Senate Transportation and Housing Committee

Informational Hearing

How to Save the State Billions: Improving Megaproject Outcomes

Wednesday, November 13, 2013
10:00 a.m. – John L. Burton Hearing Room (4203)

BACKGROUND PAPER

Introduction

On November 13th this committee will consider megaproject development and how the state could improve how it selects, develops, and delivers these costly projects. While this hearing is the first in a series of informational hearings examining the development and construction of the eastern span of the San Francisco-Oakland Bay Bridge, this hearing is focused more broadly as a discussion of megaprojects in general. The hearing participants come from varied backgrounds and are experts in the field of megaproject development.

Improving the state's performance in delivery of megaprojects is a critical and timely topic. Many of the state's challenges today require grand, visionary, expansive solutions. While megaproject development is often first associated with transportation, this topic truly touches nearly every realm of public infrastructure – from energy to education facilities, water to walls protecting us from rising sea levels, prisons to park systems. As essential projects grow in size and complexity, so does the challenge for the state to properly select and deliver these projects in a responsible, honest manner. Due to the sheer size of these projects, taking steps such as setting up governance and management structures in ways that control risk and avoid escalating costs and extended timelines can save the state billions of dollars.

This background paper provides some context by summarizing some of the recent thinking on the subject and suggests some potential solutions for the committee to consider.

Background

What is a megaproject?

For the purposes of this hearing, a megaproject is a large, complex, public infrastructure project with costs exceeding $1 billion and substantial impacts to communities, budgets, and the environment. Besides the high cost and complexity, megaprojects share other characteristics, such as:

- **Long Duration** – Sometimes spanning decades, the length of time necessary for the development and construction of a megaproject creates more ambiguity, uncertainty, and risk than most projects experience.
- **Design and Construction Complexity** – By their very nature, megaprojects embrace complex design decisions and construction methods, contributing to the difficulty of successful delivery.
- **High Public Profile** – People pay closer attention to megaprojects, and keeping the public informed as the project development progresses is critical.
- **Multiple Stakeholders** – Because the megaproject is almost always embedded in a complex network of public and private interests, the developer must strive to maintain the support of multiple and diverse stakeholders over a long period of time.
- **Project Delivery and Procurement** – Complex projects such as megaprojects often require innovation in contracting and procurement to properly allocate risk between the involved parties.

Case Study: The Bay Bridge

On Labor Day 2013, the new eastern span of the San Francisco-Oakland Bay Bridge (East Span) opened to traffic. California built this structure to replace the span it originally

constructed in 1936, which the 1989 Loma Prieta earthquake damaged and made it unlikely to withstand another major seismic event. The California Department of Transportation (Caltrans) initially proposed completing construction of the new East Span by 2003 at an estimated cost of $1.3 billion. By the time it opened nearly a decade late, the actual cost exceeded $6.4 billion.

Some have described the East Span as an "engineering marvel." It has an expected 150-year service life (double that of standard bridges), is designed to withstand the largest seismic event expected in the San Francisco Bay Area over 1,500 years, and includes numerous other engineering innovations. Moreover, its signature feature, the asymmetrical self-anchored suspension span, gives the bridge a unique and distinctive appearance. Nevertheless, it is difficult to characterize the project as a success not only in light of the significant cost increases but also in light of the increased risk to public safety caused by delays that forced motorists to travel on the seismically deficient 1936 span for years longer than initially expected.

Many factors drove the delays and cost growth that plagued the East Span project throughout its history. These included political disagreements, complex environmental challenges, and compounding economic factors such as increased bonding costs following the tragedy of September 11, 2001, and increased international demand for construction materials. Unfortunately, the East Span replacement project is far from unique among megaprojects with respect to cost escalation and delay. Other high-profile megaprojects, including the Central Artery/Tunnel Project or "Big Dig" in Boston, the Øresund Bridge tunnel connecting Denmark and Sweden, and the Channel Tunnel linking the United Kingdom to France via high-speed rail, all experienced a similar pattern of cost growth and delay.

This phenomenon of exorbitant costs and long delays has serious public policy implications, primarily:

- Lack of reliable initial cost analyses and projections hampers policymakers' efforts to make responsible decisions between various project alternatives or whether to move forward with the project at all.

