

Transportation  
Global  
Special Report

# Large Projects, Giant Risks?

## Lessons Learned - Suez Canal to Boston's Big Dig

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### Executive Summary

Infrastructure projects are popular with long-term investors because they yield stable cash flows, well protected against inflation and de-correlated from financial market cycles. But investors must remember that these projects consist of major ventures, with many types of risks (construction, traffic, operational, etc.), with big downside and little upside.

The most specific feature of infrastructure finance is that these investments are not incremental: sponsors and investors must release the whole investment before they can check whether it was justified. When digging a tunnel, for example, it is only at the operational commencement date (usually several years after the go decision) that partners will know if the demand is there, not to mention the various hazards during construction. If demand matches or overshoots the forecast, it is very difficult to expand capacity, making the upside very limited (unless price elasticity allows for increasing revenue with stable capacity and usage). Unlike venture capital, infrastructure finance cannot rely on a few successes to offset frequent failures; it must then succeed regularly.

With this report, which focuses on transport projects, Fitch Ratings intends to take a step back and examine through an historical perspective how big projects can reveal valid or invalid approaches to risk management. Big projects may be extreme cases with more risks (in nature and in degree) than the average projects' portfolio would suggest. The agency has selected seven flagship projects on several continents, ranging from the Suez Canal (1869) to the Boston Big Dig (recently completed), with a time extension deemed sufficient to allow one to draw general lessons. Most of these lessons apply not only to large projects, but are also of interest for all infrastructure projects, be they financed with public, private or mixed funding sources:

- Infrastructure projects require popular adhesion and political clarity (notably with regards to the comprehensive costs) to get approved, funded and implemented smoothly.
- Projects must be realised because they are fully desirable and viable, not only because there is funding available.
- In turn, this viability must be assessed for the very long term, due to the very nature of canals, dams, tunnels, railroads, tollroads and bridges.
- Risk allocation and governance are critical factors of success: a complex set of public and private stakeholders deals with conflicting interests.
- Planning and conception of large projects are particularly lengthy and complex; this complexity entails uncertainty, which requires contractual and financial flexibility.
- Large projects usually involve extraordinary construction constraints, which must be carefully managed, in terms of technical, contractual and managerial arrangements.
- International projects (cross-border links) are highly sensitive to geopolitics, a risk particularly difficult to manage.
- Demand forecast is difficult; for large projects, it becomes very difficult, thus hazardous.

- Project finance may not be the best option for giant projects with potential risks and targeted benefits that are beyond the scope of the usual private stakeholders. The public sector would best take on unknown needs.

### Scope and Definition

We have not deemed it necessary to precisely define what “large projects” would mean, as there is no tangible measure for this. Large projects would typically feature an unusual mix of high cost, technical complexity, political visibility and so on. Other infrastructure projects would be analysed from the same angle generally (only some risks being peculiar to large ventures). The scale basically better reveals the risks and makes them more difficult to mitigate.

Fitch focuses in this report on the projects themselves, not on the debt. Relevance to the rating exercise resides in the analysis of the operational risk profile. Some of the risks identified in this report may then be appropriately mitigated through the structuring of the debt, the liquidity and the security package, and so on.

### Introduction

Big projects are not recent in human history. The ancient civilisations, notably well organised empires, had their mega-projects too: the Romans built an impressive road network throughout Europe (8,500km of main roads), and aqueducts that provided water to cities over the centuries; the Chinese built the Great Wall (3,640km) and the Grand Canal (1,795km); starting in the Middle Ages, the Dutch reclaimed 15% of their current territory from the sea, thanks to an ambitious and complex set of dams and drainage system.

Drivers for large projects are well known. Firstly, large projects are supposed to bring extraordinary socio-economic benefits: canals, dams, railways, tunnels, main roads and bridges reshape territories, contribute to economic development and can fulfil political or military missions. Secondly, they are politically attractive because they are tangible and monumental; they allow politicians to leave a footprint in history. Thirdly, large projects, if successfully conducted, have always presented an opportunity to various groups of people to make large sums of money. Finally, resources, be they technological or material (capital, labour force) tend to be abundant, at least in prosperous countries and times.

Yet most landmark infrastructure projects have suffered from various flaws. Many have raised controversies, if not scandals. This study does not aim at finding out revolutionary conclusions about infrastructure project finance, but is an attempt to draw lessons that can be used in Fitch’s analytical approaches. These lessons also may suggest the most basic (and often forgotten) guidelines that decision makers, sponsors and investors must keep in mind when they engage in infrastructure projects.

### Lessons Learned

#### All Large Projects Require Popular Adhesion and Political Clarity

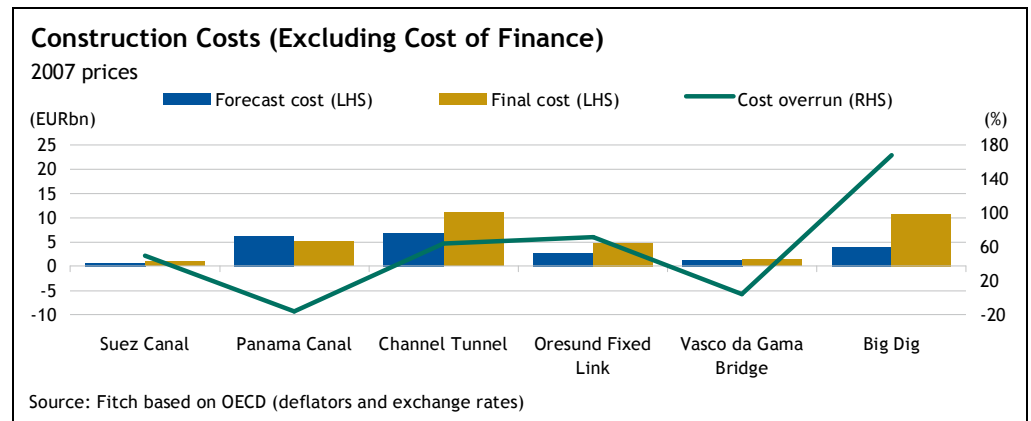
Public acceptance of the project is a starting point when it comes to highly visible infrastructure pieces (canals, large bridges, urban tunnels or motorways). Because these projects will affect people’s lives (positively or negatively), sponsors need to make sure the project is desired by the community. Indeed, there are many adverse effects of this adhesion not being met.

Firstly, local community associations can weigh on authorities to prevent or delay the authorisation processes. This was the case in the Vasco da Gama Bridge, in Portugal.

Secondly, very large projects must ensure their financing beyond the usual circles of project finance investors. They must be popular and gain broad support from the wider marketplace, sometimes including retail investors. As a matter of fact, the financing of the Suez Canal in the 1850s and the Channel Tunnel in the 1990s funded by French household savings could be considered a success, because the efforts of the sponsors were concentrated on this market. But the promoters of the IPOs failed to attract material interests in other countries than France, because they did not actively market the project there.

Finally, if getting public approval is necessary, it is not sufficient to make a good project. Indeed, many policy makers and project sponsors (be they private or public) have tended to massage the projects’ expected inputs and outputs: underestimated costs, overestimated revenues, undervalued environmental impacts and overvalued development benefits are common strategies to get the projects approved by the community. This can prove very hazardous, since actual developments would shed an even more negative light on the projects in difficulties,

if expectations were not sincerely managed. The mitigation costs of the Central Artery (Big Dig) in Boston were deemed necessary to gain popular support and indeed a vast majority of residents and communities were favourable to the project in its early days. But these costs (about a third of the total final bill) were not accounted for in the initial cost estimate, and contributed to the tremendous budget difference between the promise and the delivery. This mistake or misrepresentation has been recently observed for the London 2012 Olympics budget (now estimated to be three times higher than the bid estimate).



### Financeability Must Not be Preferred to Viability and Desirability

Large infrastructure projects involve massive amounts of public and private funding. Against the backdrop of several financial disasters (for example, the French Panama Canal), many policy makers have cunningly managed their projects by reference to “financeability” (i.e. will the sponsors be able to raise the required public and private capital?) rather than to economic viability (i.e. will the project deliver its promise?) or socio-economic desirability (i.e. does the community really need this promise to be realised?).

Sponsors and governments may be tempted to engage in projects, particularly big projects to which national or international prestige is attached, even though those projects are not really viable. They will do so if the projects prove financeable, that is to say if they can convince other parties to engage as well. This is a major reason for failures of big projects: many of them came to life because some influential people believed in them; not because their business plans or socio-economic rate of return would justify it.

A good illustration of this is the Channel Tunnel, where the project was presented as self-sufficient (toll revenues would repay all costs), but studies showed that a small deviation from base case assumptions would derail the capacity of the project to repay its costs from commercial revenues. This likely deviation happened and actual results of the project confirmed the risk was real: it underperformed from the start. The project was possibly too costly (too ambitious) compared to its economic capacity to yield revenues. However, this does not mean the project did not make sense (only a full and complex cost/benefits study of socio-economic and political impacts would reveal this), but rather that it might have required public subsidies to achieve a financial equilibrium.

It is pivotal for large projects that reasonable ranges of outcomes be explored, so that decision-makers can possibly implement necessary design or performance changes.

### Viability Must be Assessed for the Very Long Term

In contrast to the previous point, one may argue that viability is a function of financing, and that a project may prove unviable if the financing is not adapted to the project features. This is an issue at either end of the project’s lifespan.

