



Better forecasting for large capital projects

Project proposals often overestimate benefits and underestimate costs. Here's why—and what you can do about it.

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Large capital investments that are completed on schedule and within their budgets are probably the exception rather than the rule—and even when completed many fail to meet expected revenues. Executives often blame project underperformance on foreseeable complexities and uncertainties having to do with the scope of and demand for the project, the technology or project location, or even stakeholder opposition. No doubt, all of these factors at one time or another contribute to cost overruns, benefit shortfalls, and delays.

But knowing that such factors are likely to crop up, why do project planners, on average, fail to forecast their effect on the costs of complex

projects? We've covered this territory before¹ but continue to see companies making strategic decisions based on inaccurate data. Deliberately or not, costs are systematically underestimated and benefits are overestimated during project preparation—because of delusions or honest mistakes on one hand and deceptions or strategic manipulation of information or processes on the other.²

As we'll explore, the former is often the result of underlying psychological biases and the latter of misplaced incentives and poor governance. Fortunately, corrective procedures to increase transparency and improve incentive systems can help ensure better forecasts.

Psychological biases can create cognitive delusion

Most of the underestimation of costs and overestimation of benefits of capital projects is the result of people taking what's called an "inside view" of their forecasts. That is, they use typical bottom-up decision-making techniques, bringing to bear all they know about a problem, with special attention to its unique details—focusing tightly on a case at hand, considering a project plan and the obstacles to its completion, constructing scenarios of future progress, and extrapolating current trends.³ An inside view can lead to two cognitive delusions.

The planning fallacy. Psychologists have defined the planning fallacy as the tendency of people to underestimate task-completion times and costs even when they know that the vast majority of similar tasks have run late or gone over budget. In its grip, managers make decisions based on delusional optimism rather than on a rational weighting of gains, losses, and probabilities—involverarily spinning scenarios of success and overlooking the potential for mistakes and miscalculations.

Executives and entrepreneurs seem to be highly susceptible to this bias. Indeed, studies that compare the actual outcomes of capital-investment projects, mergers and acquisitions, and market entries with managers' original expectations for those ventures show a strong tendency toward overoptimism.⁴ And an analysis of start-up ventures in a wide range of industries found that more than 80 percent failed to achieve their market-share target.⁵

Anchoring and adjustment. This heuristic rule of thumb is another consequence of inside-view thinking that leads to overoptimistic forecasts.

Anchoring, one of the most robust biases of judgment, occurs because the answer to a question is subconsciously affected by the first cost or budget numbers considered. In the context of planning for a large capital project, for example, there is always an initial plan that unavoidably becomes an anchor for later-stage estimates, which never sufficiently adjust to the reality of the project's performance. In fact, the typical initial estimate for the most complex and large capital investments is less than half the final cost—as managers further underestimate the cost of completing construction at every subsequent stage of the process—even though project champions almost always see their initial plan as the *best or most likely* case.⁶

Understanding that unforeseen costs may arise, executives do generally build a contingency fund into their plans proportional to the size of the project, but their adjustments are clearly and significantly inadequate when compared with actual cost overruns.⁷

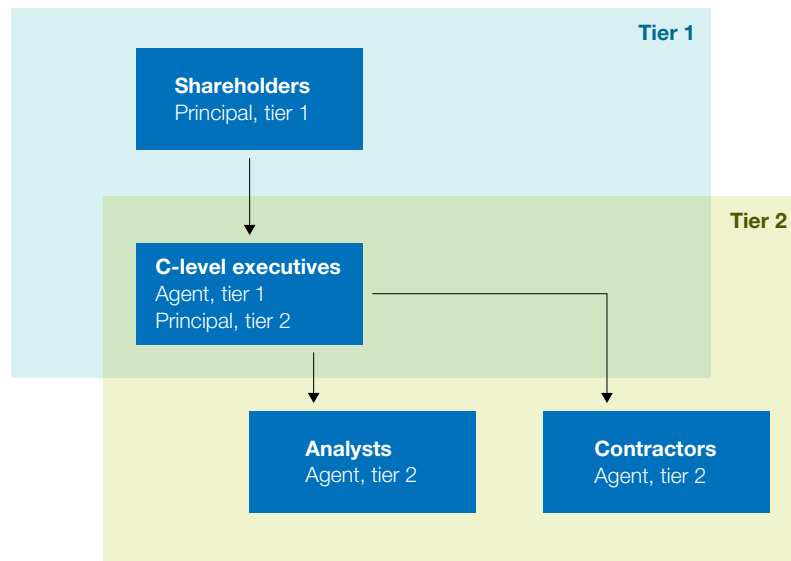
Misplaced incentives encourage strategic manipulation

