

**EUROTUNNEL: AN INNOVATIVE APPROACH
TO PROJECT FINANCING**

By

Stéphanie Roger
Elève Ingénieur de l'Ecole Nationale des Ponts et Chaussées

Submitted to the Department of
Civil Engineering in partial fulfillment of
the requirements for the degree of

**Master of Science
in Civil Engineering**

at the

Massachusetts Institute of Technology

May 1990

© MIT

Signature of Author _____

Department of Civil Engineering
May, 1990

Certified by _____

Fred Moavenzadeh, Ph.D.
Thesis Supervisor

Accepted by _____

Ole S. Madsen
Departmental Committee on Graduate Studies

EUROTUNNEL: AN INNOVATIVE APPROACH TO PROJECT FINANCING

by
Stéphanie Roger

Submitted to the MIT Department of Civil Engineering in May 1990,
in partial fulfillment of the requirements for the Degree of
Master of Science in Civil Engineering

ABSTRACT

The purpose of this thesis is to review financing packages available for megaprojects. In a first part, examples of megaproject financing are studied such as the U.S. and European Highways and the Suez Canal. Then, different ways to finance megaprojects are reviewed with a focus on a new but well proven technique known as 'project finance'. This technique has been used mostly for projects related to energy, but in the last ten years, it has started to appear in infrastructure financing packages.

The Eurotunnel project financing package has been put together with that technique. It is a precedent because of the size of this tunnel which will link England to Continental Europe and because stocks have been issued on both French and British public stock markets. This project and its financing are reviewed in detail in the third part of this thesis.

This project has taught some lessons about the financing of megaproject. It has been shown that any public infrastructure with a sufficient yield could be financed by the private sector. But a problem remains: how should projects which offer a moderate yield and which the public sector can not afford to fund be financed? It is necessary to look further into mixed financing packages which may be the solution the problem of building public infrastructures without sufficient public funds.

Thesis Supervisor: Professor Fred Moavenzadeh, Ph.D.

Title: Director, Center for Construction Research
and Education

ACKNOWLEDGEMENTS

The author wishes to thank the following persons for their help during the completion of this thesis:

-Pr. Fred Moavenzadeh, for his kind help and the research assistantship under his guidance

-Le Ministère des Affaires étrangères for their financial support

-Mme Christine Gens, Mr Roland Charbonnel, Mr Michel Chabanel and Mr Xavier de Savignac for taking the time to provide me with information

-Mr Patrick Gandil and Mme Geneviève Guinard for allowing me to study at MIT

-My parents, Annie et Claude Roger for their kind support

-Fadi Selwan for his help and warm support

-Joe Saleeby and Carine Assaf for their friendship

-the Transportation lab for allowing me to use their computer facilities

-and Mr Bernard Tarbès and the GTM-Entrepose corporation, without whom my experience in America would not have been possible.

Table of Contents

1 INTRODUCTION	8
2 EXAMPLES OF MEGAPROJECT FINANCING	10
2.1 In the United States	10
2.1.1 Toll roads:	11
2.1.2 Toll bridges:	13
2.1.3 The financing:	14
2.1.4 The Erie Canal:	15
2.2 In Europe:	16
2.3 The Suez Canal:	18
2.3.1 The history of the project:	18
2.3.2 The realization of the project:	19
3 DIFFERENT WAYS TO FINANCE INFRASTRUCTURES THAT PROVIDE REVENUES	24
3.1 Financing by the public sector:	24
3.2 Financing by the private sector:	25
3.3 Mixed financing:	26
3.4 The project financing technique:	28
3.4.1 The sharing of the risks:	31
3.4.1.1 The promoter's risk:	31
3.4.1.2 The country risk:	32
3.4.1.3 The project risk:	32
3.4.2 The evolution of project financing:	34
4 THE HISTORY OF THE TUNNEL UNDER THE CHANNEL	36
4.1 The history of the idea of a fixed link across the Channel: ..	36
4.1.1 In the Nineteenth Century:	36
4.1.2 In the twentieth century:	42
4.2 The treaty, the concession:	47
5 THE COMPETING PROJECTS:	49
5.1 The Europort (Eurobridge) project:	49
5.2 The Transmanche Express project:	50
5.3 The France Manche-Channel Tunnel project:	51
5.4 The Euroroute project:	51
5.5 Recapitulating table:	53
6 THE SYSTEM AND THE CONSTRUCTION:	55
6.1 The system:	55
6.2 The construction:	60
6.2.1 Main features:	60
6.2.2 The geology:	61
6.2.3 The construction technique:	62
6.2.3.1 Tunneling principles and techniques:	62
6.2.3.2 The tunnel boring machines:	63
6.2.3.3 The driving rates:	64

6.2.3.4 Spoil disposal:	65
6.2.3.5 Prefabrication and installation of linings:	66
6.2.3.6 Other works:	66
6.2.4 Construction programme:	67
6.2.5 The construction risks:	68
7 <u>THE DIFFICULTY OF FINANCING THIS PROJECT WITH SOLELY PRIVATE FUNDS:</u>	71
7.1 What are the conditions that the developers face?	72
7.2 How to make the financing with private funds possible?	74
7.3 How to make sure that the financial package is reliable?	76
7.4 How to reconcile the needs of the private financing and the public interest?	81
7.5 The impact of the projects:	83
7.6 Conclusion:	84
8 <u>THE FINANCING PACKAGE THAT MADE THE REALIZATION OF THE EUROTUNNEL PROJECT POSSIBLE:</u>	85
8.1 The cost of the project and the financing needs:	87
8.2 Traffic and revenue forecasts:	91
8.3 Earnings forecasts for the Eurotunnel corporation:	99
8.4 The financing:	100
8.4.1 The equity:	102
8.4.2 The credit convention:	105
9 <u>FINANCIAL COMPUTATIONS:</u>	112
10 <u>THE EUROROUTE PROJECT: FINANCING PACKAGE</u>	115
10.1 Costs and revenues:	115
10.2 Funding plan:	117
10.3 Cash flows:	119
11 <u>COMPARISON OF THE FINANCING PACKAGES OF THE EUROTUNNEL AND EUROROUTE PROJECTS:</u>	122
12 <u>RECENT DEVELOPMENTS IN THE EUROTUNNEL PROJECT:</u>	123
13 <u>THE PRIVATE FINANCING OF THE TUNNEL UNDER THE CHANNEL:AN EXAMPLE OR A SINGLE CASE?</u>	129
13.1 The public sector can partially guarantee the loan:	130
13.2 The risks can be shared, some can be taken by the banks and the rest by the public or private developer:	132
13.3 The subventions:	133
13.4 The public sector can give some capital:	134
14 <u>CONCLUSION</u>	136

Table of Figures

Project finance technique opposed to standard technique	29
Risks covered by the financing plan	91
Traffic across the Channel	92
Countries of origin of the banks involved in the bank syndic	106

Table of Tables

Shares of the Suez Canal bought by different countries	20
Projects in competition	53
Projects in competition	54
Passenger traffic forecasts	94
Freight forecast	94
Shuttles and ferries tariffs	96
Trains and planes tariffs	96
Revenues forecasts	98
Revenues forecasts	98
Forecasted income	99
Results of financial computations for the Eurotunnel project	114
Funding requirements of the Euroroute project	120
Result of financial computations for the Euroroute project	120

1 INTRODUCTION

Recently, project financing based on privatization has become one of the critical issues for the construction of infrastructures. Most projects of that kind were usually financed with government funds, or taxes, or proceeds from tolls but they always were backed by a public organization. We will first review examples of financing packages of infrastructures such as the Suez Canal, United States highways and European highways. Then, we will list the different ways of financing such projects and focus on a new and useful way, project finance.

This was the method used to finance the project which is the main example used in this thesis; the Eurotunnel project. The Channel Tunnel between France and the United Kingdom was not able to be built for a long time because of the difficulty of putting together a financing package. It had been technically feasible for a long time. We will review the history, the technical description, and the financing package of this project. We will compare it to one of its competitors and we will relate the recent developments which have taken place.

Finally, we will draw conclusions on the new ideas that Eurotunnel has brought in the matter of infrastructure financing and we will try to see

what could be done in Europe to facilitate the intervention of the private sector in such projects.

2 EXAMPLES OF MEGAPROJECT FINANCING

In this chapter, we will study how some existing infrastructure megaprojects have been financed in the United States and in Europe. We will concentrate on the history of financing packages involving financing with the proceeds from tolls.

2.1 In the United States¹

Toll facilities have existed in the United States for a very long time. In Connecticut, for example, a toll ferry crossing between Rocky Hill and Glastonbury has been in continuous operation since 1655 (121 years before the Declaration of Independence). In the following chapter, we will look into the history of toll facilities in the US and elsewhere.

1 based on:

'History of Public Works in the United States', American Public Works Association, 1976

'State and local public facility needs and financing', US Congress joint committee, 1966

'Peages Routiers et Role du secteur prive dans le developement des infrastructures routieres', OECD, 1987

2.1.1 Toll roads:

The first turnpikes in the USA were direct descendants of those in England and they appeared massively after the American Revolution. The principal reason was that neither the new Republic nor its individual States was able to assume the financial burden of providing the transport facilities necessary to bind the nation together.

In 1792, Philadelphia authorized the incorporation of a company to build and operate a road from Lancaster to the port of Philadelphia. The turnpike was completed four years later and its success prompted similar projects in other areas.

In the next quarter century, state legislatures chartered hundreds of private turnpike companies and some 8,000 miles of roads were constructed. But in the 1830s, the competition with railroads and canals was difficult and the maintenance and operating costs were too high. Many toll roads gradually fell into disrepair.

The development of the automobile revolutionized not only transportation but also the means of financing the needed roads. In 1901, New York initiated the annual motor vehicle registration fee. The original Federal Aid Road act of 1916 for the first time made funds available to

the States as assistance in building roads. Section 1 of that act stated that all roads constructed under the provisions of that act would be without tolls.

In 1919 the first motor fuel tax was enacted in Oregon and in 1932 the first Federal gasoline tax was imposed. Between 1920 and 1940, nearly 1 million miles of highways were built or improved mostly from the proceeds of highway user taxes of various sorts.

The Federal statutes and politics relative to toll facilities were emphasized in the Federal Highway Act of 1921. Despite the opposition to toll roads, the first modern toll road (the Pennsylvania Turnpike) was built entirely with Federal assistance in different forms. It opened in 1940. The success of that turnpike created a postwar boom in toll road financing and by the mid 1950s, more than 30 states had built, were building, or were planning to build toll roads. This seemed to stop in 1956 when the Federal aid Highway act was passed. This act provided aid to the construction of toll roads as long as the roads became free after the cost had been liquidated and as long as another alternate free road existed. But following 1960, there was a resurgence in the construction of toll roads and new investment totalling \$571,366,000 was recorded between 1960 and 1965. Toll roads had proven popular in areas of heavy traffic because it provided a self-supporting highway

facility relatively quickly: the costs are defrayed solely by those who support the facility and it is financed outside of the State's usual highway budget without draining current highway revenues.

2.1.2 Toll bridges:

The first toll bridges, like toll roads, were a product of the private sector. The United States, as a young country, had very limited tax resources. So, the advantages of private financing, ownership, and operation of toll bridges were obvious.

Construction and operation of toll bridges flourished and the trend toward publicly owned and operated toll bridges did not become general before 1930.

In 1927, the Oldfield act provided that federal aid highway funds could be extended to the construction of any toll bridge if the bridge was owned and operated by States or their political subdivisions and if all tolls received from the operation were applied to the repayment to the State and if no toll was to be collected after the debt was wholly repaid. This did not stop the construction of privately owned bridges. The States

and the municipalities tried to buy many privately owned bridges when they were in need of maintenance and their owners could not afford it. But many bridges remained privately owned.

2.1.3 The financing:

Over 90 percent of all toll facilities have been financed through an authority or a commission created by a State or a local government for this purpose and in certain instances via enabling legislation by the Congress.

Toll facilities are financed by the sale of bonds which fall into three general classifications: *Revenue bonds* are supported only by the income from the toll project, *Limited Obligation Bonds* are issues secured wholly or partly from the proceeds of highway use taxes, such as the State gasoline tax, but which do not carry the further guarantee of the State, *General Obligation Bonds* are backed by the full guarantee of the State, county, or municipality. Revenue bonds usually carry higher interest rates than either limited obligation bonds or general obligation bonds because of the greater risk involved. In some cases, a combination of the two or more of these financing techniques is used, for instance in the case of the New York Thruway.

The thruway is a 559 mile toll road connecting New York City with Buffalo. It was begun as a free facility shortly after World War I but it soon appeared that it could not be ended with tax resources only. It was decided to make it a toll road and the New York State Thruway was created to finance, build, and operate the facility. It obtained its first financing from short-term notes, comprising a \$10 million loan in 1950 and a \$60 million loan in 1952. In 1951, the New York electorate authorized the State guarantee of \$500 million of thruway authority bonds, which was considered sufficient to cover the costs. It became apparent that rising construction costs and additions to the thruway system would result in a cost greater than forecasted. In 1954, the legislature granted the authority power to issue revenue bonds to finance the ending of the project. The revenue bonds have first claim over the thruway income, even over the State guaranteed issues and this held the interest cost on the revenue bonds at a low level. Another unusual aspect of that package was that there were free sections on this toll road where Federal aid had been available.

2.1.4 The Erie Canal:

The Erie Canal is a 364 mile canal between Albany and Buffalo and it had to be built through largely unsettled wilderness. The State

legislature denied any financial aid, so the State assumed the responsibility for raising the necessary funds and directing the construction. The canal was completed in 1825. Traffic was so heavy that nominal tolls enabled the State to recover the \$8 million construction cost in just seven years.

The success of the Erie Canal provided the spark for a nationwide canal building boom. By 1840, various states had invested a total of \$125 million in 3,200 miles of canals.

2.2 In Europe:²

Before the second World War, most of the public infrastructures in Europe have been financed with the proceeds from taxes except in Ireland, where toll roads have been in operation since 1729, and in Italy, where the first toll highways have been built in the 1940s.

2 Based on 'Peages Routiers et role Du secteur prive dans le developement des infrastructures routieres', OECD, 1987

After World War II, Germany and Italy were the first countries in Europe to modernize their road network. Germany built new toll free highways with the proceeds from car users taxes and Italy used tolls to finance its own infrastructures.

The other European countries were not as fast; the construction of highways did not begin before 1960 but the use of tolls as financing means made some of them catch up.

In France and in Spain, highways were built using tolls as a resource. In England and in Netherlands, the State financed the construction with the help of taxes and loans. In Austria and Norway, a mixed solution was used.

Some other countries chose different ways; Belgium used a system of royalties, Switzerland made road users pay special taxes, and in Yugoslavia, where trade is a State monopoly, the highways have been financed by the State with the proceeds from tolls.

As shown above, when the public funds are too scarce to finance infrastructures, the system of tolls is widely used. It has the advantage of making the users pay directly for the service offered and to let others in peace. Let's take a closer look at the possible ways to finance infrastructures.

2.3 The Suez Canal:³

2.3.1 The history of the project:

Since the time of the Pharaohs, building a canal between the Red Sea and the Mediterranean had always been thought of as a benefit for the trade between Europe and the East (mostly India and China). The history of Egypt has been such that all attempts either failed or were destroyed after succeeding. In the nineteenth century, it appeared that this canal would be very interesting for the European countries that had no access to the Atlantic ocean and could not get to India through the Cape of Good Hope. The British saw the canal as a threat to their quasi monopoly in the trade between India and Europe and did everything in their power to prevent its realization. But in 1854, Ferdinand de Lesseps, a Frenchman raised in Egypt and childhood friend of the Viceroy of Egypt was authorized by the latter to form an international company under its own direction, the "Compagnie Universelle du Canal Maritime de Suez" to build the Suez canal between Cairo and Suez. The concession was to remain in force 99 years from the date of the opening of the canal. To prepare for the British opposition to the canal, the project was to be strictly regarded as a private enterprise on the part of De Lesseps.

