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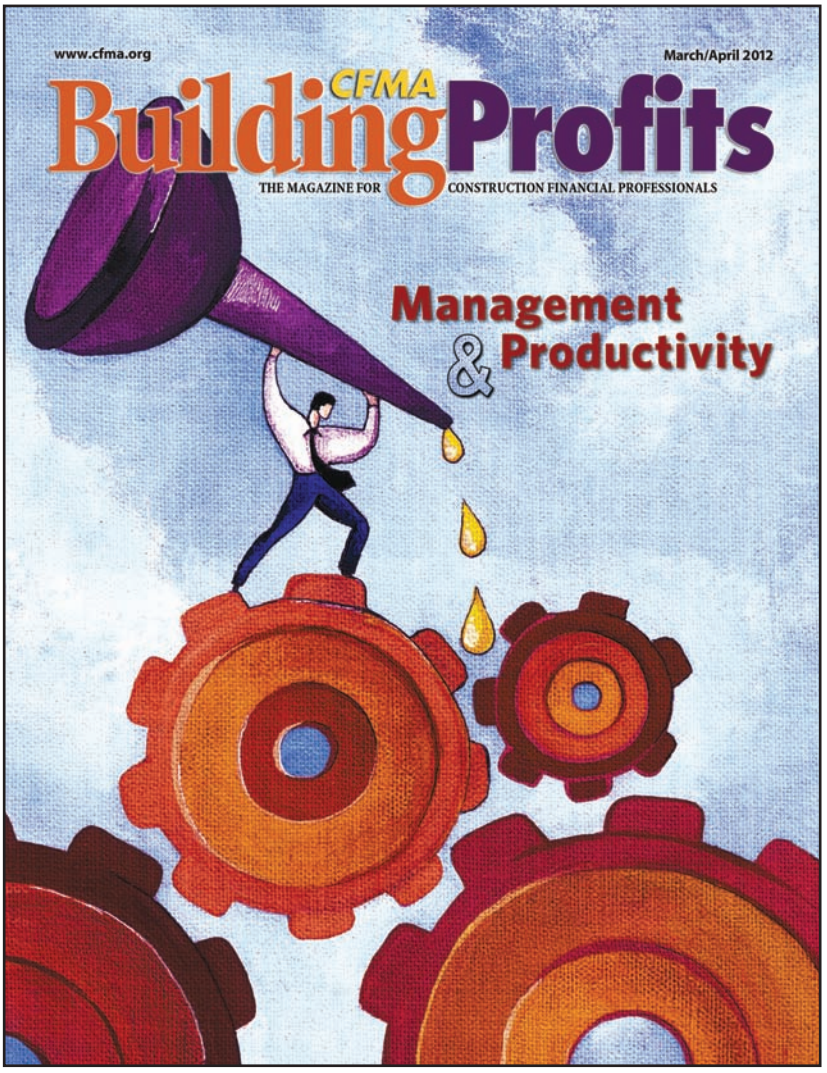

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CONSTRUCTION FINANCIAL MANAGEMENT ASSOCIATION
The Source & Resource for Construction Financial Professionals


New
PRODUCTIVITY
MEASUREMENT
STANDARD
AFFECTS REVENUE RECOGNITION

Construction productivity has historically lagged other industries, as shown below. Until it is correctly measured, it cannot be improved.

BY DR. PERRY DANESHGARI & HEATHER MOORE

The lack of a reliable method to measure productivity led the National Institute of Standards and Technology (NIST) to turn to ASTM International, formerly known as the American Society for Testing and Materials (ASTM), to develop a standard for job productivity measurement in construction.

The ASTM Standard Practice for Job Productivity Measurement (ASTM E2691-09), known as JPM, measures construction productivity periodically and continuously to inform project stakeholders about productivity changes.[1] By measuring productivity changes during construction at the task, project, and industry levels, issues can be resolved early enough to reduce waste and minimize errors. The use of this standard will hopefully lead to an elevation of construction productivity on par with other industries.

The JPM Standard

JPM measures and quantifies all activities performed to accomplish the final task of installation and distinguishes the factors that contribute to construction put in place (CPIP) from those that detract from it, such as unscheduled activities, unnecessary material handling, rework, trade interferences, and out-of-sequence work.

Using JPM provides a way to measure the progress of performance obligations by measuring the job's progress based on an aggregation of measurements of all small segments of the contract obligations. This type of tracking takes the guesswork and reporting burden out of determining the percentage of completion (POC) with the effort-expended method.

This article will introduce the three principles of JPM, explain how this standard can be used for revenue recognition based on the percentage-of-completion method (PCM), and demonstrate how it can help improve your company's productivity.

