PPPs in the rail sector - A review of 27 projects

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– WORKING PAPER –

Abstract

PPPs in the rail sector have become increasingly common in the last two decades. They have been praised and criticized for a variety of reasons. This paper provides a comprehensive study of all rail PPPs to date, in order to observe long term trends and to quantify to potential of failure or success of such PPPs. Our key finding is that optimization of risk management explains two major trends : (i) projects are moving from integrated, stand-alone systems toward sub-systems with complex interfaces with other networks or sub-systems, (ii) moral hazard, incomplete contracts and strategic bahaviors create an incentive for concessionaires to make over-optimistic ridership forecasts and explain why most traffic-based concessions failed.

1. Introduction

Over the last 25 years, 27 public-private partnerships (PPPs) have been awarded in the rail sector. Rail PPPs however are controversial. Some argue that they allowed to fund and build projects that otherwise would have been impossible to launch, or that they fostered innovative systems. Others think that PPPs are a costly way to bypass budget constraints that cost more to the taxpayer at the end of the day.

The objective of this paper is to conduct the first comprehensive review of all rail PPPs in order to reach conclusions on the conditions of success of rail PPPs, based on quantitative evidence. More precisely, we will focus on three specific questions: what are the common features and the differences among rail PPPs and how did they evolve in the last two decades? What are the specific features of rail PPPs compared to other PPPs? Why do so many PPPs fail and need public support, especially among traffic-based concessions?

In this paper, we restrict our analysis to public-private partnerships in the rail sector that include significant investment by concessionaires. We thus exclude other modes of public transportation like light rail, metro, people movers, as well as a wide variety of other kinds of public-private arrangements like operating concessions, divesture, joint ventures, private infrastructure, etc.

This paper is structured as follows. Section 2 describes the current situation of PPPs in the rail sector and the diversity in scope and risk sharing among them. A comprehensive list of rail PPPs and their main features is provided in an appendix to this paper. Section 3 provides an analysis of the outcomes and the specific risks of rail PPPs. Sections 4 focuses on traffic-based concessions and demonstrates that those should best be avoided.

2. Experience with rail PPPs to date

There is no definitive and precise definition of rail PPPs. The scope of this study is restricted to those projects that meet the following conditions:

- a contract is awarded or signed between a public entity (referred to as public authority) and a private company (referred to as concessionaire) for the design, construction, operation and maintenance of a specific material asset,
- the asset is a conventional rail system (including high-speed rail) or any sub-system (track, signalling, rolling stock, etc.), excluding light rail, metro, people movers,
- after contract's termination, the public authority retains ownership ot the asset,
- the concessionaire is in charge of the funding of the asset, including debt and equity, but may receive initial subsidies or ongoing fees from the public authority over the asset's lifetime,
- the concessionaire is bearing risks related to construction, financing, operation and maintenance costs, but may or may not bear risks related to commercial revenues.

To date, we counted 27 rail PPPs in the world, out of which 16 are located in Europe[2]**.**

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Such PPPs are just some of the many existing public-private arrangements, in which public authorities transfer some responsibilities to private entities for the construction or operation of a system. Other public-private arrangements include **privatization** (such as the British Railtrack, Japan National Railway or Canadian National), **joint ventures** (such as Russia's Aeroexpress or Japan's Sendai Air Link), **transport franchises** (such as UK's TOCs, or Netherlands' High Speed Alliance), **integrated operation concessions** (such as Latin America's freight networks), **rolling stock companies** (such as UK's ROSCOs), **public concessionaires** (such as Flytoget in Norway) or **private projects with public regulation** (such as Heathrow Express or Australia's freight lines). In addition to these rail projects, there is considerable experience throughout the world in urban rail (e.g. metro, light rail, people movers) public private arrangements (Phang, 2009). In 1988, Orlyval was the first PPP in urban rail.

(2.1) Overview of rail PPPs

PPPs have been used to build, finance, operate and maintain four types of rail projects:

- **airport rail links (ARL):** (7 PPPs) projects typically include not only the construction and operation of the infrastructure, but also the operation of the dedicated trains that run between city centers and airports. In all but one cases (*Delhi ARL*), PPP trains run on pre-existing conventional networks for part of their trips;
- **high speed lines:** (9 PPPs) 8 of them are in Europe and are infrastructure-only projects that connect on both ends with conventional networks, with open access to train operators. *Taiwan HSR* is the only non European HS PPP, it is an integrated project (infrastructure and train operation) with no connection to conventional lines;
- **equipments / rolling stock:** (4 PPPs) PPPs may be well suited for the construction and maintenance of specific equipments in order to optimize their lifecycle costs, such as signalling (GSM-R), power supply and train control (*Alb.-Alicante*) or rolling stock (*Waratah*, *IEP*);
- **conventional lines:** (7 PPPs) in relatively few cases, PPPs may be used for the construction and operation of conventional systems. Such projects are usually less technically complex but PPPs can add value because of single ownership on cross-border projects (*Eurotunnel*, *Perp.-Figueres*), of increased flexibility for freight corridors (*Adel.-Darwin*, *Liefkenshoek*) or of lack of public expertise in certain markets (*Gautrain*, *Denver Eagle*).

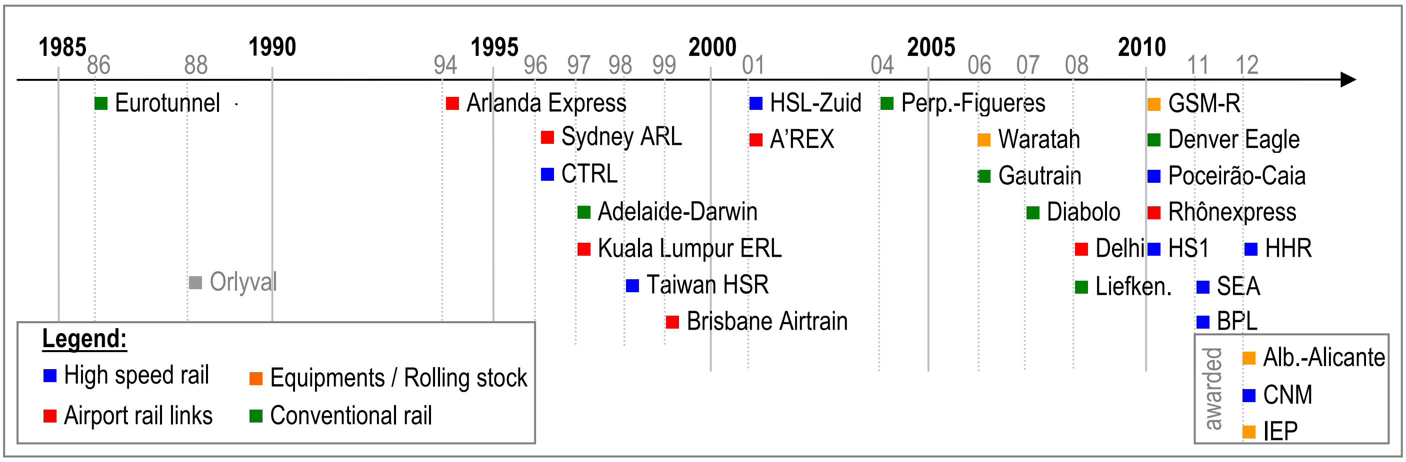

Figure 1 : Rail PPPs by signing year and type

(2.2) Long term trends.

