# Hundreds of Years of Pain, with Minimal Gain: Capital Project Cost Overruns, the Past, Present and Optimistic Future

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***Abstract* – The cost overrun phenomenon plagues capital projects worldwide. While policymakers and practitioners are aware of the potential for cost overruns to occur while procuring their projects, they have struggled to mitigate them. This article takes stock of cost overrun research and suggests two major periods stand out. First, it focuses on the period from 1960 to 2002 and briefly reviews studies examining issues influencing cost estimation accuracy. Then, we look at the present period (2002 to 2022), where the Planning Fallacy theory has been championed and identified as the best way to explain why cost overruns occur. While the Planning Fallacy has filled the theoretical void in the literature, we question its legitimacy as it has been unable to effectively address the cost overrun phenomenon. Moving forward, we suggest a line of inquiry based on the theoretical polyphony of the 'Fifth Hand' principle, which offers a new framing to remedy cost overruns in capital projects.**

*Index of Terms* – Cost overrun, capital projects, Fifth Hand, Planning Fallacy, theory

## I. INTRODUCTION

In celebration of the 50th volume of *IEEE Engineering Management Review*, the Editor, Joe Sarkis, asked us to reflect on the current state of theory and practice in project management – a tall order, indeed! As we contemplated current movements in the study of project-based work, we were taken with the challenges we see occurring on a routine basis: the development of mega-projects and their often-concomitant under-performance, either in terms of cost and schedule adherence or their failure to deliver the promised value post-investment. This reflection article offers our perspectives on the historical development and current state of large projects and the challenges of frequent cost overruns, including their causes and some remedial steps that organizations can take to rationalize and systematize these critical cost control processes.

Worldwide, capital projects have exceeded their approved forecasted budgets for centuries. Examples of well-known capital assets with cost overruns during their construction include St Paul's Cathedral (United Kingdom, UK), Palace of Westminster (UK), Suez Canal (Egypt), Montreal Olympic Stadium (Canada), Channel Tunnel (France and the UK), and Miami Science Museum (USA), to name only a few. Perhaps the Sagrada-Familia Cathedral in Barcelona (Spain) is the most infamous building experiencing a double whammy of cost and schedule overruns. Construction commenced in 1883, halted during the Spanish civil war, and recommenced in 1952. No definitive completion date has been determined, but it might be between 2026 and 2028. The construction costs may never be known. Thus, while the phenomenon of capital project cost overrun is not new, it remains a problem policymakers and practitioners worldwide struggle to address and bring under control.

In this article, we take a brief look at the research that has examined the nature of cost overruns over the last 60 years or so. Our intention is not to present a systematic review but instead offer thoughts and provide insights about how research in this area has unfolded. At face value, the future of capital project cost performance looks bleak as we deal with a profound dichotomy: the emergence of many large and costly capital projects remains overshadowed by our chronic inability to regulate and control their costs. We argue that history has a habit of repeating itself

– trying to solve a problem with the same level of thinking – as there has been an absence of a theory to guide and give meaning to the cost overrun problem.

When a theory is validated, practical and meaningful solutions can be developed to address cost overruns. Absent such theory, however, prescriptions and solutions to these overrun problems remain idiosyncratic, non-generalizable, ineffective or even unworkable. However, rather than viewing our glass 'half empty', we consider it as 'half full', suggesting that as a result of robust and, at times, conflicting debates, a new line of inquiry has emerged to mitigate the prevalence of cost overruns in future capital projects. Thus, we are optimistic that future research can provide a new pathway for the cost-effective delivery of capital projects.

Before we offer our reflections on the past and nascent developments in cost overrun research, we need to address an issue that contributed to the quagmire in the literature. That is, what is meant by a cost overrun, and what reference points are used to quantify its extent in projects (i.e., absolute and relative terms)? [1], [2].

## II. MEANING OF COST OVERRUN

Varying definitions and interpretations of the notion of cost overrun prevail. We often see terms such as 'budget overrun,' 'cost blowout', 'cost growth,' 'cost underestimation,' 'cost escalation,' and 'cost mis-performance' being used interchangeably to describe a project's cost overrun. While each of these terms can be interpreted differently, we will treat them as synonymous in this article. The simplest definition of cost overrun can be found in the Cambridge dictionary – spending more money on a project than was planned in the budget or the excess of the actual amount that is spent over the forecasted budget – though the term *budget* (e.g., initial or approved) is ambiguous, as it can have different meanings based on the point in time it is established.

