

Quantifying the Value of Union Labor in Construction Projects

Prepared for Western Canada Skilled Metal Trades

Independent Project Analysis (IPA)

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FINAL



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This IPA report analyzes the performance of union labor versus open shop labor in Western Canada using IPA's extensive proprietary database of capital projects.

This report references several earlier studies:

"The Looming Labor Shortage" that Edward W. Merrow presented for a panel discussion at the UA/MCAA Labor Relations Conference on October 30, 2008.

"Quantifying the Value of Union Labor in Construction Projects" that Michael McFadden conducted on behalf of the Mechanical Industry Advancement Fund (MIAF). December 2022.

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About IPA

Since its founding in 1987, IPA has rapidly evolved into the preeminent consultancy in project risk evaluation and in project system benchmarking and has become the industry leader in quantitative analysis of project management system effectiveness worldwide.

IPA improves the competitiveness of our owner project organizations by identifying the practices that generate effective use of capital in their businesses. It is our mission and unique competence to conduct research into the functioning of capital projects and project systems. We then apply the results of that research to help our customers create and use capital assets more efficiently. Our clients depend on our research results and quantitative measurements to enhance the value generated from their capital projects.

Our approach to increasing the success rate of a capital project is both simple and effective: IPA has developed detailed, carefully normalized databases that contain information about the entire project life cycle from the business idea through to early operation. We use these data to develop powerful statistical tools that enable us to compare project performance in numerous areas.

IPA works on behalf of project owner organizations and views project success from the vantage point of owners rather than contractors. IPA alone is responsible for the data review, analysis, and findings contained in the report.

Executive Summary

This study expands research¹ conducted on the performance of union labor in the United States to union labor in Western Canada. Past research demonstrated that union labor in the United States is more productive than open shop labor, and projects that employed union labor cost less, despite the higher average all-in wage rate paid to union labor. This study arrives at a similar conclusion. Union labor in Western Canada is more cost effective than open shop labor. The study found:

- Productivity for union labor in Western Canada is 21 percent higher than open shop labor
- Using union labor in Western Canada reduces the total cost of projects in by an average of 7 percent versus when open shop labor is used

The exact root causes for these differences cannot be identified from the data, but the findings support the claims that the labor skill, supply, and stability (e.g., less turnover) of union-sourced labor all contribute to better productivity and better project outcomes.

¹ Edward W. Merrow, *The Looming Labor Shortage*, presented at the UA/MCAA Labor Relations Conference, October 30, 2008; Michael McFadden, *Quantifying the Value of Union Labor in Construction Projects*, prepared for the Mechanical Industry Advancement Fund, December 2022.

Background

IPA's core motivation is to improve the competitiveness of our clients. With a capital project, a key lever in improving competitiveness is to reduce construction labor costs by improving construction labor productivity. As construction labor costs typically represent 30 to 40 percent of a project's total cost, even small gains in productivity can have a meaningful impact on a project's total cost.

IPA has conducted numerous studies of construction labor productivity over the past nearly 40 years. Our research has found that productivity is a function of many factors. The most obvious factor is the skill level(s) of the labor supply. However, other factors are also associated with productivity, such as management practices, weather, project size and complexity, and more.

Edward Merrow's study in 2008 for the MCAA² focused on quantifying the different drivers of labor productivity. Merrow's study demonstrated how labor productivity varies greatly from project to project and that practices such as Front-End-Loading (FEL; a measure of the completeness of planning done prior to project execution), execution discipline (e.g., not deviating from the original plan), construction labor work schedules (e.g., use of long work weeks or excessive overtime, etc.), and the source of labor (e.g., union versus open shop and subcontracted versus direct hire labor) are all statistically linked to efficiency of construction labor.

After controlling for project scope (e.g., office buildings versus chemical plant, etc.), project size, and project type (e.g., brownfield [work at an existing site] or greenfield [work at a brand new site], etc.), the project-to-project labor productivity was shown to be highly variable, as shown in Figure 1 below. Importantly, the study concluded labor productivity, after controlling for scope and level of design and planning maturity, was strongly linked to lower project costs, and that sourcing labor from unions was a key proponent of those labor cost reductions.

Distribution of Labor Productivity on Process Projects in the US

Wide Range in Productivity From Multiple Factors (e.g., Quality of Planning, Quality of Project Management, Workforce Skill, etc.)



Figure 1

Research conducted by Michael McFadden in 2022 revisited the topic, focusing on the influence of labor source on construction labor productivity in the United States. McFadden's research arrived at a similar conclusion—that union labor was significantly more productive and that the labor cost and overall project costs were lower when union labor was used.