In the previous section, we have seen that rail PPPs can be used for a variety of different rail projects, but most notably for high speed rail and airport rail links. When attempting to describe rail PPPs, three additional criteria can be used to classify existing projects:

- **interfacing:** stand-alone "all included" projects v. interlocked "parts of a larger system" projects
- **operation:** infrastructure/asset only v. integrated infrastructure/asset and train operation
- **commercial risk:** availability-based concessions v. traffic-based concessions.

In light of these criteria, three trends can be observed: from independent comprehensive toward interlocked sub-systems projects, from integrated toward asset-only projects, from traffic-based toward availability-based concessions.

[2] For the sake of comprehensiveness: PPPs have also been used for infrastructure rehabilitation, maintenance and operation projects in heavy rail (Chile, Mozambique) and metro (London underground). However such PPPs usually involve more limited amounts of investments and the issues related are very different from that of the large systems listed above. They have therefore not been included in our sample.

- **From independent comprehensive projects toward interlocked sub-systems projects**

There was a **shift from technically innovative stand-alone projects** that had a well defined object and were not to be used by pre-existing conventional trains **towards projects that are more and more integrated with the existing system**. Before 2004, all but two projects (*Eurotunnel*, *Adel.-Darwin*) were either HS lines in countries with no prior HSR experience or airport rail links. From 2004 on however, there started to be more projects on the conventional network and that are closely intertwined with pre-existing operations, especially equipment PPPs (*GSM-R*, *Alb.-Alicante*), rolling stock PPPs (*Waratah*, *IEP*) or brownfield concessions (*HS1* in the UK).

Initially, PPPs have been mostly used for two types of rail projects : **high speed rail** and **airport rail links**. One of the reasons is that these projects have relatively less interfaces with the rest of the system and are the most "independent" parts within the rail network.

- **From integrated toward asset-only projects**

Originally, **most rail PPPs were integrated concessions**, e.g. the concessionaire builds an infrastructure and operates the trains on it for a given number of years. This is the case in all airport links, in all rail PPPs outside Europe except *Waratah*, and with *Eurotunnel*. However **asset-only PPPs are an increasingly common feature**.

	integrated	asset-only[3]	total
1985 – 2005	9	2	**11**
2005 – 2012	4	12	**16**

Table 1: Number of integrated and asset-only PPPs

Infrastructure-only PPPs are frequent in Europe but nowhere else in the world due to European directive 91/440/EC which imposes separation between infrastructure and transport operations in railways. Airport express traffic-based concessions are the exception to this general rule (with the provision however that concessionaires must allow for third-party access).

- **From traffic-based toward availability-based concessions**

Over time, there was a **similar move from traffic-based towards availability-based concessions**. These PPPs differ in the following way:

- **in availability-based concessions, the public authority retains the commercial risk**: it perceives commercial revenue (either access charges or lease fees for asset-only PPPs,or farebox revenue for integrated PPPs) but makes payments to the concessionaire based on performance indicators.
- **in traffic-based concessions, the concessionaire receives commercial revenue** (access charges or farebox revenue) and does not receive payments from the public authority during operating years.

Availability-based concessions are more recent and they are still a minority. However, they are currently gaining broader acceptance, which can be explained in part by the poor record of concessionaires holding the commercial risk in traffic based concessions. In the case of airport rail links, traffic-based concessions are mostly used. In the case of HS lines, availability-based are most frequently used (with a few exceptions).

Many traffic-based concessions offer commercial risk sharing mechanisms, for instance with the concessionaire retaining all the risk within a given range and the risk shared out of this range or with a given share of commercial revenue being paid to public authorities (*Eurotunnel*, *Sydney ARL*, *Brisbane ARL*, *Seoul ARL*).

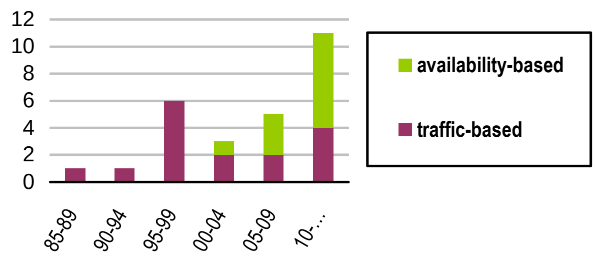

Figure 2: Number of availability and traffic-based PPPs

Rail PPPs can thus be classified in the following table:

[3] including rolling stock and equipment PPPs (*GSM-R*, *Waratah*....)

	◀ private	Commercial risk	public ▶
integrated (infrastruct. + transport)	**airport express** Arlanda, Lyon, Delhi, Kuala Lumpur, Brisbane, Sydney, Seoul **Taiwan HSR** **Gautrain, HHR** **Adel.-Darwin**	**Eurotunnel**	**Denver Eagle**
infrastructure only	**SEA, Perp-Figueres** **CTRL, HS1**		**CNM, BPL, HSL-Zuid** **Diabolo, Liefk., Poc.-Caia**
equipment & rolling stock			**GSM-R, Alb.-Alicante** **Waratah,**
other public private arrangements (examples)	**HSA** (NL) **operating concessions** (Argentina, Brazil)	**UK rail franchises** long distance	commuter **UK ROSCOs**

Figure 3 : Classification of rail PPPs

3. What are the specific features of rail PPPs?

(3.1) Most PPPs were major technical and operational successes.

The first conclusion of experience is that **rail PPPs work**: once the contracts had been signed, all but two (*CTRL*, *Po.-Caia*) projects have been delivered. Not all of them were delivered within scope, time and budget, but only two PPP projects failed prior to their commissioning. Thus from a technical perspective, rail PPPs have mostly been successes[4].