In absolute terms, Odeck [3] refers to a cost overrun as the "difference between actual and estimated costs" (p.45). Correspondingly, Cantarelli *et al*. [4], in relative terms, define a cost overrun as the "actual outturn costs minus estimated costs as a percentage of estimated costs" (p.6). A much narrower view of determining a project's cost overrun can be found in Love *et al*. [5], who use the "extent of monetary deviation from the price agreed at contract award with a contractor and settlement of the final account (i.e., final contract sum)" to determine its extent (p.3).

A cursory review of the literature reveals that the definition of cost overrun adopted varies between fields. For example, those taking an economics and policy lens tend to take a broad perspective of the problem and focus on determining a cost overrun as the difference between initial budget approval and final construction costs [6-9]. Contrastingly, within the field of construction and engineering management, the difference between contract award and final construction costs is typically adopted [10-15].

There is no 'right' or 'wrong' definition for the notion of cost overrun. Still, we must be cognizant that whatever meaning is adopted, the stakeholder perspective taken must be clear-cut, caveats must be made explicit, and the variances that can manifest between definitions acknowledged. Cost overrun is also a time-dependent phenomenon. A case in point can be found in Love *et al.*'s [5], [15] studies of social and economic capital projects where the cost differences using various reference points are identified: (1) initial base estimate→final construction costs; (2) approved budget estimate→final construction costs; (3) pre-tender estimate→final construction costs; and (4) contract award→final construction costs. It should be acknowledged that access to data at these various stages of a project's development has not been readily available to researchers. However, by using the multiple points of reference identified, we can provide much-improved clarity and meaning of a project's cost performance. Against this contextual backdrop, we now examine the past, present, and future of cost overrun research for capital projects.

## III. THE PAST: PRE-2002, AN ERA IN SEARCH OF THEORY

Our starting point to examine the problem of cost overruns is to look to the 1960s, as the scholarly literature was relatively scant on this subject before this period [17]. From 1960 to 2002, two key research themes seeking to explain why and how cost overruns occur can be found in the literature: (1) the cost estimation problem or inaccuracy of cost estimates; and (2) the procurement and management of the project.

### *A. The Cost Estimation Problem*

Besides quantifying the impact of a cost overrun in relative terms [19-21], initial studies tended to look at the inaccuracy of estimates and attribute it to bias and the "high level of uncertainty surrounding cost estimation" [17.p.28] [22-24]. Even though the estimation error problem had been identified as an issue as far back as the 1960s and 1970s, "little systematic analytic work" was undertaken, despite public agencies having access to masses of raw data [17: p.29].

According to Merrow *et al*. [17], "imperfections in estimating methods and limits on the estimating art" constitute a key factor that contributes to errors in cost estimates (p.39). Uncertainties embodied in the type and complexity of the project (e.g., geological conditions and remote location) can lead to a bias toward underestimating costs, especially when historical data from which a base estimate can be established is unavailable. To cite one example, the 390MW Dulhasti Hydroelectric plant, built in a remote location in the foothills of the Himalaya Mountains range, saw a cost overrun that amounted to a staggering 2,532% [25]. The idea that biases were an innate feature of cost estimation was well established by the 1970s, and probability analysis could be applied to improve its reliability (e.g., 90% confidence interval). Fischoff [26], drawing on his research examining how people make judgments under uncertainty, cogently states:

> "To provide valid estimates in lieu of appropriate historical data, the estimators must be experts in both the topic in question and in the making of probability estimates. There is no guarantee that these two forms of expertise go together--that is, that those who understand a system best are able to convert their knowledge into valid probability estimates and to assess the quality of their estimates…we have found that people who know the most about various topics are not consistently the best at expressing the likelihood that they are correct" (p.184).

While we knew there was a need to 'de-bias' cost estimates [17], [27], limited research endeavored to address this issue directly between the 1980s and early 2000s. There was, however, a wealth of research that sought to understand why the cost estimating process produced inaccurate estimates and determine ways in which it can be improved [28-34]. And yet, despite such a body of work, projects still experienced cost overruns.

Perhaps a contributing factor to the lack of research on systematic error and bias during this period was the absence of an agreed definition for these terms [35]. Taking a technical view of bias, Skitmore *et al*. [35] defined it in terms of the "relationship between the value of the price forecast and the value of the lowest tender" (p.159), basing it on three measures: (1) the raw difference between the forecast and the lowest bid; (2) the percentage difference between the forecast and the lowest bid; and (3) the difference of the log forecast and the lowest bid. Here bias is influenced by the target contract, the forecasting technique, feedback, and the estimator's experience. Unfortunately, Skitmore *et al*. [35] did not examine the more interesting question: how and why error and bias creep into cost estimates.