3 based on 'The Suez Canal in Peace and War' by Hugh.J.Schonfield, 1969

2.3.2 The realization of the project:

An international commission, put together by De Lesseps in 1855, stated that the project was feasible and that the cost of the canal and of the works connected with it would not exceed the figure of £8,000,000.

Following these results, an act of concession was granted by the Viceroy, though containing need for the Sultan's ratification. (At that time, Egypt was annexed by the Ottoman Empire). The capital was fixed at two hundred million French Francs, divided into 400,000 shares of 500 Francs each, bearing statutory interest at 5 percent . Investors from all nations were invited to participate in the enterprise.

The British reaction was so intense that De Lesseps found it advisable to place his interests and that of the company in the hands of Napoleon III, while still enjoying the status of freedom from governmental interference.

The shares were placed on the market in November 1858.

De Lesseps wanted the Western Powers to participate financially to the project, so blocks of shares were specially reserved for these countries. The result was disappointing and the issue would have failed had it not been for the response of France and Egypt, as shown in the table below:

Countries	Shares reserved	Shares applied for and allotted
Egyptian Government	64,000	177,642
Turkey	-	750
Egypt	42,000	998
Tunis	-	1,714
France	80,000	207,160
Algeria	-	728
Great Britain	80,000	-
Malta	-	85
Austria	40,000	163
Russia-Wallachia	24,000	174
Germany	-	5
Prussia	-	15
Sweden-Norway	-	1
Denmark	30,000	7
Switzerland	-	460
Netherlands	-	2,615
Belgium	-	573
Spain	-	4,161
Portugal	20,000	5
Italy	-	2,719
Greece	-	25
United States	20,000	-

More than half of the number of shares had been taken up in France and it was understood that many people became subscribers to protest against the British attitude.

Having obtained the initial capital, De Lesseps went on with the project. It was actually started on April 25, 1859. The British applied pressure to Constantinople so that the Porte complained about the following matter: Egyptian territory was alienated in the canal zone that had been conceded to the company and the supply of forced labour for the site deprived Egypt of 60,000 persons who otherwise might have been productive for the country. An agreement was reached, the company gave up the forced labor and 150,000 acres of land on either side of the canal for an indemnity totalling £3,000,000, to be paid to the company over a period of 15 years. The Porte then ratified the concession.

As completed, the Suez canal was 100 miles long, 150 to 300 feet wide at the surface and 26 feet deep. It opened on November 17, 1869.

The success of the canal made the English make honourable amends. But the problems were not over. The shareholders were not happy about the situation. Dividends were to be less than expected. The original cost of construction had doubled and even if indemnity awards had paid for part of the deficit, more than 100,000 FFR had to be found.

It also seemed that the shipping companies were not eager to use the canal, in the first year of operation, less than five hundred ships passed through the canal.

In 1870, the year following the opening, the value of the 500 FFR share fell to 272 FFR. The next year they fell to 208. The financial crisis was complete and a further issue of bonds became imperative. They were put on the market in 1871-1872 on the security of a tax on tolls of 1 FFR per ton authorized by the Khedive but the result was only enough to ease the crisis.

Afterwards, the returns steadily increased and the shares rose and the company prospered accordingly. By 1880, the number of transits through the canal was 2,026 compared with 486 in 1870 and the number of passengers carried had risen to 101,551 compared with 26,758.

The early problems of the company made people concerned about the following issue: what would happen to the Canal if the company crashed, whose property was it, and could it be sold. The Porte stated that the Suez canal was an Egyptian company and therefore subject to the laws and customs of the Ottoman Empire. The canal was Egyptian property operated under an act of concession by an Egyptian company which could not dispose of it.

The Khedive had been running into debt and it appeared that his only valuable asset was the shares of the Suez Canal. In the autumn of 1875, through the intermediary of French financiers (the Rotschild), Great Britain was offered the shares for 100,000,000 FFR (at that time £4,000,000) and that Disraeli, then Prime Minister had accepted. The British acquisition of nearly half the shares of the canal healed the discord between France and Britain over that subject.

In 1882, rioting broke out in Alexandria and Europeans were killed. France chose not to intervene but the English did, and Egypt became a British Protectorate. Great Britain was recognized as the guardian of the Canal and the European countries were afraid to lose its benefits. A compromise was reached in 1888 when the Suez Canal Convention was signed by representatives of Great Britain, France, Germany, Austria-Hungary, Italy, Russia, Spain, Turkey and the Netherlands. This convention stated that the canal would always be free and open to every vessel of commerce or of war without any distinction of flag.

At that time the construction and financing of the canal was completed and one could hope that its statute would remain the same. This is not what happened . The canal was nationalized in 1956, after Egypt became a republic.

the last case, the loan is guaranteed by the flow of revenues to come even if the government offers his guarantee in any form. The owner of the infrastructure will issue coupon bonds with fixed or floating maturities and with fixed or floating rates but with a government guarantee on the repayment of the capital and the interest.

3.2 Financing by the private sector:

If a project must be financed wholly by the private sector, this implies that no guarantee of any kind should be given by the public sector. Generally the public sector is implied in the concession attribution and gives the concessionaire directions. Sometimes, wholly private infrastructures are built on private land and are operated by a private company without involving any kind of concession and they are perfectly legal. It is the case of the Gross Glockner pass road, in Austria.

The owner of a private infrastructure can find financing in the three following forms: equity, bonds and loans. The proportion of each form can vary in the different construction and operation phases. For instance, it may be necessary to have a low debt/equity ratio at the beginning to obtain loans if no guarantee unrelated with the project can be offered. Once the operation has begun, it is customary to refinance the bank

3 DIFFERENT WAYS TO FINANCE INFRASTRUCTURES THAT PROVIDE REVENUES⁴

For any infrastructure project that generates revenues, the financing package can be divided into two periods, the construction and the operation. During the construction phase, it is necessary to provide funds to cover not only the construction costs but also the financial costs linked to them, and before any revenue appears. Then, during the operation phase, the revenues must be enough to cover maintenance costs and to repay previous debts. In this chapter, we will look into three different kinds of financing packages: financing by the public sector, financing by the private sector and mixed financing.

3.1 Financing by the public sector:

In the public sector, a toll infrastructure can be financed by the government, local collectivities, or specific organizations. The financing can be in the form of taxes, guaranteed loans or non recourse loans. In

4 based on:

'Peages Routiers et role du secteur prive dans le developement des infrastructures routieres', OECD, 1987

'State and local public facility needs and financing', US Congress, 1966

loans with bonds. Refinancing is necessary most of the time for infrastructures with tolls since the loan repayment schedule is often longer than the maturities accepted by the banks.

In some cases, the only guarantee of the financing package is the revenues. As we will see later, that is the case of the Eurotunnel project.

The most difficult aspect of a financing package is often finding enough equity or obtaining sufficient guarantees. Non recourse loans can be used (loans which are not guaranteed by any entity) but the yield of an infrastructure is often not sufficient.

In many private financing packages, the 'project finance' technique has been used. We will describe later in detail the contents and the purpose of that technique.

3.3 Mixed financing:

As we have seen above, it is rare that infrastructures offer a sufficient yield to be financed entirely by the private sector. Most financing packages of infrastructures have involved a guarantee of the public sector (the government for instance). This guarantee can be a guarantee of a

minimum of revenues, guarantees on the interest rates etc...

In many European countries, public and private financing packages exist in different proportions. Most of the time, a necessary condition is that the some of the revenues made by the private sector in such a joint venture must be used for the financing of other public infrastructures.

The possibilities of financing in such a case are the sane as in a private package: equity, loans and bonds. Nevertheless, the financing package can differ much from private packages since the public sector offer guarantees.

In the United States, the mixed financing packages have a lot of success. For instance, at Houston, Texas, the Friendswood Development Company has funded 10% of the construction of a road on land that it owns to hasten its completion. The Road Department of the State of Texas has accepted the funds and has decided to build a road for 11.5 million USD before scheduled.

3.4 The project financing technique:⁵

Project financing is an old technique: it was developed in America 30 years ago because the borrowers could only offer underground oil reserves as a security. A new technique was specially created: the bankers would lend on the future revenues to be earned from the sale of the oil that was going to be produced with the oilground reserves for only security. It has been much used lately for project of different sizes such as projects in the North Sea, or the Channel tunnel.

The fundamental distinction between classic financing, which is a direct loan to a company developing certain projects, and project financing, is that in the latter case, the bank directly shares the project risks with the company. The diagram shown here illustrates the difference.

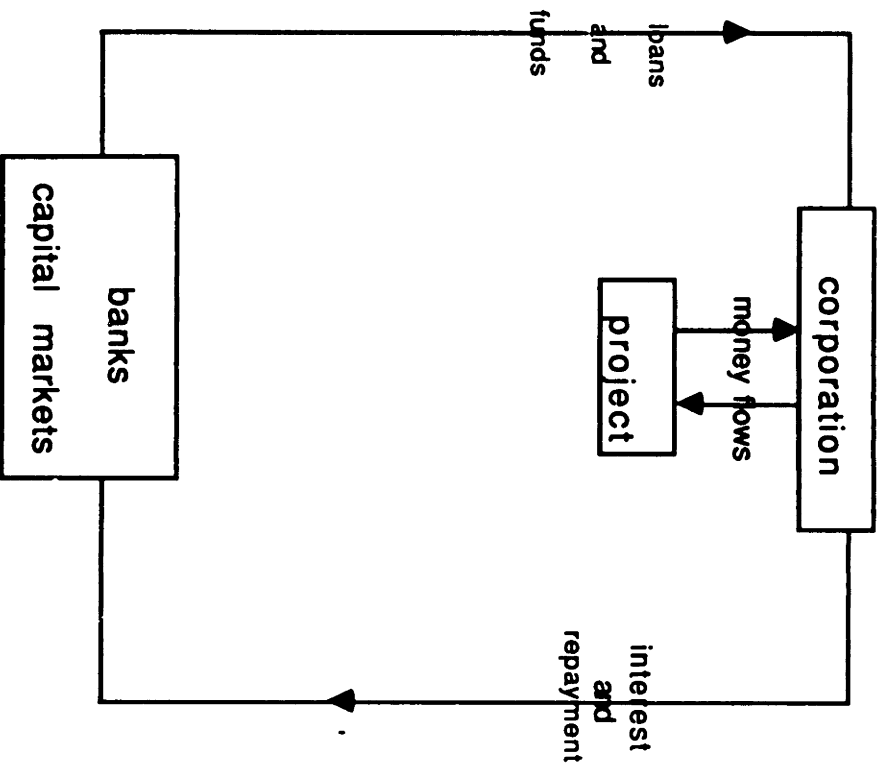
In the first case, the bank is looking directly at the company: it is the latter which commits its entire resources to pay the interest and repay the loan whatever might happen to the project. It is the general credit of the company which the banking and financial markets take into consideration for the financing for determining the conditions of the loan.

5 based on 'Project financing studies', Banque Indosuez, Feb. 1989

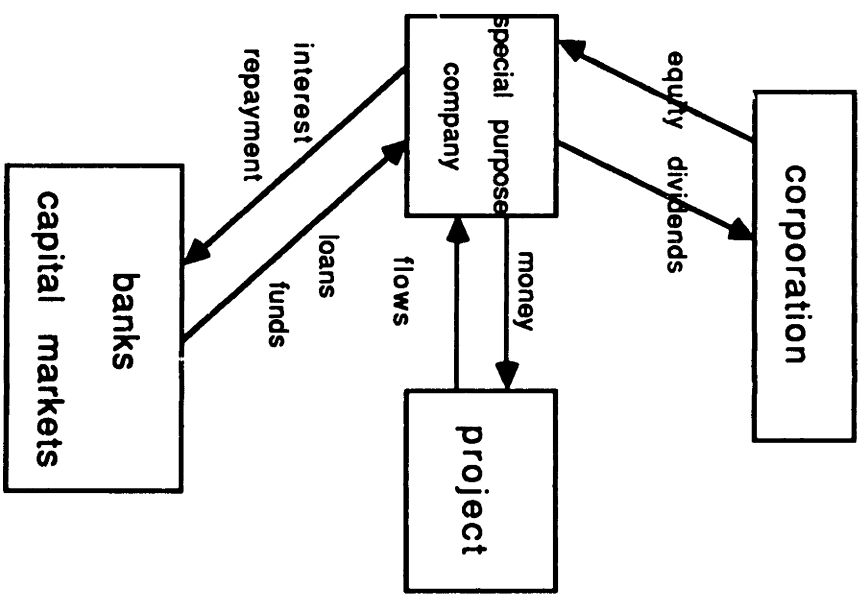
In the second case, the company is not a debtor of the bank: the project is the debtor. The bank can only be repaid from the project's cash flow and has only the project itself as security. The bank therefore takes the project risk: if it goes well, the bank is repaid; if it goes badly, the bank has no recourse against the company. It is for this reason that project financing is sometimes called "non-recourse" financing. In practice, there is a sharing of risks between the company and the bank. For certain risks, for example the market risk, there is no recourse, that is the bank will not be repaid if the market price slumps, and for others, for instance the technical risk, there is recourse, the company financially compensates the bank for the consequences of technical failure.

Using this general principle, there are many variations possible according to the degree of risk taken and the nature of the projects.

standard financing



project financing



3.4.1 The sharing of the risks:

Project financing means having risks shared between the promoters and the financiers. All the sides must have an excellent knowledge of the project and of its capacity to face up to problems: a project financing operation can only be set up if the economic structure of the project is good and also robust.

What are the risks of a project which can be shared? They can be divided in three categories: the promoter's risk, the country risk and the actual project risk.

3.4.1.1 The promoter's risk:

The promoter's risk exists of course when there is recourse against him. But in any event, it must be examined with care: what is the promoter's experience in the type of project being undertaken; what degree of commitment does he have in the project in the technical, financial and management fields? A good project with a shaky promoter can be a lot more difficult to finance.

3.4.1.2 The country risk:

The 'country', or sovereign risk exists in all cases. When one talks about risk, one thinks of war, insurrection, terrorism, nationalization and one has in mind agitated countries. But the sovereign risk exists everywhere, in France, as in Great Britain or even the United States or Japan. This risks may include risks of nationalisation, changes in the fiscal system, foreign exchange controls, devaluation, constraints resulting from environmental laws, changes in regulations or strikes.

There is no standard solution in covering these risks; it is a question of case by case analysis.

3.4.1.3 The project risk:

The project risk can be analyzed systematically in three main categories: the construction risk, the operating risk, and the market risk.

The construction is generally the one the banks like taking the least. The only tangible asset that they have is the project and its capacity to generate cash flow. What if the project can not be finished?

This risk can consist of a project costing a lot more than envisaged and that there are no more funds. Who pays in this case? The dilemma for the banks is very difficult. Should they cut their losses? In spite of everything, the banks can take the construction risk. They generally do so when they consider that the project is sufficiently sound (for example in the case of proven technology) and its promoter sufficiently experienced. This does not always prevent unpleasant surprises.

The operating risk is in general of quite a different nature. The qualities and experience required to make operational a project are different than those required to build it. This risk can be taken if the project is capable of functioning as planned and if the operator has the necessary experience. As a result, the completion test is very important. The project will only be deemed to be completed if certain tests, either purely technical (volume and quality of the production) or also financial (unit operating cost) are achieved by the operator under the control of an independent technical consultant. The completion guarantee given by the promoter will only be lifted if these tests are positive.

The market risk is the risks which corresponds to that of the price, on the market, of the product or service offered by the project. It also corresponds to the volume risk, that is to say the risk that the product sells or the service is used more or less by its potential

customers. The banks generally accept to take the market risk, after an in-depth analysis often requested by themselves from one of several independent experts, of the competition, the market evolution and factors likely to affect them. This does not mean that the banks can not be wrong: who would have forecasted the change in oil prices over the last fifteen years? It is for that reason that the banks take a safety margin in their analysis of the future cash flows of projects.

To determine the maximum amount which they will lend, the banks therefore establish a reasonably prudent scenario for the cost of the project and its capacity to generate cash flows.

