

# Approximating the Disproportionate Growth in the Cost of Capital Projects

What has caused the dramatic rise in capital project costs over the last two decades?

## Abstract

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In our 2014 Annual Perspective, titled *False Precision and the Illusion of Accuracy*, we shared our view of how increasing levels of detail in project budgets and schedules have given owners a false sense of confidence in the accuracy of their work volume measures and the resultant schedules. This combination of false confidence and rationalized optimism has been reinforced by reference to early plants that had much lower costs and shorter schedules, especially in bellwether commodity chemicals. As previously noted, we have consistently witnessed greater than twofold increases in capital cost and increased durations in hydrocarbon-related facilities since the millennium. The disproportionate growth is clearly evident when comparing capital cost per annual production in commodity chemicals, even where the current plants should show evidence of economies of scale due to their larger size.

In this analysis, we have attempted to benchmark in some detail the cost growth of a mid-1990s U.S. Gulf Coast commodity chemicals plant against a current version. Our hope is that readers can use this data to better understand the elements of capital cost growth, and to make informed decisions as to how some of this growth might be mitigated.

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## Over the last two decades, the costs of capital projects have grown disproportionately to expectations

There is a general awareness that capital project costs have grown disproportionately to other costs, yet there is little quantification of this growth. But with the current expansions on the U.S. Gulf Coast in capital cost-sensitive commodity chemicals such as ethylene, methanol, and ammonia, it becomes easier to draw comparisons to similar plants built on the U.S. Gulf Coast in prior decades, in terms of capital cost per annual ton of product.

The Westney database includes records on an ethylene plant that was built in the mid-1990s. This project was built on a typical separated brownfield site, and has been judged as a good benchmark for a successful ethylene project. In addition, Westney has been involved in several current ethylene projects, providing us with a good understanding of the physical parameters and costs of these projects.

Our clients recognized that their current projects were dramatically more expensive than inflation or escalation would support. The mid-1990s plant was roughly half the size of the current plants and based on cracking more difficult feedstock. Overall, the capital cost per KTA (kilo-ton per annum) of product for the current plants is approximately three times, or roughly 200%, higher than what we saw in the mid-1990s.

Based on indications from various consumer price indexes, costs in the United States have generally risen about 60% from 1995 to 2014.

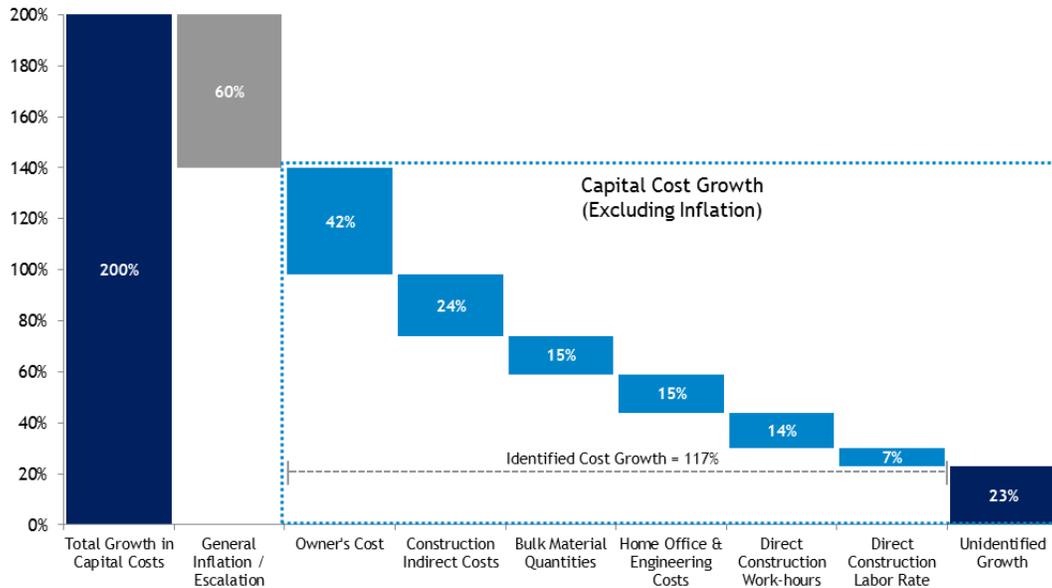
*What makes up the extra 140% in capital cost growth?*

