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HIGH SPEED RAIL PASSENGER SERVICES: WORLD EXPERIENCE AND U.S. APPLICATIONS

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Introduction and Basic High-Speed Rail (HSR)[1] Facts

High-speed rail is not a new technology. The Japanese New Tokaido Line carried its first passengers nearly 50 years ago. Since inception in 1964, HSR technology and speeds have evolved and HSR services today account for nearly 600 million passengers in at least 13 countries. Table 1 displays a brief profile of HSR systems as of 2008. Table 2, Pages 1 and 2, shows the history of passenger service growth in all major HSR countries.

HSR is more than a question of technology and investment, however. A more important aspect of HSR lies in understanding the series of institutions that countries have created to implement HSR. Although these institutions are country-specific, they have all had to confront the question of developing a business model appropriate for the country, including an organizational structure, ownership structure, establishment of access charges if the railway is not unitary, and finding sources of financing. Related to the business model is deciding how the various risks will be apportioned among the participants, an especially important question when the business model involves a mixture of public and private participation (often called Public Private Partnerships, or PPPs).

This study will first look at the experience in 13 cases, giving a brief description along with a discussion of the business model and risk allocation chosen. The study will then turn to some of the issues involved in applying this experience to the U.S. It will then set out a long range vision for HSR in the U.S. based on broad demographic information and on studies of HSR so far. Finally, the study will discuss the options and issues involved in developing potential business models and risk allocation strategies for HSR in the U.S.

Case Profiles

Japan

Although a number of railways experimented over the years with speed trials, some nearing or exceeding 200 Km/hr, the first large scale, fully operational HSR was instituted in Japan with the New Tokaido Line connecting Tokyo to Osaka. Planning for the line had commenced many years before because the existing line was essentially reaching its capacity, and Japan's

[1] "High Speed Rail" does not have a precise definition. We could simply consider it to be passenger rail that can compete with cars on superhighways and with air over medium range intercity markets. The original Shinkansen trains operated at a maximum speed of 210 Kh/hr (130.4 Mi/hr). Current HSR operations occur or are planned in the near term for up to 350 Km/Hr (217.4 Mi/hr) and a number of countries have operations at 300+ Km/Hr. In addition, in a number of countries (for example, France and Germany) HSR train sets operate at high speed on dedicated lines but also continue on conventional lines in order to provide seamless service. This paper will not attempt a rigid definition, but will instead discuss HSR in the context of each country. This paper will not discuss Magnetic Levitation as there are no such systems in intercity operation, and, except in Japan, few are planned in the near future.

national railway gauge was 1067 mm (3'6", "Cape Gauge") that would not permit speeds much beyond the existing maximum of 140 Km/hr. With the Olympic Games planned for Tokyo in 1964, Japan had an added incentive to undertake an investment in higher speed and higher capacity transport between Tokyo and Osaka. Intensive studies showed that the speeds and capacities needed could only be reached using a wider gauge track, so standard gauge (1435 mm or 4' 81/2" – "Standard Gauge") was chosen despite the fact that trains on the new line would not be able to extend service over the existing system: interchange would have to be at connecting stations.

From its inception, the Japanese system has been continuously expanded, first through to Hakata (Sanyo Line) and then to most of the remaining large cities in Japan (see Map 1). Today the Shinkansen system carries over half of the world's HSR passengers and around 40 percent of the world's HSR passenger-miles. There are plans for further expansion including extension through the Seikan Tunnel (already completed) to Hokkaido and a new express line from Tokyo to Nagoya and Osaka.

The Japanese case is especially interesting for this study because Japan underwent a radical change of business model and risk allocation. From 1964 through 1987, all the Shinkansen lines were owned and operated by the old Japanese National Railways (JNR), a Government owned, monolithic organization that controlled most of the nation's railways (Japan also has a large number of short, private passenger dominated railways that provide mostly commuter-related services). The Shinkansen lines built by JNR were wholly publicly funded and publicly operated with all risk assumed by the public sector. The Shinkansen lines were wholly integrated with the single JNR operator.

Unfortunately, JNR had slowly evolved into an exaggerated example of an uneconomic public enterprise, with very high costs and little sense of commercial objectives. Just before the Government decided to change it, annual losses were as much as US$15 billion, and the railway had a total debt of US$250 billion.

The Government decided that the only alternative was privatization. Beginning in 1987, the old JNR was broken into a number of enterprises. There were three passenger companies on the main island of Honshu: East Japan Railway Company (JR East), Central Japan Railway Company (JR Central) and West Japan Railway Company (JR West). Each of the three major Japanese islands (Hokkaido, Kyushu and Shikoku) had its own passenger railway (Hokkaido Railway Company, Kyushu Railway Company and Shikoku Railway Company). In addition, there was a single national freight railway (Japan Freight Railway Company) that provides service over the conventional lines of all six companies and pays an access fee (it is a freight analog of Amtrak in the U.S. and VIA in Canada). There was also a separate company[2] that owned the Shinkansen lines and leased them to the three main passenger companies[3] and there was a settlements corporation that took over the shares in the three main companies and assumed the liabilities of the old JNR except for those that were transferred directly to the three main passenger companies.

[2] This company has subsequently been dissolved and the ownership of the lines has been assumed directly by the three main companies.

[3] In addition to the three passenger companies of JR East, JR Central and JR West, Kyushu Railway Company (JR Kyushu) started operation of a Shinkansen service in 2004.

The details of the privatization are far too complex to be completely described here.[4] In summary, though, the net result was a dramatic shift in business model and risk allocation from one that is typical of wholly state-owned enterprises (see, for example, China below) to one that reflects at least a "partial"[5] PPP approach. Figure 1 displays the new business model and the risk allocations. All of the shares in the three main-island companies (East Japan, Central Japan and West Japan — now called "JR"s) were sold on the Tokyo Stock Exchange and Government holds no further ownership interest. The JRs operate as private companies that own or control all of their real estate and rolling stock assets. The JRs now own all of their pre-existing infrastructure, on which they pay no access charges. New HSR infrastructure is constructed and owned by the Japan Railway Construction, Transport and Technology Agency (JRTT), which leases the facilities for an annual fee that is based on the projected benefits (profits) generated by the JRs in using the lines.[6] New infrastructure is partly financed by the JRs (depending on their valuation of their benefit), but about 80 percent of the finance comes from local and central governments in the form of local contributions and grants.[7] All Shinkansen infrastructure is under the exclusive control of the JR that provides services on it. New rolling stock is fully financed by the JRs. The JRs are nominally free to make most normal business decisions and can adjust tariffs within stated upper limits: in practice, passenger tariffs have been stable for many years.

Risks are spread across a number of public agencies and the JRs. Planning, regulatory and right-of-way (ROW) acquisition risks are carried by government agencies because they are best placed to define and manage them. Construction cost risks are carried by JRTT, with costs being passed on to the Central and local governments that will bear any increased costs. The JRs carry infrastructure maintenance cost risk, rolling stock ownership and maintenance risks. Demand risk is carried by JRTT if demand is higher than expected (and new infrastructure capacity is needed) while the JRs carry the demand risk if demand falls below expectation and rolling stock capacity is too high. Most of the financing risk is actually borne by public agencies except for rolling stock and other investments (real estate, ticketing, etc.) that the JRs choose to make for their own account.

China

China represents one of the extreme data points in potential for rail passenger service. Chinese railways carry more passenger-miles than any other of the world's railways. Chinese railways carry over 25 percent of the world's total passenger-miles, 60 percent more than the entire E.U. and 136 percent of Japan's total (see Figure 2). Over the past three decades, rail passenger traffic in China has been growing more rapidly than any other railway except India, and far more rapidly than in the E.U. (see Figure 3). In addition, comparing the basic demographics that support HSR, notably distances and population density (see Figure 4), there are a number of potential Chinese markets that are easily the equal of those in Japan and the E.U. The primary difference in the past between China (and India) and other countries with major rail systems has

[4] See, for example, Tanahashi 1992, Konno 1997, Kakumoto 1997, Kakumoto 1999, Semmens 2000, Kasai 2003, Takagi 2005, and Ishida 2011.

[5] Partial is in quotes because the current institution, while fully private, is not reflective of the full, original costs to build the system, either in total amounts nor in distribution. When the new companies were established, a significant portion of the original debt was left behind, and the portions of debt and assets allocated to the three companies were not reflective of the actual costs to construct their systems.

[6] Shinkansen segments constructed with this approach are called "new Shinkansen" in contrast with the original Shinkansen which was constructed by JNR.

[7] The national Government bears two-thirds of the financing burden for Shinkansen infrastructure, while local governments bear one-third. JRTT receives lease fees from the JRs for 30 years at a fixed rate.

been income per capita, which has caused China and India to rely more on conventional speed, very high capacity rail passenger services and has limited the development of HSR. With the very rapid economic growth in China over the past 30 years, income levels and available investment capital have risen to the point that HSR has become an option.

In fact, China has an almost unique problem in that, along with its huge population, its rail network carries the highest traffic density (freight plus passenger traffic) in the world and is the critical artery of both freight and passenger travel. As a result, it faces congestion at many points. Although China is building highways rapidly, it will be impossible to support highway traffic or automobile ownership on the scale and intensity characteristic of western countries and Japan. China's only real solution is to build more rail capacity. One efficient way of doing so is adding passenger-only lines in order to permit freight to focus on existing lines where most of the industrial production is already located. Once the decision to build more passenger capacity is made, the issue of HSR versus conventional service can be weighted in favor of HSR, since the incremental cost of constructing HSR is less than the added income generated, especially where population density is high.

With few exceptions, railways in China are publicly owned.[8] The vast majority of the national rail system is owned and controlled by the Ministry of Railways of China (MOR) and is operated as a Ministry (not as a state-owned corporation as is usually the case in the E.U.).[9] Investment is centrally planned by Government and MOR, and there is extensive Government involvement in pricing and service planning. There is no rail intra-modal competition in China and MOR has no plans to permit multiple access to its tracks. It does not appear that MOR has internal lines of business, supported by cost and revenue separations, and, as a result, is not able to respond effectively to the growing force of markets in China.

Faced with the need for new, passenger-only lines, China has decided that the new lines should be high-quality. As a result, China has very aggressive, dramatic plans for HSR construction (as shown in Figure 5 and Map 2). Starting from zero in 2008, China plans to open nearly 7,600 miles (12,179 Km) of high-speed lines by the end of 2016.[10] This will be nearly twice the existing length of the world's high-speed lines as of the end of 2008! Moreover, the planned speed of the fastest services (350 Km/hr) is faster than any service that is currently provided.

MOR's plans for constructing and managing HSR grow out of its political and institutional history. As shown in Figure 6, MOR will be in charge of planning and construction and will provide most of the financing -- though some of the lines will be joint ventures with provincial and local governments. Financing will come from local and national grants as well as domestic loans and, potentially, international loans (as well as the World Bank). Only MOR Administrations[11] will operate trains on the lines, though there may be some lines with multiple Administrations operating trains on parts of the lines by mutual agreement.

[8] A part of the shares in the Guangzhou to Shenzen railway were sold to the public, but this did not prove successful and has not been repeated.
[9] There are a large number of small, locally invested railways, many of which are joint ventures with MOR.
[10] Recent reports of corruption in the construction of the HSR system have caused the railway minister to be removed and may delay the program. See, for example, article by Edward Wong in the New York Times dated February 12, 2011.
[11] MOR is organized into 18 regional Administrations, each of which is in full control of the operations of the railway in its area.

Consistent with its national ownership, all risks are borne by the public sector. Planning and regulatory functions are a shared MOR/national Government responsibility, while all other risks – investment and operating, demand and financing, are borne predominantly by MOR and to a much lesser degree by local governments. There is no private sector partnership involved: all management and all risks are in public hands.

Taiwan

The island of Taiwan is roughly 450 Km long and less than 200 Km wide –relatively short distances for an HSR system. Nevertheless, the densely populated west side of the island offers a potential rail passenger market over a distance of about 350 Km between Taipei and Kaoshiung (see Map 3).

Rail service in Taiwan has been provided by the Taiwan Railway Administration (TRA), which operates slightly over 1000 Km of 1067 mm lines. Though TRA carried over 170 million passengers in 2008, most of these were relatively short haul, commuter services. Because, as Japan had concluded, higher speed services would require a wider gauge, Taiwan decided to build an entirely new, standard gauge 345 Km railway to serve the Taipei/Kaoshiung corridor. In addition, the Government decided to privatize the project and hence the concessionaire set up the Taiwan High-Speed Railway Corporation (THSRC) to deliver the new line. This was the first entirely private, new HSR to be built.

THSRC is a consortium established by five stakeholders. It has a 35 year, exclusive Build-Operate-Transfer (BOT) concession. There are no access charges as the operation is exclusive, but THSRC does pay the government 10 percent of pre-tax profits annually as a leasing cost for the right of way; this is intended for use in rail development. The outline of the arrangement is shown in Figure 7.

The private investors received government buy-back guarantees for their financing. There were delays and cost overruns in construction due to rolling stock design problems and issues of integration of Japanese designed rolling stock with European designed infrastructure. In addition, actual demand has been far less than expected and the government has had to contribute to the company's paid-in capital, raising its share to 36.2%, compared with 27.9% owned by the five original shareholders (as of September, 2009). It is not yet clear whether the system will be viable in private hands, particularly if the debt has to be fully repaid by THSRC. It is possible that government will be forced to take a greater and greater role in ownership and support of the financial burden.

Taiwan is an example of an attempt at risk allocation that proved illusory. At first, the objective of establishing a private consortium was that essentially all risks beyond planning and regulatory oversight would be taken by the private sector. For reasons that are not clear, however, government decided to influence the decision to use Japanese rather than European rolling stock, thus exposing itself to the risks of delay in completing the system resulting from integration problems between Japanese and European design philosophies. Next, when it became clear that the initial demand levels would not provide enough operating income to cover debt service, government was unwilling to force THSRC to declare bankruptcy and reschedule its obligations. In fact, despite its intentions, it remains unclear how much risk the government actually managed to transfer to the private consortium.

Korea

Similar to Taiwan and Japan, railways in Korea were managed by a nationally owned company – Korean National Railways (KNR). KNR owned all the rail lines and provided all passenger and freight rail services in Korea, including the metro in Seoul. Beginning in the late 1990s, the government began discussing a generalized reform that, in 2005, broke KNR into an operating company, Korail (KR -- for both freight and passenger), and a network agency (KRNA), both under government ownership. In addition, government decided that the management issues of HSR were sufficiently different from conventional railroading that creation of a new operating agency (KTX) under Korail was justified.

The new high-speed line has been built in stages (see Map 4). The first stage of 224 Km, Seoul to Daegu, was completed in 2004. Most of the second stage between Daegu and Busan (196 Km) opened in November, 2010. Minor additional improvements of about 41 Km in urban areas in Daejon and Daegu will be completed in 2014. KTX service now extends from Seoul to Busan, a distance of 261 miles (420 km). Figure 8 displays the general management structure adopted. The HSR system has been constructed by KRNA and operated by KTX, as a separate division of KR. There are no competing operators on the high-speed line and no access or usage charges are assessed.

As both KRNA and KR are government owned, essentially all risks of construction, financing and commercial results have been retained in public hands (there is a small role for private loans to the public company). It is reported that demand has been stronger than forecast and that KTX is already generating an operating surplus. There is no information available to determine whether the surplus is great enough to recover any of the capital investment cost of the system.

The European Union (E.U.)

The infrastructure for railways, including HSR, is generally the responsibility of each country, and the HSR systems will be discussed below in the individual country context. The E.U. Commission has established a general policy framework within which each country must work. It will be useful to describe this framework before covering the individual country cases.

Beginning in 1991, the Commission has gradually put in place a series of Railway Directives that are applied to all railways within the Union. There are a number of aspects to this framework:

- All countries must separate their infrastructure provider from operator(s), at least on an accounting basis. Although the Commission has encouraged that the separation be institutional rather than merely accounting, countries have adopted a series of structures ranging from separated accounting to holding companies to true institutional separation.[12]
- The infrastructure (network) provider must publish non-discriminatory access charges for use of the network and must allow all qualifying operators to use the system in accord with the access charges and other conditions.

[12] See Thompson 2008 and Thompson 2005a for a more detailed description of the different approaches adopted by E.U. countries.

- Access charges should be based on "marginal cost," which in practice is interpreted to mean short term system maintenance plus allowance for congestion, with the difference being made up by government. Over and above the recommended marginal cost charges, the Commission permitted network agencies to add "markups" meant to recover a portion of (or all) fixed charges so long as the markups are "efficient" and non-discriminatory. In practice, this has yielded a wide range of access regimes, different in nearly country, including a range of charging factors for use, reservation as well as usage charges, and targets for cost recovery from users ranging from about 5 percent (Sweden and Norway) to full financial costs (some eastern E.U. countries). In addition, countries have adopted quite different balances between access charges for passenger and freight service. The net result is a patchwork of complex and sometimes conflicting access charge regimes imposed on international traffic.
- Although many E.U. railways were originally built by the private sector, all were effectively nationalized after World War II and operated as state-owned enterprises.
- The E.U. Commission takes no position on public versus private ownership and operation because the member countries exhibit a wide range of policies and values concerning the role of the private sector.
- Over the last 15 years, many E.U. governments have expanded the role of the private sector in their passenger railways. In some countries (Netherlands, Germany, Denmark and Sweden) this has taken the form of competitive franchising of local passenger services.[13] In the U.K. the government actually broke the railway into an infrastructure company and a number of passenger franchises and privatized the entire lot. The U.K. subsequently encountered a number of problems and the government has gradually re-entered the system, partly by playing an expanded financing role and partly by restructuring the franchises (discussed below).[14]
- There are as yet few fully private HSR operators, but there are plans for them to emerge in the near future. There are several wholly private companies in Britain that operate intercity trains at speeds up to 200 Km/hr (Hull trains, Grand Central, Wrexham & Shropshire) on an "open access" basis. Also, one of the the tendered regional franchises in the U.K. (Southeastern) operates 250 Km/hr trains over the U.K.'s new high-speed line. In Italy, a private sector company (NTV) has ordered a fleet of 300 Km/hr vehicles and plans to commence operations between Milan, Florence, Rome and Naples, probably in 2011. SNCF has acquired a 20 percent share in NTV.
- E.U. HSR traffic and networks have grown steadily since 1981 when the TGV began in France (see Figures 9 and 10). More important, the E.U has in place mechanisms to plan and support development of an integrated E.U. HSR network.

The E.U. plans for HSR development are summarized in Figures 11 and 12 and Maps 5 and 6, which show E.U. "HSR" line miles by category, by country and by year including lines planned for completion after 2020. The plans are summarized in the Trans-European Network for Transport (TEN-T), which includes HSR as well as conventional passenger services and freight. Significant E.U. funding is available to support the network through TEN-T grants, E.U. Cohesion and local grant funding, as well as through the European Investment Bank (EIB).

[13] In most cases (except the U.K.), the existing national railway was allowed to compete, but often had a cost structure so high and so rigid that it was uncompetitive. In both Germany and Sweden, the national railway was actually prosecuted for anti-competitive behavior vis-à-vis potential competitors.
[14] See ECMT 2007 for a discussion of E.U. experiences in franchising of rail passenger services.

It is worth emphasizing that the E.U. HSR network includes a range of speeds. Category I (>150 Mi/hr) is the largest part of the planning, but there are significant linking sections of Category II (~120 Mi/hr) and even Category III, which includes speeds specific to the requirements of a particular link . Significant parts of the system are and will remain Category II, partly for financial reasons, and partly because the distances involved do not actually justify higher speeds.

It is also noteworthy that, since 2008, the entire European rail network has been officially open to competition for rail freight services and, since 2010, has been open for cross-border passenger services, including those that may involve cabotage in the country of origin or destination. Entry has so far been restricted by conflicting technical and labor standards and, unofficially, by government policy in a number of countries. All of these barriers should fall, albeit gradually.

There is substantial competition now for "block" freight trains across Western Europe, with the national incumbent now carrying less than 80 percent of the traffic in most countries. As yet, there are only a few "open access" passenger operators[15] and most cross-border passenger trains are still operated jointly by the national railways, effectively under cartel arrangements.

France

The French National Railway (SNCF) was the first to provide HSR services in Europe through its Train á Grande Vitesse (TGV) network. Commencing in 1981, the system has been steadily developed and expanded since, and there are well established plans to continue expanding at least through 2020 and possibly longer (see Map 7). As Table 1 showed, the TGV network carries almost twice as many passengers and somewhat more than twice as many passenger-miles as any other E.U. network. Similar to Japan, the TGV network was built, and is operated, in regional segments (Map 7). Six segments (Atlantique, Nord, Est, Sud-Est, Rhône Alpes and Méditerranée) are already in operation and another four are planned to open before the end of 2016. A particularly important innovation of the TGV services is that the high-speed trains operate both on high-speed lines and on conventional lines. This has meant that, unlike Japan and Taiwan, TGV trains and service can operate seamlessly where only part of the route is high-speed line. This has also permitted TGV services to be provided beyond the French borders.

The French approach to the E.U. Directives has been to separate infrastructure institutionally with the creation of Réseau Ferrée de France (RFF), owned and regulated separately by the government. Most of the operating functions of RFF were sub-contracted back to SNCF for staffing and management and SNCF has enjoyed a monopoly over access to RFF tracks.[16] RFF has instituted a complex system of access charges based both on reserved capacity and on use. These charges are adjusted for time of day and by category of line, with the HSR lines paying considerably more than conventional lines.

The French business models and risk allocations (Figure 13) are influenced accordingly. Infrastructure is nationally owned and is likely to remain that way. Operations have been nationally owned, but, as a result of E.U. policy, will be opened up to competition from other

[15] An "open access" operator is an enterprise that decides to run a passenger train wholly without state support in the expectation of making a profit.

[16] This monopoly is gradually changing with the entry of private operators into the freight market and suburban passenger markets. In addition, a number of HSR operators, including DB, are now beginning to use RFF tracks, paying the same access fee as SNCF.

national operators, including DB, Ferrovia dello stato (FS) and Swiss Federal Railway (SBB), as well as a number of potential private operators, including Lufthansa and Air France. There are also smaller concession-based operators in local and suburban markets. Financing for the high-speed lines at first came from the government, but has, in later segments, incorporated contributions from E.U. sources and local and Départmental governments as well as private sector concessions and partnerships.

The French risk model is still heavily oriented toward government, specifically the capital risk of line planning and construction (which can in some ways be shifted to the operator(s) through the appropriate design of access charges). In overall average, the RFF charges are intended to recover about 60 percent of total financial infrastructure costs from operators with the remainder from government contributions:[17] data do not exist to determine whether the HSR lines are more (or less) cost recuperating that the system average. In principle, RFF and SNCF bear demand and operating cost risks but, since they are government owned, most of the risk ends up back with government anyway.[18] This pattern may be modified somewhat with the entry of entirely private concessionaires for shorter haul services where the concession can be permitted to fail without great disruption: ability to shift demand or operating risk to a single provider of a vital service, however, will always remain questionable.

Germany

The German approach to the E.U. Directives is a blend of accounting and institutional separation. The old DB (combined with the old East German railway –DR—in 1994), was reformed into an overall holding company (Deutsche Bahn or DB) which in turn has a number of wholly owned subsidiaries including DB Netz (infrastructure), DB Stations and Services, DB Long Distance passenger, DB Regional passenger, DB Schenker (which includes rail freight, trucking and forwarding across all of the E.U.) and an international air freight operation.

