Reference Class Forecasting: A clear and present danger to cost-effective capital investment on major infrastructure projects

Invited written evidence submitted to *The Government's Management of Major Projects Inquiry*, Public Administration and Constitutional Affairs Committee (UK House of Commons)

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Public Administration and Constitutional Affairs Committee

The Government's Management of Major Projects Inquiry

I write in response to your request to provide evidence in relation to the adoption of Reference Class Forecasting (RCF) as part of the cost overrun risk management process for major infrastructure projects. To do so, this submission briefly provides an overview of cost performance on major infrastructure projects and the sources of cost overrun. The submission

- details the fallacy of assuming optimism bias is the sole and predominant cause of overruns
- argues why RCF falls short of robust project risk quantification and is flawed in achieving cost-effective capital investment on infrastructure projects.
- concludes with recommendations for mitigating cost overrun on major infrastructure projects; and
- calls on governments and asset owners to base their investment decision making on empirically-based cost estimation approaches, backed by a disciplined stage-gate practice to alleviate the problem.

1. Cost overrun on large infrastructure projects

Major infrastructure projects facilitate the economic growth, connectivity, liveability and safety of nations. They thus form the critical lifeblood of economic prosperity and development. These projects cover different sectors such as transport, energy, water, security, telecommunication, and ICT. The main concerns of most clients are typically related to their ability to procure an asset that is able to meet its functional requirements, of the required quality, within budget and stipulated timeframe. The cost aspect of these key performance indicators typically ranks highest for most clients, especially if the project is publicly-funded. Thus, for an asset owner, managing the performance of their projects is essential to ensure they are procured cost-effectively, competitively and provides the intended benefits to its users. Their ability to reliably estimate the final cost and ensure that it does not experience significant cost overrun is vital for ensuring the adequate planning and resourcing of other projects.

In spite of its importance, project cost estimation on large infrastructure projects is not always straightforward because of the lack of information in the early stages of the project for decision-making. Large infrastructure projects routinely overrun their initial cost and time targets, irrespective of their type (e.g., roads, rails, ICT, nuclear plants, hydroelectric dams). Recent examples within the UK transport sector include Crossrail, HS2 and Edinburgh Trams Project. Here in Australia, the ongoing Sydney Light Rail project is struggling with rising costs and delays. Cost overruns are indeed a global problem.

2. Sources of infrastructure project overrun

While there is widespread consensus that infrastructure cost overrun is a pervasive problem, its *cause* remains a matter of contention and intense debate (see for example https://bit.ly/2L2mf51). The problem has been attributed to improperly managed risk and uncertainty; complexity of major projects; poor scope

definition and premature sanctioning; shifting too much risk to contractors; a lack of disciplined phased-gate project system application as well as corruption.

A recently popularised twin explanation for cost overrun on major projects by Flyvbjerg *et al.* (2004) is *strategic misrepresentation* (deception) and *optimism bias* (delusion). The delusion thesis holds that project promoters and sponsors systematically underestimate the possible impact of risks, complexity and changes that may be experienced on the project due to biases inherent in human judgement. The deception hypothesis, on the other hand, posits misaligned principal-agent relationships or political incentive; that is infrastructure project promoters deliberately manipulate and underestimate true costs to gain funding approval. At perfunctory examination, this may appear to be a reasonable explanation, especially in political circles and the popular press.

However, this causal oversimplification ignores conjoint possibilities, the role of uncertainty in complex project systems and the highly dynamic interrelationships between the different causal factors. The attribution of cause to a single source, such as optimism bias, categorically rejects the fact that cost overrun can occur from any number of different causal paths and that even very similar causal conditions can result in very different cost outcomes).

This is not to say that bias, behaviour, political motivations and strategy are not important. It is well-known that politicians often announce the projected cost of infrastructure projects well in advance of detailed scope definition, often as a pre-election commitment to attract votes. Also, intentional distortion of fact, in the budgeting process of the public sector has been a widely reported (Wachs 1989; Locatelli *et al.* 2017). What is argued here is that the claim that *bias alone* reigns supreme over all other causal explanations is unwarranted and has not been empirically demonstrated. Overrun causation stems from social, organisation, engineering, technical, environmental, political and economic sources. Thus, a holistic and systemic view of the problem has to draw on causal contributions from all these different perspectives. A focus on bias and the motivations of project proponents *alone*, at the expense and neglect of other well-documented sources of overrun, is misguided. It will lead to sub-optimal prevention strategies such as Reference Class Forecasting.

3. Reference Class Forecasting

The method proposed for 'de-biasing' cost estimates is called Referenced Class Forecasting (RCF) (Flyvbjerg 2008), which attempts to use distributional information from completed projects similar to the new project under consideration. Its proponents hype the approach as a bypass to optimism bias and strategic misrepresentation in decision-making. The approach involves the following steps

i. identification of a relevant reference class of past, similar projects;
ii. establishing a probability distribution for the selected reference class; and
iii. determine the most likely cost or time outcome for the proposed project by comparing it with the reference class probability distribution.