Whereas delusion is psychological, deception and strategic manipulation—when they occur—come out of the diverging preferences and incentives of the actors in the system, otherwise known as the principal-agent problem. In this case, the problem arises when the biases of project champions are strong enough or their incentives misdirected enough that they act, deliberately and strategically, to bring about financial or political outcomes different from those preferred by the people they represent or work for.

We've seen little, if any, truly malicious manipulation, though it can arise, for example, out of interdepartmental political wrangling or personal

Exhibit

The typical capital-investment decision involves two tiers of principal and agent relationships.



animus. More commonly, individuals may become more loyal to their division, business unit, or direct superior than to the company as a whole. Whatever the deep-seated intent, the outcome is the same: project champions occasionally overestimate benefits and underestimate costs and risks to increase the chances that their projects will be approved and funded. This results in managers promoting ventures that are unlikely to come in on budget or on time, or to deliver the promised benefits.

The relationship between principal and agent—where one person engages another to act on his or her behalf—is of particular interest because it is the space between them that allows the possibility of diverging interests. Typical examples of such relationships include a board hiring a CEO to manage the company on behalf of the shareholders or a manager hiring an employee to carry out

tasks. Large capital-investment projects are situations where a multitier principal-agent problem exists. For example, consider a typical capital-investment project, such as building a new plant or a new plane. It involves two tiers of principal-agent relationships (exhibit).

The first tier of principal-agent relationships has the executives of the company acting as the agent of the shareholders. With respect to the shareholders, the company's executives have a duty to propose capital investments that provide the greatest long-term return. This includes truthfully disclosing the costs, benefits, and risks of the project in order to increase the likelihood of delivering the project on time and on budget. That is, since they are the ones holding the most complete data about the costs and benefits of the project, the company's executives should disclose to the board the most accurate

forecasts needed to make an informed decision. However, because a company's C-level executives earn their full reward when projects succeed but share responsibility for losses or underperformance, their incentives encourage understating a project's risks and costs while overstating its benefits. Executives are also aware that it wouldn't be unusual for them to be recruited to other companies after a landmark project is approved but before it's completed—long before benefits or losses become clear. That, too, lends weight to disclosing and emphasizing the positives but playing down or hiding the negatives.

The second tier of principal-agent relationships involves the company as the principal of agents hired to provide specific services, such as analysts and contractors. Analysts are engaged to gather the information necessary for C-level executives to make the final go-no-go decision. They have an incentive to provide information that pleases the C-suite and contributes to the approval of the project. They are not paid and rewarded to tell the CEO that his or her idea is not going to work. Similarly, contractors are interested in winning a contract by offering the lowest possible price, since they know that recontracting is often possible and, unless the contract is a fixed-price, lump-sum contract, delays will be tolerated. Even if interests are divergent in this case, delays and