At the beginning of their lives, once construction is completed, projects tend to need a ramp-up period during which their revenues grow from zero to the expected “cruise regime”; this period can be of variable length and must be mirrored in the financial structure, with little or no debt principal repayment being scheduled.

At the other end, if the tenor of funding available on the markets cannot match the asset’s lifespan, the debt will need to be amortised much quicker than the “technical amortisation” (i.e. asset life) would suggest. This requires the project to yield a much quicker return than its economic potential may allow. Such cases would inevitably lead to debt restructurings, although with an initial longer tenor, they could be perfectly viable.

Infrastructure facilities typically have service lives of 50 or more years (Channel Tunnel is expected to exceed 120 years), yet are often expected to fully amortise debt in only 30 years, as was the case with the Øresund Bridge. This is driven more by the nature of traditional debt financing instruments used in many countries than the nature of the infrastructure asset. As a result, some projects may be economically meaningful, provided they find the appropriate funding sources. A mature infrastructure debt market, involving various types of players (multilateral banks, commercial banks, pension funds, insurance companies, infrastructure funds, etc.) with different appetites for various time horizons should contribute to avoid mismatches in debt funding tenors and asset potentials.

However, one must bear in mind that very long-term investments imply risks such as changes of paradigms (risks that the asset becomes useless because of profound technological or social changes). This happened in the 1830s with many European inland canals being superseded by emerging railroads. Many canal projects went bankrupt at that time. Many railroads in turn went bust in the first half of the 20th century, hit notably by the emerging automobile.

### **Governance of Large Projects Implies a Complex Set of Stakeholders; Risks Must be Carefully Allocated**

Whereas the traditional model of project finance relies on a simplified organisational and governance structure, large project companies involve a high number and variety of stakeholders. In particular, the magnitude of financial requirements and the resulting dispersion of equity and debt may exacerbate conflicts or complicate players’ strategies. In the same vein, project finance traditionally seeks to achieve a balanced allocation of risks among the various stakeholders (procuring authorities, sponsors, constructors, lenders, operators etc.); with large projects, it is made particularly difficult because one barely identifies and predicts all risks by the time of contractual closings.

In this context, it is critical that risks are very carefully allocated, to those parties most able (financially and technically) to manage them. The Big Dig experience shows that dilution of responsibilities among sponsors and their contractors (the larger funder was not in command, the decision-maker was relying on consultants who were not bearing any performance risk, etc.) led to costs inflation and a lack of accountability.

Large projects also illustrate, in contrast to the majority of project finance deals, that the use of highly leveraged structures and tight debt covenants, which limit managerial discretion, could be counterproductive. Indeed, giving the power to a large number of lenders (by definition large projects require vast syndicates) could result in lower involvement and technical expertise of the financiers, losing the financial discipline that they traditionally bring to projects. This phenomenon was particularly striking in the case of the Channel Tunnel (see below).

### Planning and Conception: Complexity Entails Uncertainty, Which Requires Flexibility

Policy makers tend to think according to what has been called the EGAP principle: Everything Goes According to Plan. In reality, events are subject to a probability that they are not actually realised. One must then accommodate for the risk that expected events and outcomes do not materialise. This would cause a deviation from the base case, sometimes even a strong deviation. Deviations typically occur when the confidence level of the planning assumptions is made lower by difficult geological, meteorological, economic or political conditions. Because they are complex in their very nature, big projects usually face these uncertainties.

The first attempt to dig the Panama Canal illustrates this rule: its main sponsor, Ferdinand de Lesseps, underestimated two factors. Firstly, the uncertainty due to unprecedented construction works in the jungle's climate (malaria and yellow fever killed thousands of workers). Secondly, Lesseps firmly wanted a sea-level canal, similar to the successful Suez precedent, disregarding the uncertainty raised by topography about the feasibility of this option (which required the digging of a long tunnel). Lesseps accepted too late the introduction of locks, once the project economics were already severely jeopardised, and the project went into insolvency one year later. The financial model was not robust enough to accommodate such flexibility.

More importantly, the allocation of risks (i.e. contracts) and the starting of construction must only be initiated once the driving assumptions (output specifications of the asset, planning authorisations, environmental studies, etc.) for the projects are stabilised.

For example, Eurotunnel, the project company that built the Channel Tunnel linking France and England, faced spiralling security requirements. This was due to the fact that the financial close preceded the authorisation granted by the Safety Commission. The Safety Commission was accused of gradually enhancing its requirements, but defended its position by the priority of safety and lack of comparable reference in such a unique project. As a matter of fact, safety costs considerably increased the financing requirements.

Environmental impact concerns have also been initially underestimated (as in the Oresund Bridge and Vasco da Gama Bridge cases) and should naturally be addressed in the planning process. If the concerns can be translated into specific performance standards, then the design process can incorporate the standards from the outset. Vasco da Gama Bridge experienced cost overruns and delays because of changing environmental regulations and because the project was tendered without prior environmental licensing. Not only does the public sector have to bear the consequences of changing environmental regulations, but it is crucial that environmental impact studies have been carried out and initial licences obtained before the projects are being tendered, so that bidders know all the environmental constraints and the mitigating measures they should include in their proposals.

Another illustration (more positive), of the necessary flexibility was the Vasco da Gama Bridge, which showed how the Portuguese government and the sponsors needed to renegotiate the concession contract (and succeeded in doing so), to better address a dramatic alteration of the project risk profile.

Generally speaking, it may be worth questioning, from a public policy perspective, whether project finance (non-recourse debt) is the most suitable funding technique for large projects with too many uncertainties. If no private stakeholder can efficiently assess and price some risks, then the government is likely to retain the risks eventually. But if this results in passing too little downside risk to the private sector (compared to the upside), then the government should probably get the facility procured traditionally, or at least keep the option to be interested in the upside (for example, by terminating the concession if it makes excessive profit).



**Methodology**

- Cost overruns are expressed as a percentage of originally estimated price, all constant prices
- Delays are expressed in comparison to initial timeline (the calendar published by the time of decision making)

**Extraordinary Construction Constraints for Extraordinary Works**

By definition, mega projects imply very large construction challenges. This is valid for all the projects mentioned later in this report. Some of the issues met are predictable: the Suez Canal designers needed to provide logistics for a huge building site in an area very remote from their homeland; Panama Canal promoters had to face lethal tropical diseases and implementing public health policies was key to ensure the success of the project. Some issues are less predictable: Channel tunnel drilling was delayed by soft soil issues under the sea, which were difficult to identify before the actual works began.

Most of the time, large projects involve audacious and creative construction methods, such as the slurry wall used in the Boston Big Dig to allow for digging without disturbing business on the surface.

For projects where sponsors face difficult design requirements but can define their ultimate needs as measurable standards, design-build can be a very attractive approach as, for example, with the Øresund bridge. Specifying the output (traffic capacity, speed, safety, ambience, etc.) rather than the facility features can help solve many of these issues.

In all cases, the selection of very capable and robust construction consortia, providing solid completion guarantees on the basis of fixed-term, fixed-price contracts, is a major element of success.

**International Projects (Cross-Border Links) are Highly Sensitive to Geopolitics**

The political sensitivity of large projects is exacerbated in the context of cross-border links, because several public opinions and a broader set of interests groups are at stake. Geopolitical interactions inevitably occur in these projects' decision-making processes, and usually make it more difficult or hazardous. Examples include the Suez Canal: the authorisation to dig the canal was granted by the Ottoman Sultan thanks to diplomatic activism by Lesseps, but subsequent adverse geopolitical pressures, mainly from Britain, caused much of the delay and cost overrun to the project. In the case of the "French" Panama Canal, the US, based on the Monroe doctrine, opposed a French governmental intervention, complicating the path to restructuring. The "American" Panama Canal was clearly an act of "sovereign" policy, with the US diplomacy and military forces creating an ad-hoc country (imposed spin-off from Colombia), to host the project. More recently, the Channel Tunnel was made possible by a treaty signed on the back of French-British friendship, but in a context of British reluctance, which closed the road to any governmental intervention and explained the lack of popular support in the UK. The close co-operation between Denmark and Sweden offered favourable conditions for the development of the Øresund bridge, which effectively is owned by the two states, and the financing of which is jointly and severally guaranteed by the two governments.

**Demand Forecast is Difficult; for Mega-Projects, it Becomes Very Difficult**

A study covering 210 projects in 14 nations worth USD58bn carried out by Bent Flyvbjerg and published in 2005 has shown that forecasters generally give poor estimations of the initial demand for transportation infrastructure projects.

According to this study, forecasts have not become more accurate over the 30-year period studied. Rail projects appear to show the worst performance, with an average overestimation of 106%. Almost three-quarters of rail projects had forecasts overestimated by more than two-thirds.

Road projects are also marked by considerable deviation, with no significant evidence of optimism (forecasts tend to be as much lower as higher than actual traffic). 50% of road projects post a difference between actual and forecasted

traffic of more than 20%. For one out of four road projects, the difference is larger than 40%.

Besides the traditional bias (already mentioned earlier), the traditional risk of error attached to forecasting is magnified by the size and the type of the projects. The more unusual the project, the less benchmarks available for the forecasters. For example, the traffic studies for the Channel Tunnel could not rely on any comparable structure, as it was a “first ever” facility of its type. Moreover, mega projects often have long gestation processes, during which economic environments may vary, making the initial forecasts less reliable by the time the facilities open to the public.