The HSR operations of DB Long Distance passenger are provided under the banner of Inter City Express (ICE). Like TGV services, ICE trains operate both on and off the high-speed network and provide international service (Switzerland, Netherlands, France and U.K in the near future) as well as domestic service. As Map 8 shows, DB Netz has a composite network, with some higher speed HSR, but also with an extensive part of the network restricted to about 120 Mi/hr (200 km/hr). As with RFF, DB Netz has published access charges that vary with use and with the category of the network: unlike RFF, the HSR access charges do not vary by time of day and they do not have a fixed component (reservation charge).[19]

The DB Holding Company owns all of the assets and operations of DB, including DB Netz. In the past, DB controlled virtually all operations on the network, but competition, especially for concessioned local services, is gradually emerging. As in Japan, Germany has always had a large number of small, local and regional operators, some wholly private, some owned by local and State governments. The DB Group and its operating subsidiaries do not receive an overall

[17] See Thompson 2008.

[18] E.U. rules prevent governments from subsidizing national companies at the expense of potential E.U. competitors. This rule might, to some extent, force governments to require that their nationally-owned enterprises take responsibility for more of the risk. In practice, the Commission has had difficulty enforcing this requirement, especially in its larger member countries like France and Germany.

[19] DB was charged by the German anti-monopoly office with purposefully instituting a system of access charges (high fixed charges and low use charges) in order to limit the entry of potential, smaller competitors. DB agreed to revise its access charges to include only variable coefficients.

subsidy from government, though DB Netz does receive support for infrastructure capital investment. According to the DB Annual Report, DB Long Distance Passenger, DB Schenker and DB Netz cover their costs and capital renewals from revenues; DB regional collects revenues from passengers, but also receives subsidies from local governments to operate local passenger services.

Figure 14 shows the German business model and risk allocation. DB Holding is a wholly government owned corporation. Although the government has announced (several times) an intention to sell a significant share of its ownership to private investors, there has been strong resistance, especially from labor unions, and the economic downturn in 2008 delayed any action. The eventual outcome is not clear. Financing for line construction has come mostly from the Federal government, but also from States (Länder) and local governments. In addition, because the DB holding company conglomerate is "profitable," it is able to borrow on commercial markets: as of 2009, DB holding had net financial debt of € 15 billion, and enjoyed a Moody's bond rating of Aa1.[20] DB Netz is also eligible for E.U. funding and EIB loans if desired.

Because DB holding is a large corporation with access to the capital markets, it is possible that it could accept some capital or operating risk. The degree of risk might be increased if some (preferably a majority, or all) of its stock can be successfully sold. In the meantime, government, as equity shareholder, will always be exposed to DB's risks. As in France, the access charges implemented by DB Netz can have the effect of shifting the balance of capital investment risk in infrastructure from Netz to DB Long Distance passenger (or the reverse). So long as the Holding company has overall responsibility, this might be shifting risk from one pocket to another in the same pair of pants: if DB Netz is separated from the overall holding, however, the risk-shifting could be much more important. Currently, the access charge regime of DB Netz is targeted at recovering about 60 percent of total infrastructure cost from operators with the remainder coming from government.

Italy

The Italian State Railway (Ferrrovia dello stato – FS) was actually the second operator of HSR in Europe after TGV. The system is now expanding within the TEN-T planning system, with links to Switzerland and France (see Map 9).

The Italian approach to the E.U. requirements was to retain FS as a holding company in government ownership and to establish a number of subsidiaries and divisions of FS: an infrastructure owning and management subsidiary (RFI); a special purpose entity charged with planning and constructing new high-speed lines (TAV); an operating subsidiary (Trenitalia) that has national/international passenger, regional passenger and freight divisions; and, a number of support functions including a rail consulting company.[21] RFI has published a set of access charges that are quite distinct from others in the E.U., but which appear to be non-discriminatory, albeit complex. On average, the total infrastructure access charge income is expected to cover about 18 percent of total financial costs so that, as of now, little cost risk has been transferred to operators..

[20] DB Annual Report 2009, pg 2. http://www.deutschebahn.com/site/ir/ir__dbag/en/financial__reports/annual__report/shop__annualreport__2009__dbgroup.html. The fact that DB is owned by the Federal Republic Government probably has an influence on DB's bond rating in addition to its "earnings."

[21] http://www.ferroviedellostato.it/cms/v/index.jsp?vgnextoid=e89268ae9d50a110VgnVCM10000080a3e90aRCRD

Interestingly, TAV was originally planned to be 40 percent privately owned, but government bought out the private shares in 1997, reportedly because construction cost and schedule problems rendered the private participation infeasible. TAV has been financed by government grants and guaranteed loans from a specialized government agency (Infrastructture SpA). E.U. grants (TEN-T) are also available as are EIB loans.

Italy is one of the first E.U. countries in which open access will lead to significant private HSR operations. A new and private company (Nuovo Trasporto Viaggiatori – NTV) will commence operations at the end of 2011, running trains from Torino to Salerno via Bologna, Florence and Rome, and from Bologna to Venice,[22] connecting most of the major cities of Italy. NTV also has announced plans to run service from Italy to Switzerland and France as soon as service in Italy is established.

Figure 15 shows that the risk allocations for HSR in Italy follow the business model. Government and TAV bear the planning and investment risk in acquiring ROW and constructing infrastructure. The access charge structure for RFI effectively means that it bears all infrastructure management cost risk. Trenitalia bears the risk of rolling stock acquisition and maintenance along with demand and operating costs. In the future, NTV will bear similar risks for its operations. With the possible exception of NTV, government ultimately bears all financial risks if the government-owned providers encounter problems.

Spain

The main Spanish railway (RENFE) network before HSR was broad gauge (1668 mm). There are also a number of regional, narrow gauge systems. Although broad gauge track is in principle as good as (maybe better than) standard gauge for HSR, RENFE opted to build the new high-speed network in standard gauge in order to permit future connections with the French TGV network and to facilitate commonality of HSR rolling stock with that of the rest of Europe. With the first HSR service (AVE) opening in 1992, Spain has steadily increased its HSR system length to about 1000 miles today and with ambitious plans to continue expanding up to 6000 miles through 2020, including a connection to the TGV system near Perpignan. (See Map 10)

The Spanish government elected to comply with the E.U. Railway Directives by splitting the railway into two agencies; an infrastructure agency (ADIF) and an operating company (RENFE) that handles both passengers and freight. With the advent of HSR, RENFE created a separate brand (AVE) to manage the HSS services. ADIF was given the job of constructing the new HSR lines and has posted an access charge system that is comparable in complexity to that in France: variable usage charges for different lines and by time of day along with capacity reservation charges that are meant to recover a significant portion of the financial cost of the HSR lines. There are no data to assess the degree of total financial cost coverage expected from ADIF. Since Spain's access charges appear somewhat lower than in France and Germany, and slightly lower than in Italy, it is likely that the coverage target is similar to that of Italy (18 percent) again suggesting that infrastructure cost risks remain with ADIF rather than being transferred at least partly to operators.

Figure 16 shows the business model and risk allocation for the Spanish system. As this Figure shows, not only has essentially all risk remained with the public sector, but AVE was initially been protected from competition from Spanish airline services, though this protection will

[22] http://www.ntvspa.it/en/nuovo-trasporto-viaggiatori/38/2/high-speed-railways-italy#

probably be removed when the merger of the national airline (Iberia) with British Airways (BAS) is fully implemented.

Sweden

Sweden has been in the forefront of railway reform in the E.U. The Swedish government was among the first E.U. governments to conclude that the existing national railway (Svenska Järnvagar, or SJ) had become inefficient and uncompetitive and urgently required reform. Three years in advance of E.U. policy, which was first promulgated in 1991, the Swedish government was the first in Europe to implement vertical separation by splitting the railway between an institutionally distinct infrastructure agency (Banverket) and an operating company, which retained the name of SJ (the freight part of SJ was later rebranded as Green Cargo). All of these companies remain fully under public ownership, though the government has considered selling Green Cargo but has yet to proceed because of the belief that the company would retain monopoly power in some remote markets.

None of the Banverket network is today capable of speeds greater than 120 Mi/hr (Map 11). Though this is the lower edge of HSR speeds, SJ manages to provide excellent schedules through the use of tilting train technology and extensive, integrated operation of intercity trains over both conventional and higher speed tracks. Also, Banverket expects to be able to raise the maximum speeds on some lines to 150 Mi/hr by signaling improvements along with limited investment in bottleneck areas. The rolling stock has been designed to achieve these speeds when signaling and track permit.

Banverket was established to implement a Swedish national policy of encouraging traffic to shift from road to rail. Accordingly, Banverket's access charges are very low and contain only variable charge components. The target for recovery of full financial costs is only 7 percent (the lowest in the E.U.), so essentially all cost recovery risk is in public hands.

The Swedish business model and risk allocations are simple, as shown in Figure 17. With the exception of some iron ore-related operations in northern Sweden, the Swedish infrastructure network is fully in public ownership. Intercity passenger operations remain in the hands of SJ; by contrast, in recent years, most of the shorter haul regional rail passenger operations have been competitively franchised to private operators (SJ's cost structure has been so high that it has found competition difficult).[23] Most of the franchises are gross cost franchises where revenue and volume risk remains with government while operating cost is shifted to the franchise operator, so only operating cost risk has been transferred. HSR remains in the hand of SJ along with all risk, though SJ has stated that intercity passenger services are profitable (paying only miniscule access charges); if true, the operating loss risk to government is minimal.

Belgium and The Netherlands

Map 12 shows the rail network in Belgium and The Netherlands. Figure 18 shows the business model and risk allocations for Belgium and Figure 19 shows the business model and risk allocations for The Netherlands.

The Belgian rail network is central to the E.U. rail system because Brussels is the capital of the Community governing system and Belgium is geographically central to much of the travel in

[23] SJ was also successfully prosecuted for anti-competitive behavior because it refused to provide surplus rolling stock to successful competitors.

western Europe. This has meant that connections to Brussels from France, the U.K., Germany and The Netherlands have become increasingly important; but, of course, the Belgian system is dependent on actions in other countries for better service to and from Brussels.

The basic Belgian response to the E.U. Directives was to separate the railway into two parts – Infrabel manages the infrastructure, and SNCB (which was the name of the old integrated railway) manages most operations. Both are wholly government owned. Infrabel has instituted a relatively simple set of access charges that are wholly variable with use, but that are different by type of train (HSR, intercity passenger, local passenger and freight). Infrabel's access charges recover about 20 percent of the full financial cost of the infrastructure, with the rest coming from government. E.U. sources for construction are also available.

HSR in Belgium is furnished by a series of international operating companies in which SNCB owns various shares. Eurostar, jointly owned by SNCF, SNCB and London and Continental Railways (LCR)[24] runs from London via Lille to Brussels or to Paris, and is buying trains to extend service to Amsterdam and Frankfurt. Thalys (ownership is 62 percent SNCF, 28 percent SNCB and 10 percent DB) trains provide HSR service among Paris, Brussels, Amsterdam and Cologne. Fyra (discussed below) trains, a joint venture between Dutch National Railways (NS) and SNCB, provide service between Brussels, Rotterdam and Amsterdam. DB operates ICE trains from Brussels to various German destinations and has announced plans to operate from Germany through Brussels and Lille to London.

For the most part, infrastructure capital and maintenance risks of HSR in Belgium remain ultimately in public hands: in addition, because access charges have a low financial target, only a limited part of the infrastructure operating cost and capital recovery risk is passed through to operators. Belgium only holds a share in ownership, and thus of capital and operating cost risk, in the international HSR operators. Presumably some of the risk has been transferred to the other partners (almost all of which are other governments).

The Dutch approach to business model and risk allocation is somewhat different. The original Dutch National Railway (Nederlandse Spoorwegen – NS) was split into an infrastructure agency (ProRail), a passenger operating company paying access charges (now NS), and a freight operating company (NS Cargo – now controlled by DB). While the government believed that improved HSR connections to the rest of the E.U. were critically important, the dense population of The Netherlands made it infeasible to construct an entirely separate and new line, requiring the new service to be partly based on existing lines, especially in and out of cities, as is true in France and Germany. Moreover, the government felt that construction of the new line would constrain public resources and therefore opted to award the project to a private consortium

The new line has been constructed by a fully private consortium (Infraspeed) awarded by the government on a Design, Build, Finance and Maintain basis. Infraspeed holds a 25 year concession to maintain the line, and receives a fixed annual payment for providing access. Operators will actually pay access charges to ProRail which will then deal with Infraspeed (as of this report, the access charges by ProRail are not yet clear). HSR operations on the line will be provided by Thalys and Fyra trains, which is a joint venture holding a 15 year concession for Amsterdam to Brussels service jointly owned by NS, KLM (a privately owned Dutch airline that is now merging with Air France), and SNCB. DB and Eurostar will also provide service on the Infraspeed line.

[24] See UK discussion below for description of LCR's ownership and history.

The risk allocation is also specific to the Dutch approach. At least some of the infrastructure cost risk was passed to the private consortium in the DBFM arrangement; however, the payment by government of a fixed annual fee to the consortium means that the demand risk has effectively been taken back into public hands and, depending on the level of the fee, the cost risk to the consortium may well be fully covered. Coverage of the infrastructure maintenance cost risk is unclear and depends on the level and structure of the fees paid by users to ProRail. Given that government pays a fixed fee and receives (through ProRail) a fee that varies with use, demand risk remains in public hands. The Dutch target for recovery of the full financial cost of infrastructure (12 percent) is quite low on the conventional network. The comparable target for the HSR infrastructure is not available.

Operating and demand risk are fully borne by the operators, most of which are in turn public agencies. Some part of the Fyra operating risk is presumably borne by KLM, but this depends on the exact nature of the partnership among NS, KLM and SNCB.

The UK: HST-125, HS-1, and the Channel Tunnel

The HSR approach in the U.K. is complex, involving three different systems and a unique (in European experience) history of railway restructuring and privatization. See Map 13. Some history is necessary to see how the pieces fit together. The business models and risk profiles for the British system are shown in Figures 20, 21 and 22.

In 1994, the British Government decided to privatize the old British Railways (BR).[25] The results, in brief, were:

- An infrastructure company (Railtrack) that was privatized. Railtrack subsequently encountered financial problems and was placed into reorganization from which it emerged as a hybrid public/private company (Network Rail) that receives public capital support. Network Rail's access charges include both fixed and variable charges, and are targeted at recovering about half of the total financial costs of infrastructure.
- 25 separate passenger franchises that were competitively awarded on the basis of maximum payment to or minimum payment from government. Most of the passenger franchises were expected to be "net cost"[26] arrangements in which the franchise owner made the demand forecasts and, within limits, was allowed to set fares. As practice has developed, there have been several cycles of bidding, and many of the franchises have been restructured and at least partially converted into "gross cost" franchises in which the franchise operates services as defined by the government and competes for minimum cost. In the process, some of the demand risk has been re-assumed by government, though some of the franchises still are effectively net cost and do retain risk (but have had a number of years of actual demand experience that reduces that risk).
- Three Rolling Stock Companies (ROSCOs). The ROSCOs competed to purchase the existing BR rolling stock, subsequently leasing it back to the operating franchises. The ROSCOs were fully privatized. Over time, the ROSCOs have purchased or leased new rolling stock from manufacturers and re-leased it to the franchises. The ROSCOs were necessary because the franchises were awarded for periods (5-10 years typically) that were

[25] The summary above focuses on the issue of rail operations and excludes many other important details of the BR restructuring and privatization.
[26] See ECMT 2007 study for definition of terms "net cost" and "gross cost."

too short for the franchise to amortize rolling stock with 30 year life. As the franchising experience has evolved, entirely new and private competitors for the ROSCOs have emerged. To ensure that there will be effective competition when franchises come up for re-tendering, U.K. operators are required to put in place specific arrangements to transfer rolling stock to new operators.[27]

Again in very broad terms, the overall results of the privatization and restructuring were positive, but with problems. Passenger demand in the U.K. since privatization has grown faster than in any other E.U. country. The average age of the passenger fleet has been cut nearly in half. Investment in infrastructure has grown rapidly, on-time percentage is high, and accidents have fallen significantly, possibly more rapidly than would have happened under BR.[28]

At the same time, the system has been a victim of its own success, and of the neglect that BR suffered during public ownership in the years before privatization. Traffic growth has led to congestion and increasing capacity has proven very expensive. Many of the original net cost franchises proved uneconomic and had to be renegotiated. Most franchises are now in the second or even a third cycle. Franchise contracts have evolved, with a degree of revenue risk sharing by government now the norm. Railtrack failed, partly because of management problems and partly because it made financial commitments it could not meet. As a result, it had to be converted into a hybrid enterprise in which the implicit government role is much larger.

The operating franchises are classified as London (commuter), Regional and Long Distance. Three of the Long Distance franchises provide 125 Mi/hr (HST-125) service: London to Cardiff (First Greater Western); London to Glasgow (Virgin West Coast) and London to Edinburgh (Eastern). Interestingly, these franchises have remained "net cost": that is, within regulatory limits on "standard" fares, they are responsible for demand estimates and revenue forecasts as well as their operating costs, including the access charges they pay. They are also net payers **to** Government for franchise rights. That said, First Great Western is now being supported by government, Virgin has been renegotiated several times, and East Coast has become a "directly operated railway" after the third franchise operator was unable to make its premium payments.

The risk profile for these three HSR franchises is: 1) because they owe a fixed (by competitive bidding) franchise fee to government along with a fixed access charge payment to Network Rail that varies only slightly with the services operated, the HSR franchises are exposed to much of the demand risk related to infrastructure costs; 2) rolling stock leases that include financial components as well as use components expose the operators to demand risk on the rolling stock (but at least some of the cost risk has been included within their franchise bids and is thus shifted to the ROSCOs); 3) ROSCOs bear some of the investment and cost risk for rolling stock, though there has been limited direct government support for rolling stock; 4) infrastructure acquisition, construction and maintenance cost risk is borne by Network Rail (with some passed to operators through the fixed component of the access charges).

The HS-1 link, from the Channel Tunnel mouth to London (St. Pancras Station) was intended to be an entirely private sector venture for the infrastructure with operations provided by Eurostar (as discussed above, a joint venture between SNCF, SNCB and LCR, the owner of the HS-1 link). The original link to the Channel Tunnel was conducted over an upgraded Network Rail link

[27] Ensuring that new operators have access to the rolling stock of the old operator when franchises are tendered has been a common problem in all of the E.U. franchise competitions. Emergence of rolling stock leasing companies Europe-wide is a potential solution.
[28] See, for example, Evans 2010.

to a new terminal alongside Waterloo Station in London. After an international competition, a 90 year Design, Build, Finance and Operate (DBFO) concession for a new link and station connection in London's St Pancras station was originally awarded in 1996 to London and Continental Railways (LCR), which completed the first part of the link in 2003 and the second part in 2007.[29] Although there was, strictly speaking, no subsidy involved, LCR did receive the U.K. share of the Eurostar train services along with properties along the route with development potential and a contract to provide train paths for domestic services that are now operated by the Southeastern franchise.

Unfortunately, LCR's demand forecasts were optimistic and it began to have financial problems in 1998, leading to increased government involvement through guaranteed lending and award of a government option to purchase the link. Attempts were made to sell the line to Railtrack, which failed because of Railtrack's own financial problems. In 2009, the owning consortium again met with financial problems, triggering full government control through exercise of the re-purchase option. In 2010, the government re-awarded HS-1 for a 30 year concession period to a consortium of Canadian investors: the government's investment in the link at that point was about £8 billion and the payment received is reported to be about £2.1 billion. The line has been opened up for use for local service and for competitive HSR service, including a proposal by DB to run trains to London from Germany.

The risk profile for HS-1 obviously changed over the life of the project. The initial conception was that all construction risks would be carried by HS-1's (LCR) owners, not the public. Eurostar was to pay a fixed fee set by government that would presumably have covered the owner's costs. In practice, demand fell below expectations, forcing HS-1 (LCR) into repeated reorganizations. Because the link was the key to improved rail service to the E.U., government was forced to step in and ensure that LCR survived until the line could be rescued. Eventually, government decided to take its losses and sell the consortium for whatever the market would bring.[30]

Cost risk for infrastructure maintenance has been shifted to Network Rail, which maintains the line under contract to HS-1. Access charges can presumably compensate it for its costs. Demand and operating cost risks, along with the cost risk for rolling stock, were successfully shifted to Eurostar (and, as demand has lagged behind early expectations, Eurostar has paid a price – but, then again, it is mostly a public sector company). The new operators will also assume most of the business risk (rolling stock, operations and demand) for the services they provide.

The tunnel under the English Channel (originally called the Channel Tunnel or "Chunnel," now often synonymous with "Eurotunnel") was a dream that probably originated when people first looked from Dover across to France. Planning and geotechnical analysis began as early as Napoleon, and were revisited periodically until the mid-1980s.

Following insistence from the U.K. Government (Margaret Thatcher), a 100 year Design, Build, Finance, Operate and Maintain (DBFOM) concession was awarded in 1986 to the Eurotunnel Groups, led by a consortium of Anglo-French construction companies with backing from international private investors. Originally budgeted at about £4.7 billion, the tunnel eventually doubled in cost, most of which was financed by debt. Shortly after its opening, the tunnel group became effectively insolvent because demand had fallen far below expectations and well below

[29] http://en.wikipedia.org/wiki/High_Speed_1
[30] Indications are that the £2.1 billion price was actually higher than government had hoped.

the level needed to service the debt. By 2006, the company was placed in reorganization, from which it emerged with a far smaller debt burden in 2008. With much lower interest payable and with demand beginning to grow, the company has been at least marginally profitable since.

The base passenger operator of Eurotunnel has been Eurostar, which originally was the sole user of the tunnel for which it paid a fixed charge as well as charges for use. In addition, Eurotunnel operates an auto shuttle, a shuttle for trucks with trailers and allows passage of freight trains, which also pay access charges. With the refinancing of the company and application an access charge regime similar to those elsewhere in the E.U., Eurotunnel is now open for all Railway Undertakings (RUs) and issues a Network Statement including its published access charges. By comparison with most E.U. railways, the Eurotunnel access charges are heavily weighted toward a fixed (slot reservation) component, thus shifting demand risk to the users. In addition, unlike any other E.U. network, the passenger train access charges are based on a reservation charge plus access fee per passenger with a fixed minimum that has the effect of shifting low demand risk to the operator but giving Eurotunnel a share of the benefits when demand is higher than the minimum (350 passengers/train).[31]

Eurotunnel appears to be one of the few modern[32] examples of a successful shift of infrastructure capital cost risk from government to the private sector. The original shareholders lost almost all their investment and the bondholders became shareholders with far less security for their investment. Access charges for the tunnel shifted at least some of the demand and operating cost risk to Eurostar and the freight operators, but demand and operating cost risk remained entirely with Eurotunnel for the auto and truck shuttle operations.

U.S. (Amtrak Acela and NEC Regional)

Amtrak (officially the National Railroad Passenger Corporation) was created in 1970 to relieve the privately owned freight railroads from the financial losses associated with rail passenger service. [33] Amtrak now operates all intercity rail passenger trains in the U.S. For many of its trains, it pays access fees to the freight railroads for the use of their tracks. For all services, it receives operating and capital assistance from the U.S. government.

Amtrak provides three types of services. It operates 15 long haul trains that usually have sleepers and diners and typically travel overnight. These trains mostly operate over the tracks of the freight railroads. It operates about 25 short haul, day trains, typically within one state and typically on freight railroad tracks. Amtrak currently contracts with 13 states to provide some of these short haul trains and many are supported by the state involved in addition to the federal support that they receive. Amtrak also operates the Northeast Corridor (The NEC -- see Map 14), the only area in which Amtrak provides services that can be called "HSR."[34]

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[31] Eurotunnel 2010 Network Statement at http://www.eurotunnel.com/NR/rdonlyres/CF12D0D4-5229-49A4-9562-9D4259C0E215/0/2010ETNetworkStatement.pdf

[32] Bankrupt railways in the 19th and early 20th century were common. There were instances of large railway bankruptcies, with attendant losses to shareholders, as late as the Conrail bankruptcy in the 1980s. It should be added that the U.S. government effectively nationalized Conrail, combined it with five other bankrupt freight railways, rebuilt it at a cost of US$8 billion and then re-privatized it in return for about USS$ 2 billion – evidently not all the risk was shifted… See, for example, Beshers 1989.