One of the reasons for this overall technical success of rail PPPs may be that contracts are usually signed at a late stage in the design process of the projects. By that time, technical feasibility is no longer in question and many risks have already been mitigated. Some projects that are not “ready” may fail in the final negotiation phase prior to contract signing (like *Paris CDG Express* and *Toronto ARL*). In such case, negotiation failure during the closing process leads to PPPs being called off and creates major delays in project delivery.

It happens sometimes that public authorities and public opinion have high expectations about PPPs, thinking that they will be able to solve the defects of flawed projects, particularly so with financial defects. There may be expectations (i) that a PPP will reduce the cost of a given project or (ii) that it will create additional resources that will lower the price to the taxpayer. Such expectations never materialized in the case of rail PPPs.

(3.2) PPPs do not create additional resources.

Very few railways in the world are financially self-sustainable and there are little reasons why things should be different for PPP projects. **PPPs alone do not create value**. At the end of the day, there are only two sources for financing: customers (passengers / shippers) and taxpayers (e.g.p ublic authorities). There is no reason why a PPP would affect the customer – taxpayer split in the financing of a project. What a PPP can do is reduce the cost of a project by optimizing its design and management and reduce the amount of debt that is borrowed by public authorities. But it can hardly generate additional customer revenue.

What a PPP does is prefinance a project by monetizing future costs or revenues: it transfers debt from public to private hands (e.g. assets and liabilities), but taxpayers will ultimately have to repay the same amount of debt (with only marginal differences). So, whatever the public authority is “saving” by construction time will have to be paid anyway during the operation period.

Private funding however does not have the same meaning in availability-based and traffic-based concessions. In availability-based concessions, it is the net present value of future availability payments that the public authority should be paying to the concessionaires. In traffic-based concessions, it is the net present value of future commercial revenue paid by end clients (access charges in infrastructure-only PPPs, farebox revenue in integrated PPPs). Thus even in traffic-based concessions, private funding is not creating additional sources of revenue compared to public provision: the public authority would have collected these fees anyway and used them to repay its debts.

[4] Although the commissionning of *HSL Zuid* was delayed by more than three years due to technical difficulties with ETCS.

In road or airport infrastructures, traffic-based concessions very often allow an infrastructure to be totally financed by the private sector. This is a major difference with rail, where few – if any – projects mange to be profitable without public subsidies. **Rail sector has always had very low self-financing rates and there is no reason why PPPs would change this.** In the case of *SEA* for instance, the private sector is only bringing 32 % of the total investment cost (and less than 15% if one excludes public guarantee benefiting debts) – but even these 32 % are not a net benefit of a PPP as compared to a public project: they are only the (very optimistic) capitalized value of future fees that would have been collected even in a public project (Coux, 2012).

Some traffic-based concessions however were initially supposed to be completely privately financed, without any public subsidy, e.g. with access charges or farebox revenue recouping both operation and construction costs (*Eurotunnel*, *CTRL*, *Sydney ARL*, *Taiwan HSR*, *KL ERL* and *CDG Express*). In none of these cases however did that intent succeed. Each time, public authorities had to provide direct financial support either by bailout (*CTRL*, *Taiwan HSR*, *Sydney ARL*), paying a substantial revenue guarantee (*Eurotunnel*) or a loan guarantee (*KL ERL*), making right-of-way available (*KL ERL*) or cancelling the project (*CDG Express*).

Therefore, **actual share of public funding in traffic-based concessions are usually higher than 50%**, as Table 2 indicates. *Eurotunnel* and *KL ERL* are the two major exceptions (although Eurotunnel resulted in major liability restructurings where financiers lost most of their investment).

project	%
Perp.-Figueres	57 %
SEA	68 %
Delhi ARL	50 %
Adel.-Darwin	57 %
Sydney ARL	(0%) 80%
Taiwan HSR	(0%) 84%

Table 2: Public funding in selected traffic-based concessions[5]

(3.3) There is no evidence that PPPs are better value-for-money than public projects.

One of the most important reasons for a public tender to chose a PPP rather than a public procurement is that PPPs are supposed to reduce lifecycle costs of a rail system. However:

- financing costs are higher in the case of a PPP since interest rates on private debt are higher than on public debt and equity shareholder have to be rewarded for their risk taking;
- transaction costs (consultants, tendering) are much higher in the case of PPPs;
- additional delays are needed in the first phases of the project, both to organize the tendering process and in the final negotiation/closing phase (which can last up to a year as in the case of *GSM-R*).

Most countries perform *ex ante* value for money assessments of both public and PPP options in order to justify their choice. Many however estimate that such *ex ante* assessment are biased since they are usually launched once the decision has already been made to use a PPP. In France for instance, the decision to launch 4 rail PPPs was announced by the Government in 2005, while the first *ex ante* value comparison was performed in 2006. Therefore these *ex ante* assessments can hardly be considered reliable estimates of public *v.* PPP value comparisons.

Ex post comparisons are neither systematically performed nor exact science. Those performed for PPPs in general (i.e.: not only rail PPPs) tend to show that **PPPs are more likely than public projects to be delivered within time and budget**: in Great-Britain for instance it was shown that among 500 PPPs 69% had been delivered within time and 65% within budget (NAO, 2009). Such studies however compare actual and contracted timetables. Our review shows that delays and cost overruns (mostly in financing of project) are likely to appear during the negotiation period between contract award and closing, as this has been observed in several rail PPPs.

Many projects for which *ex ante* assessments showed PPP would deliver the best value for money found themselves in a very different situation at the time of contract closing. **Financial crises especially have a strong impact on financial costs of PPPs** and on their value for money. In many cases interest rates were much higher at financial close than they were expected to be, thus raising the total cost of the PPP for the public authority or reducing its profitability for the concessionaire (depending on the risk allocation) : this has been the case with the Asian crisis of 1997 (*Taiwan HSR*, *KL ERL*) and with the global crisis of 2008 (*GSM-R*, *Po.-Caia*). However ultimately, most of the global economical risk actually lays on the public side:

[5] Brakets: share of public funding as of inital contractual agreement.

- in the case of *Taiwan HSR*, the contract was closed already when the crisis hit and the concessionaire was supposed to bear all the interest rates risk. This however led it to near bankruptcy, which in turn led the public side to step in and actually take most of the cost of the crisis;
- in the case of *KL ERL*, *GSM-R* and *Po.-Caia*, the crisis hit prior to contract closing and there was thus enough flexibility for the public tender to take that risk and not jeopardize the PPP.

(3.4) Some risks are specific to rail PPPs.