### Project Finance May not be the Best Financing Technique for Very Large Projects

Financing large infrastructure facilities on a pure project finance basis (thanks to non-recourse loans) may prove inadequate, as a combined result of several observations made above. The driving question is whether the private sector can efficiently manage all the risks inherent to the project. As outlined earlier, pure private financing should be carefully questioned for projects involving long gestation periods, very complex construction works, very long-term return on investment period, first-ever demand risk assessments and big funding requirements. Be it for small or large infrastructure projects, good projects are those allowing stakeholders to balance risks and rewards.

The financial failure of the Channel Tunnel shows how many uncertainties could not be addressed solely by the private sponsors and lenders of the project. Governments may need to help restore the economic balance when events beyond the control of the project’s stakeholders happen. This was illustrated by the beneficial intervention of the Portuguese government in the Vasco da Gama bridge.

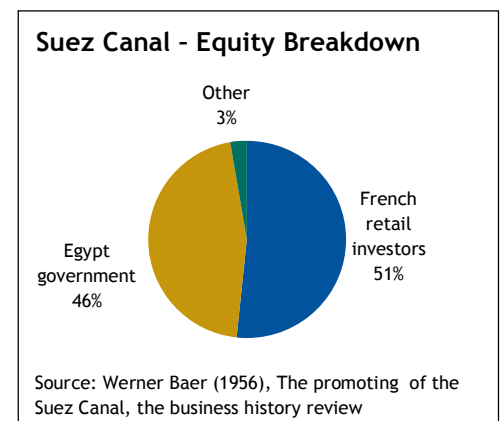
## Project Summaries

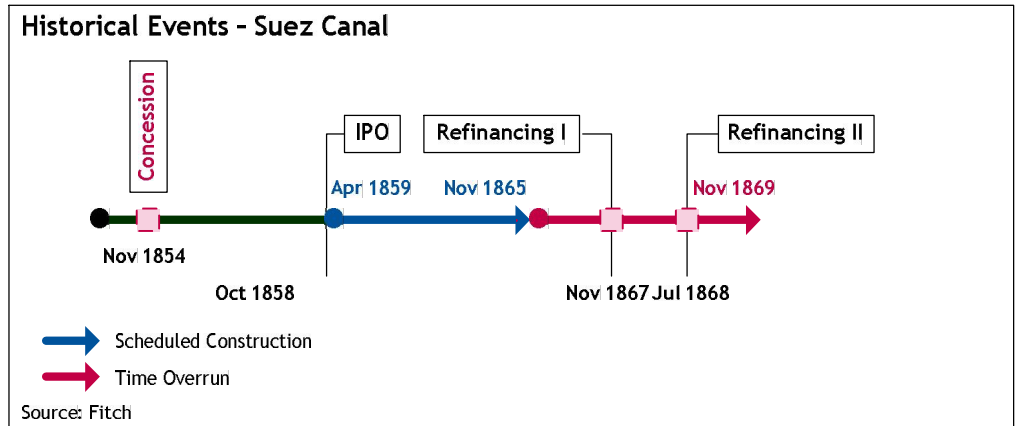
### Suez Canal (Egypt)

In 1846, a French society carried out a financial and technical feasibility study of a canal that would connect the Mediterranean Sea to the Red Sea. The company ceased further efforts due to a lack of political support. In 1854, based on this study, the French diplomat Ferdinand de Lesseps obtained from the Egyptian government (then part of the Ottoman Empire) a concession for a canal over 99 years. Between 1854 and 1859, extensive promotional activity was undertaken by Lesseps to secure public and political support in Europe and Egypt, in a context of British hostility, due to the threat that the canal posed to the maritime India route and the British interests in the Orient. The construction of a sea-level canal started in April 1859.

#### *A Primer in Many Respects*

The Suez Canal was probably the largest ever private initiative by the time of its inception. It was also the first joint stock company in Egypt: a special decree signed by the viceroy authorised the company, which was registered under Egyptian legislation, to adopt the French format and principles, creating an interesting “offshore” concept. The canal was meant to be an international link, without any privilege or usage preference given to any nation, creating a sort of “international public interest mission”.





***An All-Equity, Mainly Domestic, Funding***

The project company’s IPO in 1858 raised FRF200m (approximately EUR700m in 2008 values) and was meant to cover all costs and accommodate for unforeseen expenses. The fundraising was successful among French retail investors (more than 20,000 investors) but failed to attract large European institutional investors since the promoter refused the support of the Rothschilds (then the dominant MLA<sup>1</sup>) for the placement of shares. The Egyptian Viceroy underwrote the remainder of shares to secure the financial close.

***Construction Challenge: An Impressive Success for the Times***

Lesseps’s company (Compagnie Universelle du Canal de Suez) was set up as an integrated business (construction and operation), with a tremendous challenge: organise a huge building site, far from the homeland, requiring creation of site access infrastructures (including the foundation of Port-Said, the entry gate of the canal). It relied on the provision by the Egyptian authorities of very cheap labour (most workers were peasants forced to dedicate some time to the construction by a system of fatigue duty).

***Delays and Cost Overruns: Fair Performance, Given the Context***

Adverse geo-political pressures, mainly from Britain, the replacement of local (forced) workers by European (paid) workers and an epidemic caused a four-year delay to the project.

A first refinancing failed and a French law was enacted, allowing for the refinancing through lottery bonds (the interest rate was low but some bond holders randomly received extra coupons). Works were completed in November 1869, for a cost of FRF300m (EUR1bn in 2008 value), posting a 50% cost overrun (but this was almost totally offset by the FRF84m paid by Egypt as compensation, notably for the replacement of Egyptian forced workers by machines and European workers). When the cost of finance is included, the all-in cost of the canal amounted to FRF415m (EUR1.5bn in 2008). Moreover, the property owned by the company along the canal had gained tremendously in worth, with the irrigation opportunities created by the canal. Some of these properties (FRF30m) were sold back to the government, with a capital gain for the company.

***Good Final Performance was Underpinned by the Public Sector***

In terms of financial performance, the result was quite satisfactory, with a good return on equity offered to investors and a low gearing ratio at the end of construction (29%). This was explained by a good command of the works (despite a nominal delay and cost-overrun). But it is primarily due to the high level of involvement of the Egyptian treasury and, to a lesser extent, of the French government. French diplomacy supported and protected the project and the

**Suez: A Follow-Up**

- In 1875, the British government secretly acquired the majority of the shares of the company and gained control of the canal.
- In 1956, the Egyptian president G.A. Nasser nationalised the canal due to the US and UK refusing to finance the Egyptian Aswan High Dam, which ultimately led to the Suez Crisis.
- The canal yields revenues in the form of fees per net ton. It saves 86% of the distance between the Mediterranean Sea and Saudi Arabia.

<sup>1</sup> Mandated Lead Arranger, in charge of the syndication of a financing



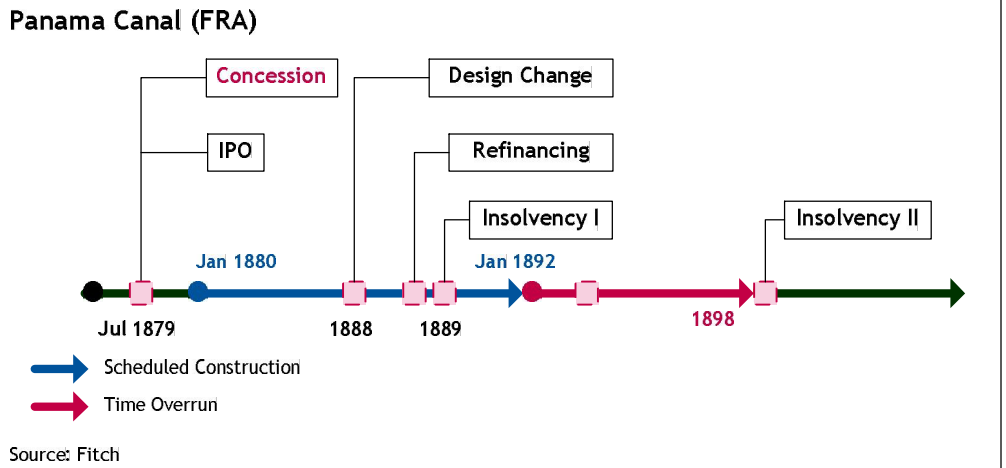
government eased the refinancing with ad-hoc legislation. More importantly, the Egyptian viceroy underwrote a substantial share of the equity and the FRF84m compensation paid and the FRF30m land acquisitions can also be seen as capital grants paid by the government.

