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European case study on the Financing of High Speed Rail

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Abstract

Australia is investigating the possibility of a High Speed Rail (HSR) system. A full Brisbane-Melbourne solution is estimated to cost about 114 billion Australian dollars. While it has been estimated that it could be capable of being self-funding in the operating phase, this excludes financing the massive initial capital outlay.

Assembling financing mechanisms for large public infrastructure projects poses many complexities, with multiple financing alternatives, various economic, social and environmental factors, as well as a range of stakeholders with different and sometimes conflicting objectives to consider. There is a clear need for a consistent and multi-dimensional framework for selecting the optimal financing solution.

Although there are well-recognised methods for establishing the economic case for public infrastructure projects, together with the optimal mix of public and private delivery, these processes are less well developed when it comes to the appraisal of financing methods.

This paper forms part of the literature review of ongoing PhD research. It presents a case study of European HSR systems, with particular attention paid to the France, which was a pioneer not only in developing the first HSR system in France, but also experimented with a range of financing models, including the world's first public–private partnership HSR financing models. From this we hope to extract key lessons that may inform a potential Australian project.

1. Introduction

This paper forms part of an ongoing literature review to inform the development of an appraisal framework for selecting optimal financing methods for a high speed rail (HSR) project in Australia. It presents international case studies relating to how HSR projects were financed and how these instruments came about. The paper touches on the institutional or delivery framework within which the financing instruments were selected, as well as the funding context. Particular attention is given to the expansive European HSR network, and includes a case study of the French TGV system.

The paper does not address the economic justification[1] for HSR projects, which has been discussed elsewhere, but rather focuses specifically on the financing aspects for raising capital for HSR. Upfront financing costs are extremely important for HSR, owing to the vast amounts of construction capital required compared to operating costs. Selecting the right finance mechanism is also significant for mega public infrastructure projects, such as HSR. This is because the use of finance mechanisms results in differences in a range of aspects. These include total costs, how it is spent over time; the sharing of cost between finance partners, as well as who bears the risks associated with an investment (GAO 2002). The Australian government appointed HSR Advisory Group also placed financing issues among

1 For an in depth comparison of economic project appraisals of international HSR projects, refer Steer Davies Gleave (2004).

the top seven important aspects to be addressed in the future (High Speed Rail Advisory Group 2013)

We initially describe the background of the European HSR network (section 2). This is followed by an explanation of the institutional framework influences the way capital is raised for construction of HSR in Europe (section 3). Section 4 reviews the financing instruments employed in European HSR, while section 5 summarises the financing of the French TGV system. The paper concludes with lessons learnt and further research requirements in section 6.

2. Background

The Japanese Shinkansen HSR started operating in 1964 between Tokyo and Osaka. Motivated by the apparent success of the Shinkansen high speed system, particularly in relief of significant congestion on existing rail routes, European railways soon followed. France was the HSR pioneer in Europe; with a Paris to Lyons line being opened in 1981 (Peterman, Frittelli and Mallett 2009).

HSR has since remained firmly on the European rail agenda and has led to an expansive HSR network, together with plans to grow the network from under 10,000 kilometre in 2008, to 22,000 kilometre by 2020, and in excess of 30,000 kilometre by 2030(EU 2010).

3. Institutional arrangements (Delivery)

3.1 Separating Infrastructure and Operations

Historically, both the building of railway infrastructure and the operation of railway services were provided largely by state-owned firms (Dutzik, Scheider and Baxandall 2011). Following the creation of the European Union (EU), a number of reforms were implemented to liberalise the European Rail Industry by separating infrastructure management from train operations. Infrastructure managers were often required to provide access to multiple operators[2].

Infrastructure managers were simultaneously allowed to levy an infrastructure charge (or access charge) on operators for capacity use. The reforms further mandated:

A balanced budget for IMs

Allowance for infrastructure managers to make a return on their investment

Principles for infrastructure charging schemes, including the requirement for passing on only costs that are directly-related to the operation of the train service (such as congestion and environmental charges); as well as the ability to use yield management[3].

The changes also opened the international passenger rail market to competition, particularly between operators, while infrastructure managers remained largely natural monopolies (Crozet 2012). Given these reforms, it makes sense to consider infrastructure financing and funding as largely separate from subsequent service operations (Roll and Verbeke 1998).

3.2 Infrastructure charges

Infrastructure managers recover part or all of their construction financing costs from operators, by way of infrastructure charges. The formulas for the calculation of infrastructure

2 Different structures emerged across Europe. In some instances the holding company remained a single entity, with only financial separation between the operators and the infrastructure manager (such as Germany; B Bahn and DB Regio, DB Netz). Other examples of financial and structural separation include Spain's ADIF and RENFE; and France's RFF and SNCF (Teixeira and Pita 2012).

3 Charging different prices for different services during different times.

charges can be divided into marginal and fullcost systems. While marginal cost systems charge the marginal cost of adding another train to the system, full cost systems comprise all elements, including initial investment cost. Two 'in between' systems also exist, as depicted in Table 1 below (Teixeira and Pita 2012).

Table 1: Charging systems

Type of system	Countries
Marginal Cost	Bulgaria, Greece, Ireland, Luxembourg, Netherlands (conventional lines), Norway
Marginal Cost Plus Additions	Austria, Czech Republic, Denmark, Finland, France, Portugal, Spain, Sweden, Switzerland, UK
Full Cost Minus Discounts	Belgium, Germany, Italy, Poland, Romania, Slovenia, Slovakia
Full Cost	Estonia, Latvia, Lithuania, Netherlands (HSR only)

4. Financing construction

4.1 Construction cost

An HSR system entails a range of cost elements, including infrastructure building costs, operating and maintenance costs. Infrastructure spending typically follows in three phases: a pre-project stage, followed by a construction phase, and finally the operations and maintenance phase (Vander Ploeg 2006). Our research focuses predominantly on financing construction.