RCF raises awareness of the need to capture good historical data and to produce reliable cost estimates. It also helps to display the scale of the opportunity or threat within a business case based on the cost performance on past projects. Unfortunately, it would appear that even before the method is validated, policy-makers in the UK, and even here in Australia, are adopting it. RCF falls short of a robust project risk quantification approach and is flawed in achieving cost-effective capital investment by Governments and asset owners. A close examination of its underlying assumptions, data and possible implications for capital spending paints a rather worrying picture. Six of these reservations are detailed below:

i. What RCF terms as 'de-biasing' is essentially just 'padding-up' cost estimates in pursuit of *cost predictability* over *competitiveness* and *cost-effectiveness*. It is easy to achieve cost predictability – just inflate the budget. The pursuit of predictability over competitiveness and cost-effectiveness in RCF does not solve the problem of cost overruns but it introduces a new one – institutionalised mediocrity. The current track record of delivering projects to agreed budgets is rather abysmal. If future estimates are then to be based on distributional information derived from poor practices and estimates from the past, public funds will be wasted through non-competitive and overblown budgets. It is a rather questionable attempt at being good stewards of taxpayer money.

ii. RCF is devoid of critical *causal data* such as the basis of the initial estimates, the stage of scope development at project sanction, whether there were any scope changes or unforeseen extraordinary risk, project complexity, etc. It essentially treats the *causal data* that drives poor cost performance as meaningless and inconsequential (i.e. that they would make no difference to improving cost estimate reliability). It also rather naively assumes that getting the budget 'right' in itself is both necessary and sufficient to stop overruns.

iii. Without answering the question of *why* (the causal data) there can be no improvement in capital effectiveness which means lower absolute capital cost and duration. RCF can only result in better predictability by targeting historical mediocrity as an objective. The does not involve any serious attempt to identify, mitigate and quantify any specific major contingent risks (events) that may affect the considered project. In other words, while using historical data is a great initiative, the key objective is not to repeat the past, but to improve on it by reducing residual risks.

iv. At no point does the research that supports RCF empirically measure optimism bias at the time of producing the cost estimates – the very thing it purports to curtail. This is surprising. It only uses the measure of cost overrun as a proxy for optimism bias (i.e. whenever there is an overrun, it has to be because initial estimators and project proponents were optimistic or negligent). The research supporting the development of the *Optimism Bias Uplifts* in RCF is a far cry from the empirical evidence needed to support the absolute claim that optimism bias and planning fallacy are the best explanations of 'how

projects work' (Love *et al.* 2019; Moschouli *et al.* 2019). Public policy should always be based on evidence, not supposition. Significant tax-payer funds are at stake in this case.

v. The danger associated with accepting the delusion and deception explanation to the neglect of other documented sources of overrun is the disincentive to improve project planning and appraisal practices. The method assumes that future projects will perform similarly to past projects. By this assumption, RCF discourages good practice of project risk and contingency management, as well as opportunities for improvement. Low estimates, even when justified and competitive will be penalised, even criminalised. The result will eventually be the incentive to overestimate cost.

vi. A further challenge to implementing RCF is the accumulation of a credible, homogeneous and representative reference class of projects with requisite causal data. Most major projects tend to be relatively rare and the context for each is usually different (e.g., HS2, Hinkley Point C nuclear power station, Edinburgh Trams and Sydney Light Rail). It may never be possible to have a sample size large enough for accurate statistical inferencing and analysis. Thus, to simply assume that a given project is comparable to past and completed projects and that a lump-sum bias uplift could be added to account for all uncertainties is a gross oversimplification of reality. The proponents may not have had access to causal data due to confidentiality and the current limitations of how the industry collects and archives data. Nonetheless, to assume that such causal data and practices would make no difference is an unfortunate overreach.

4. The Way Forward

The large scale of capital investment needed for major infrastructure projects warrants rigorous decision-making backed by robust empirical evidence. A reduction in poor cost performance will contribute to alleviating the financial burden often placed on taxpayers. Recommendations for mitigating significant cost overruns on major infrastructure projects include:

i. ***Implement a disciplined stage-gate system***: Too often, large infrastructure projects are rushed through to sanctioning before any detailed scope definition takes place. Speed and schedule pressure in the early stages of major projects typically combine to set-up major projects for failure. As a result, the task of effective risk management at the front-end[1] is so often poorly performed that far too much risk is passively retained within the project. Edward Merrow, founder of Independent Project Analysis (IPA) thus notes - "When there is pressure to move a project along quickly from the outset, corners get

[1] Front-end: The crucial stages of a project prior to sanctioning (full funds authorization)

cut and opportunists have a field day." (Merrow 2011: 2). 'Slow down' the decision-making process at the front-end and adopt a strong and disciplined stage-gate system[2].

