

Using network capacity effectively where train operators compete for paths – the UK experience

Robert Watson, David Gillingwater, Anzir Boodoo
Transport Studies Group, Department of Civil and Building Engineering,
Loughborough University, Loughborough, LE11 3TU, UK

1. Introduction

Many railways find that there is more demand for train paths on their networks than they are able to provide, requiring capacity management of one form or another to resolve this conflict. Investment in the infrastructure to increase capacity is an option, but this is expensive and often will not represent value for money. Often better, and certainly more cost effective, is to ensure that the capacity already available is used as effectively as possible.

This paper discusses how network capacity was managed in the UK prior to privatisation (which happened progressively from 1994 to 1996), the structure that was put in place at privatisation and how the roles in capacity management of organisations have developed since then. Case studies are provided to set out what can go wrong when there is competition for paths. Finally the expanding role of the Strategic Rail Authority (a body set up by government in 2001 to ensure that government objectives are met by the rail industry) is described and future prospects discussed.

Whilst this paper concentrates on developments in the UK focused on this issue, it should be noted that the European Union has also been active in this area. It has undertaken work on path allocation with a key objective of making best use of available capacity (1) and Directive 2001/14/EC (2) requires member states to put in place standard processes to analyse capacity problems and propose solutions. This directive defines the role of infrastructure manager (in the UK this is expected to be Network Rail) and requires that this body produces a capacity enhancement plan and cost/benefit analysis wherever it cannot accommodate current or forecast bids for capacity. In addition, the infrastructure manager must publish a network statement covering the nature of the infrastructure, the capacity allocation and timetabling process, procedures and criteria for dealing with congested infrastructure and restrictions on the use of infrastructure (as well as charging arrangements).

2. Prior to privatisation

British Rail, from when it came into existence in 1948 (then known as the British Railways Board) until the 1980s, managed network capacity through a regional structure of train planning offices (where the regions matched quite closely with the pre-nationalisation railway companies). During the 1980s 'Sector Management' was introduced. All traffic flows were allocated to one of five business sectors (Inter-City, London and South East, Other Provincial Services, Freight and Parcels) and decision making was gradually transferred from the existing functions (operations, civil engineering, etc.) to the new 'Sectors'. 'Matrix management' was an inevitable consequence (3). The final stage of the transition to business management was undertaken under the banner of 'Organising for Quality'. With the new organisation that came into effect in 1993, the functions were finally subsumed in the Sectors, with

matrix management replaced by 'contracts' (in truth internal agreements rather than legally binding contracts, as all the Sectors were still part of British Rail).

A key principle in the un-restructured railway was that of 'first on the graph'. Long distance passenger 'Inter-City' trains were treated as top priority, local services had to fit around them, and freight trains took whatever space was left. This principle simplified the planning task, as it substantially reduced the number of permutations that had to be considered. Despite this, considerable complexity still existed. The capacity planning responsibility for British Rail was split across a number of geographic offices, with substantial interface issues for the planning of services that passed through a number of these. Ultimately, conflicts over the use of capacity could be resolved within the one company, with the Chairman of British Rail deciding between options if lower levels of management could not reach agreement.

3. Privatisation

In the early 1990s, several potential new industry structures were considered, including privatising British Rail as a single entity, splitting the railway into regional monopolies (harking back to the situation that existed prior to nationalisation), selling the newly formed Sectors separately or dividing the railway into an infrastructure provider, competing train operating companies and supply companies (owning the rolling stock, maintaining and renewing the track and so on). For reasons discussed by Preston (4), Harris and Godward (5), White (6), Kain (7) and others, the latter option was adopted, with an Act of Parliament becoming law in 1993. 1st April 1994 was set as the date for implementation of the first phase of the restructuring process - setting up Railtrack as a separate 'GoCo' (Government Owned Company) responsible for maintenance, renewal and operation of the infrastructure. Freight operations were sold to the private sectors, passenger rolling stock was sold to rolling stock leasing companies and the Office of Passenger Rail Franchising (OPRAF) was set up as an arm of government to let franchises to the private sector to run passenger services (with these franchisees leasing rolling stock from the rolling stock leasing companies), creating around 25 passenger train operating companies (TOCs). Finally Railtrack was floated on the Stock Exchange.

