BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg

Risk Identification and Management in Investment Projects: Evidence from Real-World Projects

GULNOZA TOLLIYEVNA KARAJANOVA
Samarkand Institute of Economics and Service
Senior Lecturer, Department of Investments and Innovations
Bababekova Nargiza Utkurovna
Student of the INV-223 group
doi:https://doi.org/10.5281/zenodo.23179706

Abstract: Investment projects routinely miss their planned cost, schedule and benefit targets, yet risk identification—the first and most consequential stage of risk management—remains weakly grounded in empirical evidence. This study examines how risks materialise in real-world investment projects and which failures of risk identification best explain the observed outcomes. Using a structured secondary-data analysis, we synthesise ex post evidence from six empirical studies: a database of more than 16,000 completed projects, three sector datasets (transport, dams, electricity infrastructure) and a survey of 701 project managers. Outcomes are compared by prevalence, magnitude, dispersion and, where reported, schedule and benefit indicators; coefficients of variation and mean-to-median ratios are derived from published statistics. The results show that overruns are the norm (three-quarters to nine-tenths of projects in the sector datasets exceed their cost estimates; only 8.5% of projects meet both cost and schedule targets), that outcome distributions are strongly right-skewed (mean cost overrun of 96% against a median of 27% for large dams), that forecasting accuracy has not improved over time, and that even moderate risk-management planning weakens the negative effect of risk on project success. We propose a three-layer risk identification gap framework (epistemic, behavioural and structural), derive testable propositions and formulate practical recommendations for investors and project sponsors. The findings are limited by reliance on published data dominated by large public and energy projects.

Keywords: project risk management; risk identification; investment projects; cost overrun; reference class forecasting; optimism bias; megaprojects

Introduction. Investment projects, from transport corridors and power plants to information systems and industrial facilities, commit large and largely irreversible capital under uncertainty. The empirical record of how such commitments turn out is sobering. The most comprehensive database assembled to date, covering more than 16,000 projects in over twenty fields and 136 countries, shows that only 8.5% of projects meet both their cost and time targets, and only 0.5% also deliver the promised benefits (Flyvbjerg & Gardner, 2023). Deviations of this kind are not confined to a few notorious cases; they are a systematic feature of how investment projects are planned, appraised and delivered (Flyvbjerg, 2014; Flyvbjerg et al., 2003).

International standards define risk as the effect of uncertainty on objectives (International Organization for Standardization [ISO], 2018). The PMBOK® Guide structures project risk

management into planning, identification, qualitative and quantitative analysis, response planning, response implementation and monitoring (Project Management Institute [PMI], 2017). Identification is the foundation of this sequence: a risk that has not been identified cannot be analysed, priced, allocated or mitigated, and any subsequent sophistication in quantification is applied to an incomplete picture. Contemporary practice also recognises that uncertainty can create opportunities as well as threats, and that the process should manage both (Hillson, 2002).

Three streams of literature address the problem, largely in isolation. The first is prescriptive and process-oriented, describing techniques and standards. The second consists of perception-based surveys that relate management practices to self-reported project success. The third, developed mainly in planning, transport and energy studies, analyses ex post outcomes of completed projects and documents large and persistent forecasting errors. To our knowledge, few studies systematically translate the outcome evidence of the third stream into implications for how risks should be identified at the investment decision stage, which is where risk identification has its greatest leverage.

The behavioural literature offers the main explanatory concepts. The planning fallacy describes the tendency to base forecasts on the best-case features of the specific project (the inside view) rather than on the distribution of outcomes of comparable projects (the outside view; Kahneman & Lovallo, 1993; Kahneman & Tversky, 1979). Optimism bias leads executives to overestimate benefits and underestimate costs (Lovallo & Kahneman, 2003), and a wider family of cognitive biases affects project decisions (Flyvbjerg, 2021). A competing explanation is strategic misrepresentation: when promoters compete for approval and funding, they have incentives to present optimistic estimates (Flyvbjerg et al., 2002). Both mechanisms operate at the identification stage, because they determine which risks are considered credible enough to be written into a risk register.