- Failure to deliver on expectations (in terms of cost and schedule) generally undermines public confidence in government and encourages cynicism, thus making it substantially more difficult to pursue future investments.

- Severe cost overruns adversely impact other infrastructure needs as resources must be shifted to backfill shortfalls in the megaproject budget.

Today, California stands at a critical juncture. The state is on the precipice of beginning construction of another megaproject, the high-speed rail project, which will dwarf the East Span in both cost and scope. The state is contemplating other huge infrastructure projects in transportation, water, and energy. The purpose of today's hearing is to examine the factors that seem to undermine success with regard to megaprojects and, more importantly, to explore what steps the state can take, from a legislative, administrative, and project development perspective, in order to improve the likelihood of success in the future.

Discussion on Megaproject Development "Success"

How Do We Measure Success?

Traditionally, people judge the success of an infrastructure project, whether of mega-proportion or not, in terms of its completion on time and within budget. In the case of megaprojects, limiting cost growth is particularly critical because the project's sheer size compounds the risk of such escalation. For example, a 10 percent cost overrun for a typical $200 million project ($200 million) may be recovered through cost savings from other projects. The same relatively reasonable 10 percent cost overrun for a $2 billion megaproject could mean that another $200 million project must be delayed or canceled. Nevertheless, as discussed below, research suggests that judging megaproject success solely on the basis of cost and schedule may be inadequate. Among the questions that this committee may wish to explore in this hearing is whether or not judging success with respect to megaprojects requires a broader analysis that considers additional metrics, and, if so, what such an evaluation might look like.

The Phenomenon of Cost Growth

Among the first to document a systemic pattern of extreme cost growth and schedule delay on megaprojects was Danish economist Bent Flyvbjerg. In his seminal work, *Megaprojects and Risk (2003)*, Flyvbjerg asserts that large-scale delays and cost overruns are more the norm than the exception on megaprojects. He references multiple studies, the largest of which examined 258 projects in 20 different countries, which together document cost overruns on 90 percent of these large projects. Cost growth averaged 20 percent for road projects, 34 percent for bridge/tunnel projects, and 45 percent for rail projects. He observed, however, that overruns of 80 percent were not uncommon.[1]

Flyvbjerg cites a lack of realism in initial cost estimates as the primary driver of cost overruns on megaprojects. He asserts that initial cost estimates for megaprojects routinely underestimate, downplay, or otherwise fail to account for the level of risk associated with a megaproject, including political, economic, environmental, and geological uncertainties. Failure to adequately account for such risks up front – or in some cases to acknowledge them at all – inevitably leads to costly delays and expensive mitigation or design changes later in the project. Flyvbjerg attributes these failures largely to a phenomenon he calls "appraisal optimism," the idea that project developers typically base projections on a best case scenario even though such an outcome is rarely realistic, especially on large, complex endeavors. Moreover, he suggests that such unfounded optimism is frequently intentional - elsewhere he calls it strategic misrepresentation[2] - on the part of those with a vested interest in seeing that the project moves forward, whether for self-interested or more altruistic motives. [3]

Flyvbjerg argues that the antidote to strategic misrepresentation is comprehensive and rigorous risk-analysis, done during the initial planning phase as part of the project feasibility study. Moreover, rather than using a best-case scenario, risk analysis needs to follow the MLD-

[1] Flyvbjerg, Bent, Megaprojects and Risk: An Anatomy of Ambition, Cambridge University Press, New York 2003, p. 15-16.

[2] Bent Flyvbjerg, Mette Skamris Holm, and Søren Buhl, "Underestimating Costs in Public Works Projects: Error or Lie?" *Journal of the American Planning Association*, vol. 68, no. 3, Summer 2002, pp. 279-295.

