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Job Porosity: Identifying the Risk Factors for Project Financial Outcomes

By Dr. Perry Daneshgari & Dr. Heather Moore

Every project has associated risks at the onset of project start up. These risks can be divided into three categories: business, technical, and integration. Most of the risks, which show up during the project's life cycle, will not be known at the estimating and handoff stages of the project.

To assess the risk of projects prior to winning the job or at the start of it, contractors can rely on their experience of past projects or, better yet, have a process in place to rely on data based on multiple factors and degrees of freedom. Collectively, these risk factors are known as *job porosity*.



This article aims to explain and show the measure of job porosity as well as describe the data-based modeling to help contractors build their project's porosity factors.

CONSTRUCTION PROJECT PROCESS

Given the number of challenges in construction, a common perception is that every job is unique, and because of this, it is difficult to control and predict project outcomes. However, by collecting and analyzing the data between three independent data sources — estimating, field, and accounting — a predictive model for project outcomes has been developed.

A construction project takes such inputs as workforce power, money, and material and transforms them into a built structure with some level of time, cost, quality, and safety. In between the inputs and outputs is the construction process, which transfers the inputs to the outputs.

What makes each job seem unique is the lack of data and study within that process. Each job has inherent characteristics that will influence how the construction process will unfold; by knowing these characteristics in your company and using them to quantify the outcome, the project's financial outcomes can be predicted even before the project is awarded.

MEASURING JOB POROSITY

The owners or executives of construction companies with more than 30 years of experience can share war stories, usually tinged with emotion, with plenty of examples of bad jobs and good jobs, explaining what happened before, during, and after those jobs. Through their experiences, their wisdom is the best input to the estimating process, padding jobs that have certain conditions and shaving others based on where they know the company can take the risk. These conditions are known as the *wisdom factors*.

The job porosity factors very often match these wisdom factors; however, by adding data, the job porosity indicator will

make the risk analysis based on *data factors*. As such, the factors can be weighted (based on their true impact) and studied for relationships.

Whereas wisdom may say a certain factor matters, the data may provide more context as to where the factor matters in certain conditions or when it is confounded with other factors, as explained later.

To develop these data-based factors, MCA, Inc.'s Research and Development department set out to investigate if job porosity could be predicted and quantified. After studying data from several companies that have applied Agile Construction®, key factors that represent pores in a job were identified, resulting in leaky profits.

This starts by identifying projects that have profit fade, which is defined as not making the estimated gross profit on a project. So, if a project's estimated gross profit margin was 15% and the project finished with a 10% margin, then there was a five-point fade in profits.

All companies have profit fade and gain on their projects, and as long as the net is positive, the contractor stays alive another year. However, job porosity research identifies common characteristics associated with the fader projects so they can be predicted even at bid time and mitigated on an awarded job.

Exhibit 1 shows a schematic of the concept of job porosity, where a company's project delivery system has certain characteristics that allow projects to fade based on given layers/conditions. Depending on if, and how much of, a job contains a certain factor, the job porosity factor predicts likelihood of fade. Common characteristics of project fade (job porosity factors) are explained next.

It is critical to scrutinize the data source and quality prior to looking for job porosity in your company. Contractors cannot pinpoint their true cost drivers, such as which cost or labor codes drive project outcomes, unless they use a process for measuring job productivity, such as ASTM E2691-20.¹

What Is Job Porosity?

The measure of job porosity uses a company's project performance to predict outcomes based on certain factors, such as:

- Estimating misses
- Labor code variation
- New markets
- Project duration
- Scope management/change orders
- New employees

Porosity is a measure of a substance's void space at a very granular level. In other words, the porosity of a given material is a ratio of pores (holes or empty spaces) to material. The higher the porosity, the easier it is for air, water, etc., to flow through.