This article therefore pursues four research questions. RQ1: How frequent and how large are deviations from plan in real-world investment projects? RQ2: What is the shape of the outcome distribution, and what does it imply for contingency setting? RQ3: What do the observed patterns imply about failures at the risk identification stage? RQ4: Is there empirical evidence that risk management planning improves outcomes? The study contributes by (a) assembling verified ex post evidence from heterogeneous sectors in a single comparative frame, (b) deriving dispersion and skewness indicators from published statistics, and (c) proposing a three-layer risk identification gap framework that links empirical patterns to specific managerial countermeasures. Materials and **Methods.**

1. Research design.The study is a structured secondary-data analysis: a comparative synthesis of published empirical datasets on completed real-world projects. It is not a formal meta-analysis, and no primary data were collected. Because the underlying studies use different outcome metrics, baselines and sampling frames, and because their samples may partially overlap (the 16,000-project database extends the earlier transport dataset), effect sizes were not pooled statistically. The design is therefore descriptive and interpretive, with the aim of identifying regularities that are robust across independent sources.

2. Source selection. Sources were selected purposively against four criteria: (i) the study reports ex post outcomes of completed projects or, in one case, a multi-country survey linking risk management practice to project success; (ii) the sample is large (at least 200 observations) or multinational; (iii) the outcome is measured through explicit indicators such as cost overrun, schedule overrun, demand forecast error or success ratings; and (iv) the study is published in a peer-reviewed journal or, for the 2023 database, by an academic press on the basis of a documented research programme. Six sources met these criteria (Table 1). The source set is illustrative rather than exhaustive, and it is dominated by infrastructure and energy projects, where public data on outcomes are most available. Reported figures were taken from the original articles or from the authors' open working-paper versions.

3. Data extraction and analysis. For each source we extracted the sample size and coverage, the share of projects with overruns, mean and median deviations, standard deviations, and schedule and benefit indicators where reported. Cost overrun is defined in the primary studies as the difference between actual and estimated costs expressed as a percentage of the estimate; for the transport and dam datasets it is measured in constant prices from the decision-to-build baseline. Two indicators were derived by the author from published statistics: the coefficient of variation (CV = standard deviation ÷ mean) as a measure of relative dispersion, and the mean-to-median ratio as a simple indicator of right skewness. In addition, an illustrative calculation combined the reported mean cost and demand deviations for rail projects. Finally, the patterns were mapped qualitatively onto the stages of the risk management process (ISO, 2018; PMI, 2017) to identify where the process most plausibly fails. Only published data were used; no ethics approval was required.

Table 1. Empirical evidence used in the analysis

Source	Sample	Principal finding
Flyvbjerg et al. (2002)	258 transport projects, 20 countries, US$90 billion	Mean real cost overrun: rail 44.7%, fixed links 33.8%, roads 20.4%; all projects 27.6%; costs underestimated in 9 of 10 projects
Flyvbjerg et al. (2005)	Traffic forecasts: 25 rail, 183 road projects	Rail traffic on average 51.4% below forecast; 84% of rail forecasts wrong by more than ±20%; road mean error +9.5% (SD = 44.3)
Ansar et al. (2014)	245 large dams, 65 countries, 1934–2007	Mean cost overrun 96% (median 27%); three of four dams over budget; mean schedule overrun 44%; eight of ten late
Sovacool et al. (2014)	401 electricity projects, 57 countries, 1936–2014	Mean cost overrun 66.3%; 75.1% of projects over budget; nuclear mean about 117%
Flyvbjerg & Gardner (2023)	More than 16,000 projects, 20+ fields, 136 countries	Fewer than half on budget; 8.5% on budget and on time; 0.5% on budget, on time and with promised benefits

Source	Sample	Principal finding
Zwikael & Ahn (2011)	Survey of 701 project managers, 7 industries, 3 countries	Risk management moderates the risk–success relationship; even moderate risk-planning intensity reduces the negative effect of risk

Note. Compiled by the author from the cited studies. Overrun figures are as reported by the original authors.