ii. ***Scope definition:*** Research has demonstrated extensively that the causes of overruns are systemic. For major infrastructure projects, the level of scope definition upon which the estimate is based, in addition to the level of technology and complexity, tend to be among the main drivers (Hollmann 2016). Projects should only be sanctioned after adequate scope definition[3] and business cases have been completed. This relates to the point above about "slowing down" the project appraisal and feasibility stages to allow for an adequate understanding of risks, costs, benefits, opportunities and contingency requirements. The guiding mantra at the front-end of projects too often reads like this: 'sanction now and we will work out the details later'. This is a classic recipe for disaster. Front-end scoping can cost between 3-5% of the total cost of a typical project with existing technology and low to moderate complexity (Merrow 2011)[4]. This is good investment – it would ensure value for money for taxpayers, avoid excessive cost/schedule overrun and maximise project benefits.

iii. ***Rigorous and mandatory benchmarking:*** The implementation of a rigorous and mandatory benchmarking framework for infrastructure projects would ensure that major infrastructure investments deliver the best outcomes for the community and the best value for taxpayers. Benchmarking includes the capturing of project objectives, whole life cycle performance metrics, and causal data that reflects the systemic attributes of each project. Infrastructure Projects Authority's Best Practice in Benchmarking[5] is a good starting point for this but must also include the capturing of causal data during project delivery to support empirical and intelligent cost estimates.

Finally, there is the saying among contractors - *"winning a tender is easy. But winning at the right price is difficult"*. Unless clients start searching for *realistic* estimates, rather than the lowest absolute costs, the problem of cost overrun might remain with the industry for a long time to come. This goes to the heart of how projects are awarded in the public sector. Further, it is easy to become deluded to believe that good estimates are in themselves sufficient to stop future overrun – that is naïve. While a strong stage-gate system typically

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[2] Stage-gate systems typically contain distinct phases of project definition and decision-making (the gates). A leading example is the Front-End Loading (FEL) system of Access, Select, Define, Execute and Operate stages by Independent Project Analysis, Inc. (IPA; a leading benchmarking consultant, www.ipaglobal.com). This includes FEL 1, 2 and 3 decision gates (FEL 3 being after the Define stage).

FEL is reflected in the Estimate Classification system of AACE International (Association for the Advancement of Cost Engineering). Estimate Class is a measure of the level of maturity of the project scope definition. AACE Class 5, 4, and 3 align with IPA FEL 1, 2 and 3 respectively. These systems have been *defacto* standards in commercial industry for over 20 years. The systems apply to infrastructure projects but have been less consistently applied.

[3] Typically Class 3 level of scope definition in the AACE International or FEL 3 of Front-End Loading system

[4] According to IPA, the average percentage of total capital cost budget to complete each phase of the FEL system is 0.5% (Assess), 1.5% (Select), 3% (Define) and 95% (Execute). This is cited in the book, *Capital Works*, by Paul Barshop (2016).

[5] https://bit.ly/2OzA4KH

prevents a total disaster and lost value through overruns, large and complex projects may still encounter significant challenges from latent conditions, scope changes to meet technical needs, innovation and revised objectives. These issues typically drive-up cost. At the risk of being misunderstood and misquoted, it is worth stating that not all *cost increases* are because people lied, made mistakes or were negligent.

5.0 Conclusion

Amid tight fiscal constraints, it is crucial to develop effective tools and models to help mitigate unexpected cost overrun. This would ensure that capital-intensive projects are only committed to after robust and reliable cost estimates are prepared. This submission concludes with the following summary points:

- In a complex world with multiple actors and many uncertainties to accommodate on major infrastructure whose lifecycle typically spread over many years, the proponents of *bias only* seem vested in the idea that while the future is complex and uncertain, it is calculable and predictable – this is the classic illusion of certainty and control.
- The drivers of cost overrun are systemic, interdependent and interrelated - bias is just one among many (Merrow 2011; Barshop 2016; Moschouli *et al.* 2019). This calls into question the utility of theoretical generalizations that support the increasingly adopted cost overrun mitigation strategies like RCF.
- RCF does not involve any serious attempt to identify, mitigate and quantify any specific major contingent risks (events) that may affect the considered project. In other words, while using historical data is a great initiative, the key objective is not to repeat the past, but to improve on it by reducing residual risks.
- Using RCF will have very negative consequences for effective taxpayer spending as it adopts a simplistic causal perspective that does not accommodate many other proven causes of overrun apart from bias. Further, without contextually relevant causal data that helps to answer *why* infrastructure projects performed poorly on capital expenditure, there can be no learning for the next project.

RCF only offers its users a risk profile snapshot of an unwashed mass of mediocre projects that Government and asset owners are expected to base funding decisions on. At best, it can only improve predictability at the expense of competitiveness. That is no way of being good stewards of taxpayer money.

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