[3] Megaprojects and Risk. p. 73, 137.

principle (most likely development) and also include worst-case scenarios. This information must be fully disclosed to public and private investors, political leaders, and the general public. He notes that feasibility studies and risk analyses for future, related, projects (or stages of a project) should be conducted together because costs and risks of one can impact the others.[4]

While academics and development professionals frequently reference Flyvbjerg's research on megaprojects, his conclusions are not without critics. Indeed, a recent analysis of 30 megaprojects by the Omega Centre at the Bartlett School of Planning in London found significantly less pronounced average cost growth and schedule delay than Flyvbjerg's research suggests.[5] Even more noteworthy, the Omega study concluded that the presence of cost growth and schedule delay, even when significant, doesn't automatically constitute project failure. This conclusion may seem odd, of course, as it appears to directly contradict conventional wisdom. Indeed, within the world of project development the so-called "iron triangle" of cost, schedule, and scope is seen as the key barometer of success or failure. The Omega study, however, argues that certain inherent characteristics of megaprojects make them, in important ways, different from conventional projects. As a result, the study suggests that while the iron-triangle remains important, a broader, more complex, and more nuanced framework of criteria is needed to adequately evaluate success with respect to megaprojects.[6]

A Broader Definition of Success

To be clear, the Omega study does not suggest that cost growth and delay on megaprojects is inconsequential, nor does it dismiss the possibility that in some instances project proponents could or did engage in strategic misrepresentation. Omega researchers suggest, however, that such behavior may not be endemic or a key driver of cost growth. Ultimately, the key conclusion of the Omega study is that while cost, schedule, and scope are important, when applied to megaprojects they constitute an inadequate tool for measuring overall success. Indeed, they argue that measuring megaprojects primarily or exclusively using this framework

[4] Megaprojects and Risk. p. 84, 85.

[5] Mega Projects: Lessons for Decision Makers: An Analysis of Selected Large-scale Transport Infrastructure Projects. Omega Centre, Bartlett School of Planning, London. Executive Summary, p. 22.

[6] Mega Projects: Lessons for Decision Makers. p. 23

may lead to projects that while meeting time and cost schedules, are spectacular failures in other critical ways.

The Omega study identifies several critical characteristics common to megaprojects that distinguish them from traditional construction projects. For example, Omega researchers also argue that megaprojects need to be understood as organic phenomena, which inevitably evolve and adapt to changing circumstances over time. In addition, megaprojects have the capacity to function as agents of change in affected communities or even for society at large to a much greater degree than conventional projects.[7] Individually, each of these characteristics presents particular challenges to the successful delivery of megaprojects. Considered together, they begin to suggest a framework through which one might measure a project's success outside of the cost, schedule, and scope paradigm.

It is virtually inevitable that significant changes to a project's scope impacts the project's cost and schedule. Thus, viewed strictly through the lens of cost, schedule, and scope, such changes typically register as negative in terms of measuring project success. Cost increases and schedule impacts have consequences that should not be ignored. Yet the key insight of the Omega study is the recognition that overall success or failure, particularly in the case of a megaproject, needs to be evaluated in a broader context. While it is important to do a thorough risk assessment at the front end, the *open systems* nature of most megaprojects makes it difficult, if not impossible, to capture fully the potential impacts of such projects on the front end. Moreover, because of their *organic* nature, megaprojects inevitably evolve as society's needs change. In view of the typically outsized impact that megaprojects can have on society, the failure to allow them to evolve to address changing societal concerns can have significant costs, resulting in a project that, while meeting cost and schedule constraints, could fail to address current or future needs.

[7] Mega Projects: Lessons for Decision Makers. p. 16-17.

Toward More Successful Megaprojects: Key Elements

Beyond reconsideration of the lens through which we measure a megaproject's successful completion, other factors may contribute to a project's success or failure. The Legislature should develop measures to improve these factors in the state's megaproject development process. While not an exhaustive list, this discussion will highlight the importance of transparency, stakeholder engagement, performance-based goal setting, proper governance, risk management, and leadership.

Transparency – In order for the public to have confidence in a project, it must be clear that those responsible for its development are acting as good stewards of the public interest and of public resources. This can only occur when all project plans, documents, studies, and reports are available and accessible to the public. Further, Flyvbjerg argues that the use of independent peer review, both by experts working directly within the paradigm of official expertise and by those with professional competence but working outside that paradigm,[8] is critical both to project success and to public confidence.

Along these lines, many experts also stress the role of effective communication in project success. Communication and outreach efforts should be taken every bit as seriously, and funded as adequately, as any of the technical aspects of project development. Washington State Department of Transportation recognized the value of transparency, and after instituting a number of measures to bolster its efforts, was able to successfully raise additional statewide transportation revenues. Practitioners suggest entities that do not effectively communicate their project goals and plans find themselves constantly on the defensive and end up spending more money appeasing opponents than they would have on a successful transparency campaign beforehand.