Results

1. Overruns are the rule, not the exception. Across independent datasets, projects that come in at or below their cost estimate are the minority. In the transport sample, costs were underestimated in nine of ten projects, with average real overruns of 44.7% for rail, 33.8% for fixed links and 20.4% for roads (Flyvbjerg et al., 2002). Three of four large dams exceeded their budgets, and eight of ten were late, with the actual implementation schedule averaging 44% longer than planned (Ansar et al., 2014). In electricity infrastructure, 75.1% of 401 projects exceeded their estimates, at a mean escalation of 66.3% (Sovacool et al., 2014). The cross-sector database yields a similarly consistent picture: fewer than half of projects are on budget, 8.5% are on budget and on time, and 0.5% also deliver their benefits (Flyvbjerg & Gardner, 2023). The frequency of overruns is thus of the same order of magnitude, three-quarters or more, in every sector for which outcome data are available. This regularity answers RQ1: deviation from plan is the modal outcome.

2. Distributions are skewed and heavy-tailed. The magnitude of deviations varies widely, and the variation itself is informative. For dams, the mean cost overrun of 96% is roughly 3.6 times the median of 27%, a ratio that signals a strongly right-skewed distribution in which a minority of extreme projects dominates the average. Relative dispersion is also high in the transport data. Using the standard deviations reported by Flyvbjerg et al. (2002), the coefficient of variation is 0.86 for rail (SD = 38.4; mean = 44.7), 1.47 for roads (29.9; 20.4) and 1.85 for fixed links (62.4; 33.8); for the full sample of 258 projects it is 1.40 (38.7; 27.6). In each case the standard deviation exceeds or approaches the mean, so that a project-level estimate based on the average overrun would be a poor guide to the outcome of any single project. Fixed links, which are characterised by geotechnical and technological uncertainty, show the widest relative dispersion.

Two further patterns bear on risk identification. First, accuracy has not improved: cost forecast errors in transport show no improvement over the seventy years for which data exist (Flyvbjerg, 2006), and the dam data likewise show no decline in overruns over 1934–2007 (Ansar et al., 2014). Second, outcomes depend strongly on context. North American dams (n = 40) had a mean overrun of 11% compared with 104% for dams elsewhere, and longer planned implementation schedules were associated with higher cost overruns (Ansar et al., 2014). In nuclear power, the mean escalation of about 117% substantially exceeds that of hydroelectric projects (about 71%; Sovacool et al., 2014). These results address RQ2: the outcome distribution is skewed, dispersed and context-dependent, so that contingencies set on expected values will be systematically insufficient in the tail.

3. Cost and benefit risks compound. Risks on the cost side are frequently accompanied by risks on the benefit side. For rail projects, actual passenger traffic averaged 51.4% below forecast, and 84% of rail passenger forecasts were wrong by more than ±20% (Flyvbjerg et al., 2005; Flyvbjerg, 2006). For roads, the mean traffic error was small (+9.5%) but the dispersion was large (SD = 44.3), so that forecasts were accurate on average but unreliable for individual projects. If the mean deviations for rail are combined in a simple illustrative calculation (actual cost at about 1.45 times the estimate and actual traffic at about 0.49 times the forecast), cost per passenger would be roughly three times the level assumed at appraisal. The calculation ignores correlation between the two variables and is not an estimate for any specific project, but it shows how independently plausible deviations can jointly destroy the investment case.

4. Evidence on the effectiveness of risk management planning. Survey evidence from 701 project managers in seven industries and three countries (New Zealand, Israel and Japan) indicates that industry and country significantly affect both perceived risk levels and the intensity of risk management, that risk management moderates the relationship between risk level and project success, and that even moderate levels of risk management planning are sufficient to reduce the negative effect of risk on success (Zwikael & Ahn, 2011). This finding answers RQ4 positively, while indicating that the benefits do not require heavy formal apparatus. Its limitation is that success and risk are measured through respondents' perceptions rather than audited outcomes, so it complements rather than substitutes for the ex post datasets.

