

## **Revisit of Reference Class Forecasting (RCF): Estimating Costs of Infrastructure Projects**

Clifford Gray

### **Executive Summary**

The majority of infrastructure projects funded by taxpayer dollars generally result in cost and schedule overruns. Managers should revisit reference class forecasting (RCF) to focus on how its use improves forecast accuracy. Key managerial actions supporting use of RCF are suggested. Will your organization accept the challenge of reducing overruns?

### **Introduction**

The Boston Consulting Group estimates that \$35 trillion to \$40 trillion will be required by 2030 to satisfy the growing global need for infrastructure development. BCG also estimates that, at best, worldwide governments will be able to fund almost half the requirement, leaving a shortfall as large as \$20 trillion to \$25 trillion alone.<sup>1</sup> The US alone will need 5.4 trillion to improve infrastructure of roads, rail, water, and electricity by 2030.<sup>2</sup> Governments will fund most of these projects. Given the magnitude of the numbers and their impact on governments and society, the historical problem of horrendous over spending needs to be addressed and changed. Taxpayers deserve better.

Unfortunately past cost overruns in megaprojects have resulted in scandalous errors with projects finishing significantly higher than original estimated budgets. The literature abounds with examples. In general these studies agree that nine out of ten projects exceeded budget. “Overruns of 50% are common; cost overruns over 50% are not uncommon.”<sup>3</sup> A few famous cost overruns are listed here: <sup>(1 ibid)</sup>

Lake Placid Winter Olympics	550 %
Boston Big-Dig Tunnel	220 %
Denver Airport	200 %
Minneapolis Light Rail	190 %
Channel Tunnel	80 %
Bangkok Metro line	70 %

The cost overrun problem is very much alive today. Why are original cost estimates so far from actual costs? What are the causes of such large estimating errors? What can be done to make cost estimates more realistic? Could rigorous use of reference class forecasting (RCF) and management changes reduce those errors and save billions of taxpayers' money?

## Background

The potential of RCF received wide attention in 2007 when the research of Bent Flyvbjerg, the world's prominent expert on megaprojects, was published.<sup>4</sup> Over one hundred articles of RCF's potential have been published since. (*Search Google: RCF or Brent Flyvbjerg*) Flyvbjerg suggests the major causes for the differences in budget and actual are biased estimates of costs and benefits. The appeal of RCF seems intuitive. Unfortunately its adoption in large projects has been incredibly limited. Horrendous cost overruns continue.

## How RCF Works

RCF collects differences in planned budget cost and actual cost of similar completed projects. These actual differences are arranged statistically to show the differences by percentile and overrun percent. Armed with this information, the "inside" planner's detailed project cost estimate can be compared and evaluated (along with risk probabilities) by all project stakeholders. The key question is, *Why will the proposed project not run over by a percent similar to past actual projects?* Any stakeholder can analyze and decide the rationality and validity of the planner's explanation.

Such comparisons also serve as a benchmark for "go-ahead" decisions of the proposed project. For example, if cost estimate appears to be highly underestimated, there should be serious questioning why the project will be allowed to be implemented and take scarce resources from other potential higher value projects. Given percent differences and percentiles, realistic contingency funds can be reconsidered.

Major benefits of the inside-outside cost comparison are (1) it serves a reality check on inside estimates, (2) provides a start at promoting stakeholder due diligence and fiduciary responsibility, and (3) draws attention to accountability.

Bent Flyvbjerg's research identifies two basic areas, Optimistic and Strategic Misrepresentation, as major reasons for cost estimate errors.

**Optimistic Bias.** Optimistic bias represents a predisposition to judge a desired state. In projects, predisposition manifests in a planner's underestimated task costs even knowing similar projects have exceeded baseline budgets. These estimates assume the project will be implemented as planned, although this is seldom the case. This bottom-up perspective often fails to consider unplanned events similar projects have experienced. Omission of other relevant information leads to underestimated and over optimistic project budgets. The same delusional approach is used to assessing the expected benefits that will be derived from the project. These benefits often receive more positive weight than other less positive scenarios such as project risk. For example, megaprojects are typically risky due to long planning horizons, scope changes, and complex interconnections.

The optimistic plan often becomes sealed (anchored) and serves as a baseline for cost for project decisions. Most stakeholders accept this detailed estimate as reliable.

**Strategic Misrepresentation.** Strategic misrepresentation frequently has roots in organization pressures found in business and government. The pressure come from an individual or group deliberately slanting information with positive outcomes to gain support and funding—for example, providing employment, saving lives, or providing a monument to future generations,

Some executives and politicians desire to have the mega project as their “legacy project.” That is, they desire to have their name recognized as promoting the project—usually “for the benefit of society.” In such projects, benefits are over emphasized and cost is under emphasized. The outcome can be an egregious miss use of resources that could have been used on other higher value projects. The outcome of mega legacy projects that fit this description is common knowledge and well reported by the press.

When optimistic and strategic mismanagement biases occur, the understatement of project costs can be scandalous. Gaming the system by politicians, contractors, and planners using unrealistic estimates can be thwarted and exposed with the use of RCF because it only measures actual outcomes (outside) and does not consider detailed (inside) practices. Since over 95 percent of infrastructure projects are accepted and financed by taxpayers, the failure to use RCF to reduce bias is a failure to accept due diligence and fiduciary responsibility by project sponsors.

RCF serves remarkably well to identify and restrict estimate bias. RCF is impersonal and removes moral and emotional issues. Mitigating the effect of optimistic and strategic biases is imperative and RCF can be a significant part of the solution.