[33] See, for example, Thompson 2003, for a discussion of Amtrak's history.

[34] See Thompson 2005b for a detailed description of the history and issues involved in Amtrak's ownership of the Northeast Corridor.

Amtrak acquired the NEC in 1986 as a part of the restructuring of the freight railroads in the Northeastern U.S. Amtrak owns the tracks from Washington, DC to New York City, and it owns parts of the tracks between New York City and Boston, MA.[35] The NEC system carries two types of HSR trains – Amtrak Acela Express and Amtrak NEC Regional – along with commuter trains and freight trains.

The NEC is the only intercity electrified rail line in the U.S. The Acela Express operates at a maximum speed of 150 Mi/hr on limited sections of the NEC, but averages at best only 86 Mi/hr between Washington and New York City and about 60 Mi/hr between New York City and Boston. The current best Acela Express schedule from Washington, DC to Boston is 5:19: the slowest Shinkansen would make the trip in 3:31. The NEC Regional trains have a maximum speed of 125 Mi/hr in limited parts of the NEC, but make numerous stops and only technically qualify as HSR.

Overall, Amtrak requires in the range of US$1 billion per year in financial support and has, since its creation in 1970, absorbed well more than US$40 billion (2010$) in support. A particular part of the support has been US$6 billion in capital investment in the NEC infrastructure and rolling stock in order to improve trip times and schedule reliability.

The business model and risk allocations for Acela Express and NEC Regional trains are shown in Figure 23. The accounts for Acela Express and NEC Regional are combined with the costs of the NEC infrastructure in a way that makes clear analysis of the profitability of these trains difficult. Using Amtrak's allocations, though, the NEC trains are the only ones in the Amtrak system that cover all of their operating costs and cover their allocated capital.[36] Acela Express service is significantly more "profitable" than NEC Regional.

Amtrak is organized as if it were a private corporation, but its shares are wholly controlled by the U.S. government. Members of its Board of Directors are nominated by the President and are subject to confirmation by the U.S. Senate. Amtrak operates the NEC as an implied[37] profit center. Acela Express and NEC Regional revenues accrue to Amtrak. Amtrak charges access fees to the commuter agencies[38] and freight railroads that operate on the corridor. Amtrak has full control over the development of real estate assets it owns and revenues from development of those stations that it owns. Amtrak's operating subsidies come mostly from the federal government, but also from state governments in support of local, short haul trains. Essentially all of Amtrak's capital comes from federal sources though some capital comes from the states. In some cases, Amtrak operates short haul trains for its own account, and in some cases it operates trains under contract to state governments. Because of its quasi-federal status, Amtrak

[35] The section from the New York/Connecticut line to New Haven is owned and managed by the Metropolitan Transit Authority, a commuter agency operating trains from New Haven to New York City. Amtrak operates over this section under access rights. The section from Providence, RI to Boston, MA is owned by the Massachusetts Bay Transportation Authority (MBTA) but is managed by Amtrak.

[36] See Amtrak's Monthly Performance Reports at http://www.amtrak.com/servlet/ContentServer?c=Page&pagename=am%2FLayout&cid=1241245669222. Depreciation is not included in this calculation, nor does Amtrak have to pay back the federal money invested in the NEC infrastructure.

[37] The NEC is not managed as a separate profit center, but the accounts permit an approximate analysis of the NEC as a profit center.

[38] Commuter train access charges on the NEC tracks have been defined by Congress to be "marginal" cost in such a way that Amtrak is probably financially worse off with the traffic than without it. Freight access charges are negotiated with the freight carriers and appear to be as high as to be profitable and to discourage freight use of the NEC tracks.

is able to borrow money on private markets, sometimes with federal guarantee and sometimes without. In addition, the Acela train sets were produced by Bombardier and partially financed by Canadian export financing.

In one sense, Amtrak's risk profile in the NEC is similar to that of the private sector: it sets its annual budget (revenue and cost forecast) and then has to live within the support it receives. Amtrak is responsible for maintenance costs (rolling stock and infrastructure) on the NEC, and controls all operations on the infrastructure. If it exceeds the money appropriated to it, its officers are subjected to intense scrutiny and criticism.

On the other hand, Amtrak's political influence is such that it has the implicit backing of the U.S. Congress and thus the U.S. Treasury. There have been many instances in which Amtrak has approached running out of money before the end of the fiscal year and demanded more money: in every case, despite threats to the contrary, the DOT and Congress have come to the rescue. In actual practice, therefore, the public ultimately carries all of Amtrak's risks.

A Short Case Study of the Northeast Corridor

Despite being excluded for political reasons[39] from the Administration's list of Emerging Corridors, the NEC is recognized as being the most promising of all the potential HSR markets in the U.S. The NEC was the site of the first significant attempt at HSR service when the Pennsylvania railroad inaugurated the Metroliner services from Washington, DC to New York, and the New Haven railroad inaugurated the Turbo Train services from Boston, MA to New York, both in 1968. Metroliners were electric multiple-unit trains that were capable of speeds of over 170 Mi/hr on short stretches of track, but were operated in revenue service at 125 Mi/hr or less. The Turbo Train was an experimental design built by United Aircraft: it was powered by gas turbines and incorporated a tilting mechanism that was intended to improve trip times on the winding tracks between Boston and New York City, especially on the segment along the Connecticut coastline. Both of these services were developed during the last days of the Pennsylvania Railroad, largely as an attempt to gain favorable public notice in support of the merger between the Pennsylvania Railroad and the New York Central Railroad. Both services were successful in attracting passengers and public notice, and these demonstrations were a key foundation of the public support for improved passenger service.[40]

At the same time that public attention to HSR service in the NEC was growing, the financial condition of the Penn Central railroad (the merged Pennsylvania and New York Central railroads, and including the New Haven) was collapsing. Although the Penn Central was the largest railroad in the Northeast part of the U.S., its service was interconnected with others so that, when the Penn Central entered bankruptcy in 1971, it took most of the Northeastern railroads down with it.

The reorganization and rebuilding of the northeast freight railroads is a long and complicated story, but it had one outcome that is relevant to this study. In 1976, Congress passed the Railroad Revitalization and Regulatory Reform Act of 1976 (informally called the "4R" Act),

[39] As discussed, the NEC was separated from the other 10 corridors because the Administration believed that the NEC had already been proven as a major opportunity and wanted to give other corridors an opportunity without them having to compete with the NEC, which had already received a significant amount of Federal funding.

[40] See Thompson 1994 and Thompson 2005b for a more detailed discussion of the history of the NEC and its infrastructure.

which combined all the bankrupt railroads into a new company "Conrail" and established an agency to oversee the recovery of the system. One of the outcomes of the process was that the infrastructure of the NEC was transferred to Amtrak (because it was considered unprofitable for freight services) and the Northeast Corridor Improvement Program (NECIP) was established to manage a series of improvements in the NEC infrastructure. NECIP was initially funded at US$1.75 billion, but the budget was later increased to US$ 2.5 billion, and then reduced to $2.19 billion.[41]

NECIP began in 1976 and was largely finished by 1982, though some elements of the program continued for several more years. Though NECIP undoubtedly achieved a substantial rebuilding of the NEC tracks and stations, some key elements – notably completing the electrification link from New Haven, CT to Boston and upgrading the signaling to permit higher speeds and higher traffic density – were not completed until later because of budget limitations.[42] In addition, train services were provided by electric locomotives (based on a Swedish design) and existing passenger coaches ("Amfleet") that were not appropriate for the service.

With the assistance of DOT, Amtrak continued the NEC investment program, mostly in completion of the items left over from the original NECIP but also with continuing efforts to add capacity and operating improvements where possible. This program included the completion of the electrification from New Haven to Boston so that it is now possible to run electric trains non-stop from Washington, DC to Boston.

More important, Amtrak initiated efforts to design and procure new rolling stock that would permit higher operating speeds and incorporate a tilting design (as in the old Turbo Train) to improve the schedule from Boston to New York City. The result of this procurement was a new train system called "Acela."[43]

The Acela high-speed trains have been controversial. They were conceived by Alsthom and Bombardier as a combination of existing higher speed French bogies combined with a Bombardier tilting design. Unfortunately, partly as a result of being an engineering "camel"[44] that was not designed from the ground up for the purpose, and partly as a result of unduly strict safety requirements, the Acela was overweight and over budget. In addition, it is difficult to maintain, and has been the subject of litigation between Amtrak and Bombardier. Its service began in November, 2000 with a high degree of unreliability, but this has gradually been improved. Even so, the on-time performance of Acela in 2010 was only 80.6 percent, far below the level that would be acceptable in other countries for a premium service.

Despite the challenges that FRA and Amtrak have met in improving the NEC infrastructure and services, the NEC plays a major part in Amtrak's activities. Table 4 shows the growth of Amtrak's passengers since its founding along with the development of NEC services. Table 5 provides an overall profile of Amtrak in 2009 showing the role that each of its types of services plays. Interpreting Table 5 requires some caution, since the definition of "contribution" is not

[41] Japanese readers will be interested to know that JNR provided a series of experts to the NECIP management to assist in project engineering and planning. Their contribution was highly valued.
[42] See FRA 1986 for a detailed discussion of the achievements of the NECIP.
[43] Confusingly, the name "Acela" is used by Amtrak both as a general brand name as well as for the high-speed train name. The regional services in the NEC are called "Acela Regional," though they are actually operated by electric locomotives operating at a maximum of 125 Mi/hr. The high-speed Acela trains are properly called "Acela Express," and operate for short stretches at 150 Mi/hr.
[44] A "camel" is a horse designed by a committee that imposes incompatible requirements on a basically simple design.

precise: it is supposed to include all direct operating expenses plus an allocation of corporate overheads, but it does not include depreciation or interest. Even so, the Acela Express trains are the only ones that make a positive "contribution" to the remainder of Amtrak.

There have been many studies of ways to improve the NEC. These plans usually have had a state of good repair component in which all deferred maintenance is corrected and system components such as the aging electrification (which, south of New York City is still operated at 11kV and 25 Hz) and a number of moveable bridges that are increasingly expensive to maintain and unreliable to operate. A second component relates to expansion of capacity to allow for reducing existing congestion (a partial cause of Amtrak's poor on-time performance) and adding capacity for predictable future traffic increase by commuter agencies and by Amtrak even if the current schedule times are not improved. The final component of these studies is investment to improve the existing trip times. Four of these studies are worth careful review:

- "Northeast Corridor State of Good Repair Spend Plan." [Amtrak 2009a]. This study is a detailed analysis of those aspects of the current infrastructure that need to be repaired or replaced in order to bring the system up to good condition with modern facilities.
- "An Interim Assessment of Achieving Improved Trip Times on the Northeast Corridor." [Amtrak 2009b] This study reviews and adds to a number of earlier studies on the ways available to reduce the trip time from the current 2:45 (NY Penn to DC) and 3:15 (NY Penn to Boston) to savings of as much as 30 minutes from NY Penn to DC or 45 minutes from NY Penn to Boston. Capital costs estimated to do so would be in the range of $20 billion.
- "The Northeast Corridor Infrastructure Master Plan," [NEC 2010]. This study is a much more detailed joint study of the needs for the NEC infrastructure over the next 20 years. It was conducted by Amtrak in conjunction with the state commuter agencies, FRA and the freight railroads. Its focus is on the repairs and improvements needed to meet the capacity and service needs of all users from the viewpoint not only of intercity passenger services, but also of commuters and freight. It sets trip time goals for Acela Express of 2:15 from NY Penn to DC and 3:08 from NY Penn to Boston.[45] Taking into account the needs of all parties, it forecasts a total capital cost of $9 billion for state of good repair annualized work, and $43 billion for past state of good repair work, core capacity growth and other improvements, including Positive Train Control signaling.
- "A Vision for High-Speed Rail in the Northeast Corridor." [Amtrak 2010]. This study is explicitly a "vision" of what NEC service could be without any prior constraint on either costs or routes. It envisions trip times from NY Penn to DC as short as 1:36, and from NY Penn to Boston as short as 1:23. It includes tilting trains operating at speeds as high as 220 Mi/hr. Most significant, it analyzes an entirely new HSR route from NY Penn to Boston that would take an inland route from the NY/CT border through Hartford and Woonsocket, RI to Boston, permitting much higher speeds over a shorter route (but missing New Haven and Providence). The route from NY Penn to DC would remain essentially the same, but would require new entry/exit routes around Baltimore and Philadelphia. The study foresees that such services would earn large operating surpluses, but would require large capital investment from Federal and State sources. The total investment cost of the "vision" is estimated at $117 billion to be completed by 2040.

[45] NEC 2010, pg 20.

Background Issues for HSR in the U.S.

The broad context of HSR in the U.S. spans programs at both the Federal and State/Local levels. There are a number of jurisdictional issues that have not been important for conventional rail, but will become more important with HSR. In addition, the issue of public and private benefits will need to be addressed in detail.

Federal Policy and Financing

In the decades after World War II, Federal transportation policy was heavily highway and air oriented, with little attention to rail or urban transit. Passenger rail fares were heavily regulated and railroads were not free to adjust service in response to falling market demand. The failure of this policy became evident by the early 1970s when the financial burden of intercity rail passenger service nearly sank the private railroads, leading to the creation of Amtrak in 1970. A decade later, the collapse of the Northeastern freight railroads led to the nationalization and re-privatization of Conrail and to deregulation of the freight railroads. Deregulation was so successful that there has been no need for Federal investment in the freight railroads.

Even though Amtrak has cost the Federal treasury around US$ 40 billion since its creation, it cannot be called successful. It has survived, largely because of dedicated political advocacy by rail passenger groups and, possibly more important, pork barrel politics. Traffic has grown slowly, but there is still no fully agreed role for the various services it provides. Amtrak's long haul trains are funded for reasons of history and politics, but carry only a miniscule share of the nation's intercity transport. Its short haul trains usually amount to no more than one or at most two round trips/day on each route and have generated only a limited share of the short haul traffic. The NEC is generally agreed to be a well-justified part of the region's transport network, but has had difficulty justifying a national priority by itself as it only serves 8 of the 50 States. Outside the NEC, HSR has not been a traditional Amtrak role, and Amtrak has tended to support HSR studies and plans more for reasons of political strategy than for transport policy.[46]

U.S. urban transport policy began evolving away from inaction at about the same time as Amtrak's creation. Large scale funding for the Urban Mass Transportation Administration (UMTA – now called the Federal Transit Administration – FTA) began in 1971 and now amounts to around US$ 9 billion annually, roughly eight times Amtrak funding. It is important to underline here that FTA funding has been restricted to "transit:" that is, rail commuters, buses and other forms of mass transit. Short haul rail of the type provided by Amtrak is not included in FTA eligibility, a definition that has restricted the flexibility of state and local governments in funding the types of service that they need.

The obvious problem at the Federal level is that high-volume, high-speed intercity rail passenger service falls outside the boundaries of existing programs. In the recent past, the Obama Administration has attempted to change the situation.

In April 2009, the Obama Administration began a series of changes in US DOT policy toward rail passenger service. First, the FRA issued "Vision for High-Speed Rail in America." In October 2009, the FRA issued the "Preliminary National Rail Plan." In April 2010, the US DOT issued its "Strategic Plan FY 2010-2015; Transportation for a New Generation."[47]

[46] Amtrak has recently created a Vice President for High Speed Rail activities in order to focus its efforts at promoting HSR, -- and Amtrak's involvement in HSR.
[47] See FRA 2009a, FRA 2009b, and U.S. DOT 2010.

Taken together, these three documents reflect a significant change at the Federal level. They represent the first time that a Presidential Administration has proposed a positive plan (rather than radical budget cuts) for intercity rail passenger service in the U.S. After a number of previous studies of HSR in the past that generally concluded that the economic case for HSR was quite weak (except in the NEC), the FRA put forward a national vision for HSR that included almost all of the potential market areas for HSR and that projected a generally positive assessment of the eventual future for HSR. Finally, the DOT study announced a number of ideas that could lead to a better balance among the various modal funding programs and more flexibility for state and local officials to spend Federal money to best serve local objectives.

More dramatically, the Obama Administration, as part of its American Recovery and Reinvestment Act of 2009 (ARRA), provided US$ 8 billion in January, 2010 in funding for the High Speed Intercity Passenger Rail Program (HSIPR). See Table 3, which displays the history of the HSIPR program funding. Table 3 has been organized by the 10 Corridors proposed by the Administration plus the Northeast Corridor. The program is the first example of Federal funding for HSR, and it initiated a series of state programs proposing various levels of HSR investments. Two of these programs – California (San Francisco/Sacramento to Los Angeles/San Diego) managed by the California High-Speed Rail Authority (CA HSRA) and Florida (Miami/Orlando/Tampa) – envisioned an immediate start on true HSR systems of 150 Mi/hr or more. Most programs took a more modest approach, looking to services in the 110 Mi/hr range or even less. The California and Florida programs received nearly half of the total funding.

In October, 2010, the Administration announced another round of HSIPR funding amounting to about US$ 2.5 billion of which US$1.5 billion (over 60 percent) went to the California and Florida HSR projects, but with substantial amounts also going to the Chicago Hub. Immediately prior to the November, 2010 elections HSR (and improved rail passenger service generally) appeared to be developing rapidly, but there were clouds on the horizon as the Republican candidates for Governor of Florida, Wisconsin and Ohio had made skepticism about, or opposition to HSR a part of their campaign platform.

The results of the elections were highly unfavorable to HSR. The Republican candidates in Ohio and Wisconsin were elected and followed through on their promise to cancel their HSR programs. In response, FRA reapportioned their funds to other states that were still moving ahead with their programs. Then, in early February, 2011 the newly elected Republican Governor of Florida decided to cancel the Florida program as well, citing his belief that the Orlando to Tampa segment (the only part funded) would burden the state with operating deficits and that the proposed budget for the project was as much as 100 percent underestimated. FRA has not announced whether, and how, it will re-apportion the Florida money, partly because the Florida Congressional delegation has attempted to persuade the Governor to change his position. As of March, 2011, the Florida project is terminated and the funds will be distributed to other State applicants.

Making matters more unfavorable, the new Republican majority in the House of Representatives has embarked on a politically motivated spasm of budget cutting, with HSR squarely in their sights. To some extent this is because many Republicans are suspicious of HSR on the same grounds as the Governor of Florida, and to some extent because, though the Federal funds were awarded over a year ago, very little money has actually been expended by the States so that whatever stimulus rationale they might have had, it is true no longer. As a result, the HSIPR programs are a nearly irresistible target for efforts by the new Republican majority in the House of Representatives to cut spending. Though California's new Governor, Jerry Brown supports

the California HSR program, there is a lot of opposition to the project, partly on parochial not-in-my-back-yard (NIMBY) grounds, and partly because the CA HSR Authority has not done an acceptable job either of relations with local communities or of providing a credible implementation program, including demand forecasts, developing a business model, or financial planning. As shown in Table 3, all of the remaining states in the program are focused on improvements to conventional rail, so with Florida out of the running, California is the only remaining true HSR opportunity.

Unfortunately, there are no established federal programs available to build upon the one-time HSIPR funding. The Administration did propose in February of 2011 a $53 billion program for HSR. This program has the goal of making HSR available to 80 percent of the U.S. population within 25 years, and it proposed to spend the $53 billion within the first six years.

It is unlikely that this program will be passed for several reasons. The new Republican majority in the House of Representatives is attempting to rescind the money for the existing HSIPR commitments (along with many other programs that would normally have higher priority), and seems unlikely to reverse this position, much less support a much-expanded HSR program. In addition, the Administration did not propose a dedicated source of funding, such as an addition to the Federal and State highway fuel taxes, which means that the HSR money would be dependent on annual funding from a Federal budget that is already far overstretched. It is possible that the Obama Administration will make HSR a high enough priority that some compromise will be reached, but the outcome is at best unclear

Beyond funding issues, it is also clear that the eventual success of HSR in the U.S. will have to be based not only on intercity linkages, but also on much better systems of urban access to HSR stations. While these urban systems do exist in some cities in the Northeast U.S., they are very sparse elsewhere. Improving urban access will require not just more funding, but much better coordination among the involved Federal agencies (FRA, FTA, FAA for airport access, and the Department of Housing and Urban Development (HUD), among others). In this regard, it is quite encouraging that the American Public Transportation Association (APTA), previously an industry association for transit agencies, has announced a strong position in favor of HSR because of the synergy between intercity HSR and the services of the local transit agencies.

In parallel with an improved method of extending Federal funding for HSR, expanded use of congestion pricing on highways and at airports may also be needed. Most planning studies have identified relief of highway and airport congestion as a potential benefit of HSR, a point that has been underlined by the increasing congestion in many U.S. urban areas. Congestion pricing will increase the incentive to shift to rail; but, of course, this incentive will be less effective in the absence of a rail alternative.

State and Local Level Policy and Financing

Changes at the Federal level will have to be matched at the regional, state and local level. Only 13 of the 50 States currently have programs to provide support to intercity rail passenger services. Because Amtrak has tended to provide a large share of the funding for intercity rail passenger service, even within a single state, states have focused their resources on local transport and transit and have not had an incentive to develop active programs in support of intercity rail, including HSR.

Many states have only limited experience with PPPs because highways and mass transit have traditionally been seen as public responsibilities for which public agencies were the apparently

logical response. Only recently has experience been gained (mostly outside the U.S.) with private operation of public transit and this experience (partly because of labor union opposition) has not yet been translated into local transit applications. While this may not be serious for public transport, it will be more important for HSR where services will have to be provided on a commercial basis and private finance and market development expertise will be required (mirroring the experience in the privatization of JNR).

Another problem of the Federal/State division of authority in the U.S. is the fact that 8 of the 10 FRA Corridors (plus the NEC) will cross at least one state line (see the system vision below). This means that there may well need to be governing (funding and managerial) agencies coordinating the actions of the states involved. In the U.S. context, such regional agencies are difficult to form and are even more difficult to manage because the interests of the states never fully coincide and because the Governors of the states in the regional agency are often of different political parties with different priorities. The resulting regional agency is often too weak and financially unstable to manage a massive multi-year construction program and it rarely has stable funding to rely on.[48]

The states also mirror the problem fostered at the Federal level of inadequately developed local urban transit systems. Effective implementation of HSR will place more pressure on the state and local agencies to develop and fund urban bus and transit systems in order to support their investment in intercity HSR.

Jurisdictional Issues

Another issue that bears on the management models for HSR is the way in which jurisdiction over rail passenger services is currently established in the U.S. The role of Amtrak under current law significantly limits the role that other agencies of companies can play.

First, for expanded or improved operation on existing lines (whether or not they currently carry passenger trains), Amtrak is the only agency that has authority to mandate access to the lines: that is, Amtrak has the legal right to require that tracks be made available for Amtrak services. This right is not unlimited because Amtrak is required to pay the cost of any upgrading of speed or capacity.

Second, the U.S. freight railroads have in the past preferred to use standardized agreements developed over time and experience to deal with Amtrak rather than a multiplicity of new operators, all of which would have to be licensed and qualified and with whom new contracts would be needed. This preference may now be evolving toward neutrality, but it has acted in the past to limit entry of new rail passenger operators. In addition, Amtrak itself has exerted political pressure through its labor unions to limit the ability of state rail passenger authorities to contract with new operators.

Third, if Federal funding is used, then an HSR system will have to comply with a large number of Federal safety and other regulatory requirements, some of which can significantly affect the acquisition and operating costs of an HSR system. The Amtrak Acela is an example, because Federal safety requirements forced the equipment to be far heavier than comparable European or Japanese rolling stock. This increased the cost of the equipment and, because of its unnecessary weight, increased track maintenance and electric power consumption. Other

[48] U.S. Federal/State/Local issues were discussed in Thompson 1994. Little has changed since.

potential Federal regulations may affect labor working rules, further complicating the task of the HSR operator.

