High Speed Rail in the UK

Prof. Roderick Smith
Advanced Railway Research Centre
Imperial College London, UK

Although the high-speed link with the mainland of Europe through the Channel Tunnel has been operating from London on a dedicated line since 2007 and it is now 54 years since the shinkansen opened in Japan, it is perhaps surprising that only now is a domestic high-speed rail network being realised. Why has this taken so long in a country which gave birth to the railway and for so much of its history been in the forefront of the development of the railways?

To better understand the answer to this question, it is necessary to rehearse, albeit briefly, the history of railways in the UK. From the opening of the first true inter-city railway in the world, between Liverpool to Manchester in 1830, the rail network (as distinct from a system) spread rapidly so that in the next 20 years it was possible for both passenger and goods to reach all places of consequence as well as many villages and hamlets throughout the land. The railway was built by private finance, and operated by a huge number of private companies. The system lacked coherence and there was much unnecessary duplication of routes. Natural amalgamation took place: in 1846, 70 companies controlled 66% of the railway mileage, by 1872, 16 companies had 85% and in 1907, a period known as the Edwardian zenith of the UK railway, just 13 companies controlled 88% of the routes. But by now the profitability of many parts of the railway was being called into question and public ownership was being seriously discussed. During the first world war, the railway was directly operated by the Government, was heavily used and played a vital strategic role, but was left in a relatively poor state by the end of the war, resulting in further amalgamation to just four major vertically integrated companies each covering defined geographical regions, the so-called Grouping of 1921.

The major dislocation of the thirties world depression, was rapidly followed by the second world war, during which history repeated itself, and the railway was left in very poor physical state at the cessation. The country itself was left in a weak financial position, but reflecting a mood for change and collective action, the reforming Labour Government nationalised many major industries, including the railways, from the start of 1948. Conflicting national priorities for finance meant that repair and modernisation was slow, for example steam engines were still being made for British Railways until 1960 before being finally withdrawn in 1968. Electrification was even slower: much of the railway south of London was electrified by an obsolete third-rail low voltage DC system much of which had been installed fifty years previously, well before the 25 kV AC electrification of part of the West Coast route in the sixties.

However both rail passenger and freight traffic patronage recovered until the later fifties and early sixties, when automobile ownership expanded as the car become a byword of progress and aspiration. The railways on the other hand, were viewed as yesterday's technology, usage declined, and many little used lines were closed. These closures were part of a trend which had reduced the length of route from 32 thousand km in the Edwardian heyday, to 24 thousand by 1955 and only 15 thousand in 1970. Use of other forms of public transport also declined and, for a while, the car was omnipotent. But in the 1960's great efforts were made to reverse this decline: a Railway Technical Centre was established at Derby, which employed well trained people, and which rapidly established an excellent international reputation for its work. Electrification and speed-up of routes from Manchester, Liverpool and Birmingham to London resulted in increased ridership at a time when some of the disadvantages of universal car ownership were just beginning to emerge: congestion, unreliable journey times

The Advance Passenger Train: an underfunded and over complex attempt to overcome the sinuous nature of old track by an sophisticated train.

The High Speed Train (HST): Introduced in 1976, probably the best train built in the UK and still in service on many UK inter city routes. (125 mph = 200 kph)

