An Analysis of the Success of the Channel Tunnel Project

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Abstract. The Channel Tunnel is the largest privately funded engineering undertaking in the world. The tunnel is 51 kms in length and stretches from England to France beneath the English Channel [1]. As a crucial link in Europe's new high-speed rail network, the Tunnel is slated to open in December 1993 and be fully operational by that time. It has also been beset by financial and technical issues, missed deadlines, and high-profile disputes between the Anglo-French company Eurotunnel, which oversees the project, and its suppliers. This case study begins with the earliest aspirations for a fixed link across the English Channel in the early 1800s and ends with the commencement of the current project. This paper examines the political forces in Britain and France that influenced the project, as well as the Channel Tunnel Treaty's governing provisions. Eurotunnel Company was selected to construct and operate a tunnel, as well as handle the funding and engineering design. The study also examines the difficulties that resulted from these problems, so as to offer some references for future projects.

Keywords: Channel Tunnel · Major Risks · Eurotunnel · Stakeholders · Challenges · Management

1 Introduction

The Channel Tunnel (Chunnel) project is one of the largest privately funded construction endeavours ever undertaken [2]. It involves the construction of an underground tunnel connecting England and France. Several parties collaborated to ensure the success of this project: two distinct national governments, the banks that provided the project's financing, multiple contractors, and a number of regulatory agencies. The building of the tunnel entailed the use of new technology, and significant alterations were required due to unanticipated situations and possibilities mandated by a range of stakeholders. The Channel Tunnel is a rail tunnel connecting Folkestone, Kent, in England to Coquelles, Pas-de-Calais, near Calais, France. In the Dover Strait, the tunnel extends beneath the English Channel. It is the only unbreakable connection between the British Isles and the European continent. London is connected to Paris, Brussels, and Amsterdam via Eurostar and Thalys trains via the Eurostar and Thalys rail networks. The Channel Tunnel was officially inaugurated in 1994 [3].

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Between the two terminals, there are shuttle trains for autos and coaches, as well as trains for heavy freight vehicles. Other trains that utilise Getlink infrastructure are operated by their respective owners. Getlink, formerly known as Eurotunnel until 2017, presently maintains and operates the Channel Tunnel, together with its shuttle vehicle services and other trains going through the tunnel (including DB Schenker's freight and Eurostar's passenger services). Founded in 1986, Getlink's initial objective was to construct a tunnel connecting the two countries for 55 years, however this was eventually extended to 99 years until 2086. Getlink's headquarters are in Paris [4]. The total cost of constructing the Channel Tunnel, which was estimated in 1985 to be GBP 4.8 billion (about USD 6.2 billion at 1985 prices), ended up being far more than anticipated at GBP 9.5 billion (about USD14.5 billion in 1994).

The expenditures of the project were 80%t overstated, resulting in a massive overrun. Costs associated with construction, equipment delivery, and testing difficulties, as well as alterations to the project's design during construction, all contributed to the project's significant delays. All five banks in the TransManche Link cooperation donated private funding to the project. The company's activities were financed by GBP8 billion in debt and shareholder investment (about USD12.2 billion, 1994 prices) [5].

This research paper aims to analyse the development of the Channel Tunnel, and identify the process it takes for the tunnel to be successful and the risks that comes with growing a diversified successful businesses, and finally, summarize some major lessons learned from the development of this project, so as to offer some references for future projects.

2 Vision and Strategy

Albert Mathieu-Favier, a French engineer, presented the concept of a Channel Tunnel at the beginning of the nineteenth century. From both sides of the English Channel, Beaumont's compressed air-powered tunneling equipment were used to start tunneling. As a direct result of British invasion worries, building was immediately halted [6]. The British government remained steadfastly opposed to Sir Edward Watkin's project proposal until 1955. In response to the United Kingdom's entry into the European Economic Community in 1974, the Channel Tunnel was constructed (the Common Market) [7] (Table 1).