Many reviews provide a clear discussion on risk sharing mechanisms in PPPs or transport PPPs. Some risks however are specific to rail PPPs and help explain why they may be more complex or have a poorer record than other PPPs. The main source of this section is the Painvin (2010) review, in which risks are categorized into three groups:

politics	complexity	commercial
- lengthy decisions processes may cause scope deviations - failure to execute / interference by public authority - "political entrepreneur syndrome" - public and market acceptance - involvement in incumbent train operating company - quality of legal and institutional framework	- long and complex completion phase - technical intensity: proven technologies but complex integration: ↳ structures and ground conditions ↳ interaction of a variety of systems ↳ safety ↳ technical interfaces ↳ functional interfaces	- revenue structure - demand forecast

Table 3: Main causes of failures of rail PPPs (source : Painvin, 2010)

- **Political risk**

Political risk is very high for rail PPPs since public authorities are involved in many possibly conflicting ways in the rail sector : regulation definition, funding, infrastructure and incumbent train operating company ownership, definition of public service obligations, transport planning. This political risk can materialize in several aspects :

- lengthy decision processes and scope deviations (*Eurotunnel*: safety regulations were reinforced during construction, leading to massive cost overruns with no compensation),
- failure to execute or interference, when public authorities fail to ensure that the conditions are met for efficient performance (*Perp.-Figueres*: no connection to the Spanish HSR in the first years after opening),
- "political entrepreneur syndrome" (*Po.-Caia*: Government launched an impressive HSR PPP program with poor economic justification and had to stop the project when financial crisis hit),
- public and market acceptance (NIMBY syndrome risk that could delay or alter the project),
- involvement in incumbent train operating companies: a Government may impose conditions in a PPP that favor its own TOC, for instance when setting the access charges or allocating security costs. Or, on the other hand, a Government may transfer some risks to its operator in order to "help" the concessionaire and avoid any failure of the PPP[6].

- **Complexity related risk**

Rail networks are very complex systems due to the lack of flexibility of traffic managemet, to high security constraints and to long lifecycles. **PPPs may add organizational complexity to technical complexity** when PPP and conventional networks are interlocked, especially for infrastructure-only PPPs. In the case of *HSL Zuid*, the superstructure (track, energy, signalling) PPP was awarded before civil works were completed, before signalling technology was even ready (ERTMS) and before the first trainset had been running anywhere in the world. With all these three elements accumulating delays and cost overruns, the Government was locked in a PPP with no flexibitility and an extremely complex contractual setting which proved very costly.

In such complex systems, PPPs bring rigidity. The shortest PPPs have only a 15-year duration (*GSM-R*) but most PPPs have a 30-year or longer duration. This means that contractual conditions and interfaces with the rest of the rail system can not significantly be altered over that period of time. This is a very long time in any industry, since it is quite hard to predict what technical, political, financial conditions will prevail in 30 years from now. This rigidity has both its pros and cons :

- it provides long term visibility and previsibility while the rail sector currently often has to deal with short term and erratic policy decisions. This is the case for instance of the HSL PPPs in France: the Government and

[6] France appeared to be in the later case when access charges when set on *SEA* or when the Government tried every trick in the box in order to transfert risks from the concessionaire to SNCF in a failed attempt to make *CDG Express* happen.

RFF, its rail infrastructure manager, have never managed to provide train operators with predictable future access rates, with ad hoc raises being decided on a yearly basis. In the case of the *SEA* however, the contract sets a charging ceiling for the next 45 years and thus provides some visibility to the HST operators (though SNCF has been publicly complaining that this contractual ceiling is inconsistent with traffic forecasts);

- in Portugal however, this rigidity may come with a high price to the public sector since it may now be forced to pay high penalties to private firms should it decide to cancel the first awarded PPP (*Po. – Caia*);
- from a technical perspective, PPPs contribute to the fragmentation of rail networks, hence the risk of non homogeneity of railway technology. Railway lifecycles are very long and there is a high probability that safety regulations or technical standards will change over the lifetime of a PPP, which will bring additional complexity in the management of contracts.

- **Commercial risk**

Finally, commercial risks in rail PPPs deserve a close analysis, which the next section is an attempt to outline.

4. Transferring traffic risk to the private sector proved costly in most cases.

In the previous sections, we made little differences between availability and traffic-based concessions, and most of the risks we identified work are similar in both types of concessions. Traffic-based concessions however deserve a closer look since they seem to have a significantly worse record than availability-based concessions.

(4.1) Public authorities had to step in most traffic-based concessions

The main difference between availability-based and traffic-based concessions is the fact that the demand risk is borne by the public authority in availability-based concessions and by the concessionaire in traffic-based ones. Evidence suggests that this difference has a big impact of the likelihood for a PPP to fail or succeed. Indeed, it appears that most traffic-based rail concessions have been financial failures.

To date, we counted 14 traffic-based concessions where contracts were awarded and signed. These concessions were grouped into three categories: those in which public authorities had to intervene, in order to rescue the project, those where financiers faced important losses but public authorities did not intervene, and those which haven't failed[7]. We also distinguish the mature concessions (with more than 2 years of operation) from the projects under construction or those recently opened.

	in operation (> 2 years)	in operation (< 2 years)	under construction
rescued PPPs	Sydney ARL, CTRL, Seoul ARL, Taiwan HSR		
troubled PPPs	Eurotunnel, Adel.-Darwin, Brisbane ARL	Perp.-Figueres	
no failure	Kuala Lumpur ERL, Arlanda Express	Gautrain, Rhônexpress, Delhi ARL	SEA, HHR

Table 4 : Failures of traffic-based concessions

Among the mature concessions, five PPPs had to have public authorities step in and effectively transform the PPPs into public projects or companies:

- *Sydney ARL*: on the fist year of operation (2000), the concessionaire defaulted on its loans and the New South Wales Government had to bail out the project;
- *CTRL*: two years after construction started (1998), banks refused to lend more money to the concessionaire and the Government had to rescue the project by virtually nationalizing the PPP and transforming it into design-build contract;
- *Seoul ARL*: after two years of operation (2009), as actual ridership was only 8% of forecast, the Government asked Korail, the national rail operator, to buy 88.8% of the project shares without any further change in the concession contract, thus nationalizing the PPP;
- *Taiwan HSR*: after two years of operation (2009), the Government took over the management of the concessionaire. This was the final step of the share increase of direct and indirect public financing of the project (0% in 1998, 37% in 2005, 84% in 2009) in order to offset the very high interest loans on private debt.