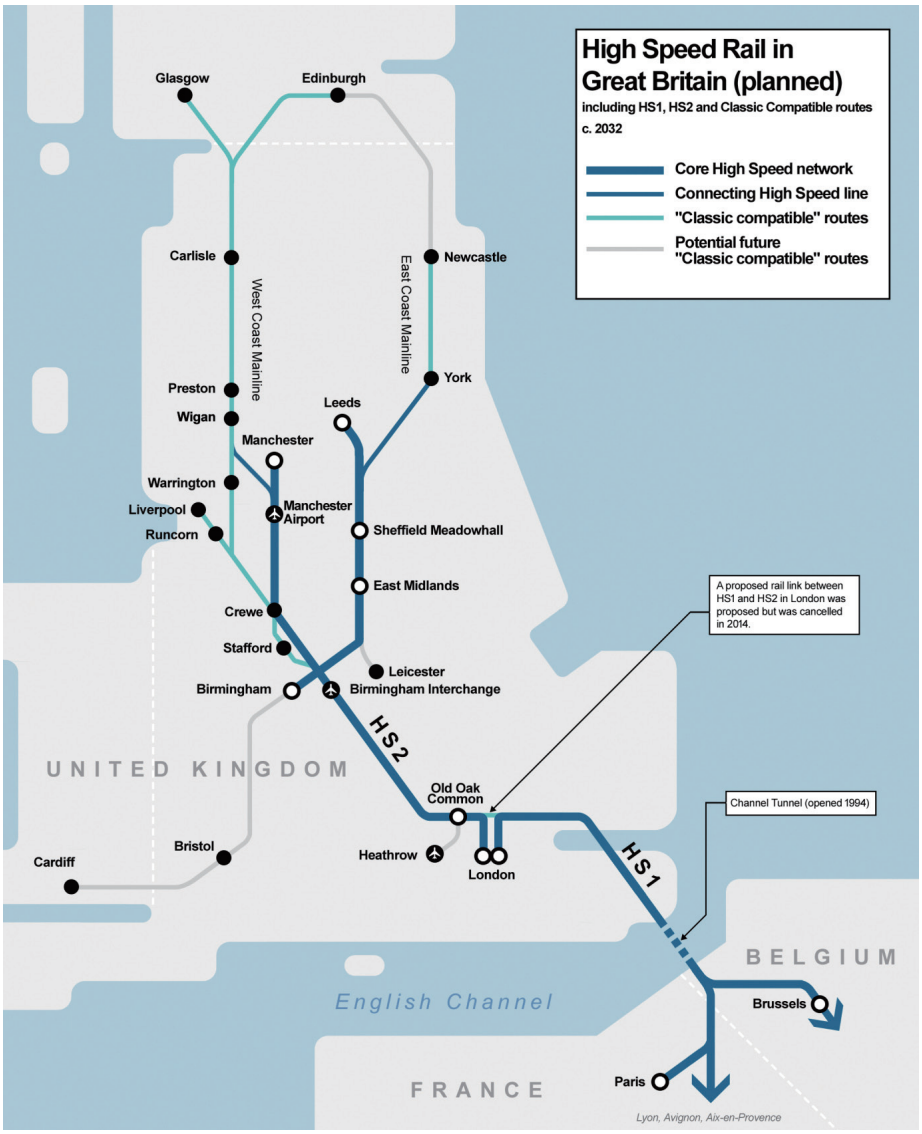
and parking difficulties came well before any concerns about pollution and the environment.

In 1969 a decision was made to improve journey times by developing a sophisticated Advanced Passenger Train (APT) which would run on existing track alignments. In retrospect, it is easy to say that, whilst major roads had been improved by motorway construction, for the railways concentration on the vehicle was not sensible, but it was, of course, much cheaper than improving and straightening existing track. Many, perhaps too many, technical innovations were incorporated in the design of APT: the need for a low un-sprung mass required the use of hydrokinetic brakes, which in turn allowed braking at a rate which conformed to the spacing of the existing lineside signalling system. Tilt was required to take curves at speeds 40% higher than existing trains, whilst light-weighting, including articulation, and high power was needed to attain the desired 50% increase in maximum speeds. The project prototype achieved a top speed of 261 kph in 1979, and a Glasgow to London (401 km) revenue journey in 4 hours and 15 minutes in 1981. However, hampered by technical niggles and chronic underfunding, the project was abandoned in the early eighties. But it spawned another train, the diesel powered Inter City 125 which benefited from much of the technical understanding from APT, but was simpler, more robust and reliable. Introduced into service in 1976, this train has been the backbone of main line express services ever since, is still going strong and is likely, now 41 years after its birth, to see further several, if not many, further years service. Initially promoted by the slogan, The Age of the Train, and much admired for its speed and ride comfort, this 200 kph train is arguably the most successful train ever produced in the UK, and is still the holder of the world diesel hauled record on 238 kph.

In the mid-nineties, the railway were privatised with the principal objective of reducing the contribution paid by the Treasury. A complicated and fragmented system emerged, in essence of operators running services on infrastructure owned and maintained by Network Rail, with vehicles owned by leasing companies. At a headline level privatisation might be considered successful: passenger km have doubled and, after a difficult start, safety is remarkably good. No passenger has been killed in a train accident for the last 11 years: the longest such period in the history of the railway. And this has happened during a period when the number of passengers and the number of journeys by rail has increased remarkably: approximately doubling since 1996, and the number of trains run has increased by nearly 30%, facts even make even more remarkable considering the much above inflation increase in fares over the same

period. This increased patronage has lead to congestion at bottlenecks on the system, crowding at key stations and a woeful record of trains being cancelled and being delayed. Readers in Japan will be surprised to learn that nearly one in eight trains last year were recorded as late, even within the generous definitions of being on-time of 5 minutes for local trains and 10 minutes for long distance, and that even after this remarkable increase in passenger use, the mode share of rail is still only 9%, far below the high twenties percentage still enjoyed in Japan.

