

Quantifying the Value of Union Labour in Construction Projects

Prepared for Western Canada Skilled Metal Trades
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This IPA report analyzes the performance of union labour versus open shop labour 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 labour in the United States to union labour in Western Canada. Past research demonstrated that union labour in the United States is more productive than open shop labour, and projects that employed union labour cost less, despite the higher average all-in wage rate paid to union labour. This study arrives at a similar conclusion. Union labour in Western Canada is more cost effective than open shop labour. The study found:

- Productivity for union labour in Western Canada is 17 percent higher than open shop labour
- Using union labour in Western Canada reduces the total cost of projects by an average of 7 percent versus when open shop labour is used

The exact root causes for these differences cannot be identified from the data, but the findings support the claims that the labour skill, supply, and stability (e.g., less turnover) of union-sourced labour 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 labour costs by improving construction labour productivity. As construction labour costs typically represent 30 to 60 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 labour 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 labour 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 labour productivity. Merrow's study demonstrated how labour 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 labour work schedules (e.g., use of long work weeks or excessive overtime, etc.), and the source of labour (e.g., union versus open shop and subcontracted versus direct hire labour) are all statistically linked to efficiency of construction labour.

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 labour productivity was shown to be highly variable, as shown in Figure 1 below. Importantly, the study concluded labour productivity, after controlling for scope and level of design and planning maturity, was strongly linked to lower project costs, and that sourcing labour from unions was a key proponent of those labour 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.)

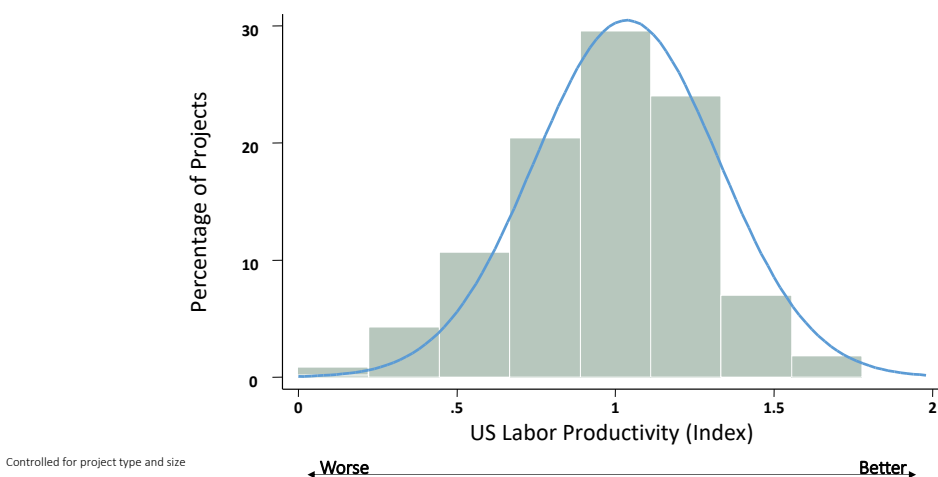


Figure 1

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

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

McFadden’s research also confirmed differences in perceived skill levels between union and open shop labour. 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 5-point Likert scale, ranging from *Low* to *High*. Project teams ranked union labour 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 labour shortages and turnover for projects using union labour 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 labour in Western Canada.

Study Framework

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

Drivers of Labour Productivity

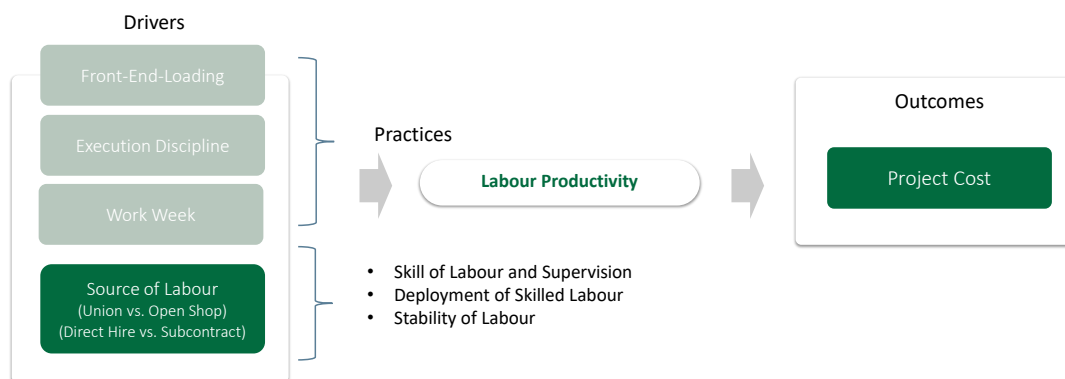


Figure 2

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 140 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\$150,000 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 labour. 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 labour, projects were coded as union if more than 80 percent of the work was completed by union labour. Similarly, projects were coded as open shop if more than 80 percent of the work was completed by open shop labour.

