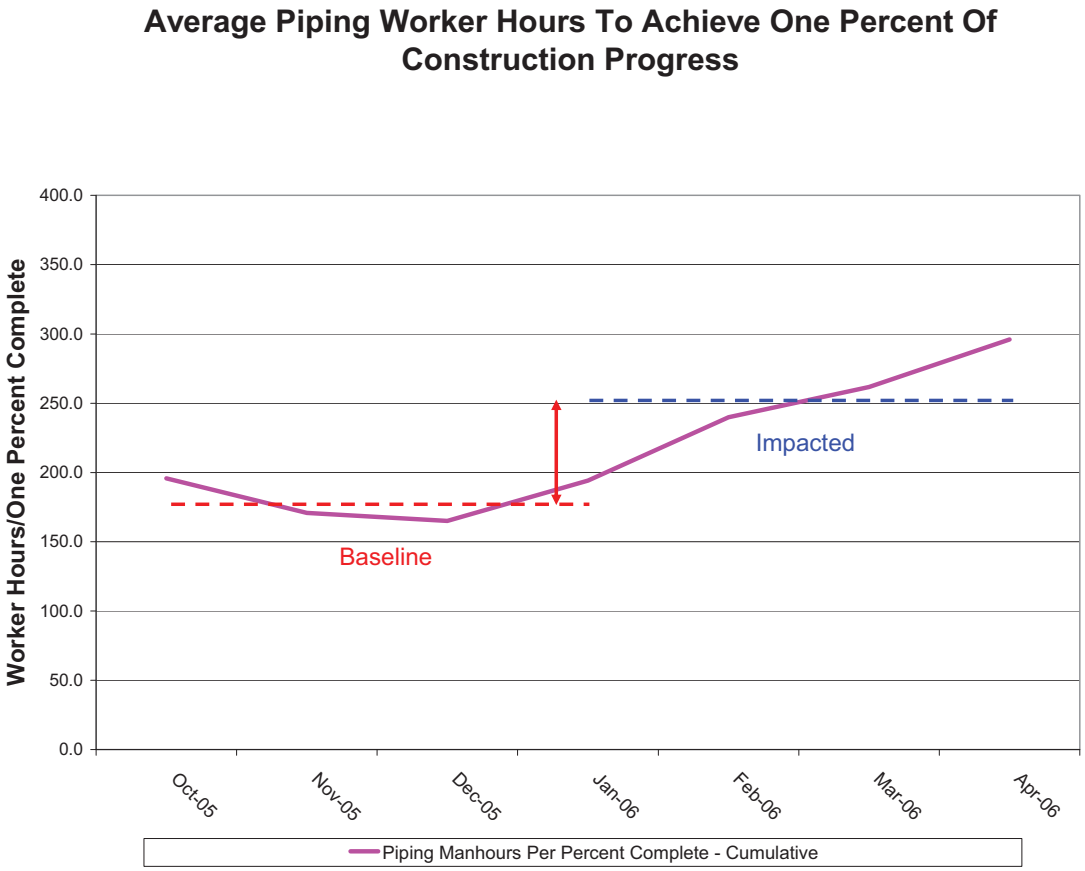

Figure 6

The expended worker hour per one percent complete approach to performing a measured mile analysis makes the requirement of comparing exact work in each period of the analysis unnecessary. This approach also allows the analysis of a project at a slightly higher level (i.e. total piping versus large bore pipe) than are many measured mile analyses performed and therefore fits with the same level that many contractors/subcontractors collect expended worker hour and work progress.

REFERENCES

1. **AACE International Recommended Practice No. 25R-03** *Estimating Lost Labor Productivity In Construction Claims*, on page 11: "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 in impacted and non-impacted sections of the project in order to ascertain the loss of productivity resulting from the impact of a known set of events."

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