Maintaining Control of Labor Productivity

Introduction
In the mechanical contracting sector of the construction industry, as with all labor intensive trades, once the project has been bought out and the material and equipment purchase orders have been entered into the job cost system, the largest single variable (and the most volatile component) that controls profit on the project is the expenditure of labor hours. Therefore, one of the keys to profitability on a project-by-project basis is maintaining control of labor productivity.

Surprisingly, many labor intensive contractors do not make any attempt to monitor and control labor hour expenditures during the life of a construction project. All labor charges are recorded to one or two general project codes, such as “field labor” or “shop labor.” This method of labor control may be adequate for small and very simple projects with limited risks of labor overruns. However, on large and complex projects that offer a mechanical contractor the potential to lose thousands, or perhaps tens of thousands, of labor hours, a system of general and summary level labor tracking results in an unacceptable level of risk. It is not standard practice in our industry for the team that prepared the original estimate to also be the team that manages its installation. Generally, most large mechanical contractors maintain an estimating department comprised of estimating professionals that will not, in the final analysis, be held responsible for the final labor expenditures on the project. Therefore, it is important to conduct in-house project initiation meetings wherein the estimators can explain, in detail, what was included and excluded in the estimate as well as defining any assumptions that were made in the preparation of the estimate. Furthermore, the basis of the labor estimate, along with any factors or special productivity rates that were used by the estimators, can be communicated to the project management team.

With so much profit or loss at stake, it is important that labor-intensive contractors make a management decision to track labor expenditures on a specific and identifiable basis on every major construction project. As set forth in this bulletin, the reasons offered for not tracking field labor are varied and generally lack substance. One excuse that is frequently put forth regarding the contemporaneous tracking of labor by element of work is the difficulty in the field with ensuring reasonably accurate reporting, such as disseminating to the labor managers the meaning of the various labor codes. Since the reporting may be unreliable, a contractor may elect not to maintain reasonably detailed labor records. Other labor managers simply aver that tracking labor by
multiple-labor codes on a regular basis is too much work and the investment of resources is not sufficiently rewarded by the value of the information gained in the process.

This bulletin will explore the arguments supporting more specific and defined labor tracking and some of the methods of achieving greater control over the expenditure of craft labor on construction projects.

**Terms and Concepts Used in Project Planning and Labor Tracking**

**Original Estimate**—the collection of bid forms, take off sheets, labor adjustment sheets, material, equipment and labor pricing documents and other, similar material that comprise the bases for the final labor estimate included in the lump sum bid for the project. Obviously, an important historical set of documents regarding the original estimate are the bid set of drawings and specifications.

**Job Planning (the Job Plan)**—the process whereby the estimators and/or the construction managers divide the original estimate into identifiable units of work to which can be assigned the materials and equipment that must be installed and the labor and construction equipment that is required to complete each unit of work.

**Activity**—the basic unit of work in a construction job plan (and in the construction schedule). The activity is the unit of work into which the overall original estimate is divided for the purposes of tracking and managing craft labor during the construction process. The original estimate is divided into activities during the job planning phase. Each activity is defined by specific geographic or contract boundaries such as: phase, building, floor, sectors and by other designations such as by column lines, systems, rooms, crew codes or other definitions that will allow specific identification of the work on the contract drawings. Each activity should be given a detailed and specific description of up to 48 characters in length in order to comport with critical path method ("CPM") schedules that are typically developed from the job plan activity listing.

The recommended size of the activity (i.e., the amount of work that is included in an activity), and the resulting duration for the activity, are based on the principle of optimized tracking. Optimized tracking refers to the greatest reasonable degree of reporting accuracy that can be expected during the course of the project. The concept of optimized tracking dictates the size of the activity in the job plan, as well as in the project CPM schedule. In scheduling, the general guideline regarding the durations of erection activities for optimized tracking suggests a range of between three to 22 work days for the majority of the activities defined in the job plan. Obviously, some activities will be only one or two days in length by necessity. However the majority of the activities in the job plan and schedule should have durations that fall within the range of 3 to 22 work days. This range or duration for the activities used in the schedule also provides for optimized tracking when these activities are also used in the job plan reporting system.

The duration of an activity is calculated by estimating the number of labor hours that will be required to complete the activity and by estimating the crew size for the work. The duration is derived by dividing the total estimated labor hours by the hours required for the crew per day. For instance, if the activity will consume 640 labor hours and the contractor plans to utilize a crew of four mechanics (i.e., totaling 32 hours per day), the resulting duration for the...
activity would be 20 work days.