Principle #1: Transfer of Value

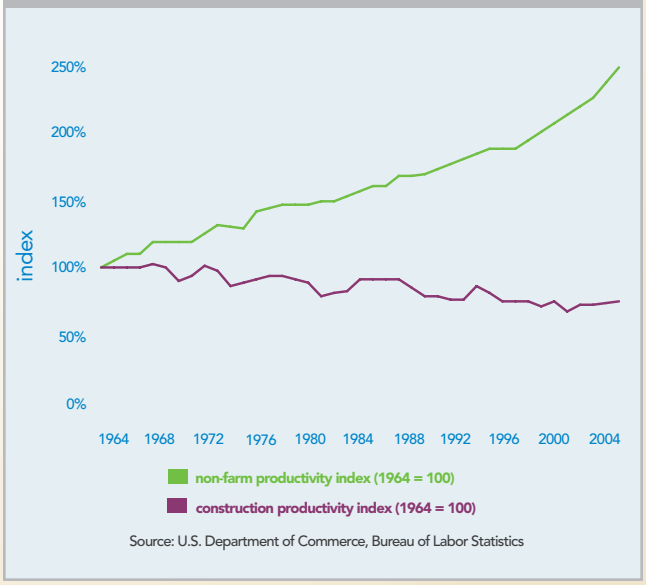
One of the fundamental principles used in the development of JPM is transfer of value with the lowest amount of errors and wasted activities.[2] The final user of a construction project considers value transferred to him in exchange for his capital and effort.

The activities that transfer value must be recognized and managed in order for a contractor to ensure the transfer of value to the end user.

Recognition of the activities that enable the transfer of value from designers, architects, engineers, builders, GCs, subcontractors, and distributors to the end user vs. the activities

Exhibit 1: Construction & Non-Farm Labor Productivity Index

Constant Dollar Contracts/Work Hours of Hourly Workers 1964-2004



Source: U.S. Department of Commerce, Bureau of Labor Statistics

Exhibit 2: Construction Activities & Attributes That Transfer or Do Not Transfer Value		
Transfer Value	**Necessary, But Do Not Transfer Value**	**Do Not Transfer Value**
Planning	Inspection	Material handling
Externalizing work (prefabrication)	Moving material to the location	Material movement (other than from delivery truck exactly to the point of installation)
Quality	Garbage removal	Rework
Safety	Permits and government regulation compliance	Repair
Reliability	Labor limitation	Errors
Predictability	Construction site space limitation	Unnecessary movement
Final assembly	Shiftwork or adjustment to operating environment	Following up on missing or incorrect information
Construction put in place		Waiting for lifts or rest area
Recordkeeping – BIM		Walking to and from point of installation
Time and cost		

that contribute to rework and waste can only happen at the point of final work and installation. Only the installer knows all of the activities that contribute to each installation, can identify performance obligations, and knows when the work is completed and ready to hand over to the customer.

Identifying which activities transfer the required value vs. those that do not will help set more accurate benchmarks for the production rate measurement and avoid hidden losses as the work is performed on the jobsite. Exhibit 2 above shows the types of activities that transfer value, those that do not transfer value but are necessary to a project, and those that do not transfer value.

Principle #2: Measure Changes in Production Rate

Changes in production rate must be visible as the project unfolds in order to improve safety, reliability, predictability, and productivity. Traditional techniques or benchmarks that measure the POC are valuable for measuring the production rate. But, they mask activities that do not transfer value and, therefore, do not capture the impact of daily obstacles (such as trade stacking, trade interference, absenteeism, lack of access to areas, etc.). In other words, a jobsite is treated like a "black box" in which only the input to it and output from it are compared. This type of treatment hides the contributors to good and poor productivity.

Unlike these traditional techniques, the JPM standard hones in on specific activities that cause changes in production rate so that they can be measured and corrected.

For example, a contractor working on a tunnel project couldn't determine why the job was so far behind schedule, since no incidents or change orders were reported that would stall production.

Once the JPM standard was implemented, the contractor realized that it took workers 20 minutes to walk down the tunnel to the actual jobsite. This meant 20 minutes at the start of each day, plus 20 minutes each time someone took a break, had lunch, etc., which adds up over the course of days, weeks, and months.

Once this fact was discovered, break facilities were added at the location of work and the impacted contractors were compensated for the extra hours needed to walk to the relocation of work.

Principle #3: Difference Between Construction Output vs. Outcome

An understanding of the difference between construction output and outcome is required to realize what productivity means and how it is measured in the JPM standard.

