Delusion, Deception and Corruption in Major Infrastructure Projects: Causes, Consequences, Cures.

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3 Delusion, deception and corruption in major infrastructure projects: causes, consequences and cures

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1. Introduction

The successful delivery of major infrastructure projects is increasingly vital to the global economy, with an estimated $22 trillion in projected investments to be spent in emerging economies alone (*The Economist*, June 7, 2008). Projected benefits include employment, the purchase of domestic inputs, improvements in productivity and competitiveness as a consequence of lower producer costs, provision of higher quality services to consumers, and environmental benefits arising from the use of new environmentally sound technologies (Helm, 2008). Yet, the track record for delivery of major infrastructure projects is poor, typically characterized by enormous cost overruns and benefits shortfalls (Merrow et al., 1988; Miller and Lessard, 2000; Flyvbjerg et al., 2003). Further, infrastructure is the third member of an 'unholy trinity' of high-risk sectors alongside arms and energy, suffering from substantial exposure to corruption (Transparency International, 2010). Global economic and development ambitions, therefore, rest on shaky foundations.

In this chapter, we draw upon recent studies by one of the authors of this chapter (Flyvbjerg) and his research collaborators, to highlight the role of delusion, deception, and corruption in explaining the consistent underperformance of major infrastructure projects in terms of cost estimates and benefits delivery. Our focus is principally on the planning and approval phase of major projects, rather than on activities that occur at later stages of the project life cycle, post-approval. We outline the implications for policy makers, planners, and commercial organizations that plan, commission, and deliver major projects, and we identify a series of steps that can be taken to improve delivery performance. Specifically, we recommend reference class forecasting, a set of statistical techniques for benchmarking projects and predicting the probability of performance outcomes under a range of alternative scenarios, and call for the design of governance structures for major projects that enable public and peer scrutiny of decision making from the outset.

We begin in Section 2 by describing the salient characteristics of major infrastructure projects and provide some illustrative examples from previous studies of the nature and extent of cost overruns and benefits shortfalls, drawing attention to the policy implications (Flyvbjerg et al., 2002, 2004, 2005, Flyvbjerg, 2005a, 2005b). In Section 3, we outline various explanations for cost overruns and benefits shortfalls proposed in the literature and discuss the strengths and limitations of each. Drawing on two previously published case studies, we argue that political–economic explanations, including corruption, offer the strongest explanation for the poor performance of major infrastructure projects. Section 4 sets out some 'cures' for the problems that currently plague major infrastructure projects. These include reference class forecasting techniques and a call for the introduction of institutional arrangements to improve public and private sector accountability. A final section concludes.

2. Characteristics of major infrastructure

Large infrastructure projects, and planning for such projects, generally have the following characteristics (Flyvbjerg and COWI, 2004):

- Infrastructure projects are inherently risky due to long planning horizons and complex interfaces.
- Technology is often non-standard.
- Decision making and planning are often multi-actor processes with conflicting stakeholder interests.
- The project scope or ambition level often changes significantly over time.
- Statistical evidence shows that factors that may inflate costs are poorly anticipated with the consequence that budgets for such contingencies are inadequate.
- As a consequence, misinformation about costs, benefits, and risks are the norm.
- The result is cost overruns and/or benefit shortfalls with a majority of projects.

To illustrate the scale of cost overruns and benefits shortfalls, we present data from two international studies of transportation infrastructure projects. The first study focuses on cost estimates (Flyvbjerg et al., 2002) and the second emphasizes demand forecasts (Flyvbjerg et al., 2005). Although the studies focus on transportation infrastructure, comparative research shows that such problems are common to a range of other major infrastructure projects including power plants, dams, water projects, large sporting events such as the Olympics, information technology (IT) systems, oil and gas extraction, aerospace and defense projects (Merrow

Table 3.1 Inaccuracy of transportation project cost estimates by type of project (in constant prices).

Type of project	No. of cases (*N*)	Avg. cost overrun %	Std dev.
Rail	58	44.7	38.4
Bridges and tunnels	33	33.8	62.4
Road	167	20.4	29.9

Source: Flyvbjerg (2007).

et al., 1988; Miller and Lessard, 2000; Altshuler and Luberoff, 2003; Flyvbjerg et al., 2003; Flyvbjerg 2005a).

Table 3.1 shows the inaccuracy of construction cost estimates measured in terms of cost overrun. The study covers 258 projects in 20 nations on five continents. All projects for which data were obtainable were included in the study.[1] For rail, average cost overrun is 44.7 percent measured in constant prices. For bridges and tunnels, the equivalent figure is 33.8 percent, and for roads, 20.4 percent. The difference in cost overruns between the three project types is statistically significant, indicating that each one should be treated separately (Flyvbjerg et al., 2002). The large standard deviations shown in Table 3.1 are as interesting as the large average cost overruns. The magnitude of the standard deviations demonstrates that uncertainty and risk are significant. The following key observations pertain to cost overruns in transportation infrastructure projects:

- Nine out of 10 projects have cost overrun.
- Overruns are found across the 20 nations and five continents covered by the study.
- Overruns are constant for the 70-year period covered by the study; estimates have not improved over time.

Table 3.2 shows the inaccuracy of travel demand forecasts for rail and road projects. The demand study (Flyvbjerg et al., 2005) covers 208 projects in 14 nations on five continents. All projects for which data were obtainable were included in the study.[2] For rail, actual passenger traffic is 51.4 percent lower than estimated traffic on average. This is equivalent to an average overestimate of rail passenger forecasts of no less than 105.6 percent. This results in large benefit shortfalls for rail. For roads, actual vehicle traffic is on average 9.5 percent higher than forecast. Rail passenger forecasts are biased, whereas this is not the case for road traffic forecasts. The difference between rail and road is statistically significant at a high level. Again the standard deviations are large, indicating that forecasting

Table 3.2 Inaccuracy in forecasts of rail passenger and road vehicle traffic.

Type of project	No. of cases (*N*)	Avg. inaccuracy %	Std dev.
Rail	25	−51.4	28.1
Road	183	9.5	44.3

Source: Flyvbjerg (2007).

errors vary widely across projects (Flyvbjerg, 2005b; Flyvbjerg et al., 2005). The following observations hold for traffic demand forecasts:[3]

- Some 84 percent of rail passenger forecasts are wrong by more than ±20 percent.
- Nine of 10 rail projects have overestimated traffic.
- Some 50 percent of road traffic forecasts are wrong by more than ±20 percent.
- The number of roads with overestimated and underestimated traffic, respectively, is about the same.
- Inaccuracy in traffic forecasts is found in the 14 nations and five continents covered by the study.
- Inaccuracy is constant for the 30-year period covered by the study; forecasts have not improved over time.