**Panama Canal (Panama)**

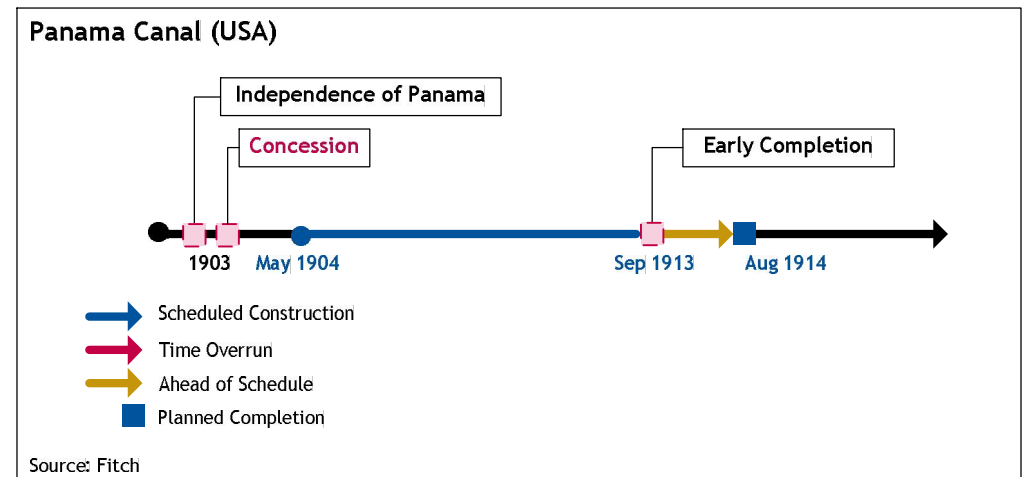
The French realised the long awaited project to dig a canal from the Atlantic Ocean to the Pacific in 1878. The Geographical Society of Paris signed a treaty with Colombia (of which Panama was then a province) to build a canal from Limon Bay to Panama City, closely following the Panama Railroad. In 1879, the Republic of Colombia granted a concession of 99 years to the Suez Canal founder, Ferdinand de Lesseps, to build and operate a canal. Based on a funding pattern similar to that of Suez (mainly equity raised in France) in 1879, works began in January 1880 with scheduled completion in 1888. Lesseps' company (Compagnie Universelle du Canal Interocéanique de Panama) bought the Panama Railway Company, which was used as the main vehicle for transport during the canal construction.

**Panama: A Follow-Up**

- Until the gradual transfer of the canal to Panama, decided in a treaty in 1977, toll policies (fees per net ton) were under US authority, which operated the canal on a breakeven basis. In 1977, royalty payments to the republic of Panama were introduced
- About 14,000 ships and 280 million tons of goods cross the canal every year. But the existing locks are too small to accommodate most modern vessels ("post panamax", i.e. more than 300m long and 32m wide). In 2006, the Panama Canal Authority decided to undertake enlargement works for a value of USD5.25bn (30% of national GDP in 2006), including two series of three locks (55% of the works' worth). These works would double the canal's capacity.



*Inappropriate Initial Design Delayed Construction*



Although his engineers suggested a canal with locks, Lesseps opted for a sea-level canal, to reduce subsequent operating expenditure. But this option, successful in Suez, required a massive 7,720-meter long tunnel through the Continental Divide at Culebra. Moreover, soft soil delayed construction progress, exacerbated by a switch in design in 1888, in favour of a lock canal, as Eiffel ultimately convinced Lesseps that the topography made it necessary. On top of this, Lesseps had to cope with frequent outbreaks of malaria and yellow fever (20,000 victims).

A last attempt at refinancing failed in 1889 after Lesseps had spent material amounts on corrupt journalists and politicians to gain government financial support (this caused a major financial scandal), in a context of US hostility. The Panama Canal Company was consequently liquidated. At that time, the construction had only reached about 40% (12.6km) and already cost more than twice the total initial budget.

**Geopolitical Matters**

After the economic failure of the French project, the US government, understanding the crucial importance of the canal to connect California to the east coast, decided to follow up the initiative. After some years of hesitation, the US decided to acquire the assets built by the French. But since the Republic of Colombia refused to transfer the rights to dig the canal, the US actively promoted the spin off of Panama from Colombia, and in 1903 the US and Panama (a kind of “ad-hoc country”) ratified a treaty securing the construction rights.

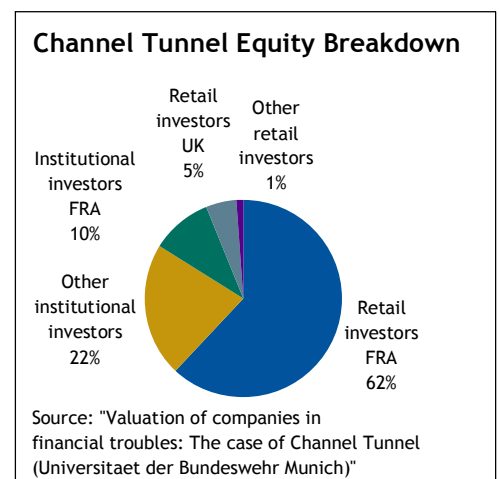
Congress selected among several design studies a lock canal intended for the use of larger ships in future. In May 1904, the US Army Corps of Engineers began construction, which was entirely funded on public monies. Eased by medical discoveries that eradicated yellow fever and reduced the incidence of malaria, completion occurred six months ahead of schedule and slightly below costs in September 1913. The canal opened in September 1914, just when WWI started. It would be 10 years before traffic would grow to the expected levels of 5,000 ships per year. Toll revenues peaked in 1929 and 1930, but did not reach that level again until 1953, because of the effects of the depression and another world war.

**The (Temporary) Decline of Private Funding and (Re)emergence of Governments**

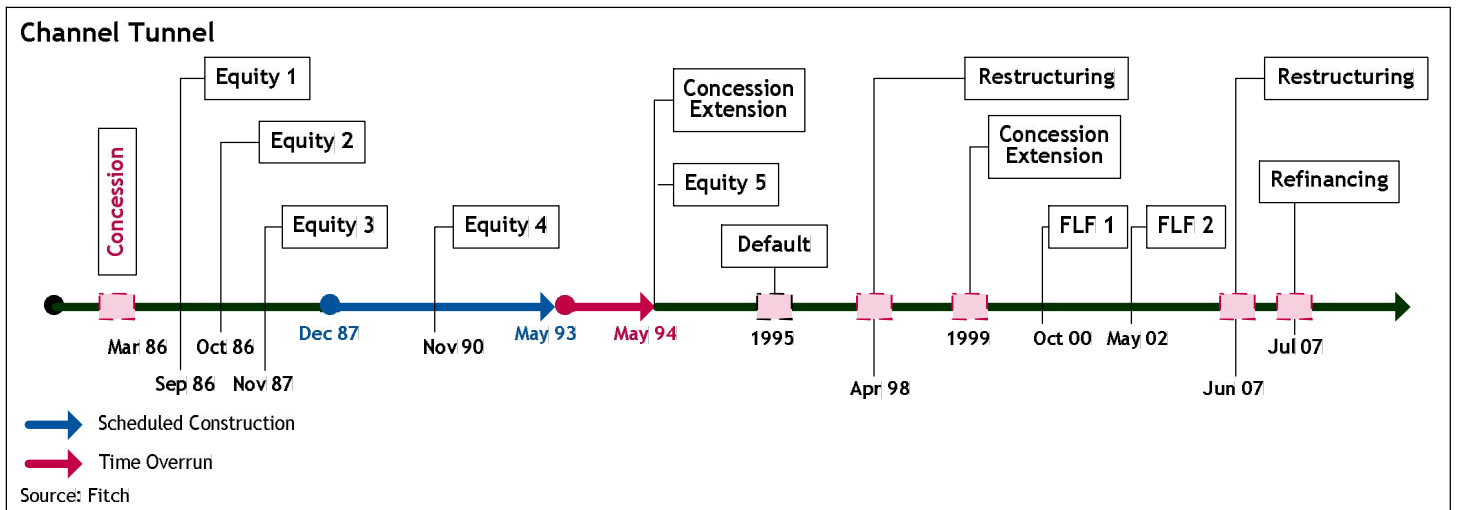
The Panama Canal is a perfect illustration of the move from private to government funding at the beginning of the 20th century. While the 19th century was the golden age for private financing of infrastructure (many major waterways and railway networks in western countries were built through concessions), a change of paradigm occurred when both economic difficulties of companies and strategic issues made governments keen on intervening in this arena.

**Channel Tunnel (France - UK)**

Over the centuries, the Channel Tunnel has been the object of dreams and a series of aborted projects, including boring works that were undertaken and stopped in the 1880s and again in the 1970s<sup>2</sup>. In March 1986, the Treaty of Canterbury was signed between France and the UK, awarding a concession with a 55-year maturity to design, finance, build and operate a fixed link over the English Channel. The winning project was a tunnel suggested by an Anglo-French construction consortium (later named Eurotunnel), on the basis of the proposal already selected in 1972.



<sup>2</sup> Both times, the UK government abandoned the project by fear of invasion (1880s) and public finance turmoil (1970s)



**The “Not a Public Penny” Challenge**

The Treaty warranted operational autonomy for the concessionaire and, following then prime minister Margaret Thatcher’s reservations, prohibited the injection of public funding or the extension of guarantees by the governments, illustrating how little enthusiasm the tunnel received from many UK political circles<sup>3</sup>. Although this was meant to protect public purses from traditional cost-overruns and intended to enhance financial discipline, this decision proved to be negative to the project. Financing the tunnel on a project finance basis (thanks to non-recourse loans) was difficult: firstly, the maximum amounts accepted in this market before this project were a third of those required for the tunnel; secondly, the longest loan maturity at that time was 15 years. It was only possible because the 10 constructors and five leading banks convinced their counterparts with a promising business plan: as soon as the tunnel would open, it would capture a high 44% of passenger traffic and 17% of goods volume.