Another issue of great importance in the U.S. is that Amtrak is the only existing passenger operator that can provide reasonably priced liability coverage in case of accidents. This is due to Amtrak's large base of operations over which the liability can be spread, to Amtrak's established base of experience on which exposure can be calculated and to a provision in Federal law under which Amtrak's maximum exposure in any single incident is limited to US$200 million. Potential competitors in the rail passenger area find this an almost impossible barrier to overcome because, with the extreme emphasis in the U.S. on litigation in the event of accidents, rail carriers are exposed to very large potential liability in the course of normal operation.

Even though it has these advantages, Amtrak has a significant disadvantage in that past Board of Directors policy has excluded Amtrak from PPP roles in which its capital is significantly at risk. This means that Amtrak can only serve as a cost-reimbursed contract manager of service and cannot accept either cost or demand risk.

All of these jurisdictional issues work together to make rail passenger service harder to establish in the U.S. than it might be elsewhere. Going forward with HSR will require that they be confronted. Entirely new and separated HSR systems will be somewhat simpler, especially if they are wholly disconnected from the existing network. Proposals to upgrade existing lines will have to deal with all of these issues.

Some progress has been made. As suggested, the freight railroads are showing more flexibility in working with new operators, and states have generally realized that a voluntary agreement to use existing lines is actually better than using Amtrak to mandate access. Amtrak has fiercely resisted the intrusion of private operators into the rail passenger business, but it has eventually lost nearly every competition because its costs are too high, operating conditions are too rigid, and it cannot take any risks. Also, many states feel that Amtrak's service has not been responsive to local needs, which is a danger when a nationally based company tries to operate responsively at a local level.

Public and Private Benefits

Perhaps the most serious hindrance to development of HSR in the U.S., at least in the past, has been that transportation policy has not been able explicitly to calculate the range of public benefits and costs that would go along with private benefits and costs. What this has meant is that public investment has been biased toward programs where the net private benefits have been great enough to generate private political pressures for public money. Highways are a good example: private benefits to truckers have been great enough to ensure a trucking lobby that supports highway construction and suppresses highway user charges (primarily fuel and oil tax) to the point that heavy trucks pay less than their impact on highway maintenance.

The imbalance becomes more significant when public benefits are taken into account. Neither trucks nor autos pay for public costs such as congestion, emissions or safety impacts, nor has there been any agreed system for computing the contribution of rail passenger (and freight) service in reducing these costs.

Most rail passenger investments are a balance between public and private benefits and costs, with rail passenger services, especially urban systems, heavily weighted toward public impacts. In fact, it is almost unheard of for an urban rail system to collect in passenger fares more than a

small percentage of its total costs, and yet governments consider that the contribution of the system in generating a large consumer surplus (the difference between what the user pays and what he or she would be willing to pay), in reduced congestion on other modes, in reduced emissions and noise and in improved safety (among others) more than compensate for operating losses. It should not be surprising that a nation that has had difficulty incorporating public benefits and costs into the overall equation would have difficulty implementing PPP arrangements when purely private net benefits will not support the investment.

Historically this has been somewhat less serious where existing systems are being upgraded (capacity or service) because the risks involved are small and calculable. It will be much more important in "greenfield" HSR systems where all the risks and investments are higher and the balance of public versus private net benefits will be significantly related to a clear evaluation of both. There is little question that, for most potential U.S. HSR systems, private financial net benefits alone will not support the system. Instead, the public will need to find a way of transferring enough of the value of the public benefits to the private PPP partner to make the project beneficial to both.

Figure 24 illustrates the four potential cases graphically. The first is the case in which passenger revenues (and other operating revenues such as station development) are great enough to cover operating costs and repay capital and in which public net benefits are also positive. In this case, a PPP is not really needed and the private sector can develop the project.

The second case is one in which the private net benefits are large enough to cover operating costs and recovery of capital and would permit the private partner in the PPP to compensate the public partner for any net public dis-benefits such as noise or congestion. Typically the method of compensation is a tax or charge, but could also be implemented through regulatory mandate (automobile fuel economy standards, for example).

The third case occurs when private net benefits are negative, but public net benefits are large enough to permit a payment from the public partner to the private partner that will yield a net positive balance to both. A gross-cost operating concession in which the private partner offers minimum operating support would be an example of this case, as would the use of an infrastructure agency whose access charges are low enough to permit the private operator to operate profitably or a net cost concession in which some portion of the capital investment is not charged to the concessionaire. This case is the rubric under which most HSR (indeed, most passenger rail) systems operate and it is the approach that appears to be required in any future U.S. HSR systems.

Case four occurs when the system is not profitable to the private sector and generates net dis-benefits for the public sector. When this happens, the project should not proceed. With perfect information, projects in this category would never be undertaken and yet, according to a number of studies, they do.[49] The reasons appear to be partly economic and partly (maybe mostly) political. Predicting the outcome of a multi-billion system to be constructed over many years and with an undeveloped market is inherently difficult and all numbers are subject to a large range of uncertainty that only dissipates as the project proceeds. The second factor is often politely called "optimism bias," which is the tendency of those who benefit from a project, but bear little risk, to exaggerate expectations. "Optimism bias" is generally much greater with the public side of the PPP and somewhat less on the private side, but only when, as suggested in the risk

[49] See, for example, Flyvbjerg, et. al. 2006 and Priemus, et.al. 2008

allocations Figures discussed in this paper, the private partner actually bears the risk of over-optimism.

It follows from the above discussion that the ability to develop generally agreed quantification of public benefits and costs to the same degree of confidence as private benefits and costs becomes a critical factor in evaluation creation of HSR PPPs. There is adequate experience for estimating capital and operating costs of HSR (allowing for the optimism bias and including the necessary allowance for uncertainty until specific experience is gained). There is less experience and agreement in quantifying the value of: consumer surplus (especially difficult because it is directly related to demand forecasting); time saved (if not included in consumer surplus); reducing noise and various air and water pollutants; reducing congestion on roads and airports/airways; lives saved when shifting traffic from air or road to HSR; and reducing carbon emissions. It is also clear that the business models available for HSR along with risk allocations possible will be strongly influenced by the ability to evaluate and incorporate both public and private net benefits into the PPP relationships.

A Long Range Vision for HSR in the U.S.

Before discussing the specifics of improved rail passenger service in the U.S., including HSR, it will be worthwhile to discuss briefly what the long-term vision might. This does not imply a program, or any particular schedule: rather, it is meant to furnish a vision of what might be accomplished by the year 2050 if the Federal government and the states develop programs and funding to vigorously pursue the idea in all areas where, after more detailed analysis, HSR is a viable PPP opportunity.

The fundamental benefit of HSR for passengers is trip time savings. Rail cruising speed can be much faster than the automobile, but rail must operate on a fixed schedule and system access requires that passengers go from origin to a rail station and from the destination rail station to their ultimate destination. Airlines can have much faster cruise speed than rail, but generally impose even more of a time delay because of access to/from airports and airport security. Airline schedules are also typically less frequent than rail.

The net result, as shown in Figure 25, is that there is a distance range, roughly from 100 miles on the lower end to upwards of 500 to 600 miles, depending on the HSR cruise speed, over which HSR is faster than any of the alternatives. HSR is also generally more reliable, more comfortable, and safer than alternative modes. There is, in other words, a distance-related “sweet spot” within which rail can offer a viable transport option if passenger demand is high enough.

Demand for passenger transport is largely determined by the population living within a reasonable access distance of the rail stations. This means that markets that have both the right distances and the right population density are the places to look.

The FRA has studied potential rail corridors for many years and the result is shown in Map 15. The FRA has designated 10 “Corridors” (sometimes called “Emerging Corridors”) that appear to have the appropriate combination of distance and population to constitute promising markets for HSR. Although the NEC is not a designated corridor, this is partly a result of the general agreement that already exists that the NEC is the most promising HSR market in the U.S. and partly because, for short range political reasons, the NEC was excluded from the list in order to give the other corridors and states a fairer opportunity to claim the current HSIPR funding.

These Corridors were studied in more detail in support of analyses that ITPS has conducted.[50] The ITPS analysis was based on the FRA Corridors, but added a few short links in order to provide a much higher degree of interconnectivity. The analysis also included estimates of the total line-miles, future corridor populations, total passenger trips, high and low CO2 emissions avoided, and high and low infrastructure costs. The results are shown in Figure 26.

In overall summary, by the year 2050, there could be projects yielding somewhat over 10,000 miles of exclusive HSR line operating at speeds as high as 220 Mi/hr. This set of Corridors could carry as many as 455 million passenger trips annually and could result in the reduction of CO2 emissions by between 4.4 million and 13.8 million metric tonnes annually. It would cost between US$ 210 billion and US$ 365 billion to construct. By comparison with the Administration's goals to serve 80 percent of the population, this system would serve about 65 percent of the population. It would also mature in about 40 years rather than the 25 years in the Administration's goals.

It appears unlikely that that all of these Corridors will be built as designated. Then again, in 1955, it would have seemed unlikely that the Interstate Highway System would be built in the way that happened in the ensuing 60 years. It is quite possible, in the unstable current political climate in the U.S., that the planned starts in California and Florida will be delayed. Even so, it is hard to reject the argument that the issue has more to do with timing than with the eventual outcome. There is a credible future for HSR in the U.S. What is the path for getting there?

Getting to the Future: Potential HSR Business Model and Risk Allocation Options in the U.S.

Three broad types of projects have emerged from FRA's HSIPR program and from past experience with Amtrak: limited upgrading to existing lines to yield minor additions to frequency or speed; more significant programs that yield higher speeds or capacity; and entirely new and separate HSR systems. These may not be mutually exclusive: minor upgrades can be based on one approach that, if successful can be followed by more significant projects using a different business model. At some point, an entirely new system, with an entirely different model can be adopted.

Minor Changes To Existing Lines

This is the "default" option in common use today. There have been many state-supported short haul trains using variants of the model (for example, the "Downeaster" from Portland, ME to Boston, MA.). In most cases, a state contracts with Amtrak on a fully cost-reimbursable basis to run trains for the state's account, and has allowed Amtrak to negotiate access charges with the freight railroad owning the infrastructure. In the past, Amtrak has not always provided the underlying cost accounting needed to ensure that all its costs are reimbursed, and some states have been able to obtain service without paying the full cost. In the future accurate cost separation and fully reimbursement will be required under sections 209 and 217 of the Passenger Rail Investment and Improvement Act of 2009 (PRIIA). Figure 27 shows the business model and risk allocations that underlie minor additions of this type.

The business model places all planning and investment responsibility on the states, while Amtrak acts as a facilitator. Rolling stock is owned by Amtrak or, in a few cases, by the state.

[50] Tanaka,Yuki, et.al. 2010.

Infrastructure, including any improvements, is owned by the freight railroad. All financial responsibility lies with the state.

Because essentially all work is contracted on a reimbursable basis either to Amtrak or the freight railroad, cost risks remain with the state. Demand risk is also the state's responsibility. All financial risk remains with the state sponsoring the service.

The primary advantage of this option is that improvements can be done in small increments with minimal financial risk. Demand response to improvements can be tested before a decision is made to attempt a larger program. Favorable experience can lead to larger programs while the cost of a failure can be limited. The disadvantage is that all responsibility and risk falls with the state. In addition, Amtrak has been effectively a monopoly provider, denying the state the benefits of competition and the innovation that PPPs can bring.

Significant Changes: Adding Speed or Capacity

There is also experience with programs to implement significant additions to speed or capacity of a rail passenger line. The California Department of Transportation (Caltrans) has had a large program both of purchasing existing freight lines that freight railroads no longer want, and/or adding capacity and speed through better signaling, added tracks, etc. Caltrans has also contracted with Amtrak to add service beyond that provided by Amtrak. The Capitols (Sacramento to San Jose) and the Pacific Surfliners (San Diego to Los Angeles) are examples. The states of Washington and Oregon have worked together to improve rolling stock, speed and frequency on service from Seattle to Eugene (Cascades). The state of North Carolina has purchased some lines in the state and has implemented a continuing program of elimination of level crossings financed by state and federal money.

This approach is also the basis for a number of the HSIPR funded projects in Wisconsin (Madison to Milwaukee and Chicago), Illinois (Chicago to St Louis), Ohio ("3C" Corridor Columbus, Cincinnati to Cleveland) and continuation of upgrading in North Carolina.

The advantage of this approach is that it can be a further test of improved service in advance of true HSR. In cases where the major trip length is short (<150 miles), speeds of 110 Mi/hr that are typical of this type of improvement can actually be good enough for permanent use (Figure 25). The market response to better service can be tested at minimum cost and risk because speeds of 110 Mi/hr are well within conventional rail technology and do not consume excessive amounts of capacity of freight lines.

Figure 28 shows the typical business model and risk allocations for significant projects. For the most part, Amtrak still is the default operator, though significant projects may raise the possibility of finding a competitive private operator. In some cases, especially when the investment is large, states have chosen to purchase the line so that they will own the improvements and in order to shift the control over scheduling and dispatching the line from the freight railroad to the state. Rolling stock is typically owned by Amtrak, but can also be purchased by the state and leased to Amtrak. So long as the freight railroad owns the track, the operator pays an access charge: the state may or may not choose to impose an access charge on the passenger operator when the state owns the line, but it will impose an access charge or use fee on the remaining operations of the freight railroad. The state generally bears the full financial responsibility (Amtrak and the freight railroad bear none), but there is often a significant share of the investment provided under federal programs such as HSIPR. Risk allocations shift

entirely to the state except in cases where a private operator is competitively obtained by the state.

New, "Real" HSR systems

There are going to be many options for establishing new HSR in the U.S. The approach chosen will depend heavily on federal and state policy and financing roles, the risk transfer objective of the system's sponsor, the expected balance of benefits and costs given that most systems will fall in case three (Figure 24), the type and scope of public sector objectives, and the sheer size of the project that, whatever the apparent benefits, might be too large for private financing.

As the discussion above established, there will be no HSR systems financed and built purely by the private sector for a number of reasons. The political and social aspects of the ROW acquisition are beyond the capability of a private entity to plan or enforce without public authority. It is unlikely that the operating surplus will fully recover all capital investment, especially if the public sector regulates tariffs for political or social reasons. The full acquisition and construction cost risks, including unexpected litigation delays, are too high for any private entity to handle without some form of public guarantee. New HSR systems have an inherently high demand risk because there is no past experience available. Experience so far shows that this demand risk cannot be wholly transferred, no matter what assurances the private partner gives.

Very explicitly, therefore, no new HSR system will be built in the U.S. without a significant public role in planning and funding the system. This will require a major commitment to acquire public expertise, just as was done in the planning and oversight of the Interstate Highway System.

Government roles outside the U.S. have included capital grants, loan guarantees, various forms of operating support and assumption of some types and degrees of risks (ROW acquisition, capital construction, rolling stock financing, and demand, among many others). At the same time, a number of opportunities for the private sector in HSR PPPs have also been proven, including construction of some parts of HSR systems, operations management, rolling stock acquisition and maintenance, and marketing). In general, private management has proven to better at developing markets and in improving efficiency though, as always, there are cases of highly effective public management as well. In the U.S. context, with the prevailing emphasis placed on use of the private sector to produce and deliver services, especially when (as is the case with HSR) the service will be competing with other private operators (buses and airlines) and should not be unfairly subsidized, the option of public operation of HSR (unlike mass transit) appears unlikely to be chosen. Some form of PPP will be mandatory.

What are the optional business models? We can define a few potential business models in order to illustrate the range of models. The listing is not complete. Also, these models are simplistic and there are many variations of the models discussed. They do serve to illustrate the interrelationships between the business model and other issues an HSR project will face.

- **The fully public, mass transit model**. In this model, the HSR public agency would acquire all needed property, manage and pay for the design and construction of the system, acquire rolling stock, set prices, collect revenues and manage operations including maintenance of rolling stock and infrastructure. This is the model for many public transit systems in the United States. Under this model, all risks would be for the agency's account, and the agency would be in position to ensure that prices are set such that the public receives maximum

benefit from reduction in emissions and congestion as well as improved safety of rail over alternative modes. This model is often chosen when the benefits of a project are primarily public and revenues are not expected to cover financial costs. However, because the HSR product in this case would be intercity rather than urban travel, the agency would also be in the position of a public sector entity competing, possibly unfairly, with private sector airlines and bus companies as well as private automobile users. As discussed above, while this approach has been used in many countries, it would not be a likely choice in the U.S.

- **The management contracting or "gross cost" franchising approach**. Under this approach, the public agency would plan, build and finance the entire system, but would contract with a separate, usually private, entity to operate and maintain it. A number of short haul U.S. rail passenger systems are operated in which Amtrak serves as a cost-reimbursable operator for the State. It is also the emerging approach for private sector participation in many passenger railways in the E.U. The agency would retain essentially all cost and demand risk, but might be able to transfer some operating cost risk to the operating contractor or franchise (especially if the contract is put out for competition) and might be able to ask the franchise to bring commercial as well as operating expertise to the venture. Depending on the revenue level and the share of revenues the franchise is allowed to retain, there might or might not be an "operating subsidy" or there might even be an operating payment to the agency (U.K. experience furnishes examples of both payment to and payment from the agency). Experience to date suggests that this option may be easier to apply when public benefits predominate.
- **A long-term "net cost" concession**. The agency would plan and construct a system to the basic capacity level expected by the agency. Potential concessionaires would compete for a long term (15 to 30 years or longer) exclusive concession to operate the system. The concessionaire would set prices, make demand estimates and determine operating frequency and capacity (subject to conditions established in the bid documents) and design and furnish rolling stock and any other commercially important assets. Depending on the commercial potential of the system and the limits set on tariffs, concessionaires might be willing to make substantial positive payments to the agency, either for construction or for operations. This is the initial model adopted for the suburban systems and Metros in Buenos Aires and Rio de Janeiro and it is similar to the models for operation of longer haul passenger franchises in the U.K. Under this model, the agency would still retain all capital cost risk for the infrastructure, but might be able to transfer at least some of the commercial and operating cost risk, including the cost and the demand risk associated with the rolling stock. Depending on the form in which the concession payments are determined (fixed in advance, share of gross or net revenue, etc) the agency could recover some, or possibly a substantial share, of the capital cost of the infrastructure. Experience to date argues that net cost approaches are more suited to projects where the services are mostly "commercial" in which private benefits play a larger role in total benefits.
- **The separated infrastructure approach**. Under this approach, the public agency would design and construct the infrastructure and then allow (subject to control over schedules and dispatching by the agency or its agent) a single HSR operator or competing HSR operators along with complementary local operators to provide service. The agency would impose an access charge based on capacity and use factors (monthly reserved train paths, train-miles operated, gross ton-miles operated, etc.). Under this approach, complementary local operators might also pay access charges on an appropriate basis, but otherwise be independent of the agency. This is the approach adopted by the E.U., though different member countries have adopted different sets of access charges that collect some part or

all of the financial costs of the infrastructure.[51] The agency would still retain essentially all capital cost risk of the infrastructure, including maintenance, and it would have to make decisions as to access charges and priorities. On the other hand, the agency could, if desired, achieve competition in the HSR market (not just for the market as in exclusive concessions) and could disconnect the operations of local operators from that of the HSR operator(s). It could also transfer a substantial portion of the demand risk to the operator(s) and could achieve fully commercial operation of the system (in fact, airlines or bus companies might be bidders to operate trains, as is the case in the U.K., Germany and France). Depending on the commercial potential of the market and the access charges set, access charge revenues could make a contribution to recovery of the agency's capital investment. This model has less value if there is only to be a single, monopoly operator on the system: even then, it can furnish a way to disconnect the infrastructure investment from rolling stock and operations in a way that could limit public involvement to infrastructure alone. With the appropriate level and structure of infrastructure charges, operators can be given incentives to provide services in a way that maximizes public benefits as well as private benefits.

- **An essentially private approach** in which the public agency would use its power to designate and acquire a right of way, establish broad system specifications, and then award an exclusive concession to a private consortium to design, build, finance, operate and maintain the system for a specified, usually long (>30 years) term, or even permanently. This model could in principle shift almost all the cost and revenue risk to the private sector and, depending on the policies of a regulator (which this approach would require) could generate a contribution to the agency's investment costs or to state finances. As discussed above, purely private options are unlikely in HSR systems because most U.S. systems will be case three (Figure 24) in which public benefits are a major portion of total benefits.

There are many variations on these options, some of which are not mutually exclusive. Local governments can (probably should) be asked to finance the construction and operation of stations in return for a share of the local area development benefits that the system generates. This is especially important because good urban access to stations (financed by local authorities) will be a critical determinant of intercity high-speed rail demand. An electric utility could be permitted to finance and construct the entire electrical power supply system in return for agreement on an electricity tariff that would guarantee an appropriate rate of return. Emergence of a Federal grant program similar to the Interstate Highway program would surely shift the financing balance among the participants in the system, while lack of such a program combined with restricted State and/or local funds would mandate that the private sector take a large role in finance and management with a consequent impact on who pays for the system, who manages it, and who bears what risk. It might also be possible to implement the models sequentially as actual cost and demand experience is gained: for example, it would be possible to shift from gross cost to net cost franchising when actual demand history has been established.

Risk allocations for new HSR systems in the U.S. are similarly complex, as Figure 29 shows. This Figure lays out the capital and operations risks for new HSR systems and shows how they might be allocated and mitigated, depending on the Business Model being employed. The Figure also emphasizes a critical issue in risk allocation – which party is best suited to bear the risk. A common problem in PPP formulation for large projects is a temptation to allocate risk where it "should" be rather than where it actually must be. For example, no private entity,

[51] See, for example, Thompson 2008.

however large, can actually carry the full risk of the capital cost of a US$ 50 billion project, no matter what promises are offered: in the final analysis, the public will have to take a major share of the risk. As another often ignored example, few if any private entities can take all the risks of economic change over a 50 year period simply because no one can foresee or allow for all possible events: some measure of flexibility and ability to renegotiate must be included in all concessions, and this is another way of saying that both parties will retain at least some risk.[52]

If there is no purely public approach in the U.S. context, and no conceivable totally private approach either, then the remaining options will require a combined approach; a public/private **partnership**. How might the available PPP options work in fostering HSR in the U.S.? Figure 30 lays out the business models described above and shows which party owns and controls the assets involved in an HSR system (ROW, track, electrification, signals, rolling stock and operating management). Figure 30 also briefly outlines the attributes of each model and gives a few examples of its application. Figure 31 looks more specifically at the risk management and financing involved with the PPP options.

Realistic Choices for the U.S.

As highlighted above, the overall transport policy and financial context in the U.S. is sufficiently distinctive that it will not be feasible to adopt any particular E.U. or Asian model directly into the U.S. Moreover, the demographics and politics of the states and regions of the U.S. are themselves sufficiently distinct as to ensure that there is no single model that will fit all corridors. Each corridor will likely be somewhat different. With this said, there are some realistic conclusions and constraints that will serve to guide planners when setting up U.S. business models including risk allocations.

The public ownership and operation model that is common in the U.S. for mass transit is not likely to be adopted for HSR. HSR services are basically "commercial," serving customers in competition with private airlines, automobiles and buses, and the balance of benefits is much more weighted toward the private side than in mass transit. Public operations will not be appropriate.

On the other hand, the demand and investment risks for new systems are too high for any private consortium to undertake on its own. In addition, public benefits will be high enough that public involvement will be needed to ensure that public benefits are maximized and that there will be sufficient transfer of public benefits to the private operator to permit financial viability for the private parties. "Mega-Projects" of the extreme size of HSR will inherently require public guidance and commitment along with an appropriate sharing of financing and risk.

This leaves management contracting, gross cost franchises and net cost concessioning as potential approaches. Infrastructure separation is also an option that could accommodate these choices in a slightly different way.