Combining the data in Tables 3.1 and 3.2 reveals that for rail, average cost overruns of 44.7 percent combine with average traffic shortfalls of 51.4 percent.[4] For roads, average cost overruns of 20.4 percent combine with a fifty–fifty chance that traffic is also wrong by more than 20 percent. As a consequence, cost–benefit analyses and social and environmental impact assessments based on cost and traffic forecasts will typically be highly misleading.

The list of examples of projects with cost overruns and/or benefit shortfalls is extensive and growing (Flyvbjerg, 2005a). Boston's 'Big Dig', otherwise known as the Central Artery/Tunnel Project, was 275 percent or US$11 billion over budget in constant dollars when it opened, and further overruns continue to accrue due to faulty construction. Actual costs for Denver's $5 billion International Airport were close to 200 percent higher than estimated costs. The overrun on the San Francisco–Oakland Bay Bridge retrofit was $2.5 billion, or more than 100 percent, even before construction started. The Copenhagen metro and many other urban rail projects have had similar overruns. The Channel Tunnel between the

UK and France came in 80 percent over budget for construction and 140 percent over for financing. At the initial public offering, Eurotunnel, the private owner of the tunnel, lured investors by telling them that 10 percent 'would be a reasonable allowance for the possible impact of unforeseen circumstances on construction costs'.[5] Outside of transportation, the $4 billion cost overrun for the Pentagon spy satellite project and the over $5 billion overrun on the International Space Station are typical of defense and aerospace projects. Our studies show that large infrastructure and technology projects tend statistically to follow a pattern of cost underestimation and overrun. Many such projects end up financial disasters, with significant social, environmental, and economic costs to the public, not least in less developed economies with little capacity to absorb such failures.

As for benefit shortfalls, consider Bangkok's US$2 billion Skytrain, a two-track elevated urban rail system designed to serve some of the city's most densely populated areas. The system is much too large, with station platforms too long for its shortened trains. Many trains and cars sit in the depot, because there is no need for them. Actual traffic turned out to be less than half of initial forecasts (Flyvbjerg et al., 2005: 132). Every effort has been made to market and promote the train, but the company responsible for the project has ended up in financial trouble. Even though urban rail is probably a good idea for a dense, congested, and air-polluted city such as Bangkok, overinvesting in idle capacity is hardly an efficient use of resources, especially in a developing nation where capital for investment is particularly scarce.

Other high-profile projects with cost overruns and/or benefit shortfalls are, in North America: the F/A-22 fighter aircraft; FBI's Trilogy information system; Ontario's Pickering nuclear plant; subways in numerous cities, including Miami and Mexico City; convention centers in Houston, Los Angeles, and other cities; the Animas-La Plata water project; the Sacramento regional sewer system renewal; the Quebec Olympic stadium; Toronto's Sky Dome; the Washington Public Power Supply System; and the US-funded Iraq reconstruction effort. In Europe: the Eurofighter military jet, the new British Library, the Millennium Dome, the Nimrod maritime patrol plane, the UK West Coast rail upgrade and the related Railtrack fiscal collapse, the Astute attack submarine, the Humber Bridge, the Tyne metro system, the Scottish parliament building, the French Paris Nord TGV, the Berlin–Hamburg maglev train, Hanover's Expo 2000, the Athens 2004 Olympics, Russia's Sakhalin-1 oil and gas project, Norway's Gardermo airport train, the Øresund Bridge between Sweden and Denmark, and the Great Belt rail tunnel linking Scandinavia with continental Europe. In Australia: Sydney's Olympic stadiums. In Asia:

Japan's Joetsu Shinkansen high-speed rail line, India's Sardar Sarovar dams, the Surat–Manor toll way project, Calcutta's metro, and Malaysia's Pergau dam. We end the list here only for constraints of space. The point is to show that cost overruns and benefit shortfalls are common and widespread globally.

Of course, some projects did meet or exceed cost–benefit targets, even if they are harder to find. For instance, costs for the Paris Southeast and Atlantique TGV lines were on budget, as was the Brooklyn Battery tunnel. The Third Dartford Crossing in the UK, the Pont de Normandie in France, and the Great Belt road bridge in Denmark all had higher traffic and revenues than projected. The Mozal smelter in Mozambique is often held up as a success story (though see Easterly, 2001 for criticism of the associated World Bank and IFC practices). This project cost $1.4 billion to construct, an amount roughly equal to the entire GDP of the country at the time. In turn, this project is attributed with attracting a further $1 billion of much-needed investment into the country (Esty, 2004). Finally, the Bilbao Guggenheim Museum is an example of that rare breed of projects, the cash cow, with costs on budget and revenues much higher than expected.[6]

Nevertheless, for the majority of major infrastructure projects, cost overruns and benefit shortfalls of the frequency and size described above present a significant policy problem for the following reasons:

- they lead to a Pareto-inefficient allocation of resources, that is, waste;
- they lead to delays and further cost overruns and benefit shortfalls;
- they destabilize policy, planning, implementation, and operations of projects, and;
- the problem is getting bigger, because projects are getting bigger.

We consider each point in turn. First, an argument often heard in the planning of large infrastructure projects is that cost and benefit forecasts at the planning stage may be wrong, but if one assumes that forecasts are wrong by the same margin across projects, cost–benefit analysis would still identify the best projects for implementation. The ranking of projects would therefore not be affected by the forecasting errors. However, the large standard deviations shown in Tables 3.1 and 3.2 falsify this argument. The standard deviations show that cost and benefit estimates are not wrong by the same margin across projects; errors vary extensively, and this will affect the ranking of projects. Thus we see that misinformation about costs and benefits at the planning stage is likely to lead to Pareto inefficiency, because in terms of standard cost–benefit analysis, decision makers are likely to implement inferior projects.

Second, cost overruns of the size described above typically lead to delays, because securing additional funding to cover overruns often takes time. In addition, projects may need to be re-negotiated or re-approved if overruns are large, as they often are (Flyvbjerg, 2005a). For example, Flyvbjerg et al. (2004) show that delays in transportation infrastructure implementation imply substantial cost escalation, typically increasing the construction cost overruns, measured in constant prices, by 4.64 percentage points per year of delay incurred after the time of decision to build. For a project of, say, US$8 billion, that is the size range of the Channel Tunnel and about half the size of Boston's Big Dig, the expected average cost of delay would be approximately $370 million/year, or about $1 million/day. Benefit shortfalls are an additional consequence of delays, because delays result in later opening dates and therefore extra months or years without revenues. Because many large infrastructure projects are loan financed and have long construction periods, they are particularly sensitive to delays, delays that result in increased debt, increased interest payments, and longer payback periods.