## **Two Common Threads**

Beyond bias, another major thread through all past project overruns is the absence of strong accountability and oversight. This absence is frequently revealed in retrospectives of finished projects.

There is general acceptance that lack of accountability and oversight are evident in tracking cost and schedule overruns of large infrastructure projects. Suggesting increases in accountability and oversight may not be a popular stance when project advocates are in strong positions or organization pressures are compelling, but the alternative is even less desirable. Some of the more promising areas for supporting RCF estimates and reducing infrastructure costs are suggested here.

**1. “Make RCF Mandatory”** is sage advice given by Flyvbjerg over a decade ago.<sup>4</sup> Its use and visibility would force some accountability by exposing bias estimates. In this age of data mining and data analytics, RCF would seem a natural requisite for any multi-million-dollar project. Cost is relatively small. The math is not sophisticated! The benefits could reach billions. In addition, RCF provides a foundation for more realistic contingency funding. RCF provides an excellent opportunity to analyze project risk and to assign realistic budget and management reserves. Some future litigation may be reduced. At the very least, RCF should be as benchmark to validate the inside cost estimate. If you wait

until the project is 150% over budget, the money is gone. Catch the error early and avoid the loss. Remember the obvious; RCF is not effective if it is not used!

**2. Vet Each Project.** Since almost all infrastructure projects are paid with taxpayer dollars, it is not unreasonable to have some *independent* agency evaluate projects for reasonableness of cost and benefit estimates to mitigate bias. A few countries have followed the United Kingdom down this path with some success-- Australia, Denmark, Netherlands, and Switzerland. The idea has also caught on with a few engineering associations in the US and UK supporting RCF. This effort needs to be scaled up. Such groups or agencies must be free of political or organizational influence. If vetting does not happen, it is unlikely any significant improvement will occur; resources will continue to be squandered at taxpayer's expense.

RCF and vetting are not limited to mega infrastructure projects. For example, if a city infrastructure project is estimated to cost \$15m, but actual is \$65m, the \$50m difference can have a disastrous effect on the city's budget and finances. It is highly probable RCF and vetting would catch such egregious errors.

**3. Bind political advocates to estimate.** To be effective RCF needs to receive overt visibility and acknowledged consideration by major supporters. Those pushing a potential project will be less bellicose if they might be held accountable for any mammoth cost overrun. Each major stakeholder has to have some political "skin in the game." Create a "Sign on" that stakeholders, including politicians, executives, and contractors, have participated in a serious review of both inside and outside estimates---no exceptions or the project does not move ahead. The more people tied to the estimate, the greater the chance of avoiding bias estimating errors.

**4. Require contractors be accountable to their estimate.** Require vendors buy into an estimate. Insist on experienced and well-trained cost estimators. Create incentives and penalties. For example, any savings are shared 50/50 for contractor and project owner. Times for identifying such savings opportunities often occur during stage gating and in-project retrospective reviews that occur early in project implementation.

Shift risk. For example, consider having the project owner accept financial responsibility for unplanned events completely outside the contractor's control and have contractors assume financial risk for any known events missed in the estimating process. Too often failure to clarify this distinction results in inadequate contingency funding and legal problems later.

**5. Have a clear, strong project leader.** Megaprojects are very complex, control is dispersed, and many stakeholders and organizations are working toward different goals. Performance goals and responsibilities need to be clear. The project leader needs to have power to fire contractors who fail to perform. The power needs to extend to dropping a project that has run amok early, before it is "locked in" and too far down the road to stop.

**6. Develop cooperative data banks** that classify project by type, size, cost, and other criteria. Make these actual cost and schedule data available to be used to evaluate “inside” estimates of similar projects.

Advocate for government, business organizations, and professional associations to support these data banks. For example, information technology firms, such as Google, IBM, Gardener, and Oracle, could support an independent data collection group to provide data to all IT organizations that participate. Professional groups, such as engineers, lawyers, Project Management Institute, American Planning Association, and Forrester Research, could develop such data banks for other infrastructure types of projects.

The six areas suggested for evaluation and improvement would vary depending on the project. But all represent an effort to increase more accountability and oversight to improve estimating and reduce cost overruns.

## Conclusions

Underestimated project cost and time have been major managerial factors leading to project overruns. With the anticipated increased spending in global infrastructure projects and the coming funding short fall, how many billions of dollars in cost overruns will not be anticipated? How many resource dollars will be squandered that could be allocated to other projects of higher value to tax payers? Why would any organization, city, state, or country pass up a chance to possibly save billions?

RCF is not the answer to all infrastructure-estimating problems, but it is bias-free, impersonal, and based on actual project data. When RCF is supported by strong accountability and oversight, effectiveness is enhanced. Beyond the use of RCF there are many other management facets that need improvement. Some avenues have been suggested. Increased accountability and oversight in every area of estimating will go a long way to shrinking errors and overruns.

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## Sources

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## About the Author



### **Dr. Clifford Gray**

Oregon, USA



**Cliff Gray**, emeritus professor from Oregon State University, has long been a project management advocate. Cliff taught student and executive classes on all aspects of project management. He has been active in the PMI organization for decades; he was one of two founders of the Portland, Oregon chapter. He has published numerous research and applied management papers. Cliff has published three project management texts. The latest book is, *Project Management: The Managerial Process, 7<sup>th</sup> Edition*, coauthored with Erik Larson of Oregon State University and is printed in five languages. The text presents a careful balance of the technical processes and the socio-cultural environment in which project managers operate.

Cliff can be contacted at [graycf@comcast.net](mailto:graycf@comcast.net).