Campos and de Rus (2009) identify the following three construction cost components and their typical relative contribution to overall construction cost[4]:

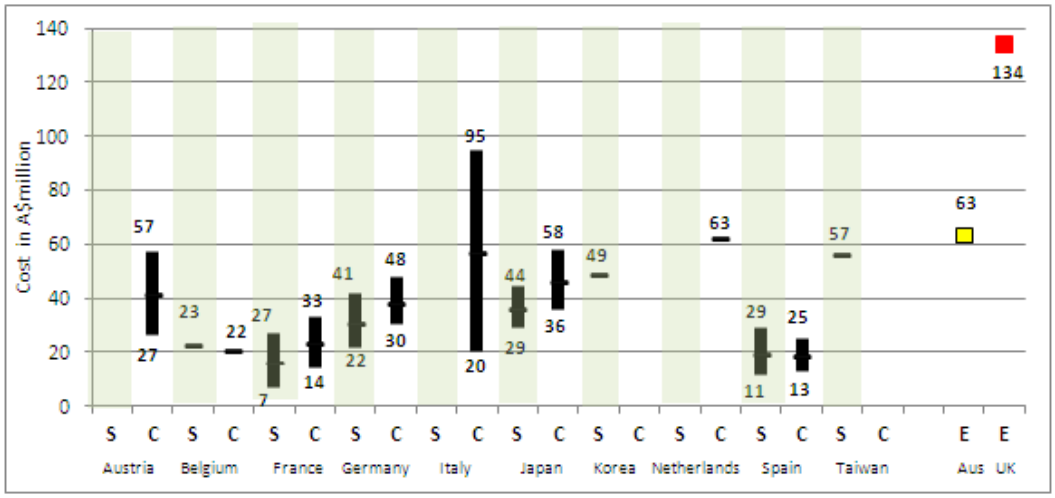
- Planning and land costs, including feasibility studies[5] often represents a sunk cost, usually between five percent and ten percent of the total investment.
- Infrastructure building costs, including terrain preparation and platform building. This component varies widely across projects depending on the characteristics of the terrain, but typically accounts for between 10 percent and 25 percent of the total investment. Technical issues and geographic obstacles may easily double this amount (up to 40–50 percent) for viaducts, bridges or tunnels.
- Superstructure costs[6] as a rule, make-up the rest of the infrastructure costs and consists of all rail-specific elements.

A number of studies review the costs of High Speed Rail infrastructure (including Esplugas *et al* 2009; Steer Davies Gleave 2004 and Mathur 2011). Campos and de Rus (2009) provides average cost per kilometre of new HSR infrastructure for a range of European and Asian countries in 2005 prices, which we have converted into Australian dollars (Figure 1) while the UIC (Mathur 2011) provide more updated estimates for HSR construction costs for Europe (Figure 2). AECOM (2013) has estimated the cost of Melbourne - Brisbane HSR at 114 billion Australian dollars. At 1,800 kilometres, the cost per kilometre would be 63 million Australian dollars per kilometre. Also shown is the estimated cost of High Speed 2, a plan to build 540 km of High Speed rail between London and Birmingham then branching to Leeds

4 These costs vary depending on the nature of infrastructure to be built in each case and the pre-existing infrastructure (Campos and de Rus 2009).
5 Includes both technical and economic feasibility studies, technical design, land acquisition and others (such as legal and administrative fees, licenses, permits, etc.) These costs may be substantial in some projects (particularly when costly land expropriations are needed).
6 Components include tracks and sidings along the line, signaling systems, catenary and electrification mechanisms, communications and safety installations. Each of these individually elements mostly represents between five and ten percent of the total investment.

and Manchester/Liverpool. The cost is estimated at 42.6 billion pounds (excluding rolling stock estimated at 7.5 billion pounds) (HS2 2013). The cost coverts to 134 million Australian dollar per kilometre and is high because 60 percent of the kilometres would be in cuttings, tunnels or concealed. The Australian and UK estimates (E) are superimposed on the right of the graph. The Australian figure is comparable to the Taiwan, Netherlands and Italian (mid point) figures (although these figures were for 2006 and have not been increased for inflation). The UK HS2 figure is over twice the Australian estimate.

Figure 1: Average cost per kilometre of new HSR infrastructure (Australian dollar million)



Notes: Figures converted at an exchange rate of €1=$A1.44 (Sept 2013) and £1=$A1.70 (Sept 2013)
Notes: S = Lines in Service; C = Lines under Construction (2005 prices); E estimates in 2012 (A) & 2013 (UK) prices
Costs include infrastructure and superstructure costs but exclude planning and land costs.
Source: Campos& de Rus (2009); AECOM (2013)

Figure 2: Average costs of HSR in Europe[7]

Item	Cost	Australian Dollar
Construction of 1 kilometre of new HSR line	€12 to €30 million	AU$17 to AU$43 million
Maintenance of 1 kilometre of new HSR line	€70 000 per annum	AU$100,000 per annum
Cost of an HS train (350 places)	€20 to €25 million	AU$29 to AU$36 million
Maintenance an HS train	€1 million per annum	AU$1.4 million per annum

Notes: Figures converted at an exchange rate of €1=$A1.44 (Sept 2013)
Source: Mathur (2011)

4.2 Financing alternatives

In Europe, financing of HSR has been sourced from a variety of sources, including various government bodies, publicly owned firms, and private investors (Dutzik, Scheider and Baxandall 2011).

Given common confusion of terminology involved in the financing arrangements for public infrastructure, it is important to distinguish financing, funding and delivery[8]. The financing of

7 Similar to figures used by the World Bank - estimates typical construction plus train-set costs outside China to range between USD 35-70 million per kilometre depending on complexity of civil engineering works, degree of urbanisation along route, and total capacity of rolling stock required (Amos, Bullock and Sondhi 2010).
8 The importance of distinguishing between these concepts and understanding how they link together has been raised in a number of recent studies, including Abelson (2011, p. 1) ‘‘The distinction between raising capital and servicing and repaying capital is important. The term ‘financing’ is often used to refer not only to raising capital for infrastructure but also to payments for the services provided by the infrastructure. The latter use of the term can produce confusion. Although the concepts of

infrastructure is defined as selecting the immediate source of upfront capital to undertake capital investment. Funding[9] is a separate matter and refers to the revenue stream that repays or recovers that upfront capital costs (Ernst & Young 2011, Chan et al. 2009, Vander Ploeg 2006). Finally, delivery is defined as making the decision of who should be responsible for providing the infrastructure and encompasses the end-to-end process of infrastructure delivery, from developing the specifications, procurement, obtaining finance, construct, to operating, funding and overseeing delivery (Henn, Sloan and Douglas 2012).

The financing mechanism selected has led to significantly different impacts. For example, the effect of using debt as opposed to accumulated public funds[10], or even within these broad categories, whether it be accumulated public funds derived from consolidated tax revenue or infrastructure levies, have differential impacts. Quantitative aspects that differ for different financing alternatives include total financing costs, how it is spread over time; how the cost is shared between finance partners, as well as how project risk is allocated (GAO 2002). A range of qualitative factors include fairness or equity, efficiency, effectiveness, reliability, administrative and compliance burden, certainty, accountability, transparency and stakeholder support (Henn, Sloan and Douglas 2012).

Financing methods are often combined to raise capital for a large project, as was the case for the Gold Coast Rapid Transit project which required a financing mix of bank debt, private equity, and contributions from federal, state and local government (Ernst & Young 2010; PWC 2011). An East Coast HSR project would have to consider all the above complexities in assembling an optimal financing structure (Henn, Sloan and Douglas 2012).