Construction *output* quantifies the work performed on a project (e.g., number of fixtures installed, lineal feet of ductwork installed, time spent installing windows, etc.). However, the measurement of the *outcome* of that work is the POC of individual activities including all the tasks required to complete the work in a format that is acceptable by the customer – independent of how much time is spent or how much work is performed.

This is the crux of the difference between output and outcome; performing work does not always result in completed work – in other words, work does not equate to production. Only the customer can determine whether or not a performance obligation has been met.

Let's consider an example that distinguishes between the two: If one of a contract's performance obligations is to pour a concrete slab, then the measure of cubic yards poured per hour is a measure of output. This measurement does not report whether or not the pour is correct and complete from the customer's perspective.

Completion of the concrete pour can only be counted as 100% complete when the performance obligation has been fulfilled and accepted by the customer – independent of how many hours it took to complete or how many cubic yards of concrete had to be poured.

PCM for Revenue Recognition

In construction, the percentage-of-completion method (PCM) is used to calculate long-term project revenue. Under current guidance, there are three allowable methods to measure progress billing under the PCM for both accounting and tax purposes:

1) Cost-to-cost, which measures POC based on costs expended to date as a portion of estimated total costs at project completion;
2) Effort-expended, which measures POC based on the actual work performed; and
3) Units-of-work performed, which measures POC based on the quantity of material installed to date as a portion of the expected material in place at project completion.[3]

The most popular method used by contractors is cost-to-cost, which assumes that a construction project's POC directly relates to its incurred costs. This assumption is the basis of the accounting-based Earned Value Analysis (EVA), which also measures completion based on cost.

However, there are some project activities where cost is not representative of the contribution to CPIP. In addition, EVA neglects to account for many activities that lead to the final assembly of a project, such as:

- Planning
- Prefabrication
- Preassembly
- Preparation for installation (e.g., layout and benchmarks, gathering tools and equipment)
- Material handling
- Modeling (CAD, BIM, GPS), testing, inspection, and commissioning

Units-of-work performed can also be used to measure POC; however, correlating POC with installed material could mask flaws or incorrectly installed material that would need to be reworked later.

For example, if a contractor estimated that a certain task required 1,000 feet of pipe and 1,000 feet were installed, then the units-of-work performed POC measure would be 100%. But, if the wrong size pipe was installed, then the performance obligation would not be fulfilled and this measurement would not reveal the problem.

Exhibit 3: Sample Use of JPM for POC Method

This exhibit represents an excerpt of the JPM information for a job; in this case, the job's total BLHB is 4,170. It is of utmost importance to recognize that the JPM's total percent complete is not a reported number by the field staff, but rather a calculated value based on the percent complete of each individual cost code and its weight contributing to the total job.

(UNIFORMAT II Level 3 Individual Element) Cost Code		Tasks	Baseline Labor Hour Budget (BLHB)	BLHB Task Weight per Cost Code	BLHB Task & Cost Code Weight per Job	Observed Percent Complete	Expended Labor Hours	Percent Productivity Differential
Electrical Service & Distribution	Main Switchboard	Remove Existing Switchboard	100	8%	2.4%	100%		
		Install Switchboard – Equip. Room 1	100	8%	2.4%	50%		
		Install Switchboard – Equip. Room 2	90	7%	2.2%	20%		
		Test & Inspect S. Board – Equip. Room 1	60	5%	1.4%	0%		
		Test & Inspect S. Board – Equip. Room 2	40	3%	1.0%	0%		
	Primary Transformer	Remove Existing Transformers	85	6%	2.0%	95%		
		Install Transformer – Equip. Room 1	95	7%	2.3%	5%		
		Install Transformer – Equip. Room 2	90	7%	2.2%	0%		
		Test & Inspect Transformer – Equip. Room 1	50	4%	1.2%	0%		
		Test & Inspect Transformer – Equip. Room 2	40	3%	1.0%	0%		
	Branch Circuit Panels	Remove Existing Panels	95	7%	2.3%	100%		
		Install Panels – Equip. Room 1	80	6%	1.9%	80%		
		Install Panels – Equip. Room 2	75	6%	1.8%	50%		
		Test & Inspect Panels – Equip. Room 1	70	5%	1.7%	0%		
		Test & Inspect Panels – Equip. Room 2	60	5%	1.4%	0%		
	Conduit Wiring to Circuit	Small Feeders	95	7%	2.3%	90%		
		Large Feeders	90	7%	2.2%	100%		
Source: ASTM E2691 Standard			1,315	100%	31.5%	48%	450	**28%**

In this example, the POC is measured by using a Work Breakdown Structure (WBS) of the activities required to complete the project, as identified by a project's field staff and project management.

