



Algorithm & Data Methodology

The Construction Labor Market Analyzer® (CLMA®) is designed to provide detailed labor market analytics and intelligence 3-5 years out for construction industry project stakeholders for industrial and non-industrial (commercial, infrastructure, civil, etc.) project activity within the United States.

Origination of Project Data

The CLMA® project database is very robust and is derived from the following 3 sources...

- Direct input into the CLMA® by construction owners (Primarily industrial projects)
- Quarterly importation of the Dodge Data & Analytics project database (Primarily non-industrial projects)
- Continuous research by the CLMA® team

The CLMA® does not collect or report on residential construction project activity.

To ensure data reliability, all projects input into the CLMA® are first processed and scored through an automated de-duplication, followed by a manual review process to ensure each project in the CLMA® database is represented only once. Additionally, projects are reviewed and updated on a minimum 90-day rotation, by the owner or the CLMA®, to ensure accuracy.

Overall, the CLMA® database represents a critical mass of construction market spending; however, the exact percentage of regional markets varies depending on the location. The completeness of the CLMA® database is continuously benchmarked against the most reliable government put-in-place non-residential construction spending estimates.

Treatment of Project Data

Regardless of the origination of project data into the CLMA® database, each project is processed through the proprietary Project Labor Forecaster (PLF®), which simplifies the task of translating project spending into construction craft labor demand profiles for projects which do not yet have detailed estimates.

The purpose of the PLF® is to assist the CLMA® in capturing project data very early the project conception and planning process, and removes a significant amount of the work typically required when setting up a new project for which minimal information is known. The early capture of project data is how the CLMA® more effectively projects demand 3-5 years out.

The PLF® includes a combination of hundreds of algorithm configurations for capital and maintenance/turnaround/outage projects which convert project budgets (TIC) into craft labor hours and headcount estimates. After the project is created and the PLF® generates the project profile, the project labor can be adjusted by the CLMA® User, if desired, through 2 specific approaches to achieve more refined outputs.

- The PLF® tool enables full capacity to change every aspect of the project profile
 - Add/remove craft disciplines
 - Adjust craft labor curves
 - Adjust when craft arrive on and depart the project
 - Adjust labor distribution percentages
 - Assign craft labor to off-site construction locations
 - Adjust hours, days and shifts
 - Adjust the labor percent of Total Installed Cost (TIC)
 - Adjust wage rates based on BLS wages or customized wage tables
- The Excel spreadsheet uploader enables a labor profile to be assigned to the project based on setup work already completed in other applications (E.g. Primavera)

No adjustment to the project parameters and/or labor profiles is required if the PLF® produces a craft demand profile that is within an acceptable margin of error. The margin of error will vary based on the industry type selected and the breakdown of the budget categories. This is discussed in more detail below.

Development of Algorithm Configurations

The proprietary algorithm configurations employed by the PLF® within the CLMA® were developed over a number of years, through a validated and consistently applied methodology that includes the following steps...

1. Knowledgeable, experienced cost engineers with relevant construction sector experience were engaged to develop initial algorithm configurations based on certain project information usually known or easily estimated early on during a project's planning phase.
2. Key pieces of data were determined to be essential for the algorithms to calculate efficiently and effectively...
 - a. Capital vs. Maintenance/Turnaround/Outage spending
 - b. Type of project (E.g. power generation, manufacturing, refinery, hospital, etc.)
 - c. Total installed cost of the project
 - d. Anticipated project construction start/end dates
 - e. Project phase (E.g. FEL)
 - f. Zip code for project
 - g. Probability of project commencement
3. Based on these data criteria and the engineers' understanding of related projects within their respective industry qualifications, initial algorithm configurations were validated internally to assure correct craft mix and profile.
4. The algorithm configurations, processes and outputs were then validated against completed and/or ongoing projects provided by owners and contractors where the exact specifications were known. This process helped determine if the margin of error was within an acceptable tolerance.
5. When needed, adjustments were made to the algorithm configurations.
6. Re-validation of the outputs were completed when necessary.
7. Final validated algorithms were then deployed to the CLMA®