To date, all European HSR projects has been either fully financed by government or built under a PPP (public–private partnership) with significant government contributions (Adler, Pels and Nash 2010) as will be discussed below.

4.2.1 Full public financing

This model entails government financing total capital costs and assuming the role of long term developer and owner. This is the most popular model for raising HSR capital to date. Public financing can be direct (approximately 40 percent of EU rail infrastructure is done this way), or through a combination of direct government support and finance by national railway companies (as in Italy and France) (Roll and Verbeke 1998). The investment of public funds has been necessary everywhere that HSR has been built, often justified by a multitude of public benefits credited to HSR, including economic, environmental, energy security-related and other advantages (Dutzik, Scheider and Baxandall 2011). Examples where HSR was fully financed by the public sector include most of the European HSR network, such as the original French TGV systems (including the South-East, Mediterranean, European East and Rhine–Rhône), Belgium, Germany, Spain and Italy (ARUP TMG 2001; CRC 2010; Mathur 2011; EU 2010; Adler, Pels and Nash 2010; Henn, Sloan and Douglas 2012; EPEC 2010) [11].

There are two main categories of public financing alternatives used for HSR: accumulated public funds or government borrowing (Dutzik, Scheider and Baxandall 2011). Accumulated funds are broadly derived from consolidated tax revenue, or infrastructure levies, while public sector borrowing includes general bonds, infrastructure bonds, infrastructure revenue bonds, or public trading enterprise borrowing. The most common form of public sector

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raising and paying for capital are often linked, they are not synonymous. In general, different parties are responsible for financing transport infrastructure and for paying for it.'

9 Van de Velde et al. (2012) performed an analysis of annual state contributions to national rail systems for a range of European countries in the context of infrastructure charges, as well as the relationship with farebox revenues per passenger. The study was, however, inconclusive with regard to the role of state funding and suggests a more complete analysis in order to draw meaningful conclusions.

10 Also called 'pay-as-you-go' '(PAYGO) financing, which is based on current revenues or savings within the public sector. This may include transfers to capital from current revenues, intergovernmental grants and contributions, budget appropriations. as well as savings in reserves and reserve funds (Vander Ploeg 2006, Chan et al. 2009)

11 Other international examples include the Shinkansen lines in Japan (developed by government owned entities, later progressed towards independent entities); South Korea and China.

borrowing is via long-term bonds (Abelson 2011). However, while this presents a summary of categories, there are multiple variations. Vander Ploeg (2006), for example, identifies over 24 types of public financing sub-categories.

Public finance for HSR was originally provided mostly on a national level. However, since the creation of the EU, EU funds have started to play an increasingly important role, especially for projects that connected countries (Roll and Verbeke 1998). EU contributions are made via the budget allocated to the Trans-European HSR network (TEN[12] and TEN-T[13]) programme and/or via the Structural Fund and the Cohesion Fund, while the European Investment Bank (EIB) also grants loans. This model entails shared financing between different public entities (such as for the French TGV). The justification for European Commission contributions is usually on the basis of benefits that extend beyond the particular country to the region as a result of through services. The size of those contributions is however often controversial (Adler, Pels and Nash 2010). Of late, a switching of finance away from the European sources, back to national and local sources has been observed in the EU27[14] (Banister and Givoni 2012)

4.2.2 Public–private partnership financing with government assistance

In the last decade, involvement of the private sector in the construction and financing of European HSR has emerged, driven by a range of fiscal constraints including the Maastricht criteria for countries' debt-to-GDP[15] ratios, as well as by the added scarcity of public finance as a result of the global financial crisis. Public–private partnership (PPP) finance for HSR remains overshadowed by full public finance and all examples include significant government financing and/or guarantees. PPP finance is a fairly recent development in HSR. It is as yet uncertain whether it will be successful for HSR. France was the first country to use PPP finance for HSR and developed their PPP framework in 2006, followed by the trialling of two PPP models for TGV projects currently under construction (discussed in section 5 below). Other European PPP HSR projects soon followed thereafter[16]. Three types of PPP schemes can be seen in European HSR, with the scope of private involvement ranging significantly, as set out in Table 3 below. More detail on these PPPs is provided in Appendix A.

12 Includes the upgrading of track covers in Germany and Austria (TEN 1), France and Spain (TEN 3), the French-Italian connection to Slovenia (TEN 6) and the French–German–Austrian links (TEN 17).
13 Network of key road and rail links within the EU27. By 2020, the TEN-T will include about 20,000 kilometres of HSR line.
14 The EU27 refers to all the current member states of the European Union (EU15 + EU12), while EU15 refer to those member states that were part of the EU in 1995 and the EU12 refers to those states that have joined since 2004.
15 The EU criteria for debt: GDP is often criticised by economists as an expedient rule that has no long-run justification, they point to the merits of the Golden Rule of public finance, which makes a distinction between capital and operational budgets, and states that governments should achieve a net operating balance over the business cycle. The Golden Rule requires current revenue to cover the use of capital but permits borrowing to finance productive investment. The main aim to manage debt levels should be to keep debt at sustainable levels.
16 Other international examples include Taiwan (Taipei-Kaoshiung); Shanghai MagLev; California, Brazil Sao Paulo to Rio de Janeiro.

Table 3: PPP schemes in Europe

Type	Investment Scope			Operational Scope			HSR Examples	Financing comments
	Civil Works	Electro-mechanical	Rolling Stock	Construction	Operation	Maintenance		
Broad based PPP	X	X	X	X	X	X	Russia (Moscow - Saint-Petersburg)	50 percent government financing for construction cost; 30-year concession for operation, with availability payments by government, i.e. government takes on patronage risk (more akin to France's "partnership" model).
PPP for infrastructure only	X	X		X		X	France	Two PPP models (refer section 5): • Concession (refers here to a model where private parties take on patronage risk) • Partnership (where government takes on patronage risk, makes availability payments).
							Spain (Olmedo – Ourense and Madrid – Badajoz)	Construction cost financed 40 percent by state owned infrastructure manager, remainder by Special Purpose Vehicle long term debt. Concession with availability payments over a 25-year maintenance period (i.e. government takes on patronage risk).
							UK – France (Channel Tunnel Rail Link)	Government backed private bond issue, operated via 30-year concession.
							UK (Tunnel Rail Link/ High Speed 1)	Build Own Operate Transfer (BOOT) type PPP. Full private financing (combination of private equity and debt) of construction. 99-year private concession to operate (amounting to indirect state subsidy).
PPP for superstructure only		X		X		X	Netherlands-Belgium High-Speed Line South	Sub-structure fully state financed. Design, Built, Maintain and Finance (DBMF) type PPP. Includes two separate concessions: a 25-ear track concession (for availability of superstructure), and a 15-year transport concession for provision and operation of train services on commercial basis.