Dr. Perry Daneshgari conceived job porosity as a measure of a project's losses based on its characteristics. The job porosity factor assigned to a project is the likelihood of profit fade, and higher job porosity leads to higher profit fade, labor losses, and overall wasted resources.

Without a reference point independent from estimating, and progress measurement independent from accounting (labor hours), the true variation in performance is not measurable. There may be data available that shows variation, but the underlying source of the data does not reflect performance.

Without those independent measures, what would stop the labor from moving hours from one labor code to another or from moving costs from one cost code to another when they run out of hours (or cost) on the planned codes? It happens all the time and leads to unreliable data, and therefore, explains why job porosity cannot be studied.

COMMON JOB POROSITY FACTORS

Estimating Misses

When a job goes south, how often are you in the crossfire between “it was a bad estimate” and “they’re messing up in the field?” How do you know the right answer? Without a third reference point between estimating and accounting, it is hard to stop the blame game. So much can change from the estimate to the jobsite conditions, but the middle ground should be based on a plan (a Work Breakdown Structure (WBS) is recommended) that the project team can reference, whether the gap is to the estimate with all of its assumptions or to the planned job conditions.

Most jobs are bid using some manual of labor units that have inherent assumptions about productivity and job conditions, but that reference point is often lost or never passed on to the project team running the job. A module of Short Interval Scheduling® has been developed to measure estimating misses, using the categories of gaps identified through job review meetings, project audits, and postmortems over the years. Exhibit 2 shows a sample of the categories that are being collected in the estimating misses module.

Capturing this data is the first starting point of identifying porosity; if any of these conditions are known at the time of project startup, then their impact on job outcome can be quantified.

Labor Code Variation

Assuming data quality is good in labor code performance data, studying the patterns of the labor code variation can quickly show predictions of job porosity. Exhibit 3 shows one example of variation in labor code productivity across two years of data from a contractor.

Based on this variation, the following are the factors used for measuring job porosity:

1. Labor codes with a lot of variation: feeder wire, feeder pipe, trim, supervision, fixtures

2. Codes that have consistent negative performance: fixtures, supervision

Exhibit 4 shows a representation from another company, where two primary codes resulted both in high variation and poor productivity:

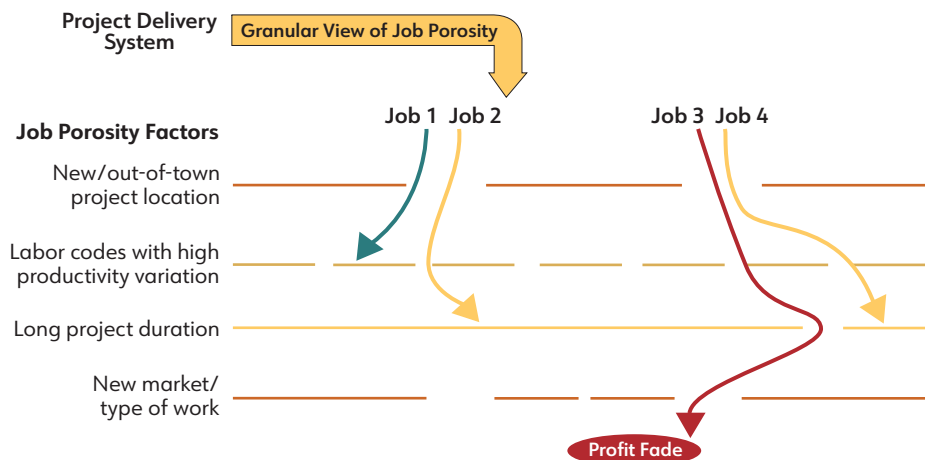
1. Security systems
2. Voice data

As shown in these examples, any time a job is being bid or planned with a heavy weight in these two codes, a high profit fade is expected. As another example, “Are Preventers the Real Heroes? Preventing Risk Pragmatically With Data” from the September/October 2021 issue of *CFMA Building Profits* explored how branch rough-in contributed to 62,500 of labor losses per year due to its consistently poor performance.²

The underlying cause of some of these factors could be even deeper than the work in the code itself, which is why studying variation and confounding porosity factors is important.