**A Hectic Funding Schedule**

The project was initially estimated to cost GBP4.9bn (in November 1987 prices). Note that in 1994, at the end of works, costs reached GBP10.1bn (in 1994 prices), of which roughly 80% was financed by debt and 20% by equity. The initial equity financing (1987) involved a complex and original dual currency syndication on two different debt markets involving 220 banks. The equity placements of GBP0.8bn, based on an ambitious targeted ROE of 17%, went smoothly in France, where the project was popular, but required pressures from the Bank of England to motivate British banks. It finally convinced 300,000 retail investors. Moreover, the bank syndication of GBP5bn took place in November 1987, in the adverse context of a financial markets crisis. It involved 198 banks for facilities of 18 years’ maturity (a record for the time). The EIB and the French public bank, Credit National, respectively took on 20% and 8% of the debt.

Construction works began in December 1987.

**A Great Technical Achievement**

The Channel Tunnel is considered a major technical achievement: It is the world’s second-longest underwater tunnel (50km, of which 38km (i.e. 75%) is under the sea<sup>4</sup>). The project actually consists of 150km of tunnels (two rail tunnels and one service tunnel). It involved 13,000 workers from 10 companies over eight years.

<sup>3</sup> It is worth remembering Lord Palmerston’s (Prime Minister under Queen Victoria) statement: “What! You want us to contribute to a work the object of which is to shorten a distance that we find already too short?”

<sup>4</sup> It is actually the world’s longest tunnel under the sea; Japan’s Seikan Tunnel, in Tsugaru Strait, is 53km long, of which 23km are underwater

**Channel Tunnel Cost Overruns**

Amounts (bn)	FRF 1985	EUR 2007
Construction budget (1985)	28.4	6.8
Construction actual (1994)	46.5	11.1
Deviation (%)	64	64
Finance and overhead budget (1985)	20.3	4.8
Finance and overhead actual (1994)	54.7	13.1
Deviation (%)	169	169
Total budget	48.7	11.6
Total actual	101.2	24.2
Deviation (%)	108	108

Source: Ponsolle in Transports n 379, 1996

Besides the Eurostar (high speed trains) that drive straight through the tunnel, trucks, coaches and cars stop at terminals, where they are loaded onto large capacity “shuttle” trains specifically designed for the tunnel.

**Delays and Cost Overruns Led to Default, Close to Bankruptcy**

Completion in May 1994 saw a delay of one year. Cost overruns of 108% for construction required several capital increases. Moreover, initial delay and slow ramp up, aggravated by a fire in 1996, which forced traffic to stop for six months, caused cash shortfalls, requiring debt restructurings. No dividends were paid, the share price dropped and the scheduled interest payments and debt repayments could not be met and had to be restructured and postponed several times<sup>5</sup>. The company has been acting at the verge of bankruptcy, with forecast revenues and the expected operational efficiency not being achieved. The national governments kept their promise not to put public money into the project, and intervened only through the extension of the concession until 2086, i.e. 45 years more than initially awarded.

The Channel Tunnel is a good example of a mega project that failed to meet its economic targets and experienced severe delay and cost overruns. For completely separate reasons, the construction costs of the tunnel doubled.

**Planning and Technical Failures Doubled Construction Costs**

The project experienced several failures:

- Despite a very long gestation time (two centuries) and the use of proven technology, this mega project actually had very little time between the go-ahead decision (1984) and the targeted commencement (1993), while it had to accommodate for design, planning and execution of one of the greatest human realisations in history.
- Eurotunnel faced spiralling security requirements, because the concession contract contained only an outline of the safety plan. More seriously, financing (and the business plan associated to it) was closed before the authorisation was granted by the Safety Commission. The Safety Commission was then accused of gradually enhancing its requirements, but defended its position by the priority of safety and lack of comparable reference in such a unique project. As a matter of fact, safety costs considerably increased the financing requirements.

Additionally, poorer than expected ground conditions increased the difficulty of drilling the tunnel and caused severe delays.

**Inadequate Risk Sharing**

Eurotunnel did not adequately pass through to the contractors many construction risks, as a result of a confusion of roles (at the time of signing the construction contracts, constructors were also the equity sponsors with decision-making powers, while individual shareholders had no power and banks small technical expertise). As a result, Eurotunnel engaged in a complex contract with constructors who were also its shareholders. The contract allocated risks in three parts: part “fixed costs” (with escalation for price changes), part “target cost” and part “cost plus”. The execution of this contract paved the way to many variations, which allowed the constructors to have the price significantly revised.

**Impaired Governance**

Whereas traditional project finance relies on a simplified organisational and governance structure, large project companies cannot deal with a simplified structure with regard to the high number and diversity of stakeholders. In particular, the importance of financial needs and the resulting dispersion of equity and debt

<sup>5</sup> Refinancing instruments include Fixed Link Finance issuances rated by Fitch (see report “Eurotunnel and Related FLF1 & FLF2 Debt Vehicles - How Far Underwater Are They?”, dated 19 May 2005)

**Channel Tunnel: A Follow-Up**

- Eurotunnel completed reorganization in April 2007 under the French equivalent of Chapter 11 bankruptcy protection, with a capital increase and the reduction of the debt by 50%, now slightly above EUR4bn.
- In 2007, Eurotunnel posted the first positive net result of its history.
- The Tunnel is used by 16 millions passengers annually (of which half through the high speed trains Eurostar), with a daily traffic of about 360 trains. About 40% of the cars and trucks crossing the Channel go through the Tunnel.
- Eurotunnel estimates that the tunnel will have reached full capacity in 2020, when a second tunnel could be necessary.

ownership exacerbate conflicts in large project companies. With the same reasoning, the case illustrates some potential counterproductive aspects of limiting managerial discretion through the use of highly indebted capital structures and tight debt covenants.

**Traffic Forecasts Underestimated Competition**

The forecasts prepared for the construction of the Channel Tunnel had fairly predicted the market share of cross-channel travel that the tunnel would capture. But the total size and growth of these markets (both passenger and freight) was considerably overestimated. Moreover, the market share of the tunnel was only achieved through a competitive battle with ferry operators and low-cost airlines, which resulted in reduced tariffs. The combination of a narrower market and fierce price competition resulted in revenues being much lower than predicted. In 1999, five years after operational commencement, Eurostar train passengers totalled only 45% of the forecast for the opening year; rail freight traffic reached 40% of the forecast. This very slow ramp up is partly due to the fact that until 2003 no high speed rail link was available on the English side (trains raced along at 300kmph in France but slowed to 130kmph in the tunnel and crawled at 65kmph on the leg to London). The full stretch on the UK side became really high speed only in November 2007; London is now within 2h15m of Paris.

**Øresund Bridge (Denmark-Sweden)**

The Øresund Bridge is a 16km (10 mile) link carrying both highway and railroad traffic across the narrow neck of the Baltic Sea called the Øresund Channel between Copenhagen, Denmark, and Malmö, Sweden (see map). Between them, Greater Copenhagen and Greater Malmö are home to 1.8 million inhabitants, making Copenhagen-Malmö Scandinavia’s largest cohesive urban area.

The link includes a four kilometre immersed tunnel; an eight kilometre, two-deck bridge; and a four kilometre artificial island (called Peberholm), which links the tunnel and the bridge. This fixed link had been long desired and its promoters (notably the business communities) succeeded to gain political approval from the Danish Government in the late 1980s.

To reduce financing costs, both national governments jointly and severally guaranteed the loans. Both nations jointly own the facility. The bridge was meant to operate under a self-financing scheme based on real tolls, which are set by an independent authority.

**Successful Design-Build Procurement, Despite Higher Than Expected Costs**

The Øresund Bridge presented a range of difficult technical challenges, notably to meet challenging environmental criteria. The national governments were able to define their performance standards and the private sector responded with innovative design, fabrication and mitigation approaches. This approach produced a number of innovations in design, construction and environmental mitigation for the bridge. Works ended in July 2000, three months ahead of schedule but with the bridge coast to coast structure 25% and the landside infrastructure 70% over budget. This cost overrun is mostly attributable to changes in design due to enhanced environmental and safety standards. Overall, the cost overrun reaches 27% in constant prices<sup>6</sup>.