While the financing instruments employed by the public sector participants in PPPs remain as listed above, private sector financing are derived from private debt, private equity or mixed private instruments (Abelson 2011).

4.3 Rationale for large public sector finance contributions

The public sector remains a dominant player in financing HSR, even in projects financed by PPP. Even since the move to PPP finance in Europe, the public sector remains responsible for more than half of the capital cost. Recent examples include the Netherlands-Belgium High-Speed Line South (public sector contribution of 86 percent), the Perpignan-Figueres connection between France and Spain (57 percent public investment), the Tours-Bordeaux line in France (50 percent public investment), as well as the initial segment of Portugal's planned HSR network, which was projected to require 55 percent of its budget coming from public sources.

Even projects that were originally intended to be fully privately financed eventually required substantial government financing. Two prominent examples of this are Great Britain's High Speed 1 line and Taiwan's HSR system, where government investment was required in the

form of public sector loan guarantees and the purchase of partial or full ownership of the companies that built the lines (Dutzik, Scheider and Baxandall 2011). Abelson (2011, p. 3) makes an important point, however, that these PPPs that require public guarantees should really be considered as *de facto* public financing:

> *When payments are guaranteed and unconditional, it is questionable whether there is any real difference between public and private borrowing. ... When government guarantees surplus income and takes the risk for shortfalls in income, nominal ownership may be private but the real effects are borne by the public sector. Income shortfalls affect public net worth and borrowing requirements. Although the transport infrastructure may be financed by the private sector, the government bears the ongoing risk. The effect on the government's fiscal position is the same as if the government itself had borrowed the money (at private sector rates) and incurred the liability for servicing and repaying the capital. The instrument used is a de facto government loan.*

The justification for public sector contributions is usually associated with the quasi-public nature of HSR and the socio-economic effects beyond financial gains associated with it (Roll and Verbeke 1998). Meanwhile, the relatively small incidence of private financing in HSR is typically explained by the range of risks and complications associated with these projects, including the mismatch between shareholders requirement for timely and adequate revenue flows; the tendency of banks to avoid excessive indebtedness of the project executor and the characteristics that make up an HSR project. These characteristics include the high upfront investment and long construction periods, coupled with scale indivisibilities and slowly rising revenues.

Given the typical cash-flow structure of HSR, the estimated financial rates of return of the Trans-European HSR network (TEN) projects normally range between three and eight per cent[17]. In the absence of additional incentives, this is insufficient for private sector investors (Roll and Verbeke 1998).

4.4 Capital Servicing (Funding)

Given the vertical seperation of infrastructure and operations, funding is also distinctly separated for construction and subsequent service operations.

Adler, Pels and Nash (2010) identify two main public funding sources to recover the investment costs associated with construction of the current European HSR infrastructure, namely taxes and tolls, as well as access charges. Taxes and tolls may be imposed by authorities involved in financing construction and include dedicated taxes, such as fuel taxes, or general taxation revenues (Roll and Verbeke 1998), corporate tax on profits and environmental tolls[18]. Infrastructure managers, who are often also responsible for construction finance, also recover their financing expenses from infrastructure access charges. When the infrastructure access charges paid by the rail operator to the infrastructure manager is close to marginal cost, the rail operator doesn't cover full infrastructure cost and government subsidies must cover part of the infrastructure cost. When the charges are higher than the marginal cost, the operator pays for a large share of the infrastructure cost.

Rail operators, in turn can recover the access charges through farebox revenue, as well as through other revenue sources, such as property development or government availability payments (such as TGV PPP concession projects, refer section 5).

17 Significantly lower than the claimed financial return rates of some of the pre-1997 French TGV lines (refer section 5). The TEN transport programme (TEN-T) was only adopted by the European Parliament and Council post 1996/7.

18 The model acknowledges that ideally the objective of the environmental toll is not to generate revenues, but to optimise the level of environmental damage, i.e. reduce the damage to a level which is consistent with welfare maximization.

5. Financing the French TGV

5.1 Investing in HSR

While other governments across Europe have been cutting back on national spending, France is one of the few countries that has continued the extension of its HSR network (McKenna 2011). In fact, French authorities have decided to accelerate the expansion of their network (TGV[19]), lately relying on PPPs in order to finance this development (Alstom 2011). In 2010, the RFF estimated an average basic construction cost[20] for expanding the network by 2020 by another 2000 kilometres at 20 million euros per kilometre, resulting in the requirement for 40 billion euros to finance their ambition plan (RFF 2010). These additional finance requirements prompted the move towards PPP financing models.

5.2 Financing

The financing of the French HSR (TGV) infrastructure is characterised by three distinct phases:

Public debt financing

Debt combined with a range of subsidies

Public–private partnership financing models

5.2.1 Public debt financing

The initial French TGV lines were financed mainly by SNCF debt on the basis of their estimated profitability, with investment proposals being evaluated according to both expected financial and social rates of return (Vickerman 1997). The French strategy was to construct the more profitable lines first. The first line, from Paris-Lyon (on TGV Sud Est) was financed entirely by SNCF debt on the basis of an expected minimum 12 percent financial rate of return. As a result of its spectacular success, in terms of both traffic and revenue generation, this return has been surpassed, and with financial rates of return estimated at between 15 percent and 30 percent per year in socio- economic terms it was fully amortised by the end of 1993 after only 12 years in service. Encouraged by the success of the TGV Sud Est, the French government committed a 30 percent contribution to the construction costs of the TGV-Atlantique. The government cited the regional development potential expected from this development, with a substantial expected social rate of return of 23 percent. By the late 1990's, TGV Atlantique was reported to be making a net return of 22 percent of the gross revenue after allowing for infrastructure costs, rolling stock and direct costs, and TGV Sud Est 38 percent. Likewise, the TGV Nord proposal was deemed financially viable with estimations of a minimum 12 percent financial rate of return (Vickerman 1997; Leheis 2009; Alstom 2011).

The TGV Méditerranée (TGV Med) was the last HSR project entirely produced and mainly debt financed by the SNCF. In addition, a state subsidy of around ten percent was contributed to guarantee the required rate of profitability of eight percent, plus contributions by the EU and local authorities (LATTS 2008; Leheis 2009). SNCF's economic evaluation in 1991 envisaged refunding the debt related to the TGV Med construction in 20 years of operating Table 3 below provides a breakdown of financing for the TGV Med (LATTS 2008).

19 TGV (Train à Grande Vitesse), France's high-speed train service, while LGV (Ligne à Grande Vitesse) is sometimes used to refer to individual high-speed lines.