For example, if branch rough-in consistently performs negative and is the heaviest weighted code in the company, the reason for poor performance may not be poor production or production rates; it could be that material handling is happening in the work associated with that code more than any other.

Exhibit 1: Job Porosity Concept



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New Markets

New and niche markets can be profitable – but only for a limited time until the market matures and the original first-to-market novelty and financial advantages erode. What was once a lucrative market when entered a few years (or decades) ago may have become a source of leaking profits, especially if the project delivery system was never setup to continuously improve performance in that type of work.

In other words, first-to-market or only-in-market allows a contractor to mask the cost of poor productivity with padded profits. Unless this niche-market contractor studies and improves its own costs and cost drivers, those advantages will go away in time.

Several job porosity factors have been found across companies that relate to this situation:

- New type of work: new technologies/ customers in the market overall; new market for your company that brings competitive advantages
- New geography/location: expanding to new locations doing the same work; expanding/opening up satellite branches

Project Duration

Although profit fade hurts worse on large jobs due to there being more money at stake, Power Law tells us that job performance suffers most in small jobs. However, independent of project size, project duration has been found to be a common job porosity factor. Longer projects have several cost drivers that lead to fade including:

- Changes in the plan that either go unnoticed or uncaptured

- Changes in project teams, whether it be internal or external

- Lack of discipline at the early- and mid-project levels, such as schedule and productivity management (“we have a long way to go” and “we have time to make it up”)

Scope Management/Change Orders

Staying on top of scope, both original and changes, can be a challenge, and it has been found to be a cause of job porosity in many companies.

In a previous article, it was explained why the costs associated with change orders are difficult to quantify and recover,³ but not recognizing and anticipating the base impacts is the most common reason why contractors fail to make money on change orders.