JPM Billing & Revenue Recognition

The JPM method provides a new means for measuring POC to recognize how much of the output fulfills contract performance requirements and, therefore, is acceptable by the customer for billing.

Traditional calculations of POC primarily rely on cost-to-cost or units of work performed, which do not provide reasonably accurate and quantifiable estimates of the construction progress toward contract completion. (See PCM for Revenue Recognition on the second page.)

The JPM standard is the first method to accurately provide a measure that can be used to quantify and bill based on the effort-expended method and addresses revenue recognition based on the actual observed POC reported by the field staff. JPM provides more substantiated and accurate progress billings for the customer, since it correlates to CPIP. It also improves the billing accuracy for the contractor, since all of the activities are correctly identified in the WBS as value transferring, and therefore can be billed for – regardless of the cost incurred.

This means many non-installation and value-transferring activities (e.g., prefabrication, material kitting, or assembly) that contribute to installation can be quantified as effort expended. And, if the CPIP is further in progress than the costs expended on a project (due to better-than-planned productivity, which would be visible if JPM is in place), then the contractor can take advantage of its productivity gain and bill for the CPIP.

JPM also reduces billing highs and lows during project progress, which results in a more stable cash flow for both the contractor and customer.

JPM Billing Process

JPM requires a contract to be broken down into tasks (including all activities that lead and contribute to final installation) using a WBS and assigns budgeted hours as a baseline to each activity. Then, the observed percent complete of those activities is recorded at regular intervals (usually weekly) and compared against the actual hours spent on major project cost codes.

The job productivity differential is then calculated, which shows the percent difference between the labor productivity reference point and the productivity based on the current job performance.

Exhibit 4: How JPM Impacts the Gross Margin Calculation

The actual costs include labor, equipment, material, etc.; they stay the same regardless of billing method used.

$$\text{Gross Margin} = \frac{\text{Job-to-Date Earned Revenue} - \text{Job-to-Date Actual Costs}}{\text{Job-to-Date Earned Revenue}} \times 100\%$$

The Job-to-Date Earned Revenue is determined using JPM output to measure POC.

Exhibit 5: Comparison of Cost-to-Cost to JPM POC

Contract Value: $1,000,000 • Estimated Cost: $800,000 • Estimated Gross Profit: 20%
2 Months Later, Work in Progress Information:

	Cost-to-Cost-Based	JPM-Based
Job-to-Date Cost	$200,000	$200,000
POC	Cost-Based Percent Complete $200,000/$800,000 = **25%**	Observed Percent Complete = **30%**
Earned Revenue	$1,000,000 X 25% = $250,000	$1,000,000 X 30% = $300,000
Job-to-Date Profit Margin	$\frac{\$250,000 - \$200,000}{\$250,000}$ x 100 = **20%**	$\frac{\$300,000 - \$200,000}{\$300,000}$ x 100 = **33%**

Exhibit 6: POC on a Monthly Basis

Using Cost-to-Cost vs. JPM

	Project Data			Cost-to-Cost Method			JPM Method		
	A	B	C	D	E	F	G	H	I
	Selling Price (Including Overhead & Profit)	Estimated Total Cost	Cost Incurred to Date	Percent of Estimated Cost Incurred to Date = column C / column B	Amount to Bill = column A* column D	Job-to-Date Gross Profit Margin = (column E – column C) / column E	Observed Percent Complete	Amount to Bill = column A* column G	Job-to-Date Gross Profit Margin = (column H – column C) / column H
Mar-10	$2,798,428	$2,609,450	$281,821	10.8%	$302,230	6.8%	10.1%	$282,461	0.3%
Apr-10	$2,798,428	$2,609,450	$341,838	13.1%	$366,594	6.8%	14.2%	$397,377	14.0%
May-10	$2,832,439	$2,609,450	$417,512	16.0%	$453,190	7.9%	18.0%	$509,839	18.1%
Jun-10	$2,832,439	$2,609,450	$438,388	16.8%	$475,850	7.9%	18.7%	$529,666	17.2%
Jul-10	$2,832,439	$2,609,450	$594,955	22.8%	$645,796	7.9%	26.7%	$756,261	21.3%
Aug-10	$2,832,439	$2,609,450	$879,385	33.7%	$954,532	7.9%	37.4%	$1,059,332	17.0%

For billing purposes, the schedule of values (SOV) is created according to the WBS. The project's POC is measured based on the aggregate of the tasks' POC to date. It is of utmost importance to recognize that the JPM's total percent complete is not a reported number by the field staff, but rather a calculated value based on the percent complete of each individual cost code and its weight contributing to the total job.