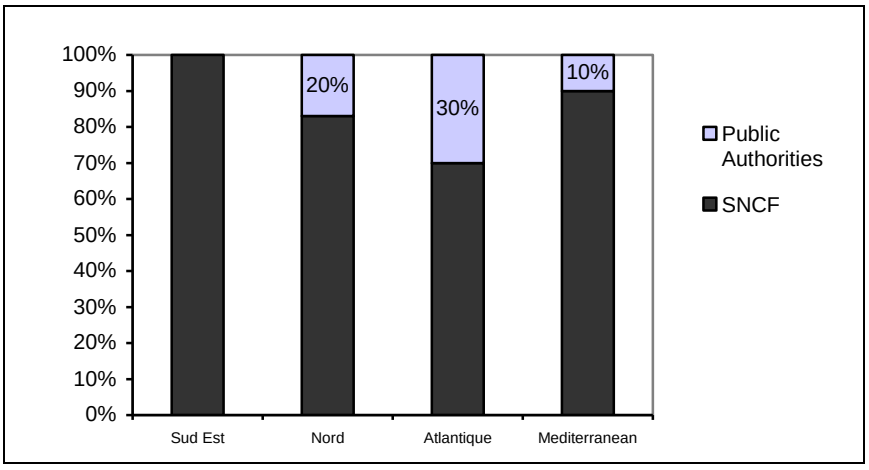
20 Campos and de Rus (2009) estimates total cost for the French TGV system to range from 4.7 to 18.8 Million euros (in 2005 prices) per kilometre for constructing lines in service by 2006, increasing to between 10 and 23 Million euros (in 2005 prices) per kilometre for projects under constructing in 2006. The main reasons for escalating construction cost are construction in more densely populated areas, as well as environmental protection regulations for noise, access, and hydrologic precautions (House of Representatives 2007)

Table 3: Financing the TGV Med

Entities	€ million (2003 prices)
Local authorities	48
EU	20
National government	416
SNCF	3 919
Total	**4 403**

Figure 3 shows the source of finance for the four major lines developed before 1997 (Alstom 2011).

Figure 3: Financing HSR projects until 1997



Additional lines were built, despite expected financial returns[21] not meeting the SNCFs minimum financial return criteria. Instead they proceeded based on other key social benefit criteria, including links to important bordering economic hubs, regional development and reduction in congestion for other transport modes (Vickerman 1997).

5.2.2 Debt combined with a range of subsidies

From 1997, all debt related to existing HSR lines was transferred to the newly established infrastructure manager, RFF (around 20 billion euros in 1997, accounting for about 60 percent of SNCFs debt) while SNCF focused on the operation of these lines (Alstom 2011; Campos and de Rus 2009; Vickerman 1997).

During this phase new HSR lines were financed as follows (RFF 2010):

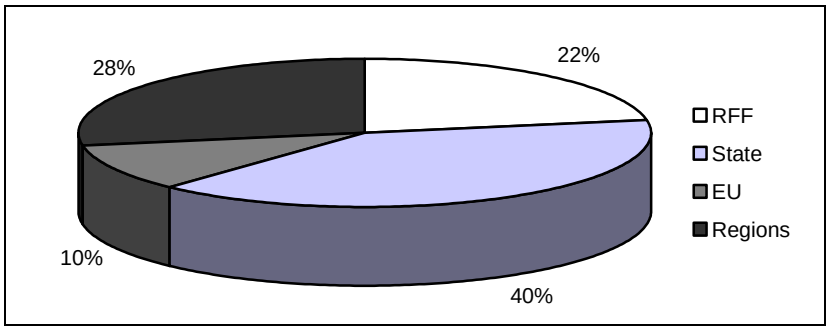
- RFF ass the sole project undertaker, and bears all risk (construction, maintenance, traffic)
- RFF debt finances a portion of full investment cost
- Financing augmented by subsidies from the French state, local authorities (including regional council, departments, and cities), other neighbouring states (e. g. Luxembourg for LGV Est) and EU contributions

21 TGV investment decisions were always based on economic project appraisals. However, these estimations were not always realised, for a range of reasons, including optimism bias related to traffic risk. This was on average overestimated by around 20 percent for HSR in France. While traffic demand for HSL Nord Europe, Interconnection IDF, Rhône Alpes and Méditerranée were overestimated, Paris Lyon and HSL Est were underestimated (RFF 2010).

During this phase, two HSR lines were constructed and financed by RFF: the LGV Est (Phase 1) which opened in 2007, followed by the LGV Rhin-Rhône (Phase 1) in 2011 (Alstom 2011). The 1997 rail reforms that led to the establishment of RFF, however, mandate a balanced budget. Therefore, investment in infrastructure (and therefore, debt financing) by RFF was limited and required subsidies by various authorities for projects that did not realise the required rate of return (Leheis 2009).

The TGV Est project appraisal estimated low financial returns, thereby prompting upfront subsidies from the State, Local authorities and the EU, while the RFF financed one quarter of the total investment cost (Leheis 2009). The TGV Est economic appraisal indicated a very low rate of return (originally estimated at four percent in financial terms, and later even lower), which led to some recasting of the project. The economic valuation for TGV Rhin-Rhône [22] was also below the required eight percent figure.. However, these projects were seen as important international links because they provide connections between some of the most dynamic regions of Europe, France, Germany and Luxembourg and serve a wide area with trains using the new infrastructure, thereby extending the market (Vickerman 1997). As a result ofthe perceived importance of these projects, the regions concerned committed to invest in the project, while the State offered guarantees (Leheis 2009). Figure 4 shows the distribution of the financing contributions for TGV East phase 1, in million euros.

Figure 4: Financing composition for TGV Est



The last line to be financed by this model was the 106- kilometre TGV Est Phase 2 (Nancy-Strasbourg), which is due for completion in 2016 at a total cost of 2 billion euros (June 2008 prices). Financing is made up as follows (Railway Gazette 2009a): RFF (26 percent); National government (34 percent); Regional and local authorities (34 percent) and EU (6 percent).