Discussion

1. Interpretation: a risk identification gap. Taken together, the results suggest that the dominant failure in investment projects is located at the identification and framing stage rather than in analytical technique. Four observations support this reading. The errors are one-directional rather than random, which is inconsistent with unbiased estimation noise. They have persisted for decades in spite of improvements in tools and data (Flyvbjerg, 2006). Their distribution has a heavy right tail that expected-value contingencies do not cover. And they differ strongly across institutional contexts, whereas project-level risk registers rarely record institutional and governance conditions. In other words, risks that materialise are often not absent from the sponsor's knowledge but absent from, or understated in, the formal appraisal. This interpretation is inferential: the datasets document outcomes, not the content of the risk registers that preceded them.

We therefore propose a three-layer risk identification gap framework. The epistemic layer comprises risks that are genuinely unknown at appraisal, such as ground conditions, technological novelty or regulatory change; the geological and technological variables in the dam and fixed-link data are typical examples. The behavioural layer comprises risks that are knowable but understated because of optimism bias, the planning fallacy or strategic misrepresentation (Flyvbjerg et al., 2002; Lovallo & Kahneman, 2003). The structural layer comprises properties of the project that amplify any risk: scale, long duration, bespoke design and tight coupling of components, which produce correlated deviations and fat tails (Ansar et al., 2014; Flyvbjerg & Gardner, 2023). The framework yields three testable propositions. P1: The share of overrun explained by epistemic factors falls as the maturity and standardisation of the technology increase. P2: The use of outside-view baselines

and independent review reduces the mean and dispersion of forecast error relative to inside-view appraisal. P3: Projects delivered in shorter, modular increments show thinner tails than comparable monolithic projects. These propositions can be tested on existing project databases and are the main contribution of the article to future research.

2. Practical recommendations. First, sponsors should replace or supplement inside-view estimates with reference class forecasting: identify a class of comparable completed projects, establish the distribution of their outcomes, and position the project within it (Flyvbjerg, 2006). The percentile of the distribution chosen for the budget should reflect the sponsor's risk tolerance and not the median outcome. Second, appraisal should include structured challenge, for example independent review of assumptions and a project premortem in which the team imagines that the project has failed and lists the reasons (Klein, 2007); this addresses the behavioural layer directly. Third, risk registers should record dependencies between risks and explicit tail scenarios, and risk governance should follow the integrated approach of ISO 31000, in which risk management is embedded in decision-making rather than performed as a compliance step (ISO, 2018). Fourth, commitment should be staged: funding gates tied to the resolution of key epistemic uncertainties allow sponsors to stop or redesign before the largest expenditures are made. Fifth, where possible, the design should be modular and the delivery period short, since long schedules and bespoke designs are associated with larger overruns and modular delivery with faster learning (Ansar et al., 2014; Flyvbjerg & Gardner, 2023). Sixth, opportunity management should be integrated into the same process so that the identification effort is not limited to threats (Hillson, 2002). Finally, organisations should systematically record ex post outcomes, since the reference class approach is only as good as the database behind it. The survey evidence suggests that these measures need not be elaborate to be effective (Zwikael & Ahn, 2011).

3. Limitations and directions for future research. Several limitations qualify the conclusions. The analysis relies on secondary data, and the sources are concentrated in large public infrastructure and energy projects; private-sector and small-scale investments may differ. Only completed projects are observed, so cancelled projects may be under-represented. Baselines differ across studies (decision to build versus later budget approval), currencies and price bases are treated differently, and partial sample overlap prevents pooling. Publication and selection effects cannot be excluded, and the survey evidence rests on perceptual measures. Finally, the risk identification gap framework is inferred from outcome patterns and has not been tested directly. Future research should combine project outcome data with the risk registers and appraisal documents created before the investment decision, test P1–P3 on private-sector portfolios, and examine how governance quality explains the large regional differences in overruns.