### Breaking down the 140% growth

In the following analysis, we seek to quantify this increase in capital costs. Please note that this is not an exact science, and we would caution that our analysis should only be considered directionally correct; however, we are confident in our basic data and approach.

Following are the factors we discovered in our analysis of the 140% growth, 117% of which is identified and 23% of which is unidentified.

## Summary Breakdown of the 200% Growth in Capital Costs from 1995 to 2014



### Owner's Cost: 42% Growth

The growth in Owner's Cost can be generally identified in the cost of control (e.g. extended FEL or FEED, recovery of "project management organization" overhead, cost of processes, etc.). Builder's risk insurance has doubled, but it is not a large sum in the total. Owner's Cost for the 1995 plant was 7% of the final cost, while current plants are typically around 15%. This is generally the case for all plants, as we have seen Owner's Cost be up to 25% of final cost in other industry segments. Commodity chemicals have historically been the bellwether for the management of Owner's Cost.

The extra 7% of final capital cost translates to 42% of the capital project cost growth.

### Construction Indirect Costs: 24% Growth

There are several contributing factors to the growth in construction indirect costs, which we measured as a percentage of direct labor. Contractor(s) management teams are larger, particularly in the area of project controls and quality assurance. Construction facilities for the U.S. Gulf Coast have also expanded, especially in the area of craft-related facilities. Construction equipment costs have risen slightly more than inflation. Contractor's overhead recoveries for field staff, construction, and supplies (i.e. small tools) are also higher in percentage terms. In both the 1990s plant and in current plants, construction indirect costs include overtime pay and employee incentive pay. And while there was no incentive pay for the mid-1990s plant, it is a significant cost in today's environment.

Indirect construction costs were 130% of total direct field labor (TDL) on the mid-1990s plant. Today's comparable percentage is 165%. This difference in percentage translates to 24% of the capital project cost growth; however, this is likely a low estimate, as TDL has also grown disproportionately.

### **Bulk Material Quantities: 15% Growth**

Quantities of the current and mid-1990s plant were examined in detail. Major equipment counts are similar, and for good reason: the basic unit operations and components are the same. Current plants are larger, affecting the size of the equipment, but not the count. The cold ends of the plants are generally identical, while the hot ends may include an additional furnace or two, though typically just larger furnaces. Pipe, electrical, and controls quantities are consistent between the plants, though in the case of pipe, larger.

The surprise is concrete and steel. Concrete quantities are three to four times the earlier plant, while steel quantities are twice the mid-1990s plant. Some of this is due to larger and heavier equipment and pipe-related loads – but that does not account for two and three times. In general, we are seeing more concrete and steel in all current plants. In LNG, the increase in concrete quantity can be attributed to larger module footprints of up to 25%. For the other plants, there is no real solid explanation. Experienced construction people tell us foundations are generally larger today for the same equipment. They relate this to the universal use of design programs. Others say paving is more abundant and thicker.

Our rationalized view of the resultant effect on cost growth after consideration of larger and heavier equipment is that concrete accounts for 12% growth and steel 3%, or a total of 15% of the capital project cost growth.

### **Home Office & Engineering Costs: 15% Growth**

The mid-1990s plant showed 2,700 home office and engineering hours per piece of major equipment. As previously noted, the equipment counts are approximately the same. The current generation of plants, when counted on the same basis, shows close to 3,400 home office and engineering hours per piece of major equipment. The good news is that the cost of engineering has been managed down by the use of high-value engineering centers, and thus cost per hour has only grown 40%.