Third, large cost overruns and benefit shortfalls tend to destabilize policy, planning, implementation, and operations. For example, after several overruns in the initial phase of the Sydney Opera House, the Parliament of New South Wales decided that every further 10 percent increase in the budget would need their approval. After this decision, the Opera House became a political hot potato needing constant re-approval. Every overrun set off an increasingly fraught debate about the project, in Parliament and outside, with total cost overruns ending at 1,400 percent. The unrest drove the architect off the project, destroyed his career and *oeuvre*, and produced an Opera House unsuited for opera. Many other projects have experienced similar, if less spectacular, unrest, including the Channel Tunnel, Boston's Big Dig, and Copenhagen's metro.

Finally, as projects grow bigger, the problems with cost overruns and benefit shortfalls also grow bigger and more consequential (Flyvbjerg et al., 2004: 12). Some major projects are so large in relation to national economies that cost overruns and benefit shortfalls from even a single project may destabilize the finances of a whole country or region. This occurred when the billion-dollar cost overrun on the 2004 Athens Olympics affected the credit rating of Greece and when benefit shortfalls hit Hong Kong's $20 billion Chek Lap Kok airport after it opened in 1998. In the current economic climate, the desire to avoid national fiscal distress has recently become an important driver in attempts at reforming the planning of large infrastructure projects, especially because major infrastructure investments form the core of expensive stimulus packages. For example, in 2008, China, India, and the United States pledged $586 billion, $475 billion, and $787 billion, respectively, for such stimulus plans (*Financial Times*, June 8, 2010).

To summarize, the policy implications of large cost overruns and benefit shortfalls are substantial. First, lawmakers, the investment community, and the general public cannot trust information about the costs and benefits of major infrastructure projects that are produced by the promoters and planners of such projects. Second, the ways in which major infrastructure projects are currently planned is ineffective in conventional economic terms, leading to Pareto-inefficient investments. Third, these problems suggest that there is a clear need for substantial reform in policy and planning for major infrastructure projects. Before outlining what can be done to improve this state of affairs, we need to examine the underlying causes of the widespread cost overruns and benefit shortfalls.

3. Causes: delusion, deception, and corruption

The underperformance of major infrastructure projects is typically attributed to uncertainties and risks related to the specific character of individual projects (Flyvbjerg et al., 2009). Such factors include technological and organizational complexity, unexpected environmental conditions such as geological features, and opposition from dissenting stakeholder groups. Of course, these factors do play a role and can have a significant impact on initial forecasts in terms of both cost and schedule. However, the focus of this chapter is not to seek ways to overcome this kind of issue, but rather to explain why it is that costs, benefits, and time forecasts for major infrastructure projects are systematically overoptimistic in the planning phase. The most promising explanations relate to delusions, or honest mistakes, and deliberate, strategic deception. In the following, delusion and deception are jointly considered, and, in particular, we argue that institutionalized practices of strategic deception are a form of corruption insofar as political and commercial players misuse their power for personal gain in a number of ways ranging from the acceptance of bribes to illegal support for election campaigns.

Kahneman and Tversky (1979), Kahneman and Lovallo (1993), and Lovallo and Kahneman (2003) attribute the large cost overruns and benefit shortfalls described above to a psychological phenomenon that they term the ‘planning fallacy’, a form of cognitive bias. Under the influence of the planning fallacy, planners and major project promoters make decisions based on delusional optimism rather than on rational weighting of gains, losses, and probabilities. In other words, they overestimate benefits and underestimate costs. They involuntarily generate scenarios of success and overlook the potential for mistakes and miscalculations. As a result, planners and promoters pursue initiatives that are unlikely to come in on budget or on time, or to deliver the expected returns.

This kind of delusional optimism offers an explanation for the performance of many major infrastructure projects that seems to absolve the planners of responsibility (Flyvbjerg et al., 2009). The existence of optimism bias in planners and promoters explains why actual costs are higher and actual benefits are lower than those forecast. Consequently, this bias would be able to account, at least partially, for the peculiar bias found in existing studies of major infrastructure projects. Yet, when forecasters are asked about causes for forecasting inaccuracies in actual cases, they do not mention optimism bias as a causal factor (Flyvbjerg et al., 2005: 138–40). The obvious explanation for this is that optimism bias is unconscious, a form of delusion, and is therefore not explicitly reflected upon by individual forecasters.

There is a large body of experimental evidence for the existence of optimism bias (for example, Buehler et al., 1994, 1997; Newby-Clark et al. 2002) yet the experimental data are mainly from simple, non-professional settings. This is a limitation of psychological explanations, because it remains an open question whether such biases can be generalized and extended beyond rudimentary laboratory settings. Delusional optimism bias would be a more powerful explanation of underestimated costs and overestimated benefits in infrastructure planning if estimates were produced wholly by inexperienced forecasters, that is, persons who were estimating costs and benefits for the first or second time and who were naive about the realities of infrastructure building and were not drawing on the knowledge and skills of more experienced colleagues. Although such situations may exist, they are the exception rather than the rule.

Given the fact that a defining characteristic of modern society is professional expertise that is constantly tested through scientific analysis, critical assessment and peer review, in order to root out bias and error, it seems unlikely that a whole profession of forecasting experts would continue to make the same mistakes decade after decade instead of learning from their actions. Intra-professional learning ought to result in the reduction, if not elimination, of collective delusion, in turn leading to estimates becoming more accurate over time. But the overwhelming weight of evidence in the studies cited earlier clearly shows that this is not happening. The profession of forecasters and planners would need to be an exceptionally optimistic and unreflexive group to maintain their optimism bias over such temporal and spatial scales. Individual cognitive bias in the form of delusional optimism may account for some of the observed performance of major infrastructure project performance, but it is an inadequate explanation by itself.

