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***THE CHANNEL TUNNEL: LE PROJET DU SIÈCLE***

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**Groupe Bagnolet**

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# THE CHANNEL TUNNEL: LE PROJET DU SIÈCLE

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## **RESUME**

Le tunnel sous la Manche est le plus grand projet d'infrastructure jamais construit en Europe. Entièrement réalisé avec des financements privés, il représente un immense défi économique et financier par l'ampleur des ressources mobilisées. Malgré la publicité contraire qui lui a été faite, cette opération peut être considérée comme un grand succès du point de vue de la gestion de projet et du transport de voyageurs, sinon du point de vue financier.

Cette contribution est la première synthèse écrite sur le projet, depuis sa réception. Elle en retrace l'historique depuis le début des années 1980 jusqu'en décembre 1996. Elle analyse tout d'abord le contexte général de la politique publique dans lequel s'inscrit le projet, et rappelle en particulier les conditions posées par le gouvernement britannique ; puis, elle retrace la lutte pour parvenir à réunir le capital nécessaire et ses implications sur la gestion du projet. Les enjeux en termes de management technologique sont brièvement traités.

La suite de la contribution se focalise sur les enjeux de la gestion de projet, et sur les différents débats et discussions qui ont concerné l'évolution du projet, les relations entre Eurotunnel et TML, et la manière dont TML s'est organisé pour relever le défi de la construction du système de transport. En conclusion, cette étude identifie (ou dégage) les leçons que l'on peut tirer de cette expérience pour le futur.

## INTRODUCTION

*If the British and French really have some interest and aim in common, they will find a way of surmounting all those much-trumpeted cultural and traditional differences (Sir Nicholas Henderson, chair of Channel Tunnel Group and former British ambassador to France, Henderson 1987 p 43).*

This paper is aimed at providing a description and analysis of the Channel Tunnel project from the point of view of the five themes that we have articulated within the Groupe Bagnolet. The data are drawn from both an extensive review of secondary sources, and from interviews conducted with key informants towards the end of 1993 within TML, and during 1995 within Eurotunnel. The paper will describe the public policy background to the project, the strategies adopted by the actors on the project, and the choice of technology, before investigating the management of the project and the organisation of TML. The paper will not cover issues of the processes of public policy formulation, and regional policy, which are well covered in Church (1995), Holliday *et al* (1991) and Marcou *et al* (1993), nor those of the wider economic benefits of the project, and marketing questions associated with its operation, which are covered by Kay *et al* (1989) and Szymanski (1995). It reports the state of affairs as at the end of 1996, at which time the financial future of Eurotunnel was still in doubt.

## PUBLIC POLICY

*There are few projects against which there exists a deeper and more enduring prejudice than the construction of a railway tunnel between Dover and Calais.*

*Again and again it has been brought forward under powerful and influential sponsorship. Again and again it has been prevented. Governments of every hue, Prime Ministers of every calibre, have been found during successive generations inflexibly opposed to it. To those who have consistently favoured the idea this ponderous and overwhelming resistance has always seemed a mystery. Winston Churchill, 1936. (cited Hunt 1994 p 151.)*

The idea of a fixed link between Britain and France was first mooted by a French engineer in 1802, much to the horror of the British military, who had recently secured the Peace of Amiens. Little came of the project and many of the others that were proposed over the years, save a collection of entertaining drawings. The first project to actually start digging was a railway tunnel which was begun in 1880 by Watkin, the chairman of the South Eastern Railway in collaboration with the Chemin de Fer du Nord. Watkin's company, which became the Channel Tunnel Company in 1887, received a charter from Parliament for experimental works, in order to test the tunnelling technology. Watkin lobbied hard for a full rights and government finance for his activities, but increasing opposition from military prevented an extension of the charter. Although technologically feasible, on the basis of the triumphs of the railway tunnels through the Alps and the invention of the Beaumont/English tunnel boring machine, the project was defeated by weight of opposition on military grounds, and establishment opinion in cultural circles (Travis 1991). The work stopped after an injunction had been served against Watkin in 1883 after some 1800 metres had been bored at both Sangatte and Shakespeare Cliff.

Undaunted, engineers and entrepreneurs from both sides of the Channel put forward a wonderful variety of schemes over the next 80 years. These came closest to fruition in the period after World War I, when elements of military opinion realised that the existence of the tunnel would have been of considerable logistical benefit during the war, and provisions were made in the Versailles treaty for its construction. However, these proposals met a similar fate when establishment opinion mobilised against the project. The extraordinary convolutions of this opposition on military grounds are well told by Wilson (1994), but, as both Wilson and Travis show, this opposition was undoubtedly rooted in a cultural insularity that pervaded many sections of the British establishment<sup>1</sup>. It was not until 1955 that Harold Macmillan, then Minister of Defence, stated categorically that there were no defence objections to the construction of a fixed link, but it still took another 40 years to realise the project.

In 1957, the Channel Tunnel Study Group was formed, including the concessionaire companies of the 1880 attempt, and a White Paper in 1963 (cmd 2137) proposed an essentially privately funded project. A joint statement was issued by the British and French governments in February 1964 favouring the initiative. Considerable debate ensued, particularly in Britain, and only in October 1972 were agreements signed between the two governments, and the Société Française du Tunnel sous la Manche (SFTM) and the British Channel Tunnel Company (BCTC) for Phase 1 of the works. These two companies combined national banking and the nationalised rail interests (SNCF and BR) and the old Channel Tunnel Company which had led the 1880 attempt. Notably they did not include construction interests; SITUMER and RTZ Development Enterprises, respectively, were appointed as project managers. The agreements provided for the two companies to build a tunnel with a combination of risk capital and loans guaranteed by the two governments in proportions ranging from 10:90 to 30:70 in favour of guaranteed capital. It was to be handed over to a publicly owned corporation upon completion. The estimated construction cost in 1973 prices was £486m.

The project was divided into three phases. The main tasks of Phase 1 were the completion of technical and financial feasibility studies, and the preparation of the legal and financial documentation for Phase 2. A government review of Phase 1 (cmd 5430 1973) recommended moving forward, and the Phase 2 agreements were signed in November 1973 after the signing of the Treaty between the two governments. Amongst other things, the Treaty and Phase 2 agreement obliged the British government to support British Rail in providing a high speed rail link from the tunnel to London. Phase 2 consisted mainly of engineering design work and preparatory construction works. Full construction works awaited agreement on Phase 3, which depended upon ratification of the Treaty between the two governments. However, politically uncertainties and a change of government in Britain in May 1974 delayed the bill, and in the November the new Labour government announced that it would not go ahead with the rail link. After an attempt at renegotiating the agreements, the tunnel's fate was sealed by an announcement from the British government that it was to be abandoned in January 1975.

In the opinion of Hunt (1994 p 152) the project was sacrificed to the need to gain political stability and reduce public expenditure at a time of considerable crisis for the British state, despite the fact it had joined the (then) European Economic Community two years earlier. Morris and Hough (1987) are more explicit, and argue that the structure of the project was flawed in a number of ways. Firstly, there was the lack of a single client - SFTM and BCTC remained independent entities dealing separately with their national governments. Secondly, there lacked a political champion on the British side, particularly after the change of government. Thirdly, although British Rail was a full shareholder in BCTC, it lacked commitment to either the tunnel or the high speed rail link, and saw them as diversions from providing a commuter service in the home counties, a view that is shared by Bonavia (1987 Chap 10). Fourthly, the shareholders of BCTC lacked the incentive to fight for the project at the

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<sup>1</sup> As a former British Prime Minister, Lord Salisbaury, reflecting upon the fate of the first attempt to dig the tunnel, put it: "Ce que nous craignons, ce ne sont pas les têtes de colonnes de l'armée française, mais les trains du plaisir du dimanche" (citd Wilson 1994 p.136).

end of 1974 due to the generous cancellation terms contained in the Phase 2 agreements. Despite the fact that the oil crisis improved the competitiveness of the tunnel against the airlines, the overall political and economic situation of Britain in 1974 meant that these flaws were starkly exposed and led to its cancellation. To these factors, Lemoine (1994 p 94) adds the "attitude foncièrement aniteuropéenne qui repose sur le vieux sentiment isolationniste" of the British, which is again supported by Bonavia (1987 p 130).

Renewed initiatives followed after the affirmation of British membership of the EEC in the referendum of 1975. These first came from BR and SNCF, but the French were generally very cool towards these initiatives (Hunt p 160) - understandably since perfidious Albion had twice let them down. The change of government in 1979 proved them right, as the incoming administration made it clear that a public sector scheme was not acceptable. The change of government in France and the rapport that was quickly established between Mitterrand and Thatcher warmed relations up, and in September 1981 the two governments announced preparatory studies. However, the Anglo/French Study Group report of June 1982 was dismissed by the cabinet. The project was kept alive by the banks who financed their own study with a modest contribution from the European Commission. The breakthrough came with Thatcher's statement of 30th November 1984, which demonstrated that she personally backed the project and thereby silenced opposition within her government (Henderson 1987).

An invitation to tender was opened on 2nd April 1985, and closed on 31st October of the same year. The announcement of the winning tender was made on January 20th 1986 to the effect that the Channel Tunnel Group and France-Manche were successful. An accord was signed between the two governments in Canterbury Cathedral on 12th February. This provided for matters such as the establishment of the Intergovernmental Commission (IGC) (Commission Intergouvernementale) to supervise the project on behalf of the two governments, particularly with regard to the safety of users, and border, customs, and immigration matters. Article 1 specified that the construction and operation of the scheme "shall be financed without recourse to government funds or government guarantees of a financial or commercial nature".

