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How Optimism Bias and Strategic Misrepresentation Undermine Implementation

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3 How Optimism Bias and Strategic Misrepresentation in Early Project Development Undermine Implementation

BENT FLYVBJERG*

3.1 Introduction

For a number of years the research program on large infrastructure at Aalborg University, Denmark, has explored different aspects of the planning and implementation of large infrastructure projects (Flyvbjerg, Bruzelius, and Rothengatter, 2003; Flyvbjerg, Holm, and Buhl, 2002, 2004, 2005; Flyvbjerg and Cowi, 2004; Flyvbjerg, 2005a, 2005b).[2] This paper takes stock of what may be learned from the research so far, especially as regards optimism bias and strategic misrepresentation in the early phases of project development.

First I will argue that a major problem in the planning of large infrastructure projects is the high level of misinformation about costs and benefits that is produced during the early stages of project development and the high risks such misinformation generates. Second I will explore the causes of misinformation and risk, mainly in the guise of optimism bias and strategic misrepresentation. In a subsequent paper, I will present a number of measures aimed at improved planning and decision making, including changed incentive structures and better planning methods (Flyvbjerg, 2007).

The emphasis will be on transportation infrastructure projects. It should be mentioned at the outset, however, that comparative research shows that the problems and causes identified for transportation apply to a wide range of other project types including power plants, dams, water projects, concert halls, museums, sports arenas, convention centers, IT systems, oil and gas extraction projects, aerospace projects, and weapons systems (Flyvbjerg, Bruzelius, and Rothengatter, 2003: 18-19; Flyvbjerg, Holm, and Buhl, 2002: 286; Flyvbjerg, 2005a; Altshuler and Luberoff, 2003).

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2 "Large infrastructure projects" are here defined as the most expensive infrastructure projects that are built in the world today, typically at costs per project from around a hundred million to several billion dollars.

3.2 Characteristics of Large Infrastructure Projects

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

- Such projects are inherently risky due to long planning horizons and complex interfaces.
- Technology is often not standard.
- Decision making and planning is often multi-actor processes with conflicting interests.
- Often the project scope or ambition level change significantly over time.
- Statistical evidence shows that such unplanned events are often unaccounted for, leaving budget contingencies inadequate.
- As a consequence, misinformation about costs, benefits, and risks is the norm.
- The result is cost overruns and/or benefit shortfalls with a majority of projects.

3.3 Size and Frequency of Cost Overruns and Benefit Shortfalls

For transportation infrastructure projects, Table 1 shows the inaccuracy of construction cost estimates measured as the size of cost overrun. The cost study covers 258 projects in 20 nations on five continents. All projects for which data was obtainable were included in the study.[3] 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 overrun between the three project types is statistically significant, indicating that each type should be treated separately (Flyvbjerg, Holm, and Buhl, 2002).

The large standard deviations shown in Table 3-1 are as interesting as the large average cost overruns. The size of the standard deviations demonstrate that uncertainty and risk regarding cost overruns are large, indeed.

[3] The data are from the largest database of its kind. 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 forecasted, construction costs at the time of decision to build. For reasons explained in Flyvbjerg, Holm, and Buhl (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 Flyvbjerg, Holm, and Buhl (2002).

The following key observations pertain to cost overruns in transportation infrastructure projects:

- 9 out of 10 projects have cost overrun.
- Overrun is found across the 20 nations and 5 continents covered by the study.
- Overrun is constant for the 70-year period covered by the study, estimates have not improved over time.

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 %	Standard deviation
Rail	58	44.7	38.4
Bridges and tunnels	33	33.8	62.4
Road	167	20.4	29.9

Table 3-2 shows the inaccuracy of travel demand forecasts for rail and road projects. The demand study covers 208 projects in 14 nations on five continents. All projects for which data was obtainable were included in the study.[4] For rail, actual passenger traffic is 51.4 percent lower than estimated traffic on average. This is equivalent to an average overestimate in rail passenger forecasts of no less than 105.6 percent. The result is large benefit shortfalls for rail. For roads, actual vehicle traffic is on average 9.5 percent higher than forecasted traffic. We see that 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 errors vary widely across projects (Flyvbjerg, Holm, and Buhl, 2005; Flyvbjerg, 2005b).