In three other mature PPPs, investors and lenders faced big financial losses but the contract hold and the PPP did not have to be rescued by public authorities:

- *Eurotunnel*: due primarily to traffic overestimates and construction cost increases, liabilities had to be restructured in 1997 and 2007, with investors and lenders losing more than two thirds of their investment. The concession also benefited from public support via the extension of the concession duration from 55 to 99

[7] Although it is formally a traffic-based concession, *HS1* is not included in this analysis because it is a borwnfield concession, where traffic risk is limited compared to greenfield traffic-based concessions.

years and through the “minimum usage charge”, a minimal revenue guarantee whose cost was ultimately borne by the French national railways (SNCF) and the British Government;
- *Adelaide-Darwin*: after four years of operation (2008), due to ridership overestimates, the concessionaire was placed into receivership, had its liabilities restructured and some debts written off, and was sold to a new investor. Initial financiers recouped only A$ 334m out of the approx. A$ 900m they put in the project;
- *Brisbane AirTrain*: after two years of operation (2003), due to ridership overestimates, the concessionaire was placed into administration, had most of its debt written off (effectively cutting total costs by half).

In the last two cases (Kuala Lumpur ARL, Arlanda Express), the PPP did not fail, even though ridership was below expectations. This success however was achieved after final negotiations forced the public authorities to increase their support above initial expectations, including in both cases providing low interests loans to the concessionaires with long grace periods (more than 10 years):
- *Kuala Lumpur ARL*: the PPP was initially not supposed to receive any public funding. However, mostly due to the Asian financial crisis that hit by contract closing time (1997), the Government had to grant the concessionaire the necessary right-of-way and debt came from Malaysian and German development banks at extremely favourable conditions and guarantees;
- *Arlanda Express*: as a result of final negotiations, besides direct grants, two thirds of the PPP financing (2.8 out of SEK 4.2bn) came from low interest State or public bank loans, in addition to public guarantees on rolling stock loans and deferred station access charges. Thus most of the risks of the PPP were actually transferred back to the public side even prior to signing of the contract – thus reducing significantly the likelihood for the PPP to fail.

It is still too early to comment on the concessions that have opened in the last 2 years (*Gautrain*, *Lyon ARL*, *Delhi ARL*, *Perp.-Figueres*) since they are still going through the ridesrship ramp-up period. However, renegotiation already happened in the case of *Perp.-Figueres* due to the 3-year delay in the opening of the Figueres-Barcelona rail link (which practically reduces to 0 the traffic on the PPP) and the Spanish Government agreed to grant an additional € 108m to the concessionaire and to extend the concession duration from 50 to 53 years. Despite this, further trouble is to be expected on that PPP due to the sharp decrease in freight traffic in France, in strong contrast with the overall assumptions ot the PPP’s business plan.

It is still more difficult to comment on PPPs that are still in the construction phase (*SEA*, *HHR*). In the case of *SEA* however, given the high level of access charges (likely to be the highest in Europe), traffic forecast are very risky and some sort of public support after commissioning appears likely.

We draw from this analysis that, out of the 14 existing traffic-based rail concessions, including 9 with more than 2 years of operation, 7 had to receive public support or have most of their debt written off, 2 benefit from very extensive public guarantees (*Kuala Lumpur*, *Arlanda*)**, 2 will likely call for public support in the first years of operation** (*Perp.-Figueres*, *SEA*)**.**

(4.2) Traffic over-estimation is a common feature of traffic-based concessions.

The main reason behind all the PPP failures listed in the previous section is the discrepancy between actual and forecasted traffic. This phenomenon has been widely studied and some call it the “winner’s curse”, a dynamics wherein winners of the bidding process become losers by miscalculating the value of a purchase made in a common value auction.

Data is not systematically collected but the following table compares available figures of discrepancies between concessionaire forecasts by the time of PPP contract signing with actual ridership.

project	actual *v.* forecast	year (years of operation)
Arlanda Express	- 25 %	2005 (6)
Orlyval	- 71 % - 55 %	1992 (1) 2000 (9)
Seoul A'REX	- 70 %	2011 (4)
Kuala Lumpur ERL	- 80 % - 65 %	2003 (2) 2010 (9)
Brisbane Airtrain	- 88 % - 68 %	2001 (1) 2010 (10)
Sydney ARL	- 66 %	2005 (6)
Eurotunnel	- 63 %	2003 (9)
Delhi ARL	- 53 %	2011 (1)
Taiwan HSR	- 55 %	2010 (7)

Table 5: Ridership shortfall in traffic-based concessions[8]

Traffic overestimation is not a specific feature of PPPs: Flyvbjerg (2006) estimates 72% of rail projects have actual traffic more than 40% below forecast and 84% more than 20% below forecast. The discrepancy between actual and forecasted figures however seems even higher that in the case of 100 percent publicly funded projects. And there is something different about PPPs: financiers are betting their own money and hence should have an incentive to do conservative forecasts, whereas public authorities really have no such incentive in publicly owned projects.

According to Dutzik (2011), there are mostly four reasons why the private sector has a poor record at holding commercial risk :

- ramp-up period are usually underestimated : ridership does not reach its steady state immediatly after opening and it takes up to 5 years to build up ridership (*Orlyval*, *Sydney ARL*);
- financing (eg interest rates and maturity) and rosy projections tailored for short term expectations on profitability, which raises the risks in the first years,
- HSL are often opened half-finished (cf *CTRL*, Korea's KTX, *Taiwan HSR*, *HSL-Zuid*), and are completed in the next years : this can be for political reasons (*CTRL*), financial reasons or technical reasons (*HSL-Zuid* : delay in the certification of ERTMS signaling);
- there is a tendency to raise ticket prices (or access charges) when ridership falls short of projections (*Arlanda Express*, *Sydney ARL*).

Traffic-based concessions however are not a rare feature in transport infrastructure: airport, port or road PPPs commonly allocate traffic risk to the concessionaire. The question then is: why do most traffic-based rail concessions fail because of bad traffic forecasts? In our view, there are two groups of reasons: (i) traffic risk is intrinsically very high in rail PPPs and very hard to mitigate; and (ii) investors bet on the fact that risk sharing between public and private sides will evolve over the contract's lifetime.

(4.3) Traffic risk in rail PPPs is both high and hard to mitigate.

Traffic overstimation is not a specificity of PPPs: Flyvbjerg (2006) estimates 72% of rail projects have actual traffic more than 40% below forecast and 84% more than 20% below forecast. One might think that overestimations are less common in traffic-based concessions, since financiers are betting their own money and hence should have an incentive to do conservative forecasts, whereas public authorities really have no such incentive in publicly owned projects. The previous section however suggests that this is not the case and that traffic forecasts are not more accurate for traffic-based PPPs than for conventional projects. We could find four explanations for this.