McFadden's research also confirmed differences in perceived skill levels between union and open shop labor. As part of IPA's data collection, owner project teams are asked to rate the skill of the craft and first line supervision on a

² Edward W. Merrow, *The Looming Labor Shortage*, presented at the UA/MCAA Labor Relations Conference, October 30, 2008.

5-point Likert scale, ranging from *Low* to *High*. Project teams ranked union labor skill levels *Above Average* about 75 percent of the time versus open shop which was rated *Above Average* about 65 percent of the time. A similar pattern holds for first-line supervision.

McFadden also found that owner project teams were less likely to report labor shortages and turnover for projects using union labor versus open shop.

This study follows and builds on the framework established by Merrow and McFadden and broadens the scope of the research to specifically measure the performance of union and open shop labor in Western Canada.

Study Framework

Figure 2 provides a framework for the study. To determine the influence of labor source on construction labor productivity, we must first control and normalize for the other factors associated with labor performance.

This step is done by leveraging IPA's database of capital projects, including thousands of projects that are each characterized by over 8,000 independent variables. These variables span the technical scope, project context (such as location), strategies (e.g., use of modular construction), and design and planning maturity at the final investment decision (FID) point for the project.

This data allows us to develop and implement a statistical model that independently quantifies the differences in labor performance as a function of these project characteristics. Once the model is trained, we can then test to see whether any residual differences are observed between projects leveraging union or open shop labor.

Drivers of Labor Productivity

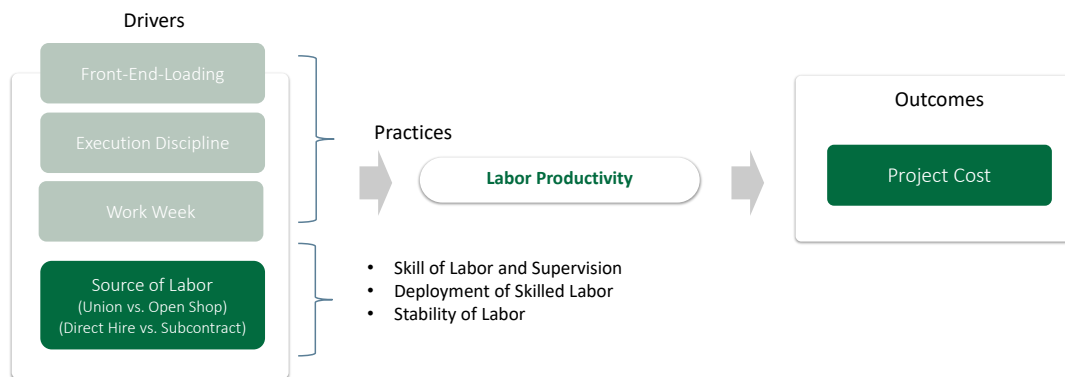


Figure 2

Study Database & Methodology

IPA's Unique Approach and Database

IPA's capital projects database includes over 25,000 projects with more than 21 million data points representing project characteristics and project outcomes. The database includes projects executed in over 100 countries by more than 550 companies.

The quality of the data is ensured by face-to-face data collections and extensive reviews of project histories. IPA's capital projects database is ever expanding as we evaluate approximately 600 projects every year. The database is supplemented with client documentation, including native cost and schedule documents, risk registers, change logs, design documents (e.g., bases of design, P&IDs, block flow diagrams), execution plans, and other critical project documentation.

The data in the database includes project outcomes, such as cost, schedule, operational, and safety performance, as well as measures of complexity and maturity of the front-end definition, which are used to understand these outcomes. The measures of complexity include technical complexity, such as scope and technology; and contextual complexity, such as the product market, location, and various other shaping issues (e.g., stakeholders), etc. Maturity of the front-end is explored by characterizing the state of the design and execution plans at various stages of front-end development.

Western Canada Database

From this larger database of projects, we have selected a dataset of 146 completed projects that were executed in Alberta and British Columbia over the past 15 years. These projects primarily come from the refining and chemical industries but also include utilities and civil infrastructure scopes. All of the projects were executed at existing manufacturing sites and largely reflect site and sustaining capital projects. Project sizes range from C\$200,000 to over C\$15 million.

As the scopes are predominantly executed within process plants, the nature of the work relies on highly skilled trades. For example, the primary scope for 29 of the projects is the replacement of intra-plant piping. Another 20 projects are focused on replacement of valves, 18 center on electrical and instrumentation upgrades and replacement, and another 17 focus on installing or repairing process equipment. Most projects involve a mix of scopes that require heavy involvement from pipefitters and welders, electricians and instrument technicians, structural ironworkers, millwrights, riggers, scaffold builders, insulators, and painters.