Industrial Algorithm Configurations	Non-Industrial Algorithm Configurations
<p>Chemical Facility Chemical Facility (Ethylene Cracker) Electric Power Generation (2x1 Gas-Fired Combined Cycle Unit) Electric Power Generation (Combined Cycle Major Outage) Electric Power Generation (Fossil) Electric Power Generation (Fossil) (Environmental) Electric Power Generation (Fossil) (New Generation) Electric Power Generation (General) Electric Power Generation (Hydro) Electric Power Generation (Large Drum Boiler Outage) Electric Power Generation (Large Drum Boiler Turbine Generator Outage) Electric Power Generation (Large Supercritical Boiler Generator Outage) Electric Power Generation (Large Turbine-Generator Outage) Electric Power Generation (Nuclear) Electric Power Generation (Solar) Electric Power Generation (Supercritical Boiler Outage) Electric Power Generation (Wind) Electric Power Generation 2x1 Gas-Fired Combined Cycle Unit Electric Power Transmission, Control, and Distribution Engineered Scaffolding (120+ feet) Manufacturing - Apparel / Clothing Manufacturing - Beverage Products Manufacturing - Computer and Electronic Products Manufacturing - Electrical Equipment, Appliances, and Components Manufacturing - Fabricated Metal Products Manufacturing - Food Manufacturing - Furniture and Related Products Manufacturing - Leather and Allied Products Manufacturing - Machinery and Equipment Manufacturing - Medical Devices Manufacturing - Miscellaneous Manufacturing - Nonmetallic Mineral Products Manufacturing - Paper Manufacturing - Petroleum and Coal Products Manufacturing - Pharmaceutical Products Manufacturing - Plastics and Rubber Products Manufacturing - Primary Metals Manufacturing - Tobacco Products Manufacturing - Transportation Equipment Manufacturing - Wood Products Maritime / Shipping Natural Gas (Down-Stream) Refinery, Terminal Natural Gas (Mid-Stream) Compressor Stations/Pads Natural Gas (Mid-Stream) Drilling, Fracking Natural Gas (Mid-Stream) Transmission & Distribution Natural Gas (Up-Stream) Wellpads, Water Impoundment, Roads Other / Misc Pipeline - Distribution (Down-Stream) Pipeline - Transmission & Distribution Pipeline - Transmission (Mid-Stream) Printing and Related Support Activities Process (Other) Refinery Refinery (Major Turnaround) Refinery (Outage / Non-Major Turnaround) Shipbuilding Steam and Air-Conditioning Supply Textile Mills Textile Product Mills</p>	<p>Airport Runways & Taxiways Auto Sales & Service Facilities Bridge (Multi-Span) Bridge (Single Span) Capitols / Court Houses / City Halls Dormitories (1-4 Floors) Funeral Homes Hospital (5+ Floors) Hotels/Motels (1-4 Floors) Landscaping Lighting - Athletic Fields Lighting - Roadways & Airports Lodges & Clubs Medical Office Building (1-4 Floors with TI) Medical Office Building (1-4 Floors without TI) Medical Office Building (TI only) Mobile Home Parks Nursing Homes Office Building HR (5+ Floors, TI only) Office Building HR (5+ Floors, with 80% Pre-Lease TI) Office Building HR (5+ Floors, without TI) Office Building LR (1-4 Floors, TI only) Office Building LR (1-4 Floors, with TI) Office Building LR (1-4 Floors, without TI) Parking Lots (Surface) Parking Structure Parks & Playgrounds Railroads Retail (TI only) Retail (without TI) Roadways (DOT Resurfacing) Roadways (DOT Widening) Roadways (DOT with Bridges) Roadways (Municipal) Roadways (Signs & Guardrails) Schools Sewage Treatment Facility (City) Sewage Treatment Facility (Municipal) Sewer Line Replacement / Upgrade Shopping Centers (with TI) Shopping Centers (without TI) Stadiums & Sport Arenas Swimming Pools Tanks (Oil / Other) Towers (Radio/TV) Transit Terminals Transmission Lines (Communications) Transmission Lines (Power) Warehouse Distribution Facility (TI only) Warehouse Distribution Facility (without TI) Water Line Replacement / Upgrade Water Treatment Facility Water, Sewage and Other Systems Worship Facilities</p>

It is important to note that the current algorithm configurations within the CLMA® are generic and designed to broadly apply to most construction projects. Generic algorithms are used because typically, no two projects are the same and therefore, it would be difficult, if not impossible to create, test and deploy an algorithm for every conceivable project possibility. A CLMA® User's capacity to easily make project adjustments using the PLF® tools, as discussed earlier in this document, offset the need to deploy countless additional configurations.