The concession agreement (cmd 9769 1986) was signed on 14th March for a period of 55 years from the date of ratification of the treaty. It reiterated that the facility was to be financed entirely with private funds without any government guarantees. In return there was to be no regulation of the fares charged, and a commitment not to support any other link with public funds or guarantees for the life of the concession. The service tunnel was to breakthrough within 7 years of date of operation of the agreement, and construction was to be completed within 10 years. The concessionaire agreed to provide at least one shuttle per hour. CTG/FM also agreed to present proposals for a road link before 2000; they then had the option to take up these proposals until 2010. In turn, the governments would not facilitate a competing fixed link before 2020. This offer to investigate a road link was a tactical move made at the last minute in order to fend off competition from the Euroroute proposal for a drive-through bridge and tunnel (Henderson 1987), as it was believed that both governments favoured such a scheme if it were feasible<sup>2</sup>.

The concession agreement also provided for the appointment of a Maître d'Oeuvre (MdO) at the expense of the concessionaire to ensure that the works were carried out to the relevant specifications, and to the agreed timetable and cost projections. It was to act not only on behalf of the client, but also on behalf of the IGC, ensuring that the terms of the concession were followed. The treaty was finally ratified after a difficult passage through the British legislature and an easy one through the French, and the texts were exchanged in Paris on 29 July 1987. The British problems were a combination of the more complex British procedures for the scrutiny of proposed legislation, and greater opposition. The two different public policy processes are compared in some detail in Holliday *et al* (1991).

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<sup>2</sup> Henderson (1987) argues that Mitterrand favoured Euroroute on the grounds that it was bigger, and would therefore leave a greater monument.

The decision to let a concession for the construction and operation of the tunnel was a radical innovation in British public policy terms (Marcou 1992). The concession has a long history in French construction dating from the time of Louis XIV, and provided the basis for the construction of the French canal and rail network in the nineteenth century. The essence of concession is the promotion of projects by the state which are implemented through private finance reimbursed by payments for the use of the facility for a determinate period. The British canals and railways, on the other hand, were built on the basis of *charters* in which a private sector promoter and financier obtained from the state the right to exploit a facility for an indeterminate period. The concession is an active instrument of public policy for infrastructure development, while the charter is a passive regulatory instrument. In the opinion of Holliday and his colleagues (1991 p.29), the channel tunnel concession agreement represents a "purification" of French concession practice, because many French concessionaires were, in practice, in receipt of public funds or guarantees - a situation that the British were determined to avoid.

Throughout the last hundred and fifty years, the attitude of the British government with regard to the financing of the project has changed little. It has always been seen as a wholly private sector concession contract. This continuity is, perhaps, best expressed in this statement made in 1874:

*The Board of Trade can have no doubt of the utility of the work if successfully completed, and they think that it ought not to be opposed so long as the English Government is not asked to make any gift, loan, or guarantee (cited Hunt 1994 p 35).*

The only exception to this policy over nearly 150 years was that the two governments were prepared to guarantee a high proportion of the loans required for the 1973 attempt. The successful arrangements reached for the third attempt, and the reasons behind the failure of the second attempt, suggest that it has never been a priority of the British government to improve fixed communications with the rest of Europe. Its attitude has always been one of facilitator rather than initiator; regulator rather than investor. Such an investment, and the associated investment in a high speed rail link to London, has never been seen as a worthy use for public funds.

## **STRATEGIC MANAGEMENT**

*The project was "assembled round a hole like a Polo mint...[there was] no client driving it forward with a vision of what the operator needed to have" Sir Alastair Morton, Co-chairman, Eurotunnel (Financial Times 19/9/95).*

*"Le premier problème est qu'il n'existait pas de maître d'ouvrage, c'est-à-dire de client, face au constructeurs" André Bénard, co-Président, Eurotunnel (La Tribune 18/6/93)*

In July 1981, Tarmac formed Channel Tunnel Developments 1981 Ltd, and was joined by Wimpey in September of that year. In February 1984, this organisation joined forces with the European Channel Tunnel Group (Costain) and the Anglo Channel Tunnel Group (Balfour Beatty and Taylor Woodrow) to form the Channel Tunnel Group Ltd. (CTG). This organisation then sought a French partner. This was France-Manche SA (FM), formed in May 1985, a consortium of 5 French construction corporations who were "non sans difficultés associés au projet" (Lemoine 1994 p 97) - Bouygues, Dumez, Spie Batignolles, Société Auxiliaire d'Entreprises, and Société Générale d'Entreprises. Henderson (1987) argues that the problems were mainly due to attempts by Bouygues to hedge their bets between the competing projects during the tender period. These two consortia provided the initial working capital of the aspiring concessionaire and began discussions with banks - CTG worked with the National Westminster and Midland banks, while FM were associated with Crédit Lyonnais, Banque Nationale de Paris, and Banque Indo-Suez. Eurotunnel SA and Eurotunnel PLC<sup>3</sup> were incorporated on the 30th October and 18th November 1985 respectively. On 2nd June 1986 Eurotunnel SA acquired FM, while Eurotunnel PLC had done the same for CTG on the 30th May 1986. This rather complex arrangement allowed the holding company to circumvent, if needed, the requirement in the concession contract that the concessionaire (ie CTG/FM) be not diversified and have no other business interests (Stannard 1990). On 5th July 1985, the British contractors formed Translink JV, while the French contractors formed Transmanche GIE on 16th July. These two came together to form Transmanche-Link (TML) on October 18th 1985 (Hunt 1994 chap 6). However, the consortium members remained significant players in the concessionaire companies throughout 1986.

The original capital of Eurotunnel was provided by the promoters - the founding banks, and the original 10 construction corporations with the latter in the majority (Tabouis 1988). Thus at the time of the signing of the concession agreement in March 1986, the concessionaire was two corporations - FM and CTG - which were then acquired to form a unified corporation - Eurotunnel SA/PLC<sup>4</sup> - upon being awarded the concession. However, when the contracts for construction and the MdO were signed on 13th August 1986, with TML and Atkins Setec respectively, the 10 original construction corporations were the majority shareholders<sup>5</sup>. The 10 members of TML held well over half the equity of Eurotunnel, while four of the 11 members of the joint board of Eurotunnel PLC/SA were also directors of the member construction corporations of TML, and one co-chairman was a former chairman of BICC, the parent company of Balfour Beatty. In addition, the senior executives of the company included 6 secondees from the TML corporations out of 15 named in the placing prospectus. This conflict of interest was to dog the project for the next eight years. It was not until September of that year that Eurotunnel was recapitalised with £46m of equity from the original banks - known as Equity 1 - who now formed a *noyau dur* and the construction corporations became minority shareholders. Equity 2 went ahead in October of that year with a private placing which, after some arm twisting by the Bank of England, raised £212m from a group of institutional investors. Although some of the actors on the French side had wanted greater participation by the construction corporations in the client organisation, this was resisted by the banks on the grounds of a conflict of roles.

Eurotunnel now turned its attention to obtaining loan capital. The *noyau dur* banks, with the exception of Indosuez, acted as the lead banks in this task. In August 1987, 50 international banks agreed to underwrite the loan and proceeded to syndicate it worldwide. A problem here was that the lead banks were also the promoters, and hence were the object of some suspicion by the syndicate banks (Stannard 1990). In the November, a credit agreement was signed with

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<sup>3</sup> They were first incorporated as ESA and EPLC respectively, re-registering under their present names in april and july of 1986 as public companies.

<sup>4</sup> Although the two companies retain separate identities under their respective legal systems, they entered into a joint venture in march 1986, and shares in each are sold jointly as indissoluble "units".

<sup>5</sup> The placing of additionnal equity - Equity 2 - was originally to have taken place in "Spring/Summer 1986", but the complexity of the process led to delays (Hunt 1994 p 185).

over 200 banks for £5b, and later that month Equity 3 was launched for public subscription which, despite the stock market crash on Black Monday (19th October), raised the required £770m. A notable feature of these activities was the relative lack of participation by the British. For every two share units sold in France, only one was sold in Britain, while the British banks only contributed 9% of the loan capital against 18% from the French, 13% from the Germans, and 23% from the Japanese. In addition an agreement was reached in the September for £1bn from the European Investment Bank to be phased over 6 years, secured against letters of credit issued by the syndicate. In July 1987, the Channel Tunnel Usage Agreement was signed with SNCF and BR which gave Eurotunnel 50% of the capacity of the tunnel for through train services. Eurotunnel are reimbursed through a usage charge which is partly a fixed annual amount, and partly a variable charge per passenger or tonne of freight.

It was also at this time that the first signs of the problems in the relationship between TML and Eurotunnel began to emerge. Alastair Morton had been appointed joint chair of Eurotunnel with André Bénard in February 1987. In the run-up to the capital raising activities of that autumn, Eurotunnel was concerned to demonstrate its firmness towards TML. A letter from Eurotunnel to TML was leaked to *The Sunday Times* of September 20th which showed its "no-nonsense" attitude towards the contractor, and Morton became increasingly associated with a public display of toughness. The problem was that the original contract was passed "en quelque sorte de gré à gré et non après une mise en compétition des entreprises par un appel d'offres" (Lemoine 1994 p 119), and the responsible of Indosuez went as far as to say that "les nouveaux actionnaires soupçonnant des entreprises d'avoir signé avec elles-mêmes lorsqu'elles étaient majoritaires un contrat léonin et les entreprises estimant être en bon foi et avoir pris les risques et des engagements précis dès le début, notamment auprès des gouvernements" (Tabouis 1988 p 62). These mutual suspicions permeated the relations between TML and Eurotunnel as things began to go wrong.