3 Fecial Challenges

The construction of the tunnel connecting Britain and France was a great feat of engineering [8]. At the time of its completion, the Channel was the most expensive building project ever conceived. Off the coast of France, six fault lines crisscrossed the first several kilometres of the tunnel's length as scientists searched for the optimal spot to drill. Each of the approximately one million concrete lining pieces used to line the tunnels was stronger than the concrete used in nuclear reactors [9]. While excavating, the subject of what to do with the fruits of the drilling arose. On the British side, around 5 million cubic metres of spoils had to be disposed of [10] (Fig. 1).

Table 1. The Channel Tunnel Project's key events and developments in the past [1]

Time	Historical Event
11-Sep-81	At their summit, the United Kingdom and France declared that the project would be funded entirely by private sources.
2-Mar-85	Proposals to release tenders from the British and French governments in order to secure financing, building and operation of the Channel project have been rejected.
12-Feb-86	It was legally signed by the two countries and referred to as the Treaty of Canterbury.
15-Dec-87	Official excavation of the British portion of the Channel Tunnel began.
10-Dec-93	TML will hand over the project to the European Tunnel Company once work is complete.
6-May-94	a new era began with the official opening of the Channel Tunnel
19-Dec-97	It was agreed by the British and French governments that the franchise period would be extended to 2086.
7-Apr-98	Restructuring of the company's finances has been completed.
2-Aug-06	The European Tunnel Company's bankruptcy petition has been authorized by the Commercial Court of Paris, according to the court's statement.
2-Jul-07	Groupe Eurotunnel S.A. (GET SA) replaced the European tunnel company responsible for the British-Strait Channel Tunnel operations on the Paris and London stock markets.
3-Mar-09	After posting a net profit of £35 million in 2008, the European Tunnel announced it will pay its long-suffering owners their first dividend: 4 euro cents per share.
4-Dec-13	By 2020, the UK Treasury hopes to raise £20 billion for infrastructure projects by selling government-owned stocks such as "European Star."

Source Da Li, Xiaoyan Lin, Xiaofeng Wu, Analysis of the Channel Tunnel Project, 2019, permitted by the author

After completing the tunnel, the waste material was simply deposited back into the canal at the tunnel's mouth, resulting in an additional 73 acres of land for the island. After the excavation was completed, a number of other difficulties needed to be addressed, such as cooling, ventilation, and pumping, among others. The contact between the train and the track generates a tremendous amount of heat. Two power plants, one on either side of the tunnel, provide electricity to the whole railway and tunnel system.

4 Stakeholders

There is an increasing demand for tunnel access, therefore the IGC asked its joint economic committee (JEC) to host a conference for all Channel Tunnel parties to discuss economic regulatory issues [11] (Fig. 2).

The opinions of interested parties:

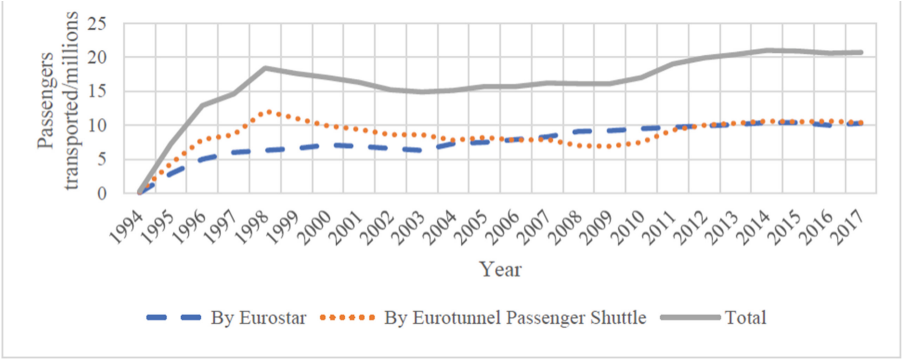

Fig. 1. Passenger traffic volume of the Channel Tunnel from 1994 to 2017[16]. *Source: "Traffic figures", Eurotunnel. Retrieved February 6, 2011–2018, permitted by the author.*