Central to this new structure were a new regulator, the Rail Regulator, and access agreements between train operators and the infrastructure manager, Railtrack. The Rail Regulator was to be responsible for determining the fair and efficient allocation of the capacity of 'railway facilities' (track, stations and maintenance depots), which he would do through approving or 'determining' access agreements where he felt it appropriate to change the proposed agreement. The access agreements would set out how much capacity the train operator was permitted to use, the conditions which he must observe, the obligations of Railtrack, how much was to be paid for the access, and what was to happen if things went wrong. It was expected that for the most part a TOC would agree the terms of the access agreement with Railtrack. Once agreed, the agreement would be sent to the Regulator for his approval, which he could give with or without modifications - or he could reject it, if he felt that the access agreement was unfair in some way (e.g. to another operator) or made inappropriate use of capacity. If an agreement could not be reached between the TOC and Railtrack, the operator could ask the Regulator to force Railtrack to enter into an access agreement.

The Regulator is required by the Railways Act 1993 (as subsequently amended by the Transport Act 2000) to have regard to 'considerations beyond the commercial wishes or interests of the facility owner [Railtrack] and the prospective user, and to

consider whether the proposed access contract is in the overall public interest..... In doing so, he consults other users and prospective users of the railway facility in question, the Strategic Rail Authority (SRA) and other funders, and other interested parties' (8).

Much has been written about the then government's objectives for privatisation of the railways – see for instance Harris and Godward (5); Shaw *et al.* (9); Kain (7); Welsby and Nichols (10). It is generally accepted that the Conservative government regarded competition as the most effective way of achieving improvements in services (indeed the Rail Regulator's objectives were explicitly framed to focus his attention on achieving competition between rail services).

Access agreements were only to set out an 'envelope' of times within which TOCs could bid for paths and Railtrack had to offer them, with new timetabling processes needed to facilitate this 'bid and offer' process. It was therefore a 'given' that new processes should accommodate competition effectively, that they should be fair between all operators and that they should be confidential between bidders until the last possible moment. There could no longer be TOCs who had rights to be 'first on the graph'; neither could there be expected to be discussion between TOCs in advance of their 'bidding' for access on the network. Indeed it was suggested that such discussions would amount to collusion and contravene competition law.

It was anticipated that the private sector would demand great flexibility, with frequent service changes to match with perceived demand and to deal with competitive threats. Major timetable changes had previously been restricted to once per year (the start of the Summer timetable in late May/early June) or, if really essential (e.g. if new rolling stock deliveries required it), twice per year (with less substantial changes at the start of the Winter timetable in September). It was considered that this would be wholly inadequate for the private sector and that something more akin to the bus industry norm would be required, with a gestation period measured in weeks rather than something around a year and an opportunity to amend the timetable every few weeks.

The new processes for allocating paths to TOCs consistent with their access agreements were set out in the Railtrack Access Conditions (subsequently renamed the 'Network Code'), a document tied in to the access agreements between Railtrack and the Train Operators and dealing with a number of multi-party rather than bi-party arrangements. 'Decision Criteria' were set out to provide Railtrack with guidelines on how to be impartial between bidders and an appeals process was put in place to enable 'case law' to be created.

Each TOC would be required to produce a detailed timetable for its services (detailed meaning 'high data intensity' with all the necessary en-route timings and other data provided). These would be transmitted electronically as 'bids' to Railtrack who would overlay them and deal with any conflicts (i.e. trains from different train operators that were planned to be on the same track at the same time) by 'flexing' those trains to run a few minutes earlier or later to achieve a 'conflict free' timetable. Revised times where necessary would then be 'offered' back to the TOCs. This bid and offer process would be repeated a further four times, with the timetable gradually being refined over this period, as TOCs 'accepted' the offers made or rejected the offer and re-bid. New bids would also be accepted in later bids, but an operator would run the risk of all the available capacity having been used up. There would be six timetables per year, with each of the timetables having five 'iterations' of bids and offers. The identity of bidders would be kept secret until the timetable was published. To achieve an overall process length no longer than previously, the bid and offer periods would

be restricted to four weeks each. This revised process, whilst in theory offering greater flexibility and meeting the objectives of competition and fairness was considerably more demanding than the old process – and of course completely untested.

4. Capacity management in practice – case studies and issues

These case studies, and the issues raised in the discussion that follows, have been developed from interviews with industry players as part of a project funded by one of the UK's research bodies, the Engineering and Physical Sciences Research Council. The project was focused on gaining a better understanding of the objectives that capacity planning processes and systems need to be able to meet.

Case Study A: Overselling available capacity – CrossCountry service improvements

Some of the franchises required the franchisee to do little more than efficiently manage current operations; while others required major investment (11). British Rail had operated a number of 'cross country' services focused on Birmingham and offering a basically hourly service pattern to the South West, South Coast, North West and North East. These were offered as a new "CrossCountry" franchise, and Virgin's bid promising to double the service frequency with a new fleet of trains was a clear winner.