Nine different owner organizations are represented, and over 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 Labour Projects (n = 79)	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	7	7
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 Labour and Project Performance

Methodology—Assessing Labour Productivity and Labour Cost

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

Labour productivity is often defined as a measure of the hours required to complete a certain measure of scope. For craft labour, 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 labour productivity this way. Additionally, labour hours are not always available. Therefore, to measure productivity, IPA has developed an approach that leverages the construction labour cost and labour rates. Specifically, we adjust each project's labour cost for differences in labour 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 labour costs on an equivalent rate basis. In other words, once we control for scope, the only difference in labour costs between comparable projects is the efficiency of the labour.

Labour cost as an outcome has a similar challenge. Labour rates vary significantly across the different crafts employed to complete a project, and the ultimate effect of the labour 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 labour costs. These models work by determining the labour productivity and total construction labour 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 Labour Productivity Benchmarking Model

IPA's Construction Labour 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 Labour Productivity Model includes over 2,700 completed projects that were executed at existing manufacturing sites from around the world. Because construction labour 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 labour rate adjusted labour 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 project's actual labour rate adjusted labour cost and dividing by the predicted labour rate adjusted labour cost. A lower index means higher productivity (e.g., fewer labour 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 Labour Cost Benchmarking Model

IPA's Construction Labour 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 labour rate adjusted labour cost, the cost model predicts the total construction labour costs. Any differences in labour rates between projects within a location remain part of the costs. These costs include both the cost of direct labour and also the indirect construction labour costs.⁴

Overview Source of Labour and Project Value

In Figure 3 below, we compare productivity and labour cost between union and open shop labour using the models described above. Overall, we observe that union labour in Western Canada is 17 percent more productive than open shop labour. This efficiency translates into a 16 percent lower overall construction labour cost. In comparison to the model predictions, the union labour 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 labour projects are systematically more productive and spending less on construction labour costs than the open shop projects. A two-sample t-test indicated the difference between the group averages was statistically significant.⁵

Union Labour vs. Open Shop Productivity and Labour Cost Performance

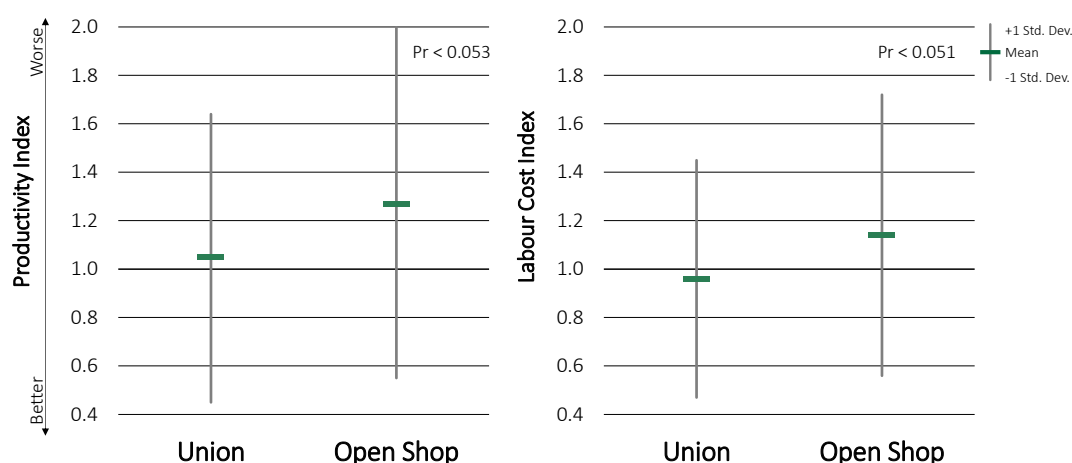


Figure 3

As Merrow reported in his study, project management practices can have a significant influence on construction labour 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 shown as a p-value, which indicates how likely we are to observe a result this large or larger when there is actually no underlying effect. A p-value of <0.05 is conventionally considered significant, meaning that such a result would occur less than 5 percent of the time if there were no true effect. The 0.05 threshold is not a strict evidentiary boundary; results very near this threshold (e.g., $p = 0.053$) provide essentially comparable statistical evidence and should be interpreted accordingly.