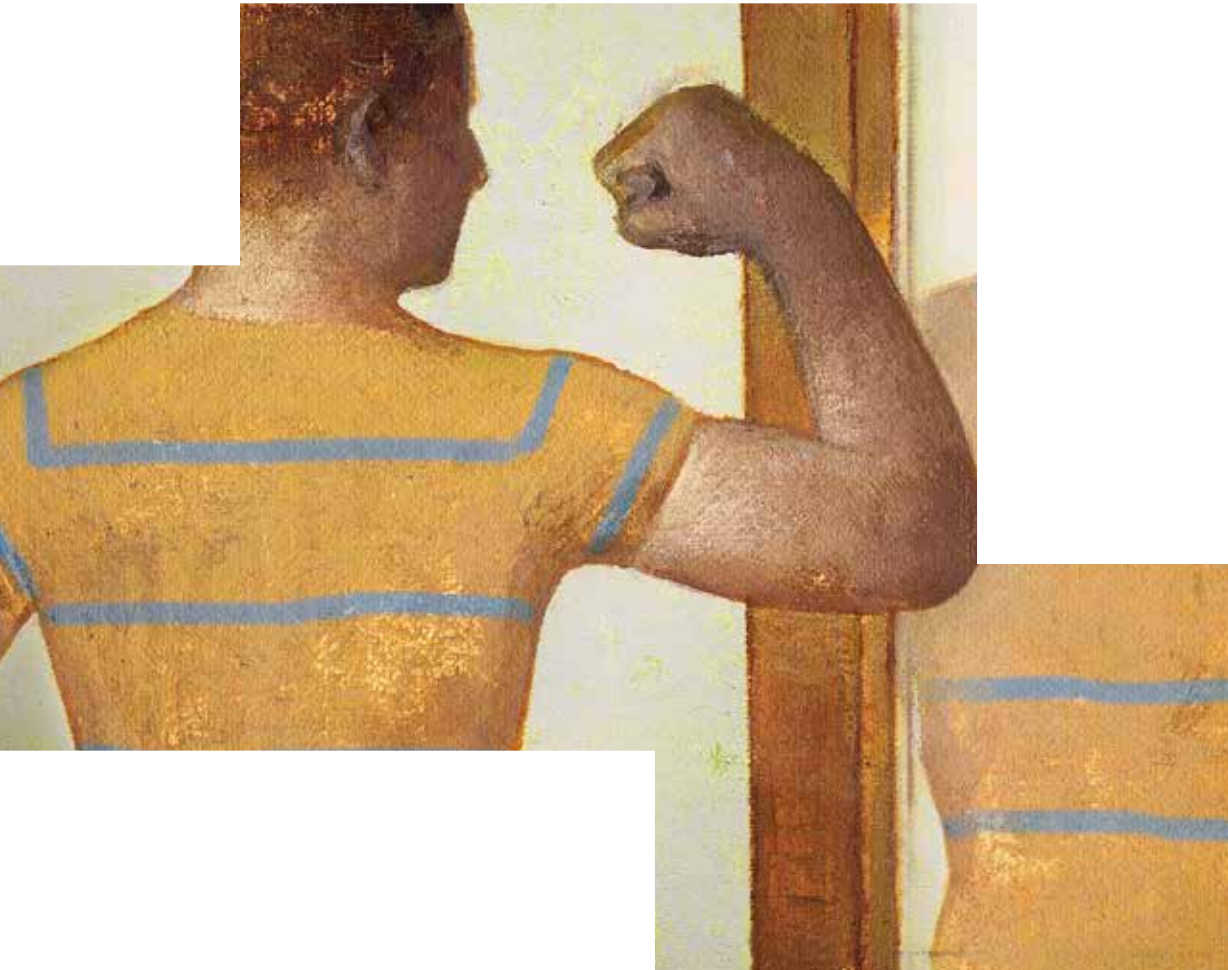
cost overruns might be tolerated unless the hiring company is held responsible.

There are also certain conditions that make strategic deception more likely within each principal-agent relationship. Self-interest, asymmetric information, differences in risk preferences and time horizons, as well as the clarity of accountability are among the most cited causes. A necessary condition for principal-agent conflicts is a difference in the actors' self-interest. When large, often multimillion- and sometimes even multibillion-dollar projects go forward, many stakeholders—including accountants, architects, bankers, construction workers, contractors, developers, engineers, landowners, and lawyers—have widely divergent incentives. In addition, executives may use large capital projects to jockey for position and control larger budgets. If these stakeholders are involved in or indirectly influence the forecasting of costs and benefits in the business case at the approval stage, they are liable to bias the entire subsequent process.

Transparency and incentives reduce delusion and deception

Delusion and deception are complementary rather than alternative explanations of why large infrastructure projects fail due to cost

When delusion and deception are intertwined, project champions can only counteract their inside view with an outside one.



underestimation and benefit overestimation. In practice, it is often difficult to disentangle them—though both can be surmounted with a combination of learning to overcome biases and providing incentives to promote transparency. Together, learning and incentives suggest a number of steps that project champions and executives can take.

Decision makers. Executives in this role must acknowledge that analysts and project champions are often overly optimistic. They should compute an adjustment on the basis of actual cost overruns

in a reference class of completed projects comparable to the project seeking funding.