3.4.2 The evolution of project financing:

At the beginning, project financing was essentially applied to natural resources. But it is in the field of infrastructures that its development is the most spectacular, as we will see in the example of the Channel Tunnel, in the remaining part of this thesis. This is due largely to the fact that governments or local authorities prefer more and more to allocate their limited funds to projects of a social nature and priority, such as hospitals, schools, or National defence. Projects which can be financed by the private sector are more and more offered to the latter

after competition and under concessions granted by the authorities.

4 THE HISTORY OF THE TUNNEL UNDER THE CHANNEL⁶

4.1 The history of the idea of a fixed link across the Channel:

If the history of the project only goes back fifteen years, the idea of a tunnel under the Channel is more than two centuries old. The biggest problems have not been technical or financial but political; it has been necessary that Britain realizes that its insularity would not be an asset in case of a war for the project to evolve.

4.1.1 In the Nineteenth Century:

The idea is first mentioned in 1751. The French geologist and physicist Nicolas Desmarests comes up with the project of a tunnel between the two continents and wins the contest launched in 1750 by the Academy of Amiens. The object of that contest is to find a way to make the crossing of the Channel easier.

6 based on:
'Eurotunnel. Annales des Mines', 1988
French Press clippings from 'Le Moniteur'

In 1802, Napoléon Bonaparte is First Consul of France. He is not yet Emperor and some Englishmen see him as a chance for democracies against corrupt monarchies. The "Ingénieur des Mines" (state engineer specialized in underground works) Albert Mathieu-Favier comes to him with a project; it is a bored tunnel composed of two passageways. In the upper one there is a paved road, and the lower one is where the infiltrated water is to be evacuated. The length of the journey is evaluated at 5 hours. The air circulation is taken care of by chimneys open to fresh air. This tunnel would run through the sand island of Varnes, half way between France and England. This island would be a rest harbor and an international town. The French and the English have just signed the treaty of peace of Amiens and approve of the project. But a war between the two countries soon flares up again and the project collapses. This war ends with the Waterloo battle.

In 1830, steam trains are invented. The projects then focus mostly on solutions involving trains.

In 1833, the "ingénieur hydrographe et des Mines" (engineer specialized in water and underground works) Aimé Thomé de Gamond attempts to draw the first map of the undersea 'relief' of the underground of the strait of Pas de Calais.

From 1833 to 1867, the French and the English go forward in

geological research and present different projects. Among them there is a project of a double railway in a tunnel and a project of a railway bridge. Aimé Thomé de Gamond comes up in 1856 with a project for a 34-km tunnel in masonry, large enough to take two rail tracks. De Gamond's timing is quite good, since this is a honeymoon period in the relations between Britain and France. The two countries are allies in the Crimean war and the bad memories from Waterloo seem to have disappeared. Queen Victoria and Prince Albert pay a State visit to Emperor Napoleon III and Empress Eugénie and a Channel tunnel seems to be a good way to cement a good relationship. Napoléon III creates the French Commission for Scientific research to examine de Gamond's project. On the British side, the Prince Consort is interested and Queen Victoria, who was sea-sick, is reported to have been keen on the project. But, typical reaction of a real Englishman, Lord Pamerston is reported to have told the Prince that if he had been born on an island, he would not be so keen on the tunnel.⁷

At that time many projects are presented and the best ideas seem to come from de Gamond. In 1866, he produces a modified version of his 1856 project. This interests John Hawkshaw (who was to become Sir John) and William Low, both British engineers and leads them to research on their own. Later, Low collaborated with de Gamond's last project. It

⁷ based on The Channel Tunnel Story by Michael Bonovia 1987

involves twin railway tunnels and once again, the timing is good since it coincided with the Great International Exhibition in Paris, Napoléon III's answer to the Prince Consort's exhibition in London.

Aimé Thomé de Gamond was an extraordinary man. He was at the same time civil, hydrographic, and mining engineer, Doctor of Law, Doctor of Medicine and a reserve officer in the Army Engineering Corps in France. He is responsible for projects of tunnels in the Irish Sea to link England to Ireland and Scotland to Ireland, in Scandinavia across the Great Belt, the Sound and the Little Belt to link two islands in Denmark and also for a plan for a credit corporation for the fishing industry and a plan for a federal constitution in France.

The project seems to be on its way to being realized when in 1870, the Franco-Prussian war leads to Napoleon III's abdication. He becomes the first President of the French Republic.

In the early 1870s, the odds are in favour of a tunnel being built. But this is without taking into consideration the unpredictability of the British politics and the attitude of the naval and military establishment.

In 1872, the first concessionaire corporation "The Channel tunnel company" is created in London. Its job is to do the first borings near Dover and Calais. If the results are positive, the company will decide

to build the tunnel.

In 1875, the first French concessionaire company "l'association Du tunnel sous-marin" is created. In the same year, the two French and British governments name a comity that will have to find a solution for the international legal problems that the construction of the tunnel will make. The French parliament votes to give the "association Du tunnel sous-marin" the concession of the railway for 99 years.

Finally, the first geological map of the undersea underground of the strait is drawn. The protocol between the two governments which will be used as a basis for the treaty that will establish the conditions in which the tunnel will be run by France and England is signed. On the French side, a pit is bored and will be used as the starting point of the tunnel. The inauguration is expected to take place in 1891.

But in England, people are not keen on the project anymore. Prince Albert is dead and Queen Victoria is reported to have told Disraeli in 1875 that she now considered the tunnel project very objectionable. The literary, scientific and artistic world join in opposition. The objections raised recall the violent opposition fifty years before to the construction of railways. Cows are supposed not to have milk anymore! Humphrey Slater and Corelli Barnett have written "The major fear of the objectors was of hordes of Frenchmen pouring through the tunnel and driving on

to London with all the well-known elan that had disturbed the Duke of York eighty years before. But the ingenuity of hysteria invented more varied objections. There was, for example, the facility that an easy means of communication with the continent would give to smugglers of small objects; the consequent inconvenience to travellers of having their persons and baggage searched! A more involved objection was that the tunnel would make it easier for the revolutionnary societies that were supposed to teem in every continental country, and especially France, to work with cognate associations in England."⁸

The Conservatives and the military who are opposed to the project battle skillfully against it. Although the tunnel is commercially and financially fruitful, it is declared to be a potential danger to national security. Work on the site quickly stops in 1882. On the French side, 1,839 meters of tunnel have been bored.

In the 1890s, the two countries are at peace. Many projects are proposed; a bridge, or a bridge with a tunnel... Most of these projects are easy to destroy in case of a conflict.

8 From 'The Channel Tunnel Story' from Michael Bonavia, 1987

4.1.2 In the twentieth century:

In 1907, the British government, after consulting the Imperial Defense comity, opposes any link between France and England for military reasons.

In 1913, the comity of the tunnel under the Channel is created in England and unsuccessfully tries to overpower the Imperial Defense comity.

In 1916, at the time of the first world war, the events show that the sea is not anymore an efficient way to protect Britain's isolation. On the contrary, the crossing of the strait makes it difficult for England to bring troops and equipment on the continent. Sir Arthur Fell asks the British government to approve a project of tunnel but the government refuses to take a decision before the end of the war.

In France, a comity of the Tunnel is created in 1919. It is presided by the Maréchal Foch who is convinced that the first world war could have been avoided if the tunnel had been built.

The French have never considered that the tunnel would be a military threat to their country. The lack of it during World War I has been painful.

But as they understand the British position, they decide to support plans which involve the possible destruction of the tunnel by the British Navy if hostilities with Britain were ever to break out.

In England, in 1929, a comity is created to study the economical aspects of the projects that have been presented. A tunnel seems to be the least expensive solution for England. The Imperial defense comity still does not want to hear about any project.

In 1938, the first French project is presented; it is a road tunnel paired with a postal tube. The biggest drawback is technical; there is no way to evacuate the exhaust fumes.

In 1947, two French and British parliamentary comities are created to study the tunnel. The international road federation wishes that the tunnel includes roads.

The military progress in 1954 shows that Britain's' insularity will not be an asset anymore in case of a war. The government headed by Winston Churchill decides that it would not oppose the construction of a tunnel anymore.

In 1957, the GETM, group of studies of the tunnel under the Channel, is created. They must make studies about the feasibility of a tunnel

which would include both a railway and a roadway. In 1960, the GETM presents a project of two railway tunnels, bored and immersed. Once again, competitors present other projects; a linear bridge of 34 kilometers resting on 164 piles, a dam, or immersed tunnels.

The two transportation departments of the two countries decided that a French and British commission should be created to compare the merits of the different projects. The commission chooses a bored railway tunnel 25 km long. This tunnel is made of two passageways which hold a railway. They will be linked every 250 meters by a passageway.

In 1964, the two governments approve of the construction of a bored railway tunnel. And in 1967, three bids are received. One year after its creation in 1969, the "Group of the tunnel under the Channel" is divided into two corporations. These two corporations sign with the two governments a protocol stating the principles of the construction, the financing and their commitments to one another. In 1972, a convention in which the construction schedule is established is signed between the two states.

The boring begins in 1973, it starts from the borings done at the end of last century. Georges Pompidou and Edward Heath sign a French

and British treaty. In it, both states commit themselves to take in charge the realization of the transportation infrastructures necessary to operate the tunnel.

On the British side, in 1974, the elections bring a new government. The labor party comes to power. They decide to stop the project for financial reasons and ask for a new project, less expensive. In 1974, the borings stop, the passageways are flooded. 300m had been bored on the French side and 400m on the British side.

In 1980, for the commission of the EEC, English experts begin studying again several projects. They conclude that the following projects are profitable; a tunnel with two railways or a bridge with a railway and a highway. Mrs. Thatcher launches again the idea of a fixed link across the Channel on the condition that it will be financed by private funds.

In 1981, Mrs. Thatcher and M. Mitterrand, at the French and British summit, ask for the creation of a work group that should compare different projects; among them are a tunnel with a single way or a double way of a diameter of 5.6 or 6.85m, a tunnel with a highway and a railway, a project with bridges and a tunnel.

A railway tunnel with a diameter of 7m is chosen in 1982. Banks

study the legal and financial aspects of the project.

In 1985, three projects are in competition; the France- Manche, the Euroroute, the Europont, the Trans-Manche express projects and a project by M. Van der Putten. They will be described in detail further.

The Trans-Manche project is selected in 1986. The 12th of February, with M. Mitterrand and Mrs. Thatcher attending, the treaty of Canterbury on the tunnel under the Channel is signed by the Foreign Affairs ministers. It will be ratified in the spring of 1987. At the same time, an agreement is signed between the French and British group "France-Manche" and the national companies of railways. This agreement indicates what will be the shares of the train traffic and the shuttle traffic. A highway project will be presented before 2000.

The events should then follow this schedule:

-summer 1987: starting point of the works

-spring 1991: end of the construction of the principal tunnels

-fall 1992: first operation of the shuttles and the trains.

-spring 1993: beginning of the exploitation

This schedule will be studied in detail further in this thesis in the chapter 6.2.4.

4.2 The treaty, the concession:

The construction and the operation of the Eurotunnel system are regulated by international, French and British laws.

The treaty between France and the United Kingdom is the main text which allowed the creation of the Eurotunnel system. It has been signed the 12th of February 1986 and ratified the 29th of July 1987 after the parliaments of the two countries completed the necessary proceedings. The treaty states that the Eurotunnel system will be built and operated by the private sector.

The concession is an agreement between the two governments, France Manche and the Channel Tunnel Group. It states that the corporation that has been granted the concession should finance, build and operate the system. The concession will last 55 years from the 29th of July 1987.

In France, the laws 87-383 and 87-384 of the 15th of June 1987 have allowed the ratification of the treaty and accepted the concession.

The Channel Tunnel Act became a law in England on the 23rd of July 1987. It confers the Secretary of State prerogatives that allow him to buy land for the construction of the Eurotunnel system.

In the concession, the two governments agreed to build the infrastructures necessary to keep the traffic near Eurotunnel fluid and to let the Eurotunnel corporation manage the system freely.

Each group will be taxable on the revenues of his side of the tunnel.

In the concession, Eurotunnel is granted a preferential right to build and operate a second link if the need arises before 2010.

These are the main points stressed in the legal documents which have made the project possible.

5 THE COMPETING PROJECTS:⁹

The construction of the fixed link between France and England will be the construction site of the century. But before that, the battle raged between the competing developers. Four major projects were competing and a fifth one which had never been very serious. It had been put in place by Mr. Van der Putten and its cost was 140 billion FFR. The other four projects were: Europont (Eurobridge), Transmanche Express, Euroroute and France Manche-Channel Tunnel Group. The last two were the most likely to win and they didn't spare any effort to discredit the other project.

5.1 The Europont (Eurobridge) project:

This was a mostly English project. It had been managed by the firm ICI Fibers. It was an original idea since it involved a sustained bridge in which the deck was replaced by a road tunnel. The pylons were ventilation chimneys. The project was huge: 8 pylons 340m high (6 of them in the sea), and 7 spans 5km long. To sustain each span, there were 4 cables

9 based on:

'Manche: quelle liaison?', Industries et Techniques, 01/20/86

'Liaison transmanche: quelle solution?', Ingénieur constructeur, 01/86

1.4m of diameter made of "parafil", a new material by ICI-Dupont six times lighter than steel with a similar mechanical resistance. To make the structure even lighter, the "bridge-tunnel" which contained two highways was to be built with special concrete and the road cover was to be made of "Estercrete", a cement reinforced with polyester. It was four times lighter than traditional cement. The main drawbacks of the project were that the presence of six pylons in the sea created risks of collision with boats even if those pylons were protected by sirens and radars and that no real financing package had been developed.

5.2 The Transmanche Express project:

This was the last project to enter the race. It had been developed by the British Ferries and it was technically realistic. It was composed of two bored tunnels, one for the road traffic and the other for the trains. The four conducts were linked every 500m by passageways and the cars speed was limited to 100km/h. Every 2km, air purifying stations were installed and the fresh air came from wells. This project had the support of the English Chamber of the Commons. Since it had been proposed by the owner of the British Ferries, it would have resolved the unemployment problems that would have arisen at the opening of the link in the ferries

personnel. This personnel would have kept the same boss but moved into a different company. Apart from SCREG, no contractor had been chosen.

5.3 The France Manche-Channel Tunnel project:

This project had been put together by the following contractors: Bouygues, Dumez, SAE, SGE, SPI Batignolles on the French side, Balfour Beatty, Tarmac and Taylor Woodrow on the English side. The basic idea was to have shuttles and trains travel in a tunnel. The tunnel was to be 50.5 km long (37km will be under the sea) and to link Cheriton (UK) to Frethun (France). The tunnel had two railway conduits with a single lane 7.3m of diameter which were on each side of a maintenance passageway. This is the project which won the competition and it will be described in detail further.

5.4 The Euroroute project:

This project had been developed by the following contractors and banks: Alstom, GTM Entrepose, CGE (Compagnie Générale d'électricité), Banque Paribas, Societé Générale on the French side and

British Shipbuilders, British Steel, John Howard, Trafalgar House, Barklays Bank, Kleinwort Benson and UK construction on the British side. It was more futurist than the previous one. But it was also more complex. It was composed of a road link and a rail link. The road link comprised

-a series of cable stayed bridges each carrying two dual carriageways with hard shoulders, linking the French and British coasts with artificial islands situated either side of the main navigation channel,

-two artificial islands with shallow spiral ramps allowing the traffic to descend or ascend from an immersed tube . The islands also catered for the installation of leisure activities and an enclosed harbour

-an immersed tube sunk into the sea bed which carried the road traffic under the main navigation channels.

The rail link ran through an immersed tube the full width of the Channel.

The road link's free flow design capacity was 3,000 vehicles per hour. The limiting factor was ventilation, which would have become less of a restriction as cleaner exhausts were introduced. For most traffic, weather conditions would have reduced the use of the link for less than 1% of the time.