Addressing this void, Mak and Raftery's [35] study of risk attitude and systematic bias (e.g., adjustment and anchoring bias, representative bias, and availability bias) in the estimating and forecasting of construction costs concluded that "there is little significant support for the existence of severe and systematic bias in this study" (p.320). Thus, estimators' skill, training, and expert judgment (i.e., *error*) may markedly influence an estimate's accuracy but not necessarily *bias*. Retrospectively, we know that efforts to improve an estimator's skills (e.g., training in risk analysis) and the estimation process (e.g., using historical data and statistical methods) did not effectively address the cost estimation problem during this period.

Another important issue influencing a capital project's cost underestimation during this period was *strategic misrepresentation* – "the planned, systematic distortion or misstatement of fact – lying – in response to incentives in the budget process." [37: p.437]. In a nutshell, Wachs [38] defines strategic misrepresentation as simply 'making numbers lie'. Estimators are often confronted with the dilemma of remaining ethical when, for political reasons, a public agency requests a decision to appear more favorable and justifiable through a supposedly objective analysis. The resulting pressures and their implications can give rise to cynicism. According to Wachs [38], an effective estimator is one "who can cloak advocacy in the guise of scientific or technical rationality." (p.477). Moreover, Wachs [38] suggests that it is relatively easy to justify a project's viability by falsifying or manipulating the numbers when information is unavailable or there prevails information asymmetry between stakeholders. Empirical evidence of lying in the cost estimation process was not forthcoming as it is, of course, difficult to uncover and prove. However, still, suspicions of its existence undoubtedly have long been present.

### *B. The Procurement and Management of the Project*

The processes used to procure and manage capital projects were consistently put under the microscope between 1960 and 2002. These finished projects generally performed poorly, were regularly over budget, were delivered late, and suffered from quality issues. Worldwide, governments sought ways to improve the delivery of their capital assets and, in so doing, initiated reforms to their policies and practices as a consequence [39-46]. As part of these larger analyses, scope and design changes, the form of procurement method (i.e., separation of design and construction activities), poor project management, ineffective project teams, and the economic, institutional, and political environment have been repeatedly identified as key contributors to cost overruns [6], [17], [27], [47-51]. Let us briefly consider each of these issues in turn.

#### 1. Scope and Design Changes

A project's scope "describes the work to be performed", enabling an estimator to determine its cost [27: p.69]. So, when a project's scope contains ambiguities and is ill-defined, the accuracy of the cost estimate is impacted. Suffice it to say a cost estimate's accuracy depends on the level of detail and information in the scope definition, as empirically demonstrated in Love *et al*. [5], [15]. Notably, Peurifoy and Oberlander [52] identify three levels of accuracy based on a project's scope definition: (1) conceptual estimate, which does not include design information, should be accurate within +40 and -10%; (2) preliminary estimate, based on a tentative design should be accurate within +25 and -5%; and (3) detailed estimate prepared upon the completion of the design, which is expected to be accurate with +10 and -3%. *However, design is seldom, if ever, complete*. More often than not, the contract documentation contains errors and omissions, which can result in contractual claims and thus increase costs for clients and contractors [53].

Design changes (e.g., due to stakeholder or legislative requirements) can have a significant impact on costs and engender "ripple effects" through a project [17: p.40]. They can also occur due to scope changes generally attributable to a poorly developed brief. When changes are required, a project's momentum can be severely impacted, causing delays, contractual claims, disputes, and increased costs. A cost contingency sum is often set aside to cover risks and uncertainties in the estimating process and minor errors and omissions that may have occurred (for example, building projects routinely assign a 10% budget contingency to account for changes and subsequent cost escalation). However, a cost contingency is not intended to cover significant changes in scope, industrial action, inclement weather, price escalation, and changes in exchanges rates, which can all contribute to projects increasing their costs. Thus, despite the recurrent use of cost contingency in practice, it has seldom been enough to accommodate cost overruns. The UK's Crossrail project in London is a telling example.

