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Statement:

Boston's Central Artery/Tunnel project, commonly known as the "Big Dig," serves as an example of a publicly funded, privately executed "megaproject" which experienced drastic cost and schedule overruns due to a number of project management issues. The project was originally estimated to cost \$2.6 billion in 1982 dollars, and ended with actual cost of \$14.8 billion in 2007 dollars, with schedule and quality issues which delayed completion for almost two decades. While the project achieved the desired results of reduced traffic congestion and replacing an ugly and congested elevated freeway, the project was a financial disaster, with numerous quality control issues such as defective concrete, thousands of leaks, and a collapsed tunnel ceiling. Many of the lessons learned from this project can be applied to Department of Energy (DOE) projects, specifically emphasis on risk sharing between the contractor and owner, contractor quality oversight, and strict management of scope creep.

Discussion:

Boston's Big Dig project is not an isolated case. The cost track record of transportation mega-projects is poor (based on a 10 percent success rate). The costs are historically significantly underestimated, with 90 percent of major transportation infrastructure projects suffering cost overruns. The average rail project costed 45% more than projected, and the average highway project costed 20 percent more. Risks were largely disregarded in feasibility studies by assuming what the World Bank calls the EGAP principle: Everything Goes According to Plan. The contracting approach used in this case put major risks of cost overruns onto the shoulders of the state and taxpayers. With this model, private contractors lack strong incentives to anticipate risks that led to problems and costly change orders.

Analysis:

The primary factor driving increased cost of megaprojects is scope creep. In order to prevent scope creep, the analysis makes several recommendations:

Improve up-front planning by using separate design and construction contractors. This allows the federal owners to provide ample design oversight prior to start of construction, bid a single design to multiple construction contractors, and provide more effective oversight of construction. This can also prevent scope creep based on the independent design basis with stringent contract change control and quality oversight.

Shift project risk to the contractor through contract mechanisms, specifically fixed price contracts or cost caps. These contracts require fewer project and contract management resources but increased construction and quality oversight. By controlling the cost the DOE will pay for the project, the impetus is placed on the contractor to complete the project on time and within schedule in order to generate profit.

Use public-private partnerships with long-term concessions based incentives for investors to generate revenue based on the output of the project. In infrastructure projects, this is typically generated with tolls paid to the responsible partner.

Additionally, though not directly mentioned in the article, it is recommended to consider breaking "megaprojects" into smaller, more manageable pieces. This allows for greater cost, scope, and schedule control. This approach should be balanced against the possibility of increased contractor and subcontractor mobilization costs and potential difficulties in integrating requirements between projects.

Some of the suggestions posed in the analysis of the Big Dig are not viable for the majority of DOE construction projects. The benefit of public-private partnerships in infrastructure projects is the ability for infrastructure to generate revenue for investors. DOE projects, particularly EM and NNSA construction projects, do not have a marketable output. Some efforts have been made by DOE to capitalize outputs generated by construction projects, but projects such as MOX or WTP do not have outputs with intrinsic value to investors. This makes it difficult for the DOE to generate investors for a true public-private partnership.

Actions:

The lessons of the Big Dig have been the subject of many discussions. Many of the lessons are somewhat obvious. Mega-projects need:

- Teamwork between government agencies and the prime contractor;
- Precise goals, benchmarks and schedules;
- Projected costs expressed in construction year dollars and, where uncertain, in ranges of dollars rather than single numbers;
- Carefully estimated cost and schedule contingencies;
- Cooperation between all stakeholders;
- Champions to fight for these projects;
- Honesty and candor throughout to protect public confidence, and
- Vigilance against project scope creep.

DOE-EM can apply the lessons learned from the Big Dig project by:

1. Improving up front planning by establishing clear cost, scope, and schedule objectives. This can be accomplished as suggested in the article by using a separate design firm, bidding the construction to multiple contractors, and separating the project into smaller, more manageable pieces.
2. Focus on allocating the risk to the party that can best control it. Completion of a full design effort allows DOE to decrease performance risk and provides for more open competition with objective selection criteria. This in turn allows appropriate allocation of cost and schedule risk to the contractor through a firm fixed price or cost cap/hybrid approach.
3. Provide stringent oversight of contractor quality to prevent rework.
4. Where available, consider using public-private partnerships with long-term concessions based on possible revenue generated by project outputs. While this option may not be widely available based on the type of projects DOE-EM typically manages, it could be considered for some infrastructure improvements which may be required for future projects.

Critical Decision(s): All

Facility Type(s): All

Work Function(s): Acquisition, Project Management, Construction

Technical Discipline(s): Construction Management, Contract Oversight



BEFORE

AFTER

REFERENCES:

1. Robert W. Poole, Jr. and Peter Samuel. Transportation Mega-Projects and Risk. The Reason Foundation, Los Angeles, California, February 2011. Retrieved from https://www.google.com/url?q=http://reason.org/files/transportation_mega_projects_risk_big_dig.pdf.
2. City-Geography Relationship. Museum of the City. Retrieved September 10, 2014 (<http://www.museumofthecity.org/wp-content/uploads/2014/03/Boston-Big-Dig-Before-and-After.jpg>)