Stakeholder Engagement – According to many experts, the success of any project, especially one as inevitably complex as a megaproject, depends heavily on the effective engagement of stakeholders. Megaprojects tend to have a much broader spectrum of both direct and indirect impacts. Thus, they have the potential to spark interest and concern from a wide

[8] Megaprojects and Risk, p. 112-113.

range of stakeholders. Therefore, having a robust process for engaging and interacting with stakeholders, beginning during the conceptual phase and stretching throughout all phases of the project is essential. According to Virginia Greiman, Deputy Counsel and Risk Manager for the Central Artery/Tunnel Project (the Big Dig) in Boston, stakeholders are a key resource on megaprojects. Among other things, she emphasizes the importance of viewing them as partners, valuing their contributions, and developing and maintaining a relationship of trust. [9]

The development process of the Doyle Drive Replacement Project in San Francisco is an example of effective stakeholder engagement. Amidst a heavily-populated geography and touching more than a dozen local, state, and federal entities, building consensus and getting to construction was a decades-long process. To attain buy-in, project consultants developed a suite of explanatory materials, signage, visualizations, and a web presence. They then brought together a wide spectrum of stakeholders from neighbors and tenants, to visitors and special interest groups to collaboratively determine the proper approach.

Performance Specifications – According to Flyvbjerg, a critical weakness of conventional project development is the failure to employ a *performance specification* approach. Too often, project planners either begin with, or at least move quickly to, discussion and analysis of specific technical solutions and project alternatives. The problem with this is that as soon as particular technical options are proposed, many stakeholders immediately gravitate toward support or opposition to those specific alternatives. He observes that in many cases, such support or opposition is rooted in concerns regarding specific elements of the project but can obscure focus on broader goals and objectives. Moreover, once drawn, lines of support and opposition can be difficult to change.

Flyvbjerg suggests that project developers should begin instead with a planning process focused on defining and building public consensus around the range of performance-based goals and objectives that any eventual project should be expected to achieve, such as improved sustainability, safety, or cost-effectiveness. He believes that a robust commitment to development of consensus among a broad range stakeholders and the public prior to a discussion

[9] Mega Project Management. p. 81.

of technical solutions is critical to project success. Such an approach, he argues, forces people to focus on the ends rather than the means, the project's goals rather than specific technical issues related to a particular proposed solution. This not only ensures that stakeholders have an opportunity for early engagement in the process, but also provides a clear measuring stick against which all subsequent technical solutions can be equally measured.[10]

For example, the next time the state considers building a new large bridge, it should begin by defining performance specifications for the bridge, such as the level of seismic safety, the volume and types of traffic it must accommodate, and what cost constraints it needs to meet. Then, once these various parameters are adequately defined, the state can judge any proposed project alternatives against these specifications. In the past, the state has launched into discussions of possible alternatives to major infrastructure projects before adequately determining the desired performance measures by which to judge the proposals.

Governance Structure – Key to the management of any complex endeavor, such as a major construction project, is an effective governance structure. Indeed, undertaking a major project without ensuring an adequate governance regime exposes an organization to "a high degree of failure."[11] The governance structure defines the system of relationships within an organization as well as the processes and procedures through which decisions are made and performance is monitored. In order for a large and complex organization to function effectively, roles and responsibilities of various individuals and entities should be clearly defined, and lines of accountability must be transparent.

Greiman observes that because every major project has unique elements and specific needs and demands, no single type of governance structure will work for every project. In addition, because megaprojects tend to evolve over time, the governance structure must be flexible enough to adapt to new demands that may emerge. Flyvbjerg is quite critical of conventional public sector project governance, suggesting that it requires government to play too many, and often conflicting, roles. He notes that in many cases, the public agency in charge of a

[10] Megaprojects and Risk. p. 115-117.

[11] Megaproject Management. p. 111-113.

project serves as its promoter, and at the same time, is also expected to serve as guardian of the public interest, responsible for ensuring that concerns over issues such as environmental protection, public safety, and financial risk, are fully addressed. We must consider and adequately address this conflict to improve megaproject outcomes.