Management Contracting

Management contracting, in which the public agency plans, designs and builds the system and designs and acquires the rolling stock, would clearly work. The advantage of the approach is that it would permit the public to ensure that all public objectives (environmental impact,

[52] See ECMT 2007, especially pg. 197 ff, for a thorough treatment of concessioning issues, including risk allocation.

consumer surplus, congestion reduction, etc.) are maximized to the extent possible. It would at the same time improve operating efficiency by comparison with public operation by permitting competition for the operating contract. Any surplus of revenues (with prices set by public authorities) over contracted costs can be applied to capital recovery.

The downside is that all but a minor part of the risks of the project would remain in public hands and only a very minor part of operating cost risk would be transferred. Equally important, the entire financial burden would fall on the public sector. Given the uncertainty that prevails in the U.S. about budget deficits and expenditure reductions at the federal and state levels, this might be a fatal defect.

Generally speaking, management contracting works best when the service to be delivered has no commercially competitive aspect and/or is heavily supported by public benefits. It can also serve as a transitional approach. When demand has been established and infrastructure costs have been managed, a transition to gross cost or net cost franchising will be possible.

Gross Cost Franchising

Gross cost franchising would work for most of the same reasons that management contracting would work. It would have the minor added advantage of bringing the private sector more into calculation of demand and assumption of demand risk, especially if the franchise includes bonus/malus provisions for promoting demand and decreasing costs. It is also possible to promote private investment in rolling stock or other assets, but only with public guarantee.

Gross cost franchising has essentially the same disadvantages of management contracting in that the public partner would still hold the vast predominance of risk and would have to raise most of the money. Gross cost franchising works best when the public wants to increase the role the private sector plays includes more involvement in demand forecasting and operating efficiency, but the public agency is still not able or willing to expand the private role into pricing or net income generation. When demand has been established and infrastructure investment costs managed, a transition to net cost concessioning would be easier.

Net Cost Concessioning

In principle, net cost concessioning or franchising, along the lines of the initial suburban concessions in Buenos Aires or the long distance franchises in the U.K. could shift a significant financing and risk burden to the private partner. In addition, some commercial risk (pricing and efficient cost management) can also be shifted and governments could expect the private sector partner to do a better. In Buenos Aires, the government even shifted some investment cost risk to concessionaires by requiring concessionaires to bid on a specified investment program and including those costs in the total bid. The U.K. government shifted rolling stock investment risk to the ROSCOs (for both gross and net cost franchises), but this was possible only because franchises were initially forced to lease the existing rolling stock from the ROSCOs. Even where franchises were re-bid, the new franchise initially had to deal with the ROSCOs so the ROSCOs had only limited market risk for rolling stock.[53] In later years, competitors for the ROSCOs have emerged through creation of Special Purpose Vehicles (SPVs) that will deal with a particular franchise. In many cases, though, the SPVs include management responsibility from the ROSCOs.

[53] The ROSCOs turned out to be the most consistently profitable segment of the privatized U.K. system.

Net cost concessioning was possible in Buenos Aires and in the U.K. because there was a demand record to work with. Concessionaires could plan for improvements in demand and income because they had many years of past demand to analyze and project. It is less likely that private investors in the U.S. would risk billions on a completely unproven market unless the potential returns appeared to justify the risk, which is not the case with HSR. Even the best of foreign systems, where demographics are in the short run more favorable than the U.S., did not generate enormous returns.

In actual world practice, net cost concessioning has tended to run into problems for the same reason that most U.S. Air Force airplanes end up being over cost and behind schedule. At the outset, the public agency appears to have all the power, and promises are extracted from bidders: once the bid has been awarded and a monopoly supplier market position has been established, the balance of negotiating power tends to shift from public to private partner. In rail concessioning, this has meant that the public ended up assuming many of the risks it thought it had transferred to the private sector partner.

Net cost concessioning appears unlikely to be the first stage of U.S. HSR systems because demand risk for a new system cannot be transferred successfully and because there will always be a substantial public component in the planning and construction of HSR systems – a component that it would be difficult to transfer.

Infrastructure Separation

Infrastructure separation is an option that will work with gross cost franchising, net cost franchising and with entirely separate, even private operators. With appropriate access charges, it is a good way to develop competition in a market (for example, competing high-speed operators as will happen in the Channel Tunnel and HS-1 in the U.K.) or to accommodate non-competing operators such as the local gross cost commuter franchise operators in the U.K., Sweden, Germany and Norway. It can also accommodate entirely separate and private operators like the freight rail company (EWS) in the U.K.

Aside from promotion of multiple use of the infrastructure, the primary advantage of infrastructure separation is that it can limit public involvement to infrastructure investment and regulation of access charges while permitting a maximum transfer of commercial risk (including rolling stock) to private operators. In U.S. corridors such as California that plan to have not only an intercity HSR operator but also several local operators, separation might be a useful option. By comparison, in Florida, where only a single operator is planned, separation might not have as much to offer. Infrastructure would combine easily with management contracts or gross cost franchising although, as in the U.K., access charges will simply be a pass-through from the agency supporting the service to the infrastructure agency. Net cost concessioning, especially with multiple operators, might succeed in transferring some of the access costs to the concessionaire (and customers).

The primary disadvantage of separation is that it leaves the infrastructure cost and capacity risk in public hands. It is possible that, if demand proves to be sufficient, access charges can be set to recover some or all of the public investment. It seems more likely that competitive award of the HSR operations concession (or sale of the business rights) would generate some positive payment to the network agency, but that a significant part of the infrastructure cost will never be recoverable from operators.

The Case of the NEC and its Institutional Structure

It is highly significant that the studies cited above concerning the future of the NEC, with one exception, (Thompson 2005) do not discuss the NEC as an institution except to observe that the current, fragmented institutional framework does not work. For example, the "NEC Infrastructure Master Plan" [NEC 2010], while it was a path breaking effort in bringing closer coordination among the various operators on the NEC (the lack of coordination, even conversation, was a matter about which all operators had complained), made no significant proposals about how the ownership or operation of the NEC might be improved. The Amtrak "Vision" suffered from the same implicit assumption that Federal financing would somehow emerge to meet the needs with no discussion of why the existing institution had failed in the past to attract such investment nor why an unchanged institution would somehow succeed in future.

Organizations resist change, and Amtrak (and the commuter agencies in the NEC) is certainly no exception. The complexity of the NEC, with Amtrak intercity trains, 8 commuter agencies and 7 freight railroads using parts of the same, common infrastructure certainly encourages caution in designing institutional change. With that said, though, it is interesting to compare the NEC with the institutional models discussed earlier.

An immediate observation is that the NEC seems to be one of the few cases in the U.S. where infrastructure separation is an obvious solution. In fact, all but Amtrak are already separated from the infrastructure (except for Amtrak's operations in Connecticut west of New Haven, where all but the local commuter agency (MTA/CTA) are separated operators). If Amtrak's intercity services (and those of its long haul services that use the NEC) were separated from its infrastructure and each service paid an access charge on the same basis as other operators, then access and services to all operators would be on the same basis. This would also have the advantage of clarifying the economic performance of all of the services using the NEC.

Ownership of the NEC infrastructure is likely to remain in public hands because of the dominance of public operators. Adoption of a DB-type organization where an Amtrak holding company controls both high-speed operations and infrastructure, but infrastructure is operated as an independent subsidiary, would be one option. Transfer of the NEW infrastructure to the DOT [Thompson 2005] with subsequent leaseback either to Amtrak or to a newly-created Federal-State compact to operate and maintain would also be possibilities. In either case, as is the policy in the E.U., the major responsibility for capital investment will remain with the Federal Government (intercity) and the States (commuter). Freight railroads would have the responsibility to pay for investments that they needed for their use. It is, in any case, appropriate for the public (Federal and State) to retain the major capital funding role because of the high public benefits that rail can produce in the congested NEC conurbation.

More radical possibilities could be found in franchising or concessioning either the Amtrak high-speed services or some of the local commuter services. For example, the U.K.'s Virgin West Coast franchise carries far more passengers and passenger-km, and operates over a longer route, than the Acela Express and the NEC regional services. At least 5 of the U.K. shorter haul franchises carry more passengers and more passenger-km than any of the commuter agencies on the NEC (and, of course, many of the commuter agency passengers and passenger-miles do not involve the NEC).[54] There is nothing about the NEC operations that would prevent concessioning or franchising and, in fact, two of the commuter operations (MBTA and Virginia Rail Express) are now being operated by concessions.

[54] Compare ORR 2010 with the NEC 2010 data at pg 5.

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Table 1

Profile of Higher Speed Railways

Country	Miles of Higher Speed Line: > 150 mph "Express"	Miles of Higher Speed Line: 100 to 150 mph "Regional"	Miles of Higher Speed Line: Total	2008 HSR Passengers	2008 HSR Passenger-Miles
Japan (3 JRs)	1,482		1,482	310,237	50,710
China	20	4,724	4,744		
Taiwan (THSRC)	214		214	30,581	4,077
Korea (KTX)	149		149	38,016	6,308
France (RFF/SNCF)	1,051	3,215	4,266	116,054	32,642
Germany (DB)	537	977	1,514	74,700	14,490
Italy (FS)	330	1,718	2,049	23,882	5,513
Spain (ADIF/RENFE)	773	483	1,255	22,955	6,514
Belgium (SNCB)	108		108	9,697	670
UK (/Eurotunnel/Eurostar)		70	70	9,100	617
Sweden (Banverket/SJ)		1,600	1,600	8,764	1,858
Netherlands		120	120	5,966	538
U.S. (Acela)		450	450	3,399	631
U.S. (NEC Regional)		450	450	7,489	1,145
World Total	4,665	13,356	18,021	660,840	125,714

Sources: UIC, International Railway Statistics 2008, Table 10 and Table 50
UIC, International Railway Statistics, Time Series 1970 to 2008
Amtrak, Monthly Performance Summary, Sept 2008

Note: China does not release HSR passenger data.
UK and NL traffic almost certainly includes higher speed traffic not represented by the lines shown.
Sweden data mostly represent X2000 trains on 200 Km/hr lines.

Table 2, Page 1 of 2

HSR Passenger Traffic AS DEFINED BY THE RAILWAY INVOLVED (generally >160 km/Hr)

	JRs (Shinkansen) *Japan*			KORAIL *South Korea*			THSRC *China-Taiwan*			DB AG *Germany*			FS *Italy*			NS *Netherlands*		
	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)
1964	11,018	3,912	355															
1965	30,967	10,651	344															
1966	43,784	14,489	331															
1967	55,250	17,991	326															
1968	65,903	21,027	319															
1969	71,574	22,816	319															
1970	84,627	27,890	330															
1971	85,354	26,795	314															
1972	109,854	33,835	308															
1973	128,080	38,990	304															
1974	133,195	40,671	305															
1975	157,218	53,318	339															
1976	143,000	48,149	337															
1977	127,000	42,187	332															
1978	124,000	41,074	331															
1979	124,000	40,986	331															
1980	126,000	41,790	332															
1981	126,000	41,717	331															
1982	143,000	46,105	322															
1983	161,000	50,440	313															
1984	164,000	50,826	310															
1985	180,000	55,423	308															
1986	183,012	55,943	306															
1987	206,822	57,414	278															
1988	227,759	64,351	283															
1989	236,536	65,965	279															
1990	260,057	72,173	278															
1991	275,104	74,221	270							5,100	2,000	392						
1992	276,531	73,061	264							10,200	5,200	510						
1993	275,855	72,563	263							14,600	7,000	479						
1994	262,985	68,248	260							21,300	8,200	385						
1995	275,900	70,827	257							27,259	8,700	319	2,190	1,100	502			
1996	280,964	72,948	260							27,363	8,850	323	3,348	1,300	388	330	31	94
1997	282,815	73,214	259							30,947	10,073	325	6,916	2,438	353	650	73	112
1998	280,457	71,019	253							31,201	10,155	325	10,897	3,638	334	776	90	116
1999	277,437	70,034	252							35,642	11,591	325	13,050	4,464	342	863	100	116
2000	280,607	71,154	254							41,610	13,925	335	15,510	5,086	328	978	113	116
2001	282,492	72,316	256							46,668	15,515	332	18,785	6,763	360	1,836	191	104
2002	278,365	71,537	257							47,636	15,255	320	18,010	7,078	393	1,915	201	105
2003	282,559	73,000	258							56,480	17,457	309	19,092	7,431	389	4,929	664	135
2004	290,045	74,669	257	19,882	5,557	279				63,705	19,604	308	20,712	7,925	383	4,923	657	133
2005	301,336	77,903	259	32,370	8,937	276				66,819	20,853	312	21,906	8,550	390	5,070	687	136
2006	305,046	79,439	260	36,737	9,919	270				69,533	21,635	311	23,236	8,912	384	5,286	733	139
2007	315,778	82,823	262	37,315	10,028	269	15,556	3,520	226	70,531	21,919	311	23,430	8,818	376	5,410	800	148
2008	310,237	81,658	263	38,016	10,158	267	30,581	6,566	215	74,700	23,333	312	23,882	8,878	372	5,966	867	145
2009	288,836	76,309	264	37,477	9,937	265	32,349	6,863	212	73,709	22,561	306	33,377	10,746	322	6,005	915	152
2010																		

Source: UIC, International Railway Statistics, various years, Suga 2003, SNCF statistics
Source for AVE: Anuario Estadistica de Fomento
Source for Amtrak: Amtrak data made available to author, and Amtrak Monthly Performance Summary, various years. 2004 numbers are estimated

Table 2, Page 2 of 2

HSR Passenger Traffic AS DEFINED BY THE RAILWAY INVOLVED (generally >160 km/Hr)

	RENFE (AVE Only) *Spain*			RENFE *All "high-speed"*			SJ *Sweden*			SNCB/NMBS *Belgium*			SNCF *France*			Amtrak NEC Acela/Metroliners			Amtrak NEC Regional		
	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)	Pass (000)	Pass-Km (000,000)	Avg Trip Length (Km)
1964																					
1965																					
1966																					
1967																					
1968																					
1969																					
1970																					
1971																					
1972																					
1973																					
1974																					
1975																					
1976																					
1977																					
1978																					
1979																					
1980																					
1981													1,260	700	556						
1982													6,080	3,600	592						
1983													9,200	5,700	620						
1984													13,770	8,300	603						
1985													15,380	9,300	605						
1986													15,370	9,400	612						
1987													16,970	10,400	613						
1988													18,100	11,200	619						
1989													19,160	12,200	637						
1990							15	6	400				29,930	14,900	498						
1991							235	94	400				37,000	17,900	484						
1992				1,314	400	304	392	154	393				39,300	19,000	483						
1993				3,256	900	276	799	272	340				40,120	18,900	471						
1994				3,554	900	253	871	305	350				43,910	20,500	467						
1995	3,900	1,290	331	3,862	1,200	311	1,186	415	350				46,590	21,430	460	2,001	na	na	5,872	na	na
1996				3,415	1,100	322	3,035	1,101	363	2,781	320	115	55,915	24,787	443	2,011	na	na	5,665	na	na
1997				4,032	1,266	314	3,814	1,332	349	4,699	555	118	62,881	27,583	439	2,081	na	na	5,548	na	na
1998				4,694	1,516	323	4,767	1,605	337	6,877	788	115	70,575	30,619	434	2,135	496	232	5,786	1,516	262
1999				5,093	1,674	329	5,446	1,812	333	6,978	804	115	74,258	32,192	434	2,241	522	233	5,803	1,522	262
2000	5,600	1,940	346	6,425	2,210	344	6,298	2,047	325	7,614	865	114	79,685	34,747	436	2,408	570	237	6,113	1,527	250
2001				6,998	2,409	344	6,730	2,227	331	7,809	889	114	83,481	37,404	448	2,652	666	251	6,020	1,625	270
2002	6,300	2,180	346	7,208	2,506	348	7,264	2,390	329	8,011	909	113	87,860	39,856	454	3,214	912	284	5,760	1,537	267
2003	6,000	2,030	338	7,334	2,531	345	7,236	2,400	332	7,785	878	113	86,742	39,604	457	2,937	819	279	5,975	1,554	260
2004	6,200	2,090	337	7,560	2,747	363	7,354	2,422	329	8,235	940	114	90,890	41,439	456	2,967	*831*	*280*	6,405	*1,601*	*250*
2005	7,200	2,320	322	7,176	2,325	324	7,100	2,330	328	8,573	982	115	94,020	43,130	459	2,453	679	277	7,116	1,677	236
2006	8,700	2,700	310	6,519	2,601	399	7,600	2,490	328	9,067	1,000	110	97,862	44,853	458	2,668	759	284	6,755	1,623	240
2007	9,100	2,590	285	11,409	3,593	315	8,470	2,775	328	9,163	1,018	111	105,366	47,966	455	3,191	929	291	6,837	1,655	242
2008	16,300	5,480	336	22,955	10,490	457	8,764	2,992	341	9,697	1,079	111	116,054	52,564	453	3,399	1,016	299	7,489	1,844	246
2009	17,000	5,977	352	28,751	11,505	400	9,071	3,050	336	9,561	1,061	111	114,395	51,864	453	3,020	919	304	6,921	1,702	246
2010																3,219	923	287	7,149	1,704	238

Source: UIC, International Railway Statistics, various years, Suga 2003, SNCF statistics
Source for AVE: Anuario Estadistica de Fomento
Source for Amtrak: Amtrak data made available to author, and Amtrak Monthly Performance Summary, various years. 2004 numbers are estimated

Table 3

Evolution of High-Speed Intercity Passenger Rail (HSIPR) Funding (US$)

Corridor	State	First HSIPR (Jan 28, 2010)*	Second HSIPR (Oct. 28,2010)**	Reallocation (Dec 9, 2010)***	Total
Northern New England	MA	70,000,000			70,000,000
	NH		2,240,000		2,240,000
	VT			2,700,000	2,700,000
Empire	NY	151,000,000	28,460,289	7,300,000	186,760,289
Keystone	PA	26,400,000			26,400,000
Southeast	DC	2,900,000			2,900,000
	GA	750,000	4,100,000		4,850,000
	NC	545,000,000	22,000,000	1,500,000	568,500,000
	VA	74,840,119	45,508,000		120,348,119
Chicago Hub	IL	1,101,250,000	3,711,576	42,300,000	1,147,261,576
	MI	40,310,214	161,112,773		201,422,987
	MN	600,000	40,000,000		40,600,000
	MO	31,000,000	3,608,700	2,200,000	36,808,700
	OH	400,000,000		(385,000,000)	15,000,000
	WI	822,000,000		(810,000,000)	12,000,000
Florida	FL	1,250,000,000	808,000,000	342,300,000	2,400,300,000
Gulf Coast					-
South Central	TX		5,600,000		5,600,000
California HSR	CA	2,250,000,000	741,000,000	624,000,000	3,615,000,000
California non-HSR	CA	99,400,000	160,574,000		259,974,000
Pacific Northwest	OR	8,000,000	8,967,248	1,600,000	18,567,248
	WA	590,000,000	30,952,243	161,500,000	782,452,243
Northeast Corridor	DC	4,270,500	10,000,000		14,270,500
	CT	40,000,000	120,900,000		160,900,000
	MD	69,400,000			69,400,000
	NJ	38,500,000			38,500,000
	RI	1,200,000			1,200,000
	DE		13,300,000		13,300,000
	MA		32,500,000	2,800,000	35,300,000
Non-corridor Projects	various	273,383,823	239,745,356	5,974,060	519,103,239
Other adjustments	na			825,940	825,940
		7,890,204,656	2,482,280,185	-	10,372,484,841
				-	

Indicates planned speed >150 Mi/hr

* http://www.fra.dot.gov/Pages/press-releases/341.shtml

** http://www.fra.dot.gov/rpd/downloads/Summary_of_FY10_Selected_Projects_1010.pdf

*** http://www.fra.dot.gov/Pages/press-releases/231.shtml

Table 4

Amtrak Passengers (000)

	Acela Express	NEC regional**	Total NEC	All Other	Total
1971					
1972					13,700
1973					14,700
1974					16,700
1975					15,800
1976					16,900
1977					19,207
1978					18,919
1979			11,800	9,607	21,407
1980			10,800	10,419	21,219
1981			10,800	9,810	20,610
1982			10,500	8,542	19,042
1983			10,500	8,539	19,039
1984			10,800	9,143	19,943
1985			11,200	9,576	20,776
1986			10,700	9,628	20,328
1987			10,700	9,741	20,441
1988			11,200	10,300	21,500
1989			11,100	10,300	21,400
1990			11,200	11,000	22,200
1991			10,900	11,100	22,000
1992			10,100	11,200	21,300
1993			10,300	11,800	22,100
1994			11,700	9,500	21,200
1995	2,001	5,872	11,600	9,100	20,700
1996	2,011	5,665	11,000	8,700	19,700
1997	2,081	5,548	11,100	9,100	20,200
1998	2,135	5,786	11,900	9,200	21,100
1999	2,241	5,803	12,300	9,200	21,500
2000	2,408	6,113	12,900	9,600	22,500
2001	2,652	6,020	12,077	11,427	23,504
2002	3,214	5,760	12,242	11,171	23,413
2003	2,937	5,975	10,746	13,282	24,100
2004	2,967	6,405	11,317	13,736	25,054
2005	2,453	7,116	9,569	13,127	24,164
2006	2,668	6,755	9,431	14,876	24,307
2007	3,191	6,837	10,040	15,807	25,850
2008	3,399	7,489	10,898	17,818	28,716
2009	3,020	6,921	9,939	17,228	27,167
2010	3,219	7,149	10,368	18,348	28,716

***** Today's Acela trains started operations in late 2000. Prior to that time, the main high-speed service was provided by "Metroliners." Data do not exist for a clear separation prior to 2000.

** NEC regional consists of all NEC trains that are not "express." They have typically been locomotive hauled and make frequent stops.

Source: Author's calculations based on Amtrak Monthly Performance Summaries, various issues, and archives of Amtrak data.