During this period, tensions started to emerge in the role of the Maître d'Oeuvre. From a British point of view, the MdO combines some of the functions of The Engineer under the construction contract and a client's project manager. It also had obligations under the concession agreement to the IGC, and provided an independent view for the investor banks under the credit agreements (Grimond and Middleton 1989). However, as relations between TML and Eurotunnel deteriorated, they increasingly communicated directly with each other, leaving the MdO in a difficult position (Byrd 1994 p 70). In order to resolve to clarify roles and to strengthen its project management capabilities as a client, Eurotunnel established the Project Implementation Division (PID) in January 1988. This was formed from some of the MdO staff, strongly supported by Bechtel staff, and augmented by new hires (Byrd 1994; *Le Temps de la Finance* 28/11/89; interview 5/9/95). Thereafter, Eurotunnel was able to exert a more knowledgeable influence over TML. The Atkins-SETEC team was then left in a purely audit role on the project on behalf of the IGC and the investor banks.

During 1988, it became clear that costs would significantly overrun the original budget, and there were also fears about the programme. A war of nerves developed between the two with Morton developing a reputation for aggression. Early progress on tunnelling was painfully slow. In August of 1988, Morton publicly criticised the corporate members of TML for its lack of attention to the management of the project (Hunt 1994 p 214), and in the October forthrightly declared that "we don't have a tunnelling problem. We have an equipment and management problem. Bad ground is not to blame for the delays" (cited *ibid* p 216). The war of attrition between the two parties continued with a series of key documents being leaked to the press by both parties, and came to a head in 1990. Although an accord on the issues in dispute between TML and Eurotunnel had been reached in January 1989, and relations appeared to have improved, the necessity for Eurotunnel to seek additional finance in late 1989 prompted an explosive row which threatened the future of the whole project. Eurotunnel argued that as the original members of CTG and FM had prepared the original cost estimates that had formed the basis of the winning bid in 1986, they should take responsibility for the cost overruns that were

now threatening the project. TML countered that the main sources of cost increases were subsequent design changes, rather than the original estimates.

Eurotunnel and TML had put their dispute to the MdO for arbitration, but when it pronounced in the December largely in favour of Eurotunnel in December 1989, TML rejected its conclusions. An accord was reached on 8th January, but TML reacted angrily to the ensuing press release from Eurotunnel on 11th January which unfavourably compared the British half of TML with its French counterpart. A letter from TML's chief negotiator to Eurotunnel repudiating the statements in the press release was leaked to the press (*Contract Journal* 25/1/90) and further soured relations. The later announcement of the appointment of Morton as Chief Executive, a new post which had been intended to provide a buffer between Morton and TML, only compounded the situation. TML took Eurotunnel to court in pursuit of withheld progress payments of £62m, and the court found in TML's favour. However, Eurotunnel had no money with which to make the payments, as the banks were refusing to allow Eurotunnel to draw further funds until the dispute between the parties was settled.

By now, the banks had become disenchanted with Morton's aggressive style (*Financial Times* 16/2/90). Although relations between Bénard and the French consortium members were difficult, they never deteriorated to the depths of the British side. At the intervention of the governor of the Bank of England (Hunt p 233), Eurotunnel was persuaded to provide the desired buffer, and a revised accord was finally reached on 20th February "hours before the receivers would have needed to be called in" (*Financial Times* 6/5/94). John Neerhout Jnr was duly seconded from Bechtel to become Project Chief Executive, and the banks unlocked the drawing rights on March 1st. This period also displayed a split between the British and French members of TML - the latter boycotted the meeting with the governor of the Bank of England, and had to be persuaded separately to accept the deal by Bénard (Hunt 1994).

With relations patched up, and new management in place on both sides, progress on the project rapidly improved. Eurotunnel turned its attention to raising the additional funds that were required. It planned to do this in two ways. Firstly, it returned to the original bank syndicate for further funds. This was not entirely successful, as more than a third of the members banks refused to provide further funds, and the lead banks were obliged to increase their own exposure (*Financial Times* 9/10/90). In particular, the Japanese banks, reeling from their own stock market crash and constrained by new banking regulations were reluctant (*Financial Times* 17/8/90), and were only persuaded by a direct appeal by Thatcher to the Japanese prime minister, who in turn cajoled these banks (*Financial Times* 6/5/94). This exercise raised approximately £1.8b. On this basis, a rights issue was launched to shareholders which was surprisingly successful (*Financial Times* 6/12/90) in raising £577m. The European Investment Bank also provided a further £300m, and the next year £200m was raised from the European Coal and Steel Community as part of the programme of refinancing the project with long-term funds at fixed rates (Hunt 1994 p 243).

In 1990, it still looked as if the tunnel would be open in June 1993, but by 1992, it became apparent that this could not be achieved and a target of December 1993 was announced (*Financial Times* 6/10/92), and it became clear that Eurotunnel was, again, short of finance. Although Eurotunnel only needed a further £290m to pay for the completion of the project, its financing requirements were badly hit by the delays in the opening of the tunnel due to the lost revenue. The official opening finally took place on May 6th 1994, 12 months later than the original date which, together with the settlement of the outstanding disputes with TML and Bombardier cleared the way for a second rights issue and further requests to the banking syndicate. In May 1994, £693m from the core banks, and a further £50m from a separate syndicate was agreed. On this basis, the rights issue was underwritten for £816m (*Financial Times* 27/5/94). In order to tempt investors to invest in a company that was not promising to break even until 1998, the rights issue had to be heavily discounted, and a new class of senior debt on more favourable terms than the main debt had to be created (*Financial Times* 27/4/94). These sums increased the total funds raised by Eurotunnel to over £10b (approx 3.3:1

loan:equity), in contrast to the £6b (5:1 loan:equity) originally defined in the response to the invitation to tender.

Despite the fact that the tunnel was now officially open, there were a number of delays to the launch of revenue earning services, for reasons which are discussed below, and the full range of services (rail freight; HGV shuttle; Eurostar; tourist shuttle) was not available until 22nd December 1994. Once these services were launched they failed to meet the revenue projections due to increased competition on price from the ferries and the airlines. The most obvious manifestation of this was a marketing war that broke out between the ferries and Eurotunnel in the summer of 1995 which further damaged revenues. The turnover to Eurotunnel's year end in December 1994 was £30.6m against the projection in the May 1994 rights issue of £137m. This resulted in a loss of £386.9m, against a projected loss of £191m, coupled with predictions from the board that the relationship with the banks would have to be renegotiated (*Financial Times* 11/4/95). Turnover running at around half the predicted level for the first half of 1995 meant that further losses of £464.5m were accumulated. While the company easily covered its operational costs, interest payments of £60m per month were swamping the revenues generated and the debt burden had mounted to £7.8b. Negotiations with the bank consortium to resolve this situation moved slowly, and on 14th September 1995, Eurotunnel announced that it was suspending payments on all debts, except the senior debt, for up to 18 months to allow the situation to be resolved.

The future of Eurotunnel was in the balance. The suspension of interest payments was only a breathing space. Its attempts to recoup the situation by launching claims against the members of TML, and against the national governments for unfair treatment in comparison to the ferries, even if successful, would provide only partial relief. Meanwhile, a £2.5b claim against BR and SNCF aimed at a renegotiation of their agreement with Eurotunnel, was rejected by the International Chamber of Commerce (*Financial Times* 1/11/95). The options facing the banks (*Financial Times* 15/9/95) in relation to their delinquent debtor were to:

1. take possession of the asset on which they have a charge - the tunnel and its systems - but it is of little intrinsic value.
2. take over the management of the tunnel, but the effectiveness of the current management is not in question, and there is no sign that the banks could do any better themselves.
3. call in the administrators, but this would mean that they lose control of their asset, and the same problems of option 1 would emerge.
4. swap debt for equity, but this would wipe out the value of the equity currently held by investors.

A further option canvassed in France was to nationalise the tunnel (*Le Monde* 29/10/94). This was advocated by the Association pour l'Action Eurotunnel, which consists of individual shareholders in the scheme in France, where 79% of the shareholders are located. This was later moderated to the taking of a symbolic holding in the company by SNCF (*Le Monde* 3/12/94). However, this approach would, apparently, be in contradiction to Article 1 of the treaty because SNCF is owned by the French government. Following the brinkmanship that was by now commonplace for the project, an agreement was proposed in October 1996 that the banks should take an increased equity stake in Eurotunnel, raising their share to 45.5%. This would both directly reduce Eurotunnel's debt by £2b from £9.1b, and lower the interest payments on the rest (*Financial Times* 8/10/96). The task then started of convincing both the 225 syndicate banks and the 750k shareholders of the merits of the proposal, which relies heavily on improved turnover from operations.

## **TECHNOLOGY MANAGEMENT**

*"we always knew that from the geological and general tunnelling point of view, the job was not difficult". Colin Kirkland Technical Director of Eurotunnel (Contract Journal 1/11/90).*

During the 1970s, SNCF and BR had developed the "mousehole" project - rail only with one 6m running tunnel. This was rejected by the British Parliament in 1981 on the grounds that it did not provide for vehicles, and that its sponsorship by the two nationalised railway systems meant that it would not be able to raise the finance required. A UK/French Study Group commissioned by the two governments reported in early 1982 that a twin bored rail tunnel capable of carrying vehicle shuttles was the most appropriate solution. Bridges, immersed tubes, artificial islands, and ventilation shafts were all seen as having unpredictable consequences on the hydrology of the Channel and posing a threat to shipping. Moreover, a drive across route posed a threat to the continuance of the ferries which would still be required to carry dangerous loads and to provide competition for the new facility (Hunt 1994 p 164).

A Franco/British Channel Link Financing Group, mounted at the initiative of the banks reported in May 1984 that the only option that offered commercial viability was the CTG's proposal, but with a six year construction period it offered no chance of being financially viable without government guarantees. A reanalysis of the project by the CTG established that the programme could be reduced to 4.5 years with a 10% increase in construction costs (Hunt p 167). This reduction was critical in establishing the feasibility of the project. On this basis, the invitation to tender was prepared by an Anglo/French Working Party

The invitation to tender in 1985 received four responses, two of which can be considered to have been serious - the successful one and Euroroute which was a drive-through bridge/tunnel combination promoted by, amongst others, GTM and Usinor on the French side, and Trafalgar House and British Steel on the British. The concept involved two bridges leading to artificial islands which were then connected by a 25km tunnel. The CTG/FM proposal was accepted on the grounds that it:

- offers the best prospect of attracting the necessary finance;
- carries the fewest technical risks that might prevent it from proceeding to completion;
- is the safest project from the traveller's point of view;
- presents no problems to maritime traffic in the Channel;
- is the one that is least vulnerable to sabotage and terrorist action;
- has an environmental impact that can be contained and limited." (cmnd 9735 1986 15).