Leverage of concessionaires on actual ridership is limited compared to other infrastructure types. Except for stand-alone projects (e.g. *Taiwan HSR*, *Seoul ARL* and, to some extent, *KL ERL* and *Adel.-Darwin*), trains have to operate both on the conventional and the PPP networks. Therefore the two networks are interlocked and should be able to coordinate, have integrated traffic control, shared technical standards, and performance on the PPP infrastructure will be impacted by performance of the conventional network. In the case of *Perp.-Figueres* for instance, despite infrastructure being commissioned on time, commercial traffic did not start until 10 months later (with limited trafffic) and will not operate as planned until 5 years later because adjacent network (e.g. HS lines towards Barcelona) was not ready. This, of course, is an extreme case. But for *SEA* for instance, actual ridership

[8] Sources: Arlanda: Nilsson (2008), Seoul: Korea Times (09/10/2009), Korail press release (13/01/2011), Kuala Lumpur: Wikipedia, Brisbane : Bradley (2005), BrisbaneBusinessNews (08/2010), Sydney : Sydney Morning Herald (11/03/06), Eurotunnel: (number of Eurostar passengers) Bartlett (2011c), Delhi: IBNLive (09/12/2011), Taiwan: THSRC

is highly impacted by the access pricing of the adjacent network and by the congestion risks at the Paris Montparnasse station – and there is little the concessionaire can do about it.

Leverage on ridership is also limited by **high levels of price elasticity**. With elasticity close to -1 in rail (e.g. a 1% increase in average price ticket will result in a 1% decrease in ridership), concessionaires cannot increase ticket prices in order to offset poor ridership levels. This is a major difference with road concessions, where consumers are usually much less sensitive to prices.

This lack of operational leverage is in contrast with the very **high actual financial leverage in rail PPPs**. In a typical traffic-based PPP, private funding will be made of 20 – 30% of equity and 70 – 80% of debt. In many cases, public grants will come in addition and finance 50% or more of total investment costs. Therefore the actual share of equity in the total cost of PPPs is low, actual leverage is very high and small differences on the revenue side imply big differences in the actual value of the PPP.

Moreover, in infrastructure-only concessions (*SEA*, *CTRL*, *Perp.-Figueres*, *HS1*), **discontinuities** make net revenue quite unpredictable and sensitive to small differences that concessionaires cannot affect. For instance, on a busy HS line (such as *SEA*), with 100 trains per day, one additional return train makes a difference of 2% in gross revenue but of more than 20% in net earnings. This ratio (2% of revenue v. 20% of earnings) is not specific to rail PPPs (even though, as shown in previous paragraph, it is higher than for other infrastructure types), but what makes rail unique is that there is no intermediate possibility between 0 and ±20% in net earnings: the additional train is either running or not. This makes ridership forecasting for infrastructure-only PPPs a very risky gamble.

Most of the traffic-based concessions are integrated concession, including both transport and infrastructure (airport rail links, *Taiwan HSR*, *Gautrain*, *Eurotunnel*, *Adel.-Darwin*). There are three noticeable exceptions with infrastructure-only traffic-based concessions: *CTRL*, *SEA*, *Perpignan-Figueres* (plus, to some extent, *Eurotunnel*). One can argue that transfering traffic risk to infrastructure-only concessionaires is even more risky than with integrated concessions, for concessionaires have still more limited leverage on actual ridership, especially in terms of quality of service or marketing.

(4.4) Investors expect part of the traffic risk to be transferred to public authorities over contract's life.

We conclude from the previous section that traffic risk is extremely high in rail PPPs and that the private sector should therefore not be willing to take it, unless for a very high price. But in fact the opposite case prevails and there seems to be little difference in the attractivity to private investors of availability-based and traffic-based rail PPPs. The main reason is that the risks the concessionaires are taking are actually not as high as the previous section suggests. Indeed, experience suggests that negotiations between public authorities and prospective concessionaires are rather asymmetrical, and lead to asymmetric risk sharing.

Rail projects are very political entities, more so than most other public infrastructure projects (on a par with roads). Typical governments will apply three types of pressure: the line must be built, the trains must run and price/quality must be acceptable. Rail is a public good and whoever may be contractually in charge of rail performance, governments will still be held responsible by citizens. This can explain why, in some situations, concessionaires have extraordinary bargaining powers. They know that and they count on that. Here we should distinguish between contractual arrangements (e.g. what is agreed upon during contract's award) and extra-contractual arrangements (e.g. what happens over the life of a contract).

Prior to contract signing, there is a **strong will of the public sector to make the project happen**, which may result in the public authority being "locked" into the PPP. It is therefore ready to accept taking more risks, giving more guarantees than planned or intended. All PPPs benefit from public guarantees, but most often the extent of these guarantees is unknown to the general public. There are mostly two types of guarantees: **ridership guarantees** (the public authority provides part of the difference in commercial revenue between anticipated and actual ridership) and **loan guarantees** (the public authority pays part of the financial charges if the concessionaire is unable to handle them). All but one PPP in our list (*Taiwan HSR*) used one of these guarantees. Therefore, official pricetags, e.g. the amount of subsidy a PPP is granted, may have little in common with actual pricetags. In the case of *Eurotunnel* for instance, the project was not granted any subsidy. However, a revenue guarantee was established in order to compensate the concessionaire should freight traffic fall below a given threshold for the first 15 years of operation. This guarantee was paid each of these 15 years by the British Government and the French National Railway, a public company. For *SEA*, more than two thirds of the debt is guaranteed. For *Arlanda Express*, a fifth of the project's funding comes from a conditional loan from the State for which the concessionaire will repay neither principal nor interests until it makes sufficient profit – in the first 18 years of the concession, it has not repaid anything.

But more important are the **extra-contractual arrangements** like duration extensions, bail outs, early termination, etc. Those arrangements are the consequence of two elements: (i) prime investors in PPPs are usually builders or suppliers and loss on equity is the tradeoff for profits on construction, (ii) contracts are not complete and investors know that public authorities intend to retain more control on rail projects than stated in contracts.

Regarding the first of these elements (investors are usually builders of the project), as was seen earlier, the levels of subsidy and debt in a typical PPP explain why equity rarely accounts for more than 10% of the total cost of a rail PPP. Thus the maximum risk for investors is 10% of the project's costs. If, in the same time, investors also build the project, their turn-over is closer to 100% of the project's costs and, therefore, their maximum loss, once construction risk is mitigated, is in the range of 10% of their turnover. Not so risky after all. Equity may just be the price to pay to secure unusually large projects.