An alternative explanation is political–economic in nature and proposes that planners and promoters of projects deliberately deceive project sponsors by overestimating benefits and underestimating costs. The primary motivation for doing so is to increase the likelihood that their projects, and not the competition's, gain approval and funding (Wachs, 1989, 1990; Flyvbjerg et al., 2002, 2005, 2009; Flyvbjerg, 2005a, 2009). According to this explanation, planners and promoters purposely design scenarios that highlight success and disguise the potential for failure. Ultimately, this results in the pursuit of ventures that are unlikely to come in on budget or on time, or to deliver the promised benefits. This form of 'strategic deception' (Flyvbjerg et al., 2009) can be traced to political and organizational pressures, agency problems and distorted incentives, for instance competition for limited funds or vying for position, and in this sense the behavior is rational. However, if we define corruption in its broadest sense, as including both low-level opportunistic payoffs and systemic corruption implicating whole organizations, governments and political systems (RoseAckerman, 2006), the practice of deliberate, strategic misrepresentation of costs and benefits comes into focus as a form of corruption alongside bid-rigging and collusion (Dorée, 2004; Van Bergeijk, 2007). The personal benefits for those involved on the commercial side include bonuses and kickbacks from being awarded a contract, as well as opportunities to engage in further low-level corruption through procurement of materials. For elected officials, benefits may include enhanced status or recognition through association with a flagship project such as an airport. For non-elected officials rewards are likely to take the form of career progression or direct bribes from bidders.

Corruption, in this broader sense, has strong explanatory potential for understanding the systematic underestimation of costs and overestimation of benefits observed in major infrastructure projects over time. A crucial research question is to demonstrate that estimates of costs and benefits are intentionally biased to deceive in order to serve the interests of promoters in getting projects started. Such questions are notoriously hard to investigate using forensic economic investigation methodologies (Van Bergeijk, 2007), because in order to establish whether corruption has taken place, one must be able to establish the intentions of the actors involved. Other social science methodologies, such as interview-based case studies, face the difficulty that for legal, economic, moral, and other reasons, promoters and planners who might have intentionally skewed estimates of costs and benefits to get a project started are unlikely to report this to researchers. Despite such challenges, two studies did succeed in getting forecasters to talk about how mechanisms of strategic deception work in practice. Illustrative findings from these studies are provided below.

Flyvbjerg and COWI (2004) interviewed public officials, planners, and consultants who were involved in the development of large UK transport infrastructure projects. In the interview extract below, a planner with a local transportation authority hints at the institutional pressure to reduce cost estimates and how this conflicts with his professional judgment and technical knowledge:

> You will often as a planner know the real costs. You know that the budget is too low, but it is difficult to pass such a message to the counsellors [politicians] and the private actors. They know that high costs reduce the chances of national funding. (Cited in Flyvbjerg, 2009: 352)

Experienced professionals such as the interviewee above know that actual costs will be higher than estimated costs, but because of political pressure to secure funding for projects they hold back this knowledge. Similarly, a different interviewee explained the strategic necessity of emphasizing benefits in order to get projects funded:

> The system encourages people to focus on the benefits – because until now there has not been much focus on the quality of risk analysis and the robustness [of projects]. It is therefore important for project promoters to demonstrate all the benefits, also because the project promoters know that their project is up against other projects and competing for scarce resources. (Cited in Flyvbjerg, 2009: 352)

The pressure that such practitioners face to emphasize benefits, potentially at the expense of rigorous analysis of risk and project design may result, for instance, in the discounting of broader social objectives such as the mobility of ethnic groups between different neighborhoods (Priemus, 2007). Competition between projects and authorities for funding creates political and organizational pressures that, in turn, generate a perverse incentive structure and culture within which it appears rational, and normal practice to emphasize benefits and de-emphasize costs and risks. A project that looks highly beneficial on paper is more likely to get funded than one that does not. Ultimately, deliberate deception is rewarded.

Specialized private consulting firms are often engaged to help develop project proposals at an early stage. In general, the interviewees' experience of consultants was that they maintained high professional standards of integrity and brought a valuable outside view to project planning. Yet, interviewees also found that consultants sometimes had a tendency to focus on the justifications for the project rather than critically scrutinizing the underlying cost and benefit assumptions. In the following extract, a project manager offers a view on why this is the case:

> Most decent consultants will write off obviously bad projects, but there is a grey zone, and I think many consultants in reality have an incentive to try to prolong the life of projects which means to get them through the business case [the commercial or political justification for the project]. It is in line with their need to make a profit. (Cited in Flyvbjerg, 2009: 352)

The consultants who were interviewed for this study also acknowledged that project appraisals often focused more on promotion of the benefits than on analysis of expected costs. Their explanation was that this was the result of client pressure and that for the specific projects discussed 'There was an incredible rush to see projects realized'. One interviewee, expressing a widely held view, saw project approval as essentially about 'passing the test' and precisely summed up the rules of the game like this: 'It's all about passing the test [of project approval]. You are in, when you are in. It means that there is so much focus on showing the project at its best at this [early] stage'. (Cited in Flyvbjerg, 2009: 352)

To summarize, Flyvbjerg and COWI's study shows that strong interests and strong incentives exist at the project approval stage to present projects as favorably as possible, that is, with benefits emphasized and costs and risks de-emphasized. Local authorities, local developers and land owners, local labor unions, local politicians, local officials, local MPs, and consultants all stand to benefit from a project that looks favorable on paper and they have little incentive actively to avoid bias in estimates of benefits, costs, and risks. National bodies, such as certain parts of the Department for Transport and the Ministry of Finance who fund and oversee projects, may have an interest in more realistic appraisals, but so far they have had little success in achieving such realism.

In a similar vein, Wachs (1986, 1990) interviewed public officials, consultants, and planners who had been involved in transit planning cases in the US. He found that a pattern of highly misleading forecasts of costs and usage could not be explained with recourse to technical errors or honest mistakes. In case after case, planners, engineers, and economists told Wachs that they repeatedly needed to 'revise' their forecasts because they failed to satisfy their superiors. This dissatisfaction did not arise from a critical assessment of the assumptions, methodology or calculations used, but rather from a subjective, political evaluation that the forecasts produced were not dramatic enough to gain federal support for the projects. In the following extract Wachs (1990: 144) recounts an episode during one of his interviews to illustrate this point:

> One young planner tearfully explained to me that an elected county supervisor had asked her to estimate the patronage of a possible extension of a light-rail (streetcar) line to the downtown Amtrak station. When she carefully estimated

> that the route might carry two to three thousand passengers per day, the supervisor directed her to redo her calculations in order to show that the route would carry twelve to fifteen thousand riders per day because he thought that number necessary to justify a federal grant for system construction. When she refused, he asked her superior to remove her from the project, and to get someone else to 'revise' her estimates.