The proposal consisted of twin 7.6m running bores capable of carrying shuttle vehicles with a 4.8m service tunnel running between them with a vehicular facility provided by a "rolling road" shuttle service. Technically, it was virtually identical to the 1973 attempt, except that the running bores had been enlarged; indeed the concept had been fully developed in 1960 by the Channel Tunnel Study Group (Lemoine 1994 p 93).

MANUFACTURER TYPE	NATIONALITY	DRIVE	
Howden	British	UK service seaward	o/f
Robbins/Markham x 2	US/British	UK main seaward	o/f
Howden x 3	British	UK landward	o/f
Marubeni/Mitsubishi	Japanese	FR main landward x 2	c/f
Robbins	US/Japanese	FR service seaward	c/f
Marubeni/Mitsubishi	Japanese	FR service landward	c/f
Robbins/Kawasaki x 2	US/Japanese	FR main seaward	c/f

Table 1: Tunnellers

The details of the enormous engineering and logistical effort can be found in (Harris *et al* 1996; Kirkland 1996; and Penny 1996). While the overall principles of engineering design were

necessarily the same on both sides, different engineering choices were made according to differences in practices between the two sides, and differences in the geological conditions. An example of this is the differences in the tunnellers. 11 tunnellers (tunnel boring machines) were required to bore the three 50km tunnels, as shown in table 1. The French-based machines were of the more sophisticated and expensive closed face (c/f) type rather than open face (o/f) due to the more difficult ground on the French side, particularly a fault just off the French coast. The original intention of procuring these tunnellers within France was frustrated when France's sole manufacturer went into liquidation (*Financial Times* 6/4/88). Due to the much shorter length of the French landward drives, only one machine was required to bore both main tunnels. Another example is the choice of the innovative New Austrian Tunnelling Method (NATM) for the construction of the two British cross-overs where TML drew heavily on the expertise of the Austrian firm of Ingenieurgesellschaft Lasser-Feizlemayer. This technique, while cheaper, poses greater risks, and was rejected by the French engineering team who chose a more traditional method because of the greater uncertainties regarding the geology on the French side.

A third example is in the engineering of the over-bridges for loading at the two terminals. As TML's Chief Executive explained,

*"The French are less robust but more realistic from a cost standpoint. For example, look at the standards of the over-bridges in the two terminals where we used French government standards and the other UK Department of Transport standards, There are significant elements in the UK design covering risks that the French do not include"* (cited Anderson and Roskrow 1995 p 199.)

*The result of this is that the over-bridges on the British side are much more massive and expensive* (interview 5/9/95).

The terminal works were not especially challenging, although the constrained size of the UK terminal at Cheriton meant that extensive land stabilisation was required. The mechanical and electrical services, however, posed a variety of challenges. The catenary systems within the concession area are built to TGV specification, although achieving this in the context of the tunnels meant considerable innovation. The track beds, destined to become the most intensively used in the world, use an American ballast-free system. The tunnels are artificially cooled and ventilated, although the ram action of the trains provides significant ventilation as well. The shuttle trains themselves pose few technical problems, although the overall system may be described as one of the most sophisticated transport systems in the world. The Eurostar trains which take the through train services through the tunnel have to cope with the systems of France, Belgium, and BR's erstwhile Southern Region. The French TGVs normally have synchronous motors, but it was decided to use instead GEC's new asynchronous motor on the grounds that its lighter weight allowed the installation of the equipment necessary to cope with the three different railway systems.

The main environmental problem posed by this project - as opposed to the associated high speed rail link projects - was the disposal of the 8m m<sup>3</sup> of spoil from the tunnels. Although there had been considerable opposition to the use of the Cheriton site as a terminal in the early 1970s, this was no longer a major issue. The 5m m<sup>3</sup> spoil from the UK side was used to reclaim land from the sea at the foot of Shakespeare Cliff, while the French tipped their 3m m<sup>3</sup> behind a dam in a dry valley at Fond Pignon.

## **PROJECT MANAGEMENT**

*There is, I believe, a fundamental error in the nature of the construction contract which led to lack of trust on both sides. Colin Stannard, former Managing Director of Eurotunnel* (Stannard 1990).

The contract signed between Eurotunnel and TML in August 1986 was based on the standard FIDEC form for international construction contracts, and provided for three main elements of works, each let on a design and build basis:

- The tunnelling works were let on a target cost basis. TML would work on a cost-plus basis, and be paid a fee of 12.36% of the target cost including adjustments for variations and inflation. Any cost overruns would be paid for on a 70:30 Eurotunnel:TML basis, up to a cap of 6% of the target cost adjusted for inflation and variations. Eurotunnel would pay 100% of any cost overruns over this cap. TML would also receive a bonus for completing the works below the target cost of 50% of the amount saved. Liquidated damages were payable at a rate of £354k per day for the first 183 days and £536k thereafter up to a cap of £162m for failure to meet specified milestone dates and the final completion date. It was planned that the French would bore at a rate of 500m each month and the British 1000m, and milestone dates were included in the contract.
- The terminals and the fixed equipment in the tunnels were let on a fixed price lump sum basis, subject to adjustment for inflation. This included items such as railway tracks and catenary systems, terminal buildings, and tunnel safety installations.
- The rolling stock for the shuttle trains was let on a procurement basis. TML would manage their acquisition on behalf of Eurotunnel, and be paid a percentage fee for this service.

The contract period was to run for 84 months from May 1986. After the issue of the Certificate of Completion, the maintenance period was to be 12 months for the building and civil works, and 24 months for the electrical and mechanical works. Defects liability lasted 10 years for the building and civil works, but less for electro-mechanical equipment that had a shorter design life. Preparatory works for tunnel access, precast lining segment manufacture, and spoil disposal started in late 1986, and the construction of the permanent works started in December 1987.

Eurotunnel was just finding its feet and was little more than a paper organisation at the time the construction contract was signed. Effectively, the contract was negotiated between the banks and the contractors (Stannard 1990). The banks continually tried to move the contractor onto a fixed price in order to reduce their own risk. However, this was impossible given the inherent uncertainties of the project. The only source of cost information and an estimated outturn cost the banks had was TML, yet it was with TML that they were trying to negotiate. The banks therefore worked on the basis that TML's estimates were high. Conversely, TML worked on the basis that the estimates had to be low enough to ensure that the project went ahead. "In banking you bid high and then trim your margin: in contracting you bid low and then get your profits on the variations" (Stannard 1990 p 53). This analysis is supported by a senior Taylor Woodrow executive who argued that

*"The project price.... was put together to convince the governments, it was a viable price, a promoter's price. What it was not was a contract price. We should never have undertaken to do the work for anything like the sums that were in the submission to the governments" (cited Byrd 1994 p27).*

This fundamental difference in negotiating practice only enhanced the tensions between the two sides.

The original programme was that the completed facility would be handed over to Eurotunnel in December 1992 for commissioning and an opening in May 1993. Progress payments were to be made on a forward-funding basis - each month's claim was for the value of the works planned to be completed the following month, subject to a retention of 5%. The project was, therefore, inherently cash-positive from TML's point of view. The members of the TML consortium were also obliged to place a 10% performance bond subject to the issuing of the Certificate of Completion. The Eurostar and freight trains were the responsibility of the three railway companies and beyond the scope the contract between TML and Eurotunnel. The MdO was appointed on a fee plus disbursements basis with responsibilities to the IGC under the concession contract, and responsibilities to Eurotunnel for inspecting and checking the

engineering design and construction work of TML, as well as monitoring progress and expenditure. The overall contractual structure of the project is shown in figure 1.

The budgeted value of the contract, in 1985 prices<sup>6</sup>, was £2.71bn, an increase on the £2.6bn cited in the UK White Paper (cmdnd 9735 1986 appendix C), and the even lower figure of £2.33bn in the CTG/FM proposal of the previous autumn. To this figure has to be added Eurotunnel's costs of land acquisition, running costs, consultant's fees, inflation, and most importantly of all, interest charges which, with a contingency allowance, more than doubled this sum to the original £6bn capitalisation. The first increase in costs was announced in October of 1988 - some 7% in the tunnelling costs. On both sides of the channel the tunnellers had been giving problems, and these were particularly severe on the British side. The British machines were designed to operate in dry rock, and so when wet rock was unexpectedly encountered on the seaward service drive problems mounted - hand finishing was required behind the machines and progress was slowed. The damp atmosphere also adversely affected the operation of the Hunslet site transport locomotives. By August 1988, the French were 12 weeks behind programme, and the British 5 weeks. Further cost increases were incurred when the Robbins/Markham machines on the British side were shut down for three weeks and extensively reengineered below ground in Autumn 1989. Although they had been modified based on the experience of the Howden in the seaward service tunnel, this proved inadequate, and considerable further work was required (*Financial Times* 5/4/90).