Exhibit 2: Estimation Feedback – Overrun Tracking

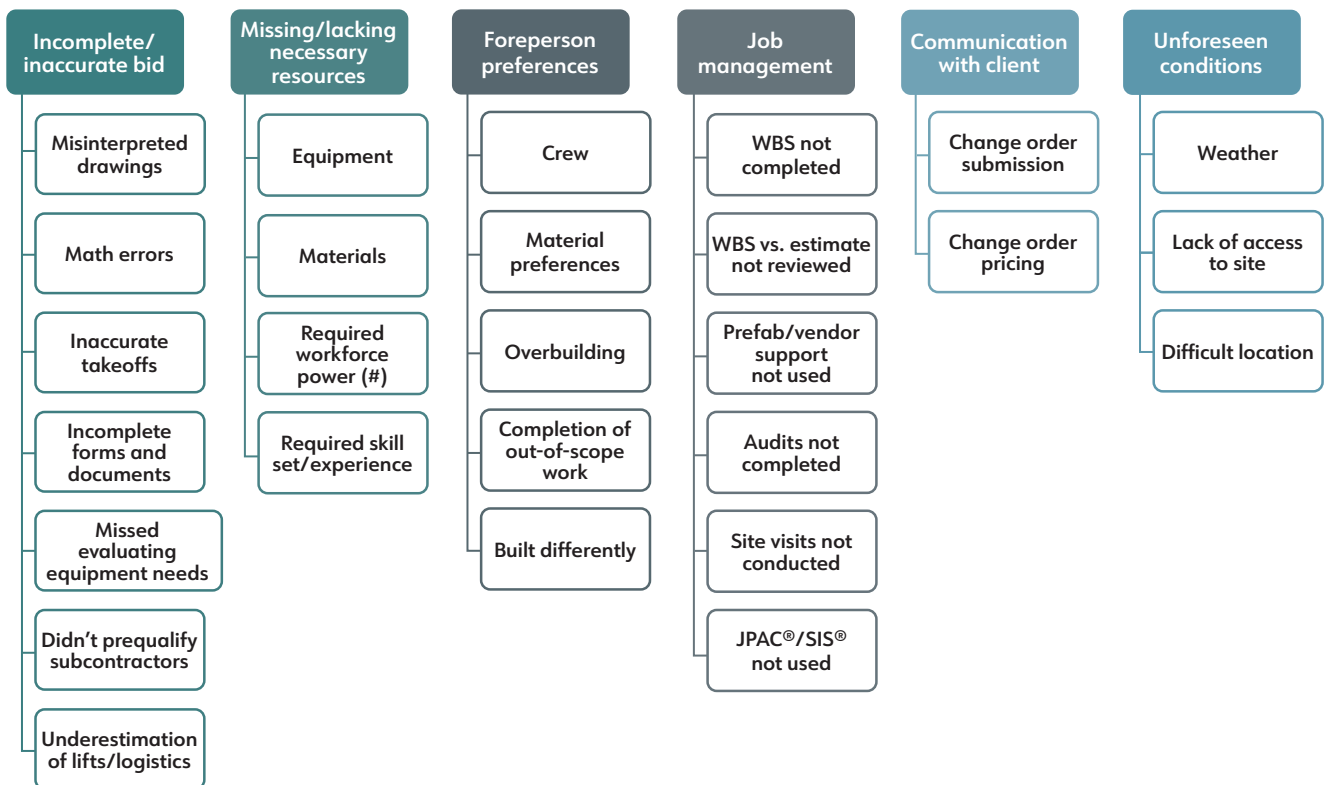
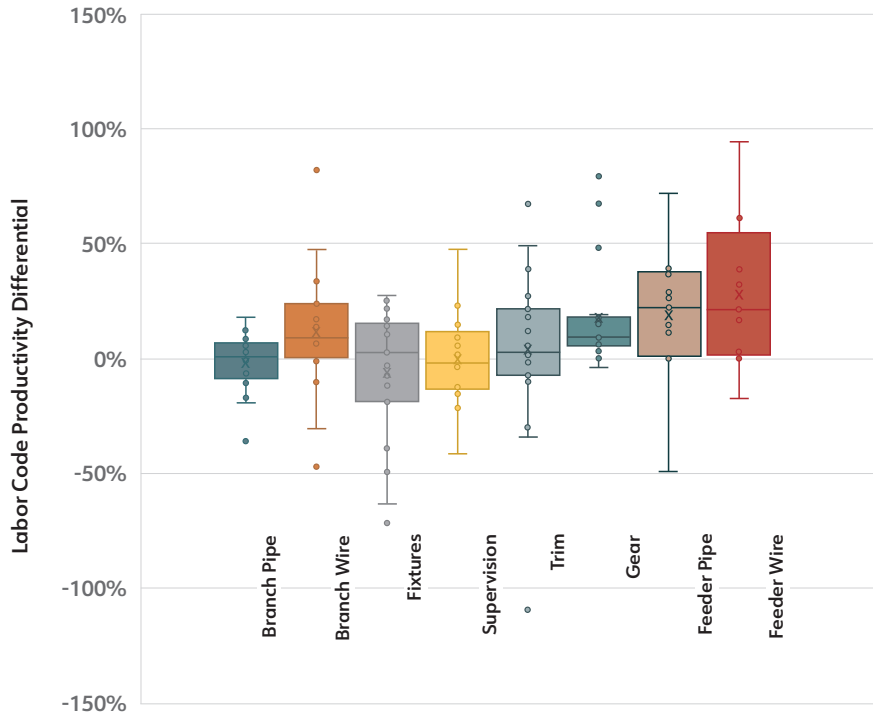
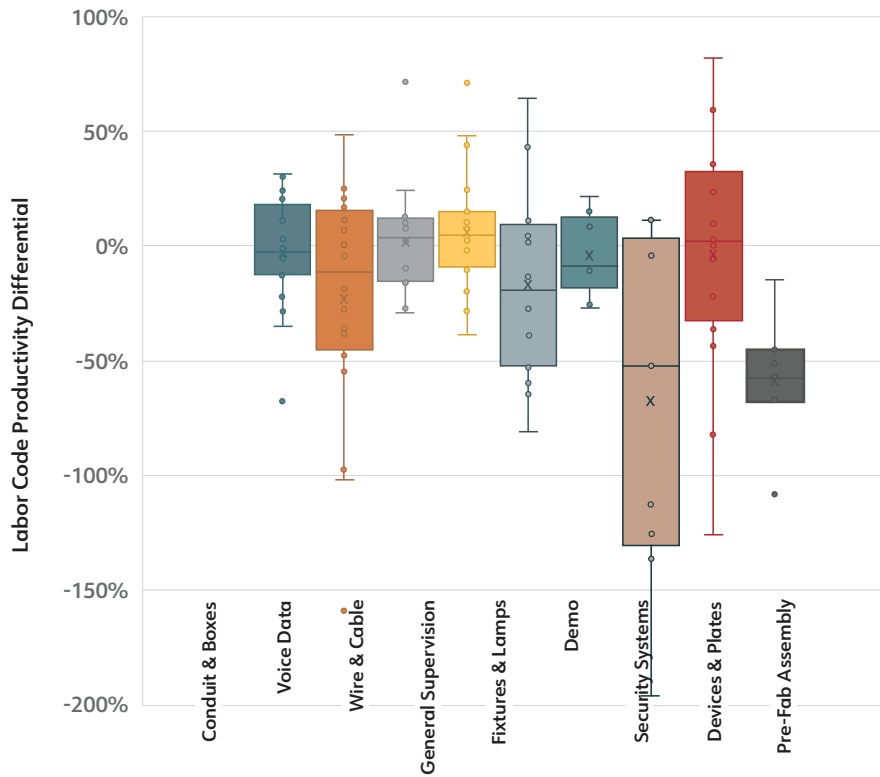