The following observations hold for traffic demand forecasts:

- 84 percent of rail passenger forecasts are wrong by more than ±20 percent.
- 9 out of 10 rail projects have overestimated traffic.
- 50 percent of road traffic forecasts are wrong by more than ±20 percent.

[4] 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).

- The number of roads with overestimated and underestimated traffic, respectively, is about the same.
- Inaccuracy in traffic forecasts are found in the 14 nations and 5 continents covered by the study.
- Inaccuracy is constant for the 30-year period covered by the study, forecasts have not improved over time.

It must be concluded that if techniques and skills for arriving at accurate cost and traffic forecasts have improved over time, these improvements have not resulted in an increase in the accuracy of forecasts.

Table 3-2 Inaccuracy in forecasts of rail passenger and road vehicle traffic.

Type of project	No. of cases (N)	Avg. inaccuracy %	Standard deviation
Rail	25	–51.4	28.1
Road	183	9.5	44.3

If we combine the data in Table 3-1 and Table 3-2, we see that for rail an average cost overrun of 44.7 percent combines with an average traffic shortfall of 51.4 percent.[5] For roads, an average cost overrun of 20.4 percent combines 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 like those described above will typically be highly misleading.

Cost benefit analyses and social and environmental impact assessments are typically central in the early phases of project development, for instance in pre-feasibility and feasibility studies. Ideally, decisions in early-phase development should be informed. Given the data presented above, we see that in reality decisions are often misinformed. This presents a major risk to those paying for projects and hoping to benefit from their impacts.

3.4 Projects With Cost Overruns and Benefit Shortfalls

The list of examples of projects with cost overruns and/or benefit shortfalls is seemingly endless (Flyvbjerg, 2005a). Boston‘s Big Dig, otherwise known as the Central Artery/Tunnel Project, were 275 percent or US$11 billion over budget in constant dollars when it opened, and further overruns are accruing due to faulty construction.

[5] For each of twelve urban rail projects, data exist for both cost overrun and traffic shortfall. For these projects average cost overrun is 40.3 percent; average traffic shortfall is 47.8 percent.

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 worldwide 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."[6] Outside of transportation, the $4 billion cost overrun for the Pentagon spy satellite program 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. Unfortunately, the consequences are not always only financial, as is illustrated by the NASA space shuttle. Here, the cooking of budgets to make this under-performing project look good on paper has been linked with shortchanged safety upgrades related to the deaths of seven astronauts aboard the Columbia shuttle in 2003 (Flyvbjerg 2004).

As for benefit shortfalls, consider Bangkok's US$2 billion Skytrain, a two-track elevated urban rail system designed to service some of the most densely populated areas from the air. The system is greatly oversized, with station platforms too long for its shortened trains. Many trains and cars sit in the garage, because there is no need for them. Terminals are too large, etc. The reason is that actual traffic turned out to be less than half that forecast (Flyvbjerg, Holm, and Buhl, 2005: 132). Every effort has been made to market and promote the train, but the project company has ended up in financial trouble. Even though urban rail is probably a good idea for a dense, congested, and air-polluted city like Bangkok, overinvesting in idle capacity is hardly the best way to use resources, especially in a developing nation in which capital for investment is particularly scarce. Such benefit shortfalls are common and have also haunted the Channel tunnel, the Los Angeles and Copenhagen metros, and Denver's International Airport.

Other 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 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, 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

[6] Quoted from "Under Water Over Budget," *The Economist*, October 7, 1989, 37–38.

continental Europe. In Australasia: Sydney‘s Olympic stadiums, 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. The list ends here only for reasons of space.

This is not to say that projects do not exist for which costs and/or benefits were on or better than the budget, 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. 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.[7]

3.5 Why Cost Overruns and Benefit Shortfalls Are a Problem

Cost overruns and benefit shortfalls of the frequency and size described above are a problem for the following reasons:

- They lead to a Pareto-inefficient allocation of resources, i.e., waste.
- They lead to delays and further cost overruns and benefit shortfalls.
- They destabilize policy, planning, implementation, and operations of projects.
- The problem is getting bigger, because projects get bigger.