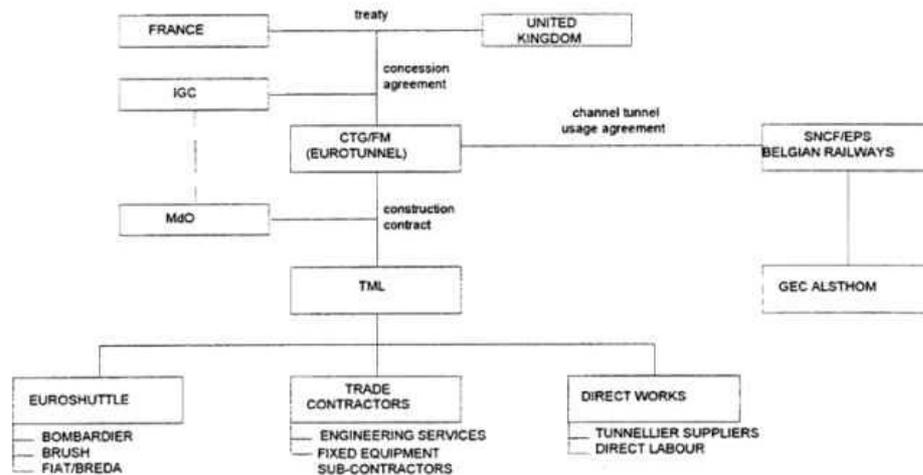


Figure 1: Contractual Arrangements

Once these problems had been resolved, tunnelling speeds increased rapidly. The service tunnel drives broke through in December 1990, the north running tunnel in May 1991, and its southern partner in June. Although the British had tunnelled much further than the French, these breakthroughs took place a little nearer England than planned as the French had been able to make up more ground against the original programme<sup>7</sup>. These last two breakthroughs were both ahead of schedule, but this had been achieved at a cost of greatly increased manpower and expensive modifications to the tunnellers amounting to £781m.

<sup>6</sup> In the following text, all prices are constant 1985 prices, unless indicated by an asterisk.

<sup>7</sup> In the event, the British tunnelled 81,92 km, and the french 64,72 km.

The procurement items were mainly obtained from a variety of suppliers in a loose Euroshuttle consortium. The British company, Brush, in association with Swiss/Swedish company ABB

the passenger railcars, with much of the assembly work being carried out by its French subsidiary ANF Industrie, and BN of Belgium. Breda and Fiat of Italy supplied the railcars for

tenders for the equipment were coming in much higher than had been expected in 1985. By 1989 the chair of TML was arguing that the depression in the railway equipment industry in the

Enhanced safety features specified at the instigation of the IGC following a series of railway accidents in Britain and France also raised costs ( 15/6/89). A decision was therefore taken to reduce costs by reducing the speed of the trains from 160km/hr to 130km/hr.

enclosed.

The IGC, after considerable debate, accepted in December 1989 the principle that car

announced that the fire doors in the railcars carrying these passengers had to be widened by 10cm. ( 9/4/91). This led to considerable redesign, increased costs, and delays in delivery of the railcars. Eurotunnel claimed £1b\* from the IGC in compensation for a number

Bombardier claimed FF 3.4b\* from Eurotunnel. The former claim was settled with a 10 year extension of the concession in December 1993, while the latter was settled in the same month

after Bombardier had stopped work in protest for 3 months (*Financial Times* 14/12/93). Bombardier thereby became Eurotunnel's largest shareholder. Due to these factors, costs rose by £460m.

with them were the subject of tough negotiations between TML and Eurotunnel, it was the lump sum works that generated most of the public displays of acrimony. While the target cost

and the procurement contract allocated all the risks to Eurotunnel, the lump sum contract allocated all the risks to TML. Therefore, once changes became necessary in the specification

to incur additional costs and also penalties on the tunnelling contract.

There were a number of changes required to the items specified in the contract of August 1986.

construction started before design had been completed. A TML representative argued that "the project was not properly designed in advance by Eurotunnel, and they developed a habit in the *Financial Times* 9/1/90). Perhaps the most important change was that as the design of the trains was completed

expected that the air drawn in by the trains would provide adequate cooling, but it this proved inadequate, and 400mm chilled water circuit through half the length of the running tunnels was

systems for controlling air pressure in the tunnels, and the lower power supply requirements allowed a reduction in the electrical substations but also meant further renegotiations of the

Changes were also made to the termini. Considerable additional earthworks were required at the awkward Cheriton site due to IGC imposed changes in arrangement of the access roads for

forced Eurotunnel to authorise changes to the site access roads and drainage (Byrd 1994 p108).

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The search for savings meant the loss of a £10m *grande arche* spanning the road approach to Sangatte. As a result of these and other changes, costs rose by £105m for the terminals.

	1986 Budget	1990 Forecast	1994 Outturn	%Increase
Tunnels	1329	2009	2110	59
Terminals	448	491	553	23
Fixed Equipment	688	814	1200	43
Rolling Stock	245	583	705	188
<b>TOTAL</b>	<b>2710</b>	<b>3897</b>	<b>4568</b>	<b>69</b>

#### NOTES

All figures in millions of pounds at 1985 prices.

Source: Eurotunnel Rights Issue Documentation 1990 and 1994

**Table 2: Channel Tunnel Costs**

The overall picture is given in table 2, which gives the figures in constant 1985 prices broken down by the main categories of work. The overall budget overrun in constant prices is 69%, the largest proportional increase being the rolling stock. The three construction elements of the overrun amounted to 58%. To these figures needs to be added the £72m paid in performance bonuses to TML under the terms of the original contract. Additionally, Eurotunnel paid £36m for direct works undertaken outside the contract with TML. The cost overruns were apparently more serious on the French side than the British, as is shown in table 3. However, these figure cannot be taken as authoritative as they were produced before all claims were settled. The project was finally handed over on the 10th December 1993, some 12 months late, a programme overrun of 14.2%.

	% cost overrun
Tunnel France	66.6%
Tunnel Britain	57.5%
French terminal	35%
British Terminal	17.9%
Transport Equipment France	100%
Transport Equipment Britain	73.5%

source: calculated from figures provided in *L'Usine Nouvelle* 29/4/93

Though outside the TML/Eurotunnel contract, the procurement of the 31 Eurostar trains to be operated by European Passenger Services (EPS) and the railways of Belgium and France also presented similar problems. The lack of a single project office shared between the three rail agencies in the early stages of the procurement of these trains delayed decision making. The trains were to be provided by the British company GEC and the French company Alstom which merged their electrical engineering (mainly power stations and transport equipment) interests in June 1989 to form GEC Alstom. The development of GEC's new asynchronous motors took longer than expected. These delays were compounded by a two year argument between BR and SNCF over the choice of a cab-based signalling system - in the end a French system was preferred - and logistical and coordination problems within the newly formed GEC Alstom. The decision to build different parts of the trains in France, Britain and Belgium compounded the

problems. In December 1993, EPS had only taken delivery of one train (*Independent* 10/12/93). New problems arose in 1993 when it was found that the gaps in the third rail were tripping the safety system in the Eurostar trains. The solution to this problem entailed replacing 3000 track relays between Cheriton and Waterloo (*Financial Times* 6/5/94). The supply of 46 locomotives for freight and sleeper haulage by Brush presented fewer problems, as did the procurement of coaches for long distance sleeper services from the British company Metro-Cammell, which is part of GEC Alsthom.

These delays in the procurement of rolling stock have had profound implications for the project. Although the tunnels were completed on time, the installation of the fixed equipment and construction of the terminals suffered significant overruns, and the lack of trains with which to commission the fixed installations, has led to expensive delays in offering a cross-channel service. Through freight and commercial vehicle shuttle services built up in the month after the opening, but full passenger services were not available until the end of 1994. Although a figure of £50m\* per month was denied by Eurotunnel as the cost of the delays (*Financial Times* 6/4/94), the difference between the original opening date of May 1993 and the commencement of something approaching a full service in late 1994, which missed the 1994 holiday season, may have cost in the order of £650m\* in lost revenues on Eurotunnel's own figures from the 1994 Rights Issue documentation. This figure includes losses from the lack of revenues from the Eurostar and through sleeper services for which Eurotunnel claimed £1b\* from BR and SNCF; against this, the two railway authorities counter-claimed for delays in offering the freight service facility. The dispute was settled largely in favour of the railways.

Following the issuing of the Systems Acceptance Certificates for the fixed equipment and the rolling stock, commissioning could begin, but was not fully completed by the issuing of Tests on Completion until January 1995. The original commissioning period planned was 6 months from December 1993 to May 1994, but, effectively, it doubled to 12 months. As problems mounted it was decided to prioritise the commissioning of the freight services. Freight shuttle services started in May 1994, and a full 24 hour service in November of that year. The through freight came into service in the June. The IGC finally gave approval for the operation of limited Eurostar services in August 1994, but a full public service was delayed until the November. The IGC finally gave approval for the commencement of limited passenger shuttle services (Le Shuttle) on an invitation-only basis in August 1994, but full services for the public were not implemented until December of that year, and the final train was not received from Bombardier until July 1995, over 24 months late. Only the rail freight service met the deadlines that had been stated in the Rights Issue prospectus of May 1994, and even the launch of this service was behind the programme envisaged earlier in the year of a March start for freight, and a May start for passengers.

Patrick Ponsolle, the co-chairman of Eurotunnel placed the main source of these problems with the IGC. However, many of the problems with the commissioning were generated by the way the project was managed. Ponsolle admitted that, "nous avons peut-être sous-estimé le temps nécessaire pour que nos équipes se familiarisent avec le matériel qu'elles allaient utiliser et avec l'ensemble des procédures et fonctionnement du système" (*La Tribune* 16/12/94). The problems were that due to the tortuous negotiations between TML and Eurotunnel, there was for a long time no clear date for the handover. Due to the delays to the construction programme, the commissioning was then fast-tracked in order to bring forward the revenue-earning period. This meant that construction and commissioning were taking place simultaneously, with one shift on construction and the other on commissioning. The complexity of the system was also underestimated. In particular, the number of fail-safe elements in the system made it very difficult to operate partially. If someone was working on an element, an alarm would go off which would shut the system down. This was compounded by the fact that a central part of the commissioning is the training of operative staff, so system shutdowns could not be overridden as this would have effectively trained staff to ignore warning signals (interview 5/9/95).

