Chapter 1

Introduction to Construction Cost Estimating

1.1 COST ESTIMATING – ART OR SCIENCE?

Is cost estimating an art or a science? My usual response to this question is that cost estimating is both, but more art than science. The science part is made up of engineering and statistics. And the art of estimating is based more on economics and subjective modeling based, and relying on the estimator's experience and knowledge of construction.

Good accurate cost estimating has been the mainstay of human development for at least 8,000 years. Every great empire sustained growth and development because they could afford it. And they could afford this economic development because, among other things, they were good at estimating costs in advance of expenditures. Many other groups suffered through a trial-and-error method of achieving sustained economic development for myriad reasons. But one reason could be that they were very poor cost estimators. This may be a gross oversimplification, but good cost estimating is better than bad.

1.2 STRUCTURE OF THE MANUAL

This manual is not meant to be a rigorous economic analysis or scholarly investigation. It is an outline for preparing good cost estimates for water treatment plants. In this manual the reader will find; basic water treatment plant design philosophy and process schematics; predesign cost estimating methods and procedures; process parameters and their cost curves; and total plant costs, including tables and equation functions; as

well as capital and operations and maintenance cost for each type of complete water treatment plant.

The estimating methodology is an amalgam of the best practices of cost estimating and the personal experience of the authors. We have freely used studies and public documents provided by governments and our own historical project data. These tools have provided us with a sound way of developing cost estimates based on specific parameters for individual processes of conventional as well as advanced water treatment plants.

1.3 RULES OF THUMB FOR GOOD ESTIMATES

In the busy life of an engineer or manager, there is rarely enough time to develop a comprehensive detailed cost estimate. So, one may look around for someone not so busy and free to take on the assignment. They may give the assignment to the newest addition to their staff. If this person has enough experience, the estimate will be good. If they have little experience, the estimate will be very poor. And there will be negative repercussions to the budget for design and construction. Cost overruns will run amok, reputations will suffer, and the owner will be very unhappy.

- So, the first rule of thumb is to assign the cost estimating to the best-qualified staff person and give them a copy of this manual to help guide them through the effort.
- The second rule of thumb is to resist the temptation to assume that cost estimates have the same precision as engineering tasks. If they did, they would not be called estimates. Many predesign estimates are carried out to the dollar and much is made of expected accuracy. At this level of estimate a line item estimated to the nearest $10,000 is a reasonable level of accuracy.
- The third rule of thumb is complete the design philosophy and design parameters before estimating the costs. Time is better spent developing solid design parameters such as the detention time, volume of process vessels, and redundancy of process units that will make operation and maintenance of the plant possible.
- Rule of thumb number four is to assign an experienced person to review the estimate. This is obvious on the face of it, but the estimate is usually the last thing to develop when the design budget is exhausted and there is only one day before the report is due.
- The fifth and final rule of thumb is to check the math.

1.4 USE OF HISTORIC DATA

All cost estimators and many engineers and managers keep historic costs in their lower-left desk drawer. This information is a gold mine to their staff and organization. Once adjusted for appropriate indices and level of detail, this data could be added to the cost curves in this book and used to improve the in-house capabilities of the estimator, engineer, manager, and organization. The tables and cost curves contain the formula used to get the best fit for the cost data behind the curves in this manual.

If your experience is the same as the authors, you will find that there appears to be a great variation in data and results. There are many root causes for these variations. Some are the results statistical anomalies; others, economic disparities; yet others, poor record keeping and adjustments. Even with the original, "primary" data, we found coefficients of colinearity (r-squared) in the neighborhood of 0.60 for the total cost of a conventional water treatment plant. And got r-squared(s) of 0.35 for pumping stations. In summary, do not expect precision, but constantly test your assumptions, recheck the math, and review the work of others.

1.5 ADJUSTING THE NUMBERS

Historic costs have a way of remaining constant. They represent the actual price of goods and services at some time in the past. They can be adjusted to another time or place on the basis of a cost index published by either the government or a private entity that is generally accepted by the industry or constituency it represents. It is important that the estimator select the most reliable index and apply that index to the historic cost to compare it to other costs, either actual or estimated. Once adjusted, the resulting cost is no longer considered primary data.

Adjusting actual costs from some time in the past to the current period presumes that the goods and services that made up historic cost have not changed and the costs for all components have changed in exactly the same way. Making this adjustment can introduce inaccuracies into the estimate. Adjusting the actual cost from place to place either across the country or from country to country is even riskier. And making both types of adjustments can eliminate any reasonable expectation of accuracy.

Our recommendation is to make at least three separate estimates of the cost using different means and assumptions. The cost curves and

tables in this manual are one way to go about the estimating process. Getting input from someone of greater experience is the second. And using actual costs from published documents as comparisons could be the third. In this way the estimator is able to plot a triangle of points and test the individual process or complete treatment plant cost model for reasonableness.