5.5 Recapitulating table:

Project	Technique	Nature of the work	Length of construction	Cost
France Manche Channel Tunnel Group	*bored railway tunnel 50km lg *shuttles carrying cars + classic trains + TGV trains	borings making shuttles	7 years	50 bn FFR
Euroroute	*for cars: 2 cable stayed bridges 7 km lg linked to artificial islands by an immersed tunnel 21 km long *for trains: bored tunnel 38 km long	prefabrication borings	6 years	100 bn FFR
Europont	*for cars: highway tube 37 km long, on bridge *for trains: bored tunnel	prefabrication borings	5 years	60 bn FFR
Transmanche Express	*for cars: bored tunnel 50 km long *for trains: bored tunnel 50 km long	borings borings	5 years	40 bn FFR

Project	Partners
France Manche Channel Tunnel Group	France: Bouygues, Dumez, SAE, SGE, Spie Batignolles, Lyonnaise des Eaux Indosuez, BNP, Crédit Lyonnais, SGB, Crédit Agricole, BCI, Groupe Drouot UK: Balfour Beatty, Costain, Tarmac Construction, Taylor Woodrow, Wimpey National Westminster Bank, Midland Bank
Euroroute	France: Alsthom, CGE, Usinor, GTM ENTREPOSE Société Générale, Paribas UK: British Steel, British shipbuilders, J.Howard, Trafalgar House Barclays, Kleinwort Benson
Europont	France: Nord France, Société Belge des Bétons, Chantiers Modernes, Ballot SA Banque NSM, Continental Trust UK: ICI Fibers, Blue Circle Cement, Polymer Cements, Brown and Root, Laing International Arbuthnot Latham Bank, Bank of Credit and Commerce International
Transmanche Express	Concessionary: British Ferries Consulting: Crédit Suisse-First Boston, Crédit Du Nord Support: City Corp, Deutsche Bank, First Chicago, First Interstates, Chemical Bank, Yamaichi Bank

The project that won the competition was the "TRANSMANCHE_CHANNEL TUNNEL GROUP" project. It was judged to be the safest and the best value. We will describe it in details later.

6 THE SYSTEM AND THE CONSTRUCTION:

6.1 The system:

The Eurotunnel system is composed of three tunnels and two terminal stations. It has been conceived to offer two different services: for the road users, it will be the continuation of a highway thanks to the frequent shuttles and for the train users, it will be the missing link between the French and British railway systems.

The Folkestone-Calais link will be, as soon as it opens, one of the busiest links of the world. 360 trains and 210 000 tons (SI) of freight will go through it. This link will need the best train and security technologies available. Moreover, it will be a frontier between England and the continent. New techniques are needed to manage continuous flows. The system will be operated by 2200 people, British and French.

Road vehicles carrying passengers and freight will travel between the UK and French terminals on specially designed shuttles operated by Eurotunnel itself. The shuttle trains will consist of a number of specially designed wagons. These wagons will be brightly lit, well ventilated and will incorporate modern design and safety features. Different types of shuttles will carry passengers and freight vehicles. The ferry-trains, that is the shuttles, will depart every 12 minutes. Each train will be composed

of 12 or 24 wagons. Each wagon is a container of 25m long and 4m large and will allow the cars to go on board at each extremity of the train and to travel inside the train.

The vehicles will go to the boarding zone by roads and bridges affected to each type of traffic: compact cars, cars with trailers, buses and trucks. There, the drivers and passengers will buy tickets and go through customs and passport controls for both countries. This is expected to take around 15 minutes in total for cars and their passengers. Assistants will help the cars to the right boarding zones. They will also be trained to cope with emergencies. Once the vehicles are parked, the passengers will remain inside. The boarding and the evacuation of the vehicles will only take a few minutes.

The shuttle-trains will be much larger than the usual European trains; 750m long, 4m large 5m high. These trains will weigh between 1500 and 2000 tons (SI). They will be moved by two or three locomotives of 4000 to 6000 kW of power. A passenger shuttle train will be able to carry up to the equivalent of 200 cars.

The operation will begin with 18 of those trains; 9 for the freight, 9 for the cars. Others will have to be ordered to face the growing traffic.

The trains will take 33 Mn to join the two terminals Their average

speed will be 117 km/h and they will go as fast as 160 km/h. The terminals will look like classical railway stations but the piers will be reserved to cars.

The maintenance will be in the hands of a specialized staff based in the terminals.

British Rail and SNCF, the French national railway, will operate through trains for passengers and freight. The two railways have announced that they will work together to develop through services between the UK and France and other destinations in mainland Europe. SNCF and the Belgian railway, SNCB, are proposing to build a new high-speed line in northern France and Belgium. This, together with special rolling stock commissioned by all three railways would mean a high speed train service taking around three hours for London to Paris and just over two and a half hours for London to Brussels. Hourly or more frequent services are planned during the day between Waterloo station in London and the Gare Du nord in Paris and between London and Brussels.

There will also be through services between other cities in the UK and cities in the rest of Europe.

Freight trains of wagons and containers will run from starting points

around Britain directly to destinations on the Continent.

The international trains, the TGV (high speed trains) the night trains and the freight trains will go into the tunnel via a connecting system which will allow the passenger trains to enter the system at full speed and freight trains to stop for control. The trains will find a fixed equipment compatible with their own. The catenary will be classical (25 KV) but its alimentation will have to take into account the impossibility of installing electrical sub stations under the sea. Each half tunnel will have to be alimented from the extremities. The signalization will allow the tunnel to have a high debit. It will be of the "Cab Signal" type. A classical luminous signalization can not be used since it is too faint and it can be confusing in a long tunnel. The Cab signal must be adapted to the variety of trains that will use the tunnel. The signalization will also include a sophisticated speed detector. Finally, trains will be able to communicate between themselves.

The control and the management of the link will be in the hands of a general staff. All the staff will have to be bilingual.

The safety is most important. The two governments chose this project because it was the safest.

The tunnel is a very complicated work. It is composed of two principal

galleries in which the trains will travel and each gallery will have a continuous platforms. Between those two galleries, a service gallery will run and will be connected to the main galleries every 375m. This service gallery will provide aeration and a shelter in case of a fire. Then, it will allow the firemen and the ambulances to get to the place of the accident if there ever was one.

The biggest risks, that is the risks of a collision are eliminated by the fact that each tunnel is unidirectional and there cannot be any inundation since the hydraulic network is over-sized.

The shuttle trains are specially conceived to bring maximum protection in case of a fire. They will be conceived as moving containers that can be isolated by "stop-fire" doors after evacuating the passengers. And in each of them, a system of detection will allow the driver to have information about the environment. Attendants on board will check that the security conditions are met; no smoking, no ignition before the train has stopped etc... They will be specially trained and they often will be tested.

6.2 The construction:

6.2.1 Main features:

The rail link will be provided by two 6-7m diameter tunnels with their exits at Castle Hill, north of Folkestone in the UK and Beussingue Farm, near Sangatte, in France. Each tunnel will be approximately 50km long, of which 38km will be under the seabed between Shakespeare Cliff and Sangatte. The tunnel running centers will be spaced 30m apart and a 4.8m diameter service tunnel will run centrally between them.

All three tunnels will be interconnected for operational and safety reasons. Transverse passages 3.3m in diameter will connect the rail tunnels with the service tunnel at 375m intervals. This spacing ensures that any shuttle stopping in the tunnel is adjacent to at least two cross passages for passengers to be able to disembark.

In addition, there will be 2m diameter piston-effect relief ducts between the running tunnels at 250m intervals. These will allow the pressure pulse in front of a train to reduce aerodynamic drag.

At two points along the tunnel length, there will be crossover chambers. These will allow trains to transfer between running tunnels, for example while maintenance is being carried out in a particular section of a tunnel.

The vertical profile of the tunnels will provide low points to which they will drain from both directions. Sumps at these points will collect seepage which will be removed by pumping to the surface near each coastal crossing point.

6.2.2 The geology:

As part of the preliminary research for the Project, consultants to Eurotunnel made a new study of the extensive geotechnical information available on all the areas where tunneling will take place. The three main strata along the route of the tunnel in descending order from the seabed are: Middle Chalk, Lower Chalk and Gault Clay.

The Middle Chalk and upper section of the Lower Chalk are of relatively brittle fractured material. However, the lower part of the Lower Chalk is a mixture of clay and chalk known as Chalk Marl. This material is considered ideal for tunnelling. It is a moderately strong, uniform and slightly plastic material and it is generally without discontinuities. The underlying Gault Clay, while also virtually impermeable, is weaker, and exhibits strongly plastic behavior leading to non-uniform deformation when stressed.

To exploit those geological characteristics, the route and alignment

of the tunnels have been planned, subject to operational requirements, to locate the maximum length within the favorable Chalk Marl and to minimize, wherever possible, construction in unfavorable grounds.

As a result, in the undersea section, it is planned to bore approximately 90 per cent of the tunnels through the Chalk Marl at a depth of approximately 100m below sea level. This will give a normal thickness of rock above the tunnels of 40m, reducing to 17m near the French coast.

It is not expected that the construction of the tunnels will be delayed through geological problems, because the geology of the chalks under the Channel is well understood and because of the general excellence of the Chalk Marl as a ground for tunnelling.

6.2.3 The construction technique:

6.2.3.1 Tunneling principles and techniques:

The tunnels will be driven from both sides of the Channel, using six tunnel boring machines on the UK side and five on the French side. At peak, five machines will be in use on each side simultaneously. The central service tunnel will be bored first, to act as a pilot tunnel. As this tunnel advances, the ground ahead and to each side will be

probed to investigate and confirm ground conditions. This will allow any fissures to be grouted before the running tunnels are bored. Boring of the two running tunnels will start when the service tunnels have advanced approximately 5km from the coast.

The tunnelling techniques to be used are well proven and have been used on such projects as the Jubilee and Victoria Lines of the London underground and the CERN particle research facility near Geneva. It is known that water-bearing fissured ground will be encountered on the French side; this will be bored using pressure balanced tunneling machines. Tunnelling will start at each coast, in each case working outward to meet near mid-Channel and inward to the inland Tunnel portals. On the UK side, the landward tunnels will be 8km long and three TBMs will be used, whereas on the French side, the landward tunnels will be only 3km long and this will allow one machine to bore both running tunnels

6.2.3.2 The tunnel boring machines:

On the UK side the running and service tunnels will be excavated by TBMs of the open face type but with the facility of closing down the face should the need arise. Shield advancement will be achieved by the use of hydraulic rams and gripper pads acting on the

surrounding ground area or by jacking off the completed lining. A lining, normally of precast concrete segments of the unbolted wedge block type, will be built immediately behind each machine.

On the French side, the TBMs will be of the closed type with the machine being thrust off the lining, which will be built inside the tailskin of the machine. The machines will, however, also be capable of operating in an open face mode where ground conditions allow.

The TBMs will incorporate equipment for probing to explore the ground ahead of the faces of the service and running tunnels and will have a facility for ground treatment if found necessary.

6.2.3.3 The driving rates:

The expected driving rates for the service tunnel are as follows, based on boring for 18 hours/day and 28 days/month.

	Design	Average to meet	
	Sustained	Expected	Programme
UK side (m/h)	5.0	1.73	1.4
French side (m/h)			
open mode	4.4	1.32	0.83
closed mode	2.0	1.32	0.83

The rates of driving for the running tunnels will be slightly different from those for the service tunnel.

6.2.3.4 Spoil disposal:

On the UK side, primary and secondary conveyors attached to the TBMs will load trains of muck skips hauled by electric locomotives. The trains will travel to the underground chamber at Shakespeare Cliff where the spoil will be discharged into transfer bunkers. From these bunkers, the spoil will be carried to the surface by inclined conveyor for disposal at the reclamation area behind the new sea wall. Some spoil from the landward tunnels will be used in the terminal area.

On the French side, the spoil will be handled similarly by conveyor and train to the point where the skips will be discharged into the shaft at Sangatte. Spoil will be received into the sump at the bottom of the shaft and pumped to Fond Pignon for disposal. If necessary, dry spoil could be transported to the terminal to be used as filling.

6.2.3.5 Prefabrication and installation of linings:

Tunnel linings will be formed in the main from precast concrete segments which will be produced in dedicated "precast yards" at the Isle of Grain in the UK and Sangatte in France respectively. However, where necessitated by ground conditions, and at junctions for crossovers, ductile iron bolted lining sections will be employed.

Within the tunnels both concrete and iron lining sections will be taken to the faces by special rail wagons, where they will be passed through the TBMs by conveyor and erected mechanically.

6.2.3.6 Other works:

Within the tunnel system, there will be expensive secondary construction work, such as the excavation of the crossover tunnels

and the transverse passages and piston effect relief ducts. This work will be carried out with special purpose boring machines (road-headers) and other earth moving machinery. Workers, materials, and machinery will be brought to the workfaces by a construction railway laid in the tunnels.

6.2.4 Construction programme:

The construction programme provides for a period of six months following completion and fitting out of the works, during which time the tunnel will be tested under simulated conditions.

There are three key items which are essential for the planned opening date of May 1993 to be achieved:

- the completion of the tunnelling works and the associated mechanical and electrical works

- the design and procurement of rolling stock

- the development of the software for control and communications systems.

6.2.5 The construction risks:

The risks associated with tunneling are well understood and will be managed through the selection of specific techniques, machinery and investigations.

The most important of these risks are the following: flooding, fire and ground collapse. These risks will be covered by insurances.

There are only two conceivable sources of major water inflows into the undersea sections of the tunnels during construction. They are the presence of an ungrouted borehole open to the sea on, or adjacent to the tunnel line and the existence of water-bearing fractured ground connected either to the sea or to a large water-bearing fissure.

A properly grouted borehole would cause no difficulty or danger to tunnel construction. The alignment of the tunnels has been carefully planned to avoid all known existing boreholes. In the unlikely event of water ingress from a borehole both the French and English TBMs have been designed to cope with anticipated inflow rates.

There is a possibility that site investigations and accompanying geophysical surveys have failed to discover a water-bearing fissure. In order to locate fissures ahead of the machines, systematic probing

techniques will be employed. The use of small camera probes and seismic equipment is being investigated. These would enable a more detailed geological mapping of the ground ahead of the machines.

The risk of fire will be minimized by adherence to the following preventive measures. One has to be sure that at all times, there is the minimum of combustible materials in the tunnels. Suitable extinguishing equipment should be provided at all locations after consultation with the French and British fire services. A key personnel should be trained especially to deal with fires. Heat sensors should be fixed to any potentially combustible piece of equipment which would trigger shut-off on overheating. The rules laid down for the proper use of welding and oxyacetylene equipment should be strictly observed. The ventilation systems should be periodically controlled and it should be possible to reverse or shut them off. Breathing apparatus or emergency air supply should be provided to the working face.

The risk of ground collapse must always be a major consideration in any tunnelling work. The ground on the UK side is stable enough to be safely left unsupported over a small length for a short period of time. This enables the lining for most part to be erected immediately behind the TBM shield. If the ground conditions require so, the UK machines will have the facility for sealing the face in an emergency, and it will be

possible to build the tunnel lining inside the tail-skin (protective shield) of the TBM. On the French side, because the ground is generally less stable, this method will be used at all times.

The probing techniques mentioned above will enable any areas of fissured and water-bearing ground to be stabilized by the injection of cement or chemical grouts in advance of the machines. The machines will also be fitted for radial grouting should the need arise.

7 THE DIFFICULTY OF FINANCING THIS PROJECT WITH SOLELY PRIVATE FUNDS:¹⁰

The economical context of a fixed link across the Channel has changed very much between 1973 and 1985. In 1973, the link could not be privately financed without governmental help because the traffic was not felt important enough. But in 1985, this context was altered by the integration of the United Kingdom with the European Economic Community and the emergence of a new financing technique called 'project financing'.