Let's 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 not be affected by the forecasting errors, according to this argument. However, the large standard deviations shown in Table 3-1 and Table 3-2 falsify this argument. The standard deviations shows 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 when overruns are large, as the data show they often are (Flyvbjerg, 2005a). In a separate study, it was demonstrated that delays in transportation infrastructure implementation are very costly, increasing the percentage construction cost overrun measured in constant prices by 4.64 percentage points per

[7] For an explanation of the success of the Bilbao Guggenheim Museum, see Flyvbjerg (2005a).

year of delay incurred after the time of decision to build (Flyvbjerg, Holm, and Buhl, 2004). 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 thus 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, as delays 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 football needing constant re-approval. Every overrun set off an increasingly menacing 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, Holm, and Buhl, 2004: 12). Some megaprojects are becoming 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 new $20 billion Chek Lap Kok airport after it opened in 1998. The desire to avoid national fiscal distress has recently become an important driver in attempts at reforming the planning of large infrastructure projects, as we will see later.

3.6 Policy Implications

The policy implications of the results presented above are as follows:

- Lawmakers, investors, and the public cannot trust information about costs, benefits, and risks of large infrastructure projects produced by promoters and planners of such projects.
- The current way of planning large infrastructure projects is ineffective in conventional economic terms, i.e., it leads to Pareto-inefficient investments.
- There is a strong need for reform in policy and planning for large infrastructure projects.

Next, the paper examines the causes of cost overruns and benefit shortfalls.

3.7 Causes of Cost Overruns and Benefit Shortfalls

Three main types of explanation exist that claim to account for inaccuracy in forecasts of costs and benefits: technical, psychological, and political-economic explanations.

Technical explanations account for cost overruns and benefit shortfalls in terms of imperfect forecasting techniques, inadequate data, honest mistakes, inherent problems in predicting the future, lack of experience on the part of forecasters, etc. This is the most common type of explanation of inaccuracy in forecasts (Ascher, 1978; Flyvbjerg, Holm, and Buhl, 2002, 2005; Morris and Hough, 1987; Vanston and Vanston, 2004; Wachs, 1990). Technical error may be reduced or eliminated by developing better forecasting models, better data, and more experienced forecasters, according to this explanation.

Psychological explanations account for cost overruns and benefit shortfalls in terms of what psychologists call the planning fallacy and optimism bias. Such explanations have been developed by Kahneman and Tversky (1979), Kahneman and Lovallo (1993), and Lovallo and Kahneman (2003). In the grip of the planning fallacy, planners and project promoters make decisions based on delusional optimism rather than on a rational weighting of gains, losses, and probabilities. They overestimate benefits and underestimate costs. They involuntarily spin 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 ever deliver the expected returns. Overoptimism can be traced to cognitive biases, that is, errors in the way the mind processes information. These biases are thought to be ubiquitous, but their effects can be tempered by simple reality checks, thus reducing the odds that people and organizations will rush blindly into unprofitable investments of money and time.

Political-economic explanations see planners and promoters as deliberately and strategically overestimating benefits and underestimating costs when forecasting the outcomes of projects. They do this in order to increase the likelihood that it is their projects, and not the competition's, that gain approval and funding. Political-economic explanations have been set forth by Flyvbjerg, Holm, and Buhl (2002, 2005) and Wachs (1989,1990). According to such explanations planners and promoters purposely spin scenarios of success and gloss over the potential for failure. Again, this results in the pursuit of ventures that are unlikely to come in on budget or on time, or to deliver the promised benefits. Strategic misrepresentation can be traced to political and organizational pressures, for instance competition for scarce funds or jockeying for position, and it is rational in this sense. If we now define a lie in the conventional fashion as making a statement intended to deceive others (Bok, 1979: 14; Cliffe et al., 2000: 3), we see that deliberate misrepresentation of costs and benefits is lying, and we arrive at one of the most basic explanations of lying that exists: Lying pays off, or at least political and economic agents believe it does. Where there is political pressure there is misrepresentation and lying, according to this explanation, but misrepresentation and lying can be moderated by measures of accountability.

3.8 Testing the Validity of Explanations

How well does each of the three explanations of forecasting inaccuracy--technical,

psychological, and political-economic--account for the data on cost overruns and benefit shortfalls presented earlier? This is the question to be answered in this section.