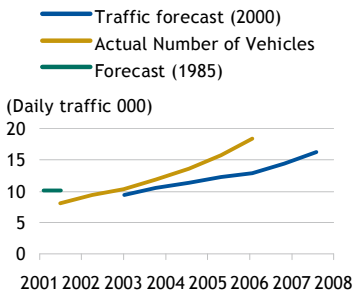


<sup>6</sup> EUR1.57bn (value 1990) at go-ahead decision in 1991; EUR1.99bn (value 1990) in 2000 at project completion



**Øresund Bridge Traffic**

Actual vs Forecast



Source: Øresundsbron

**Øresund Bridge: A Follow-Up**

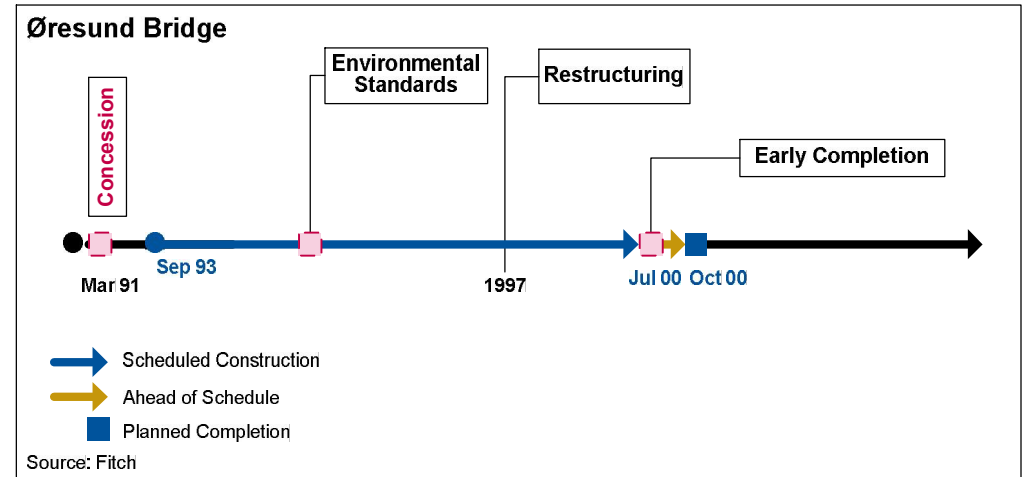
- More than half of all traffic between Sweden/Norway and Denmark/Germany now use the Øresund Bridge
- The fixed link experienced very dynamic car and train traffic trends, with an average of close to 20,000 passengers per day in 2008, notably thanks to a strong rise in commuting (mostly Danes moving to Sweden and Swedes working in Copenhagen). Growth has slowed in 2008, but commuters' traffic is expected to be resilient to the economic crisis.

**Lisbon Map**



Source: Fitch based on Macquarie

**Environmental Issues were Underestimated**



The construction contract was signed in March 1991, before any environmental impact assessment study (EIA) was carried out. In search for public consensus and to respond to environmental groups' opposition, politicians had to engage in promotional activity. Yet environmental groups, backed by the Swedish Water Court, succeeded in bringing major amendments to the project, such as a route change and some of the basic performance specifications (relating to water flow). Despite these constraints, the project was successfully completed and is now seen as a model of environmental sensitivity and protection. In projects of this size and complexity, environmental impact concerns will naturally be addressed in the planning process, but if the concerns can be translated into specific performance standards, then the design process can incorporate the standards from the outset.

**Questionable Initial Viability Assessment**

The decision makers (national governments) were assured in 1991 by the project promoters that the Øresund Bridge would be self-financing. As was pointed out later by the Danish court of accounts, assessments were showing that even minor variability from the projected costs and revenues could make the project non-financially viable (i.e., unable to pay back its costs in the 30-year time frame).

**Traffic Ramp-Up was Slower but Stronger than Expected**

Initial traffic on the facility came in well below projected levels, thereby lowering the amount of revenue produced by the facility. Planning projections estimated 10,000 vehicles per day for the roadway in the opening year, along with 16,500 to 19,000 rail passengers. But in calendar year 2001 (the first full year of operation), even after a toll reduction, the average daily traffic was only 8,100 road vehicles and 13,400 rail passengers. This was due in part to stiff competition from ferries that have traditionally operated on the Sound, especially for commercial freight traffic seeking a lower-cost alternative. It took two years for traffic to reach and outperform the estimates, but it rapidly exceeded initial forecasts.

Because of the higher costs and lower revenues of the first years, the financial equilibrium of the project is precarious. According to forecasts revised in 2007, even under a high-growth scenario, with aggressive assumptions about regional economic growth and trip-making, the facility will not likely be repaid until 2029 or 2030. Under more moderate assumptions, that period extends to 2035, and under a "stagnation" scenario (where traffic growth has slowed to 1% per year by 2025), the period extends to 2046 and beyond.

**Vasco da Gama Bridge (Portugal)**

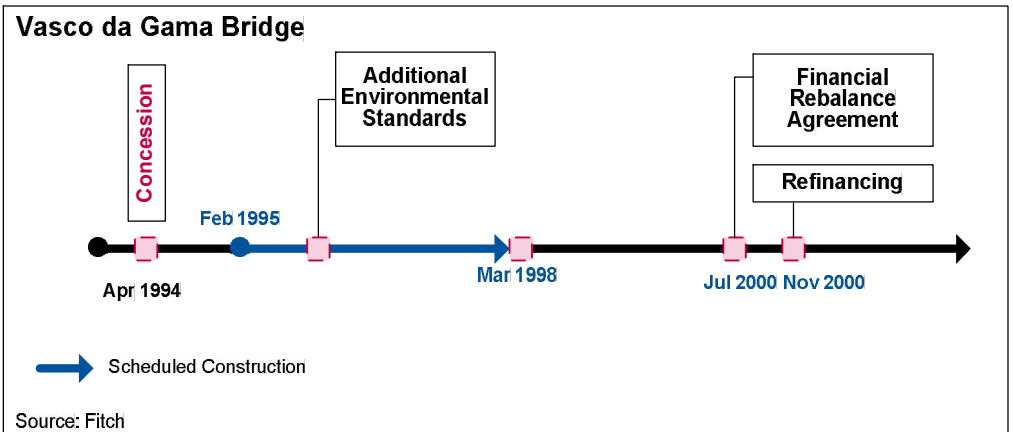
The Portuguese Ministry of Public Works and the Ministry of Finance studied in 1991 a second crossing over the Tagus River in the Lisbon urban area. This second

crossing was made necessary by the anticipated congestion of the first one, the 25th of April Bridge in operation since 1966. In 1990, the project location was selected, based on the rationale to revitalise Lisbon's waterfront district for EXPO'98, and to connect to the Lisbon Ring Road and major North-South motorways.

It was decided to opt for a PPP and the process that led to signature of the concession contract took five years. "Lusoponte", the winning consortium, suggested a concrete pylon, cable-stayed bridge with four lanes of traffic. To secure the future financial balance of the project, Lusoponte was granted the monopoly on every potential future road link across the Tagus, within a radius of 25km around the bridge. The operation of the 25th of April Bridge (and its toll revenue, which was set to increase) was included into the concession and the existing bridge was brought for free in the concession income generating base, to avoid inefficient competition and to "subsidise" the new bridge. The concession period had an interesting feature: it would mature after 33 years or once 2.25 billion vehicle trips made on two bridges combined would have been reached, whichever came first, when ownership reverted to the government.

### Vasco da Gama Bridge: A Follow-Up

- The Terms of the concession agreement are being modified to defer the introduction of a fourth lane on the Vasco da Gama Bridge until the threshold of 101,000 vehicles per day is reached (the previous threshold was 52,000, with actual traffic of 68,000 as of December 2007)
- In December 2007, following the Portuguese government announcement that a third crossing will be built over the river Tagus, the grantor has expressed a desire to renegotiate the crossing monopoly clause currently favouring Lusoponte.
- In 2008, Macquarie sold its stake in the project. Vinci, Mota-Engil and Autostrade are now the major shareholders.



### Design and Construction Success

The project achieved unquestionable success in terms of planning and building: it opened on schedule in March 1998 and took only three years to build a 12km bridge situated in an urban zone. Operational and maintenance constraints were efficiently included at the design stage, to minimise their future costs: since the suspension cables would not permit a cradle installation to access under the deck for inspection, it was decided to insert a small fixed platform for inspection that would run beneath the 800 metre long deck. This resulted in a much more efficient maintenance programme.

But two main sets of issues affected this project: the planning stage had been too short to capture all constraints and public resistance to the new toll policy required a change in the economic plan.

### Firm Deadline Constrained Planning and Inflated the Construction Budget

The target to have the bridge open for the World Fair left virtually no flexibility to amend planning: due to a delay in getting the government approval, construction needed to start very quickly. The first issue was purely technical: the driven piles were supposed to be 60m deep, but instead it was necessary to go up to 100m deep. Moreover, the inter-tidal zone of the piles had to have twice the anticipated thickness of concrete to prevent steel cables from corroding

After construction had already started in February 1995, the environmental lobbyists obtained design modifications to address mitigation of wetland and bird preservation issues, traditionally highly sensitive in a river mouth area. This entailed important design variations, which could have been addressed upfront if

the environmental impact studies had been conducted before. Allegedly, construction was completed on time, but it was slightly over budget (4.5% in constant terms). As the constructors and concessionaire claimed they were attributable to the grantor's design variations, the cost overruns were addressed in the global financial rebalance agreement agreed in 2000 (see below).

***Population's Protest Against Toll Increases; Traffic is Below Forecast***

However, the financial equilibrium was most affected by the toll rates policy. The strong protest that followed the announcement of the toll increase on the old bridge<sup>7</sup>, including a roadblock by hauliers and other citizens in June 1994, prompted the government to change the concession's terms. It was thus decided to adopt different toll levels on the two bridges and increase the old bridge tolls only when other transport alternatives would be available, namely the rail crossing on the 25th of April bridge and new river ferries. This resulted in the 25th of April Bridge being more attractive than initially planned, and in contrast the Vasco da Gama bridge less so. As a matter of fact, the former records traffic slightly above base case (6% as of December 2007), that is to say above capacity, while the latter is continuously below (by 27% in 2007).