From this dataset, we coded the projects as having been executed using either union or open shop labor. Roughly 60 percent of the projects were coded as union with the other 40 percent being open shop. Because many of these manufacturing sites rely on both union and open shop labor, projects were coded as union if more than 80 percent of the work was completed by union labor. Similarly, projects were coded as open shop if more than 80 percent of the work was completed by open shop labor.

Over 10 different owner organizations are represented, and half of the owners are represented in both the union and open shop samples.

The dataset project characteristics are shown in Table 1 below.

Western Canada Database Description

Characteristic	Union Labor Projects (n = 85)	Open Shop Projects (n = 61)
Project Size (²⁰²⁶ C\$ millions)	Median - 2.97 Range - 0.15 > 15	Median - 2.18 Range - 0.37 > 10
Authorization Year	Median - 2017 Range - 2010 – 2024	Median - 2017 Range - 2010 – 2023
Number of Owner Companies	8	8
Project Type	4 percent Greenfield/Colocated 13 percent Add-On/Expansion 73 percent Revamp	5 percent Greenfield/Colocated 31 percent Add-On/Expansion 64 percent Revamp

Table 1

Analysis—Source of Labor and Project Performance

Methodology—Assessing Labor Productivity and Labor Cost

To understand the performance of construction labor, we look at two measures of efficiency—productivity and cost.

Labor productivity is often defined as a measure of the hours required to complete a certain measure of scope. For craft labor, we often look at hours per unit of installed material (e.g., feet of pipe, tons of steel, cubic yards of concrete). This approach is useful when examining the performance of individual crafts, but it is difficult to determine a project's overall labor productivity this way. Additionally, labor hours are not always available. Therefore, to measure productivity, IPA has developed an approach that leverages the construction labor cost and labor rates. Specifically, we adjust each project's labor cost for differences in labor rates between what the project paid and the prevailing rate at the time for comparable projects in the United States Gulf Coast. The effect is that any rate-based differences are normalized out of the costs and we are left with labor costs on an equivalent rate basis. In other words, once we control for scope, the only difference in labor costs between comparable projects is the efficiency of the labor.

Labor cost as an outcome has a similar challenge. Labor rates vary significantly across the different crafts employed to complete a project, and the ultimate effect of the labor source has to weigh these differences as a function of the crew mix used to complete the project.

To address these challenges, IPA developed benchmarking models for productivity and labor costs. These models work by determining the labor productivity and total construction labor cost for a project based on its scope, the maturity of engineering and planning, and execution strategy. This approach produces performance indicators for the entire project, representing the collective performance from all trades (e.g., civil, electrical piping, steel, etc.).

IPA's Construction Labor Productivity Benchmarking Model

IPA's Construction Labor Productivity Model is a regression model. Specifically, we use Ordinary Least Squares (OLS) regression to estimate productivity as a function of project characteristics.

Ordinary Least Squares is a statistical method used to quantify the relationship between one or more explanatory variables on an outcome. The model estimates coefficients for each explanatory variable by measuring how changes in the explanatory variables are associated with changes in the outcome. To arrive at the coefficients, the model identifies the linear slope that results in the smallest overall error between the prediction derived from the slope and the actual outcome.³

IPA's Construction Labor Productivity Model includes over 2,700 completed projects that were executed at existing manufacturing sites from around the world. Because construction labor is primarily a function of the installed bulk materials, the model measures the types (e.g., pipe, cable, instrumentation, etc.) and mixes of the newly installed bulk materials and equipment, as measured by their cost, to account for the project's scope. Costs of the steel materials are adjusted for differences in alloy. The model also controls for key measures of project engineering maturity and planning, such as Front-End Loading, as well as varying execution strategies, such as overtime and modularization.

After the model is trained, we then predict the labor rate adjusted labor cost for the sample of projects executed in Western Canada. To explore differences between union and open shop, we first calculate an index by taking the predicted labor rate adjusted labor cost and dividing by the project's actual labor rate adjusted labor cost. A lower index means higher productivity (e.g., fewer labor hours per installed material).

³ The slope that minimizes the sum of the squared errors. Squared to penalize larger errors more than small ones and to prevent positive and negative errors from cancelling out.