The above extract also highlights the organizational pressures faced by individuals who may consider being a 'whistleblower'. Often there is very little protection for whistleblowers within their own organizations, or indeed in the courts (OECD, 2009; Transparency International, 2010). In another example of strategic deception in the calculation of costs and benefits, Wachs (1990: 144–45) gives the following account concerning a public transit project:

> A planner admitted to me that he had reluctantly but repeatedly adjusted the patronage figures upward, and the cost figures downward to satisfy a local elected official who wanted to compete successfully for a federal grant. Ironically, and to the chagrin of that planner, when the project was later built, and the patronage proved lower and the costs higher than the published estimates, the same local politician was asked by the press to explain the outcome. The official's response was to say, 'It's not my fault; I had to rely on the forecasts made by our staff, and they seem to have made a big mistake here'.

Like Flyvbjerg and COWI (2004), Wachs also interviewed consultants and his findings were similar. As one of his consultant respondents put it, 'Success in the consulting business requires the forecaster to adjust results to conform with the wishes of the client, and clients typically wish to see costs underestimated and benefits overestimated' (1990: 151–2). On the basis of this study, Wachs (p. 145) concludes that forecasts of costs and benefits are presented to the public as instruments for deciding whether or not a project is to be undertaken, but they actually serve as instruments for getting public funds committed to a favored project. Further, Wachs (1986: 28, 1990: 146) talks of 'nearly universal abuse' of forecasting in this context, and he finds no indication that it takes place only in transit planning; it is common in all sectors of the economy where forecasting and planning inform policy making.

In conclusion, the UK and US studies obtained similar results. The insights from these studies can explain the data on cost underestimation and benefit overestimation in major infrastructure projects described earlier. Both studies falsify the notion that in situations with high political and organizational pressure the lowballing of costs and highballing of benefits is primarily caused by non-intentional technical error or individual delusional optimism bias. Both studies support the view that in such situations promoters and forecasters intentionally use the following formula in order to secure approval and funding for their projects:

$$\textit{Underestimated costs} + \textit{Overestimated benefits} = \textit{Project approval.}$$

Using this formula, and thus 'showing the project at its best' as one interviewee said above, results in a perverse Darwinism, the 'survival of the un-fittest' (Flyvbjerg, 2009). It is not the best projects in terms of value to society that get implemented, but the projects that look best on paper. And the projects that look best on paper are the projects with the largest cost underestimates and benefit overestimates, other things being equal. But these are the worst, or 'un-fittest', projects in the sense that they are the very projects that will encounter most problems during construction and operations in terms of the largest cost overruns, benefit shortfalls, and risks of non-viability. They are designed that way.

4. Cures

It should by now be obvious that the planning and implementation of large infrastructure projects is in need of reform. Delusion, deception and corruption needs to be addressed in all its forms, not only low-level corruption in the form of opportunistic payoffs, theft of materials, and bribes to officials and contractors that plague infrastructure projects post approval (Global Infrastructure Anti-Corruption Centre, 2008) but also the corrupt organizational arrangements that directly reward cost-underestimation, benefits overstatement, and project approval in the first place. This is not to say that costs and benefits are, or should be, the only basis for deciding whether to build large infrastructure projects. Clearly, forms of rationality other than economic rationality are at work in most projects and are balanced in the broader frame of public policy decision making. But the costs and benefits of large infrastructure projects often run in the hundreds of millions of dollars, with risks correspondingly high. Without knowledge of such risks, sound economic decision making will be distorted.

In contemplating what planners can do to help reform come about, we need to distinguish between two fundamentally different scenarios: (i) planners and promoters consider it important to get forecasts of costs, benefits, and risks right, and (ii) planners and promoters do not consider it important to get forecasts right, because optimistic forecasts are seen as a necessary means to getting projects started. The first scenario is the easier one to deal with, and here better methodology will go a long way toward improving planning and decision making. The second scenario is more difficult, and more common, as we saw above. Here changed incentives are essential in order to reward honesty and punish deception, where today's incentives often do the exact opposite. Thus two main reform measures are: (i) better forecasting methods, and (ii) improved incentive structures, with the latter being the more important.

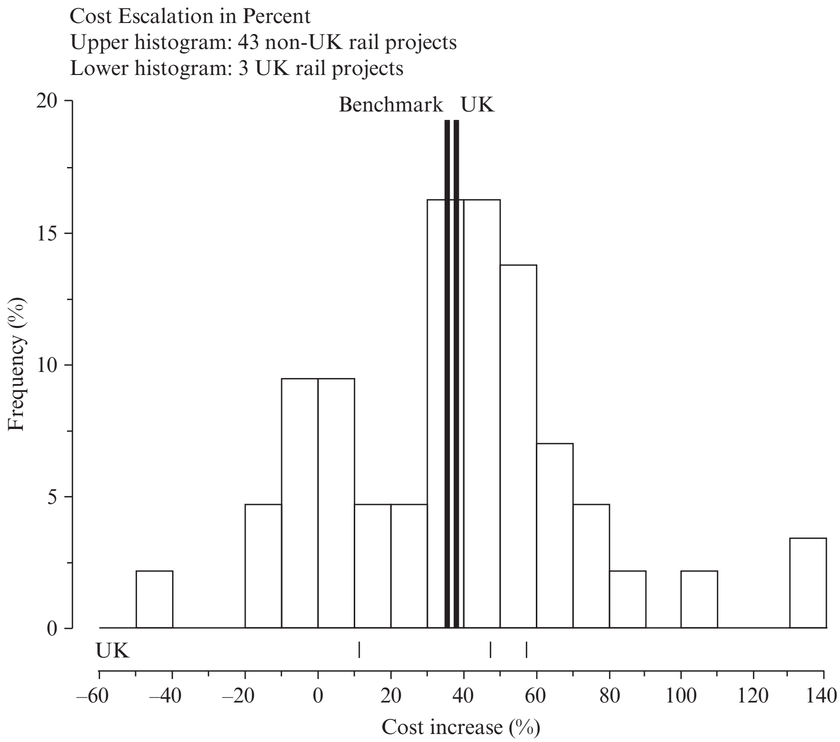
Better methods: reference class forecasting

If planners genuinely consider it important to get forecasts right, we recommend that they use a new forecasting method called 'reference class forecasting' to reduce inaccuracy and bias. This method was originally developed to compensate for the type of cognitive bias in human forecasting Kahneman found in his Nobel prize-winning work on bias in economic forecasting (Kahneman and Tversky, 1979; Kahneman, 1994). In practice, reference class forecasting has proven more accurate than conventional forecasting methods. Following the publication of a study by Flyvbjerg et al., (2005), the American Planning Association (2005) officially endorsed reference class forecasting to its membership:

> APA encourages planners to use reference class forecasting in addition to traditional methods as a way to improve accuracy. The reference class forecasting method is beneficial for non-routine projects such as stadiums, museums, exhibit centers, and other local one-off projects. Planners should never rely solely on civil engineering technology as a way to generate project forecasts.