2. Procurement Method

The traditional design-bid-build procurement method used to procure projects has been extensively criticized [40], [42], [45]. Under this method, design and construction activities are separated, adversarial relations between contractors and clients can manifest, claims and disputes are common, and cost overruns are highly likely. To attempt to counter this dreary cycle of embedded conflict, calls for the use of collaborative and relational forms of procurement was made by Latham [42]. As a result, we began to see increasing use of partnering-type arrangements and non-traditional procurement methods [54]. And yet, there remained no evidence that the cost performance of projects improved; that is, cost overruns were still a problem irrespective of the procurement method used [55].

Similarly, in the 1990s, several local, state and federal governments began emphasizing New Public Management (NPM). They adopted the Private Finance Initiative (PFI) – a form of Public Private Partnership (PPP) – to acquire value for money and improve efficiencies while procuring capital projects. Contrary to expectation, PFIs, for example, were a failure for the UK National Health Service (NHS) projects – leading to higher price tags than direct-funded projects due to their financing costs, which a public sector alternative would not incur. For example, on average, the financing costs of NHS PFIs added 39% to a project's total costs [56].

The introduction of PFIs under John Major's Conservative government in the UK has led to contracting methods that have been inflexible, overly complex, and a source of significant financial risk to governments [57]. Due to their poor financial performance, a moratorium is in place for the future use of PFIs and PPPs in the UK [57].

## 3. Project Management and Teams

Project management is "responsible for the organization, leadership, control, and integration of the efforts of personnel and organizations involved in a construction effort" [17: p.41]. Thus, the way a project is managed can influence estimation error and the degree of cost overrun that is incurred. Therefore, there exists a vast body of research on the managerial issues needed to deliver projects successfully, how teams can work more cooperatively, and the types of leadership required to ensure their realization [51], [54], [58-60]. The importance of using relational procurement methods (e.g., involving contractors early in the design process) was also identified as a way to help engender and facilitate effective project management and collaboration between parties so that constructability and accuracy of cost estimates could be improved [61].

4. Economic, Institutional, and Political Environment

Economic, institutional, and political factors reside outside the direct control of a project and are difficult, if not impossible, to forecast. Construction costs will vary with economic and market conditions (e.g., price of materials, workforce supply, and (de)inflation), which will need somehow to be incorporated into a project's estimate. Adjustments for escalation and cost indices are typically made when estimates are prepared, and the design progresses through its development. Still, they are difficult to determine as estimators deal with 'known unknowns'. What is more, it can take several years or decades between the point in time a project's budget is approved and its construction is completed, and during this interval, governments, regulations and laws can change, which can impact costs. While research acknowledged the impact of economic, institutional, and political factors on cost estimation accuracy, these issues received limited attention other than from economists.

In sum, despite 40 years of research, cost overruns in projects continued to prevail, and there were no signs of them abating. Beyond introducing changes to the way projects were delivered and managed and applying new practices and processes to improve the performance of projects, something more fundamental had been overlooked, yet it went unrecognized. No theoretical framing for understanding and explaining cost overruns had been proposed.

## IV THE PRESENT: 2002 TO 2022, EMERGENCE OF THEORY

Before 2002, research into cost overruns had focused on the project environment, and little theory had been established to explain why they manifested. Research has tended to take a fragmented and insular approach to examining the cost overrun problem, relying on single-case studies or anecdotal evidence in lieu of broader applications. Without a theory, there was no lens to look at and understand why cost overruns were repeatedly occurring in projects.

Flyvbjerg *et al*.'s [7] statistical analysis of 258 capital projects from around the world was an important addition to our knowledge base, suggesting that "cost estimates used to decide whether such projects should be built" were "highly and systematically misleading" (p. 279). Furthermore, they concluded that "underestimation cannot be explained by error and is best explained by strategic misrepresentation," and under no circumstance should cost estimates be trusted, claiming that '9 out 10' projects incur cost overruns (p.279). This work brought attention to what we already knew or, at least, suspected occurred [37], [38], [62], but had not been able to empirically demonstrate. Moreover, Flyvbjerg *et al*. [63] went on to state that "cost estimates have not improved, and cost escalation not decreased over the last 70 years" (p. 71).

### *A The Planning Fallacy Theory*

Recognizing there was an absence of a theory to describe cost overrun causation, Flyvbjerg [66] drew on behavioral economic theories of decision-making under (reducible) uncertainty developed by Kahneman and Tversky [67], [68], Kahneman and Lovallo [69], and Lovallo and Kahneman [70] suggesting psychological (i.e., optimism bias) and political (i.e., strategic misrepresentation) explanations better account for inaccurate cost estimates.