The effect on the freight and the passenger traffic across the Channel after the United Kingdom entered the European Economic Community in 1976 has been enormous. Between 1975 and 1985, the freight has increased by 5% p.a. And the passenger traffic by 6.5% p.a.. The surface traffic at the very place the tunnel is going to be built is expected to double between 1980 and 2000. This expected increase in traffic will make the financing of the project from its revenues possible. The technique referred to as 'project financing' which has been developed

10 based on:

'La liaison fixe Transmanche: un défi économique et financier', Pierre Mayer, 1982

'Manche: quelles liaisons?', Rapport du groupe de travail Franco-Britannique sur la liaison Transmanche, La Documentation Française, 1982

'Le tunnel sous la Manche', Les Annales des Mines, 1988

between 1975 and 1985 mostly for energy related projects appears to be a good solution for the financing of the link. This seems especially true since the British and French governments want it to be financed entirely by private funds. Moreover, the improvements that have been achieved in tunneling and bridge building technologies will allow the developers to be more creative than was possible in 1975. A simple tunnel is not any more the only possible solution to the problem of creating a link across the Channel.

In conclusion, the conditions in 1985 are such that an innovative project must be put together, with a financing package that relies exclusively on private funds. To show how difficult it will be to finance this project privately, we will review the conditions that have to be faced by the developers, the incentives that should be offered to the investors, the ways to make sure that the financing package is reliable and the ways to reconcile the interest of the public with the necessities of private financing.

7.1 What are the conditions that the developers face?

Private financing of the fixed link across the Channel is surprising

because it is a transportation infrastructure facility which tend to be generally financed with taxes,as we have seen earlier. This will not be the case for this project because the two governments do not want it to be affected by a lack of public funds and because it does not have the same importance for the two states. Its existence is more important for British than for French trade. If the link had to be financed by public funds, it would never be built.

Moreover, the project is so important by its size and by the length of the construction period that the amount of money to be raised is unprecedented. The link will be 50 km long, will take around 7 years to build and will cost between 27 and 54 billion FFR, depending on the project. We have seen above that the technique of 'project financing' is appropriate for such a project since the only way to repay the loans will be from the revenues generated. The problem is that this technique is rather new and most projects that have been financed this way have been energy related; their financing was shorter and they were less expensive projects. It will be the first time that such an extended and massive project (in size and in cost) is financed by 'project financing'. But some particularities of the link allow it to be financed in such a way; it is a 'mega project' and it is a utility; the link will be long and risky to build but once built, its yield will be certain and the loans will be easily be repaid by its revenues.

The fact that the link will be useful for the public makes the governments interested in it, even if they refused to back it. They have to choose the project which establishes the tightest links between the developers, the States and the banks so that it will be in the best interest of the three parties to collaborate as efficiently as possible and to make the financing of this project by private funds possible.

7.2 How to make the financing with private funds possible?

The two governments tried to make the development of the link as easy as possible when they published official recommendations. They were mostly concerned by the unity of the system and the length of the concession.

The unity of the system must be preserved even if each half of it is managed by a country with different laws; English and French laws will apply to those parts of the link which are in England and France respectively. The French and British governments have established the Intergovernmental commission. This commission will draw up regulations concerning the construction and the operation of the link

and will have powers of direction. Such matters as safety, security, and the environment will be regulated by national laws adopted in the two countries.

The customers of the link must be treated the same way as customers using different transportation means across the Channel in matters of immigration and customs.

Then, the developers of the projects must say what the length of the concession should be and give the reasons of that choice. If the concession is too short, the loans are unlikely to be repaid and the investors will have a poor yield. And if the concession is too long, the States will lose the benefits of a profitable utility and the developers will earn too much money. This is why the length of the concession is critical.

After reviewing the financing packages of each project, to ensure that they are reliable, the states have decided to call banks as consultants. The British government has chosen Schroders bank and Chase Manhattan Bank and the French government has chosen Crédit Commercial de France and Morgan Guarantee Trust. These banks have drawn the following criteria to judge the reliability of the packages.

7.3 How to make sure that the financial package is reliable?

The financing of the link is based on the following principles concerning the percentage of capital required, the currencies and the provenance of the loans and the necessity to allow a refinancing.

As it is the case in most project financing packages, the amount of capital requested is 20%. The banks involved in the financing would not be willing to participate with a lower percentage, as the banks would bear too much risk and the investors not enough. The amount of money needed (between 27 and 54 billion FFR) can not be raised on the French and British money markets only. As a result, the loans must be international and emitted in different currencies.

If necessary the project should be able to be refinanced. This way the length of the repayment of the loans could be longer and reach 18 years instead of the 15 years that are common in project financing. The initial lenders could be replaced by new ones, the corporation could pay higher dividends and the interest payments could be lowered. As new lenders would enter, there would be fewer risks involved in the project than during the first financing and the interest rates could be lower. This would minimize interest expenses.

To ensure the reliability of the financing package, special attention must be given to the risks and the manners in which they are shared, the internal rate of return and the rate of return on the capital.

Construction represents the highest risks. It is improbable that the project should not be finished for technical reasons. But exceeding the budget and running late is probable and is therefore an important source of risk.

The project must be as defined as possible to make the length of the construction and the estimated costs reliable figures. The risk associated with these delays or overcosts should be carried mostly by the contractors by the means of careful contracts. It is wise to make sure that the classical ways to share the risks such as fixed price contract and penalties for delays can move the risk from the operators to the contractors and the insurance companies.

The exploitation risks are not very important. Once in service, the fixed link will provide rather certain, growing and easy to forecast revenues until the end of the concession. The project is very risky before the beginning of its service and moderately risky afterwards. The risks of the exploitation are mostly a traffic level lower than expected, or tariffs that have to be lowered or a possible reaction of the competing transportation ways or larger than expected operating costs .

The financing risks are important too. The international loans must be repaid in currencies which are not the currencies of the revenues and this causes a big currency risk. These repayments are exposed to exchange rate movements. The floating interest rates can be affected by an increase in real interest rates which can make the financing more expensive. These risks can be hedged with currency and interest rate swaps on the bond markets. (It will be necessary to hedge on the French and British bond markets too since the expenses are half in British Pounds half in French Francs and the revenues will be mostly in British pounds because two thirds of the traffic will originate in the UK. The problem is that the length of the swaps offered is shorter than the maturities of the loans)

The political risks are covered by guarantees of indemnisation (in case of a nationalization) or of fiscal and legal non discrimination.

The most dangerous risks must be reduced to attract investors and lenders. For this purpose, close attention must be given to the reliability of the basis data: the construction costs, the revenues and the cash-flows. The less reliable the data is, the more capital and the higher the revenues banks are going to require before lending to this project resulting in a higher the return on capital asked by the investors.

This is why it is important to build a base case as reliable as

possible. The experts of the two governments and their consulting banks have developed themselves careful and reliable cases. A basis central case has been made and then adapted to the different projects under different hypothesis. Then an analysis followed, concerning the sensitivity of the project to interest rate and currency movements.

What are the important points that the banks and the investors are going to require?

The amount of money to be raised is between 27 and 54 billion FFR. The more expensive the project, the more it will need financing from banks in currencies which are neither French Francs nor British Pounds. The use of different currencies in the financing package will expose the project to exchange rate movements.

If the link has to be financed by banks that do not have experience in project finance, those banks will be more risk averse and will want more backing from the governments unless the package is strong enough to convince them that the risks they are exposed to are acceptable. The American banks are reluctant to lend money for periods exceeding 12 years. Also, because the project associated with this loan has no impact on the American economy, there is no incentive for the American banks. The stronger the package and the shorter the maturity of the loans, the more money can be raised.

But the fact that the French and British governments will decide together who wins this project will be an incentive for the banks to finance it. And as the energy economy is in crisis now, more funds will be available for the financing of this project in the form of 'project financing'.

An amount of one or two billion dollars can be raised on the financial markets for a project. But what would be the incentives for private investors? We have to look into it assuming that the loan will be repaid in 18 years.

The private investors have two mentalities: either they keep their share for the rest of the concession or they sell it two or three years after they bought it and make a profit.

An investor who wants to sell his share soon after he bought it wants a high yield. It won't be the case here. The size of the capital venture market in England and in France is not sufficient for this project to be financed by this sort of investors.

This is why this investment will mostly interest risk-averse investors who intend to keep the share in their portfolio. The rates of return on the capital required by such investors were 14.8% in France, 15.7% in Britain, 14.4% in the US and 8.6% in Japan in 1985. These

rates take into account the inflation rates, the long term interest rates and the average of the risk premia on the markets in the last three years preceding 1985.

We now have a rule of thumb to evaluate the different projects according to their internal rate of return, their return on capital, and the length of the repayment of the loan.

The officials have concluded that several projects could be privately financed. This is why they had to look into the way the projects met the needs of private financiers while not going severely against the public interest.

7.4 How to reconcile the needs of the private financing and the public interest?

As the link is an infrastructure facility that will be publicly used, the governments had to be very careful to choose the right project. They had to be sure that they would not have to be financially or legally involved even indirectly and they had to look into the impact of the different solutions on the two countries.

To guard themselves against the first point, the governments have decided not to give backing or economical or financial help to the project. The governments needed to be careful not to let themselves be trapped in the relationship between the developer and the national railway companies, the guarantees of the bank loans or the length and the conditions of the concession.

The relationship between the developer and BR and the SNCF (the British and French railway companies) is very important. The revenues from these companies is expected to be between 26 to 47% of the revenues of the project in 2003. As the companies are subsidized by the states, the states will be indirectly charged by the link. For instance, if the network is not used at its full capacity by the railways, it would be tempting to make them pay a fixed price and to make them in this insidious way guarantee the developer against traffic risks. Such a financing plan is not acceptable for the States as most of the risk must be borne by the developer.

Most of the projects are put together by a group of contractors and banks of which the contractors are clients. The states should be sure that no conflict of interest will arise and make the prices rise. The manager of the project should be independent from the developers.

As the states do not want to back the project, the loans will be

guaranteed by the assets of the developers. The financing in the form of 'project financing' implies that the banks may take over as developers in case of bankruptcy. The states are not liable.

The concession period should not be too long or too short. If it is too long, the project could be nationalized and if it is too short, the loans may not be repaid.

The length of the concession has a small impact on the late cash flows. (The IRR is affected only slightly by it in the case of most projects) Nevertheless, the length of the concession is a guarantee for the investors that they will get their money back.

The supposed length of life of the projects must weigh heavily on the choice of the concession length. The States must be sure that they will receive an infrastructure facility that remains viable after the concession ends.

7.5 The impact of the projects:

During the construction the impact of the project on the economy of the concerned countries will be important if the investment is

large.

During the operation, the consequences on transportation, on employment in the neighborhood of the tunnel will be the greatest. Fiscal revenues will be generated for the concerned states during the construction and the operation periods. These revenues will vary much according to the projects

7.6 Conclusion:

The decision to privately finance the link across the Channel seems to be bold. As a matter of fact, the project financing technique has never been applied to such a huge project, for an infrastructure facility which will be public, or for a project with such a long construction period.

The goals of the financiers and of the states are obviously different. Now we have to see how the Eurotunnel project appears to be the best answer to these problems.

**8 THE FINANCING PACKAGE THAT MADE THE
REALIZATION OF THE EUROTUNNEL PROJECT
POSSIBLE:¹¹**

The financing of the Eurotunnel project is a challenge for the three following reasons; it is the biggest project financing package ever made. It is the first financing of a project of this size without the guarantee of any state and it involved the constitution of the first franco-british corporation that emits undissociated french and British stock.

It has broken two world records. The project involves the largest bank syndicate ever put together for a project. There are 198 banks involved and together they bring 50 billions of francs. It had been thought before it happened that the highest number of banks that would be interested in participating in such a complicated financing package would be 120. The project has also raised 7.7 billion french francs on the french and

¹¹ based on:

'Information memorandum: Eurotunnel', Arranging banks, 08/87
'Eurotunnel, augmentation de capital, introduction en bourse', Note d'information, 10/27/87
'Le Tunnel sous la Manche', Les Annales des Mines', 1988

british stock markets soon after the biggest crash of the stock exchange since 1929.

Nevertheless, gathering close to 60 billion french francs has been difficult since the project involved was not your idea of a simple one!

The project had to be financed with the project financing method: the revenues generated by the project must be the only source used to repay the loans and to pay dividends to the investors. The lenders and the investors are the ones who bear most of the risks.

The success of the financing package depended on the ability of the developers to demonstrate that the risks of the project were limited and that the projected revenues would be enough to make the project appealing to the lenders and the investors.

Since the beginning it was known that to exist, the project had to be financed by the private sector.

The project has been conceived after a market study and with the technical solution which involved the fewer risks and the biggest yield for the lenders and the investors.

We will review the cost of the project and the financing needs, the traffic and the revenues, the earnings of the corporation, the raising of the equity and the credit agreement.

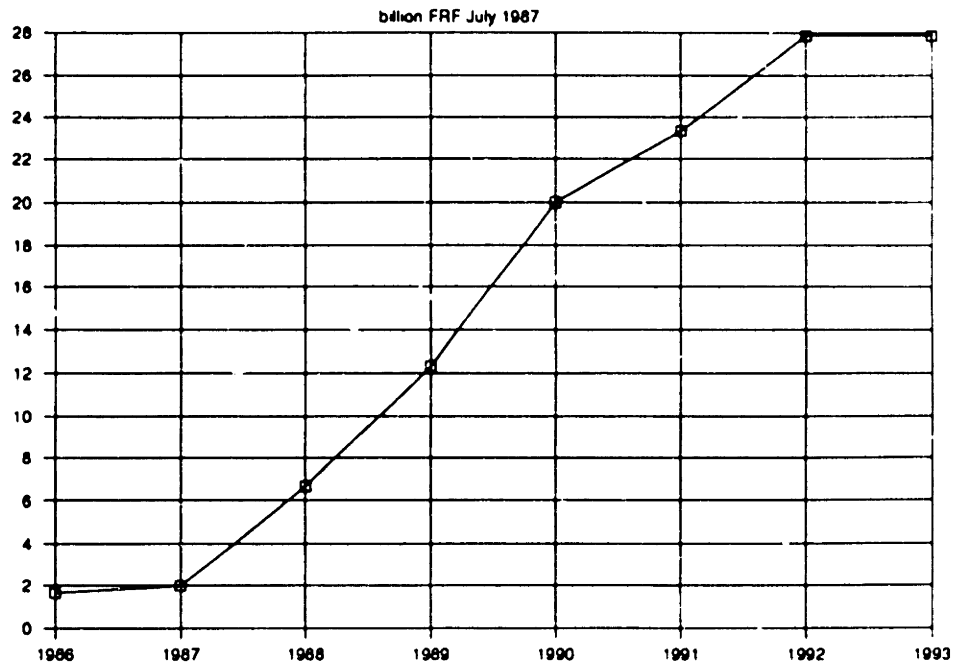
8.1 The cost of the project and the financing needs:

The construction cost has been estimated at the time of the bidding at 27 billion FFR of 1985 and since then, the price has changed to 27,88 billion FFR of 1987. This price can be broken down as follows:

	billions of FFR
-boring and lining of the tunnels and underground structures (target works)	13.672
-terminals, fixed equipment automatic monitoring system of the trains and cooling system	11.692
-shuttles, locomotives and spare	2.520

	27.884

Construction cost

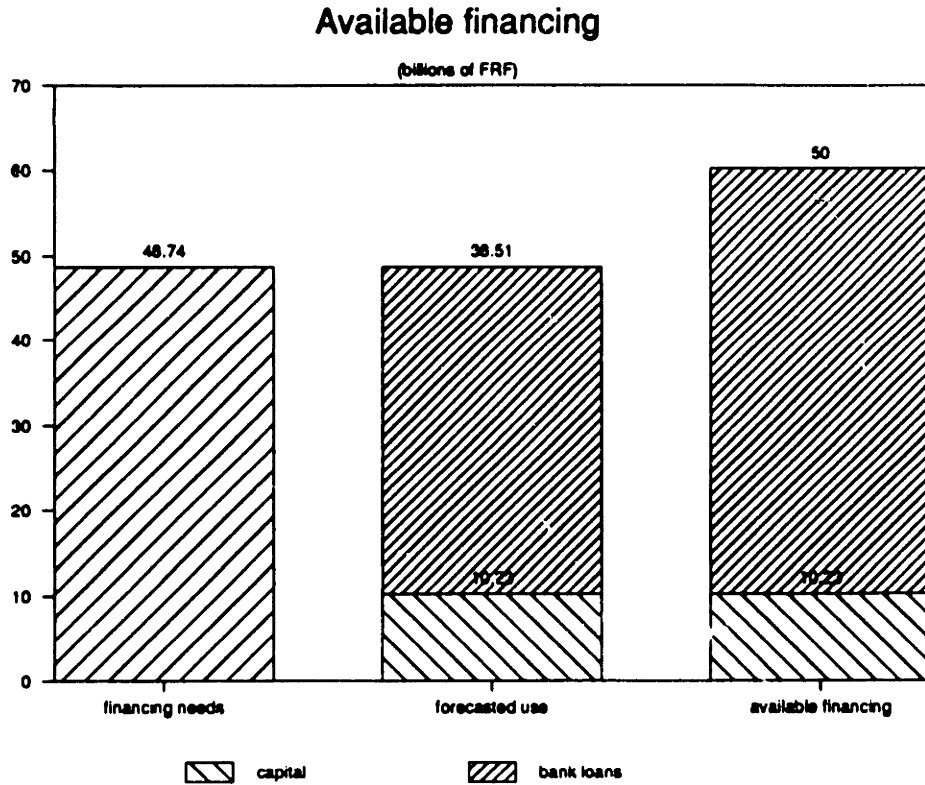


The expenses incurred by Eurotunnel during the construction period have been estimated at 6.417 billion FFR. These costs include management, operations and office costs, financial fees, construction phase insurance premiums, land acquisition and provisional sums.