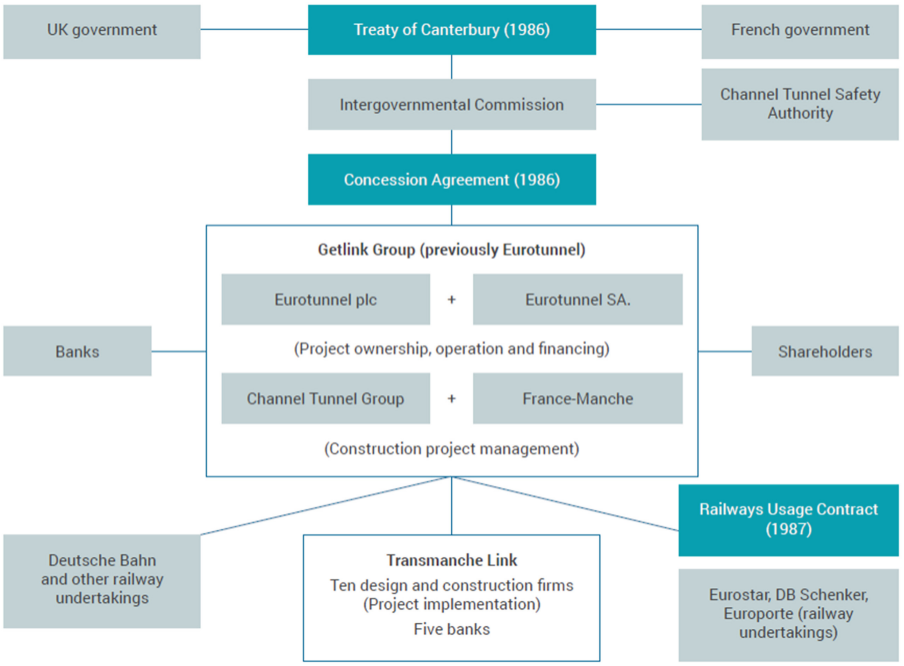

Fig. 2. A summary of the Channel Tunnel's contractual arrangement [17]. Source: M. Grant, Features: Big Project Financing – Financing Eurotunnel. Japan Railway & Transport Review No. 11, 1997, pp. 46–52. East Japan Railway Culture Foundation (EJRCF), permitted by the author

There must not be a system of punishments for interruption that has a detrimental effect on small railroad firms, particularly freight. When further developing the Tunnel regime, Eurotunnel and IGC should benefit from other networks' best practices and aim for approach homogeneity, at the very least across Eurotunnel, HS1, and RFF. To persuade operators that the regulations were being followed, enhanced performance

transparency was required. If the procedures in the Network Statement are inconsistent with the usage agreement, they are not compliant. International services require the availability of Dollan's Moor and Fréthun. IRG-Rail might play a role in advocating an integrated strategy for international corridors, supported by operators' traffic predictions, in the development of the arrangements going forward. Improving the Channel Tunnel's accessibility[12].

When the time came for a brief, public discussion on how to make the Tunnel more accessible:

- Eurotunnel presented their planned ETICA programme for subsidizing increasing freight flows, which was generally well received by freight stakeholders.
- If IGC and Eurotunnel review the list of prohibited commodities, rail freight via Eurotunnel might possibly open up certain hitherto restricted markets.
- There was pressure on IGC and Eurotunnel to enhance its technological and safety capacities in order to level the playing field for new entrants and consumers alike. Conclusions and next steps

As a consequence of this productive dialogue, the regulator and its stakeholders have decided to:

- Hold such events at least once a year in the future.
- Continue focusing on gaining a knowledge of the business backdrop, enhancing the transparency of access agreements, and addressing specific problems of concern (such as security and safety requirements).
- Ensure Eurotunnel fulfil its representative's obligations.