As previously mentioned, bias had been previously identified as problematic, but little was known about its nature or how it manifested in cost estimates, as it had received limited attention. To this end, optimism bias is a "cognitive predisposition where people (estimators) judge the future in a more positive light than warranted by actual experience" [66: p.6]. Thus, estimators will "underestimate costs, completions, and risks of planned actions" and, at the same time, "overestimate the benefits of the same actions" [66: p.7]. This behavior is called the "Planning Fallacy" [70: p. 58]. Here, people (i.e., estimators) take an 'insider view' by focusing on specific anticipated or planned actions rather than adopting an 'outside view' based on outcomes of similar and past actions. Both overoptimism (unintentional bias) and strategic misrepresentation (intentional bias) form part of the Planning Fallacy (Ika *et al.,* 2020), which has been heralded by Flyvbjerg's [66] and Flyvbjerg *et al.*'s [71] as the 'best' underlying theory to explain 'how projects work'.

To counteract the bias found in adopting an 'inside view' during decision-making, Kahneman and Tversky [68] and Kahneman [72] proposed the use of Reference Class Forecasting (RCF) to predict the outcome of a planned action based on actual outcomes in a reference class of similar actions to that being forecasted. So, to combat the potential of optimism bias and strategic misrepresentation, Flyvbjerg and COWI [73] applied RCF to a sample of transport projects to establish a series of uplifts for their selected reference class, which they argue should then be added to a cost estimate to improve its accuracy. The Planning Fallacy theory has been widely accepted by policymakers worldwide as it provides an understandable and plausible explanation as to why projects exceed their budgets. Furthermore, RCF is being used by public sector agencies in countries such as Ireland and the UK to de-bias the estimates of their capital projects.

### *B. An Alternative, But Overlooked Theory*

An alternative theory to the Planning Fallacy (also referred to as the *Malevolent Hiding Hand* [74]), which has been generally overlooked in the project management literature, is the (*Benevolent*) *Hiding Hand principle* propagated by Hirschman [75], [76]. It "describes the systematic discrepancy between what proponents propose when seeking permission for projects and what processes actually lead to certain outcomes" [77: p. 979]. The observations of Hirschman [75] suggest that managers and decision-makers are "tricked" into undertaking large-scale projects, as they underestimate their capacity to apply creative solutions when dealing with the difficulties that may arise during the process of construction (p.13). According to Hirschman [76], "the only way in which we can bring our creative resources fully into play is by misjudging the nature of the task, by presenting it to ourselves as more routine, simple, undemanding of genuine creativity than it will turn out to be" (p.13). In this instance, the errors associated with underestimating difficulties are "roughly" offset by misjudging our ability to overcome them [76: p.13]. The 'rough' offsetting process can result in managers and decision-makers underestimating the difficulties, costs, and risks, and overestimating the benefits and odds of success of capital projects [78]. Hence, the Hiding Hand arises from "offsetting underestimations of knowledge and complexity" [79: p. 8].

Flyvbjerg [80], unconvinced that the Hiding Hand could serve as a competing explanatory theory to the Planning Fallacy, warned that accepting this explanation and its subsequent implications was "wrong", "biased", and potentially "disastrous" (p.176). Interestingly, Flyvbjerg's [80] assertions did not go unnoticed. They were criticized for: (1) presenting a strawman argument to statistically support the Planning Fallacy by dismissing the 'difficulties' and 'problem-solving abilities' from the Hiding Hand's statistical hypothesis and failing to consider full-lifecycle costs and benefits [78]; (2) being careless of and ignoring primary data sources, considering projects as free-standing and discrete and showing no linkage between costs and benefits [81]; and (3) dangerously assessing the value of qualitative scholarship (and thus doing injustice to verbal argumentation) through the lens of large sample quantitative datasets without acknowledging the obvious limitations of such a statistical approach [82]. Ultimately, the ongoing debate regarding the Hiding Hand has led to it being considered a competing, or even complementary, explanation to the Planning Fallacy [78], [79], [83], [84].

### *C. Stagnation: Generally, the Same Results, but a Different Era*

Even though considerable support exists for the Planning Fallacy theory explanation [85-87], it is not without methodological and theoretical limitations, which we will address in the next section of this article. We hasten to note that the construction engineering and management and project management literature, bar the work of a few authors such as Ika *et al*. [79], Liu and Napier [88], Jennings [89], and Lind and Brunes [90], has been unable to provide original and adequate explanations of cost overruns beyond the studies published before 2002 – an explanatory theory has not been forthcoming. Needless to say, we repeatedly see the same causes being identified and a tendency to focus on explaining the failings of a project's internal management and operations [91-93]. Clearly, cost overruns remain an ever-present reality!