Risk Management – Megaprojects are risky endeavors, and project success depends in large measure on the effective management of these risks. To be truly effective, identification of risks should begin as early as possible during project development, ideally while the project is still in the conceptual phase. Researchers acknowledge that particularly during early stages, specific risk events are often difficult to predict. Even early on, however, it is generally possible to identify likely types and sources of risk (such as political, environmental, fiscal, or design risks), and to estimate risk exposure based on experience with other projects. Following initial identification, risk management entails development of a robust risk assessment identifying: 1) what can go wrong, 2) how likely it is to occur, and 3) the likely impacts if it occurs. Following this analysis, risks are prioritized (based on probability and severity of impact) and response strategies developed. Such strategies can involve efforts to avoid some risks, tolerate others, and transfer still others (in whole or in part) to other parties.[12]

Legislation in 2005 required the state to develop such a risk management tool for the East Span project. While the project had suffered significant delay and cost increases to that point, since instituting its complex risk management program, among other things, the new span opened relatively on time and within its contingency budget. The Legislature should consider applying risk management requirements to all large infrastructure projects similar to those required for the East Span project.

Leadership – Beyond the aforementioned, largely technical and process-based elements, that contribute to the success or failure of a megaproject, many experts point to one other factor – effective leadership – as fundamental to the project's outcome. While the need for effective project management was addressed above, most clearly in the discussion of governance, Greiman and others stress that leadership is a separate, albeit complementary function. She

[12] Megaproject Management. p. 267-271.

frames the distinction this way: management is about coping with complexity whereas leadership is about coping with change. Managers, she says, achieve their goals by planning, setting targets, and monitoring results against the plan, whereas leaders create a vision, develop strategies and implement them. While managers use processes and procedures, leaders must impact human emotion, change minds, motivate, and inspire individuals to do things they have never done before. In as much as projects and especially megaprojects are about change, effective leadership is essential. Specific traits she highlights include honesty, competence, inspiration, and forward-looking vision.[13]

The Omega researchers also noted, among their conclusions, the need for strong and sustained leadership in promoting visions that megaprojects should seek to fulfill. They argue specifically that politicians need to assume a major leadership role in steering major transportation projects through the process, and in sustaining the momentum of a project's development. Ultimately, research suggests, the success of a megaprojects depends on the presence of leaders who are willing and able to champion a project vision and sustain it over a period of time.[14]

Conclusion

Given the complexity involved in megaproject development, it is understandable that the state may have suffered some less fortunate outcomes to date. Research has shown what pitfalls exist, and if we create structures for evaluation of these projects as well as properly selecting alternatives and effectively overseeing future endeavors, the state should be able to mitigate risks and improve our overall ability to deliver megaprojects.

Questions for Consideration:

1. Based on your experience with large projects, how would you define "success" and how do you measure it?

[13] Megaproject Management. p. 391-393

[14] Mega Projects: Lessons for Decision Makers. p. 38-39.

2. Can you share with us some examples of any megaprojects with which you have been involved where project goals shifted (or new potential benefits have emerged) during project development? How were these developments handled? Do you have practical recommendations for us as far as planning for and managing this kind of dynamic?

3. If, as some suggest, project success needs to be measured with broader criteria than cost, scope, and schedule alone, how should various costs and benefits be balanced? As a practical matter, what governance and evaluation structures need to be put in place to facilitate this kind of analysis during the project development process?

4. Professor Flyvbjerg has suggested changes to the traditional governance structure of public infrastructure projects, including, in part, that the public agency refrain from serving as project promoter in order to maintain an arms-length relationship to the project. Do you agree with this approach, and, if so, how would you envision it working in practice?

5. Professor Flyvbjerg has also proposed that the initial stage of megaproject development involve identification of performance-based criteria, independent of specific solutions. Can you share with us any real-world projects of this kind of process? What practical strategies are needed to accomplish this?

6. Oversight is critical to the success of any project. What elements need to be in place to ensure success? In particular, what do you see as the most appropriate and effective role for elected officials (*i.e.*, the Legislature) in this process?

7. Environmental issues are a critical element of megaproject development and can be a substantial source of risk, frequently leading to delay and cost growth. What strategies (statutory, administrative) would you propose to mitigate this risk?

8. What role does the delivery method play in determining megaproject success? Are there tools needed that California does not have at its disposal today that would enhance the prospects of success on future megaprojects?

9. What role, if any, do you see that project financing plays in managing risk on projects?

10. What other suggestions do you have that would facilitate California's future success in megaproject development?