In turn, the cost code percent complete is also calculated based on the individual activities reported under that cost code and their weight. The SOV creates the basis for monthly billings to be submitted as construction proceeds. The amount to bill and revenue are calculated based on the percent complete as work progresses.

Sample Billing Comparison of Cost-to-Cost & JPM Methods

Under the cost-to-cost method, the percent complete for each cost code is derived from dividing job-to-date actual costs by estimated total costs. This percentage is then multiplied by the contract amount to determine the earned revenue for the billing period.

Under JPM, the observed percent complete is a measure of effort expended and is used to calculate the amount to bill by using the percent of work complete (rather than percent of contract cost incurred) to determine the proportion of the selling price that can be billed. (See Exhibit 3 on the third page.)

Gross Profit Margin

The JPM method for revenue recognition also impacts the calculation of gross profit margin on projects. According to *Financial Management and Accounting for the Construction Industry's* definition of gross profit margin (contract price minus contract cost), the contract price is represented as the amount billed monthly on a project and the contract cost is independent of the revenue recognition method used.

The contract price is determined as the portion of the contract value recognized to date, which will change as a project progresses. Exhibit 4 on the previous page shows how JPM impacts the gross margin.

Sample Profit Margin Comparison of Cost-to-Cost & JPM Methods

Exhibit 5 on the previous page shows how the calculations compare for the amount to bill based on cost-to-cost and JPM methods for the same project. In this scenario of a $1 million project, the observed percent complete measured with JPM is higher than the cost percent complete for the billing cycle; therefore, the earned revenue and gross profit are higher.

Exhibit 6 shows monthly calculations of earned revenue and gross profit by comparing cost-to-cost and JPM methods from an actual project example. In some months, the cost-to-cost percent complete is higher than the observed percent complete, which could be caused by the lack of recognition of

the effort expended on tasks that contribute to installation or lower than expected labor productivity during that time.

In other months, when observed percent complete is higher than the cost-to-cost percent complete, the amount to bill is higher and shows that the labor productivity is better than expected, which is another positive outcome of using effort-expended to measure POC.

Exhibit 7 below uses the data from Exhibit 6 to show how JPM can lead to more accurate billing based on CPIP. In March, the observed percent complete is lower than the cost percent complete.

However, as the project progresses, the labor productivity improves and, in effect, increases the revenue earned to date. In August, since labor is more productive than expected, the revenue earned based on the JPM method is more than that earned using the cost-to-cost method (i.e., more CPIP than labor cost expended for the same time period).

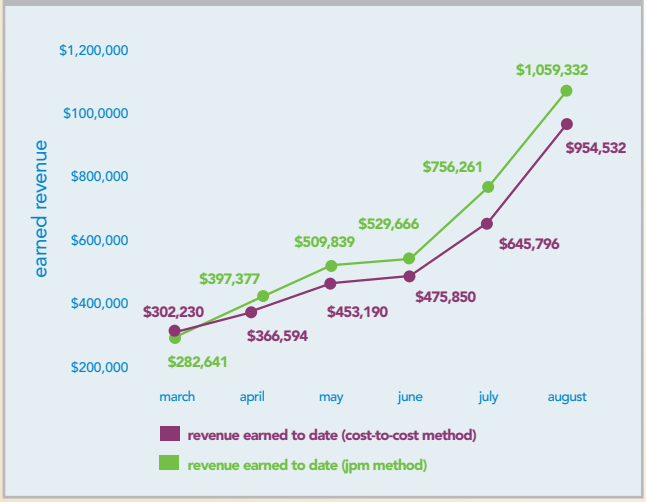
Summary

JPM recognizes revenue by separate performance obligations, which includes all the intellectual property as well as planning activities, and satisfaction to the performers of all types of contract work through the effort-expended method.

It can be used to improve billing by using the observed percent complete (as reported regularly from the project) as the quantification of POC, which can then be used to calculate the project's earned revenue. This helps reduce the effort to bill, provide substantiation for the amount billed, and advance the timeline of cash flow for the job.

Overall, JPM can help a contractor improve its financial performance, cash flow, and gross profit. ■

Exhibit 7: Monthly Revenue Earned



Endnotes:

1. *www.astm.org/Standards/E2691.htm.*
2. The concept behind transfer of value is built on John Nash's contributions to game theory, known as Nash equilibrium.
3. Jensen, D. and Craig, J. "The impact of TAMRA '88 on U.S. Construction Accounting Practices." *Construction Management and Economics*, Vol. 16, No. 3, pgs. 303-313, 1998.

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