It is, fortunately, not all doom and gloom, as cost estimation accuracy may not be as bad as was initially claimed by Flyvbjerg *et al*. [7] since Love *et al*.'s [5], [15] analysis of 132 large-scale projects revealed that approximately '5 out of 10' experienced cost overruns. Similarly, Ika and Feeny's [9] analysis of 2800 world bank projects found that '6 out of 10' projects incurred a cost overrun. Though a relative improvement over the original suggestions, these numbers still reflect a continuing problem with both cost estimation techniques and runaway project budgets. While it has been widely claimed that technological innovations such as

Building Information Modeling (BIM) would minimize cost overruns, there is no evidence to support this case. In fact, Love and Ika [84] and Love *et al*. [94] show that cost overruns do not vary between non-BIM and BIM-enabled projects. Further, with the increasing use of Alliances and Two-Stage Management Contracting, we have seen projects procured using these delivery methods less susceptible to cost overruns [51], [84]. Indeed, a collaborative team that jointly prepares the target outturn cost estimate and works collectively to meet it often helps improve a project's cost performance.

### *D. Does the Planning Fallacy Explanation Stack Up?*

While the work of Flyvbjerg *et al*. [7] has been identified as seminal [85], several authors have raised concerns about the reliability and validity of the work and the use of RCF [2], [78], [79], [88], [95], [96]. Hence, the truth claims and causal mechanisms underpinning the Planning Fallacy explanation for cost overruns, though compelling, are still an open question. Given the weight of the original study, it is worth considering some validity issues in Flyvbjerg *et al.* [7], [63]. We can briefly summarize the criticism of the research underlying the Planning Fallacy and how RCF is being used to de-bias cost estimates:

- *Quality of the data*: The sample in Flyvbjerg *et al*. [7] comprised 258 projects constructed between 1910 and 1998 from 20 countries and five continents. The data comprised primary and secondary data. Primary data was only collected for 37 projects, and the remaining 221 were derived from data collected by other researchers in varying formats from different countries [7], [63]. Notably, in an additional study by Flyvbjerg [80], the same dataset was used and incorporated into a sample of 2,062 projects from 104 countries on six continents collated between 1927 and 2013. Yet, no international standard format describes the detail required for an estimate when the decision-to-build is taken. The extreme heterogeneity of the data renders the findings unreliable.

- *Differences in time*: Eighty-eight years, for example, is a long time in technological and economic terms. Between 1910 and 1998, we saw significant technological developments and the increasing use of automation (e.g., plant and equipment) in construction. No consideration was given to the different technologies and construction methods used; all projects were treated equally. Additionally, the procurement method was not identified and considered. Undoubtedly, different procurement methods were used and influenced by the availability of funding to finance a project.
- *Evidence of causal claims*: Optimism bias and strategic misrepresentation have *not* been found to empirically exist in the empirical studies conducted by Flyvbjerg *et al*. [7], [63], and Flyvbjerg [80]. No evidence that optimism bias was contained in a cost estimate has been presented – it has only been *assumed* to exist. In other words, while clear evidence of 'effect' was uncovered (significant project cost overruns), the explanation of 'cause' stands on shakier ground, as the Planning Fallacy is supposed to be the culprit. Even if optimism bias was present in a cost estimate, demonstrating that it caused a cost overrun would be almost impossible, considering the complex outturns that unfold during the delivery of capital projects. Similarly, this explanation applies to strategic misrepresentation;
- *Assessment of risk, but not uncertainty:* With optimism bias and strategic misrepresentation assumed to markedly manifest without ample empirical demonstration, the uplifts to de-bias cost estimates produced from RCF serve only one purpose: to pad a cost estimate and its contingency, though without much justification. Uplifts are derived from probability distributions and can only cater to risk ('known unknowns') as these probabilities can be assessed in advance of the less complex

projects. However, they cannot accommodate the (irreducible) uncertainty (‘unknown unknowns’) inherent in the more complex, large-scale, or transformational projects where these probabilities are by essence unknown. Clearly, factors such as scope changes, complexity, and uncertainty play a big role in the incidence and magnitude of cost overruns.