A provision for inflation has been computed. The annual inflation rates for 1987 and thereafter are 4% with an increase of 0.5% p.a. until 1991. From 1991, the inflation is assumed to stay constant, equal to 6% p.a. As a result, the provision for inflation for the construction period is equal to 4,691 billion FFR of 1987.

The net financing costs until June 1993, including interest expenses and commissions amount to 9.751 billion FFR.

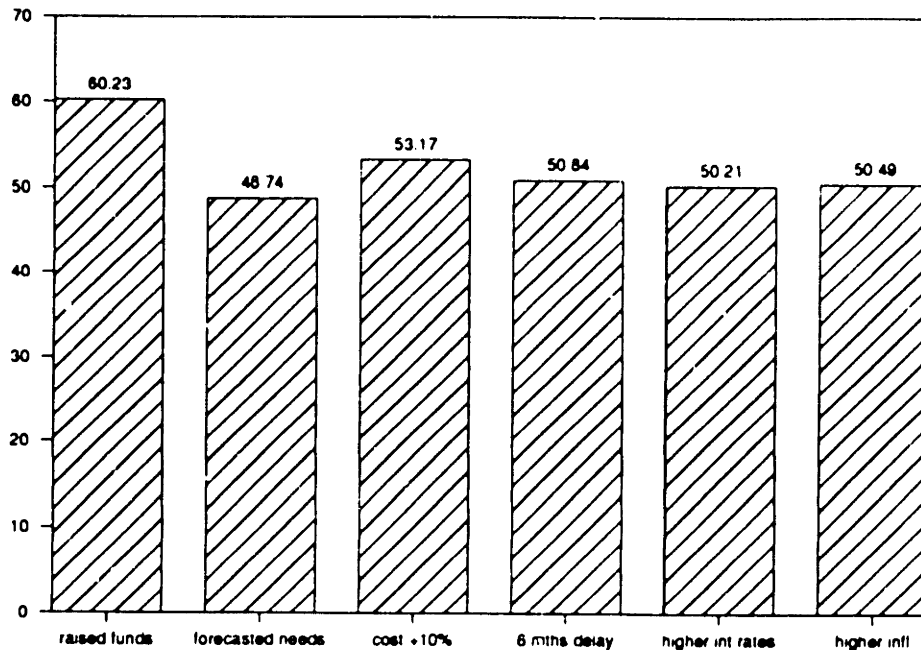
The sum of all the costs computed above equals 48.739 billion FFR of 1987. The total financing requirement of the project until its opening time in 1993, will be funded by equity and credit facilities. As we will see later, Eurotunnel is expected to raise 10.23 billion FFR in equity and 50.00 billion FFR in loans (40 billion as the principal loan and 10 billion as a stand-by credit). The sum of these amounts is superior to the financing requirements by 11.5 billion FFR, as shown in the graph below.



This margin is supposed to meet additional financial needs that might be caused by unexpected rises in prices, financial costs, a bigger construction cost or a higher inflation.

It has been shown that the amount of money that has been raised is enough to face different hazards such as a cost augmentation of 10%, 6 months of delay in the construction, higher interest rates and a higher inflation. None of these possible hazards can make the security margin of 11.5 billion FRF insufficient.

Risks covered by the financing plan

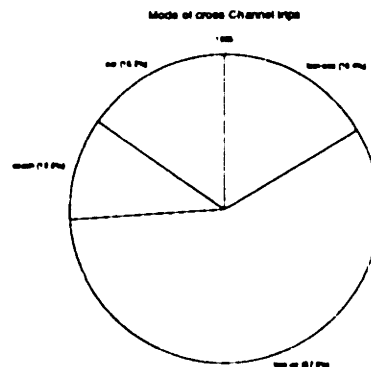
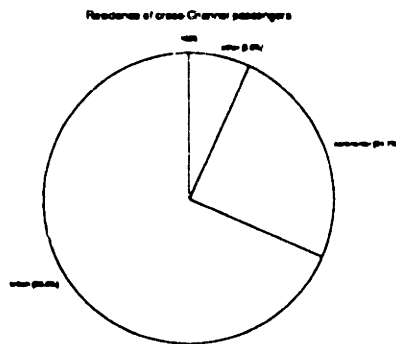


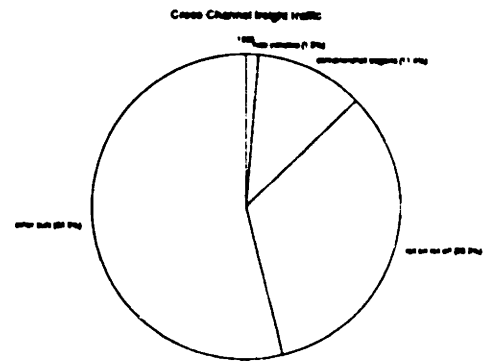
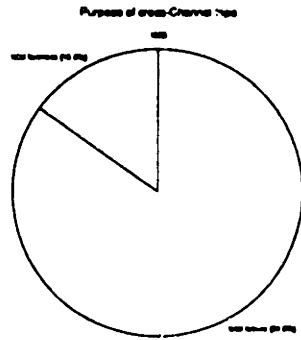
8.2 Traffic and revenue forecasts:

The traffic across the Channel (passengers and freight) has grown significantly between 1963 and 1983. The analysis of the reasons of this growth such as the adhesion of the United Kingdom to the EEC in 1973 shows that this growth is not temporary. The increased frequency and quality of the ferries between Dover and Calais and the construction of the M25 highway in England support this theory. Two other important reasons are the growth of the GNP and the consumption of the families in the countries in which the traffic originates. The most important may

be the growth of the English GNP since two thirds of the traffic originated in England in 1986. The hypothesis that have been taken to compute traffic forecasts include a growth of the English GNP of 2.15% p.a. between 1985 and 2003 and 2% p.a. between 2003 and 2013 and a growth of the consumption of the families of 2.05% and 1.9% for the same periods. Similar hypothesis have been made for France and the adjoining countries.

In 1985, 48 million passengers and 60 million tons (SI) of freight have crossed the Channel between England and mainland Europe. 20 million passengers (42%) have used the ferry, 7 millions (15%) of which have taken their car; 28 millions (58%) have taken the plane, 6 millions (12%) of which travelled between France, Belgium, Luxembourg, Netherlands and the United Kingdom. These last people will be a target for the Eurotunnel advertising campaign.





The results of these forecasts were that in 1993, the traffic across the Channel would be made of 67 millions of passengers and 84 millions of tons (SI) of freight. In 2003, those figures should reach respectively 94 and 123 millions. The traffic generated by the existence of the tunnel has been taken into account; this traffic should be 4.3% of the existing traffic at the time of the opening and 6.5% two years later. So, what will be the market share of Eurotunnel and what will be its revenues?

For each segment, the market share of the tunnel is different. The shuttles should attract 63% of the people travelling by car. The direct train services between Paris or Brussels and London should attract more than 90% of the pedestrians now crossing the Channel on boats, 30% of the people travelling by bus and 15% of the airplane passengers. The attracted freight should be 37% of the existing freight in 1987.

As a result, the traffic in Eurotunnel should be 44% of the passenger traffic and 17.5% of the freight across the Channel. at the time of its opening and evolve as shown below:

PASSENGER TRAFFIC (millions passengers) p.a.	actual 1975	actual 1985	forecast 1993	forecast 2003	forecast 2013
projected existing traffic	25.7	48.1	64.3	88.1	111.9
traffic generated by tunnel	-	-	2.8	5.5	6.8
total traffic	25.7	48.1	67.1	93.6	118.7
traffic in tunnel	-	-	29.7	39.5	46.6

FREIGHT (millions of tons SI p.a.)	actual 1975	actual 1985	forecast 1993	forecast 2003	forecast 2013
projected existing freight	37.2	60.4	84.4	122.1	169.8
freight generated by tunnel	-	-	-	0.5	0.6
total freight	37.2	60.4	84.4	122.6	170.4
freight in tunnel	-	-	14.8	21.1	27.8

Those figures have been computed taking into account the length of the travels and the tariffs shown below. (Those prices are in FFR 1987)

Shuttles and ferries			
TARIFFS	overcraft FFR 1986	ferry FFR 1986	ferry or shuttle FFR 1993
Cars and passengers (2.55 per car)	646	587	558
Freight Roll on roll off	-	1,477	1,182

Planes and direct trains			
TARIFFS	plane FFR 1986	plane FFR 1993	direct train FFR 1993
Business	800	640	399
Individual trip	521	495	239
Group trip	370	370	144

The operating revenues of Eurotunnel will have three sources; the shuttle fares, the price paid by SNCF and British Rail (the French and British railways companies) for the use of the tunnel and its operation, and the ancillary revenues such as restoration or duty free sales.

The price paid by BR and SNCF to use the tunnel is split into a fixed yearly payment and tolls which are a function of the traffic, but that will be superior to a minimum amount for the first twelve operating

years. These minimal payments will amount to 90 million FFR per month. The railway companies also will pay the operating expenses incurred by their trains. The consultants have computed the following ancillary revenues; a shuttle passenger is expected to spend 20.80 FFR in duty free sales and 6.20 FFR for drinks or food and the other ancillary revenues amount to 51 millions FFR of 1987 per year.

The following table shows the forecasted revenues for 1993, 1994, 2003 and 2013, in 1987 FFR.

REVENUES MILLION FFR	1993	1994	2003	2013
Shuttles	1,823	2,647	3,411	4,017
Railways	1,406	2,164	2,493	2,705
Ancillary	310	445	562	642
Total	3,539	5,256	6,466	7,364

These revenues can be broken down in a different way:

REVENUES MILLION FFR	1993	1994	2003	2013
Passengers	2,400	3,459	4,140	4,561
Freight	829	1,352	1,764	2,161
Ancillary	310	445	562	642
Total	3,539	5,256	6,466	7,364

These revenues may have been underestimated for the following reasons. The growing rate of the British GNP (which is a key factor for the traffic across the Channel) is expected to go down compared to the average of these last 25 years. Nevertheless, the real growth in the UK is already above the expected growth rate. This growth rate may prove to have been underestimated.

The growth rate of the passenger traffic is expected to go down by 65% and the freight growth rate by 50% until 2003. An historic approach shows how pessimistic this hypothesis is.

Concerning the traffic generated by the existence of the tunnel, the consultants have once again been conservative. They forecast a growth of 6% for the passenger traffic and of 0.5% for the freight.

The real example of the French train TGV Paris-Lyon has shown that one could expect a traffic growth generated by a new transportation means as high as 27%.

8.3 Earnings forecasts for the Eurotunnel corporation:

The consultants have used the traffic and tariffs forecasts to estimate the revenues with constant prices. Using the forecasted inflation rates, one gets the following results; the first positive earnings will appear in the first year of operation of Eurotunnel. The table below shows the forecasted income for the years from 1993 to 2041.

Million FFR	1993	1996	2003	2013	2023	2033	2041
Gross Income	4,876	9,084	15,857	32,358	61,843	113,560	178,236
Income before taxes	703	2,731	9,268	24,100	48,795	91,522	144,532
Dividends payable per unit	-	5.58	14.57	38.03	76.96	144.43	228.85

Dividends will be given in 1993 and they will grow by 21 % p.a. until 1998 and they will reach 100% of the issuing price in 2012.

8.4 The financing:

The total financing requirement of FFR 48.739 billion is to be funded by equity and the credit facilities. To prevent exposure to inflation or construction risks, it has been decided that 60 billion FFR were to be raised. Since the banks would lend the funds in the form of a project financing, without any other guarantee than the assets of the Eurotunnel corporation and the concession of 55 years given to the project and without any source of payment other than the revenues of the tunnel, they decided that they would demand a capital at least equal to 10 billion FFR. They also demanded that 7 billion FFR of this capital should be spent before any drawing on the credits could

occur. This was intended to make the stockholders committed to the project. On the other hand, the stockholders wanted to be sure that the loans would be approved before investing in it. This made necessary a permanent dialog between the lending banks and the banks in charge of the equity. The solution was that the banks would sign the credit agreement on the 11th of November 1987 before the stocks were issued but that the banks would allow drawings on the credits only when the totality of the capital would be subscribed.

The final financing plan was the following:

CAPITAL	million FFR
-subscribed privately	2.530
-subscribed publicly	7.700

	10.230
 LOANS	
-principal loan	40.000
-credit stand-by	10.000

	50.000
TOTAL	60.230

This financing plan has been elaborated by a corporation created out of nothing. The bid had been won by a group of French and British developers. On the French side, they were a group made of contractors

mostly and of banks. Out of this group, an independent corporation had to emerge and place itself among the biggest European transportation corporations. This company had to seem reliable to its lenders and shareholders. One can wonder about the ethical qualities of a financing plan where banks are at the same time part of the lenders' group and of the borrowers' group.

8.4.1 The equity:

How were the 10 billion FFR of equity gathered? The project was perceived as very risky, and rightly so. The British parliament still hadn't ratified the treaty, the dockers' and ferries lobbies were very strong, it was not sure that Margaret Thatcher would be reelected, and the example of the tunnel between the two northern islands of Japan which had run over budget made everybody afraid that the same would happen to Eurotunnel.

At the beginning, in a few operations called EQUITY I, the developers became founding stockholders and invested 500 million FFR in September 1986. After this, things looked a lot better for the project; Mrs Thatcher had been reelected, the Treaty was on its way to being ratified and 40 international banks had reached a first agreement on

possible credit facilities. But Eurotunnel needed money, it was time for EQUITY II. In October 1986, 7 billion FFR were raised from financial institutions in France and England, and also in Belgium, Germany, Italy, the United States and Japan. The banks which engineered this subscription were Indosuez, the BNP, and the Crédit Lyonnais on the French side and Morgan Grenfell associated with Robert Fleming on the British side. Since the beginning, in France, many financial institutions were interested in Eurotunnel, and it was easy to make them subscribe. The most famous are: the Compagnie Financière de Suez, the Caisse des Dépôts, the Crédit National, the Crédit Agricole, the Crédit Foncier de France, UAP, GAN, AGF and Group AXA. On the British side, it was much harder since the privatizations decided by the Thatcher government made the available private funds much in demand. The ferries lobby took that opportunity to try to make the project collapse but failed. Eventually the funds could be raised on both sides of the Channel.