Conclusion. Evidence from thousands of completed projects shows that cost and schedule overruns and benefit shortfalls are the typical outcome of investment projects, that their distributions are skewed and heavy-tailed, and that they have not diminished over time. These patterns point to weaknesses in how risks are identified and framed at the investment decision stage, more than to weaknesses in analytical technique. The proposed three-layer framework separates epistemic, behavioural and structural sources of the gap and links each to specific countermeasures:

outside-view baselines and percentile-based contingencies, independent challenge and premortems, tail-aware and dependency-aware risk registers, staged commitment, and modular delivery. Even moderate risk management planning appears to protect project success, so the barrier to improvement is less the cost of the methods than the willingness of decision-makers to confront the historical record. For practice, the recommendations offer a concrete agenda for investors and project sponsors; for research, the propositions provide hypotheses that can be tested on project-level data.

References

1. Ansar, A., Flyvbjerg, B., Budzier, A., & Lunn, D. (2014). Should we build more large dams? The actual costs of hydropower megaproject development. Energy Policy, 69, 43–56. https://doi.org/10.1016/j.enpol.2013.10.069
2. Flyvbjerg, B. (2006). From Nobel Prize to project management: Getting risks right. Project Management Journal, 37(3), 5–15.
3. Flyvbjerg, B. (2014). What you should know about megaprojects and why: An overview. Project Management Journal, 45(2), 6–19.
4. Flyvbjerg, B. (2021). Top ten behavioral biases in project management: An overview. Project Management Journal, 52(6), 531–546.
5. Flyvbjerg, B., Bruzelius, N., & Rothengatter, W. (2003). Megaprojects and risk: An anatomy of ambition. Cambridge University Press.
6. Flyvbjerg, B., & Gardner, D. (2023). How big things get done: The surprising factors behind every successful project, from home renovations to space exploration. Currency.
7. Flyvbjerg, B., Holm, M. K. S., & Buhl, S. L. (2002). Underestimating costs in public works projects: Error or lie? Journal of the American Planning Association, 68(3), 279–295. https://doi.org/10.1080/01944360208976273
8. Flyvbjerg, B., Holm, M. K. S., & Buhl, S. L. (2005). How (in)accurate are demand forecasts in public works projects? The case of transportation. Journal of the American Planning Association, 71(2), 131–146.
9. Hillson, D. (2002). Extending the risk process to manage opportunities. International Journal of Project Management, 20(3), 235–240.
10. International Organization for Standardization. (2018). Risk management—Guidelines (ISO Standard No. 31000:2018).
11. Kahneman, D., & Lovallo, D. (1993). Timid choices and bold forecasts: A cognitive perspective on risk taking. Management Science, 39(1), 17–31.
12. Kahneman, D., & Tversky, A. (1979). Intuitive prediction: Biases and corrective procedures. TIMS Studies in Management Science, 12, 313–327.
13. Klein, G. (2007). Performing a project premortem. Harvard Business Review, 85(9), 18–19.
14. Lovallo, D., & Kahneman, D. (2003). Delusions of success: How optimism undermines executives' decisions. Harvard Business Review, 81(7), 56–63.

15. Project Management Institute. (2017). A guide to the project management body of knowledge (PMBOK® guide) (6th ed.).
16. Sovacool, B. K., Gilbert, A., & Nugent, D. (2014). An international comparative assessment of construction cost overruns for electricity infrastructure. Energy Research & Social Science, 3, 152–160.
17. Zwikael, O., & Ahn, M. (2011). The effectiveness of risk management: An analysis of project risk planning across industries and countries. Risk Analysis, 31(1), 25–37. https://doi.org/10.1111/j.1539-6924.2010.01470.x