Technical explanations have, as mentioned, gained widespread credence among forecasters and planners (Ascher, 1978; Flyvbjerg, Holm, and Buhl, 2002, 2005). It turns out, however, that such credence could mainly be upheld because until now samples have been too small to allow tests by statistical methods. The data presented above, which come from the first large-sample study in the field, lead us to reject technical explanations of forecasting inaccuracy. Such explanations do not fit the data well.

First, if misleading forecasts were truly caused by technical inadequacies, simple mistakes, and inherent problems with predicting the future, we would expect a less biased distribution of errors in forecasts around zero. In fact, it was found with high statistical significance that for four out of five distributions of forecasting errors, the distributions have a mean statistically different from zero. Only the data for inaccuracy in road traffic forecasts have a statistical distribution that seem to fit with explanations in terms of technical forecasting error.

Second, if imperfect techniques, inadequate data, and lack of experience were main explanations of inaccuracies, we would expect an improvement in accuracy over time, since in a professional setting errors and their sources would be recognized and addressed through the refinement of data collection, forecasting methods, etc. Substantial resources have in fact been spent over several decades on improving data and methods. Still our data show that this has had no effect on the accuracy of forecasts. Technical factors, therefore, do not appear to explain the data.

It is not so-called forecasting "errors" or their causes that need explaining. It is the fact that in a large majority of cases, costs are underestimated and benefits overestimated. One may agree with proponents of technical explanations that it is, for example, impossible to predict for the individual project exactly *which* geological, environmental, or safety problems will appear and make costs soar. But one must also maintain that it is possible to predict the risk, based on experience from other projects, *that* some such problems will haunt a project and how this will affect costs. Such risk can and should be accounted for in forecasts of costs, but typically is not. For technical explanations to be valid, they would have to explain why forecasts are so consistent in ignoring cost and benefit risks over time, location, and project type.

Psychological explanations better fit the data. The existence of optimism bias in planners and promoters would result in actual costs being higher and actual benefits being lower than those forecasted. Consequently, the existence of optimism bias would be able to account, in whole or in part, for the peculiar bias found in most of our data. Interestingly, however, when you ask forecasters about causes for forecasting inaccuracies in actual forecasts, they do not mention optimism bias as a main cause of inaccuracy (Flyvbjerg, Holm, and Buhl, 2005: 138-140). This could of course be because optimism bias is unconscious and thus not reflected by forecasters. After all, there is a large body of experimental evidence for the existence of optimism bias (Buehler et al., 1994; Buehler, Griffin, and MacDonald, 1997; Newby-Clark et al. 2000). However, the experimental data are mainly from simple, non-professional settings. This is a problem

for psychological explanations, because it remains an open question whether they are general and apply beyond such simple settings.

Optimism bias would be an important and credible explanation of underestimated costs and overestimated benefits in infrastructure forecasting if estimates were produced by inexperienced forecasters, i.e., persons who were estimating costs and benefits for the first or second time and who were thus unknowing about the realities of infrastructure building and were not drawing on the knowledge and skills of more experienced colleagues. Such situations may exist and may explain individual cases of inaccuracy. But given the fact that in modern society it is a defining characteristic of professional expertise that it 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. Learning would result in the reduction, if not elimination, of optimism bias, which would then result in estimates becoming more accurate over time. But our data clearly shows that this has not happened.

The profession of forecasters would indeed have to be an optimistic--and non-professional--group to keep their optimism bias throughout the 70-year period our study covers for costs, and the 30-year period covered for patronage, and not learn that they were deceiving themselves and others by underestimating costs and overestimating benefits. This would account for the data, but is not a credible explanation. Therefore, on the basis of our data, we are led to reject optimism bias as a primary cause of cost underestimation and benefit overestimation.

Political-economic explanations and strategic misrepresentation account well for the systematic underestimation of costs and overestimation of benefits found in the data. A strategic estimate of costs would be low, resulting in cost overrun, whereas a strategic estimate of benefits would be high, resulting in benefit shortfalls. A key question for explanations in terms of strategic misrepresentation is whether estimates of costs and benefits are intentionally biased to serve the interests of promoters in getting projects started. This question raises the difficult issue of lying. Questions of lying are notoriously hard to answer, because a lie is making a statement intended to deceive others, and in order to establish whether lying has taken place, one must therefore know the intentions of actors. For legal, economic, moral, and other reasons, if promoters and planners have intentionally cooked estimates of costs and benefits to get a project started, they are unlikely to formally tell researchers or others that this is the case. Despite such problems, two studies exist that succeeded in getting forecasters to talk about strategic misrepresentation (Flyvbjerg and Cowi, 2004; Wachs 1990).