Throughout the life of the project, relationships between TML and Eurotunnel were punctuated by a number of formal agreements which allowed the project to keep going, even if they did not resolve all the outstanding issues. The first of these was the Joint Accord in January 1989, when it was agreed to extend the original opening date of the tunnel by one month to June 1993, to settle all outstanding payments, and TML promised to improve the quality of its management. However problems continued through 1989 as disagreements over the cost of the lump sum works grew, and by June 1989 some £384m was in dispute between the two sides. A second accord was reached on 20th of February 1990 which resolved a number of areas of contention. The main points were that, firstly, it provided for a reduction of 25% in the staffing of Eurotunnel's 350 strong PID which had long been resented by TML as its presence was seen as reflecting Eurotunnel's mistrust of TML. Secondly it provided for the capping of TML's commission on the procurement items. As rolling stock costs had soared, the percentage fee had proved a goldmine to TML. Thirdly, the cap on TML's liability for 30% of extra costs incurred on the target cost contract of 6% of total project costs was removed, although the baseline for the calculation before TML incurred such costs was raised by nearly £300m to take into account cost increases already agreed. Finally, changes were agreed in the senior management of Eurotunnel.

From February 1990, relations between TML and Eurotunnel improved. However, hostilities again broke out in October 1991 over progress payments. Some £1.2b was at stake - £800b on the fixed works, and £400b on other items (*Financial Times* 7/9/91). Because these payments did not reflect the cost increases, TML risked going cash-negative. The issues were put starkly by the chair of Dumez - "we are determined to see Eurotunnel take responsibility for their extra costs. The contractors will not finance the project" (cited *Financial Times* 24/10/91). This message was reinforced at a press conference held in Paris by all ten heads of TML's constituent companies. They backed their claim by threatening to stop work on those elements which were the subject of dispute - in particular the cooling system. The matter was taken to the Disputes Panel<sup>8</sup>, which found in favour of TML in March 1992, and ordered an additional £50m\* each month to be paid over the existing £25m\* monthly payment (*Contract Journal* 2/4/92). This decision was overturned in September 1992 (*Financial Times* 1/10/92) by the Arbitration Panel<sup>9</sup>, but TML were not obliged to repay the additional £200m\* which had already been paid.

Negotiations were to continue for the rest of the life of the project. In October 1992, Eurotunnel offered a settlement which included payment of approximately £200m in shares and other paper, in addition to £1b in cash was rejected (*Financial Times* 24/8/92;16/12/92), but further discussions brokered by the Bank of England led to a working truce on 27th July 1993. This protocol, for which Neville Simms, the chief Executive of Tarmac is accorded much of the credit (Anderson and Roskrow 1994 p206) was crucial, for it laid out the agreed commissioning programme, and the conditions for the handover of the facility to Eurotunnel. Henceforth, the parties promised to "undertake best efforts to ensure cooperation over the commissioning and early operation of the project, working together towards the achievement of the common goals identified in the Protocol".

Although the fixed installation and terminal works were finished in April 1993, some four months late, they could not be commissioned due to the lack of rolling stock. After August 15th 1993, TML would incur serious penalties for late delivery costing some £240m in the first year. Eurotunnel agreed to waive these penalties so long as TML handed over the completed works on December 10th. However, no agreement was reached on the outstanding lump sum costs at this time, although Eurotunnel agreed to advance TML £235m\* pending final settlement of the dispute. TML met this target, and the tunnel was finally opened officially on May 6th 1994, 12 months after the date originally planned. Agreement was finally reached on 5th April 1994, on all claims except those related to procurement items with a payment of between \*£50 and \*£60m. However, in September 1995, Eurotunnel announced that it was making a fresh claim

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<sup>8</sup> This consists of five experts chaired by a law professor.

<sup>9</sup> This consists of three lawyers appointed under the rules of the international Chamber of commerce.

against the members of TML for around \*£1b, despite the fact the Tests on Completion were complete and the contractors' performance bonds had been returned (*Financial Times* 22/9/95).

**TML ORGANISATION**

*Of course there are difficulties, but nothing insurmountable. There is of course the language difference, but they are very talented in this respect, whereas we're just abysmal. There is also the way they think - I can't explain what it is, but our minds seem to work differently. It must be a national characteristic - one thing for sure, its not bloody-mindedness! We can sit around a table with our opposite numbers and within minutes reach an absolute agreement on any objective, and then in as many minutes both sides will arrive at precisely the opposite means of achieving it* (John Reeve, Directeur-Général TML. Cited Hunt p 220).

TML is an integrated consortium of two consortia - Transmanche GIE and Translink JV - with a common capital, and distribution of the profits in equal shares; its overall structure is illustrated in figure 2. Initially, it operated with a nationally based twin structure with British and French Directeurs Généraux reporting to a chief executive. In the early stages, the organisation was highly centralised, and each Directeur Général could keep control of most activities on his side of the Channel. Once the project went on site in the summer of 1987, the organisation grew rapidly and decentralised to five main Directorates (Anderson 1992). This structure, as it was in February 1988, is illustrated in figure 3. While engineering functions were integrated in the Engineering Directorate and Transport System Directorate, construction functions were completely separated on national lines. Within this structure, each area of operations was treated as a profit centre, or sub-project. For instance, Transmanche's Construction Directorate was divided into sub-projects for tunnelling, terminals, and concrete lining prefabrication. These sub-projects were supported by an engineering capability, and administrative, commercial, quality assurance, human resources, and project management functions. Each sub-project director was responsible for establishment, client relations, choice of construction techniques, choice of subcontractors, safety, and the achievement of sub-project objectives (Mativat 1991).

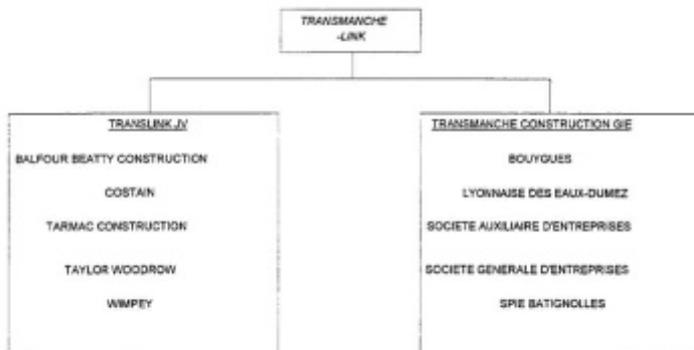


Figure 2 The TML Consortium

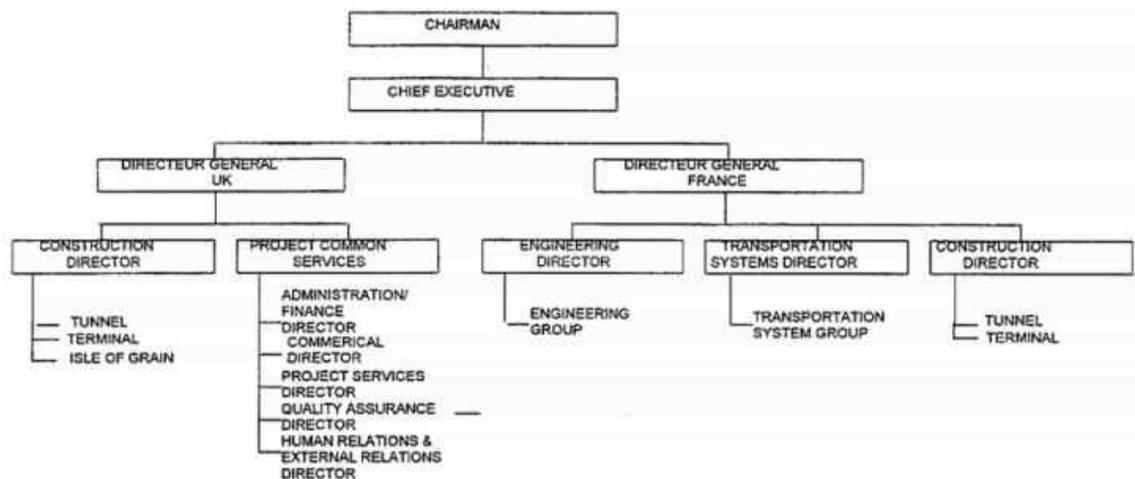
Senior management were seconded from the consortium mother companies. Despite this the complexity of the project effectively gave TML "un certain degré de liberté par rapport à ses entreprises commanditaires. Des principes de direction, des règles d'organisation et des procédures particulières communes ont mis en place" (Lemoine 1994 p 128), and one informant argued that the Directeurs Généraux operated with "very little supervision from TML as a whole". In this period, TML was staffed mainly with secondees from the mother companies, and there was a suspicion that they were not the best staff available - these were retained by the mother companies for getting new work (interview 5/9/95).

Engineering design was located in a joint office in Sutton under the Engineering Director where the anglo-french Engineering Group coordinated the engineering design process (Brown 1989).

national construction industries. On the UK side, TML relied heavily upon engineering consultants such as Mott Macdonald, BDP, and Kennedy Henderson. On the French side, in *bureau d'études* of the TML member

carried out all design work; for the fixed equipment, which was subcontracted, they took the process up to definitive design before handing it over to the Transport Systems Group (TSG)

procurement items, TSG took over after the preparation of performance specifications by the



source: Byrd (1994)

Figure 3 TML Organigramme February 1988

Engineering Group.

engineering effort was, effectively, starved of cash. As John Reeve argued,

*"The lack of certainty and real finance was a great brake on the project. All through this*

*We had to blast on with the tunnel design as a matter of priority. but we were held back on the terminals and the fixed equipment for lack of cash"*

This lack of attention to the fixed equipment design was to cost the project dear.