Obviously and within reason, the more specific the activity data, the more valuable is the reporting information. Therefore, it is advisable to differentiate between the types of systems that may occur within the same geographic area, resulting in more than one activity in an area. For instance, if the mechanical contractor has HVAC piping, plumbing piping and duct work within the same area, each principal trade would have its work identified by separate activities. Similarly, if the mechanical contractor has large bore weld joint carbon steel pipe, socket weld small bore pipe and thin wall stainless steel pipe work, all in the same area or phase of the project, it is useful to divide this work into three discrete activities by type of piping system based on the crews that will perform the installation work.

Furthermore, the activity should be defined during the job planning phase such that the work can be commenced and not halted until the activity is completed. This is one of the characteristics of an efficiently planned construction project; namely that the activities express continuity of work such that there is no planned “start-stop-start” disruption contemplated in the baseline job plan or CPM schedule.

Once the mechanical contractor has developed its activities, this information should be shared with the prime contractor for integration into the project master schedule. If the prime contractor has already prepared the overall master schedule, the mechanical contractor must determine if the activities created in its job plan comport with the mechanical activities created by the prime contractor. If the activity durations of the prime contractor do not comport with those contained in the mechanical contractor’s job plan, then a written request should be submitted to the prime contractor requesting the required modifications. If the prime contractor refuses the reasonable schedule modification requests of the mechanical contractor, the prime contractor should be placed on notice that the baseline master schedule is not reasonable. Specifics should be provided in the written notice as to the activities and/or logic that are incorrect or inconsistent with the mechanical contractor’s reasonable plan to prosecute its base contract work.

Activity Identification (“ID”) Code— the unique numeric, or alphanumeric, identifier that is given to each activity. The application of activity IDs may be dictated by the contractor’s job costing system, the labor performance software in use and by the scheduling software that may be employed on the project. In order to simplify the overall labor tracking operation on a construction project, it is important to utilize the same codes for all cost, labor and schedule tracking software systems. Having one single set of activity IDs for all control systems used on a project will increase the accuracy of the reporting and reduce the overhead costs to develop and update the systems.

Labor Performance Report (“LPR”)— the report format that provides the planned and the actual performance data for use by field and office management during the life of the project. There is not a single, “best” form of this report and many mechanical contractors have developed their own, highly effective, version of the LPR. The LPR can take on many different forms and is called by different names by various mechanical contractors, but for the purpose of this bulletin, the report that provides the labor tracking information will be known as the LPR. One example of an LPR is shown at the bottom of the following page. The code fields are identified from left to right as
follows:

**Activity ID Code**—the unique identifier for each activity

**Activity Description**—the definition of the work that is to be performed

**Planned Hours**—the originally estimated (or re-estimated hours) hours to perform the work

**CO Hours**—estimated change order, or scope change, hours

**Revised Plan**—the total of the original estimated hours and estimated change order hours

**Last Percent Complete**—the progress of the activity at the previous reporting period

**Current Percent Complete**—the progress of the activity at the current reporting period

**Earned Hours**—the “should have spent” hours (Revised Plan x Current Percent Complete)

**Previous Total Actual Hours**—the actual hours charged as of the last reporting period

**Current Actual Hours**—the actual hours charged through the current reporting period

**Variance Week –2**—the craft hour variance as of two weeks prior to the current period

**Variance Week –1**—the craft hour variance as of one week prior to the current period

**Current Week**—the current period craft hour variance (– over budget / + under budget)

By maintaining a current and accurate job plan, the productivity of each activity of work can be measured on a period-by-period basis (usually measured by pay period). Once the activity ID codes, activity descriptions and the planned hours have been input at the outset of the project, the regular input data consists of: (i) any revisions to the original job plan hours (i.e., changes in scope); (ii) the actual hours from payroll information; and (iii) the percent complete of the activity. In return for the input of the above-listed data, the project team has at its disposal a powerful tool that allows management to review with specificity the areas of labor expenditure that exceed the budgeted job plan labor hours. Most importantly, it permits the project management team to identify specific activities of work that are indicating unproductive progress before the activity is complete, thus

<table>
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<tr>
<th>Activity ID Code</th>
<th>Activity Description</th>
<th>Planned Hours</th>
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<th>Rev Plan</th>
<th>Last % C</th>
<th>Current % C</th>
<th>Earned Hours</th>
<th>PT AH</th>
<th>C Act Hrs</th>
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<th>Wk -1</th>
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allowing the project management team to proactively address the forecast labor overrun before it becomes an historical loss.