The approach used by the CLMA® provides highly effective market intelligence outputs when applied to the trillions of dollars of construction spending represented within the CLMA® database. We have consistently validated this assumption through our economic analysis, as well as feedback from the CLMA® User network.

The CLMA® also engages in a continuous improvement effort to update and adjust the algorithm configurations whenever verifiable information is received from the User network. Additionally, CLMA® Users may request very specific, customized algorithms to assist in project setup and management processes with the CLMA®.

Specific Algorithm Considerations

One of the challenging project inputs upon which the PLF® relies and for which clarification is warranted, is the assumption used for estimating of the percentage of the total installed project cost that will be expended on direct construction craft wages and on craft labor wage rates.

Using traditional Work Breakdown Structures (WBS), project costs can generally be broken into the following general categories:

1. Project Management (2%)
2. Engineering (15%)
3. Owner Supplied Materials (40%)
(Equipment and Materials purchased directly by the owner)
4. Construction (40%)
5. Startup (3%)

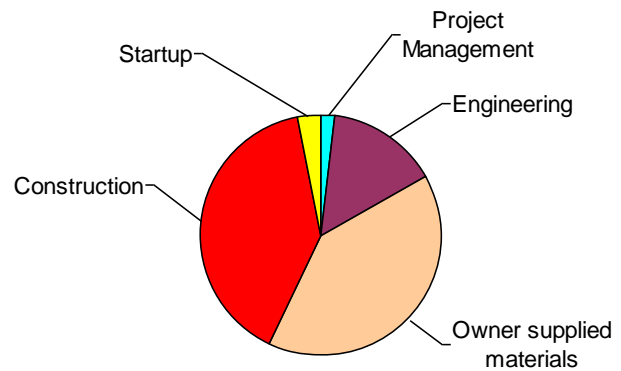


Chart 1: Estimated allocation of project costs.

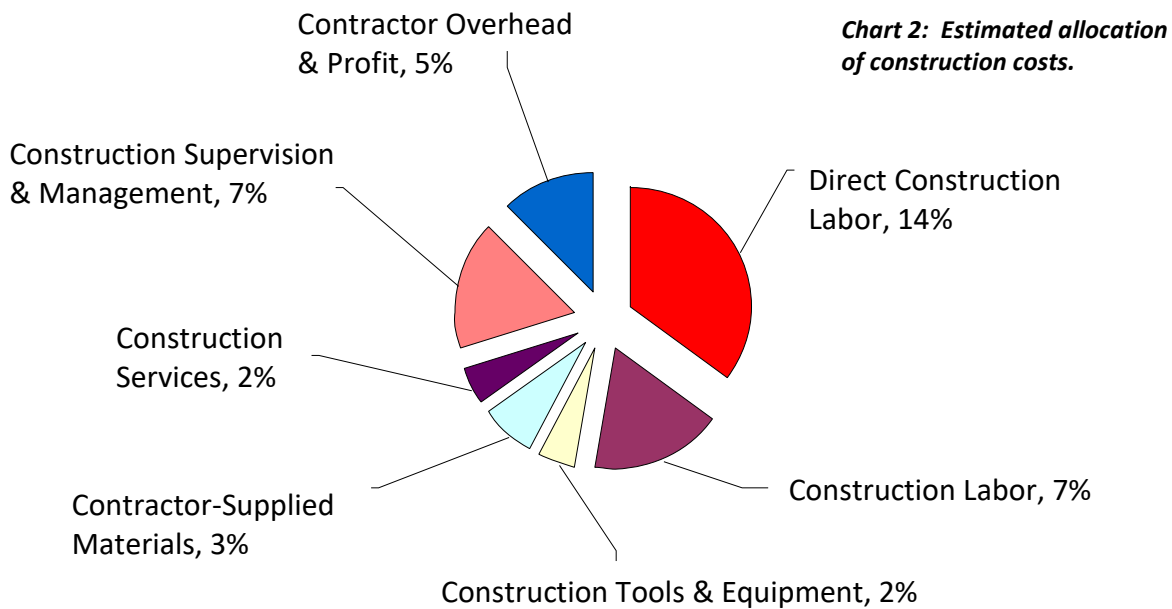
Note that these percentages are illustrative only. While the allocation of project budgets vary by the nature of the project and the scope of the work to be performed, budgets can generally be allocated as shown in Chart 1.