Regarding the second of these elements (incomplete contracts), investors know that rail projects too are "too big to fail". **Moral hazard and strategic behaviors are common issues**: when things start to go wrong in the project and the concessionaire is facing financial difficulties, the public part is left whith two options: let the concessionaire fail and accept infrastructure not being commissionned or trains stopping running, or bail the concessionaire out and support it through hard times – even if the public sector has no contractual obligations. These risks of performance failure are unacceptable for public authorities: the asset has to be delivered on time, trains have to run and quality of service needs to be as expected. A failure of the PPP is an option, whereas a failure of the system is oftennot an option. Therefore there is a natural temptation for bidders to overestimate ridership and thus lower their requirements for public funding, betting on the fact that public authorities would support them when traffic fails to materialize. This is even more likely to happen now than in the 1990s, since there is now a solid record of ridership falling short of projections in traffic-based concessions. There are strong indications that such strategic behavior and conscious overestimation has happened with *CTRL*, *Seoul ARL*, *Taiwan HSR*, *SEA* and *Perpignan-Figueres* – at a minimum.

In addition, investors also know that, unlike in the bidding phase, no competition exists anymore by renegotiation time, hence an increased bargaining power. For *Perp.-Figueres* for example, TP Ferro was in excellent position to negotiate the compensation for the 5-year delay in the opening of the HS line to Barcelona.

This all leads to public authorities bearing much more risk than initially anticipated and the private sector having only a limited incentive to assess ridership realistically.

5. Conclusion and perspectives

As of 2012, 27 rail PPPs had been launched since the 1980s. A quick analysis reveals the wide diversity of rail PPPs; two types however proved more successful than others: **airport links integrated traffic-based concessions** and **HS infrastructure availability-based concessions**. The reason for these two types of projects to be so popular with private investor may be that those are rather isolated infrastructure, with relatively simple interfaces with pre-existing conventional networks.

Most of these PPPs are technical and operational successes but end up being financial failures. Public budgets have had to bear much of the cost of these failures. Yet it is unclear whether PPPs perform financially better or worse than public schemes because PPPs reveal failures that could have been hidden in the case of public projects.

Our review however shows reasonable grounds for hope, when considering past long-term trends and trying to anticipate future trends. Since the 1980's rail PPPs have come in the form of three rising waves:

- **a first "wavelet" in the 1980s** with projects of unsophisticated design (*Eurotunnel*, and its counterparts among people movers *Orlyval*) that set the way for later development,
- **a second wave in the 1990s** (1994 – 1998), with optimistic traffic-based concessions in high speed rail (*CTRL*, *Taiwan HSR*) and airport links (*Arlanda*, *Sydney*, *Brisbane*, *Kuala Lumpur*). In parallel, that period was one of euphoria of international institutions (Worldbank, ADB...) towards public private arrangements in developping countries, especially in Latin America and Southeast Asia[9];
- **a third big wave in the late 2000s** (2006 – 2012), with more complex projects, more intertwined with existing systems, more availability-based projects in HSR (*BPL*, *Proc.-Caia*), airport links (*Delhi*, *Lyon*), equipments and rolling stock (*GSM-R*, *Alb.-Alicante*, *Reliance*) and conventional rail (*Gautrain*, *Diabolo*, *Liefkenshoek*, *Denver Eagle*).

[9] The 1997 Asian and 2001 Argentinian crisis made such projects slow down significantly in the early 2000s.

This third wave is likely to end soon, mostly because European countries are now scaling down their rail infrastructure plans due to the financial crisis and because of mixed successes of the second wave PPPs. In France for instance whereas 4 PPPs are supposed to be signed in 2010 – 2012, none is in the pipeline for the following years and all projects are publicly-owned. Over these three decades however, clear trends can be observed:

- **availability-based concessions are increasingly used**: whereas there was none prior to 2001 (HSL Zuid), they tend to become the norm,
- PPPs are moving from landmark projects towards **projects that are more intertwinned with the rest of the network**,
- PPPs are moving **from new stand-alone transportation systems** (airport links, stand-alone HSR) **towards improvements to existing rail networks** (equipment, rolling stock renewal, HS missing links).

This does not mean however that the era of PPPs itself is ending. PPPs in the last 25 years have come and gone in waves and new generations are coming that try to correct the defects of previous generations. Another wave could come in the late 2010s. Although any prediction is pure speculation, **the next generation of rail PPPs could have the following characteristics:**

- **more brownfield concessions**. In 2010 Great-Britain, the winning consortium paid a fee of £2,1 bn (€ 2,5 bn) for the 30-year brownfield concession of *HS1*. In France, in late 2011, CDC Infrastructures, a French public infrastructure investment fund, expressed its interest in brownfield concessions of French HS lines, reportedly estimating a total value of €13 – 18 bn for 30-year traffic-based concessions of the existing 1,900 km of HSL;
- **more improvements and renewal of existing infrastructures, equipments or rolling stock**. In Great-Britain, the *Intercity Express Programme* finally received to go-ahead by the Government and should close soon, whereas the Department for Transport has announced that it is contemplating the PPP option for the procurement of *Crossrail* rolling stock; furthermore PPPs could be used for the implementation of the DfT's network electrification plans. In France, the State is looking for ways to tender competitively the operation of Intercity trains while to renewing the aging fleet of such trains without raising public debt – PPPs could be an efficient way to finance this € 1 – 2 bn investment.

As was seen above, it is not clear whether the global outcome of rail PPPs is rather positive or negative. Many mistakes were made, with naivety by governments and investors deserving much of the blame. Much has been learned from these mistakes and it is especially clear that there is now globally more wisdom about PPPs on the public side (though exceptions survive). It can therefore be hoped that the fourth wave of PPPs will be one of smaller, better designed, less risky projects. With such conditions, railways might at last benefit from PPPs.

6. References

Allen Consulting (2007), "Performance of PPPs and Traditional Procurement in Australia", report to Infrastructure Partnerships Australia, 63 p.

Coux, P.-D. (2012), "Concession de la LGV Sud Europe Atlantique Tours – Bordeaux : un succès qui en appelle d'autres", Infrastructures & Mobilité 115 (January 2012), p. 30-34 (*SEA*)

de Abreu e Silva J., Silva D., Sussman J. (2011), "The Portuguese HSR Network – Relating Financing to Strategic and Operations Issues", ESD Working Paper , MIT, 17 p. (*Po.-Caia*)

Dutzik, T., Schneider J., Baxandall P. (2011), "High-Speed Rail : Public, Private or Both ? – Assessing the Prospects, Promise and Pitfalls of Public-Private Partnerships", US PIRG Education Fund report, available online, 40 p. (*HSL Zuid*, *TwHSR*, *Po.-Caia*)

Flyvbjerg B., Skamris Holl M., Buhl S. (2006), "Inaccuracy in traffic forecasts", Transport Reviews, Vol.26, No. 1, 1 – 24, January 2006

KPMG (2010), "Rail at high speed – Doing large deals in a challenging environment. Lessons learned from Portugal's first HSR PPP project", 12p. (*Po.-Caia*)

National Audit Office (2009), "Performance of PFI Construction", 40 p.