Here we present an outline of the method. A fuller description can be found in Flyvbjerg (2003) and Lovallo and Kahneman (2003). Reference class forecasting consists in taking a so-called 'outside view' on a particular project. The outside view is established through information on a class of similar projects. The outside view does not try to forecast the specific uncertain events that will affect the particular project, but instead places the project in a statistical distribution of outcomes from this class of reference projects. Reference class forecasting requires the following three steps for the individual project:

1. Identification of a relevant reference class of past projects. The class must be broad enough to be statistically meaningful but narrow enough to be truly comparable with the specific project.
2. Establishing a probability distribution for the selected reference class. This requires access to credible, empirical data for a sufficient number of projects within the reference class to make statistically meaningful conclusions.
3. Comparison of the specific project with the reference class distribution in order to establish the most likely outcome for the specific project.

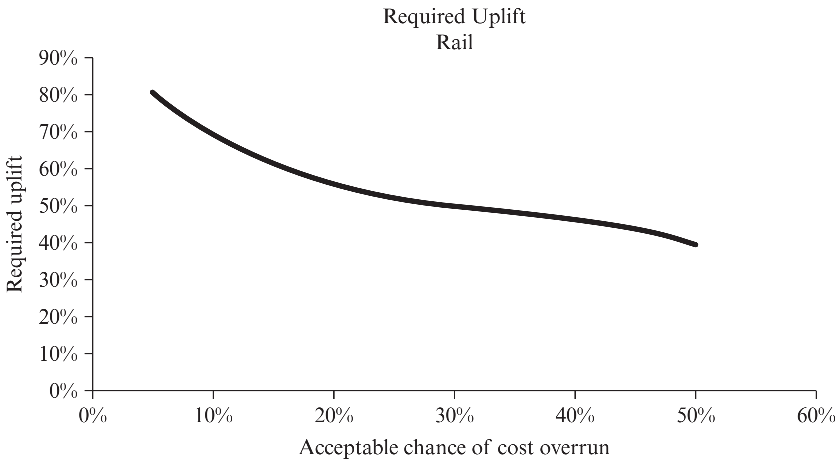


Source: Flyvbjerg (2007).

Figure 3.1 Inaccuracy of construction cost forecasts for rail projects in reference class (average cost increase is indicated for non-UK and UK projects, separately, constant prices)

To take an example from our work with developing reference class forecasting for practical infrastructure planning, planners in a city preparing to build a new subway would, first, establish a reference class of comparable projects. This could be the relevant rail projects included in the sample described earlier in the article by Flyvbjerg et al. (2002). The planners would analyze the projects included in the reference class to be sure they are indeed comparable. Second, if the planners are concerned, for example, with getting construction cost estimates right, they would then establish the distribution of outcomes for the reference class regarding the accuracy of construction cost forecasts.

Figure 3.1 shows what this distribution looks like for a reference class relevant to building subways in the UK, developed by Flyvbjerg and



Source: Flyvbjerg (2007).

Figure 3.2 Required adjustments to cost estimates for UK rail projects as function of the maximum acceptable level of risk for cost overrun (constant prices)

COWI (2004: 23) for the UK Department for Transport. Third, the planners would compare their subway project to the reference class distribution. This would make it clear to the planners that unless they have reason to believe that they are substantially better forecasters and planners than their colleagues who did the forecasts and planning for projects in the reference class, they are likely to have grossly underestimated construction costs. Finally, planners would then use this knowledge to adjust their forecasts for more realism.

Figure 3.2 shows what such adjustments would be for the UK subway case. More specifically, Figure 3.2 shows that for a forecast of construction costs for a rail project that has been planned in the manner that such projects are usually planned – that is, like the projects in the reference class – this forecast would have to be adjusted upwards by 40 percent if investors were willing to accept a risk of cost overrun of 50 percent. If investors were willing to accept a risk of overrun of only 10 percent, the forecast would have to be increased by 68 percent. For a rail project initially estimated at, say £4 billion, the cost increases for the 50 and 10 percent levels of risk of cost overrun would be £1.6 billion and £2.7 billion, respectively.

The contrast between inside and outside views has been confirmed by systematic research (Gilovich et al., 2002). The research shows that if people are asked simple questions requiring them to take an outside view, their forecasts become significantly more accurate. However, most individuals and organizations are inclined to adopt the inside view in planning major projects. This is the conventional and intuitive approach. The traditional way to think about a complex project is to focus on the project itself and its details, to bring to bear what one knows about it, paying special attention to its unique or unusual features, trying to predict the events that will influence its future. The thought of going out and gathering simple statistics about related cases seldom enters a planner's mind (Lovallo and Kahneman, 2003: 61–2). And this is certainly the case for cost and benefit forecasting in major infrastructure projects. Despite the many forecasts we have reviewed, we have not come across a single genuine reference class forecast of costs and benefits, and nor has Kahneman, who first conceived the idea of the reference class forecast.[7]

Although understandable, planners' preference for the inside view over the outside view is unfortunate. When both forecasting methods are applied with equal skill, the outside view is much more likely to produce a realistic estimate. That is because it bypasses both cognitive and political biases such as delusional optimism and also incentives for strategic deception, and it cuts directly to outcomes. In the outside view, planners and forecasters are not required to make scenarios, imagine events, or gauge their own and others' levels of ability and control, so as to avoid mistakes. Of course, the outside view, being based on historical precedent, may fail to predict extreme outcomes, that is, those that lie outside all historical precedents such as issues arising from the use of novel technology or unanticipated environmental conditions. But for most projects, the outside view will produce more accurate results. In contrast, a focus on inside details is the road to inaccuracy.

The comparative advantage of the outside view is most pronounced for non-routine projects, understood as projects that planners and decision makers in a certain locale have never attempted before, for example, building an urban rail system in a city for the first time, or a new major bridge or tunnel where none existed before. It is in the planning of such new efforts that the biases toward delusional optimism, strategic deception and opportunities for corruption are likely to be especially large. To be sure, choosing the right reference class of comparative past projects becomes more difficult when planners are forecasting initiatives for which precedents are not easily found, for instance, the introduction of new and unfamiliar technologies. However, the majority of major infrastructure projects are both non-routine locally and use well-known technologies. Such projects are, therefore, particularly likely to benefit from the outside view and reference class forecasting. In this way, reference class forecasting also functions as a form of benchmarking (Rose-Ackerman, 1999) and can also be used as a check on outright corruption by comparing cost data on materials procurement, especially in the context of capital-intensive projects.