IPA's Construction Labor Cost Benchmarking Model

IPA's Construction Labor Cost Model mirrors the productivity model in everything but the outcome (target) variable. The model training sample and independent variables between the two models are exactly the same. However, instead of predicting the labor rate adjusted labor cost, the cost model predicts the total construction labor costs. Any differences in labor rates between projects within a location remain part of the costs. These costs include both the cost of direct labor and also the indirect construction labor costs.⁴

Overview Source of Labor and Project Value

In Figure 3 below, we compare productivity and labor cost between union and open shop labor using the models described above. Overall, we observe that union labor in Western Canada is 21 percent more productive than open shop labor. This efficiency translates into a 19 percent lower overall construction labor cost. In comparison to the model predictions, the union labor is, on average, very close to the model estimates. However, the open shop projects are systematically higher than the model estimates. In other words, after controlling for scope and prevailing regional differences, the union labor projects are systematically more productive and spending less on construction labor costs than the open shop projects. A two-sample t-test indicated the difference between the group averages was statistically significant.⁵

Union Labor vs. Open Shop Productivity and Labor Cost Performance

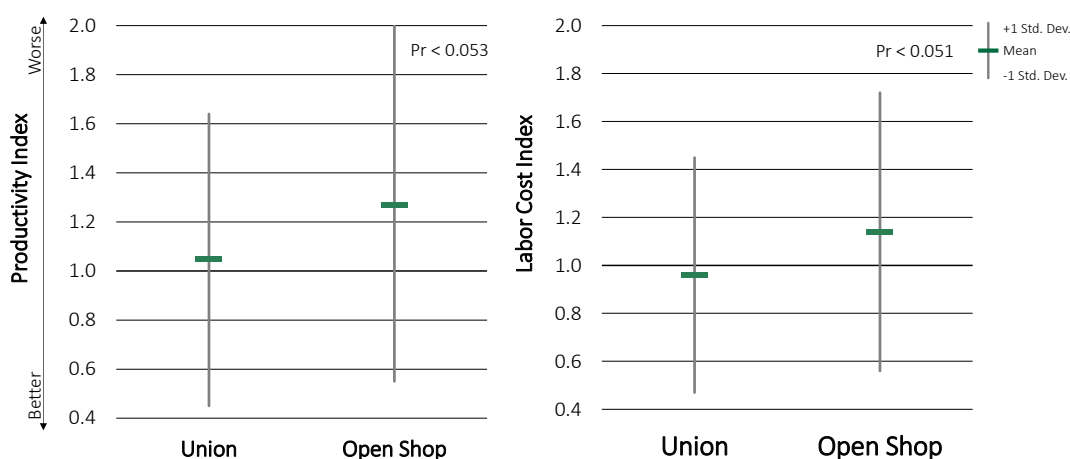


Figure 3

As Merrow reported in his study, project management practices can have a significant influence on construction labor productivity. To rule out the influence of other factors, representativeness tests were conducted across the standard driver practices.

⁴ Includes payroll taxes, wage benefits, subcontractor overhead and profit, bonds, insurance, incentive craft pay differentials including overtime premium, field office expenses, temporary facilities, small cranes, field reward, and recognition events, etc.

⁵ We use a measure of statistical significance that is shown as a p-value in which a p-value of <0.05 indicates the findings have a less than 5 percent chance of being random; in other words, there is a 95 percent chance the effect being tested can be considered real.

IPA's key measure of preparedness to enter execution⁶ is the Front-End Loading (FEL) Index.⁷ The FEL Index measures the maturity of the front-end engineering and execution planning prior to project authorization,⁸ and has proven to be the strongest measure of project success.⁹

Other key driver practices include clarity of project objectives, having all influential members represented on the project team, and strong project controls during execution. IPA evaluated each practice and each reflects an unbiased assessment of the owner team's level of front-end definition and execution control.

A comparison of the average values across these Best Practices shows no statistical difference in any of the practices between the union and open shop samples. That is, the union sample was in no way advantaged from a better defined and controlled project.

To help understand what may be driving the differences between the union and open shop results, McFadden's research explored several factors empirically linked to labor efficiency—skill level, labor availability, and turnover. For this sample of projects, skill level and turnover measures are unavailable due to differences in survey design; however, labor availability could be tested.

IPA's survey for site and sustaining capability projects asks the owner project teams to indicate whether the project experienced any construction labor shortages that had an effect on the project's cost or schedule performance. The question is answered "yes" or "no."

The union projects in the Western Canada sample experienced a labor shortage that affected the project's cost and schedule performance just over 3 percent of the time. The open shop projects experienced a shortage 18 percent of the time. The difference in these averages is statistically significant, with a p-value of 0.01. Though the skill differentials cannot be assessed, the union labor offers a clear advantage in labor availability, which itself is strongly correlated with labor efficiency.