Nilsson J.-E., Hultkrantz L., Karlström U. (2008), "The Arlanda Airport Rail Link: Lessons Learned from a Swedish Construction Project", Review of Networks Economics, 7:1 (March 2008), p. 77-94. (*Arlanda Express*)

Omega Centre, Bartlett School of Planning, Case studies on *Arlanda Express* (2011a), *Channel Tunnel Rail Link* (2011c), *HSL-Zuid* (2011h), Omega Centre for Mega Projects in Transport and Development, available online

Painvain N. (2010), "High Speed Rail Projects : Large, Varied and Complex", Global Infrastructure & Project Finance, FitchRatings, 19 p.

Phang S.-Y. (2009), "Transformation of the Urban Rail Sector through PPP", Journeys 3 (2009): 23-35.

Spoehr J., Whitfield, J.D., Quiggin J., Sheil C., Davidson K. (2002), "Partnerships, privatisation and the public interest", Centre for Labour Research, University of Adelaide (September 2002), 54 p. (*Sydney AL*, *Brisbane Airtrain*)

TERA International Group (2006), "Best practices for private sector investment in railways", raport to the Asian Development Bank and The World Bank Group, 112 p. (*KL ERL*)

Willams R., Greig D., Wallis I. (2005), "Results of Railway Privatisation in Australia and New Zealand", The World Bank Group, Transport Paper 7 (September 2005), 70 p. (*Adel.-Darwin*, *Sydney ARL*, *Brisbane Airtrain*)

<u>Appendix:</u> Awarded rail PPPs as of April 2012

	country	signing	start of operation	scope[10] I	T	3	duration (years)	length (km)[11]	traffic risk A	C	bailout / cancel°[12]	investment costs	comments
high speed rail													
CTRL (*greenfield*)	UK	1996	2003/2007	X	X		90	108		X	1998 (B)		built in two phases
Taiwan HSR	Taiwan	1999	2007	X	X		35	345		X	2009 (B)	$15 bn	only integrated (transport + infrastructure) HSR PPP
HSL Zuid (infra)	NL	2001	2009	X			30	125	X			€ 1.3 bn	only superstructures & equipments + maintenance
Poceirão – Caia	PT	2010	cancelled	X			40	167	X		2011	€ 1.34 bn	cancelled by Government in July 2011
HS1 (*brownfield*)	UK	2010	2010	X			30	108 (0)		X		Ø	first brownfield concession of rail infrastructure
SEA	FR	2011	(2017)	X			50	302		X		6,7 Md€09	
BPL	FR	2011	(2017)	X			25	182	X			€ 3.4 bn	
HHR	SArab	2012	(2015)	X	X		C+12	450		X		€ 7bn	equipment + RS + operation (no civils)
CNM	FR	(2012)	(2018)	X				80	X			€ 1,6bn	contract awarded
airport rail links													
Stockholm - Arlanda Express	SU	1994	1999	X	X	X	45	39 (20)		X		€$_{10}$ 0,4 bn	
Sydney – Airport Rail Link	AU	1995	2000	X	X	X	30	30	X	X	2000 (B)	A$ 0.8 bn	0.6 financed by Govt, administration in 2000
Kuala Lumpur – KLIA ERL	Mal	1997	2002	X	X		30	57		X		RM 2.4 bn	no public subsidy
Brisbane – Airtrain	AU	1999	2001	X	X		C+35	16	X	X	2003 (R)	A$ 233m	receivership in 2003
Seoul - A'REX	SKorea	2001	2007	X	X		C+30	60	X	X	2011 (B)	€ 2.2 bn	bailed out by Korail in 2011
Lyon - Rhônexpress	FR	2007	2010	X	X		30	23 (8)		X		€ 0,12 bn	shared infrastructure with public light rail
Delhi - Airport Rail Link	IN	2008	2011	X	X		30	23		X		\$$_{10}$ 0.6 bn	stand-alone system
conventional rail													
Eurotunnel	UK/FR	1986	1994	X	X	X	55⇨99	51		X	97,07(R)	12.5 Md€	infrastructure + shuttle services
Adelaide – Darwin	AU	2000	2004	X	X		50	1 420		X	2008 (R)	A$ 1.3 bn	infrastructure + freight services / SPV
Perpignan – Figueres	ES/FR	2004	2010	X			50⇨53	44		X		1.1 Md€04	cross-border link (incl. 8km tunnel) between FR and ES, mixed traffic (freight + HST)
Gautrain	SAfrica	2006	2010	X	X		20	80		X		$ 3.7 bn	mass transit between Jo'burg, Pretoria & airport
Diabolo	DE	2007	(2012)	X			40	3	X			€ 0.29 bn	rail connection between network & Brussels airport, infra only
Liefkenshoek	BE	2008	(2014)	X			38	16	X			€ 0.7 bn	freight only tunnel to link two banks of Maas in the port of Antwerpen; equipments built by Infrabel
Denver Eagle P3	US	2010	(2015)	X	X		34	54	X			$ 2,1bn	infrastructure + rolling stock + train operations
equipments / rolling stock													
Waratah	AU	2006	(2014)	X					X		2012 (B)	$ 3.6 bn	626 carriages

[10] I : investment, T : transport, 3 : third-party-access

[11] First figure: total length of the system; second figure (in brackets): lenght of new infrastructure built under the PPP (if different).

[12] (B) bailout; (C) cancellation; (R) liability restructuration

	country	signing	start of operation	scope[10]	duration (years)	length (km)[11]	traffic risk	bailout / cancel°[12]	investment costs	comments
GSM-R	FR	2010	n.a.	X	15	n.a.	X			equipment of 14,000 km of core network with GSM-R + maintenance
Intercity Express Programme	UK	(2012)	(2016/18)	X	30		X			600 carriages (DEMU) + maintenance facilities
Albacete - Alicante	ES	(2012)		X	20	167 (0)	X		€ 281m	signalling & telecom supply & maintenance
other significant out-of-scope projects										
Paris - Orlyval	FR	1988	1991	X X	C+30	7	X	1993 (C)	1,7 bn FF87	automatic metro between Orly airport and commuter station
Oslo - Flytoget	NO	1994	1999	X X X	-	60	X		~€1bn	public-public partnership
Paris - CDG Express	FR	Ø	Ø	X X	35	32 (9)	X	-	€ 0,64 bn	construction of 9 km of new infra + operation, awarded & cancelled