Exhibit 3: Company 1 Example: Labor Code Productivity Variation



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Exhibit 4: Company 2 Example: Labor Code Productivity Variation



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New Employees

Lower tenure of both field and project management employees is often a cause of job porosity. In looking at one case, when the project manager (PM) was with the company for less than two years, their projects experienced fade 71% of the time, as compared to 48% of the time for more tenured PMs.

This can mean that both total experience (years in the business, typically measured by age) and experience within the company as the learning curve and culture alignment take time.

USING JOB POROSITY FACTORS

The factors mentioned previously should sound familiar to most; however, they typically end up as excuses or, in the best case, explanations of profit fade during or after a job's completion.

The job porosity model is meant to characterize and quantify these factors so fade can be predicted and avoided. A project gets a porosity factor/score as

it is moving through the pipeline (pre-award), which could be used to make a go/no-go decision at bid time. Once a project is awarded, the porosity factor is revisited for risk mitigation.

Exhibit 5 shows an example of a decision-making model built uniquely for a company based on their performance and the factors that lead to job porosity. The model gives the company's executives, estimators, and PMs a data-driven view before bid time of how likely a project is to fade.

Some factors are primary drivers of profit fade while others are secondary and only have an impact in certain conditions. For example, in some companies, project duration as a stand-alone factor correlates with project fade, whereas other factors only matter in certain types of work.