***Government Eventually Took on Additional Risks***

Portuguese legislation obliges the public authorities to compensate the concessionaire for any reduction in the initial internal rate of return caused by changes decided by the grantor (a mechanism called "Economic and Financial Rebalance<sup>8</sup>"). The concession contract was thus revised to cover notably the loss of revenue stemming from the freezing of old bridge tolls. Six financial rebalancing agreements were signed, resulting in a final general agreement, which mainly entailed an extension of the concession period<sup>9</sup>, as well as a different risk sharing arrangement. The government notably agreed to increase its financial participation, to finance the maintenance of the 25th of April Bridge and to share interest and refinancing risks. Generally speaking, the stakeholders demonstrated strong flexibility and the concession model evolved considerably, shifting from a "two bridges, one price" concept to the final "two bridges, two prices" formula.

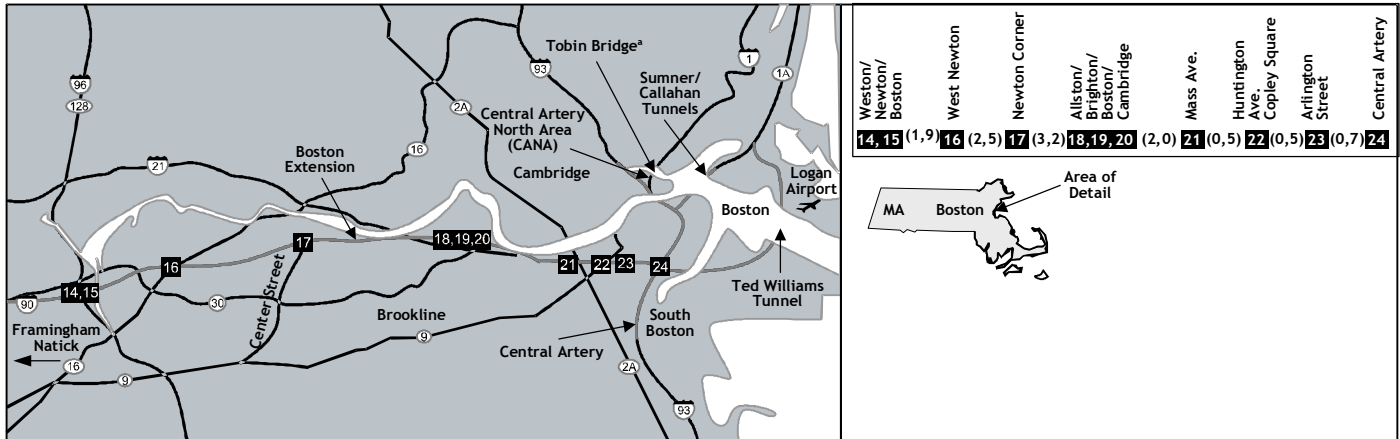
<sup>7</sup> Toll rates had become symbolic, with the rates having remained unchanged since the opening in 1966, even during the years of rampant inflation

<sup>8</sup> The Portuguese rebalance system includes compensation for both debt and equity funders.

<sup>9</sup> The new model established that the concession would mature in 2030, while the previous contract stated that the concession would terminate when traffic would reach a given level, estimated to be achieved between 2019 and 2023

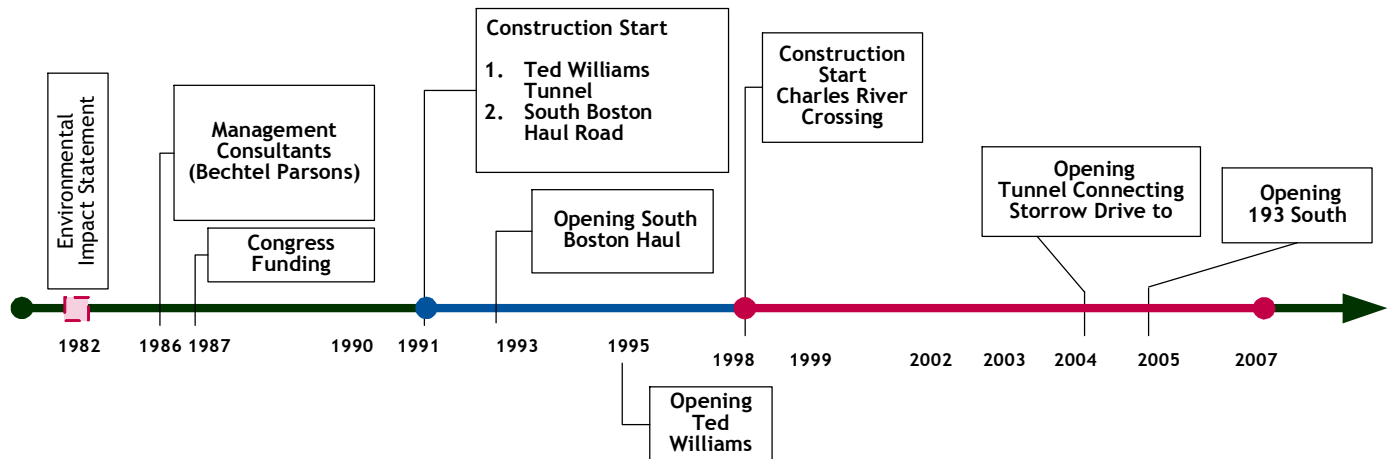
**Boston - Central Artery Tunnel "Big Dig" (US)**

**Massachusetts Turnpike – Metropolitan Highway System**



Metropolitan Highway System  
 "Owned and operated by Massachusetts Port Authority". (0.0 - Distance (miles) between Interchanges)  
 Source: Massachusetts Turnpike Authority

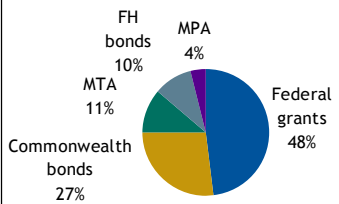
**Central Artery Tunnel Project**



Scheduled Construction  
 Time Overrun  
 Source: Fitch

The Central Artery Tunnel (CA/T) is a project aimed at burying, enlarging and expanding the old six-lane Central Artery (I-93) built in 1949 in Boston under the form of an elevated urban highway, which bisected downtown Boston and barred pedestrians from the waterfront. The new Interstate Highway System engulfs 12.1km of urban highways, of which 6km (49.9%) are tunnels, 3.7km bridges and 2.4km surface streets, comprising an extension to Logan International Airport. The project was highly subsidised by state and federal authorities, but also gets revenues under a real toll scheme.

**CA/TP - Funding Instruments**



Source: Fitch, Massachusetts Turnpike Authority Metropolitan Highway System, Sep 05

**A Giant Public Procurement Project**

In August 1986, a general contract to manage planning, design and construction was granted to Bechtel/ Parsons Brickerhoff JV by the Massachusetts Department of Public Works (MDPW). However, this is not an example of traditional project finance, as the federal government (and to a lesser extent the State of Massachusetts) have provided the bulk of the funds, with the Massachusetts Transportation Authority issuing revenue bonds to finance construction. Works began in December 1991 and were scheduled to end in 1998 with 118 individual construction contracts signed and funded by the Commonwealth of Massachusetts, the Federal Highway Authority and the MDPW.

**Record Cost and Schedule Overruns Caused by Series of Factors**

Since the approval of the USD2.6bn initial budget by the Congress in 1985, the project was subject to extensive changes in scope and design and at February 2007 98.8% of the CA/T was completed at a cost of USD14.8bn.

This cost is around 3.6 times higher than the initial cost (at a constant price of 1982, i.e. once inflation is neutralised). The impressive ballooning of the project costs was mainly attributable to design changes, right of way acquisitions (including buildings worth several tens of millions of dollars) and increasing project scope.

The project was scheduled to be completed in 1998, but actually was completed in 2008, although most of the works were delivered by 2000. Despite the obvious deviation from original planning, it is very difficult to allocate blame for the cost and schedule overruns. Yet some lessons can be drawn from these difficulties.

**Insufficient Monitoring, Expertise and Control from Sponsors**

Although the main funder was the federal government, which exercised only scarce control on the project's development, the latter has been managed by the Massachusetts Turnpike Authority (an unaccountable public entity created by the state). This breached the golden rule that "the payor is the decision maker". But at the state level as well, control appears to be subject to criticism, as noted by the House Oversight Bureau (parliamentary audit office). Notably, the state kept a hands-off approach, delegating key segments of the project management to external consultants (Bechtel and Parsons) whose contract had an "open-ended structure". Moreover, consultants were accumulating several roles (preliminary designer, design coordinator, construction coordinator, contract administrator), and hence were often in charge of checking their own work, reducing incentives to alert if issues in upstream roles were likely to have consequences downstream. To avoid this, the sponsors (public authorities) would have required excellence in management of initial costs, scope and complex contract language. The lack of internal expertise prevented the procurement authorities from being in the driving seat.

**Mitigation Costs Were not Disclosed to the Public at Decision Time**

Costly mitigation efforts (to alleviate the negative impact on Boston of the Big Dig's construction, from interrupting business to harming the environment) were necessary to gain popular adhesion to the project and temper even reasonable criticism. Indeed, many communities (big firms, environmentalists, airport neighbours) obtained pledges, such as the continuity of service on the existing six lanes during the works, the creation of green open spaces, and the design of exit routes far from residential areas, etc. These mitigation expenses have accounted for about a third of the final cost, and were not included in the original budget forecast. More accountable planning would have required those costs to be disclosed and publicly justified.