As there is limited empirical evidence to demonstrate that the Planning Fallacy causes cost overruns, we suggest that it leaves too many unanswered questions as an explanation of project behavior. This is not to say the Planning Fallacy should be discounted; quite the contrary. But we need to understand how optimism bias within a professional team environment can influence cost underestimation if it does exist. Equally, we know strategic misrepresentation can occur, as evident from what transpired with High-Speed (HS) 2 in the UK. Here, an inquiry concluded that HS2 Ltd and the Department for Transport deliberately lied, as they knew HS2 could not be delivered on time, on budget, and within scope, and, in doing so, withheld information that would have informed parliament and the public about the true nature of the project [97]. But anecdotal evidence is not full-blown empirical evidence! Assuming strategic misrepresentation occurs in all capital projects is unreasonable, considering the checks and balances and governance that many public sector agencies have in place. It would be foolhardy to ignore the Planning Fallacy – even though questions surround its truth claims and causal mechanisms – as it provides a degree of plausibility to a cost overrun explanation.

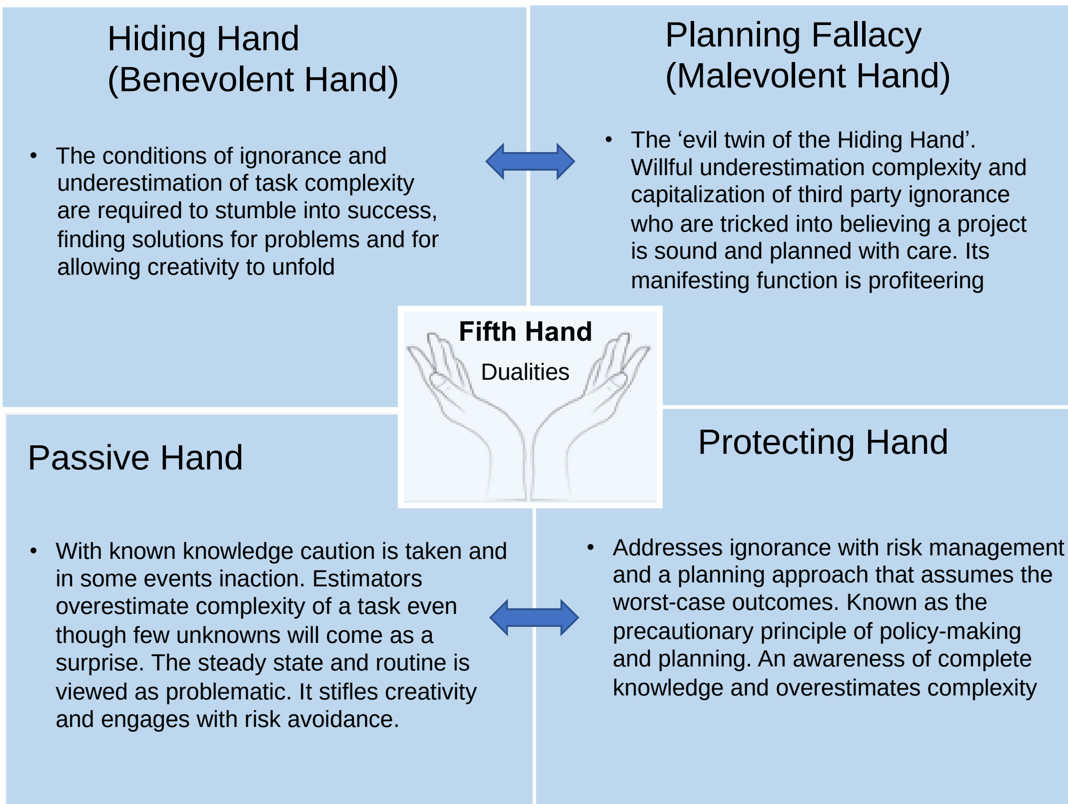
## V. WHERE TO NEXT? THE OPTIMISTIC FUTURE

Two theoretical principles, the Planning Fallacy and the Hiding Hand have been identified to explain cost performance within the framing of ‘project behavior’. Neither one nor the other can capture the varied complexities that unfold in projects and adequately explain why they perform the way they do. A theoretical deadlock currently exists between these two principles, though the Planning Fallacy is more discussed in the field of project management [78], [79], [83]. Regardless of the Planning Fallacy's popularity and the perception that it is the 'best' explanation of project behavior, the Hiding Hand also plays an important role [83]. Accordingly, Ika *et al*. [79] have proposed a theoretical polyphony that captures the elements of these and other principles of project behavior, which they refer to as the *Fifth Hand*.