Flyvbjerg and Cowi (2004) interviewed public officials, planners, and consultants who had been involved in the development of large UK transportation infrastructure projects. A planner with a local transportation authority is typical of how respondents explained the basic mechanism of cost underestimation:

> "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."

Experienced professionals like the interviewee know that outturn costs will be higher than estimated costs, but because of political pressure to secure funding for projects they hold back this knowledge, which is seen as detrimental to the objective of obtaining funding.

Similarly, an interviewee explained the basic mechanism of benefit overestimation:

> "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."

Such a focus on benefits and disregard of risks and robustness may consist, for instance, in the discounting of spatial assimilation problems described by Priemus (forthcoming) elsewhere in this issue. Competition between projects and authorities creates political and organizational pressures that in turn create an incentive structure that makes it rational for project promoters to emphasize benefits and deemphasize costs and risks. A project that looks highly beneficial on paper is more likely to get funded than one that does not.

Specialized private consultancy companies are typically engaged to help develop project proposals. In general, the interviewees found that consultants showed high professional standard and integrity. But interviewees also found that consultants appeared to focus on justifying projects rather than critically scrutinizing them. A project manager explained:

> "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. It is in line with their need to make a profit."

The consultants interviewed confirmed that appraisals often focused more on benefits than on costs. But they said this was at the request of clients and that for specific projects discussed "there was an incredible rush to see projects realized."

One typical interviewee saw project approval as "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 stage."

In sum, the UK 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 deemphasized. 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 to actively avoid bias in estimates of benefits, costs, and risks. National bodies, like 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, although the situation may be changing with the initiatives to curb bias set out in HM Treasury (2003) and Flyvbjerg and Cowi (2004).

The second study was carried out by Wachs (1990, 1986). Wachs 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 patronage could not be explained by technical errors, honest mistakes, or inadequate methods. In case after case, planners, engineers, and economists told Wachs that they had had to "revise" their forecasts many times because they failed to satisfy their superiors. The forecasts had to be cooked in order to produce numbers that were dramatic enough to gain federal support for the projects whether or not they could be fully justified on technical grounds. Wachs (1990: 144) recounts from his interviews:

> "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."

In another typical case of cost underestimation and benefit overestimation, Wachs (1990: 144-145) gives the following account:

> "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 in the UK study above, Wachs specifically interviewed consultants. He found, as one consultant put it, that "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: 151-152).

On the basis of his pioneering study, Wachs (1990: 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 are actually instruments for getting public funds committed to a favored project. Wachs (1990: 146, 1986: 28) 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 routinely plays an important role in policy debates, according to Wachs.

3.9 Survival of the Unfittest

In conclusion, the UK and US studies arrive at results that are basically similar. Both studies account well for existing data on cost underestimation and benefit overestimation. Both studies falsify the notion that in situations with high political and organizational pressure the lowballing of costs and highballing of benefits is caused by non-intentional technical error or 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:

Underestimated costs + Overestimated benefits = Project approval

Using this formula, and thus "showing the project at its best" as one interviewee said above, results in an inverted Darwinism, i.e., the "survival of the unfittest." It is not the best projects 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 "unfittest," 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 have been designed like that.

A later paper will present ideas of how this situation may be improved (Flyvbjerg, 2007).

3.10 Summary

This paper identifies as the main problem in major infrastructure developments pervasive misinformation in the early phases of the project cycle about the costs, benefits, and risks involved. A consequence of misinformation is massive cost overruns, benefit shortfalls, and waste. The paper then explores the causes of misinformation and finds that optimism bias and strategic misinformation best account for the available evidence. In the case of strategic misrepresentation, planners and promoters deliberately misrepresent costs, benefits, and risks in order to increase the likelihood that it is their projects, and not the competition's, that gain approval and funding. This results in a negated Darwinism with "survival of the unfittest," where often it is not the best projects that are built, but the most misrepresented ones.

3.11 References

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