The corporation became truly independent since its founding stockholders were a minority. The construction contracts had to be re-negotiated because the new stockholders suspected the contractors to have been lenient towards themselves as they were both client and contractor. These conflicts of interest result of the degree of precision that the governments expected in the bids. The contractors must be part of the bidding group because no developer would commit himself

without the contractor on a price that the contractor has set alone.

In the summer of 1987, Eurotunnel began to need other funds. EQUITY III, that is the issuance of stock on the public market was ready to be launched. 7.5 billion FFR had to be raised.

The technical problems were numerous. The stock issued was the stock of a binational corporation building and operating the tunnel. The corporation did not have any past, so the investors had to rely on forecasted balance sheets to make their decision. The stock had to be in both French and British stock exchanges so that the public could buy and sell and it had to be exchangeable in France and in Great Britain. So it had to comply to British and French stock exchange rules. There would not be any dividends before six years and the British and French stockholders would have to have equal rights.

A new financial instrument was created, the unity. It is composed of two undissociated stocks; a stock of the French corporation, Eurotunnel SA and a stock of the British corporation, Eurotunnel PLC. These two corporations would share equally the revenues and the costs of the tunnel.

It appeared that Eurotunnel was not ready to launch Equity III in June 1987 as expected. The treaty would not be ratified and the

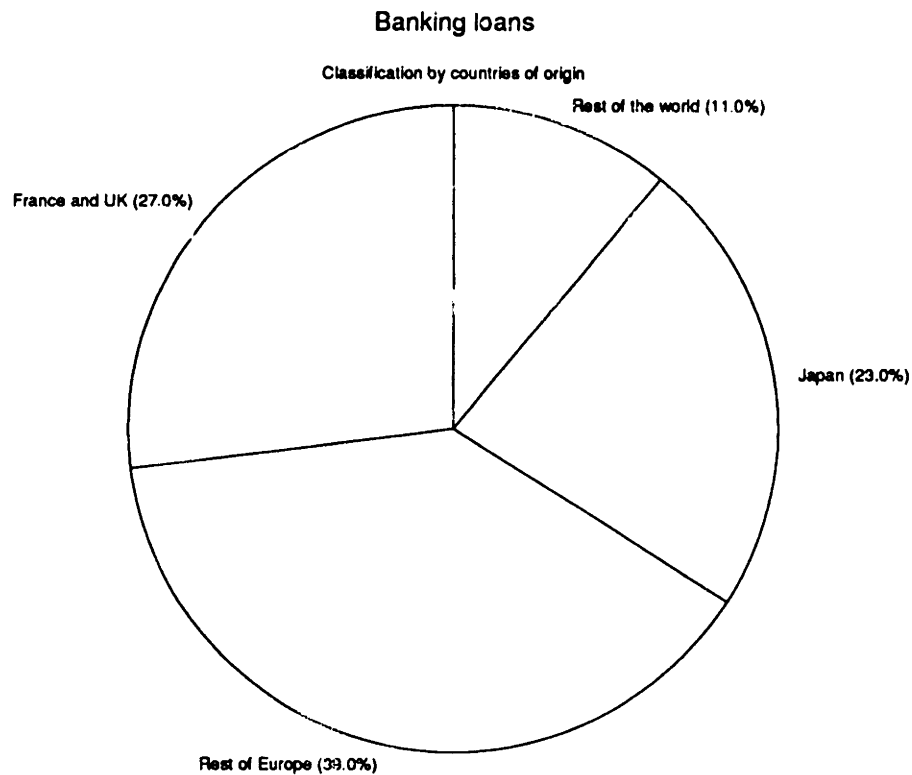
credit convention would not be signed. It was decided to delay the operation until autumn. The banks would finance Eurotunnel until then, this way, they would guarantee some of the money raised in Equity III. This decision was going to be very important since the crash of October 1987 would already have happened when the subscription took place.

The stocks were issued in spite of the crash. The price was chosen to be 35 FFR per unit for 24 FFR for Equity II and 20 FFR for Equity I. It was not a huge success. 200,000 small investors in France and 100,000 in Britain became stockholders of Eurotunnel. The remaining amount of equity has been subscribed by institutions.

8.4.2 The credit convention:

The credit convention gives Eurotunnel loans and credit letters in six parts for a total of 50 billion FFR (of which 20% are a standby credit) which can be broken down as follows: it is composed of 2.6 billion British Pounds and 21 billion FFR and 450 million USD. It will be possible to make drawings in other currencies. Some of these facilities will guarantee the loans of the European Bank of Investment and of the Credit National. The countries of origin of the banks involved

are represented in the graph below:



The credits facilities can be suspended if the following conditions are not filled; Eurotunnel should have spent at least 7 billion FFR of its capital, the construction should be well under way and the banks or their technical consultants should approve of the construction schedule for the future. Moreover Eurotunnel will not be able to draw

on its credits if the bank debt cover ratios are not above a minimum value and if the corporation does not give the banks regular progress reports.

The first drawings will be possible from the 1st of July 1988. The credits will then be available for a maximum period of 7 years. The repayments will occur as soon as positive cash flows appear and when the utilization period is over. A repayment schedule has been made and allows the total repayment of the debt the fifteenth of november 2005.

In the first years of operation, Eurotunnel will have to put aside a part of its cash to build and keep reserves for repayments at a required level. After two summers of operation, Eurotunnel will be allowed to repay its loans in advance but not more than 20% of the total debt per year. If a refinancing seems appropriate, Eurotunnel will then have the right to do so.

The principal commissions that Eurotunnel will have to pay are the following: initially 9/8% of the total amount of the credits and 1/8% per year of the amount of the credits which have not been drawn.

The interest will be computed on the basis of the market rates of the currency and the market involved and a premium will be added.

This premium will be a function of the progress made in the construction and the amount already drawn.

Eurotunnel will give securities to the lending banks. These securities will be the assets of the company, the concession and the assets of its subsidiaries. These securities will allow the banks to replace Eurotunnel if they fail in the management of the project.

The credit convention states that banking cases should be made periodically to check on the progress of the project and its existing and forecasted cash flows.

Cash flow provisions will be prepared at least twice a year and will be based on data such as the investment and operating expenses, the traffic and the revenues, the taxes, the inflation the interest rates and other economic factors. The hypothesis will be made with data given by Eurotunnel. The banking cases will allow to compute debt cover ratios.

One of the most important conditions of the loans is the bank debt cover ratio that is the ratio between the future actualized cash-flows until 2005 and the total of the loan (excluding the BEI loan). Eurotunnel will not be able to draw on its credits if this ratio is lower than 1.2, will not be able to re-finance its debt if this ratio is lower

than 1.3, and will not be allowed to pay dividends if it is lower than 1.25. If the ratio stays lower than 1 during 90 days in a row, the banks can take the project over.

If we consider the cash flows occurring 18 years after the opening of the tunnel, their present value is 30% higher than the amount of the debt. This margin is lower than the usual ones required in 'project finance' packages and it has been difficult to overcome this difficulty. The banks accepted it considering that the ratio becomes 1.44 if two more years of cash flows are taken into account and that it becomes 2.20 if the total length of the exclusively is taken.

Another important ratio is the total debt cover ratio. It is the ratio of the present value of the cash flows until 2020 to the total debt. Eurotunnel will not be allowed to draw on its credits if this ratio is lower than 1.9, and to re-finance the project if the ratio is lower than 1.9. If this ratio stays lower than 1.3 during more than 90 days in a row, the banks can take the project over.

Another interesting particularity of the credit agreement is the agreement made with the European Investment Bank. This bank will loan the project 10 billion FFR and this loan will be guaranteed by the banks which have signed the credit convention. As a result, they will not be added to the 50 billion lent by the banks of the syndicate.

The European Bank of Investments bears less risks than the private banks since its loan will be guaranteed by the other banks until the time of the refinancing, that is during the period when the risks are the biggest; the construction period and the beginning of the exploitation.

The banks also used a banking case with more pessimistic hypothesis than Eurotunnel did. They wanted to make sure that they would be repaid. Their hypothesis were that: the tunnel would open after a delay of 6 months, the costs would be 2 billion FFR higher than expected because of inflation and higher financial charges and the TGV (high speed train) would be ready to be operated only two years after scheduled.

The results were that the amount of money that had been raised was sufficient to cover these eventualities and that the IRR, though lower by 1 point, was still acceptable . On those basis the loans would be repaid in 18 years. This length has been prohibitive for most American banks.

In reality, because of the refinancing which should take place, the length of the loans should be brought down to 11 years. The repayment period could have been even shorter if the banks had agreed on being repaid later.

The refinancing of the project will shorten the maturities of the loans, lessen the interest expense incurred by the project and allow to raise the dividends.

This project has a yield which is low at the beginning but which grows rapidly. This loan makes the banks run a risk of immobilization of their capital but not of loss.

9 FINANCIAL COMPUTATIONS:¹²

Two base cases have been prepared to analyze the project economics and their impact on the loan repayment schedule using assumptions selected by the owning group and the arranging banks: the owning group case, representing Eurotunnel's base case projections and the banking case, representing the arranging banks' view of the most likely outcome of the project, based on the assessments of their consultants.

The assumptions taken in the owning group case have been previously explained.

The banking case assumptions are the following. The construction costs have been computed assuming that the tunnel would open after a delay of six months. As a result 300 million FFR have been added to Owning Group costs to cover such costs for the period of delay. The revenue forecast by the consultants of Eurotunnel have been used with the following variations suggested by the banks' consultants (Prognosis):

-greater reduction in air fares due to the liberalisation of European air transport

12 based on:
'Information memorandum: Eurotunnel', 08/87
'Eurotunnel: augmentation de capital, introduction en bourse', Note d'information, 10/27/87

-slower build-up in utilisation of the system

-no created traffic (other than price induced traffic) on through rail services until full TGV (high speed train) services are introduced. (forecasted in May 1995)

The net result of those variations is to reduce the revenues in the Banking Case by 15.8% in 1994 and 4.5% in 2000 from those in the Owning Group case.

Financial computations have been done and both cases and gave the following results:

	Owning Group Case	Banking Group Case
Maximum Bank Exposure (FFR m)	38,390	40,680
Average Term Of Exposure (years) ¹³	5	10
Final Repayment (period/year)	2/1998	2/2005
Minimum Bank Debt Cover Ratio (2005) ¹⁴	1.68	1.29
Minimum Total Debt Cover Ratio (2007) ¹⁵	1.81	1.44
Minimum Total Debt Cover Ratio (2020)	2.59	2.20
Project IRR ¹⁶	17.33	16.52
Permitted Refinancing Date	1/1995	1/1996
Final Repayment With Refinancing (period/year)	2/1998	1/1999
Year First dividend Declared	1994	1995

13 This is the weighted average period of bank exposure

14 Calculated on the basis of the maximum term of loans plus two years

15 Calculated to the date when the concessionaire's exclusivity ends

16 Internal rate of return before interest and tax

10 THE EUROROUTE PROJECT: FINANCING

PACKAGE¹⁷

The Euroroute consortium comprised 11 private and public sector companies based in France and the UK, who have between them the industrial and commercial experience to design, build, operate, and arrange the financing package for the link. They were supported by a wide range of consultants and intended in due course to appoint an experienced project manager. Each national group was to form two companies; one to own and operate the concession and to be responsible for finance and overall coordination, the other to be responsible for the construction. Joint ventures were to be established through which the respective British and French companies would have operated together.

10.1 Costs and revenues:

The total cost of the main construction work can be broken down as follows: using mid-1985 prices, it was expected to amount to FFR 42.7

17 based on:

'Euroroute: proposition de lien fixe transmanche', Euroroute, december 1985

'Euroroute: financial information memorandum', Euroroute, december 1985

billion for the road link and F 14.2 billion for the rail link. Financing charges were not included. The road link was due to open to traffic in mid 1993 and the rail link up to two years later.

The estimate of the operating costs was based on studies by consultants in the UK and by Euroroute France using their experience of toll motorway operations.

The revenue projections have been calculated by Coopers & Lybrand and Transroute. In their analyses, they have examined the trends of the past twenty years and have produced forecasts for the total market over the whole period of the concession on the basis of the projected economic growth. The proportion of each type of traffic which would divert to Euroroute has then been calculated, taking into account time and distance savings and relative quality of service and price (including consideration of the competitive reaction of other modes). To the resulting revenue has been added an element representing new traffic generated by the existence of Euroroute and a further element for duty-free and other purchases by travellers. The revenue projections are the result of state of the art analysis and experienced judgement, thus minimizing the margin of error inherent in long term forecasts.

10.2 Funding plan:

The funding plan is principally concerned with the structure of the project finance package required during the construction period and its subsequent refinancing.

It was the intention that Euroroute France and Euroroute UK would each be responsible for raising one half of the overall funding requirement, under a closely coordinated plan, with most funding operations being arranged jointly.

Binding commitments for funds sufficient to cover the full cost of the construction of the road link together with adequate provision for overrun were to be put in place immediately after the ratification of the Treaty which was expected by mid 1987. In outline, Euroroute would have:

- issued equity and convertible bonds in mid 1987 to be called during the early phase of the construction period.

- syndicated bank loans on the French and English domestic markets and on international and other markets. These loans would have been drawn throughout the construction period of the road link. They would

have been arranged so as to be repaid within 6 years of completion of the road link, thus having a maturity of up to 12 years from initial commitment, subject to market conditions at the time of the syndication

-used suitable instruments and opportunities afforded by the markets to issue bonds (wether straight or with equity features) and commercial paper, in order to widen the pool of funds available to the project, optimize the overall terms and conditions of the finance, and reduce the average cost of funds. Such issues would then have been substituted for corresponding amounts of the syndicated bank loans

-after completion of the road link, used the same instruments to obtain the necessary refinancing of a portion of the maturing debt

In general, funding for the road link would have followed a similar pattern, with finance being committed following the conclusion of agreements with SNCF and British Rail.

Euroroute would have seeked to protect investors and lenders from the project risks inherent in the construction phase. Whilst the proposed construction methods themselves minimized a number of risks, care would have been taken when negotiating the construction contract to ensure that, as far as possible, all major risks were taken by the Construction joint venture and that, where available, insurance cover

was put in place. Adequate bonding of the construction joint venture was to be arranged and an independent project manager would have supervised all the aspects of the contract.

Once the link was operational, revenues would have formed the principal source of security for lenders and would as such have been charged together with all other assets of the Concession companies.

10.3 Cash flows:

The total funding requirement is made up as follows:

FFR billion	Road	Road and rail
Capital cost (1985)	42.7	56.9
Inflated capital cost	56.1	78.6
Funding costs	18.4	22.0
Requirements for funds	74.5	100.6
Funded by		
Debt	59.7	81.0
Equity	14.8	19.6
Requirements for funds	74.5	100.6
Additional commitment to provide for overruns etc	10.7	14.2
Total commitment	85.2	114.8

The results of IRR calculations are the following:

	Road	Road and Rail
Internal rate of return on the project	10.6%	10.4%
Internal rate of return on the capital	11.4%	11.2%
First year interest fully covered by revenue	1995	1996
First year no debt	2009	2009
Total construction period debt	FFR 59.7 bn.	FFR 81.0 bn.
Maximum total debt outstanding	FFR 60.8 bn.	FFR 83.4 bn.
Cover ratio	1.8	1.8

11 COMPARISON OF THE FINANCING PACKAGES OF THE EUROTUNNEL AND EUROROUTE PROJECTS:

The financing packages of the Eurotunnel and Euroroute projects were rather similar. The main difference is in the size of the investment. The total investment of Euroroute would have been the double of the total investment of Eurotunnel. With similar revenues, this difference in the costs made the internal rate of return of the Euroroute project be considerably lower than the internal rate of return of the Eurotunnel project.

The Eurotunnel project was chosen over the Euroroute project because the commission decided that the investment required for the last was too high and that the project was too ambitious. Since it was the first time that such a huge project would be financed privately, they preferred to choose the project that was the least ambitious, thus the most likely to succeed.