Table 5

Amtrak Profile in 2009*

	Percent of Passenger Trips	Percent of Passenger-Kilometers	Percent of Total Revenue**	Avg Trip (Km)	Avg Rev/Pass-Km (2009 US$)	"Contribution" per passenger-Km (US$)
NEC Total	37.0	28.0	47.0	264	0.3259	0.0000
Acela Express	11.1	9.7	22.8	305	0.4506	0.1180
Regional	25.5	18.0	24.2	246	0.2585	(0.0630)
Short Haul	48.0	28.0	28.0	204	0.1943	(0.1300)
Long Haul	15.0	44.0	25.0	995	0.1066	(0.2150)
Total System	100.0	100.0	100.0	348	0.1921	(0.1320)

* For FY ending September 30, 2009
** Includes state support

Source: Amtrak, Monthly Performance Summary, September 2009

Figure 1

JAPAN

The Business Model

Structure	East Japan. West Japan and Japan Central are corporations that own and operate passenger services and ancilllary activities
Ownership	EJR, WJR and JRC are private corporations with all stocks listed on Stock Exchanges
Access Charges	Old HSR infrastructure is owned without access charges, new infrastructure is leased from JRTT for annual fee based on the benefits generated by the JRs. Access is limited to JRs.
Financing Sources	New infrastructure is financed partially by JRs and the remainder is one-third by local governments and two-thirds by grants from the national Railway Development Fund (RDF). RDF is funded by payment from 3 JRs (50%) and from grants and loans. JRs finance their own rolling stock

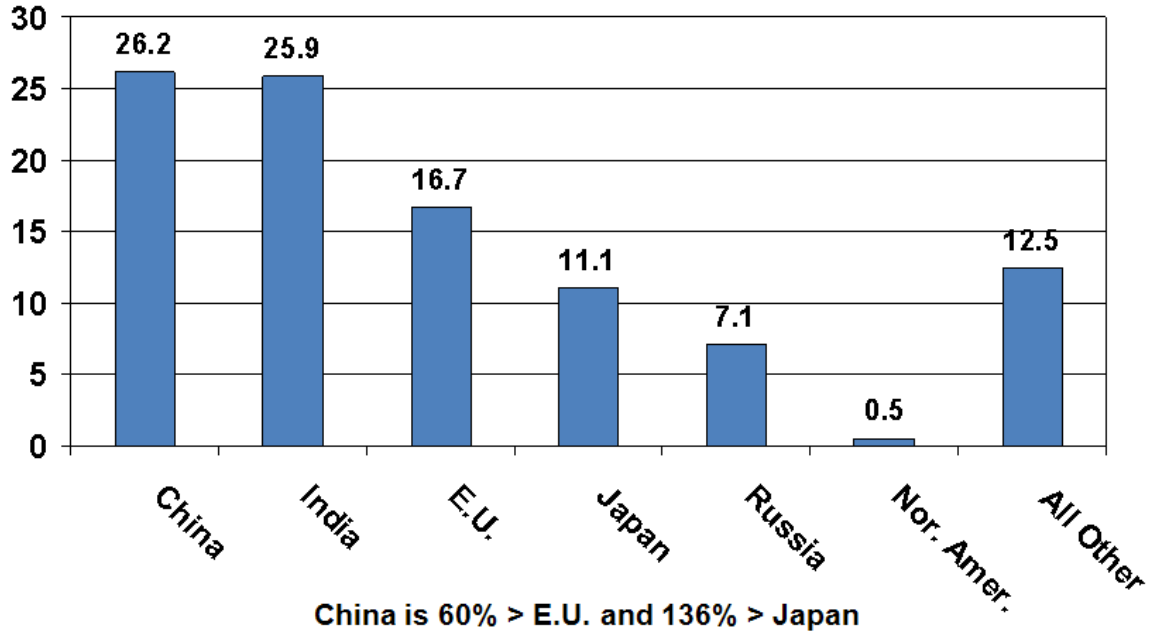
Risk Type	Allocation
Planning	JRs with local and national government (RDF)
Political/regulatory	Maximum tariffs are fully regulated and rarely raised
ROW Acquisition	Local and national government responsibility
Infrastructure Construction	Japan Railway Construction, Transport and Technology Agency (JRTT), a public agency, does construction and takes the cost risk.
Infrastructure Maintenance	JRs through contract to private maintenance contractors
Rolling Stock Acquisition	JRs
Rolling Stock Maintenance	JRs
Demand and Revenue	JRTC takes risk if demand is higher than expected, JRs take risks (subject to renegotiation) if demand falls below expected levels
Financing	Most financial risk is borne by public sources. JRs carry risk for rolling stock and for infrastructure investments they choose to make for their own benefit.

Figure 2

Potential for HSR in China

Percentages of the World's Total Rail Passenger-Miles

(2005 data)



China is 60% > E.U. and 136% > Japan

Figure 3

Rail Passenger Traffic Trends

(Million Passenger-Mi)

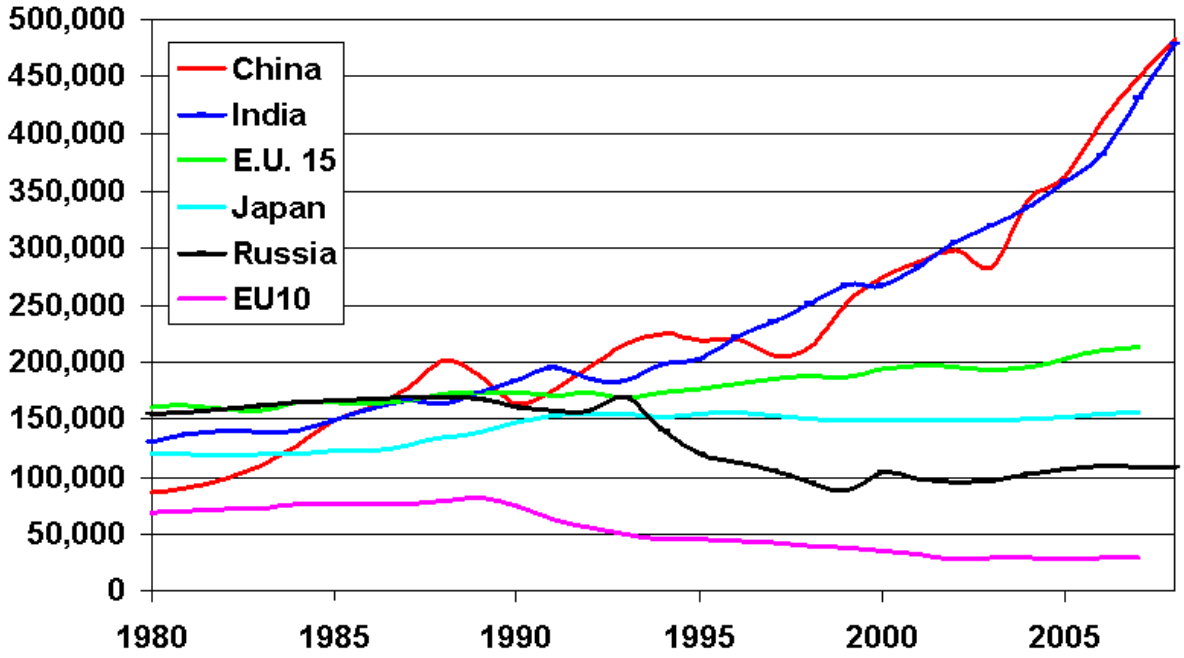
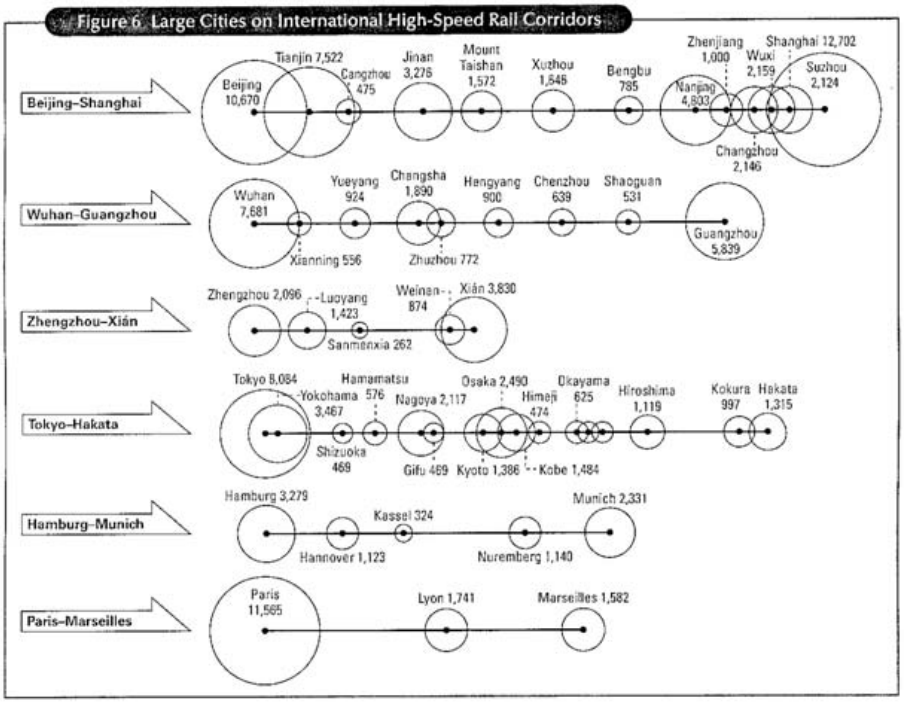


Figure 4
China HSR Compared with Japan, Germany and France



Source: Hiroshi Okada, "High Speed Railways in China," Japan Railway and Transport Review" Issue 48, August 2007, pg 28

Figure 5
Planned Km of HSR In China

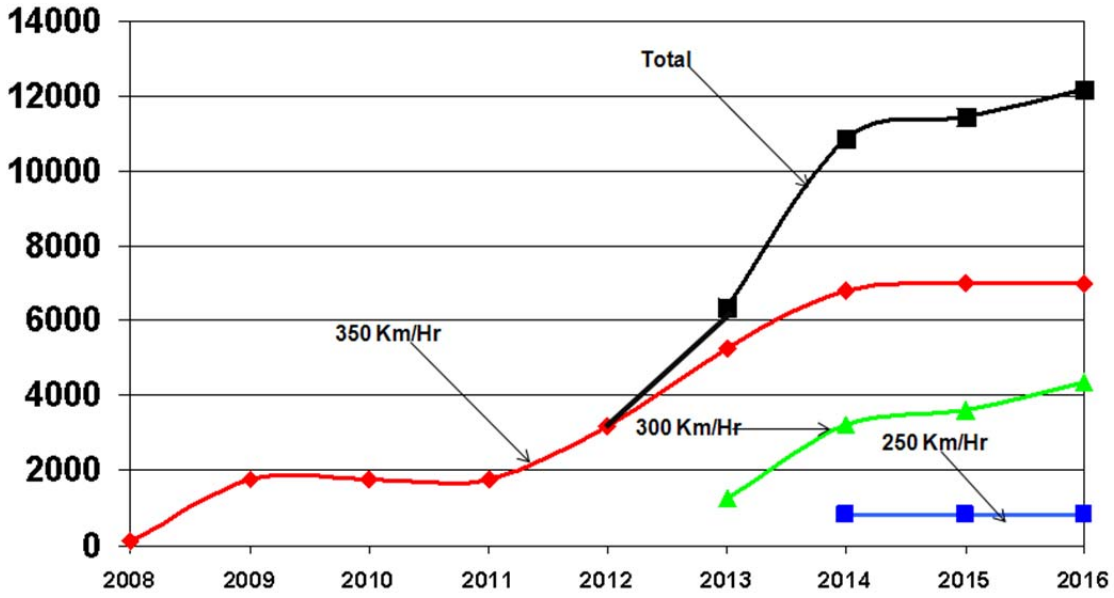


Figure 6

CHINA

The Business Model

Structure	The Ministry of Railways (MOR) of China is a unitary Government Ministry (not a corporation)
Ownership	The existing railway is mostly centrally owned (there are also railway lines owned by local governments). Some of the new high speed lines will be jointly owned by national and local governments
Access Charges	None. There are charges for electrification. Access is limited to MOR services
Financing Sources	Some new HSR lines are jointly financed by local governments with a share between 20% and 50% of investment cost. MOR receives national grants and loans, and can borrow on international markets

Risk Type	**Allocation**
Planning	MOR (national Government) within national plans
Political/regulatory	Tariffs are completely regulated by national government
ROW Acquisition	MOR
Infrastructure Construction	MOR
Infrastructure Maintenance	MOR
Rolling Stock Acquisition	MOR
Rolling Stock Maintenance	MOR
Demand and Revenue	MOR
Financing	MOR

Figure 7

TAIWAN

The Business Model

Structure	Taiwan High Speed Rail Corporation (THSRC) is an integrated railway with exclusive use of infrastructure
Ownership	THSRC owned by 5 party investor and builder consortium has 35 year BOT concession
Access Charges	None. THSRC is exclusive user. THSRC pays 10% of pre-tax profit to governmentas lease fee for infrastructure. This is intended for rail development.
Financing Sources	Government guarantees. Delays, cost overruns and low demand have forced government to increase its share. Government has guaranteed buy-back and taken an investment share in the company.

Risk Allocations

Risk Type	Allocation
Planning	Government, then THSRC
Political/regulatory	THSRC -- then Government. Decision to use Japanese rolling stock on European infrastructure caused problems of delay and cost
ROW Acquisition	THSRC
Infrastructure Construction	THSRC -- then Government
Infrastructure Maintenance	THSRC
Rolling Stock Acquisition	THSRC, but Government influenced the decision
Rolling Stock Maintenance	THSRC
Demand and Revenue	THSRC- but low demand (only 30% of forecast) has effectively shifted some risk to Government to permit THSRC survival
Financing	THSRC, but Government has now provided over 30% of paid-in capital.

Figure 8

KOREA

The Business Model

Structure	The old, unitary KNR was divided. Korail (Government corporation) operates services, including high speed service (KTX). Korea Rail Network Authority (KRNA) builds lines and improves existing lines. Construction of HS line done by Korea High Speed railway.
Ownership	Wholly government owned agencies
Access Charges	None
Financing Sources	98% Government loans and grants, 2% private loans

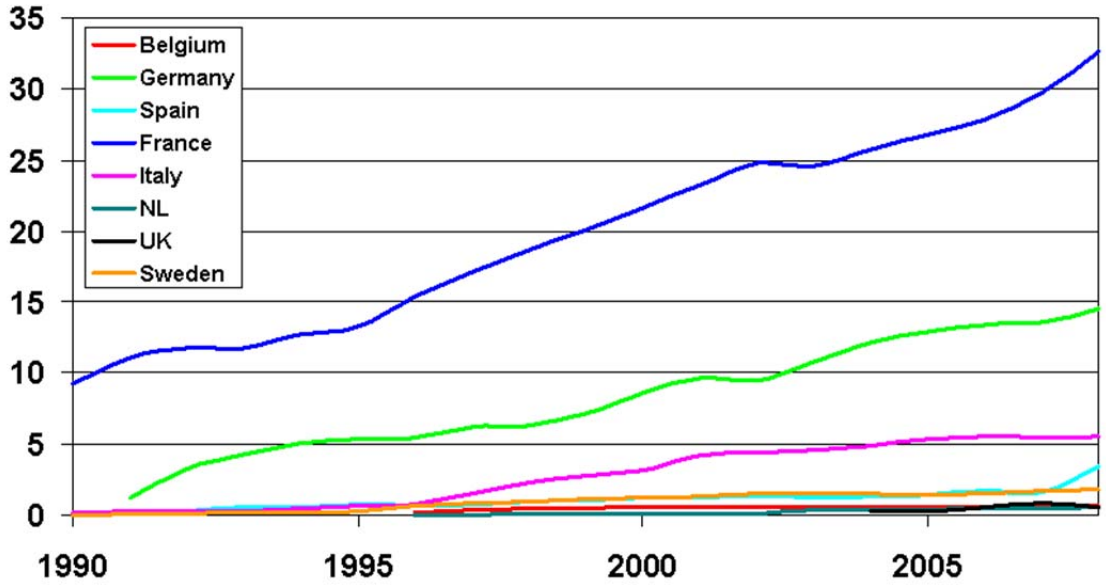
Risk Allocations

Risk Type	Allocation
Planning	Government
Political/regulatory	Tariffs are regulated
ROW Acquisition	Government
Infrastructure Construction	Government Corporation
Infrastructure Maintenance	Government Corporation
Rolling Stock Acquisition	Competitive procurement
Rolling Stock Maintenance	KTX
Demand and Revenue	Government (but demand is > expected)
Financing	Government

Figure 9

E.U. HSR Traffic

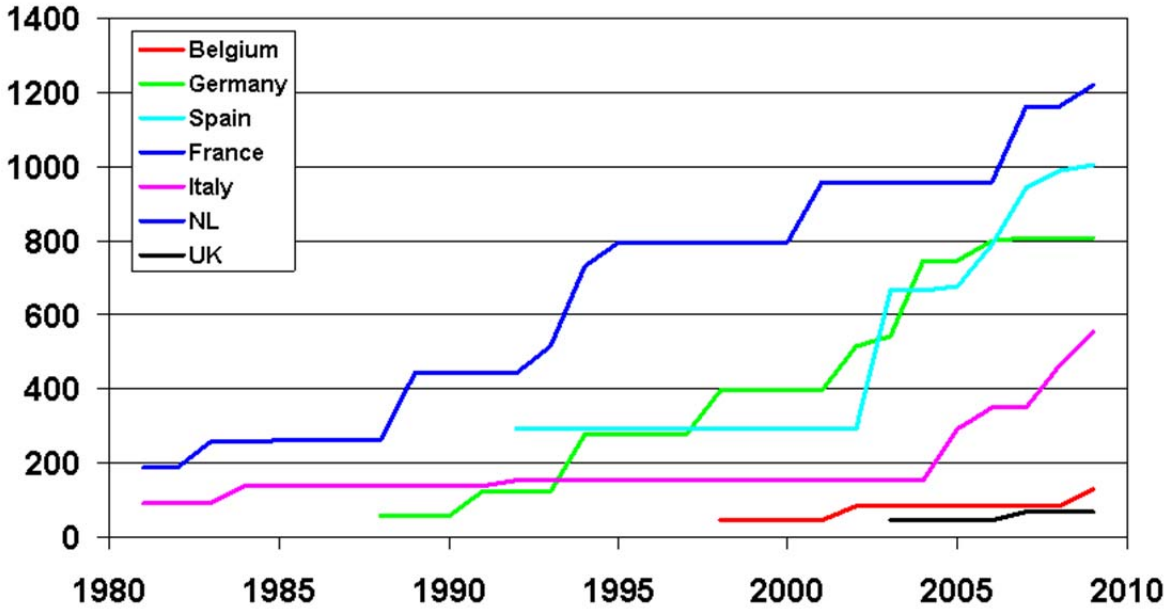
(billion passenger-miles)



Source: http://ec.europa.eu/transport/publications/statistics/statistics_en.htm
(3.3 Performance of Passenger Transport)

Figure 10

E.U. HSR Line Miles



Source: http://ec.europa.eu/transport/publications/statistics/statistics_en.htm
(3.5 Infrastructure)

Figure 11

Future E.U Rail Network Development

E.U Rail Network Development

Category of Line	Max Speed (Mph)	Length in 2008 (Mi)	Length in 2010 (Mi)	Length in 2015 (Mi)	Length in 2020 (Mi)	Planned Total after 2020 (Mi)
I	>150	3,467	3,949	7,044	9,332	13,055
II	~120	2,466	2,611	3,232	4,418	6,041
III	Specific	86	105	185	655	686
Total		6,019	6,665	10,461	14,406	19,782

Note significant use of ~120 Mph systems

Source: MVV Consulting and Tractabel Engineering, "European High Speed Rail- An Easy Way to Connect," presentation 24 April 2009

Figure 12

E.U. HSR Line Miles by Category

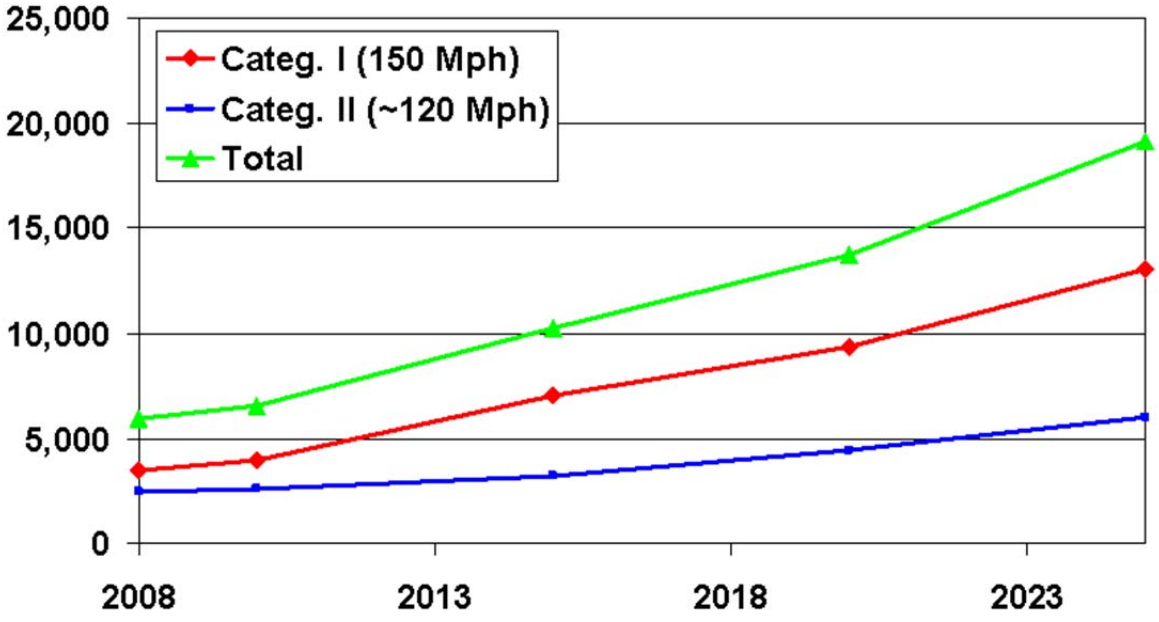


Figure 13

FRANCE

The Business Model

Structure	SNCF is a government corporation that provides all national passenger services and most suburban services. It also provides most freight services. RFF is the national rail infrastructure agency that oversees construction and maintenance of the infrastructure, though it contracts with SNCF to carry out the actual work.
Ownership	Both SNCF and RFF are publicly owned, as is all French rail infrastructure. Some lines procured on PPP concession or partnership basis with lease to RFF for management
Access Charges	RFF has access charges that have a fixed component (for scheduled slots) and a variable component that varies by time of day. In addition, the charges vary by type of line, with HSR charges being highest, and are different for intercity passenger, local passengers and freight.
Financing Sources	French High Speed Lines have been constructed in segments, each with a somewhat different approach to financing. The first line (Sud-Est -- Paris to Lyons) was totally government financed. Later lines have been partly financed by local governments, with E.U. funds and by the private sector through concessions and partnerships.

Risk Allocations

Risk Type	Allocation
Planning	Government plan, coordinated with SNCF and RFF
Political/regulatory	Limited tariff regulation, but considerable political involvement in planning and construction of new lines
ROW Acquisition	RFF, but strict environmental procedures
Infrastructure Construction	RFF with competitive contract, or concessionaire/partnership
Infrastructure Maintenance	RFF
Rolling Stock Acquisition	SNCF (from private suppliers)
Rolling Stock Maintenance	SNCF
Demand and Revenue	In concessions, demand risk lies with concessionaire: for partnerships, demand risk lies with RFF. But, RFF's access charges will eventually shift demand risk to SNCF
Financing	RFF and SNCF, but with implied guarantees

Figure 14

GERMANY

The Business Model

Structure	DB Holding is wholly government owned, though an IPO was planned for 2008 (postponed). DB Holding owns DB Netz, Intercity (which operates ICE trains), Regio (local trains) and Railion (freight - also owns the freight companies in Denmark, Netherlands and UK).
Ownership	DB Holding is a wholly givernment owned corporation
Access Charges	DB Netz access charges are based on line type (higher for HS lines), by trains type (intercity, local and freight) and are based on train-km operated. There are no fixed charges.
Financing Sources	German Federal Government, local governments (Länder), E.U. funding. DB holding also borrows on commercial markets.

Risk Allocations

Risk Type	Allocation
Planning	German Government, Länder, DB Holding
Political/regulatory	Inter city trains are regulated at the Federal level. Local trains are often subsidized by local governments and are regulated at that level.
ROW Acquisition	DB Netz
Infrastructure Construction	DB Netz (under contract)
Infrastructure Maintenance	DB Netz
Rolling Stock Acquisition	DB Intercity
Rolling Stock Maintenance	DB Intercity
Demand and Revenue	DB Intercity
Financing	DB Netz, DB Intercity and ultimately DB Holding

Figure 15

ITALY

The Business Model

Structure	The Italian Railway (Ferrovia della stato, or FS) has an infrastructure subsidiary (RFI), as well as a special purpose entity (Treno Alto Velocità -- TAV) charged with planning and constructing high speed lines. Another FS subsidiary, Trenitalia, operates passenger services in Italy. TAV has a 50 year concession to design, finance and construct HS lines. After completion, HS lines are owned by RFI, though TAV can charge an access fee.
Ownership	FS, and all its subsidiaries, are wholly government owned corporations. TAV was originally 40% privately owned, but government bought out the private investors in 1997. In 2011, there will be a new HS operator (NTV) that will compete with Trenitalia HS services on TAV lines
Access Charges	RFI has a complex access charge system based on train-km that differs by line and "node" used.
Financing Sources	Government grants and loans, and private borrowing that was backed by the government. E.U. Major financing agent is Infrastrutture SpA , a government agency that finances Italian infrastructure.