Improved incentives: public and private sector accountability

There is a second scenario where planners and other influential actors do not find it important to get forecasts right and where planners, therefore, do not help to clarify and mitigate risk but, instead, generate and exacerbate it. Here planners are part of the problem, not the solution. This situation may need some explication, because it may at first sound counterintuitive. For good reason, it is typically assumed that the planning profession is inherently interested in being accurate and unbiased in forecasting, in much the same way as it is often assumed that scientists are interested in the pursuit of objective knowledge. Indeed, it is an explicit requirement in the American Institute of Certified Planners (AICP) Code of Ethics and Professional Conduct that 'A planner must strive to provide full, clear and accurate information on planning issues to citizens and governmental decision-makers' (American Planning Association, 1991: A.3). The British RTPI has laid down similar obligations for its members (Royal Town Planning Institute, 2001). However, the literature is replete with things planners and planning 'must' strive to do, but which they don't. Planning must be open and communicative, but often it is closed. Planning must be participatory and democratic, but often it is an instrument of domination and control. Planning must be about rationality, but often it is about power (Flyvbjerg, 1998; Watson, 2003). This is the hidden side of planning and planners identified by Flyvbjerg (1996) and Yiftachel (1998), but it is remarkably underexplored by planning researchers and theorists.

Forecasting has its hidden side. It is here that 'planners lie with numbers', as Wachs (1989) has aptly put it. Planners on the hidden side are busy not with getting forecasts right and following the AICP Code of Ethics but with getting projects funded and built. And, as described previously, accurate forecasts are often not an effective means for achieving this objective. Indeed, accurate forecasts may be counterproductive, whereas biased forecasts may be effective in competing for funds and securing the go-ahead for construction. 'The most effective planner', says Wachs (1989: 477) 'is sometimes the one who can cloak advocacy in the guise of scientific or technical rationality'. Such advocacy would stand in direct opposition to AICP's ruling that 'the planner's primary obligation [is] to the public interest' (American Planning Association, 1991: B.2).

Nevertheless, seemingly rational forecasts that underestimate costs and overestimate benefits remain an established formula for project approval. Forecasting is here mainly another kind of rent-seeking behavior, resulting in a make-believe world of misrepresentation that makes project prioritization an opaque and almost arbitrary process. The consequence is that too many projects are approved that should not be. Moreover, many projects do not proceed that probably should, if only they had not lost out to projects with more 'effective' misrepresentation (Flyvbjerg et al., 2002). In this situation, the question is not so much what planners can do to reduce inaccuracy and risk in forecasting, but what others can do to create systemic checks, balances, and incentive structures that would align the interests of planners with those espoused in their own code of ethics. The challenge is to change the power relations that govern forecasting and project development. Better forecasting techniques and appeals to ethics are likely to be insufficient; institutional change with a focus on transparency, accountability, and eliminating the opportunities for corruption is necessary.

As argued in Flyvbjerg et al. (2003), two basic types of accountability define liberal democracies: (i) public sector accountability through transparency and public control, and (ii) private sector accountability via competition and market control. Both types of accountability can be effective tools to curb planners' misrepresentation in forecasting and to promote a culture that acknowledges and deals effectively with risk. In order to achieve accountability through transparency and public control, the following would need to be embedded in the relevant institutions (the full argument for these measures is in ibid. chs 9–11):

- National-level government should not offer discretionary grants to local infrastructure agencies for the sole purpose of building a specific type of infrastructure. Such grants create perverse incentives. Instead, national government should simply offer 'infrastructure grants' or 'transportation grants' to local governments, and let local political officials spend the funds however they choose, but the national government should make sure that every dollar spent on one type of infrastructure reduces their ability to fund another.
- Forecasts should be subject to independent peer review. If large amounts of taxpayers' money are at stake, such review should be carried out by national or state accounting and auditing offices, such as the Government Accountabilty Office in the US or the National Audit Office in the UK, both of which have the independence and expertise to produce such reviews. Other types of independent review bodies might be established, for instance, within national departments of finance or within relevant professional bodies.

- Forecasts should be benchmarked against comparable forecasts, for instance using reference class forecasting as described in the previous section.
- Forecasts, peer reviews, and benchmarking should be made available to the public as they are produced, including all relevant documentation.
- Public hearings, citizen juries, and the like should be organized to allow stakeholders and civil society to voice criticism and support of forecasts. Knowledge generated in this way should be integrated into planning and decision making.
- Scientific and professional conferences should be organized where forecasters would present and defend their forecasts in the face of colleagues' scrutiny and criticism.
- Projects with inflated benefit–cost ratios should be reconsidered and stopped if recalculated costs and benefits do not warrant implementation. Projects with realistic estimates of benefits and costs should be rewarded.
- Professional and occasionally even criminal penalties should be imposed on planners and forecasters who consistently and foreseeably produce deceptive forecasts. An example of a professional penalty would be the exclusion from one's professional organization if one violates its code of ethics. An example of a criminal penalty would be punishment as the result of prosecution before a court or similar legal body, for instance where deceptive forecasts have led to substantial mismanagement of public funds (Garett and Wachs, 1996). Malpractice in planning should be taken as seriously as it is in other professions. Failing to do this amounts to not taking the planning profession seriously.

In order to achieve accountability in forecasting via competition and market control, the following would be required, as practices that are both embedded in and enforced by the relevant institutions:

- The decision to go ahead with a project should, where at all possible, be made contingent on the willingness of private financiers to participate without a sovereign guarantee for at least one-third of the total capital needs.[8] This should be required whether projects pass the market test or not, that is, whether projects are subsidized or not or provided for social justice reasons or not. Private lenders, shareholders, and stock market analysts would produce their own forecasts or would critically monitor existing ones. If they were wrong about the forecasts, they and their organizations would be hurt. The result would be more realistic forecasts and reduced risk.

- Full public financing or full financing with a sovereign guarantee should be avoided.
- Forecasters and their organizations must share financial responsibility for covering cost overruns and benefit shortfalls resulting from misrepresentation and bias in forecasting.
- The participation of risk capital should not mean that government gives up or reduces control of the project. On the contrary, it means that government can more effectively play the role it should be playing, namely as the ordinary citizen's guarantor for ensuring concerns about safety, environment, risk, and a proper use of public funds.