5 Major Risks and Lessons

5.1 Major Risks

The Risk Analysis of Tunneling Projects study incorporates political risk, force majeure risk, technical risk, and economic risk. Risks include construction risks, contract risks, and risks connected to misjudgments and errors in the tunnel's purpose and job, which render the tunnel inappropriate for its purpose (functional risks) [13]. The underlying risk of tunnel operation, namely functional risk, must be addressed appropriately. During tunnel operation and upkeep, the functional risk is the most prominent. Tunnel management must optimize all tunnel features, ranging from tunnel equipment systems to tunnel structural maintenance and monitoring, in order to provide uninterrupted and secure traffic flow throughout the tunnel.

These important hazards have been identified and evaluated with care. The current situation of the economy has a significant impact on market conditions. Due to a multitude of factors, tunneling projects might have unattainable objectives. Time overruns include project-concurrent work and payments, as well as business disruption and stoppage due to force majeure (Table 2).

Since its opening in the early 1990s, the Channel Tunnel has had three catastrophic fires[14]. These instances have the potential to cause losses in the tens of millions of

Table 2. The risk breakdown is used to structure internal and external resource tunneling initiatives [18]

Risks From External Sources	Risks From Internal Sources
1) Political risk	1) Contractual risk
2) Social risk	2) Investment risk
3) Economic risk	3) Employer risk
4) Legal risk	4) Management risk
5) Environmental conditions at the project site	5) Planning risk
6) Natural disasters	6) Time overrun
	7) Human risk
	8) Equipment and material resources-related risk
	9) Financial commitments and guarantees
	10) Technical risk (design and implementation)

Source: Lee, Yong Siang & Ghazali, Farid. Major Functional Risks for Operation and Maintenance of Tunneling Projects. ESTEEM academic journal, 2018(14):24–37, permitted by the author

dollars, as well as severe disruption and extra financial damage. The 1999 fire that forced the closure of the Mont Blanc Tunnel for three years cost the Italian economy an estimated $2.5 billion, while the improvement to the service cost 206 million Euros. In 1996, due to fires in the Channel Tunnel in France, the tunnel's usually thick lining was lowered to 0.17 m. Along a length of 240 m (70 m toward Britain and 170 m toward France), the concrete was deteriorated to the level of the first reinforcing bars. During the Channel Tunnel fire of 2008, six trains and one locomotive were destroyed. Due only to economic losses, the tunnel closure resulted in a total loss of 215 million Euros.

5.2 Major Lessons

Some of the tunnel's problems were created by the corporate structure, which is unlikely to occur again.

Problems with the Channel Tunnel:

Almost every major construction project has similar challenges, but the tunnel's extensive modifications and the reasons for their necessity are especially pertinent. As with other public projects, the procurement procedure was hastened.

Unimaginable was a short schedule for a project of this size. As anticipated, crucial design aspects were entirely absent. Air friction caused by high-speed trains was not anticipated to cause the tunnel to get particularly hot. Adding a chilled water air conditioning system to the design was a miscalculation that ultimately cost a great deal of money. The gallery welcomes the project's development.

Isn't it reasonable that the sooner it is initiated, the sooner it will be completed, saving money and allowing the project to realize its benefits earlier? Such attitudes are deemed by some in the industry to be hopelessly naive. If the design has not been adequately validated, the project may undergo modifications, resulting in longer delays and a higher total cost. The consortium's decision to place a high priority on the timely completion of the Channel Tunnel necessitated extensive architectural modifications. The one-year delay was caused by the rolling stock being delivered late, which was one year behind schedule [15].

