

Modernize Industrial Engineering with Data Driven Labor Standards

Revolutionize your labor management practices with machine learning

Labor standards are a method of establishing an expected performance level for a unit of work. Traditionally, labor standards are created by industrial engineers through a very time intensive, and thus expensive, process. For a modern distribution center with 300,000 square feet and 12 or more direct labor processes, you can conservatively expect to pay upwards of \$75,000 to \$100,000 in engineering costs and wait several months for engineers to develop such standards the traditional way. Easy Metrics offers a more efficient solution.

Big Data and advanced computing tools have enabled new ways to develop labor standards outside of spreadsheets. These tools and practices reduce the cost and time to create labor standards, as well as improve their accuracy.

The Labor Standard Formula

A labor standard can be defined by the basic formula of:

$$ELS = AX + BY + CZ + \dots + D$$

Where:

ELS = Engineered Labor Standard

X, Y, Z = input metrics for the process such as cases, feet traveled, lines, etc.

A, B, C = coefficients for each of the metrics X, Y and Z respectively

D = process time (a constant usually reserved for manufacturing or value added kitting lines)

The traditional industrial engineered approach is to use a reductionist model to solve for the ELS and each respective coefficient. This is done via a combination of observations using time and motion studies and historical data sets created over many thousands of recorded observations. Each process is broken down into distinct components and independently measured for time.

Picking example - Calculating a labor standard

As an example, let's look at a picking process where we have the following metrics available: lines, orders, distance traveled, and cases. For this example, the formula for ELS is:

$$ELS = (A * lines) + (B * orders) + (C * distance) + (D * cases)$$

The metrics are found in or can be derived from the Warehouse Management System (WMS) data. The number of lines and the number of orders are derived by summing the data, and case count is typically a field found within the WMS. Distance is calculated using a travel matrix of XYZ distance calculations. Within the WMS data, you are able to see the locations you have to travel to in order to pick the lines; referencing those locations against a travel matrix reveals the distance traveled.

Traditional Industrial Engineering Approach

For the following example, assume that an industrial engineer conducts a 30 minute picking observation and that the following data was extracted from the WMS:

Orders – 1
 Lines – 14
 Cases – 23
 Distance – 315 feet

The industrial engineer, now needing to solve for each coefficient, will observe an employee for some predetermined period of time and will record the time required to physically execute each of the picking process steps.

It should be noted that, in this traditional approach, the industrial engineer will have to spend additional time developing the standard if a static standard operating procedure (SOP) has not been created or is not being adhered to.

A break down of these steps is as follows:

1. Look at the scan gun for the order and location of the first line, and key in appropriate information
2. Walk to the location of first line in order
3. Scan the location
4. Cut shrink wrap on pallet with box cutter
5. Scan the first case in order
6. Grab the case and place case in cart
7. Scan the 2nd case in order
8. Grab case and place in cart
9. Look at the scan gun for next line location
10. Repeat above processes until all lines are completed
11. Travel to shipping locations
12. Place cases in shipping bin
13. Scan order and each case into shipping
14. Look at scan gun for next order

Each of the individual steps above are not in the WMS data, but are work elements of the process. The engineer measures the time it takes for each of these steps. They conduct many observations across many different employees for each process to build up the work element data set. The work elements are assigned to their respective metric/coefficient.

These elements can then be summed up and used to calculate the coefficient for each of the respective metrics. Each of the above steps correlates to one of the coefficients in the ELS formula. Those associations are as follows:

Orders – 1, 13, 14
 Lines – 3, 4, 9
 Cases – 5, 6, 7, 8
 Distance – 2, 10, 11

Over many hours of observations for each process across many employees, the engineer can build up hundreds of data elements and then use them to calculate the coefficient for each metric for the respective process. Sometimes Predetermined Motion Time System (PMTS) tables are referenced to expedite the process and validate results; nonetheless, substantial human effort is required. The end result is ideally an engineered labor standard that is fair and consistent across all employees—but the cost of manual development can be staggering. The traditional manual approach can take between 200 and 400 hours for initial development, with an additional 40-80 in annual maintenance. This can result in upwards of \$100,000 in costs. By comparison, Data Driven Labor Standards require a minute fraction of that.

Data Driven Methodology

Easy Metrics' Data Driven Labor Standards follow a similar development path, but instead of using observations and time and motion studies, it uses the on-site data available to solve for the coefficients mathematically. In general, 1000 or more data points is recommended to build the data driven standard. The more data points available, the tighter the standard that can be calculated. Big data architecture and tooling enables you to calculate standards on millions of rows of data quickly. For example, picking is calculated using orders, lines, cases and distance traveled. The formula will be the same:

$$\text{Data Standard} = (A * \text{lines}) + (B * \text{orders}) + (C * \text{distance}) + (D * \text{cases})$$

The steps to calculate data driven labor standards are:

1. Identify the metrics available in the data for the process.
2. Calculate the correlation of each metric to the output labor standard.
3. Run a multivariate non-linear optimization model on the correlated metrics across all employees for the process.
4. Filter the data for outliers due to dirty data
5. Run a multivariate nonlinear optimization model for each employee and optimize to lowest standard deviation.
6. Create a multiple metric table with all possible outcomes sorted from min to max employee standard deviation.