Given this situation, the Government has been persuaded that the construction of a high speed railway network could increase capacity and relieve paths on the conventional network for local traffic and freight, whilst at the same time reduce the chronic out-of-balance bias to the southern half of the country. Several years of intense debate have now concluded, Parliamentary approval has been granted and the high-speed railway is beginning to take physical shape.



The current plan for new high speed lines in the UK. An cross county connection from Liverpool to Manchester and Leeds is currently being mooted to create a Northern Powerhouse economic conurbation.

Initially, a line was planned between London and Birmingham, a modern mirror of the inter-city route opened in 1838. Later a extension to the core cities of the north of England was proposed, whilst an east-west link across the country linking Liverpool, Manchester, Leeds and York is being actively promoted. It can be seen on the map that the distances involved are relatively short, in the 100 to 200 km range, thus reducing the pressure for very high operational speeds and emphasising the need for capacity.

As a long time advocate of high speed rail for the UK, the author is delighted that after such a long gestation period, physical action is now being taken to build such a network. However, my enthusiasm is tempered by several inconvenient facts, First, there have been no real efforts to win the hearts and minds of the public. In an era of constrained public finance and many worthy competing calls, as in health, education, security and housing, many people see the building of a new railway as an unnecessary luxury. The arguments about using the new railway to stimulate the economy cannot be made in a vacuum. Links with policy are weak or absent: new infrastructure is necessary but not by itself sufficient. A overall plan for the shape of eventual complete system has not emerged, and links with other transport modes, particularly airports have not been developed to best advantage. But even more concerning are the plans to operate the railway as an extension of existing arrangements.

It has been announced that mirroring the current system of operation of the railway, the new high speed trains and infrastructure will be not be operated with vertical integration. Furthermore trains will operate off and on the ends of the newly built track onto the existing network. This has many adverse consequences. First, the poor timekeeping record of trains on the existing (classic) railway, will be inherited on the high speed lines from day one. As a result rapid turn-round times at terminus stations and more platforms and indeed more trains will be needed. At London Euston, the plan is to built 13 new platforms,, the tracks from which will reduce to two tracks at the throat of the station with a complexity of switches and crossing which can only severely hamper reliability. After more than 50 years of growth on the most densely operated line in the world, the Tokaido shinkansen, operations are from just five platforms. Over the decades, during the construction and remodelling of Tokyo Station to accommodate both the JR Central and East shinkansen lines, the station has not been closed for a single day. Already there have been weekend closures of Euston and worse is to follow.

Because much of the rolling stock will not be captive to the new lines, it will have to be robust enough to deal with the lower track standards of the classic railway, some trains will have to be capable of operating in both electric and diesel modes, and will have to accommodate, for example, different crashworthy standards, braking distances, signalling and control system for the two types of track. They will also be constrained in width because of the restricted loading gauge of the classic system, limiting the number of seats across each carriage thus increasing energy consumption per passenger transported. All these factors increase complexity and expense while simultaneously reducing reliability and efficiency, and most certainly are not best world practice. Furthermore the weight and therefore axle loads of the duel mode vehicles will be much higher than captive stock, inevitably leading to much higher maintenance costs of the high-speed line. Clearly these fundamental weaknesses have been brought about by well meaning but flawed political decisions rather than operational and engineering experience and best practice. It is the authors hope that financial stringencies, caused by the UK decision to leave the EU, to which has been added the failure of Carillion, a major construction company which had major contacts with HS2, will lead to a rapid strategic re-evaluation to order to produce what could be a cheaper, both in capex and opex, and more efficient, reliable system.

NASA's picture of Europe by night clearly shows centrers of population. Existing UK plans for new high speed lines are contained with the triangular zone. Connections with the northeast and the Edinburgh/Glasgow conurbations may be made in the future, as might a line serving London from South Wales and the West. The population density of the Low countries and the north of Italy is well illustrated as are the distributed cities of Germany and the Paris domination of France.

Biographical note

Roderick Smith is Professor of Advanced Railway Engineering at imperial College London. He has served as Chief Scientific Advisor to the UK Department of Transport and as President of the Institution of Mechanical Engineers. He has visited Japan more than 70 times since his first visit in 1974 and has strong links with RTRI and the major Japanese railway companies. He is invited to lecture on railway and energy matters in countries all over the world and runs his own company consulting on railway matters.