**Political Resistance to Toll Increase and Precarious Financial Position**

Historically, toll increases by the MTA have been met with political resistance. In 2002, the scheduled toll increases were delayed by six months and also

**Big Dig: A follow-up**

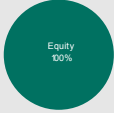

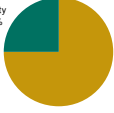
- In July 2006, a ceiling collapsed in the Ted Williams Tunnel, causing the death of one motorist and the closure of the tunnel for a long period.
- Additionally, political differences are influencing the Authority's rate setting ability and has limited the extent of toll increases. The MTA is seeking additional annual funding to cover CA/T expenses. At this time there has been no indication from the Commonwealth that any further support will be provided.



incorporated unexpected discounts, including continued electronic toll collection discounts for passengers that were not originally forecast. The 2008 toll adjustment continues the electronic toll discounts while increasing cash tolls to levels that were projected in 1999. Many observers believe the most recent toll increase will not generate sufficient revenues to cover obligations in the near future.

Appendix A — Key Features of Projects

Key Features of Projects

	Asset type	Total cost	Sponsors (at financial close)	Constructors	Commissioning date/ construction start/ operational commencement	Funding pattern
Suez Canal	Sea level canal: 193.5km long, 55m wide, 17.7m draft	FF200m (EUR911m; USD1.25bn)	Compagnie Universelle du Canal Maritime de Suez SA	Compagnie Universelle du Canal Maritime de Suez SA	30 Nov 1854/ 25 Apr 1859/ 17 Nov 1869	
Panama Canal (FRA)	Sea level canal (design change to lock canal): 12.6km (40%) completed	USD265m (1889)	Compagnie Universelle du Canal Interoceanique de Panama (later) Compagnie Nouvelle de Panama	Compagnie Universelle du Canal Interoceanique de Panama (later) Compagnie Nouvelle de Panama	15 Jul 1879/ 01 Jan 1880/ 1898 (termination)	Mainly equity
Panama Canal (US)	Lock canal: 31.5km long, 304.8m lock length, 33.5m lock width, 12m ship draft, 32m ship beam	USD352m (1914), EUR5.16bn (2007) USD7.07bn (2007)	Congress of the United States of America	US Army Corps of Engineers	23 Feb 1904/ 04 May 1904/ 15 Aug 1914	
Eurotunnel	Undersea rail tunnel: 50.5km long, (75% undersea), 40m below seabed on average (down to 107m)	GBP10.1bn (1994), GBP14.1bn (2007) EUR20.6bn	Channel Tunnel Group Ltd France Manche SA, retail investors	Balfour Beatty C. Ltd., Costain UK Ltd., Tarmac C. Ltd. (now Carillon), Dumez SA. (now Vinci), Bouygues SA., Spie Batignolles	14 Mar 1986/ Dec 1987/ 06 May 1994	

Key Features of Projects (cont.)

	Asset type	Total cost	Sponsors (at financial close)	Constructors	Commissioning date/construction start/operational commencement	Funding pattern
<b>Oresund Bridge</b>	Cable stayed double deck bridge: 7.8km long, main span 490m long, approach bridges 3.74km, 3km long, 32.5m wide, 55m clearance, Immersed tunnel: 4km long, artificial island 4km long	DKK30.1bn (2000), DKK34.4bn (2007), USD6.45bn (2007), EUR4.71bn (2007)	Danish Gov. Swedish Gov.	Skanska AB, Hochtief AG, Hojgaard & Schultz A/S, Monberg & Thorsen A/S, NCC AB, John Laing Ltd., Vinci, etc	23 Mar 1991/ 16 Sep 1993/ 01 Jul 2000	 Guaranteed debt 100%
<b>Vasco da Gama Bridge</b>	Cable stayed bridge: 420m long, 30.9m wide, 47m clearance	EUR1.03bn Jul 00 EUR1.35bn (2007) USD1.85bn (2007)	Lusoponte, a consortium, held by: Kvaerner <sup>10</sup> (24%), Campenon Bernard (Vinci group) (22%), Bento-Pedroso (Odebrecht group) (15%), Somague (14%), Mota Engil (14%), others (11%)	Novaponte, a consortium made up of: Kvaerner C. Ltd., Vinci Group, Bento Pedroso C. SA, Somague, etc	Feb 1995/ Jul 1995/ 29 Mar 1998	 Equity 8% Debt 33% Grants 54%
<b>Central Artery/Tunnel Project ("Big Dig")</b>	Interstate Highway System Project: 12.1km urban highway (49% underground), of which 6 km tunnels, 3.7km bridges	USD14.8bn (2007), EUR10.8bn (2007)	Commonwealth of Massachusetts, Federal Highway Authority, Massachusetts Port Authority, Massachusetts Department of Public Works	Bechtel/Parsons Brinkerhoff, 118 separate construction contracts, Modern Continental, Slattery, Perini Corporation, Jay Cashman, Obayashi Corporation, etc	28 Aug 1986/ 19 Dec 1991/ 28 Feb 2007 (98.8% complete)	Mainly federal grants, plus various bonds (grants anticipation notes, revenue backed notes)

Source: Fitch

<sup>10</sup> Trafalgar House was the initial partner; it was taken over by Kvaerner in 1996, and then by Skanska

Appendix B — Performance of Projects on Key Issues

Performance of Projects on Key Issues

	Geopolitics	Local politics	Planning and conception	Construction	Funding	Demand	Pricing and operation
<b>Suez Canal (FRA - Egypt)</b>	UK opposition to French initiative; concession negotiations with Ottoman Sultan	Egyptian Viceroy financially backed the project, French legislation enacted to allow a second refinancing through lottery bonds	Good performance	Time overrun (four years), cost overrun (50%)	Failed IPO, project company refused a syndication by the Rothschilds, refinancing failed twice	Good performance	Good performance
<b>Panama Canal (FRA - Colombia)</b>	Concession Bonaparte-Wyse (grants construction rights), Monroe doctrine (US obstacle to French government guarantee)	Bribery of French politicians in a refinancing, promoters prosecuted for financial fraud	Late implementation of engineers' proposal of a lock canal, design change one year before liquidation	Time overrun (one year), 100% cost overrun for 40% of project achieved, c.20,000 deaths during construction	IPO failed, failed refinancing, no sovereign guarantees, assets finally sold to US	n/a	USD3/ton on predicted traffic of 6m tons pa
<b>Panama Canal (US - Panama)</b>	Hay-Bunau-Varilla Treaty (US-Panama: concession), Independence of Panama from Columbia (1903)	US supported the spin-off of Panama from Colombia	Congress pushed for larger locks to enable use of bigger future ships	On time (one year ahead of schedule), on budget (16% below estimated costs), 5,609 deaths during construction	100% funded by the US Congress	Traffic reached expected level with 10-year lag (project opened by start of WWI)	Fees calculated on a breakeven basis
<b>Channel Tunnel (FRA - UK)</b>	Channel Tunnel Treaty (imbalance in willingness between France and UK, UK push to prohibit government guarantee)	National governments encouraged retail banks to distribute share syndication	Safety issues largely underestimated at initial planning stage	Three different types of contracts including "cost plus". Cost overruns 108%, time overrun (one year), conflict of interest (one entity acting as principal and agent in construction contract)	Initial under-capitalisation, large syndication (220 banks), several suspended interest payments, last financial restructuring and refinancing in 2007	Over-optimistic traffic forecast, five years after opening, traffic reached only 45% of expected for opening year	Price fight with ferries and low cost airlines; Good operation record despite two fires in tunnel
<b>Oresund Bridge (DEN-SWE)</b>	Strong support for regional integration policy	Government financial backing, environmentalist group opposition, court rulings for environmental protection	Environmental issues underestimated; successful design-build procurement	Cost overrun (25% bridge, 70% landside infrastructure), completion ahead of schedule (three months)	Government guarantees. Debt retirement expected later than initially planned	Ramp-up slower but stronger than expected. Traffic up by 20% in year two	Stiff competition from ferries led to toll reduction

Performance of Projects on Key Issues (cont.)

Geopolitics	Local politics	Planning and conception	Construction	Funding	Demand	Pricing and operation
Vasco da Gama Bridge (POR)	WWF opposition, public resistance to higher tolls	Design modification during construction, late contract signing caused additional costs, initial contract lacked approved EIA	Turnkey contract. On time, slight cost overrun 4.5%, concession extended in 2000 by two years to March 2030 (35-year tenor)	Initial loan fixed interest (in a high interest rate environment), global financial rebalance agreement (Portuguese state makes compensation payments if toll rates are changed)	Actual traffic 27% below base case. Main reason is change in toll policy on “competing” 25th April bridge	Toll frozen (by government) under public pressure. Compensation obtained through changes in risk allocation
Central Artery/Tunnel Project (“Big Dig”) (US)	High mitigation costs accepted (but not accounted for in initial cost plan) to gain popular adhesion. Political resistance to frequent toll increases	Project management delegated to external consultants with open-ended contract. Extensive changes in scope and design occurred	Huge cost-overrun due to design changes, right of way, deficiencies, delays (leaks and wall breaches), fraudulent conduct of constructors, one death and costly tunnel closure due to tunnel ceiling collapse	Mostly federal grants and state bonds. 11% of funding was sourced from revenue bonds	Not available. Only a small portion is tolled.	Toll collection at tunnels and interchanges from inbound traffic

Source: Fitch



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