In other companies, PM tenure and geography may not lead to fade on their own, but when they are combined (e.g., a new PM running work in a new

market), the project has a higher porosity factor. Exhibit 6 shows an example of this multi-dimensional model. The productivity of certain labor codes varied based on two different factors that were found through MCA Inc.'s research:

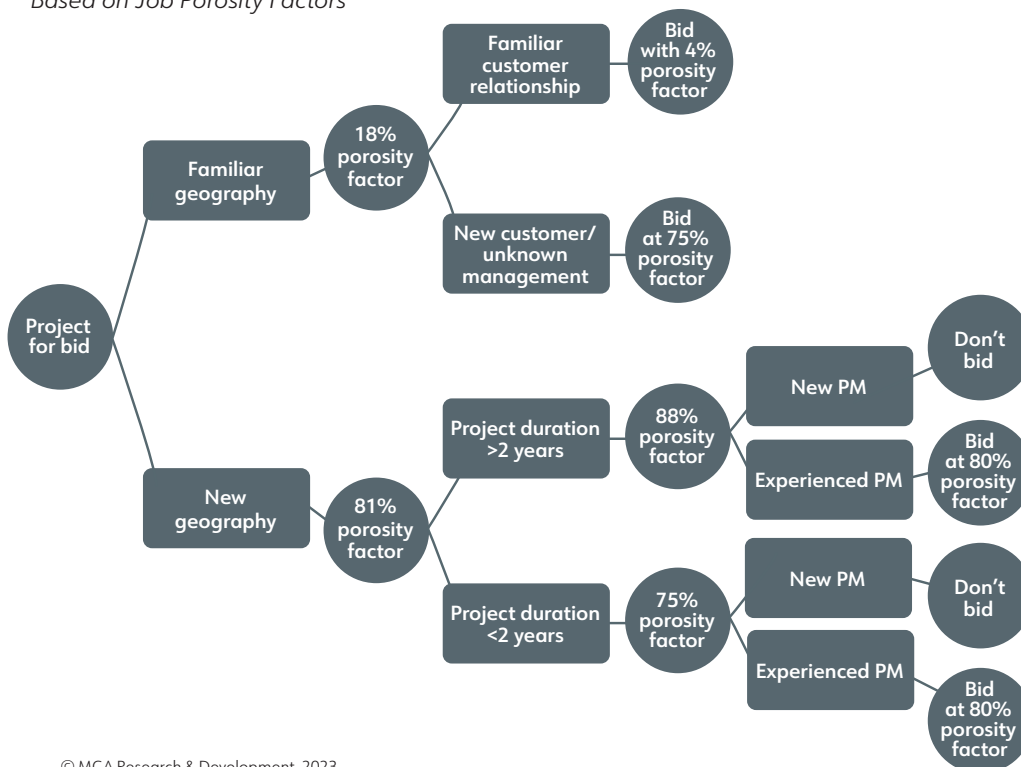
1. Type of work (Type 1 as new construction and Type 2 as renovation)
2. Area (Area 1 as local market and Area 2 as out of town)

Previously, this company may have thought every job is unique, but based on historical performance and high data quality, they began to use these factors to bid and plan the work differently based on these two simple dimensions.

CONCLUSION

The job porosity model shows that although every project seems to be unique, data proves otherwise and the construction process is characterized by factors that can predict how the project will turn out. As long as historical data is studied and data is collected and

Exhibit 5: Decision Tree
Based on Job Porosity Factors



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analyzed to provide an accurate picture of the project conditions in real time, the job porosity concept and model can accurately predict the likelihood of profit fade even before the job is bid. The model can also be used to work on internal processes that can reduce the exposure to fade and mitigate risk when projects are awarded with any job porosity factors present. **BP**