Using this budget allocation, the construction cost category includes more than just direct construction craft labor. Typical construction cost components include:

1. Direct construction labor costs (craft wages which appear on the workers W2 forms)
2. Construction labor adds (E.g. Workers' Comp Insurance, Health & Welfare Benefits)
3. Construction tool and equipment costs

4. Contractor Supplied Materials (Equipment and materials purchased directly by the construction contractor)
5. Construction services costs (E.g. temporary facilities, gases, electrical service, water)
6. Construction supervision and management costs
7. Contractor overhead and profit

As with the overall project budgets, the allocation of these costs vary by the nature of the work and specific contractor performing the work. Assuming that total construction costs will consume about 40% of the total installed cost of the project (as shown in Chart 1 above), a typical allocation of the WBS elements related to construction costs can be allocated further as shown in Chart 2:



The CLMA[®] is pre-populated with craft labor wage rates supplied by the U.S. Department of Labor Bureau of Labor Statistics (BLS) for each state. These rates generally reflect 90th Percentile unburdened W-2 wage rates and may or may not be applicable to each project. In addition to the bare wage rates, the CLMA[®] provides factors for burdening the rates, as well as General Services Administration (GSA) per diem rates.

Using a project example which includes the BLS wage rates, the labor percent of the TIC is presumed to be 14%–20% (see Chart 2 above) with respect to the project cost allocated to direct construction labor. Conversely, if fully burdened craft labor wage rates were used to reflect the total cost of construction labor, the labor percent of the TIC would be presumed to be 30%–40% with respect to the project cost allocated to direct construction labor.

Depending on the nature of project and the scope of the work, it is recommended that the direct construction labor cost percentage appropriate the specific project is used. All wage rates supplied by the CLMA[®] may also be replaced or augmented by a User's specific wage data. The percentages shown above are for illustration only and do not represent recommended values for any specific project.

Craft, Engineering & Project Management Disciplines

Craft Disciplines	Engineering & PM Disciplines
Boilermaker Boilermaker Welder Boilermaker Welder (Mig) Boilermaker Welder (Tig) Bricklayer / Blockmason Carpenter (All Unspecified) Carpenter (Concrete Form / Rough) Carpenter (Finishing) Carpenter (Floor Covering Installer) Carpenter (Interior Systems) Carpenter (Lather) Carpenter (Pile Driver / Operator) Carpenter (Scaffold Builder) Carpenter (Welder) Concrete Finisher / Cement Mason Craft Helper Electrician Elevator Installer and Repairer Firewatch Floorhand Glazier HVAC/Refrigeration Mechanic Instrumentation Technician Insulator Ironworker (Reinforcing) Ironworker / Welder (Structural) Laborer Lineman Machinist Millwright Millwright (Welder) Motorman Operator (Driller and Blaster) Operator (Heavy Crane) Operator (Heavy Equipment Mechanic) Operator (Heavy Equipment) Operator (Material Handler) Operator (Rotary Driller Oil and Gas) Operator (Truck Driver) Other Painter Pipefitter Pipefitter (Sprinkler Systems) Pipefitter / Combo Welder Pipelayer (Under Ground) Plasterer / Stucco Mason Plumber Rigger / Signalperson Roofer Roughneck Sheet Metal Worker Tile / Marble Setter Tool Drag Welder (Speciality) Welder (Underwater)	Construction Manager Contract Administrator Designers (Cad) Engineer (Civil) Engineer (Cost & Schedule) Engineer (Field) Engineer (Mechanical) Engineer (Power & Control) Engineer (Process) Engineer (Resident) Engineer (Safety) Engineer (Structural) Engineer (Utility Systems) Engineering Project Manager Estimator Field Procurement Representative Finance/Accounting Inspector / Quality Assurance / Quality Control Lean Construction or Productivity Improvement Resource Maintenance / Turnaround / Outage Manager Safety Specialist / Representative Specialists for Craft Training & Development Superintendent Tools and Equipment Manager