The human resource management policies for the tunnelling workers were very different on the

were "travelling men" (Lemley 1992), housed in a temporary camp which presented considerable problems of recruitment and retention. Tensions with the local community were

country. Unlike on the French side, there was little attempt to favour local workers. 95% of the operatives on the French side, however, were recruited in the Nord Pas de Calais region ( *Français Hebdomaire* 22/11/94), itself a depressed region. These workers were seen as part of

comprehensive help in finding jobs as their time on the tunnel came to an end. Due to space

constraints on the British side, many of the operatives were based at the factory for tunnel lining segment production on the Isle of Grain, some 100 km away from the main Cheriton site, and the segments were transported by rail. The French segment factory was on the site at Sangatte.

The British side of the tunnelling operations, despite an apparently easier task, experienced many management problems during 1988 when it hit unexpectedly bad ground. This compounded the existing organisational problems and prompted outbursts of frustration from Eurotunnel. The essence of the problem was that the senior managers seconded from the UK members of TML had great difficulty in working together. An ex-Mowlem manager was appointed to resolve these problems as someone from outside the consortium member companies. As he put it, "I diluted the cliques and made us more a team. Before that we were bunches of Taywood people, bunches of Costain people and so on" (cited Byrd 1994 p80), and the management of the tunnelling operations and the site transport system were integrated. These weaknesses in construction management were also responsible for the relatively poor safety record of the UK tunnelling operations (Byrd 1994 p145).

Under pressure from Eurotunnel, it was decided to strengthen the Supervisory Board which was placed under the eye of the Members' Assembly which consisted of the Chief Executives of the member companies. A unified management structure to reflect the shift from the tunnelling phase of the project to the fitting out was developed, which is illustrated, as it was in December 1989, in figure 4. The most notable feature is the reinforced role of Chief Executive, and the grouping of operations responsibilities under the Construction Managing Director. The new structure disbanded the Engineering Directorate and devolved its civil responsibilities to the Construction Groups, which now reported to the common Construction Director. Transportation system engineering became the responsibility of the Transportation Systems and Engineering Group (TSEG). TML's headquarters were also moved from Sutton to Folkestone to improve liaison between the engineering functions and site operations. Over this period almost all of TML's senior management were eased out or quit (Anderson 1992 ; Kakoullis 1991). The two Directeurs Généraux - John Reeve and François Jolivet - resigned in June 1989. They followed the Chairman and Chief Executive of TML, Andrew McDowall who was demoted to Deputy Chairman in the February and replaced by Philippe Essig of SNCF as Chairman. Many of those who left during this period were the secondees, and together with the growing size of the establishment, those secondees left were increasingly diluted. Towards the end of the project, staff were overwhelmingly (97%) British or French nationals, with the balance coming largely from Ireland. Most (72%) were recruited especially for the project, but the majority (55%) were employed by the mother companies rather than either of TML's two constituents.

The logic was explained by TML's new Chairman, thus:

*We have decided to place the two contracting sides of TML under the responsibility of one man for two reasons: firstly to facilitate improvements through learning from the experiences of the other side - each side has a lot to learn from each other. Secondly, we are now going into the next phase of the project, the installations equipment, the fixed equipment, all the mechanical and electrical work. This will be a very complicated job. (Philippe Essig, cited Contract Journal 15/6/89).*

The tunnelling operations could be separately managed from each side of the Channel, but once the fitting out started, they had to be treated as a common operation. Similarly, the integration of the Transport Systems and Engineering Directorates followed the shift of emphasis from civil to mechanical and electrical engineering. While these developments followed the overall evolution of the project, it is also clear from the level of staff turnover that a more fundamental transformation of TML's senior management was also taking place in response to the demands of Eurotunnel. Staff increasingly came from organisations such as SNCF, Morrison Knudsen and the British Department of Transport. Following the 1989 accord, Jack Lemley, who had been a Morrison Knudsen vice president before working in his own consultancy practice, was appointed chief executive of TML in July 1989 to complement Philippe Essig as chair.

As the project moved to the fitting out phase, TML increasingly subcontracted the bulk of the work, placing subcontracts in the name of either Transmanche GIE or Translink JV. Many of these subcontracts were, however, with other divisions of the mother companies. For instance, Tarmac Construction, in consortium with Montcocol and other French companies won the contract for installing the railway tracks, while Balfour Beatty Power in consortium with Spie Batignolles installed the catenary systems. By July 1992, this consortium was in dispute with TML (*Contract Journal* 16/7/92). Many subcontractors were encouraged to form a consortium with an opposite number from the other side of the channel. For instance, due to a desire for a commonality of image through the system, BDP came together with Groupe 6 to work on the design of the two terminal buildings at Sangatte and Cheriton.

TML was reorganised again during early 1991 as the project moved fully into the fitting out phase in a move towards greater centralisation. The immediate problem was the coordination of the mechanical and electrical installations, but these reflected deeper cultural problems between "office" and "site". TSEG were responsible for design, with all the uncertainties thereby entailed. They also had to cope with delays caused by Eurotunnel's slow approval of designs and lack of clear definition of requirements. The Construction Groups, on the other hand, complained of lack of design information and the pressure of programme constraints. TSEG had a flatter matrix organisation with a longer term perspective, while the Construction Groups were more hierarchically organised with short term goals. Initially, TSEG had retained overall responsibility for the M&E installations in terms of programming and commercial control, while the supervision of installation was carried out by M&E departments within the Construction Groups. This led to coordination problems between both the Transport Systems and Construction Groups, and within the Construction Groups between the Civils and M&E departments. The M&E departments were disbanded, and the Construction Groups took direct overall responsibility for the M&E installations from Transport Systems (Anderson 1992), however the pressures on the M&E programme had led to the departure of the Director of TSEG in September 1991 and his replacement by Keith Price, a Morrison Knudsen main board director, shortly after the resignation of Essig (Hunt p 239).

As the project moved fully into the commissioning stage at the beginning of 1992, a further reorganisation took place, and the organisation became much flatter. The Groups were abolished, and all the operational aspects were brought under a single Director of Operations. Many of the remaining Directors were responsible for financial, legal, and commercial matters - a reflection of the level of dispute with Eurotunnel. This structure, as of March 1993, is shown in figure 5. This type of structure was retained by TML for the rest of the life of the organisation, although it was continually adjusted as TML wound down during 1993.

At the end of 1988, TML employed some 8000 people - 2200 on the French side, 4900 on the British, and 847 in design offices - and reached a peak of 11700 by late 1989. Lemoine (1994 p 128) argues that this disparity between the British and French sides can be explained by the less sophisticated technology used on the British side, lower UK labour costs, and the poorer adaptation of the British contractors to international competition due to lower productivity. However, these comments ignore that fact that the French had only 5 tunnellers to the British 6, and that the British had approximately twice as far to tunnel as the French. This is due to the fact that the British landward drives are much longer than the French, and that the breakthrough points were much closer to France than Britain. For instance the service tunnel broke through 22km from the British coast and only 16km from the French. In addition, the TML Liaison Office - effectively the head office was located in Folkestone. The British operations were also split between Folkestone and the Isle of Grain with inevitable implications for overheads and transport (*Contract Journal* 20/11/86).

Although the formal status of the two languages was equal, the project worked largely in English for the bi-national coordination. Success "owed much to the readiness of the French to accept English as the working language. As a general rule neither the French nor the English pride themselves on their knowledge of foreign languages; but I have to confess that in the world of the tunnel the French far outstripped us in linguistic ability" (Henderson 1987 p 44).

There was certainly inter-cultural rivalry on the project. Pierre Matheron, the director of TML's French operations, describes the rivalry between the teams to cross each other's frontiers (*Les Echos* 10/12/90). A French informant saw the project as dominated by the British (interview 6/1/93), while his British opposite number saw it as dominated by the French (interview 9/7/93). What differed was the basis of the domination - the British dominated through their expertise in financial matters, while the French dominated through their expertise in technical matters. Another informant regarded the refusal of the French to buy British tunnellers at this point as a sign of the nationalistic tendencies within the project. However, the same informant explained that, "where it mattered it wasn't a problem - professionals get on because they respect each other's competence", and that perhaps the main cultural problem was trying to explain to the French what a quantity surveyor did that an engineer could not do (interview 5/9/95). More of a problem was integrating management systems. For instance, with regard to health and safety, smoking and the drinking of alcohol were completely forbidden on the British side, but cigarettes and wine were tolerated in moderation on the French.

As the risks of losing money on the project became a reality for the consortium members during 1990, differences in policy towards taking provisions in their accounts emerged between the British and French sides. These differences may be explained by the different accounting policies in the two countries where reported profits tend to be maximised in Britain in order to please shareholders, and minimised in France in order to reduce tax liabilities, and the much weaker balance sheets of the British companies whose domestic market was then already in recession (*Contract Journal* 19/9/91). By the end of the project, a total of around £200m had been taken in provisions by all of the consortium members, and they did not expect to recover all of these following the final settlement (*Contract Journal* 2/6/94).

## DISCUSSION

*L'achèvement du Projet tient du miracle compte tenu des différences culturelles linguistiques, morales et sociales. La réussite résulte probablement dans l'adhésion d'une majorité à un objectif commun* (TML Manager responding to UCL survey, October 1993).

As a starting point for analysis, it will be useful to place the performance of the channel tunnel project in context. The benchmarks provided by the RAND Corporation survey (Merrow 1988) of megaprojects (>\$500m @ 1984 prices), which cover the period from the commencement of detail design through to handover, can be compared to the performance of the channel tunnel project, as shown in table 4. If the facts that the programme data for the Channel Tunnel also include scheme design and that this project was at the top end of the RAND Corporation's sample in terms of scale and complexity, are taken into account, then the performance of Eurotunnel and TML can only be described as good. The Channel Tunnel was not a failure in conventional project management terms.