The procurement and supply of the new trains went relatively smoothly but obtaining the necessary paths for the extra services did not. Railtrack had the task of slotting extra services across the network whilst working within the access agreements of other operators and with the constant risk of being accused of being unfair to these operators. The challenge was a new hourly interval timetable covering the country from North East Scotland to the tip of South West England, interfacing with 18 of the 25 TOCs' operating areas. After nearly ninety iterations over two years of planning, Railtrack produced a timetable which met their internal planning rules and had the agreement of other TOCs. The new service was introduced in Autumn 2002 and within a few weeks it was clear that it would not work. Trains were having to be 'terminated short' because they were running so late and train running performance plummeted.

What went wrong? Interviewing under the EPSRC grant was undertaken before this new service went into operation but whilst the timetabling task was under way. It was therefore discussed in several of the interviews and provided useful insight. Railtrack, it was suggested, had set out to please everyone – partly because of constraints placed on it by the access agreements it had and partly because it lacked the level of analysis necessary to convince TOCs (or the Regulator) that it could not achieve all that it was being asked to do.

The net effect was too many trains on certain sections of the network, particularly major 'pinchpoints' at stations and junctions, leading to knock on delays that persisted through the day. In addition, turnround times for many services were insufficient to allow for late running, compounding delay or leading to station stops being missed out to make up time. Compounding this, junction upgrades necessary for the new service were delayed, and while it was assumed the new trains' power and speed would enable them to recover from delays and regain timetable slots, this

rarely happened in practice. A Virgin Trains spokesman recently confirmed the problems, saying 'the timetable worked in theory, but if a couple of trains were late, then it had an impact' (12).

Case Study B: Overselling capacity – West Coast Main Line

Virgin Trains again provided a compelling bid for the West Coast franchise, promising better services through a major upgrade. After winning the franchise, they brokered a profit sharing deal with Railtrack whereby the infrastructure would be upgraded to permit 140mph tilting trains to run services from London to Birmingham, Liverpool, Manchester and Glasgow.

Railtrack underestimated the cost of the infrastructure works but also, after persuading the Regulator to approve its access agreement with Virgin Trains, found that the combined access rights of all operators on the route could not be met even after the upgrade. It was a widely held view amongst interviewees that Railtrack would have been unable to meet its commitments on the West Coast route and indeed Railtrack had been unable to meet the terms of an enforcement notice placed on it by the Regulator (13). Railtrack was potentially in breach of contract with a number of TOCs, had the government not intervened in 2001 by putting Railtrack into receivership.

One example of the problems was Railtrack's contract with Virgin Trains was the planned separation of services on the West Coast Main Line between London and Rugby, where the fast lines were to be used exclusively by Virgin Train's 140 mph tilting trains, with up to 14 trains an hour. At present, other passenger and freight services also use these tracks, and analysis undertaken after the contract was signed demonstrated that there was not sufficient capacity on the slow lines for all other services to be taken off the fast lines. In addition, local train franchisee Silverlink, running between London and Northampton had access rights over the fast lines, to which a number of solutions were suggested, including 140mph express trains between the two towns. A further problem only understood after the contract had been signed was that station stops were required for the Virgin trains at Watford Junction and Milton Keynes Central, both major traffic generators. On other high speed railways worked to this intensity, such as the French Lignes à Grande Vitesse and the Japanese Shinkansen, trains stop in platform loops so they can be overtaken by the following non-stop train. Such infrastructure was not part of the West Coast plan.

Whilst it is the case that many of these problems were the result of poor planning rather than the changed Industry structure, the impact of the contracts in place was to make it very expensive for Railtrack to produce a workable solution.

Case Study C: Competition in action – open access

Operator A sought 'open access' access rights to operate a new service over his own 'territory' but extending into the territory of another TOC (called operator B here as confidentiality was requested) offering new through journey opportunities. Operator A then sought to take up latent access rights, agreed with Railtrack when it took up the franchise, for a further service entirely within his own territory – offering greater service frequency but, according to interviewees, having rather more to do with protection of revenue and paths, to retain its place in the market. As a result, Operator A only got a small proportion of the access rights asked for.

The outcome does not appear to have been the best possible for either operator or for the passenger: Operator A did not get a sufficiently frequent service to provide good journey opportunities and attract passengers and has since withdrawn the service; Operator B has been running an additional service each hour which is not needed to meet demand and impacts adversely on the performance of the network overall.