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 labour efficiency—skill level, labour availability, and turnover. For this sample of projects, skill level and turnover measures are unavailable due to differences in survey design; however, labour availability could be tested.

IPA's survey for site and sustaining capital projects asks the owner project teams to indicate whether the project experienced any construction labour 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 labour 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 labour offers a clear advantage in labour availability, which itself is strongly correlated with labour efficiency.

Conclusions

This study marks the third formal investigation by Independent Project Analysis into productivity and labour cost performance by labour source. As with past research by Merrow and McFadden, this study again finds a statistically significant difference between labour productivity and costs between projects that use union versus open shop labour. On average, union construction labour in Western Canada delivers lower labour costs than open shop labour by about 16 percent.

This study finds that union labour is significantly more productive than open shop labour, and this higher productivity is linked to significant labour cost savings. As construction labour costs across this sample of projects represents an average of 43 percent of the total capital cost of the projects, a 16 percent savings in construction labour costs translates into a 7 percent reduction in total project costs to owners.

To put this into context, consider an example—a C\$5.2 million-dollar refinery project to replace some piping and instrumentation. The project also includes some equipment. Using open shop labour, the project's construction labour costs were C\$2.2 million. If performed by union labour, and given the results of this analysis, we could expect the construction labour costs to decrease to C\$1.9 million. In the figure below, the typical split among cost categories is shown between a project using open shop labour versus union labour.

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.

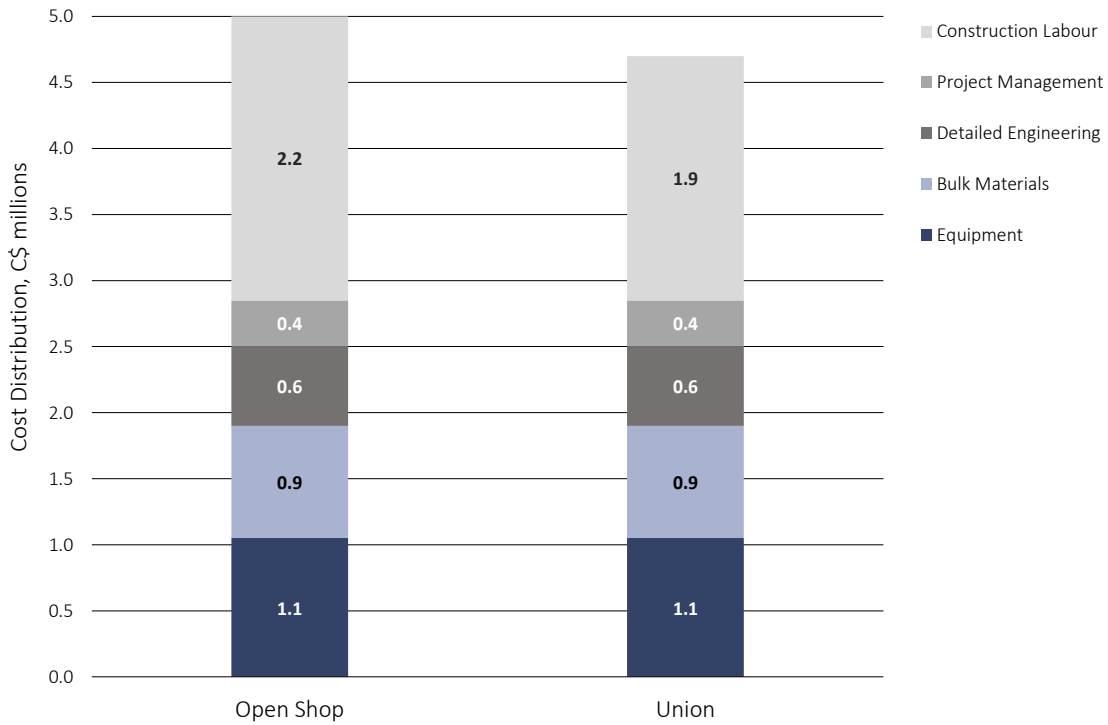


Figure 4



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