Conclusions

This study marks the third formal investigation by Independent Project Analysis into productivity and labor cost performance by labor source. As with past research by Merrow and McFadden, this study again finds a statistically significant difference between labor productivity and costs between projects that use union versus open shop labor. On average, union construction labor in Western Canada delivers lower labor costs than open shop labor by about 20 percent.

This study finds that union labor is significantly more productive than open shop labor, and this higher productivity is linked to significant labor cost savings. As construction labor costs across this sample of projects represents an average of 43 percent of the total capital cost of the projects, a 19 percent savings in construction labor costs translates into a 7 percent reduction in total project costs to owners.

To put this into context, consider an example—a C\$5 million-dollar refinery project to replace 700 m of pipe that will be installed in existing racks. The project also includes some minor instrumentation and electrical work. Using open shop labor, the project's construction labor costs were C\$2.2 million. If performed by union labor, and given the results of this analysis, we could expect the construction labor costs to decrease to C\$1.85 million. In the figure below, the typical split among cost categories is shown between a project using open shop labor versus union labor.

⁶ Time from the start of preparation of first issue for construction drawings through mechanical completion.

⁷ The FEL Index measures the maturity of the site understanding, design, and execution planning at project authorization. Elements of the site reviewed include soils assessment, plot plans, environmental requirements, health and safety requirements, local content requirements, material availability, etc. The design considers the status of heat and mass balances, equipment specifications, piping and instrumentation drawings, single lines, etc. Review of the execution plan evaluates the status of contracting, the project team (roles and responsibilities, availability, etc.), engineering, procurement, and construction execution plans, permitting, project controls, risk, quality, change management, etc.

⁸ Sometimes referred to as Authorization, Sanction, or Final Investment Decision (FID).

⁹ Safety, competitive and predictable cost and schedule performance, and predictable operational performance.

Savings like these, when extrapolated to a 50 to 100 million dollar annual capital portfolio, represent a significant boost to the competitiveness of these manufacturing assets for owner companies.

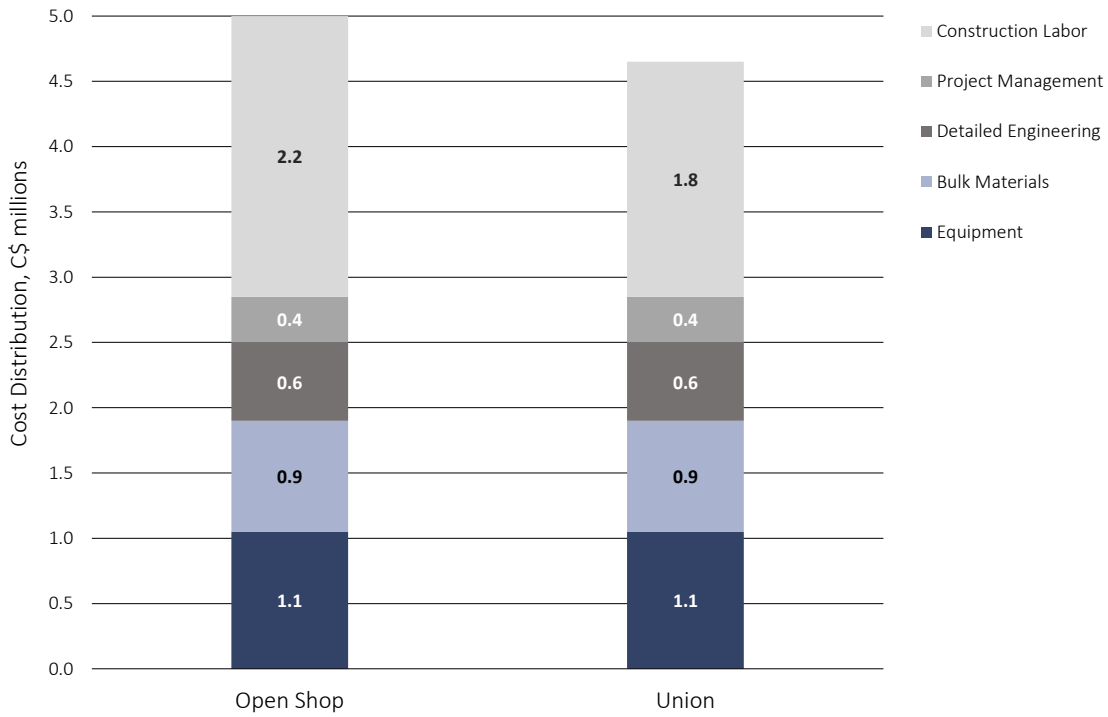


Figure 4



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