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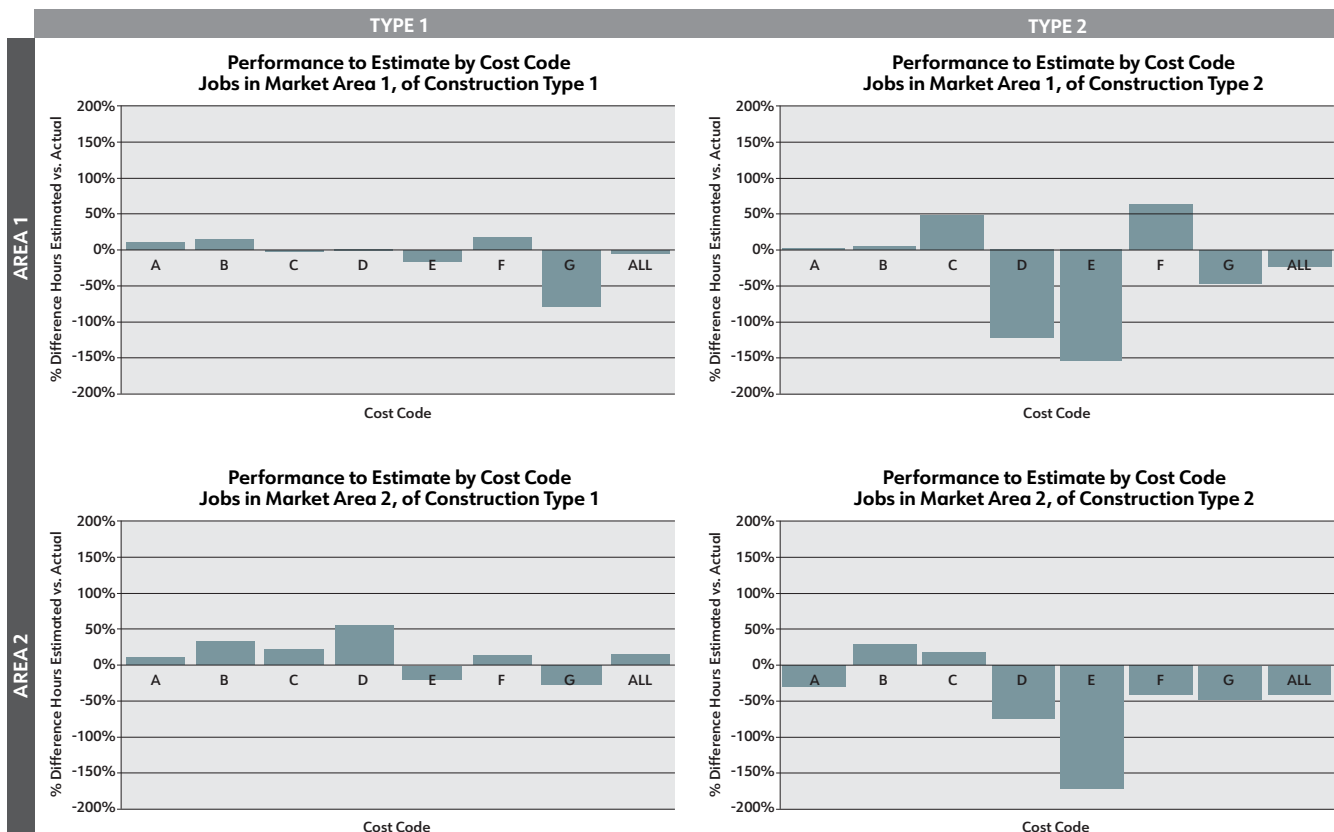


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Endnotes

1. "Standard Practice for Job Productivity Measurement." *ASTM International*. April 24, 2020. astm.org/e2691-20.html.
2. Moore, Dr. Heather; Daneshgari, Meik; & Daneshgari, Sonja. "Are Preventers the Real Heroes? Preventing Risk Pragmatically With Data." *CFMA Building Profits*. September/October 2021. cfmabponline.net/cfmabp/09102021/MobilePagedArticle.action?articleId=1727302.
3. Daneshgari, Dr. Perry & Nimmo, Phil. "Managing the True Cost of Change Orders." *CFMA Building Profits*. May/June 2022. cfmabponline.net/cfmabp/05062022/MobilePagedArticle.action?articleId=1793436.

Exhibit 6: Not All Jobs Are the Same



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