**The Purposes of, and Methodologies for, Tracking Labor**

The single, best reason to maintain better control of field labor expenditures is to increase profit. There are other sound reasons for a higher degree of labor control on construction projects, which include:

- Establishing, or verifying, the accuracy of the contractor’s bidding units
- Developing an early warning system that will allow proactive management intervention
- Mitigating, or documenting, the inefficiencies associated with non-contractor caused impacts as well as accurately quantifying the associated costs

In fact, these reasons to track labor expenditures contribute to the concept of maintaining, or increasing, profit on the project. The job plan should be developed with the input and direct assistance of the field labor supervisors (sometimes called the labor superintendent or general foreman). The inclusion of the principal labor managers will increase the opportunity for accurate labor reporting. An essential element of
accurate labor reporting is the clear definition of the work included in an activity.

Documenting the elements of an activity is an essential ingredient in achieving accurate labor reporting. One means of meeting this goal is to mark the outlines or boundaries of each activity on a set of contract drawings. The graphic example below shows how depicting the extents of a specific job plan activity can provide relevant documentation that can be constantly referenced during the life of the project.

In addition, other forms can be utilized to capture the details of each activity that can be referenced during the project to ensure that the actual labor hour reporting is accurate. The form shown below has been used on large and complex projects to document the labor, equipment and material required to perform each activity. The form allows the contractor’s planning team to record each set, or task, which will be required to complete the activity. Such records can substantially improve the quality and accuracy of actual labor hour reporting in the field.

Any project reporting system requires an investment in terms of management resources. If a contractor expects to derive valuable management information from any reporting system, whether cost or labor efficiency, attention to detail and accuracy are a necessity. A “corporate culture” that supports accurate cost and labor reporting is essential. Once the initial data has been input and collected, the contractor has the following data that must be accurately coded and input on a period-by-period basis:

- Actual field craft labor hours charged to each activity ID code
- Estimated scope change hours that must be input to update the job plan
- Current period percent complete progress by activity ID code

The foregoing represents the ongoing data that must be collected and entered into the LPR to allow the report to provide a variety of output data that can be used by the project management team proactively to address productivity “events” that serve to reduce profits and/or cause delays to the construction schedule. The software cost for implementing and maintaining a labor tracking and trending system is not the limiting factor for the use of such systems. Reporting systems as described herein can now be accomplished using some of the more advanced features of Microsoft Excel®. Therefore, the actual costs of the software and computer platform to run such systems are no longer a bar to their implementation. It is simply reduced to the will of the mechanical contractor to track the expenditure of its most valuable and volatile resource—field labor.

With an accurate LPR, the project management team can readily and effectively evaluate the productivity of defined areas of the project including specific crews, labor managers or other defined features of the work. Often, inspection of the updated job plan activity ID codes will alert the project management team to inefficient labor trends that can be investigated by physically observing the work and interviewing the labor foremen to determine whether the deteriorating labor productivity has been caused by changed conditions, unanswered RFIs, other impact events beyond the control of the mechanical contractor or self-induced inefficiencies.

However, if the contractor does not institute quality control checks and
reviews of the data and the period-by-period coding of the actual labor hours to the job plan activity ID codes, the resulting inaccuracies arising from this neglect may render the LPR unreliable. For instance, some mechanical contractors offer a bonus to labor managers for hours saved on the project. This program may have the unintended effect of promoting the “balancing” of actual labor hour charges each reporting period. If the craft labor manager sees an activity ID code decreasing in efficiency (i.e., the negative variance increases each period), there may be a temptation to improperly reassign craft hours from the inefficient code to a labor code that is reporting highly productive work. This sort of “balancing” renders the LPR information suspect and unreliable.

Every reasonable effort should be engaged to ensure that the craft labor managers who generally decide to which activity ID code actual labor hours are assigned are charging the hours to the correct activity ID codes. This may even entail changing the contractor’s bonus incentive plans to move away from bonuses granted purely on incremental reporting of labor efficiency. In addition, the labor managers must be given the time and clerical support to allow for accurate collection of the necessary data. Whatever steps are employed to ensure accurate charging of actual labor hours will be effort well spent in terms of providing an invaluable tool for the project management team to detect potential losses of labor productivity before they become significant.