The debt was mounting in the RFF accounts, as raised by the Economist (2001, p. 63-4):

> *The real horror of French rail finances is buried in ... Réseau Ferré de France (RFF)… In the mid-1990s, SNCF as it was then constituted was going as bust as only a nationalised industry could, halfway through spending FFr300 billion on its TGV network. So the huge debts were shunted into the new state-owned company-where the grim financial picture is still tucked away. … The long-term debt inherited by RFF has risen from euro 20.7 billion four years ago to euro 22.8 billion, and there is little prospect of reducing it by much. So, over the past three years, under a programme known as "reform of reform", the company has tapped the international capital markets for loans worth euro18.5 billion, not to spend on shiny new lines but just to refinance its old debts. As a result, RFF pays interest charges amounting to euro2.4 billion a year.*

22 The total cost of the TGV Rhin-Rhône was around 2,312 million euros, made up as follows: Alsace region: 206 million euros (8.91 percent; Burgundy region: 131 million euros (5.67 percent); Other regions: 316 million euros (13.67 percent); State (AFITF) 751 million euros (32.48); RFF: 642 million euros (27.77 percent); Switzerland: 6 million euros (2.85 percent); Europe: 200 euros (8.65 percent).

At the same time, SNCF continued operating the rail system, fully financing rolling stock, with all lines apart from the TGV Est operating profitably[23]. Fares cover all costs, including modernisation. TGV Est is the exception and requires cross-subsidisation by highly profitable lines, such as TGV Sud Est, with public funding support amounting to about 76 percent (House of Representatives 2007). Since 2008, however, the RFF has started increasing access charges significantly (increasing by 40 percent between 2008 and 2012) to recover their large debt. SNCF responded with concerns about maintaining their competitiveness and threats to cancel lower ridership routes (Transport Politic 2011).

5.2.3. Public–private partnership financing models

Since the global financial crisis, there has been an increasing need to subsidise rail services in France including HSR routes. The French state, however, maintained their stance to keep public subsidies to a minimum, all the while stating their firm commitment to keep extending the HSR network (Crozet and Chassagne 2013). In order to continue development of the HSR network the French have, therefore, shifted their financing model to involve the private sector. A number of PPP financed projects are currently under development, and these are dealt with individually below

a) LGV Sud Europe Atlantique (SEA)

LGV SEA is a 300-kilometre double-track high speed passenger rail extension to LGV Atlantique and connecting Tours and Bordeaux with several connections to the existing network. It is proposed to be financed by a 50-year concession model. In other words the private partner is responsible for system availability, infrastructure quality and economic profitability. All design, construction and operation risks, including traffic risk, are borne by the private concessionaire (Alstom 2011; Ellwanger and Wilckens 1994; Railway Gazette 2009b).

The 50-year concession contracted the LISEA consortium in 2011. The total financing requirements for constructing the line amounted to 7·8 billion euros and was made up of a mix of debt and contributions, with around half coming from the French government and EU (RFF 2010; Dutzik; Scheider and Baxandall 2011)[24].

Funding of the line consists of track fees charged on trains using the corridor, all accruing to the private investor – including any profits. It was envisaged that track charges will cover 55 percent of the construction cost. In the meantime, the RFFs share of project costs (14 percent) is expected to be cross subsidised by other lines (Transport Politic 2011).

b) Perpignan – Figueres Franco-Spanish cross border link

The 44·5-kilometre Franco-Spanish cross-border HSR link is another example of a concession PPP. The line was commissioned by the national railways of France and Spain, to be operated as a joint venture, and was built by a consortium of private firms representing both nations. The concessionaire took on financial risk in the venture in exchange for permission to operate the line's infrastructure and charge tolls on every passenger and freight train that crosses the tracks at rates established in the concession agreement (Dutzik, Scheider and Baxandall 2011).

Project delays meant that the service could not start operating as anticipated, and required an extension of the concession agreement from 50 to 53 years, as well as additional

23 SNCF has made significant profits from its TGV services, which have reached 900 million euros annually in recent years, which has been applied to cross-subsidize losses on slower intercity trains and TER regional rail services (Transport Politic 2011).

24 Total financing package was estimated at 7.8 billion euros, of which capital cost was 6.2 billion euros (French railway sector's largest PPP deal to date). LISEA's contribution was 3.8 billion euros, with the remainder coming from RFF, national and local government. The European Investment Bank offered to provide 1.2 billion euros, made up of a mix of government-guaranteed and non-guaranteed loans to the consortium and the French state, plus contributions to the EU's TEN-T programme (Railway Gazette 2011c). RFF's share of construction cost amounted to 14 percent (Transport Politic 2011).

government funding to ensure the financial stability of the concession group (loan funding of 20.4 million euros in 2009, 45.9 million euros in 2010-12 as well as 62 million euros in additional support). In total, financing involved a public investment of 57 percent of project costs (Dutzik, Scheider and Baxandall 2011). The EU contributed 25 percent (69·75 million Euro) from the Trans-European Transport Network budget and cited the benefits from cross-border mobility (Railway Gazette 2011b).

c) LGV Bretagne Pays de la Loire (BPL)

The LGV BPL is a 132-kilometre high-speed line that will connect Le Mans with Rennes. The line should be completed in autumn 2016, and includes a number of public benefits. Described as a 'strategic project for western France', the new line is expected to boost transport links to the regions involved, thus improving their access to major European centres as well as releasing capacity on the existing lines for freight and improved regional passenger services. The new line is expected to provide a significant economic boost to western France, and the construction contract involved a commitment for placing more than 30 percent of the work with local companies, this will create 10,000 jobs during the construction phase. France also sees HSR as an important part of its environmental policy, and hailed the signing of the agreement as a key step in the government's commitment to develop a further 2 000 kilometre of high speed line by 2020 under the Grenelle de l'Environnement programme (Railway Gazette 2012b).

Given the expected large public benefits of this project, it was decided to finance it on the basis of a partnership model. Eiffage Rail Express (ERE) has been contracted to build the new line, together with 32 kilometres of connections to the existing network, under a 25-year PPP contract including finance and maintenance. Eiffage is also responsible for maintaining the new line for 25 years, while operational responsibility will remain with RFF. Once up and running, public payments will be paid to ERE to cover its capital investment and maintenance costs. These payments are based on an availability scheme. As a result the Public Authority effectively bears the traffic risk (Alstom 2011; Railway Gazette 2011e).

ERE will receive contributions from the local authorities and RFF during construction of the line, but will also raise 1 billion euros via a consortium of 12 banks (Railway Gazette 2011e). The main project cost is estimated at 3.3 billion euros, of which RFF is providing 1.4 billion Euro, while the balance is shared equally between the French government, local authorities, EU, European Investment Bank (552.5 million euros), and Caisse des Dépôts[25] (250 million euros over 20 years).

d) LGV Contournement Nîmes – Montpellier bypass line (CNM)

The LGV CNM is expected to open towards the end of 2017. A 25-year PPP contract covering financing and construction of the 70-kilometre mixed-traffic high speed line was signed in mid 2012. The main purpose of this line is to increase capacity for freight traffic in a semi-urban area. Similar to the LGV BPL, financing is structured as a partnership model, based on availability payments (Alstom 2011). OC'VIA, a consortium consisting of a range of construction and infrastructure companies (including Alstom) and financing partners (Meridiam Infrastructure and banking group, FIDEPPP) was selected to design, build, maintain and finance the line. RFF will also take direct responsibility for construction of stations for the first time[26] (Railway Gazette 2011b ; 2012a).