The difference between hours spent on the mid-1990s plant and current hours (on an equivalent equipment count priced at \$105 per hour) translates to 15% of the total capital project cost growth.

### **Direct Construction Work-Hours: 14% Growth**

After adjusting for the growth in concrete and steel, which is already considered in this analysis and has been adjusted for the current larger plants, we calculate work-hour growth

at 28%. The major components of the growth are scaffolding and work-hours per linear foot of pipe. Electrical and instrument unit work-hours are slightly higher, but are not major contributors.

The 28% extra work-hours at a bare labor rate of \$28 per hour translates to 14% of the total capital project cost growth.

### Average Base Wage for Total Project Direct Labor: 7% Growth

The average base wage for total project direct labor has increased. We define **base wage** as the posted hiring rates exclusive of burdens, benefits, incentives, and contractor mark-ups. Our definition of the average base wage for total project direct labor consists of the average base wage of all crafts, inclusive of journeymen, helpers, and apprentices; it can be calculated as total project direct labor cost divided by total project direct work-hours.

The mid-1990s plant was completed with the total project average direct labor rate at 85% of the journeyman pipefitter wage rate. Currently, it is roughly 93% of the journeyman pipefitter rate. This basically indicates that there are now more general foremen, foremen, and journeymen than helpers, apprentices, and laborers in the project labor mix.

The difference between the 93% and 85% wage rates translates to a \$2.50 wage increase (net of inflation / escalation) across all of the direct work-hours, or 7% of the total capital project cost growth.

### Unidentified Growth: 23%

We would expect if we could access the files of material and equipment suppliers and subcontractors, we would find disproportionate growth similar to the analysis above that could easily account for the remaining 23% of the total capital project cost growth. We welcome additional perspective on what other factors could be major contributors to this growth.

### A bit of good news

The average cost of equipment per item (Total Equipment Cost divided by equipment count) is only 55% higher in 2014, or slightly less than inflation / escalation. This is even more surprising considering that current equipment is significantly larger with more material content. We did not have enough data to quantify bulk materials; however, based on some sampling, bulk materials appear to show the same trend as major equipment. Our view is that the emergence of a very competitive global market and distribution system is tempering the cost of both major equipment and bulk materials. There is also a slow-down in the current market for the cold ends equipment and materials due to the downturn in LNG, where similar components are used.

## Westney helps clients identify and mitigate excessive capital cost growth through our Independent Value Assurance diagnostics

One of the main issues with capital cost growth is that most owners do not quantify the potential growth in their project(s) until it is too late. Project teams should be given optimistic targets, but company leadership who desire predictability need to understand the key project issues and range of potential outcomes.

Our decades of industry experience have enabled Westney to provide clients with an experience-driven, top-down, independent view of the projected cost, schedule, and work-hours for a project using our Risk Resolution® methodology. We independently value the project's key risks and benefits in a "straw man" to assure that all risks (no matter how sensitive) are considered. Our independent view combats rationalized optimism, and provides clients with a risk-adjusted interpretation of key project metrics.

Using our proprietary Predictability Calibration® diagnostic, Westney is also able to define the key issues that lead to predictable cost and schedule outcomes. We have consolidated these issues into 42 Predictability Factors™, which form the basis of our methodology. This tool provides clients with an independent verification of the likelihood of project success, along with detailed, actionable recommendations that will improve project predictability and performance.

Our diagnostics are forward-looking and project-specific. The outputs are based on several industry experts' knowledge and insight into the specific project's technical/commercial issues, location, contracting strategy, team, and risk factors – not just a benchmark of previous projects that may or may not be relevant to the unique challenges and environment of the project being evaluated.

If you would like to discuss the contents of this publication, or hear more about the type of work that we do, please give us a call at (713) 861-0800 or email us at [info@westney.com](mailto:info@westney.com).