The primary goal of the labor tracking and trending methods described herein

![Activity Planning Form](image-url)
is to increase profit. The mechanism by which that goal is achieved is known as "proactive management." Simply put, this sort of management occurs when a project team is able to identify negative trends within its labor budgets early enough to allow the manager to identify the discrete work activity in which the inefficiency is occurring and to take steps to totally remedy or mitigate, or at least identify the source and location of, the productivity loss. Assuming that the activity has been properly developed, it will have definable and specific geographical boundaries such that the labor manager can walk onto the project and "stand" in the area of the activity. The presence of such specific labor tracking and trending can allow the manager to evaluate the potential causes of the reported inefficiencies and take the appropriate action before the loss becomes project-wide.

**Labor Productivity Trending**

In order to grasp quickly the overall labor productivity on a construction project, it is essential that the data be presented in a format that can be readily acted upon by the management team. Various summary reports and trending curves can be produced from the LPR. For instance, from the summary of the LPR, the total project (or the mechanical portion thereof) can be computed on a period-by-period basis. This data, in combination with the variances computed within the LPR, can be combined to create a curve or trend of labor productivity, as can be seen in the example below:

From this sample curve, the trend of the labor expenditures can be plotted and

![Labor Productivity Variance Tracking & Trending Curve](image)

quickly evaluated by the project
management team. On this example, the total project percent complete, labor hours over/under budget and percent variance are shown on one chart. These types of easily assimilated graphic presentations can be augmented with other types of “roll up” trending reports that have their data derived from the LPR without any further input by the project team. Other sorts of “roll up,” summary level reporting that can be generated from the data described previously herein includes the following example:

Such summary level reports require no further input from that described herein and can provide valuable management information. From the above example, the following data can be derived:

- Total hours ahead or behind the job plan
- Total project percent complete in terms of labor hours
- Progress gained by period in terms of labor hours
- The progress (by percent complete) that must be achieved by period
- Required crew size at the planned rate of performance
- Required crew size at the actual rate of performance
- Historical reporting on the activities that have been completed
- Trending of the active activities

These data can provide further insight into the typically non-linear expenditure of labor hours on a construction project and within each discrete activity. The object of any reporting methodology and output reporting is to increase profits and eliminate the end-of-project labor

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**Labor Performance Summary**

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<th>12/24</th>
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loss “surprise” that afflicts a large number of otherwise sophisticated and successful mechanical contractors.

**When Loss of Labor Productivity Claims Arise**

On some projects, the mechanical contractor sustains a substantial loss of labor productivity for which the contractor seeks recovery from a prime contractor or owner. Each year, MCAA member firms incur hundreds of millions of dollars in unplanned labor expenditures due to loss of productivity impacts not caused by the mechanical contractor. To the extent that it can be demonstrated that the mechanical contractor was not the cause of such losses, it may be necessary to develop a loss of productivity claim. In some cases, the very survival of the contractor may depend on the success of such a request for equitable adjustment. Once the mechanical contractor’s estimate has been eliminated as the source of the loss, the mechanical contractor should determine what other events cause the loss of productivity. Some commonly overlooked items are the impacts of RFI’s, field change directives and “field fit-to-suit” conditions, which are seldom incorporated into the compensation for change orders. After careful evaluation of the events that adversely affected the labor productivity on a project, the mechanical contractor has the option of either absorbing the loss or preparing a loss of productivity claim. One of the acceptable methods of computing loss of productivity is the “measured mile” method. This method is described in the bulletin describing “How to Use the MCAA Labor Factors.” Simply put, this methodology computes inefficiencies by measuring a contractor’s actual productivity rate achieved in a time frame or area of lesser impact and compares the contractor’s actual productivity in a time frame or area of representative impact.

Among other information that is necessary in order to perform a measured mile analysis, the contractor must have available comparative data in order to compute the varying production rates. If the contractor maintained an LPR system similar to that described herein, then the data required to perform a measured mile analysis can usually be compiled.

By referencing its estimate, or by taking off systems by activity ID codes, the contractor can equate labor hours to the quantity of material installed. A measured mile analysis requires knowing the actual hours expended to install a unit of material; for instance, hours actually expended to install a linear foot of 14” ASTM A-53 schedule 40 butt weld pipe by area or time frame. The vast majority of mechanical contractors do not track materials installed on a period-by-period basis. However, the materials and conditions of installation can be readily analyzed by reviewing the historical data that supports the job plan and the LPR. Assuming the mechanical contractor has retained the records (such as contract drawings marked by activity ID code or the Activity Planning Form) that provide the basis of each activity, the materials installed in the activity can be estimated or, if the Activity Planning Form has been used, the material data are readily available without the need to reestimate the materials.