Total project cost estimation comes to 2.3 billion euros, of which the consortium will contribute 1.5 billion euros during the construction phase. Of that, 1 billion euros comes from loans from 11 commercial banks. Once construction is completed, 80 percent of the debts will be refinanced during the operations phase of the concession. Refinancing is expected to benefit from lower interest payments in view of the guaranteed RFF revenue stream. The

25 French financial organisation, government institution under control of the parliament.
26 Two new stations at Nîmes and Montpellier.

public sector, including the EU, the French government, the region of Languedoc-Roussillon, the department of Gard and the cities of Nîmes and Montpellier will contribute the remaining 0.8 billion euros (Railway Gazette 2012d).

5.3 Summary

The financing of the French HSR network has evolved from a traditional full public financing model (public tender) to a liberalised model that includes two different types of PPPs. A summary of how project risks are allocated in these three models is presented below (RFF 2010):

Table 4: French TGV financing models

Risk	Public tenders	PPP (Partnership)	Concession
Financing	RFF	Private	Private
Design/ Construction	RFF	Private	Private
Operation and Maintenance	RFF	Private	Private
Availability	RFF	Private	Private
Traffic	RFF	RFF	Private
Examples	TGV Est, Rhin- Rhône	TGV BPL	TGV SEA

However, on account of the large debts that RFF has inherited, it is still plagued with high indebtedness, which recently led to a credit ratings downgrade[27].

6. Conclusion

This paper provides a summary of the financing of the European HSR, with particular attention to the French TGV. We saw that the French invested in HSR based on economic valuations, and was willing to commit public debt if a project was deemed economically viable. The French case study is particularly interesting, not only since they are the first European country to invest in HSR, with one of the largest HSR networks, but also since the French applied a variety of financing models over time. . These models have often evolved to adjust to the external environment, which imposed changes, such as the EU debt limitations. When faced with these limitations, in line with a global move to PPP financing, the French allocated the financially viable components of lines with lower traffic risk to private parties, thereby exchanging public capital expenditure for operating expenditure. However, public investment was always required. Where traffic risk was too high, the government assumed responsibility through availability payments and refinancing. Today RFF has massive debts and requires ongoing public support. However, given the recent and ongoing nature of these PPPs, it is too early to assess the full impact of these financing models or judge its ultimate success or failure.

While the French TGV is not a perfect case study to replicate in Australia, and still grapples with serious financial issues, it presents some considerations for the financing of a potential Australian HSR:

- Investing in the most profitable portions of the HSR network first is helpful, as the success of prior projects makes financing of new projects less problematic or risky – whether private or public sector financing is involved.
- The need to match financing timeframes with the lifetime of HSR assets:

27 Moodys (2012) recently downgraded RFF's rating from to-Aa1-from-Aaa, citing excessive debt.

> *Rail projects are long-term investments, with rates of return typically calculated on the basis of a 50-year term for major schemes. Taking our three pilot projects, a contract term is envisaged for ... 30 to 60 years.*
>
> Railway Gazette 2007

- Applying different financing models to different sections, depending on the anticipated financial performance and other social considerations that emerge from a robust economic appraisal of the project (e.g. concession vs. partnership PPP models).
- Vertical separation offers an opportunity to create a more transparent division of infrastructure management, finance and operations, as well as a closer alignment between the natural monopolistic nature of the track infrastructure, as opposed to operations, which lends itself more to competition: However, it may also create inefficiencies, and requires serious consideration of incentives for optimal management of the entire system.
- Structuring and negotiating between the multiple parties involved in PPP finance structure can take much longer than pure public financing, as evidenced by the Perpignan-Figueres HSR line connecting France and Spain, for which the concession agreement took almost 5 years to finalise.

Importantly, this literature review confirmed earlier research findings that while there are well-recognised methods for establishing the economic case, as well as the delivery model for public infrastructure projects, these processes are less well articulated when it comes to the appraisal of financing methods. The authors could not find any evidence of a rigorous appraisal of alternative financing mechanisms. Instead, it appears as if financing models often emerged in response to externally imposed long-term trends in financing and fiscal policy such as the EU debt limitations associated with the Maastricht criteria and a global move to PPP financing models.

Since this phase of the research involved only a literature review, important details of the financing mechanisms employed were not able to be found n publicly available information. Important aspects that remain unanswered include:

- Details of financing mechanisms (e.g. interest rates of bonds, maturity timeframes, the impact of the Euro, inflation, etc).
- The motivations for selecting particular financing mechanisms (e.g. debt vs. grants).
- The repercussions of selecting a certain financing mechanism, e.g. were other projects shelved as a consequence and the impact of credit rating downgrades?

A mega public infrastructure project such as the East Coast HSR would require a fine grained selection mechanism of financing alternatives. The development of such an appraisal mechanism is envisaged as the next step in our research.

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Appendix A: Public–private partnership financing in European HSR

Three types of public–private partnership (PPP) schemes are evident in European HSR, with the scope of private involvement ranging significantly. European examples are discussed below.

1. Broad based PPP

- Russia (Moscow - Saint-Petersburg, 600 kilometre 20 billion Australian dollars): Russian state railways (RZD) expects to usea broad-based PPP project that covers the building of civil works, electro-mechanical, and rolling stock, as well as maintenance and operation. RZD plans to provide half of the capital cost during construction (2015-2018), followed by availability payments to the concessionaire, provided that minimum infrastructure performance criteria are met. While train operation and revenue risk will remain the responsibility of RZD, the infrastructure concessionaire will be responsible for maintenance of the line for 30 years. The private partner will also have the right to determine the number and location of any intermediate stations (Railway Gazette International 2010a; 2010b; 2011f).