The Fifth Hand aims to provide a balanced explanation for a project's cost performance and reconcile the Hiding Hand and Planning Fallacy. It considers two other principles that have yet to be examined within the context of capital projects: (1) *Protective Hand* (i.e., where ignorance is addressed through risk management and worst-case scenario planning); and (2) *Passive Hand* (i.e., where creativity is stifled and risks avoided) [77], [79].

In Figure 1, we present a conceptualization of the proposed Fifth Hand, comprising the various hands that can explain 'why' deviations in a project's cost performance manifest. We suggest that it would be inappropriate to assume that either bias (the dominant explanation since 2002) or error (the dominant explanation between 1960 and 2002) is the sole root cause of cost overruns. Both are equally at play, but we have yet to garner an understanding of how they interact to produce inaccurate cost estimates.

We do not view the behavioral hands in Figure 1 as dialectical poles. Instead, they take on different roles that can help shape their duality and provide a richer and more in-depth explanation of a project's cost deviations and how best to mitigate them. Moreover, the Fifth Hand offers a framing to understand, in hindsight, 'what went right' and 'what went wrong' during a capital project's delivery to stimulate learning from 'best practice'. The upshot is that we can learn under what conditions 'projects work or not' and how and when statistical analysis or rules of thumb (heuristics) can ensure risk and uncertainty are both adequately considered and incorporated into a cost estimate. For example, the Fifth Hand reconciles the Hiding Hand (cost and benefit overruns) and the Planning Fallacy (cost overruns and benefit underruns) by accommodating the shades of grey between overoptimism and over-pessimism but also benefit overruns and underruns. Thus, connections between people's experiences and views and analytical distinctions of usually compartmentalized concepts can be combined, allowing meaningful insights into the nature of project performance to be unearthed [79], [98].




Adapted from Anheier [77: p.9]

Figure 1. A conceptualization of the Fifth Hand: The dualities of project behavior

The Fifth Hand is a new conceptualization that aims to explain and provide meaning to project behavior including the cost overrun problem in capital projects, placing it in the larger context of benefit and value creation and delivery. It is yet to be tested and validated, but we are optimistic that it will enrich our understanding of project behavior. Even though governments have applied RCF to mitigate optimism bias and strategic misrepresentation, cost overruns still occur. A case in point is the Edinburgh Trams project (UK). Overall, the Planning Fallacy offers a useful but limited perspective that requires still deeper analysis on the causes of project overruns. With a new theory being proposed, we can be optimistic about what the future holds for project behavior research and practice.

## VI CONCLUSION

Our article has briefly examined how cost overrun research has evolved over the last six decades. Admittedly, we have only scratched the surface of this vast and complex subject area. However, cost overruns have been and continue to be a problem for policymakers and practitioners worldwide.

Studies examining the nature of the cost overrun problem before 2002 abound in the literature. The studies were project-centric, focusing on error as the overarching explanation for project drift including: (1) why and how scope and design changes occur; (2) the effectiveness of the procurement method; (4) the role and functioning of project management and teams; and (5) to some extent, the economic, institutional and political environment. Even though bias in cost estimates and strategic misrepresentation were identified as problems contributing to cost overruns, they received little attention. More notably, there was an absence of a theory to guide and give meaning to the cost overrun problem. This absence of a theory stymied progress toward mitigating capital project cost overruns.

Recognizing that a theory was absent, Flyvbjerg *et al*. [7], [63] opportunistically drew on Kahneman and Tversky's [67], [68] Planning Fallacy, repositioning it as an all-encompassing cost overrun explanation. The Planning Fallacy was well-received by policymakers and academics as it was alluring and simple to understand. However, its narrow scope and lack of consideration of a project's context and conditions within which they are delivered, not to mention the "black box" of project management processes [78], has resulted in it failing to live up to expectations as a contemporary theory of cost overrun causation.

A robust debate has ensued about the legitimacy of the Planning Fallacy explanation, especially in relation to its opposing number, which has remained mainly behind closed doors in project management, the Hiding Hand principle [2], [71], [74], [78], [80], [83]. The Fifth Hand emerges from this debate and potentially provides a broader and balanced view of the cost performance problem. While it has yet to be empirically tested and validated, we are optimistic that it will provide a coherent and meaningful theory of project behavior, which can help tackle the cost overrun problem in the future.

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