Table 3. Assessment of Project Management [6]

Rating Scale: 5–Excellent, 4–Very Good, 3–Good, 2–Poor, 1–Very Poor

Project Management Area	Inception Phase	Development Phase	Implementation Phase	Closeout Phase	Average
Scope Management	2.00	2.00	2.00	2.00	2.00
Time Management	3.00	3.00	2.00	3.00	2.75
Cost Management	2.00	2.00	2.00	1.00	1.75
Quality Management	4.00	4.00	4.00	4.00	4.00
Human Resource Management	3.00	3.00	3.00	2.00	2.75
Communications Management	2.00	3.00	3.00	2.00	2.50
Risk Management	2.00	2.00	2.00	2.00	2.00
Procurement Management	3.00	2.00	1.00	1.00	1.75
Integration Management	3.00	3.00	3.00	3.00	3.00
Average	2.67	2.67	2.44	2.22	**2.50**

Even though this was a tremendous accomplishment, it was only possible because the construction and design were completed concurrently. Even if the political repercussions were the most harmful, the Channel Tunnel serves as a cautionary tale about how not to obtain massive public works; this is a lesson that must be learned.

6 Project Management

As part of the project's objectives, a brand-new rail system with low transit time and high capacity in a confined subterranean setting was created. The 1986 Treaty of Canterbury created the undertaking's political foundation. The success of the project also depended on the capacity to efficiently communicate between the tunnel's two sides. As a Project Manager, you will be accountable for Based on the conceptual design, the anticipated cost of the project was calculated to be £5 billion. In order to keep costs low, the project manager had to employ subcontractors at various phases of construction using fixed-price contracts (Table 3).

The tunnel was initially scheduled to open on May 15, 1993, however construction difficulties pushed that date back [Date of occurrences obtained from Wilson and Spark (1994)]. Accelerated plan for the Channel Tunnel Due to the scale of the project, many subsidiary efforts were started concurrently in order to accomplish all of its objectives. The link between the length, cost, and quality of the Channel Tunnel project. It was Eurotunnel's responsibility to fund the project without assistance from the government or bank financing. The Intergovernmental Commission (IGC) was created to ensure the achievement of quality objectives [16].

Numerous analyses have investigated the Channel Tunnel to see what went wrong with such a massive construction undertaking. A number of financial and technical issues, publicly publicized missed deadlines, and high-profile confrontations arose between ET and its subcontractors TML. Because banks and contractors dominated ET's approach to

design and administration, it was largely criticized to its long-term financial stability, the Channel Tunnel was able to weather the storm despite all the delays and cost overruns [17]. The 15,000-strong team consisted of legislators, government employees, bankers, attorneys, and analysts from around the world. A assessment found that in the Risk Management report, engineering risk was prioritized over process and approval risk [18].

7 Conclusion

In order to provide a lasting connection between the United Kingdom and Europe, France and the United Kingdom must demonstrate a great deal of political will to complete the Channel Tunnel. During the creation and management of the project, financial issues prompted a series of reorganizations and caused the private sector to incur enormous losses. After the tunnel was opened, the financial difficulties were further exacerbated. Ferries did not disappear as initially predicted, and low-cost carriers intensified competition. Eurotunnel was rescued from collapse for the fourth time in 1998 and is now facing a new life struggle. The company still has debts of £6.4 billion and a basic operating profit of £170 million last year was more than amortized in interest payments of £318 million.

Nonetheless, several restructuring and refinancing attempts, the participation of a large number of private owners, and the Channel Tunnel's operating model based on the terms of the Railways Usage Contract were able to resolve the financial issue. If the design had been finalized and agreed upon with the IGC before construction began, some of the project's financial difficulties may have been averted.

In this instance, the importance of proper planning and design is evident. The Treaty of Canterbury, the Concession Agreement, and the binational direction of the IGC guarantee that the project will continue to operate even if the United Kingdom quits the European Union as a result of the Brexit vote. Proper planning is vital in the case that it helps in minimizing costs by using available resources in an optimum condition. This enables the team to have a shared vision when creating a project in order to fulfill the goal of the organization.

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