Case Study D: competition in action - the ORCATS raid

Most tickets can be used on any operator on a route and, since it would be prohibitively expensive to do more than a small sample count of which passengers use which trains, some allocation mechanism is required. ORCATS (Operational Research Computerised Allocation of Tickets to Services) was developed by British Rail to help understand passenger decisions and therefore offer the best overall service; it was the only available system to allocate revenue between operators and has been used since privatisation to allocate revenue between TOCs running along the same route. ORCATS was designed to do to take account of competition between TOCs and, as a result, an important perverse incentive exists, known as the 'ORCATS raid'.

By understanding how the ORCATS algorithms work, it is possible for TOCs to adjust their timetables so as to get the maximum revenue allocation, without necessarily offering any extra passenger benefits. Interviewees gave examples of a number of additional services which they considered were being operated simply to 'raid' the revenue of other operators. See Doe (14), for a brief example of the problem.

From a network capacity point of view, these extra trains mean extra congestion and hence extra delays and the evidence from interviewees suggested that there were often insufficient passenger benefits from the extra services, as many were designed to increase revenue allocation rather than provide the best journey opportunities, to offset the costs of worsening performance.

Issues

Analysis of the case studies set out above suggests that there were a number of weaknesses with the access regime as formulated at privatisation. In particular, mechanisms to ensure that the best overall capacity usage was achieved do not appear to have been in place, with TOCs encouraged to run extra trains where there was insufficient overall benefit (case studies C and D), and with no mechanism in place to take off services that had a smaller benefit than the new service proposed (case studies A and B). This must however be seen in the context of a network that was not considered to be congested and where industry players for the most part did not fully understand the extent of the performance reduction that would result from the additional trains they proposed to run.

Strain was caused because after the processes had been set up to facilitate competition, the government required (some interviewees suggested rather as an afterthought) that 'network benefits' (the ability to use a number of different train operators' services to efficiently complete a journey) should be protected. On the one hand the process had to be confidential so that competitive advantage could be maintained and on the other sharing proposals was necessary to ensure that travellers who needed to use the services of several train operators would get good quality journeys (meaning good connections for interchange). There have been many who have suggested that the government's thinking was muddled and

inconsistencies abounded (see e.g. Welsby and Nichols, 10). Inevitably this conflict in objectives led to sub-optimisation in capacity utilisation. Adamson *et al* (15) predicted these problems, stating 'co-ordination [is] inherent in the timetabling process, which in practical terms is impossible to replicate through market mechanisms'.

Another problem inherent in the way the industry was restructured at privatisation was that the 'Passenger Service Requirements' that formed the minimum service specification that government required franchisees to deliver were very specific. Whilst providing some protection against service reductions, these have to some extent 'ossified' the timetable, as it initially proved hard to change the 'PSR' once it had been put into the franchise agreement – even where the proposed change would improve service levels overall.

Interviewees suggested that Railtrack's response to the rigidity in access agreements and PSRs was for the most part only to progress schemes that could be achieved without disadvantaging any TOC and this tended to lead to changes being resisted or expensive infrastructure schemes proposed.

One interviewee suggested that, in retrospect, TOCs should have been keener to use the appeals mechanism permitted by the Access Conditions, which would then have given the Rail Regulator the opportunity to become involved (as the Rail Regulator only had the right to intervene at the point an access agreement needed his approval or if a dispute between industry players was brought to him).

On the positive side, it should be noted that the access regime did allow a significant number of extra services to run that were worthwhile and these additional services have helped passenger km and freight tonne km to grow substantially since privatisation.

5. Remedying the deficiencies

5.1 Changes within the existing industry structure

A number of capacity allocation problems, including those set out above and has led the Rail Regulator to review industry processes and make a number of changes. In particular he has required Railtrack (and now Railtrack's successor, Network Rail) to improve its processes, making better capacity plans and undertaking more thorough analysis and he is putting an additional 'use it or lose it' clause into future access agreements, to prevent TOCs from retaining access rights which they do not intend to use and which prevent alternative, beneficial, uses for that access.

Railtrack proposed and implemented, with industry agreement, a series of changes to the timetabling processes, reducing the number of timetable changes back to pre-privatisation levels and introducing a 'timetable conference' each year for plans to be shared. Competition and confidentiality in timetabling has largely been replaced by collaboration. A further potential improvement comes from centralisation of key planning tasks - Network Rail has now set up a 'Strategic Access Planning' organisation to focus its forward capacity planning activities in a single team.

These changes could be expected to improve the use of capacity and some benefits are already seen through better thought through requests for access rights and a willingness by Network Rail to reject requests for access that appear not to have

sufficient overall benefits – particularly where there are performance disbenefits from extra services on congested parts of the network.