12 RECENT DEVELOPMENTS IN THE EUROTUNNEL

PROJECT:¹⁸

After introduction of the Eurotunnel stock (unities) on the financial market, the price of that stock dropped to 24 FFR due to the effect of the stock crash which had taken place in October 1987, just before it was issued. But in March 1988, its price was once again equal to the issue price 35 FFR.

The construction began in 1988. The French and the British had to dig on 150 km, 110 of which are under the sea. The geology on the French side is worse than on the English side, as we have seen earlier. Then, the Som Delattre Corporation went bankrupt. They were supposed to help with

18 based on:

'Des financiers traversent la Manche', L'Expansion, 12/6/85

'Les Américains boude le tunnel', Le Nouvel Economiste, 10/3/86

'Les vrais défis du tunnel', L'Usine Nouvelle, 03/17/88

'Financement, une confortable avance', Le Nouvel Economiste, 5/6/88

'Manche: les batailles du tunnel', Le Nouvel Economiste, 5/6/88

'TML wins more time and money for the Chunnel', Construction Today,
March 1989

'Armistice entre Eurotunnel et Transmanche-Link', Les Echos, 04/04/89

'Tunnel sous la Manche: des comptes à creuser', Le Temps de la Finance,
11/28/89

'Despite delays and cost overruns, Tunnel workers continue digging', The New York Times, 12/18/1989

'Eurotunnel obtient le déblocage de ses crédits', Le Monde, 01/13/90

the construction of the tunnelling equipment. This equipment finally arrived on the site in February but was not used before March. This explains why, in May 1988, the French were 90 days late compared with the English.

If the construction was not entirely successful, on the French side, this was not the case of the financing. When Eurotunnel published its yearly report for 1987, it showed that it had 10.2 billion FFR of capital and that only 4.5 billion had been spent. We have seen earlier how the financing package was put together. But this financing turned out to be very expensive: at the end of 1987, it had already cost 700 million FFR for the capital (it represents 7% of the funds raised) and nearly as much for the bank loans. And Eurotunnel still had not drawn on its credits.

But this advance in the financing had allowed Eurotunnel to show an income equal to zero for the first two years. The next years during the construction will show of course a negative income, but Eurotunnel, at the beginning of 1988, still expected to give dividends equal to 14 FFR in 1994. This would have represented a yield of 40%.

In the spring of 1988, there has been troubles between Eurotunnel (concessionaire) and Trans-Manche Link (contractor group formed of the five English and five French contractors involved in the project). TML made claims on costs and on delays. The claims covered mainly poor ground under Shakespeare Cliff on the British side and delays during autumn 1987

when Eurotunnel imposed financial restrictions after it delayed its Equity III share launch. The client Eurotunnel put back the contractual opening date of the Channel Tunnel by one month and offered a substantial package of new cash payments and incentives worth up to 2 billion FFR to its contractor TML. Early settlement of the major outstanding claims was attributed to Eurotunnel's attempt to improve its bitter relationship with TML. Eurotunnel had earlier preferred to leave the claims unsettled as it believed any early agreement would be at too high a price.

In November 1988, Eurotunnel drew on its 50 billion FFR credit line for the first time. On the 31st of March 1989, 5.14 billion FFR at an average rate equal to 8.9% had been drawn in four currencies. Most of it was drawn in French Francs at the average rate of 8.7%. In 1988, for the first time, the construction costs were higher than the financial costs.

At the end of 1988, the presidents of Bouygues, Dumez, Spie Batignolles, SAE, and SGE, the main French contractors of TML, had publicly replied to the criticism that ET had made about TML, they had accused TML of being incompetent. Then the tempest had calmed down. TML got a new manager, a very well known French corporation manager, Philippe Eissig. Nevertheless, the cost problems remained. The project cost evolved from 48.7 billion FFR to 54.5 billion FFR. Then, it was announced that the rolling stock was twice as expensive as expected (6.3 billion FFR

instead of 2.7 billion FFR). The estimated total cost was now 60 billion FFR and it covered exactly the money raised earlier. So, Eurotunnel had to find a way to raise more money, as the credit convention states.

At that time, the uncertainty about the future of the project was reflected in the stock price. First sold to the public in November for L3.5 each, the shares hit a high of L11.64 in June 1988 at the London Stock Exchange. But the investors concern about the cost overruns have caused the price to fall sharply. At the end of December 1989, its price was around L5.00.

Then, in October 1989, new problems arose between Eurotunnel and TML, concerning mostly the price of the lump sum works. TML and Eurotunnel had to reach an agreement. If not, the bank syndicate would not be able to write a new credit agreement. The new maturity is rumored to be 20 years.

Eurotunnel has announced that it intended to raise more equity in 1990 (it is expected to be 4 to 5 billion FFR, but it is not sure wether another public launch will occur or wether the founding shareholders will provide the funds.). If this amount of equity is raised, the return on capital may fall from 18.5% to 13%. This may still be attractive to investors, since the worst construction risks are over.

Another problem that arose in late 1989 was the will of the City of London to have the section inside London of the high speed link put underground. This would be very expensive and make any high speed link between London and Paris unlikely to operate before 1998.

Then, at the beginning of 1990, the arranging banks that head the bank consortium decided to make 2.5 billion FFR available to Eurotunnel. The credit had been frozen up to that time, following the crisis between ET and TML. These two finally agreed on a deal: the construction price has been fixed at 15.8 billion FFR (instead of 12.9 at the beginning). If the costs rise above that figure TML will have to pay for 30% of the overruns. Several decisions have been taken to save money, among them the decrease of the speed of the shuttles inside the tunnel. This would allow ET to save 1 billion FFR.

The 20th of February, a deal was signed between ET and TML. The direction of the construction site was removed from Alastair Morton, the head of the English branch of ET, and given to John Neerhout, an American engineer from Bechtel. Mr Morton had never gotten along with the contractors. He nevertheless keeps his post as president of ET plc.

In February 1990, the tunnelling was late in Britain and in advance in France. The service tunnel was on schedule on both sides, but the two railway tunnels were 21 and 17 weeks late in England and 12 and 16 weeks

in advance in France. Maurice Legrand, president of the Anglo-French commission of the Channel Tunnel estimates that the English are 75% above their budget. The main problem in England is now the frictions between the engineers who are English and the workers who are mostly Irish and who are paid better than the engineers thanks to bonuses. The French are 25% over their budget.

As a result the Eurotunnel stock is today a stock that interests speculators.

13 THE PRIVATE FINANCING OF THE TUNNEL UNDER THE CHANNEL:AN EXAMPLE OR A SINGLE CASE?

The financing of Eurotunnel has many aspects that can be used for the financing of other projects such as the high-speed train (TGV) in the North of France.

The development of private financing packages which bear all the risks of a project is limited because such a technique can only be applied to projects that have a fast growing and certain yield. That is seldom the case for infrastructure projects. It was already not evident that it would be the case of the Eurotunnel project.

But the alternative is not only between financing totally guaranteed by the states and financing totally private. In most cases, a mixture of public and private funds can be the solution.

The 'project financing' technique is adapted to such a case. But for that, the public sector must fully understand the conditions under which the private investors and bankers can intervene and they must adopt their state of mind. This will necessitate a change in the attitude of the employees.

The problem is the same for a private or public developer when a project

doesn't offer a sufficient yield to allow the banks to put in place a non-recourse credit which covers 100% of the financial needs (with the 'project finance' technique) and when the developer thinks that the yield is enough for the revenues to be the only source of debt service.

This difference in the viewpoints can be explained by the following reasons. The banks may have taken revenues and costs forecasts which are more pessimistic than the ones the developer took. The banks may demand a security ratio, that is an actualized revenue much superior to what is needed to repay the debt and on a period of time much shorter than the lifetime of the equipment. And undertaking the project may have some good consequences for the developer that the banks cannot take into account; for instance commercial benefits for a private developer or social benefits for a community.

In those cases, the developer can do something to have his loan anyway.

13.1 The public sector can partially guarantee the loan:

To make the debt-cover ratio acceptable to the banks, the non-recourse part of the loan can be lowered and the developer can offer

a guarantee for the rest. The developer only runs a limited risk since the loan that he guarantees can be repaid by the revenues of the project. But the lenders of the non-recourse part are repaid with the revenues in priority.

In most financing packages of energy or mining related projects undertaken by the private sector, the private developers guarantee a part of the loan and this part is called 'limited recourse loan'. Financing packages completely 'non-recourse' are exceptional. If it accepted to guarantee a part of the loan and if the rest was to be non-recourse, the public sector would take risks which are analog to the ones that the private developers always take. The cash-flows are first used to repay the non-recourse loan and then the guaranteed loan. The public sector must make sure that the revenues have been correctly estimated and that they are sufficient to cover the debt service of the two loans.

If that is not the case, the public collectivity runs the risk that the revenues generated by the project are not enough and must find a way to cover a possible deficit. It will be sure that the project will be undertaken efficiently and that the deficit will be minimized since the private sector will be on its side in the financing package.

13.2 The risks can be shared, some can be taken by the banks and the rest by the public or private developer:

A project that can not be financed if the banks bear all the risks may be possible to finance if the developer takes some of those risks. The developer may give a technical partial guarantee covering a specific risk, or a guarantee that he will cover the overcosts, or a guarantee of a minimum traffic, or a guarantee of refinancing in the case it would not be possible on the market.

In all cases, the public sector would only take risks that private developers are used to take. The guarantee only covers a limited risk and that was not the case of the limited loan guarantee mentioned earlier. This is not a financial guarantee and it does not increase the public debt. The guarantee is not very likely to be exercised. But this way, the public sector or the State gives a margin of safety that the banks need to ask for a lower debt cover ratio.

If it is not sufficient for the banks to finance the totality of the project with a non recourse loan, the State or the collectivity can guarantee some of the risks and guarantee a part of the loan. This is common practise for private investors.

13.3 The subventions:

The public intervention can be more powerful. If the project does not have sufficient revenues, the public sector can help it in giving a subvention that lowers the investment or special interest rates that lower the financing costs or an operating subvention that lowers the operating costs.

Once more, the 'project finance' technique can be used in such a case. A simulating model is created and allows to see the influence of the subvention on the repayment schedules and on the yield of the project.

The State gives subventions to projects that remain privately managed to compensate for the effect that public use will have on the operating expenses for instance.

The only other possible solutions would be that the public sector takes in charge the financing or drops the project. It is much less costly to give a subvention, especially so if the subvention is only given at the beginning of the project rather than yearly. A lump sum subvention computed with the forecasted budget of the project shows more concern of the public sector than later subventions given to cope with operating

deficits.

13.4 The public sector can give some capital:

When the project is an infrastructure with a limited and deferred rentability, it is even more difficult to find capital than non-recourse lenders. A long construction period makes it impossible to give dividends before at least the first year after the opening and makes the financing costs higher because of inflation and interest rates. And because of the discounting of the future revenues, they only have a little weight and they often are too little to make the investors interested. The problem is even worse when the project needs yearly maintenance or expansion investments that eat up most of the revenues.

A solution to that problem would be to limit the private capital to a share that would make it rentable and to complete it by public funds that would have less but certain remuneration and that would give the priority to the private funds. It could be in the form of a reimbursable subvention with small interest rates and a reward in case of success.

A subvention that is repaid if the project is successful is more attractive than a subvention that would be lost. Such a solution is

necessary to find investors if the rentability of the project is small.

A participation to the capital of the project can be necessary if the State wants to keep control of the of the project and of the revenues while transferring some of the risks to private investors.

It is not possible to transfer risks to the private sector without transferring revenues.

14 CONCLUSION

The financial package of the Eurotunnel project has been a success. This financing package is innovative because it is the first where shares have been sold to the public. The problems that have appeared are due to delays and overcosts. This has nothing to do with the financing package. If the project does not succeed, it will not be because of the financing but because of uncorrect estimations.

The example of the Eurotunnel project has been encouraging and since 1987, many countries have decided to finance their infrastructure facilities with the BOT (Build-Operate-Transfer) method. In many European countries (such as France, United Kingdom, Spain and Greece for toll highways), and also in Turkey (for power plants), in Thailand (for the Bangkok expressway), and in Australia (for the Sidney harbour tunnel), governments resort to private funds to have their infrastructures built.

The budget restrictions that many governments undergo today make this tendency even stronger. Nevertheless, as we have seen earlier, the bureaucracy in some European countries make it difficult. For instance, in France, the financing of the northern TGV (high speed train) is still not finished. And most projects don't offer the yield that Eurotunnel did. But, as most of these projects are less expensive than Eurotunnel was, one can

hope that some new financing methods are created, especially concerning the raising of the equity.

But as most projects will not be profitable enough to be totally financed with private funds, many mixed financing packages will appear. The private investors will be on the same side as the public sector, the private investors will have limited power on the project and the public sector will subsidize the project in one form or another.

BIBLIOGRAPHY

- 1 Les Annales des Mines, Le tunnel sous la Manche, Paris, France, Mai 1988
- 2 American Public Works Association, History of Public Works in the United States, Chicago, Illinois, 1976, p.23-53, 53-131
- 3 Arranging Banks, Eurotunnel: Information memorandum, London, United Kingdom, August 1987
- 4 Banque Indosuez, Project financing: a financial technique at the service of projects, Paris, France, February 1989
- 5 Michael R. Bonavia, The Channel Tunnel History, London, United Kingdom, 1987, p.15-27, 38-44
- 6 Construction Today, TML wins more time and money for Chunnel, London, United Kingdom, March 1989
- 7 Les Echos, Armistice entre Eurotunnel et Transmanche, Paris, France, 4 Avril 1989
- 8 Euroroute, Proposition pour la liaison fixe Transmanche, Paris, France, Octobre 1985
- 9 Euroroute, Proposition pour la liaison fixe Transmanche: Financement, Paris, France, Octobre 1985
- 10 Eurotunnel, Eurotunnel: Augmentation de capital, introduction en Bourse, Paris, France, Octobre 1987
- 11 Eurotunnel, Eurotunnel: a technical description, London, United Kingdom, August 1987
- 12 Eurotunnel, Eurotunnel: group accounts, London, United Kingdom, 1988
- 13 Eurotunnel, Eurotunnel: progress report, London, United Kingdom, 1988
- 14 L'Expansion, Des financiers traversent la Manche, Paris, France, 6-19 Decembre 1985

- 15 Industries et Techniques, Manche: Quelle liaison?, Paris, France, 20 Janvier 1986
- 16 Ingénieur Constructeur, Liaison Transmanche, quelle solution?, Paris, France, Janvier 1986.
- 17 Joint Economic Committee, US Congress, State and local public facility needs and financing, Washington DC, 1966, p.238-283
- 18 Le Monde, Eurotunnel obtient le déblocage de ses crédits, Paris, France, 13 Janvier 1990
- 19 Pierre Mayer, La liaison fixe à travers la Manche, un défi économique et financier, Paris, France, 1982
- 20 Le Nouvel Economiste, Les Américains boudent le tunnel, Paris, France, 3 Octobre 1986
- 21 Le Nouvel Economiste, Manche: les batailles du tunnel, Paris, France, 6 Mai 1988
- 22 New York Times, Despite delays and cost overruns, tunnel workers continue digging, New York, New York, December, 18, 1989
- 23 Shinichi Okano, A financial evaluation of the Eurotunnel project, MIT, 1988
- 24 Le Point, Tunnel sous la Manche: zizanies en sous-sol, Paris, France, 26 Février 1990
- 25 Rapport du groupe de travail franco-britannique sur la liaison transmanche, Manche: quelles liaisons?, La Documentation Française, Paris, France, 1982
- 26 Hugh J. Schonfield, The Suez Canal in peace and war, 1869-1969, Coral Gable, Florida, 1969
- 27 Sealink British Ferries, Eurotunnel, une appréciation de l'estimation, Paris, France, 21 Juillet 1986
- 28 Le Temps de la Finance, Tunnel sous la Manche: des comptes à creuser, Paris, France, 28 Novembre 1989
- 29 Usine Nouvelle, Les vrais défis du tunnel, Paris, France, 17 Mars 1988