



LOCATION AND PRODUCTIVITY FACTORS

HOW TO COMPARE APPLES TO ORANGES



Author: *Elmer Sachteleben, Cost Engineer CCE, Director of Cost Engineering Academy*

Summary

It is tempting to think that you can simply take an existing plant and create that same asset in a different location for the same cost. Sadly, there's no such thing as identical projects. However, management often seems to think so. What to keep in mind when building a plant abroad? This article zooms into some of the location and productivity factors and gives an insight on how to obtain them.

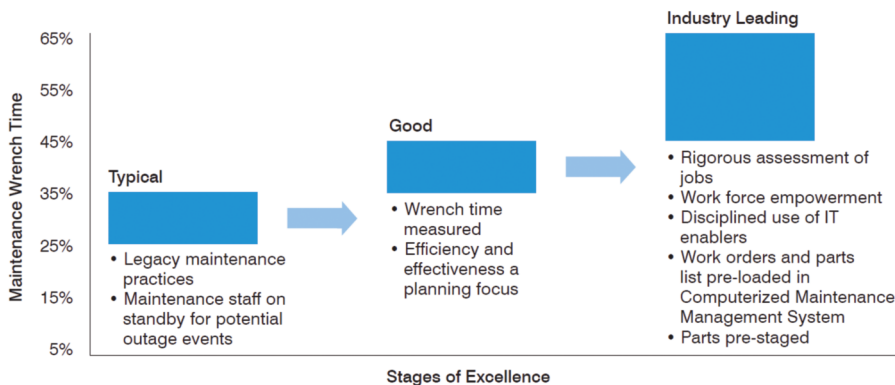


Figure 1 - Observed Maintenance Wrench Time, Power Industry (Steinhubl, Leeuwen, & Rogers, 2009)

It's all about the data

Every cost engineer knows that data is essential for any estimate. The only way to gather data, is to make sure that costs are structured. A breakdown structure, whether it is Cost or Work, helps to gather data and to analyse it and thus becoming an essential business intelligence tool for projects.

Setting up a correct and workable structure and keep it fixed for all future projects, is one challenge. Getting everyone on board and have them fill in the correct numbers is another challenge, but we'll keep that for another article.

There are many factors that influence an estimate, how to compare apples to oranges?

First: projects have to be comparable. Locational influences have to be extracted and all other effects need to be constant. Try to find projects with comparable scope and split off the unique parts. For example, with an Onshore Gas Processing Plant: is there a jetty or other extra infrastructure? Separate these unique features from the rest of the scope, and you will have something to compare.

Second, divide the scope in market baskets: identify and group parts of the project that show a common fluctuation in cost and hours when translating to a different location. Make a table of the market baskets showing costs versus location. When the collected data allows it, get more details by splitting the various baskets in the following cost categories:

- Equipment and materials
- Construction labour and engineering staff
- Supply & Erect contractors and construction equipment
- Management and supervision

Third: bring costs to the same price level and currency. Most likely, the resources for projects have been purchased in different currencies. Translate them into your reference currency using the exchange rate from that time. The next step is to index all costs and bring them to the current price level, taking inflation into account. This step also introduces a risk that has to be quantified: currency exchange rates.

The ratio of the different costs and hours now provides the location factor per market basket.

With these first steps, one part of locational factors is established. Differences in project price is not limited to the variation of market prices only. The project' environment and execution-related information is important to know as well. Think about climate, soil, regulations, productivity, availability of local and imported equipment/ materials and contractors, restrictions and regulations regarding import, housing of personnel, temporary facilities and the current infrastructure to name a few.

In this article, we will zoom in one of the most difficult resources to estimate: labour, and how to adjust the known hours for an activity for project specific conditions. What are the factors that influence productivity? Let's take a look at wrench time and temperature.

Wrench time

For construction work, productivity measures the time that employees spend on value-added work, also known as "wrench

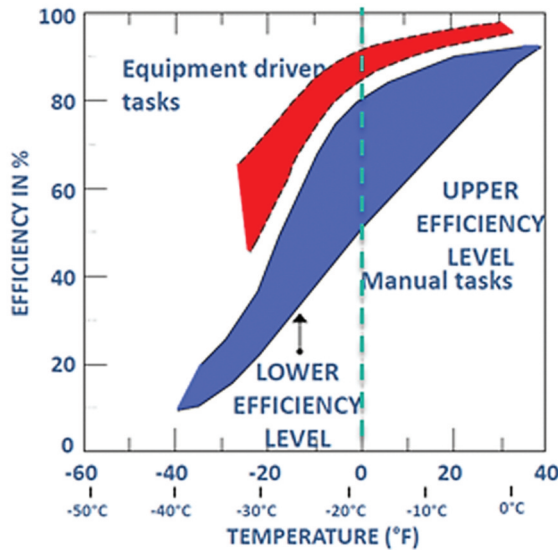


Figure 2 - Drop in efficiency for working under cold conditions.

time”. Figure 1 shows that maintenance workers in the power industry have an average wrench time of about 25 to 35 percent, with a maximum of about 60 percent.

It’s important to note that these figures are not set in stone, there is no guarantee for these productivity factors. Some tasks may take longer because of workers’ inexperience, a lack of appropriate tools, or poor planning. Or worst case scenario: defective work needs to be redone. All of these factors can influence overall productivity.

Activity type	Rotterdam	Antwerp	Amsterdam
Bolting & Hydrotest piping	1.00	1.10	1.20
Bolting and opening&closing equipment	0.90	1.10	1.20
Handling piping	0.80	1.10	1.20
Welding piping SS	1.10	1.10	1.20
Welding piping CS	1.05	1.10	1.20
Welding piping LACS	1.30	1.10	1.20
Equipment repairs	1.90	1.10	1.20
Equipment (de-) installation	1.18	1.10	1.20

Figure 3 - Example of geographical variations in contractor efficiency for various mechanical tasks

Studies like these are translated into factor tables for quick application.

Temperature

The productivity factor for any given activity changes with the weather conditions. Figure 2 represents the range in which manual tasks vary (blue area) or the more automated tasks (red area). Note how fast productivity drops below 0°C.

Studies like these are translated into factor tables for quick application. An example for mechanical activities is given below:

When no historical data is available

Performing a location factor study to find factors for market effects and productivity is a time-consuming process that requires a considerable set of structured historical project data. Not every cost engineer has at his/her disposal a comprehensive international data set reflecting locational conditions. External, maybe even local sources can be consulted for specific data

Project control and productivity

Knowing about factors that influence productivity is an important aspect of cost management and project control. Comparing estimated and actual productivity gives an indication of the performance of contractors. This information is essential to analyse why overruns occur and can be used to handle disputes.

Conclusion

Applying relevant location factors allow you to translate the required resources from location to location. These factors have to be updated on a regular basis. A consistent approach should be in place to quantify these effects.

The actual productivity can be related to the planned productivity by a factor. Like location factors, this means there is always a basis of reference that needs to be determined first.

Determining the above factors is only possible when estimates and cost data is consistently structured. When no company information is available, a consulting firm

can be of assistance in providing elaborate locational data and context, or even help in compiling and reviewing cost estimates.