Assuming that the contractor has accurately recorded the actual hours charged to each activity ID code, the hours required to install the material and equipment within an activity are identifiable. With that information in hand, a contractor can compare the labor required to install systems in less impacted time frames or areas with the labor required to install similar systems in the impacted time frame or area. The measured mile method is not dependent...
upon the contractor’s estimate because it uses actual installation rates achieved on that particular project site to form the basis of the productivity comparison. As noted in “How to Use the MCAA Labor Factors,” on some projects it will be impossible to perform a measured mile analysis, even if proper labor productivity data is available. On many projects, there is no identifiable unimpacted, or less impacted, period thereby preventing the contractor from applying a measured mile analysis. In such cases, the MCAA factors described in “Factors Affecting Labor Productivity” and “How to Use the MCAA Labor Factors” can be useful in estimating the cause and effect of various sources of inefficiency such as “Reassignment of Manpower,” “Crew Size Inefficiency,” “Dilution of Supervision” and “Overtime Inefficiency.” This data and an explanation of what a loss of productivity claim entails are addressed in the other MCAA bulletins as noted above.

Conclusion
Measuring labor productivity during the course of a construction project requires discipline, dedication of the labor management team and an earnest desire to understand the somewhat ethereal and amorphous concept of labor inefficiency. The pursuit of this understanding, however, can lead to more profitable construction projects and avoidance of substantial losses that are occasioned by impacts causing loss of labor productivity.

Author’s Note
Obviously, the labor tracking and trending concepts described herein were not originated by the writer. I am compelled to credit many experienced and highly profitable mechanical contracting firms, well known within the MCAA membership, for developing, testing and proving the inestimable value of the labor tracking and trending systems described in this bulletin. The writer had the privilege of having been employed by one such firm and had the opportunity, on a first-hand basis, of experiencing the hard work developing and maintaining an accurate LPR system and also of witnessing the material benefits that resulted from this proactive management concept.

Paul L. Stynchcomb, PSP, CFCC FTI CONSULTING

1 For the purpose of increasing the competitive nature of a bid, many mechanical contractors “discount” the detailed labor estimate by some factor or percentage. Any such adjustments should be carefully documented in the bid file.

2 In today’s construction environment, the most widely used CPM scheduling software system is Primavera®. This software system allows activity descriptions of up to 48 characters in length, however the software allows for many additional fields into which the planner may place area, floor, column line, crew identification, or other code information in order to track the activity with greater particularity.

3 “Erection Activity” as opposed to procurement activities, such as “Fabricate and Deliver Chiller,” which may have a duration of many months and will not be assigned field erection labor in the job plan or in the schedule.

4 Some mechanical contractors require that the construction team “re-plan” the project once it has been transferred from the estimating department. The construction team may find differences in the construction estimate” as opposed to the original estimate. The job plan should reflect the planned hours determined by the team that will actually take responsibility for the profitability of the project.

5 The frequency of the reporting periods is generally governed by the frequency of the pay periods of the field craft labor, which is usually weekly or twice monthly. The longest
effective reporting period in terms of labor tracking and trending is approximately monthly.

6 Many mechanical contractors find it very valuable, and highly profitable, to have the construction team perform a re-estimate of the project before commencement of the work. While time-intensive, this operation provides an invaluable learning experience for the project team concerning the particulars of their specific project and will provide for a reasonably detailed job plan that relates to the manner in which the project team will actually prosecute the work. Another benefit of this process is the identification of long lead-time procurement items.

7 To the extent that change orders have been issued, the original estimate for materials must be adjusted for the material items added by the change orders to create the “adjusted estimated quantities.” This is true for field labor as well.

Prepared by Paul Stynchcomb, PSP, CFCC of FTI Consulting, with peer review performed by: Ronald Pearson, President/CEO of The NewMech Companies; Matthew Hahr, V.P. of John J. Kirlin, Inc.; Richard Freeman, Exec. V.P. of Stromberg Metal Works, Inc.; Robert Cox, Esq. of Watt, Tieder, Hoffar & Fitzgerald; and Robert Windus, Esq. and Stuart Sakwa, Esq. of Moore & Lee, LLP.