They shouldn't rely entirely on their own insight to weigh the influence of delusion and deception, but they should also require project champions to construct a comprehensive list of all the risks likely to affect the delivery and operation of the proposed capital investment. Such lists should include construction risks, including timescale and cost perspectives; operational risks, such as maintenance risk and revenue risk; and a share of risks associated with potential climate

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and weather events. The list should also clearly identify who owns each risk—the company, its subsidiaries, or its contractors, for example—and whether they are transferable through insurance or financial instruments.

When delusion and deception are intertwined, project champions can only counteract their inside view with an outside one—that is, with the perspective that comes with multiple analogous cases, for example, through forecasting methods known as reference-class or similarity-based forecasting. Such approaches essentially ignore the details of a case at hand and do not attempt any detailed forecasting of the case's future. Instead, they focus on the performance of a reference class of cases chosen because they are similar to the one proposed.

For example, similarity could be determined by project type, governance structure, complexity, and so forth. Managers would then also assess a proposed investment to estimate its position in the distribution of outcomes for the class. Taking an outside view, executives and forecasters are not required to create scenarios, imagine events, or gauge their own and others' levels of ability and control, so they do not risk incorrectly estimating these factors. When both the inside and outside view of forecasting are applied with equal skill, the outside view is much more likely to produce a realistic estimate.

One motion-picture company, for example, used a reference-class forecast of movie-project success weighted by similarity, based on the judgment of moviegoers, to decide which movies it would promote. That process improved forecasts by more than 135 percent relative to single-project analogies—and since all the information needed is available to executives before they spend money on production or marketing, they can improve profits by focusing investment on the movies most likely to be successful.

Senior executives and boards of directors.

Companies should offer incentives that decrease the likelihood of strategic misrepresentation of costs, time frame, and benefits by increasing transparency and encouraging project champions to provide more accurate forecasts. For example, they can offer both financial and nonfinancial rewards for planners whose estimates prove to have been accurate, subject forecasts to detailed assessment and criticism, and even levy penalties for seriously misleading forecasts. Penalties for contractors can include a financial obligation to pay for overruns or delays—or dismissal, for internal executives making particularly egregious forecasting errors.

To ensure responsibility, companies should also place the financial risk of delay and cost overruns with the contractors who bid on portions of the project. This mitigates the likelihood of the

winning bidder turning out to be the one who most underestimates the true costs, with the expectation that the initial low price will be compensated for through overpricing as the scope increases. When compensation is not possible, there is less chance that the bidding price is artificially low. If bidders instead bear financial penalties for cost overruns or for being late, then they have incentive to disclose information that they wouldn't otherwise have shared. In our experience, even these minimal incentives are often not in place.



Psychological biases and misplaced incentives often lead to inaccurate forecasts of project costs and completion time. Managers who are aware of the problem can help address it by using outside-view forecasts and structuring incentives in a way that keeps everyone focused on company-wide goals. ○

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- ² Daniel Kahneman and Dan Lovallo, “Delusions of success: How optimism undermines executives’ decisions,” *Harvard Business Review*, July 2003, Volume 81, Number 7, pp. 56–63, hbr.org.
- ³ Daniel Kahneman and Amos Tversky, “Intuitive predictions: Biases and corrective procedures,” in *Forecasting: TIMS Studies in Management Science*, ed. Spyros Makridakis and Steven C. Wheelwright, pp. 313–27, Catonsville, MD: Institute of Management Sciences, 1982; Daniel Kahneman and Dan Lovallo, “Timid choices and bold forecasts: A cognitive perspective on risk taking,” *Management Science*, 1993, Volume 39, Number 1, pp. 17–31; Kahneman and Lovallo, “Delusions of success.”
- ⁴ Ulrike Malmendier and Geoffrey Tate, “Who makes acquisitions? CEO overconfidence and the market’s reaction,” *Journal of Financial Economics*, 2008, Volume 89, Number 1, pp. 20–43.
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- ⁶ Edward M. Merrow, Christopher W. Meyers, and Kenneth E. Phillips, *Understanding Cost Growth and Performance Shortfalls in Pioneer Process Plants*, RAND Corporation, 1981, rand.org.
- ⁷ Nils Bruzelius, Bent Flyvbjerg, and Werner Rothengatter, *Megaprojects and Risk: An Anatomy of Ambition*, New York, NY: Cambridge University Press, 2003.