Risk Allocations

Risk Type	Allocation
Planning	TAV in coordination with government
Political/regulatory	Given the government guarantees in place, government will eventually bear most political and regulatory risk
ROW Acquisition	TAV. This was difficult due to historic sites and Italian litigation and was a significant factor in the full nationalization of TAV
Infrastructure Construction	TAV
Infrastructure Maintenance	RFI
Rolling Stock Acquisition	Trenitalia and NTV
Rolling Stock Maintenance	Trenitalia and NTV
Demand and Revenue	Trenitalia and NTV bear initial risk, but government might eventually have to compensate them if demand is below forecast
Financing	Government in effect guarantees any shortfall to RFI and TAV if access charges do not reach forecast levels.

Figure 16

SPAIN

The Business Model

Structure	The Spanish network has a national infrastructure agency (ADIF) and a national operator (RENFE). The high speed services are called AVE.
Ownership	Wholly government owned
Access Charges	ADIF has access charges per train-km that differ by type of line, time of day and type of train. In addition, ADIF has slot reservation charges
Financing Sources	Government and E.U. funds (TEN-T, Cohesion and Regional Development funds). EIB loans to government.

Risk Allocations

Risk Type	Allocation
Planning	ADIF/RENFE
Political/regulatory	Government restricted airline competiton with AVE while the air carrier (Iberia) was state-owned. Such protection may be removed when Iberia is privatized and permitted to compete for domestic traffic.
ROW Acquisition	ADIF
Infrastructure Construction	ADIF
Infrastructure Maintenance	ADIF
Rolling Stock Acquisition	RENFE/AVE
Rolling Stock Maintenance	RENFE/AVE
Demand and Revenue	Government/ADIF
Financing	Government

Figure 17

SWEDEN

The Business Model

Structure	Sweden has an infrastructure agency (Banverket), and intercity operator (SJ) and a series of regional operators, some of which are concessions. The freight operator, Green Cargo, may be sold (DB is a potential bidder)
Ownership	SJ and Banverket are wholly government owned.
Access Charges	Banverket charges marginal cost access charges by type of train based on gross ton-km and train-km. There is no distinction by line
Financing Sources	Government

Risk Allocations

Risk Type	Allocation
Planning	Government and Banverket
Political/regulatory	Government controls Banverket and SJ
ROW Acquisition	Banverket
Infrastructure Construction	Banverket (contract)
Infrastructure Maintenance	Banverket
Rolling Stock Acquisition	SJ or franchises
Rolling Stock Maintenance	SJ or franchises
Demand and Revenue	Government and SJ
Financing	Banverket, SJ and Government

Figure 18

BELGIUM

The Business Model

Structure	SNCB is separated between an infrastructure provider (INFRABEL) and an operator (SNCB) of passenger and freight services
Ownership	Government
Access Charges	INFRABEL access charges are based on gross ton-km and train-km and vary by type of train (HS passenger, intercity passenger, local passenger, and freight)
Financing Sources	Government, E.U.

Risk Allocations

Risk Type	Allocation
Planning	Government, INFRABEL and SNCB
Political/regulatory	Government
ROW Acquisition	INFRABEL
Infrastructure Construction	INFRABEL
Infrastructure Maintenance	INFRABEL
Rolling Stock Acquisition	SNCB (partner in Thalys and Eurostar)
Rolling Stock Maintenance	SNCB, Thalys, Eurostar
Demand and Revenue	SNCB, Thalys, Eurostar, ICE
Financing	Government

Figure 19

THE NETHERLANDS

The Business Model

Structure	The existing Dutch network is split between an infrastructure agency (ProRail) and an intercity operator (NS). The new high speed line will be provided by a PPP consortium (Infraspeed) with a 25 year concession on a DBFM basis: government pays Infraspeed a fixed annual fee adjusted for availability. Operations are provided by Thalys (which pays an access charge) and by High Speed Alliance (HSA), a joint venture between NS and KLM that has an exclusive 15 year franchise to provide domestic services (Fyra).
Ownership	All infrastructure is owned by government agencies
Access Charges	Access charges are paid by all operators to ProRail. The structure of the access charge regime on the high speed line is not fully defined
Financing Sources	Government, E.U. funding, EIB loans and private borrowing by the Infraspeed consortium

Risk Allocations

Risk Type	Allocation
Planning	Government
Political/regulatory	Government
ROW Acquisition	Government (Rijkswaterstaat)
Infrastructure Construction	Divided between land and basic grading and preparation which was government responsibility (due to very poor and unpredictable soil and substructure conditions) and rail facilities (superstructure) which was the responsibility of Infraspeed consortium.
Infrastructure Maintenance	Infraspeed
Rolling Stock Acquisition	HSA and Thalys
Rolling Stock Maintenance	HSA and Thalys
Demand and Revenue	HSA, Thalys and government. Infraspeed receives an annual lease fee (adjusted for availability with 99.46 % minimum) and takes no demand risk.
Financing	Government and Infraspeed (for their portion)

Figure 20

UK HST-125

The Business Model

Structure	The UK national rail system is split between infrastructure (Network Rail) and a number of private franchises. Three of these franchises operate HST-125 services
Ownership	Network Rail is a hybrid organization that exists between public and private ownership. It operates as a not-for-profit utility. The franchises are private and for-profit. Franchises bid on a basis of minimum support from government or maximum contribution to government.
Access Charges	Network Rail collects both a fixed charge and a charge per train-km that differs by type of service and by time of day.
Financing Sources	Government grants and borrowing by Network Rail (that has an implicit government guarantee)

Risk Allocations

Risk Type	Allocation
Planning	For infrastructure, Government and Network Rail bear the risk.
Political/regulatory	Office of the Rail Regulator regulates entry and access charges
ROW Acquisition	Network Rail
Infrastructure Construction	Network Rail (contract construction)
Infrastructure Maintenance	Network Rail
Rolling Stock Acquisition	Rolling Stock Leasing Companies (ROSCOs) and, in some cases, Franchises
Rolling Stock Maintenance	ROSCOs
Demand and Revenue	Shared between Franchises and Government
Financing	Network Rail, Franchises, ROSCOs and government

Figure 21

UK HS-1

The Business Model

Structure	The Channel Tunnel Rail Link (CTRL) was initially awarded to London and Continental Railway (LCR) as a 90 year DBFO concession. It is now an open access infrastructure provider. Network Rail manages the line.
Ownership	Currently owned by HS1 Ltd, a successor to LCR
Access Charges	Operators pay a line-specific access charge
Financing Sources	Initially financed by private sector equity and borrowing with subsequent government grants, loans, guaranteed loans and E.U. grant aid

Risk Allocations

Risk Type	Allocation
Planning	LCR backed by government
Political/regulatory	Office of the Rail Regulator
ROW Acquisition	LCR (HS-1)
Infrastructure Construction	LCR (HS-1)
Infrastructure Maintenance	Network Rail
Rolling Stock Acquisition	Eurostar and other operators
Rolling Stock Maintenance	Eurostar and other operators
Demand and Revenue	Eurostar (access payments are guaranteed at stated level)
Financing	LCR, government and Eurostar

Figure 22

UK and FRANCE CHANNEL TUNNEL

The Business Model

Structure	Eurotunnel is a private corporation that has a concession until 2086 to build and operate the tunnel under the English Channel. There are a number of operators: Eurostar (passengers), a Shuttle (cars and trucks) and freight trains.
Ownership	Eurotunnel is privately owned. Eurostar is a corporation jointly owned by SNCF, SNCB, and Eurostar UK (a subsidiary of LCR).
Access Charges	Eurotunnel charges all operators access fees which have a large fixed component.
Financing Sources	Private capital. Eurotunnel was reorganized (essentially bankruptcy) and debt and interest were reduced.

Risk Allocations

Risk Type	Allocation
Planning	Eurotunnel
Political/regulatory	Extensive safety regulation significantly increased costs and delayed opening
ROW Acquisition	Eurotunnel
Infrastructure Construction	Eurotunnel. Final costs were 80% above forecasts.
Infrastructure Maintenance	Eurotunnel
Rolling Stock Acquisition	Operators
Rolling Stock Maintenance	Operators
Demand and Revenue	Eurotunnel, though operators had to guarantee a level of payments in return for half of the tunnel's capacity. Demand has been consistently far below projections. After financial restructuring, Eurotunnel is covering operating costs
Financing	Eurotunnel

Figure 23

US: AMTRAK ACELA EXPRESS

The Business Model

Structure	Amtrak is a corporation organized in the District of Columbia. It operates long haul and short haul trains over the tracks of private freight railroads (paying an access fee) and it operates its own trains over the NEC tracks. Other commuter and freight railroads also operate over the NEC and pay an access fee to Amtrak. By law, Amtrak has a right of access to freight infrrastructure. Acela and NEC Regional trains are operated as separated business profit centers within Amtrak
Ownership	Amtrak is wholly owned by the U.S. Government. In some cases, states have bought tracks from private railroads and contract with Amtrak for maintenance and operations
Access Charges	Amtrak pays access fees to freight railroads off the NEC, and charges access fees to freight railroads and to commuter operators on the NEC. Amtrak does not attempt to charge Acela Express and NEC Regional comparable access charges that would yield an improved profit center picture
Financing Sources	U.S. Government grants and loans, and contract support from states and local agencies for contract operations. In some cases, Amtrak has leased rolling stock from private suppliers. Purchase of Acela was financed in part by Canadian Government export financing

Risk Allocations

Risk Type	Allocation
Planning	Amtrak and state agencies
Political/regulatory	Amtrak's charges are not regulated, but Amtrak suffers significant political interference from Congress. U.S. DOT controls Amtrak budget and regulates Amtrak's safety practices
ROW Acquisition	Amtrak, states or freight railroads, but subject to U.S. environmental limitations
Infrastructure Construction	Amtrak (contracted or with own labor force) for NEC. Freight railroads off NEC
Infrastructure Maintenance	Amtrak on NEC, contract states off NEC, and freight railroads
Rolling Stock Acquisition	Amtrak on NEC, contract states off NEC
Rolling Stock Maintenance	Amtrak (Acela maintenance was originally part of a furnish and maintain contract). Off NEC, contract states take all risk
Demand and Revenue	Amtrak -- backed up by U.S. Treasury for NEC and long haul, contract states take risk for contracted short haul trains.
Financing	U.S. Treasury

Figure 24

The Public/Private Project Benefits Balance

	Private net benefits	Public net benefits	Outcome	When could this happen?	Remarks
Case I	+	+	Project should go ahead	Rail project is profitable to the private operator with purely private financing, **and** it reduces road or air congestion, reduces total emissions or improves road or air safety	Private sector will do; no PPP needed, but some public coordination or regulation needed. Very rare case
Case II	+	-	If private net benefits are sufficiently > public net dis-benefits, regulation or tax can shift enough benefits from private to public for project to go ahead. If not, project should stop.	Rail project is profitable to the private operator with purely private financing, **but** it generates added road or air congestion, increases total emissions, reduces road or air safety, or causes undesirable development	PPP is appropriate if benefits and dis-benefits can be balanced. More likely for air than for HSR.
Case III	-	+	If net public benefits are sufficiently > than private losses, then public support (capital or operating) can cause the project to go ahead. If not, project should stop.	Rail project is unprofitable to the private operator, **but** it improves road or air congestion, improves road or air safety, or reduces total emissions	PPP is appropriate if benefits and dis-benefits can be balanced. Possible case for some HSR corridors
Case IV	-	-	Progect should not go ahead	Rail project is unprofitable **and** it adds to road or air congestion, increases total emissions or increases accidents	Should not be done by either private or public sector. Less common, but possible if rail load factors are too low

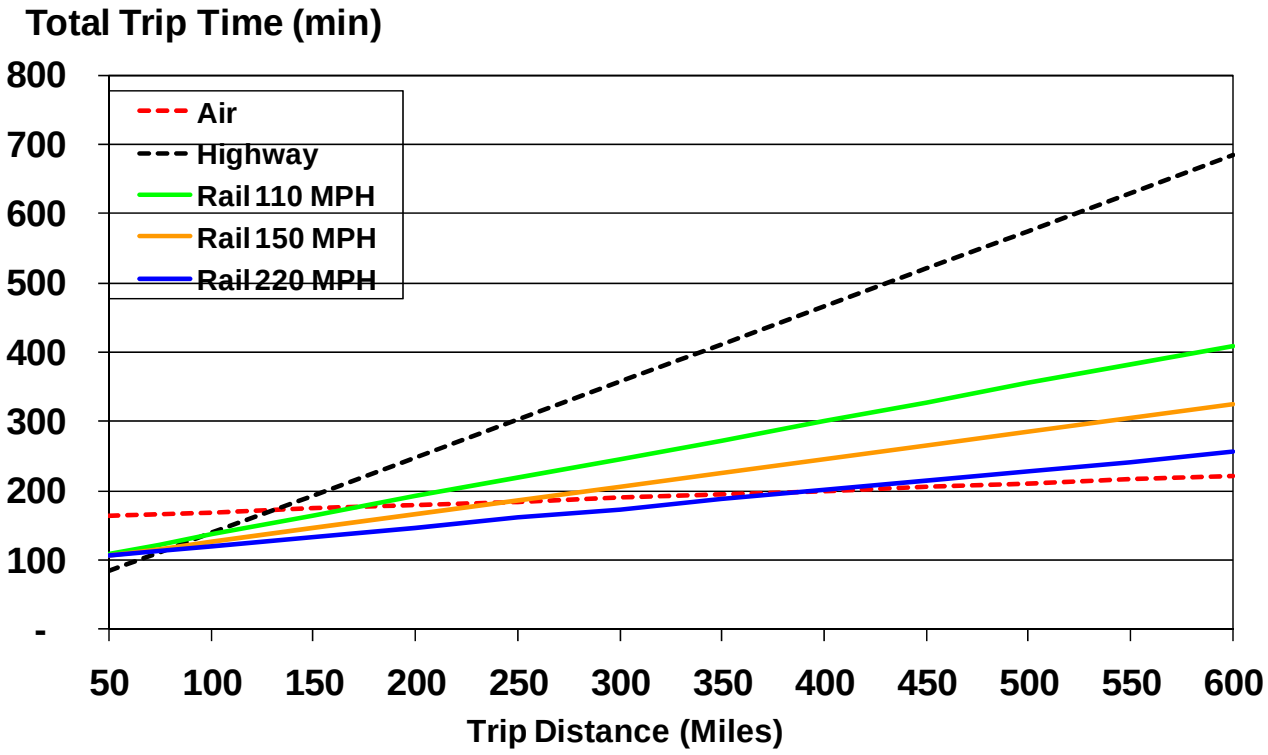
"Private net benefits" = revenues from passengers and ancillary sources minus private operating and financial costs
"Public net benefits" = value of reduced congestion, emissions, accidents, etc, minus and public operating and capital costs

+	Indicates a positive net value
-	Indicates a negative net value

Figure 25

The Role of Speed:

Total Trip Time in Minutes Versus Distance



Source: Author's trip time model

Figure 26

Summary Program

Corridor	HSR Line Miles	2050 Corridor Population (million)	2050 Corridor Trips (millions)	Total CO2 savings (metric tonnes)		Low Infrastructure Cost (2009$ Millions)	High Infrastructure Cost (2009$ Millions)
				Low	High		
California	1,088	54.1	101.0	1,292,113	3,878,697	35,904	63,104
Pacific Northwest	467	14.5	12.3	76,070	245,354	7,005	9,340
Florida	478	31.6	28.9	135,212	509,228	7,170	26,768
Chicago Hub	2,137	39.1	66.0	544,612	1,502,751	49,151	74,795
South Central	1,202	33.0	63.9	759,691	2,416,287	14,424	52,888
Southeast	1,659	33.2	84.4	795,858	2,604,359	29,862	49,770
Gulf Coast	1,024	22.0	21.6	219,380	688,417	18,432	30,720
NEC	457	54.5	35.0	289,370	874,338	11,425	26,049
Keystone	486	16.6	9.9	34,030	166,381	11,178	17,010
Empire	630	28.1	22.6	188,070	722,979	12,600	17,010
Northern New England	665	15.3	9.9	54,681	185,283	13,300	17,955
TOTAL	10,293	277.0	455.5	4,389,087	13,794,074	210,451	385,409

Includes links added to FRA base

Figure 27

US: MINOR IMPROVEMENTS

The Business Model

Structure	Amtrak operates trains on freight infrastructure
Ownership	Most infrastructure owned by private freight railroad. Rolling stock owned by state or by Amtrak. Stations owned by local authorities or by Amtrak
Access Charges	Amtrak pays access fee and incremental investment, charges state. State can pay directly
Financing Sources	State funding

Risk Allocations

Risk Type	Allocation
Planning	State, with Amtrak Assistance
Political/regulatory	State, though there is some risk of political interference at the Federal level
ROW Acquisition	Owned by the freight railroad
Infrastructure Construction	If any, done by freight railroad for account of Amtrak and the state
Infrastructure Maintenance	Freight railroad for Amtrak's account
Rolling Stock Acquisition	Amtrak (sometimes state) for state's account
Rolling Stock Maintenance	Amtrak for state's account
Demand and Revenue	Depends on how Amtrak is compensated by the state. Usually the state bears demand and operating cost risk, though demand can be based on Amtrak forecasts
Financing	State (Amtrak bears no risk)

Figure 28

US: SIGNIFICANT IMPROVEMENTS

The Business Model

Structure	Amtrak operates trains on infrastructure owned by others. In some cases, Amtrak can be replaced by a separate contract operator
Ownership	Infrastructure is usually owned by freight railroads, but can be owned by states (charging freight railroads an access fee). Rolling stock can be owned by state, Amtrak or a lessor.
Access Charges	Amtrak (or contract operator) pays access charges on private infrastructure, may not pay on state-owned infrastructure depending on contracts
Financing Sources	States, sometimes with Federal share. Contract operator might finance some things (rolling stock) under lease or for a fee.

Risk Allocations

Risk Type	Allocation
Planning	State, or regional association, with Amtrak assistance
Political/regulatory	State
ROW Acquisition	If required, will be done by state or freight railroad
Infrastructure Construction	Can be done by the freight railroad, state, or Amtrak, depending on infrastructure ownership. Cost risk is borne by the state
Infrastructure Maintenance	Freight railroad or Amtrak (or contract operator) for state's account.
Rolling Stock Acquisition	State or Amtrak (or contract operator) for state's account
Rolling Stock Maintenance	Amtrak (or contractor) for state's account
Demand and Revenue	State
Financing	State

Figure 29

RISK ALLOCATIONS FOR NEW HSR SYSTEMS IN THE U.S.

Capital			
	Type of Risk	**Allocation and/or Mitigation Measures**	**Who is Best Suited to Bear the Risk?**
Environmental Analysis	Litigation and delay cost	Public outreach	Public
Right of Way Acquisition	Delay, litigation cost	Eminent domain reduces delay but can increase cost risk	Public
Right of Way Improvements (grading, tunnels, major bridges)	Construction cost and schedule	Careful design and competitive contracts	Can be either public or private. In large projects, public is best placed to bear
Track design and construction	Construction cost and schedule. Compatibility	Competititve procurement. Use unified design for track, ET and rolling stock	Public or private
Electric traction design and construction	Construction cost and schedule. Compatibility	Competititve procurement. Use unified design for track, ET and rolling stock	Public or private
Signal design and construction	Construction cost and schedule. Compatibility	Competititve procurement. Use unified design for track, ET and rolling stock	Public or private
Stations design and construction	Construction cost and schedule. Coordination with local agencies	Intensive outreach and detailed agreement with local authorities	Private sector after agreements with local authorities
Rolling Stock design and construction	Delay in availability and unacceptable performance. Incompatibility with infrastructure	Use proven designs. Rolling stock can be leased rather than purchased. Design rolling stock and infrastructure as a system	Private sector can bear
Information Technology	Unacceptable performance	Use proven approaches. Can be leased, or can contract with separate companies	Private sector can bear
Financial	Debt cost too high, equity unavailable	Public guarantee of private borrowing	Public or private guarantors
Operations			
	Type of Risk	**Allocation and/or Mitigation Measures**	**Who is Best Suited to Bear the Risk?**
Revenue (Demand and Price)	Demand or allowed prices too low	Avoid over optimism, define and enforce regulatory regime. Public can guarantee minimum demand levels	Public (gross cost franchise) has become typical. Net cost franchises would transfer risk to franchisee
Train operations costs	Low demand causes unit costs to be too high or overoptimistic cost estimates	Competition for train operations, or a part of franchise award	Private sector can bear cost estimates within agreed demand levels. Public sector bears risks outside agreed levels
Energy Supply and Costs	Energy supply restricted or costs too high	Futures or long term contracts	Public may need to assume risks of major supply or cost shocks due to international disturbances.
Infrastructure Maintenance	Costs too high, or poor coordination with operations	Contract maintenance under enforceable agreement with operations dispatching	Private sector can bear risks
Rolling Stock Maintenance	Maintenance costs too high, or reliability and availability too low	Contract maintenance under enforceable agreement with supplier. Use leasing and/or restrict to experienced suppliers	Private sector can bear risks
Public support	Public support inadequate or not paid in full or on time	Enforceable agreements subject to international arbitration	Public

Figure 30

DIAGRAM OF POTENTIAL BUSINESS MODELS: HOW THE PPP OPTIONS FUNCTION

		Right of Way	Track	ET	Signals	Rolling Stock	Operations	Attributes (why do it?)	Examples
Public agency	**Full Public Operation**	public agency	public agency	public agency	public agency	public agency	public agency	Full public transparency. Most popular model when social benefits and/or public agencies are dominant. Would not function well as a competitive business.	China, Korea
Gross cost or management contract	**Management contract**	contracted	contracted	contracted	contracted	contracted	Contractor manages train under agency instruction	Mostly social benefits, but permits more efficient operation through competition for the management contract. Pricing done by pubic, securing social benefits.	Capitol trains in California
	Gross Cost Franchising (UK, EU suburban and regional)	franchise manages	franchise manages	franchise manages	franchise manages	UK has separate ROSCOs	Franchise manages operations	Can provide competition **for** the market if desired. Usually awarded for shorter periods to enhance public involvement, which requires that rolling stock be handled separately.	Most UK franchises short haul, Germany, Sweden, NL franchises
Net cost	**Net cost Concessioning**	Concession does maint.	Concession does maint.	Concession does maint.	Concession does maint.	Leased or owned	Concession manages operations and plans services	Usually for 30 years or more. Minimizes public outlay and maximizes positive concession payments to the public.	Argentina, Brazil, Mexico
Infrastructure separation	**Infrastructure separation**	Network manager	Network manager	Network manager	Network manager	Leased or owned	Provides multiple operators	Can provide competition in a given market, and can permit easy accommodation of no-competing operators.	Basic E.U. model
Essentially private	BOOT	Public owns after transfer	Concession	Concession	Concession	Leased or owned	Can be Unitary or Multiple Operators	Fundamentally works when public is only needed to define the activity and secure the ROW.	Taiwan (at first)
	Exclusive BOO	By owner	By owner	By owner	By owner	Leased or owned	By owner	Works when private benefits exceed private costs. Limited or no transparency for public.	Channel Tunnel

indicates public ownership or control

indicates private ownership or control

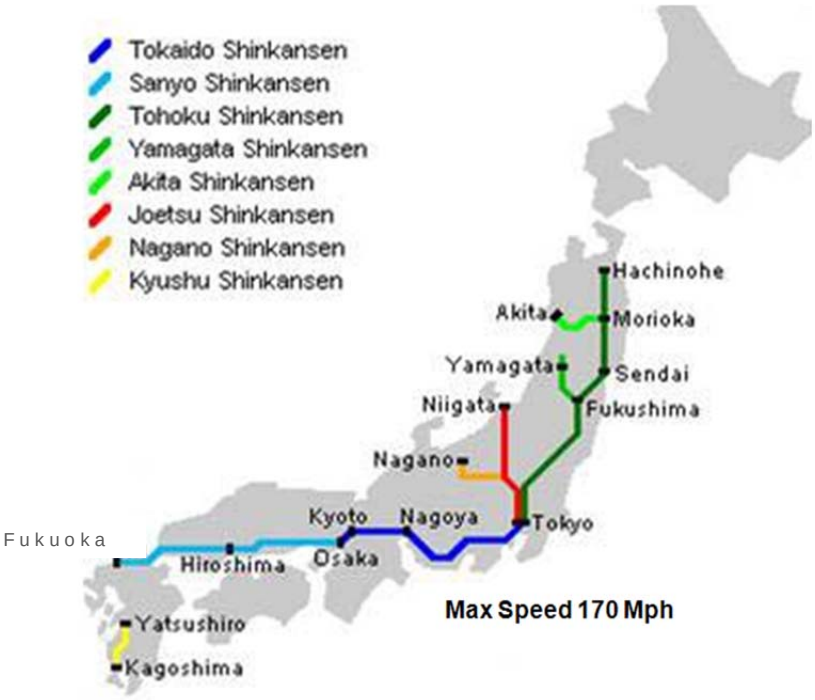
Figure 31

PPP RISKS AND FINANCING

Option	Risk Management	Financing	Remarks
Management Contract	Public sector takes all design and construction risks. Contractor may take some operating cost risks if demand is as specified by public sector	All financing from public except for working capital needed by contractor. Rolling stock may be leased, but will be guaranteed by public owner	Common approach for non-commercial activities (NASA facilities) where risk is high. Less appropriate where contractor has to compete with other operators
Gross Cost Franchise	Public sector takes investment (including environmental and schedule) and demand risks, franchise takes operating cost risk within specified demand levels	Public responsibility, though franchise can be required to provide financing (but with public guarantee). Public and private can share investement with agreed payback approach	Common approach when the benefits are heavily social and commercial activity is secondary
Net Cost Franchise	Demand risk, and some part of investment risk shifted to franchise	Private sector can provide more financing, but some forms of public contribution or guarantee are always required	More appropriate for mostly commercially oriented activities, or which HSR could be an example if demand risk were manageable
Infrastructure Separation	Public sector takes infrastructure investment risk. Access charges can pass some or all of investment cost to operator(s) and can shift some demand risk if desired. Can be used with gross cost or net cost franchising, or with private operators not under franchise.	Infrastructure initially financed by public (but can be repaid from access charges. Operators responsible for all rolling stock.	Appropriate when competition is an explicit objective and when public sector is willing to take initial infrastructure capital risk.