2. PPP for infrastructure only

- UK – France (Channel Tunnel Rail Link): The channel tunnel was opened in 1994. When the UK and France originally agreed to build the Channel tunnel, the agreement stated that no public funds were to be used. The project was therefore structured as a Build Own Operate Transfer (BOOT) type PPP, with a long-term concession (99 years) to operate the line. Although no government finance was employed, the Railway Usage Contract (concession) that the British and French railways signed with Eurotunnel amounts to, in effect, an indirect state subsidy (Steer Davies Gleave 2004). Eurotunnel, a consortium of civil contractors and financiers was formed to raise finance, develop and operate the line (Flyvbjerg, Buzelius and Rothengatter 2003). The tunnel was financed partly from investment by shareholders and partly from shareholder debt[28]. The project has experienced a number of ups and downs, including significant cost overruns (Flyvbjerg; Buzelius and Rothengatter 2003; Wilson and Spick 1994)
- UK (High Speed 1 (HS1)): HS1 followed after the opening of the Eurotunnel, and was constructed at a cost of 5.8 billion pounds. The line was built by a consortium called London and Continental Railways (LCR), which financed the project by selling government-backed bonds. The project has experienced a number of ups and downs, with shareholding changing over time. Today, the 30 year concession to operate and maintain the infrastructure belongs to a consortium of Canadian pension funds, while ownership of infrastructure and the freehold to the land remains vested with the state (BBC News Online 2010). At the end of the concession period all rights will revert to the government. HS1 receives revenues from track access charges sold on a commercial basis. (Railway Gazette 2010c). Those proposing an HSR line between London and the West Midlands (High Speed 2 or HS2) is also considering some form of PPP financing. The project is estimated to cost around 50 billion pounds, including rolling stock (Parker and Pickard 2013).
- Spain[29] (Olmedo – Ourense; 344 kilometres; 65 billion euros) and Madrid - Badajoz (450 kilometres; 4 billion euros): This PPP covers infrastructure only (civil works, electro

28 Private finance for this project was of unprecedented scale. CTG/F-M raised an initial equity of 45 million pounds, increased by 206 million pounds private institutional placement, A further 770 million pounds was raised in a public share offer that included press and television advertisements, a syndicated bank loan and letter of credit added another 5 billion pounds, all amounting to total investment costs at 1985 prices of 2,600 million pounds (Wilson and Spick 1994). At completion in 1994 actual costs were 4,650 million pounds (in 1985 prices), an 80 percent cost overrun owing to a combination of factors, including expanding safety, security, and environmental demands by regulators (Flyvbjerg, Buzelius and Rothengatter 2003).

29 HSR was regarded as a way to enable rail to compete with other modes, as well as encouraging regional economic development. The first line, Madrid-Seville, was built to serve the International Exhibition in Seville in 1992. Subsequent

mechanical, construction, 25-year maintenance contract) and excludes rolling stock and operations (Alstom 2011). Private partners are also partly responsible for finance. Projects are to be executed by a special-purpose vehicle (SPV) with the state-owned infrastructure manager ADIF owning a minority share (ten percent). ADIF is to provide 40 percent of total project cost during the construction phase, with the remainder raised through long-term debt, while availability payments will be made over the 25-year maintenance period (Railway Gazette 2011a; 2011d; 2012c).

3. PPP for superstructure only

- Netherlands – Belgium High-Speed Line South (HSL South): This Design, Built, Maintain and Finance (DBMF) concession is the Netherland's largest PPP project to date and involves a long term infrastructure capacity concession (Crozet 2012; Prorail 2008; Van de Velde and Heuvelhof 2008) for superstructure only (construction and maintenance of electromechanical aspects - track, signalling and electricity - only). Underground track was built the traditional way, with several engineering contracts, paid by the state directly. The PPP involves a multitude of parties and represents an extreme form of splitting up of the production chain into individual contracts, both vertical and horizontal as depicted in Table 2 (Prorail 2008; Van de Velde and Heuvelhof 2008). The project has experienced significant delays and cost overruns[30].

Table 2: PPP Parties

Party	PPP Role
Ministry of Transport and Public Works -	Commissioning body
Project Organisation Rijkswaterstaat HSL-Zuid	Overall project manager
ProRail[31]	Manages contract between Infraspeed and government, responsible for capacity, reliability and safety.
Various contractors (consortia)	Civil works: Design and construction of substructure (concrete foundations).
Infraspeed[32]	Track concessionaire: Design, construction, financing, operate and maintain superstructure[33] for a period of 25 years. Paid by the state for the realised availability of track[34]. Track concessionaire has no commercial responsibility for the usage of the track capacity.
HSA (High Speed Alliance)[35]	Transport concessionaire: 15-year concession for provision and operation of a minimum required number of train services on a commercial basis (i.e. no subsidy). Concessionaire owns trains and has to pay state an infrastructure usage charge for right to use the track. This charge was maximised in a competitive tendering process.

A number of HSR PPPs were also recently cancelled, these are discussed below:

construction of a whole network of lines was encouraged by Keynesian policies so as to relieve large-scale unemployment by a major public works programme (Nash 2008).

30 A range of problems (illegal collusion among bidders for the construction contracts, poor coordination among the various contracts, and unexpected delays) led to massive cost overruns in the construction of the line, most of which became the responsibility of the government (Dutzik, Scheider and Baxandall 2011; Van de Velde and Heuvelhof 2008)

31 Dutch government rail infrastructure manager

32 Consortium composed of construction companies and institutional investors (Fluor Infrastructure, Siemens Netherlands, Koninklijke BAM Groep, Innisfree and HSBC Infrastructure) (Van de Velde and Heuvelhof 2008; Prorail 2008).

33 Including rails, overhead wire system, power supply and safety and communication system) (Prorail 2008, Van de Velde and Heuvelhof 2008)

34 Infraspeed receives revenue from the Dutch State, which is determined on the basis of agreed levels of daily availability performance, and independent of the level of traffic. These payments cover the financing, operating and maintenance cost, taxes and the returns on shareholder investment.

35 Contract awarded in competition to consortium composed of NS (state-owned Dutch national railway, owns 90 percent) and ten percent is owned by Air France-KLM (Van de Velde and Heuvelhof 2008; Dutzik, Scheider and Baxandall 2011).

- Portugal (Poceirão to Caia; 180 kilometres; 1.6 billion euros). This was supposed to be Portugal's first HSR PPP project, and also the country's largest PPP for its first HSR line (EPEC 2010). The PPP project was split into sections of line ranging from around 100-300 kilometre , and individuals contracts worth around 2 to 4 billion pounds (HS2 2009). Concessionaires were expected to contribute 49 percent of total project construction cost, while infrastructure manager Refer would add 3 percent and the Portuguese government 7 percent. The remaining 41 percent would come from EU funds, including 197 million euros from the TEN-T programme. Annual maintenance costs were estimated at 12.2 million euros. The state contribution was expecting to pay 41 million euros per year over the expected 35-year operating period (Railway Gazette International 2009c; 2010c; 2012b). The PPP gained momentum in 2010, with the award of the first section of a long term concession contract to ELOS consortium. However, Portugal's HSR plans were abandoned in 2011, following legal irregularities in the midst of a devastating financial crisis (McKenna 2011).
- Poland (Varsovie, Lodz, Kalisz-Ostrowska, Wrocław and Poznań; 450 kilometre; 7 billion euros). This proposed project was cancelled in 2011 owing to insufficient funding from the EU.