Whether projects are public, private, or public–private, they should be vested in only one project organization with a strong governance framework. The project organization may be a company or not, public or private, or a mixture. What is important is that this organization enforces accountability *vis-à-vis* contractors, operators, and other stakeholders and that, in turn, the directors of the organization are held accountable for any cost overruns, benefits shortfall, faulty designs, and unmitigated risks that may occur during project planning, implementation, and operations. If the institutions with responsibility for developing and building major infrastructure projects would effectively implement, embed, and enforce such measures of accountability, then the misrepresentation of cost, benefit, and risk estimates, which is widespread today, could be substantially mitigated. If this is not done, strategic deception will continue to be rewarded, and the allocation of funds for major infrastructure projects will remain wasteful, undemocratic, and corrupt.

5. Conclusion: towards better practice

Fortunately, after decades of widespread mismanagement of the planning and design of major infrastructure projects, signs of improvement have recently appeared. Challenges are being mounted to the conventional consensus that strategic deception is an acceptable way of getting projects approved. Corporate corruption scandals, such as Enron, have triggered a response to corporate corruption that is feeding back into government with the same objective: to curb financial waste and promote good governance. Although progress is slow, governance and accountability are gaining a foothold even in major infrastructure projects, not least for the practical reason mentioned earlier that the largest projects are now so big in relation to national economies that cost overruns, benefit shortfalls, and risks from even a single project may destabilize the finances of a whole country or region. Lawmakers and governments increasingly recognize that national fiscal distress is too high a price to pay for the conventional way of planning and designing large infrastructure projects, and commercial contractors face increasing risks of punitive financial and legal penalties as well as reputation damage for poor performance. The drivers for reform are coming from beyond the agencies and industries conventionally involved in infrastructure development, a factor that promises to accelerate progress.

For example, in 2003 the Treasury of the United Kingdom required, for the first time, that all ministries develop and implement procedures for large public projects that will curb optimism bias. Proposals for infrastructure projects that do not demonstrate they have taken into account this bias at the planning stage, according to prescribed methodologies, will be denied access to funding (Mott MacDonald, 2002; HM Treasury, 2003; Flyvbjerg and COWI, 2004). In 2004, the Netherlands Parliamentary Committee on Infrastructure Projects for the first time conducted extensive public hearings to identify measures that will limit the misinformation about large infrastructure projects given to the Parliament, public, and media (Tijdelijke Commissie Infrastructuurprojecten, 2004). In Boston, the state government sued to recoup funds from contractor overcharges for the Big Dig that were directed related to cost overruns that could have been anticipated at the outset. Internationally, governments and regulators are likely to follow the lead of the UK, the Netherlands, and Boston. It is too early to tell whether these measures will ultimately be effective. It seems unlikely, however, that the forces that have triggered these measures will be reversed, and it is those forces that reform-minded groups need to support and work with in order to curb institutionalized strategic deception and waste. We are now at a turning-point where convention meets reform, power balances change, and new practices emerge.

Strategic deception, corruption and the subsequent cost overruns and benefit shortfalls are endemic to major infrastructure projects. This chapter has argued that the key tools for limiting this practice are better methodologies and accountability at the planning and approval stages. The professional expertise of planners, engineers, architects, economists, and administrators is certainly indispensable to delivering the infrastructure that supports the economic and development goals of society. However, the studies presented in this chapter provide evidence that the cost and benefit assessments made by these groups are more often than not unreliable and should be carefully examined by independent specialists and organizations who are able to take an 'outside view' (Flyvbjerg, 2009; Flyvbjerg et al., 2009). The same holds for judgments made by project-promoting politicians and officials.

Consequently, reformers should develop and employ institutional checks and balances – including financial, professional, or even criminal penalties for consistent and unjustifiable biases in claims and estimates of costs, benefits, and risks. The key principle is that the cost of making a significantly and avoidably inaccurate forecast should result in a penalty on those making the forecast, a principle rarely observed today. It would be naive to expect that this transformation could happen overnight, and clearly, the precise mix of policy initiatives to combat this problem will depend on a range of local and national conditions and characteristics, and over time. The conventional mode of planning and designing major infrastructure projects has deep historical roots and is firmly embedded in professional and institutional practices. However, given the stakes involved – saving taxpayers from billions of dollars of waste, protecting citizens' trust in democracy and the rule of law, realizing much-needed economic development objectives and avoiding the destruction of environmental assets – the impetus for change has never been so great.

Notes

1. All costs are construction costs measured in constant prices. Cost overrun, also sometimes called 'cost increase' or 'cost escalation', is measured according to international convention as actual out-turn costs minus estimated costs in percent of estimated costs. Actual costs are defined as real, accounted construction costs determined at the time of project completion. Estimated costs are defined as budgeted, or forecast, construction costs at the time of decision to build. For reasons explained in Flyvbjerg et al. (2002) the figures for cost overrun presented here must be considered conservative. Ideally financing costs, operating costs, and maintenance costs would also be included in a study of costs. It is difficult, however, to find valid, reliable, and comparable data on these types of costs across large numbers of projects. For details on methodology, see ibid.
2. Following international convention, inaccuracy is measured as actual traffic minus estimated traffic in percent of estimated traffic. Rail traffic is measured as number of passengers; road traffic as number of vehicles. The base year for estimated traffic is the year of decision to build. The forecasting year is the first full year of operations. Two statistical outliers are not included here. For details on methodology, see Flyvbjerg (2005b).
3. It should be noted that the figures cited here refer to the initial demand forecasts provided at the time of project approval. Of course, it is possible that a lag effect occurs and demand does eventually reach or exceed projections. However, the point still holds that forecasts rarely take this possibility into account sufficiently at the project approval stage, with the result that forecast revenues are also lagged, leading to longer payback periods and increased interest payments on finance.
4. For each of 12 urban rail projects, we have data for both cost overrun and traffic shortfall. For these projects average cost overrun is 40.3 percent; average traffic shortfall is 47.8 percent.
5. Quoted from 'Under Water Over Budget', *The Economist*, October 7, 1989, 37–8.
6. For an explanation of the success of the Bilbao Guggenheim Museum, see Flyvbjerg (2005a).
7. Personal communication, author's archives. The closest we have come to an outside view in large infrastructure forecasting is Gordon and Wilson's (1984) use of regression analysis on an international cross section of light-rail projects to forecast patronage in a number of light-rail schemes in North America.

8. The lower limit of a one-third share of private risk capital for such capital to effectively influence accountability is based on practical experience. See more in Flyvbjerg et al., (2003: 120–23).

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