Similar to Engineered Labor Standards, Data Driven Labor Standards identify the metrics available in the WMS data for the associated process. Easy Metrics then calculates the correlation of each metric to the data standard independently with a scatter diagram built into its software tools. Studying correlations of metrics to standards is often rather eye opening; we frequently see engineered processes with up to 20 input metrics. However, when measuring metric correlation to ELS, 3-7 metrics have the most statistically significant impact.

Based on correlation, Easy Metrics runs a multivariate nonlinear optimization model on the correlated metrics to determine the initial coefficients for the respective metric in the labor standard. Nonlinear optimization uses advanced mathematics to get to the result. You can achieve the same with multiple nested FOR-NEXT loops with step functions as a brute force method, however this approach will go beyond most computer's capabilities with multiple metrics and larger data sets. It is also recommended that the user set ranges for each coefficient, if known; the ranges can be found in the same engineering tables used by the industrial engineer in the calculation of engineered standards. For example, for distance traveled, a person will walk at a speed between 1.5 and 3.5 miles per hour which is 132 to 308 feet per minute or 0.18 to 0.43 seconds per foot. Using a range per metric reduces the processing time and power needed as well as reduces the chance of an unrealistic result.

From this resultant data set, the user can plot a standard distribution curve and you will see there will be outliers on both the high and low end of the resultant labor standard. Because the WMS data is human generated, there will be inherent errors in the data caused by employees deviating from the process. If the user calibrated the standard to 100%, they may see many data points at 10% or 50% that are the result of bad data. It is best to filter out data that is outside 2-3 standard deviations. This can be done manually or programmatically.

The next step is to run a multivariate nonlinear optimization model optimized to minimize employee standard deviation and not overall process standard deviation. Optimizing to the employee level takes into account variances between employees.

The final step is to create an output table that ranks from minimum to maximum by employee standard deviation for all possible metric configurations. The user then chooses the best configuration and uses the coefficients for the labor standard.

Easy Metrics OpsFM includes all of this tooling programmatically and automates most of the above steps. This proprietary technology substantially reduces the time and cost required to develop and maintain labor standards. When compared to the traditional approach, Easy Metrics only requires 10-20 hours for initial development and an equal amount of annual maintenance; Data Driven Labor Standards will often cost less than one-tenth of the traditional approach.

Easy Metrics has run comparison models across hundreds of processes and have found that the data driven approach consistently creates a tighter labor standard than industrial engineered approach. Using Big Data incorporates all information into the process standard calculation and not just observations. The financial markets have used this approach the last 2 decades in trading algorithms to great success.

Ongoing cost of ownership

Another factor to consider is the ongoing cost of standard maintenance. Operations change and thus the labor standards often change with them. For traditionally engineered models, you should budget 4-8 hours in audits per engineered process every 6 months.

With Data Driven Labor Standards, Easy Metrics tooling and reporting enables the user to recalibrate standards in about 15 minutes per process.

Method of setting standard	Pros	Cons
Existing KPI's	<ul style="list-style-type: none"> • Simplistic single metric goals (units/hr) • Provides a goal to achieve 	<ul style="list-style-type: none"> • Ineffective for high-variance processes
Engineered Standards	<ul style="list-style-type: none"> • Industry norm for setting standards. • Determined by IE's time & distance studies • Measures each defined process separately • The generally accepted method by unions 	<ul style="list-style-type: none"> • Significant upfront investment of both dollars and time • Not highly scalable or maintainable; when a process changes the standard become obsolete • Standards are accurate based on subset of what IE saw during limited sampling • Does not factor in what is already being achieved; standard set could be less or equal to current output
Data Driven Standards using Data Regression	<ul style="list-style-type: none"> • Calculated using multiple metrics across each individual process • Looks at thousands of data points to gain insight into current output • Cost effective solution & standards can be set quickly • Highly scalable & maintainable • Reasonable & consistent stretch goals are set above current output 	<ul style="list-style-type: none"> • Targets are set based on historical data or output; may not account for existing inefficient processes • Cutting edge - gaining traction, but not yet the industry accepted method of setting standards

About Easy Metrics

Easy Metrics fuels operational excellence in distribution operations.

Operations and finance leaders use Easy Metrics' API integration platform and machine learning to analyze, plan, and forecast their labor spend so they can drive operational speed and efficiency, price their products and services profitably, and drive employee engagement.

With Easy Metrics, they translate raw operations data from multiple data sources into their costs by: activity, process, facility, people, and equipment. They use actionable reports across their network, to optimize labor spend, cut waste, plan facility investments, and drive labor strategies that ultimately fuel the growth of their business.

Learn how to develop data driven labor standards with Easy Metrics. Create and update your labor standards in a fraction of the time and cost compared to traditional engineered approaches.