Performance Criterion	Megaprojects Average	Channel Tunnel
Budget Increase	88%	69%
Programme Overrun	17%	14.2%
Conformance Quality	53% performance not up to expectations	performance as expected
Operational Profitability	72% not profitable	operationally profitable, but overwhelmed by financing costs

*Table 4 Project Management Benchmarks*

However, the project simply is not financially viable, and the world's savers, via rights issues and additional loans from the syndicate banks, have been obliged to pour something like £6bn\* more than they intended into the project. The financial restructuring, incomplete at the time of writing, is very much an attempt to make the best of a very difficult situation. The following

discussion will attempt to identify how a relatively successful project got into such a situation, so that lessons can be learned for other major projects in Europe and elsewhere.

The symbiotic relationship between TML and Eurotunnel is fundamental to this story. The attempt to clearly delineate the responsibilities of concessionaire and principal contractor did not work. Jonathan Aitken, a local British MP, described the quarrels between the two as a "lover's tiff" (cited Kakoullis 1991 p 44). The more appropriate metaphor is parent and child. TML's members acting as promoters gave birth to Eurotunnel and nurtured it early on; Eurotunnel then had to find its own way in the world and therefore publicly proclaimed its independence from a hurt parent. The problem remained that the child was tainted in the eyes of the world by its parent. For some, such as the deposed Directeur John Reeve, "things started to go wrong when we pulled out of ownership of the Channel Tunnel; we should have stayed there as owner operator - just like Trafalgar House has done on the Dartford river Crossing" (*The Sunday Times* 8/10/89). This view surfaced again when rumours that the French members of TML wanted to take over Eurotunnel spread during the middle of 1993 (*New Builder* 14/5/93). These points are manifestations of a profound ambiguity in the role of the members of TML - they promoted the project as a concession contract, but were not prepared, or able, to take the risks of being concessionaire. This ambiguity soured relations on the project because Eurotunnel was obliged to try to appear to be playing tough with TML in order to secure the confidence of bankers and investors, which led at times to public displays of almost pure theatre. In the opinion of Jack Lemley, the Chief Executive of TML, the rows themselves cost as much as £1b\* and caused the job to be 9 months late (Anderson and Roskrow 1994 p199). This is almost certainly an overestimate, but it is clear that they did not help the project.

These problems were reinforced by the inappropriate choice of contract type for the terminals and fixed equipment, which was driven by the insistence of the financiers for risk transfer (Byrd 1994; Cohendet 1993; Stannard 1990), rather by an appraisal of the appropriate balance of risks between client and contractor. It is no accident that most of the acrimony revolved around the lump sum contract, for this was the one which transferred risk largely to TML. At the same time, Eurotunnel could not fulfill the basic condition for the use of such a contract type - no changes in technical requirements. This inability was inherent in the structure of the project. Firstly, the time scale required for the completion of the project on a privately financed basis compressed the programme so that, in effect, it was a fast-track project. Secondly, critical aspects of the design were subject to a public regulatory authority, the IGC. As others have noted (Merrow 1988; Stinchcombe and Heimer 1985), regulatory authorities are not project orientated, and are not happy making decisions in rhythm with project milestones. Thirdly, Eurotunnel was a novice client building a unique facility. Major changes in technical requirements were inevitable on a project of this type, and under such conditions it was totally inappropriate to attempt to transfer the bulk of the risk to the contractor.

The general air of mistrust between TML and Eurotunnel generated by these factors meant that there was a strong tendency towards bureaucracy - "puisqu'on se méfie de ses partenaires et puis qu'il faut justifier ses propres compétences, on multiplie les contrôles tatillons, on fait appel à des sociétés de consultants coûteuses en faisant grimper par là même les coûts de transaction et de contrôle" (Cohendet 1993 p 20). The large number of different actors involved - contractor, concessionaire, financiers, concessor - all preferred to retain their own independent advisors. One commentator summarised the situation as thus: "there are so many advisors and sub-advisors involved in the project that I hate to think of the amount of paperwork being produced. One thing is for sure, none of them are digging a tunnel" (*The Sunday Times* 8/10/89). The generation of this massive weight of transaction costs on the project is a product of the complex set of simultaneous interactions between the actors compounded by deep mistrust between the two principal ones. In turn, the financiers, at least in the early stages, were suspicious of the nature of their relationship, which therefore generated further antagonism between Eurotunnel and TML.

Given the structure of the project, changes in technical requirements were inevitable, yet the mechanisms for negotiating the time and cost implications of those changes appear to have been totally inadequate. Three third party actors were involved here - the MdO, the Disputes Panel, and the Arbitration Panel. None appeared to have adequate legitimacy to resolve the intractable disputes between the parties. In the end, the issues were resolved by the two principal parties sitting down and thrashing out the issues round the table, but it was only after the middle of 1993 that real progress was being made along these lines. In the meantime, the uncertainties involved compounded the project management problem. For instance, it was clear from May 1991 that the June 1993 deadline could not be met due to delays on the procurement items and the M&E works, yet agreement on its revision took another two years. In the meantime, TML managers were obliged to work to deadlines which they knew to be unrealisable (Anderson 1992).

TML itself faced a number of problems although, perhaps surprisingly, these did not appear to stem, for the most part, from its binational or ten member consortium nature. This may be due to the large-scale recruitment of staff especially for the project, and a testament to the wisdom of Henderson's comment which opens this paper. However, the appointment of an American to the strengthened Chief Executive role in 1989 does suggest underlying national tensions in the move away from a twin-headed organisation. Apart from the tensions associated with this change, TML's problems seemed to stem largely from the pressures generated by a highly uncertain and hostile environment. The high turnover amongst senior management must be a cause for concern. Although any project organisation evolves through a number of phases related to the progress of the works, the main shifts in organisation structure within TML appear to have only been possible with the departure of senior managers and their replacement by outsiders. It seems unlikely that this was due to problems of resistance to change, at least after 1989; more probably, it was due to the extraordinary pressures experienced in the job.

These problems were compounded by a fundamental weakness in the structure of the consortium. The 10 members were essentially civil engineering contractors, and they "viewed the project very much as a civil engineering one" (Byrd 1994 p 24). One third of the contract sum was, however, for power engineering and rolling stock items, and it was the rolling stock which experienced the most ferocious cost inflation. While TML did recruit senior executives from rail operators such as SNCF, this is not the same as having corporate involvement to back up the skills. The inclusion of a power and railway engineering corporation in the consortium, such as GEC Alsthom, would almost certainly improved cost forecasting and control for these items. It is notable that most other consortia and joint ventures for rail concession contracts do include such corporations.

This weakness in the structure of TML is symptomatic of the failure to properly scope the project. The fundamental assumption of all the parties at project definition stage around 1985 was that this was a civil engineering project. This is reflected in the rousing conclusion to the UK government White Paper which argued that "the fixed link is a challenging and exciting project. It will be the largest *civil engineering* project for many years and the largest in Europe ever undertaken by the private sector" (cmdnd 9735 1986 £ 64 my emphasis). It is to this failure of scoping that the failure to plan adequately for the commissioning process must be attributed. As one informant put it, what is being built is not just a tunnel, but "an integrated transport system" (interview 12/2/93), but the implications of the systems nature of the problem were not fully appreciated by senior management until too late.

These problems might have been recognised earlier had the engineering of the fixed equipment and termini not been starved of cash during 1987. It is clear that not enough effort was put into engineering prior to commencement on site. The combination of pressure from the banks, the civil engineering culture of the project, and uncertainty due to the tortuous British legal processes led to a lack of full engineering effort in the early stages. This meant that crucial aspects of the design had to be changed relatively late, in addition to the problems associated with the IGC.

Pressure from the banks pushed the project into fast track mode - it went on site after only around 15% of the programme had elapsed. This contrasts starkly with the Severn Bridge (see Working Paper 12), which did not go on site until one third of a 6 year programme had elapsed, on a project that, while technologically challenging, did not feature the systems complexity of the Channel Tunnel.

Organisationally, the decision to let the construction contract to a single integrated consortium meant that any particular contractual dispute affected the project as a whole. The usual strategy in the face of complexity is to break the overall problem down into smaller problems. This was the strategy adopted on Storebælt (see Working Paper 14), where the bridge and tunnel project was let as four separate packages, and the rail transport systems were taken outside the construction contract. While this project has faced enormous technological problems, particularly in the east tunnel, client/contractor relations have never become as bad as on the channel tunnel, and it has been possible to manage each problem separately. Both of these solutions of allowing more time for design and breaking the project down into a number of separate packages has been adopted to an even greater degree on the channel tunnel rail link (Hirst 1996).

It is often argued that the external environment poses some of the largest risks for projects of this type (e.g. Merrow 1988). Certainly, the relatively rapid growth of the latter part of the eighties caused problems - price inflation was serious, particularly for the procurement items. However, this same boom also allowed the refinancing of the project in 1990 and 1994 on the basis of upwardly revised revenue projections based on increased traffic forecasts (Stannard 1990). In the end, these revisions were robust enough to withstand a 69% cost increase. What they could not withstand was a 12 month overrun in construction time; and, in particular, an 18 month delay in the provision of a full revenue-generating service. The main dynamic of risk on the project was internally generated by the structure of the project - the decision to fast track due to the source of finance; the choice of an inappropriate contract type due to the source of finance; the family feuds do to the necessity for Eurotunnel to prove its independence to the sources of finance. It is difficult to escape the conclusion that the attempts to reduce uncertainty in order to enhance financing capability are, of themselves, the main sources of the uncertainty, and hence cost and time overruns, on the project. The project was lucky because these errors were absorbed by unforeseen favourable changes in the external environment

The Channel Tunnel project is one of the largest and most complex integrated construction projects ever undertaken. It demanded an extraordinary range of technical expertise, deployed on a massive scale. It was inevitable, then, that things would go wrong - in retrospect, it is remarkable how many things have gone right