5.2 The Strategic Rail Authority's new role

The SRA was set up to 'create a clear, coherent and strategic programme for the development of the railways and provide a single body accountable to the Secretary of State for strategic planning, co-ordinating and supervising the activities of the rail industry and for the disbursement of appropriate public funds' (16). The formation of the SRA was seen as necessary to ensure that the overall direction that the railway industry took was focused on meeting government objectives, particularly its 'Ten Year Plan' for transport (17)

Of particular importance to this paper is that the SRA was required to 'develop a policy for the utilisation of network capacity.' (Directions and Guidance to SRA from the Secretary of State, 18) The Directions and Guidance go on to say that 'in an ideal world sufficient capacity would be available for all users. Much more can be done to optimise the capacity of the existing network and the SRA should work closely with Railtrack and the industry to identify measures to achieve this. Where this is not possible, for instance where physical locations are constrained, hard choices may have to be made to identify priorities where operators' aspirations may conflict with one another'.

The SRA has spent since the beginning of 2002 considering how it can achieve better capacity utilisation. It has now published several documents which set out its position: its Capacity Utilisation Policy consultation (2002), Statement of Principles (2002), Network Utilisation Strategy (2003) and its first route-specific study, the Midland Main Line Route Utilisation Strategy consultation (2003). In addition it has published its Strategic Plan (2002, 2003), setting out its wider objectives and plans and its Appraisal Guidelines (2003), which set out how different options will be judged (all these documents are available from the SRA website at www.sra.gov.uk). The SRA has reviewed how much freedom it gives franchisees to set their own timetables and for all new franchises, franchisees are required to get SRA's approval before seeking access rights or bidding for specific paths. This helps SRA to work towards more effective use of network capacity – but clearly reduces the extent to which there is competition between train operators.

Returning to the case studies, the SRA has been able to use its power (as funder of the industry) to put right some of the problems caused. For the cross country services (case study A), the SRA has worked with all operators to produce a coherent service pattern, agreeing reductions in service levels where duplication existed and where benefits were exceeded by costs, particularly performance disbenefits. For the West Coast, a Strategy has been published, setting out a rational set of infrastructure enhancements focused on cost-effectively meeting the needs of the many users of the route. Unfortunately 140mph running has been ruled out at least for the short term, as the capacity and performance problems that this higher speed creates have been judged to outweigh the benefits of shorter journey times. The problems of case studies C and D are being resolved by restricting franchised operators' freedom to bid for additional or varied paths – future franchise agreements will require any TOC seeking to vary its access rights or paths to seek the SRA's permission first.

Two further examples have already emerged of how capacity utilisation could be improved through the SRA working with TOCs. The first is a proposal put forward in

2002 by First Great Western, the TOC running franchised services from London to the West Country and South Wales (19). By restructuring the timetable between London and Reading and changing the types of trains used, the TOC found that it would be possible to increase the number of peak hours seats by 30% and, at the same time, improve performance. The second is the Midland Main Line Route Utilisation Strategy, with extra peak hour seats and extra inter-urban services potentially possible without a material performance impact through the introduction of longer trains and restructuring the timetable to reduce knock-on delays.

6. Conclusion

Recent discussions with Network Rail and TOCs suggests that the changes described above will improve capacity utilisation. All industry parties appear to be focused on improved performance and better matching capacity to demand. There appears to be a common view that effective use of the available capacity is an essential element of a successful rail industry. Richard Bowker has pointed out that unless the rail industry can demonstrate that it is using what it has now effectively, there is little justification for further funding of major enhancements (20). There also appears to be an acceptance that the SRA has a key role to play (21).

'Open Access' operators (operators not under franchise from the SRA) provide freight services and a small number of passenger services and the SRA does not have direct influence over them. However the Rail Regulator does take account of effective network utilisation when considering requests for access from open access operators in the same way as he does for access requests from franchised operators.

One remaining area of concern relates to modelling processes and tools. There is still in the UK insufficient analysis of capacity utilisation options. Current modelling tools can prove complex, slow to use and are insufficiently understood; the outputs of are often difficult to interpret. More work is needed to understand how different capacity utilisation will impact on demand and on train running performance. The SRA and ORR recognise this, having included in their recent 'concordat' (22) the statement that 'the ORR and the SRA will work together to develop better measures of network capacity, and a better analytical toolkit for informing decisions on the allocation of capacity between different types of passenger and freight flows'.

Overall, then, it appears that the UK railway industry has found ways to manage capacity effectively in a multi-organisation public-private railway. The important lesson for other railways being reorganised and privatised is that a substantial degree of co-ordination appears to be necessary to get the best out of the available capacity.

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