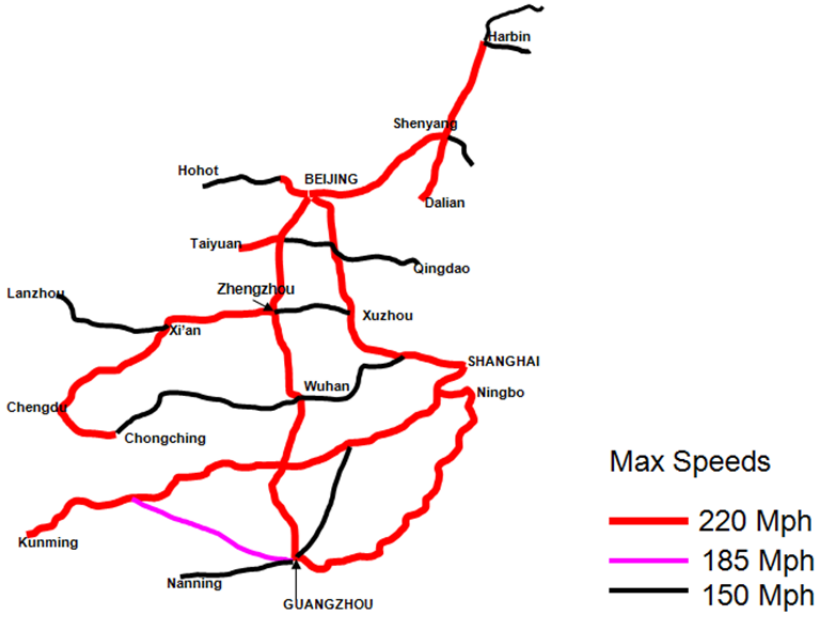
Map 1

The Japanese Shinkansens



Map 2

Dedicated Passenger Lines in China
Planned Completion in 2016

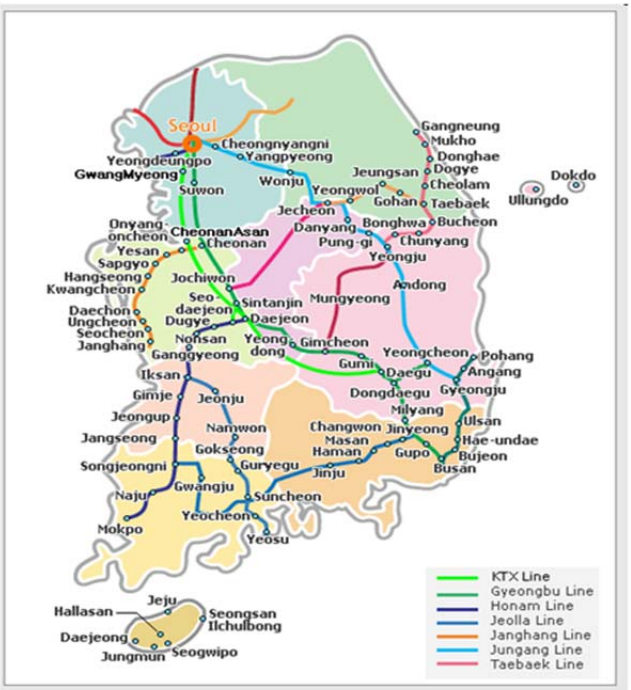


Major Cities: 103 million population

Map 3
Taiwan

Max Speed 185 Mph

Map 4
Korea



Max Speed 185 Mph

Map 5

E.U. HSR Lines (Categories I and II) in 2008

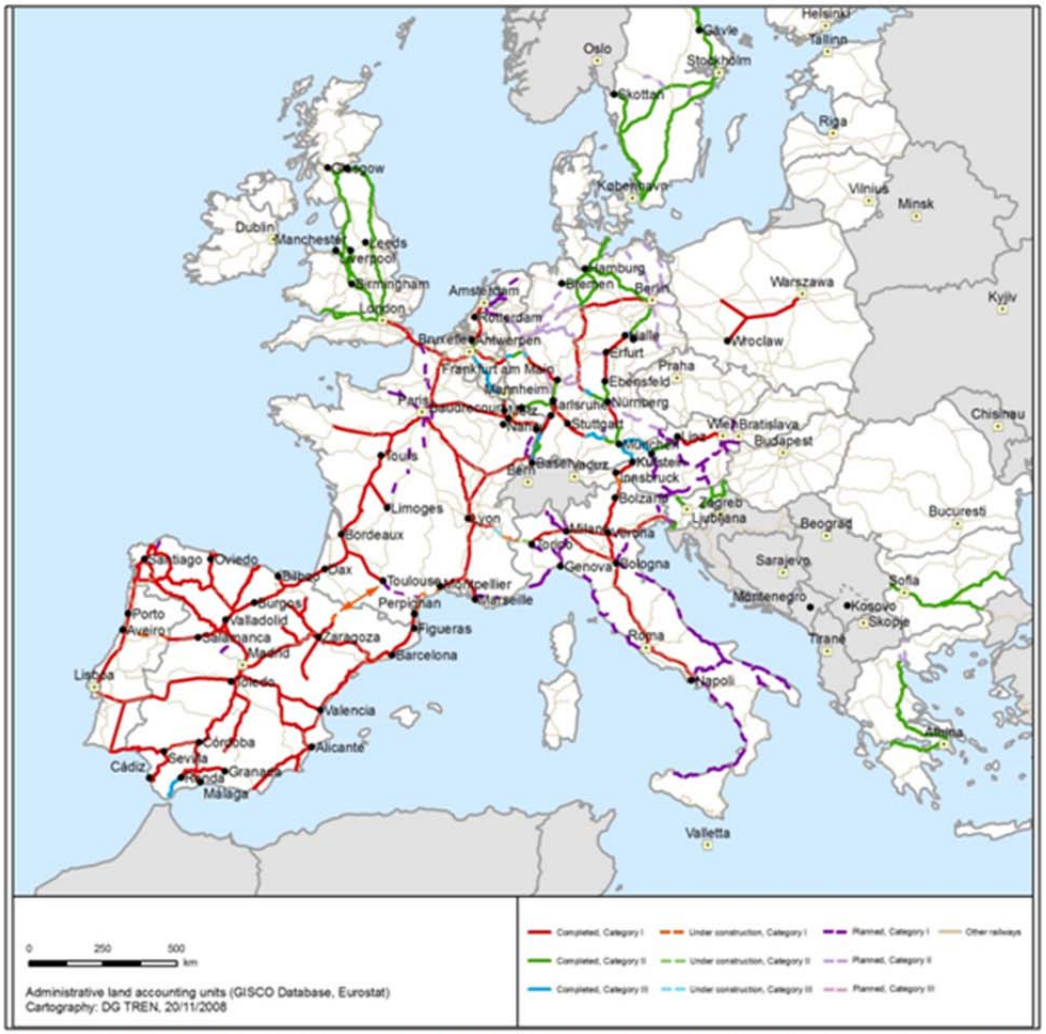
Note Significant Category II Lines

Source:http://ec.europa.eu/transport/infrastructure/studies/ten_t_en.htm (Maps-EU)

Map 6

E.U. HSR Lines (Categories I and II) in 2020

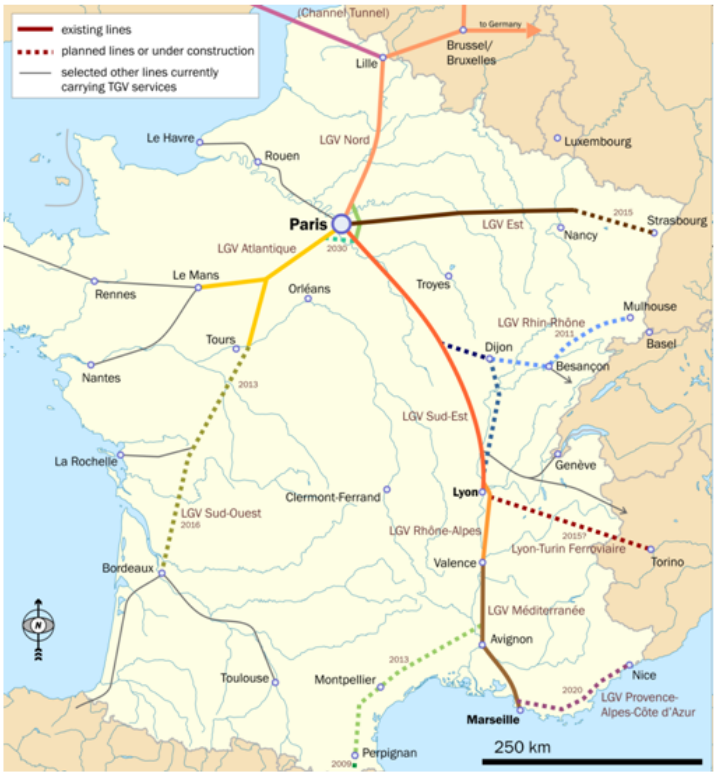
Note Significant Category II Lines Remain



Source:http://ec.europa.eu/transport/infrastructure/studies/ten_t_en.htm (Maps-EU)

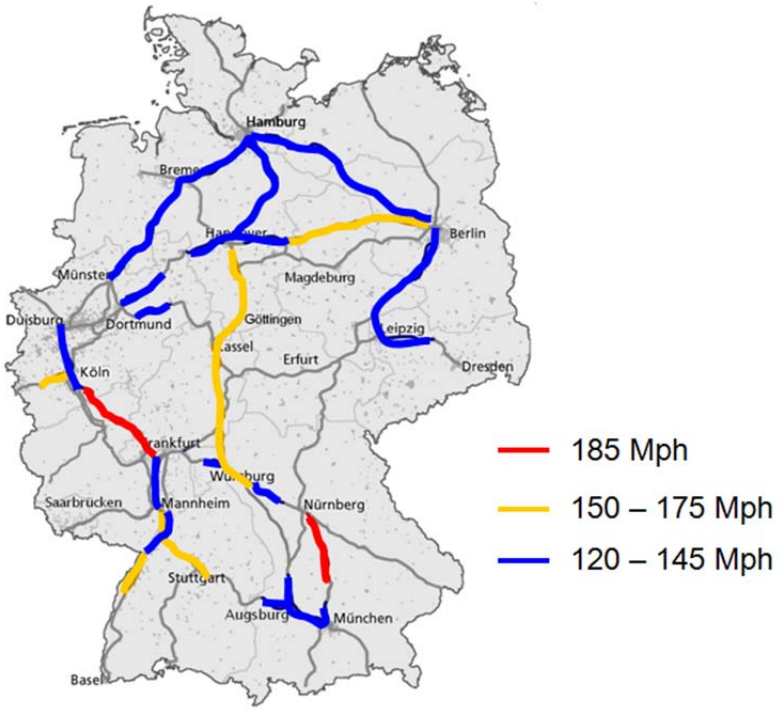
Map 7

French TGV Network

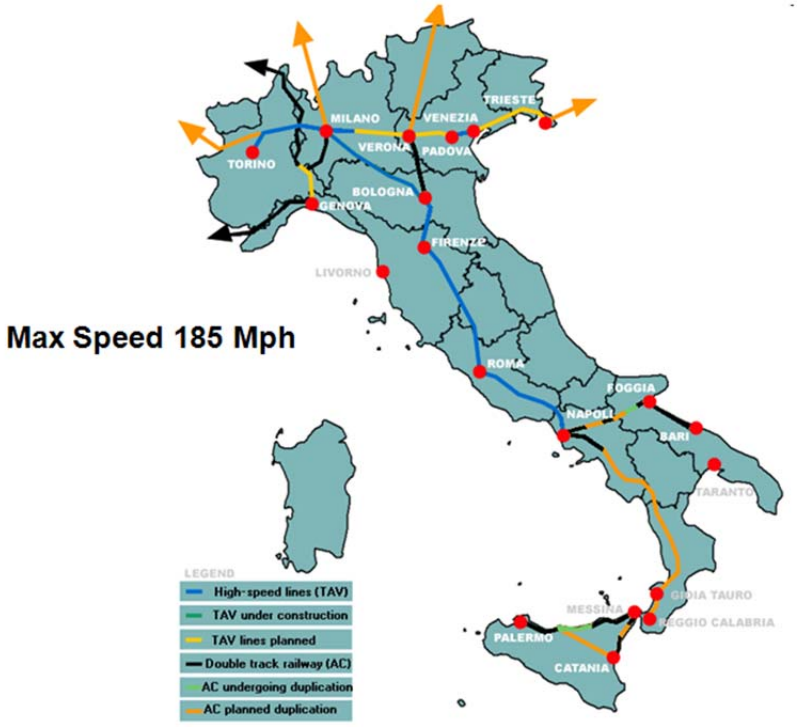


Map 8

Germany



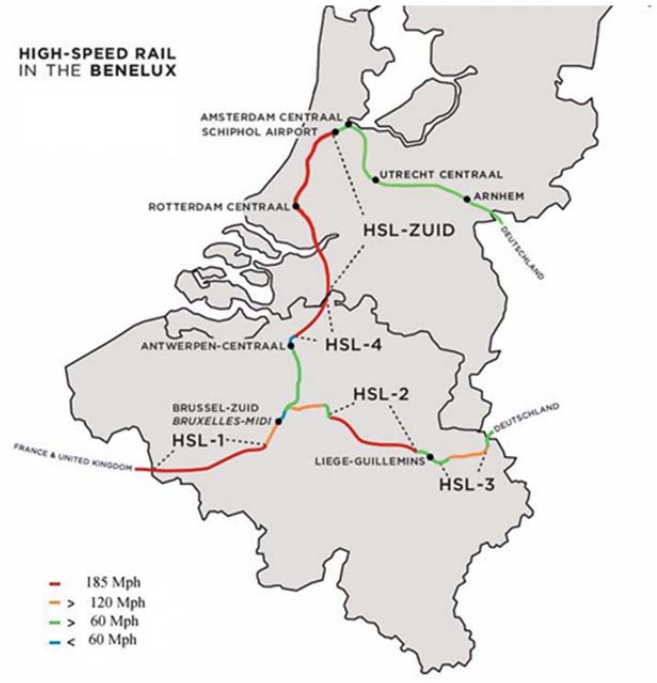
Map 9
Italy



Map 10
Spain

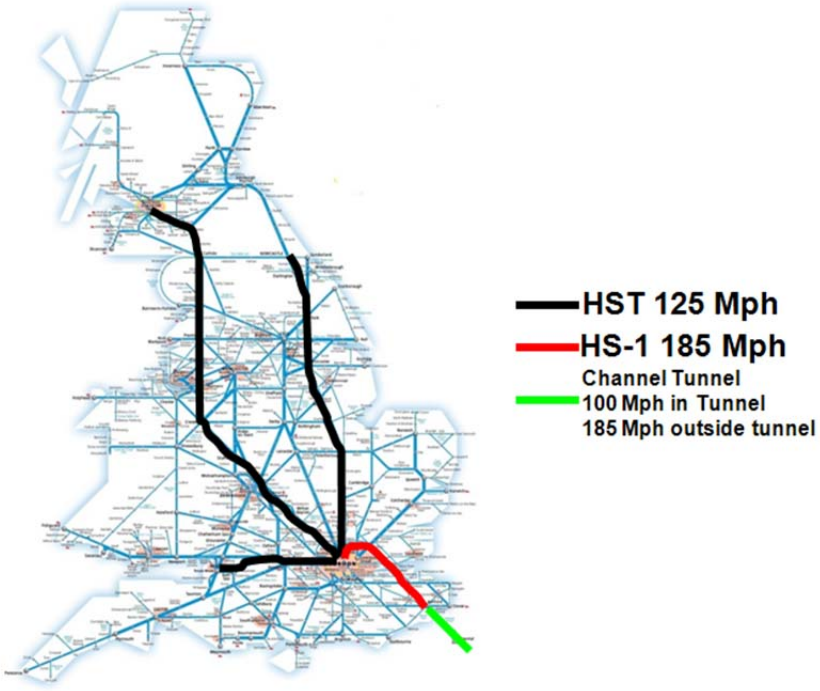
Map 11
Sweden

Map 12
Belgium and Netherlands HSR



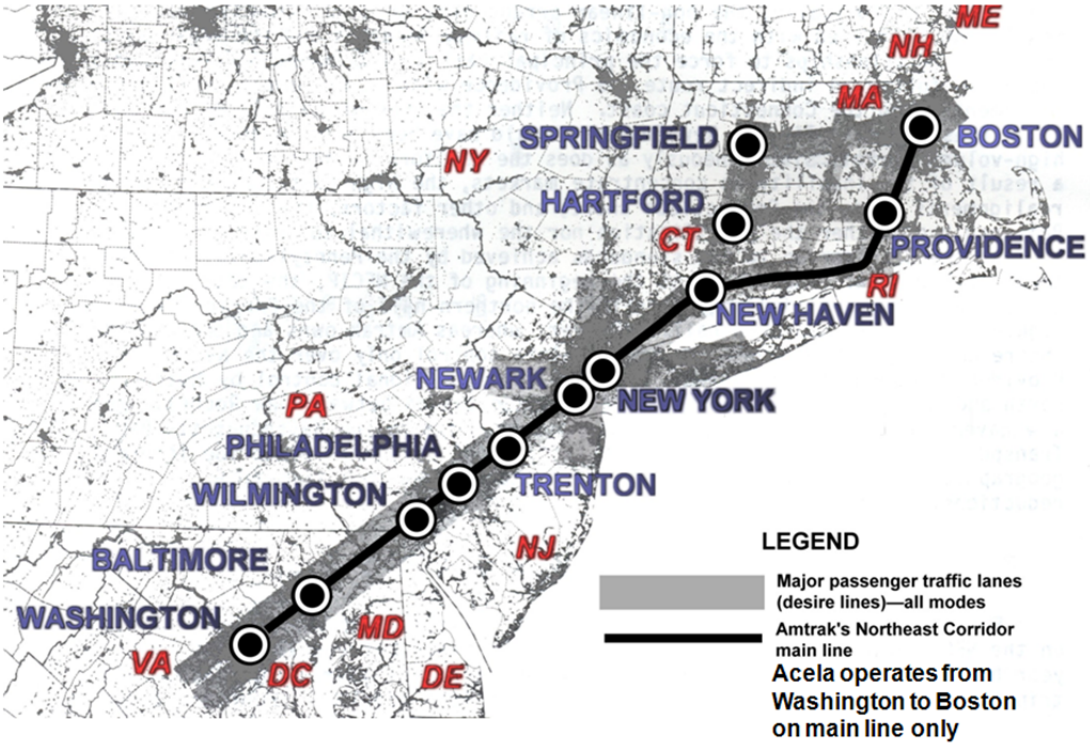
Map 13

U.K. Rail System



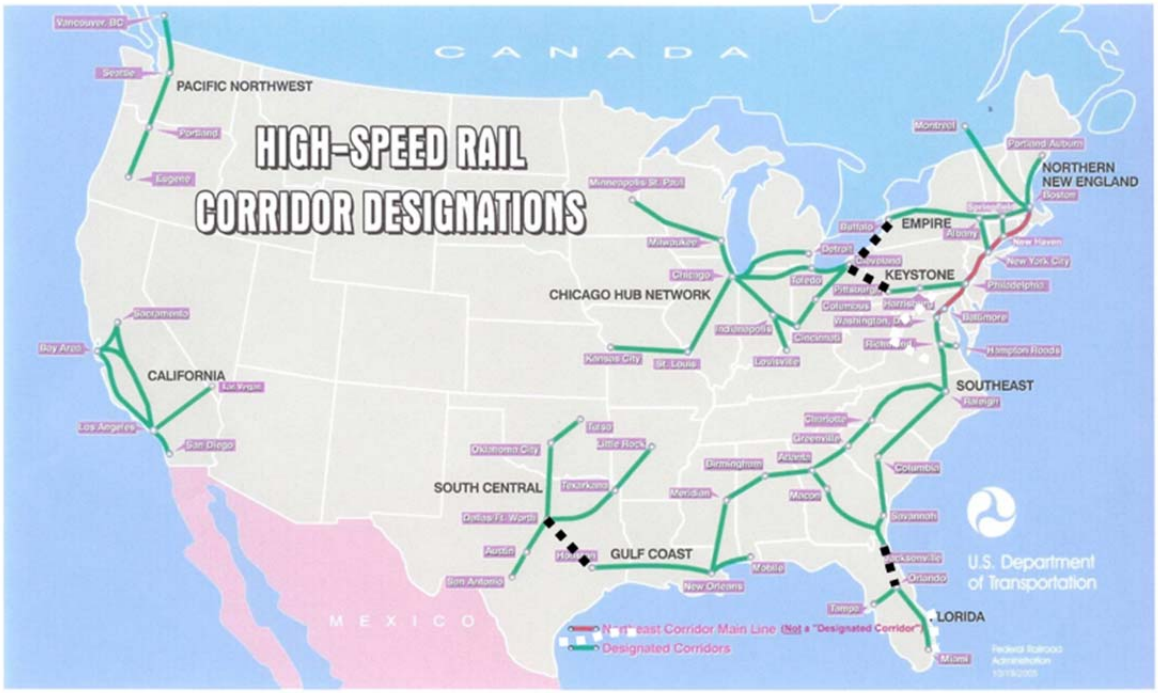
Map 14

The Northeast Corridor



Map 15

The Ten FRA Designated Corridors and the NEC: The Long Term VISION



▪▪▪▪▪▪ Indicates link added to FRA base