National Audit Office

The Modernisation of the West Coast Main Line

REPORT BY THE COMPTROLLER AND AUDITOR GENERAL | HC 22 Session 2006-2007 | 22 November 2006

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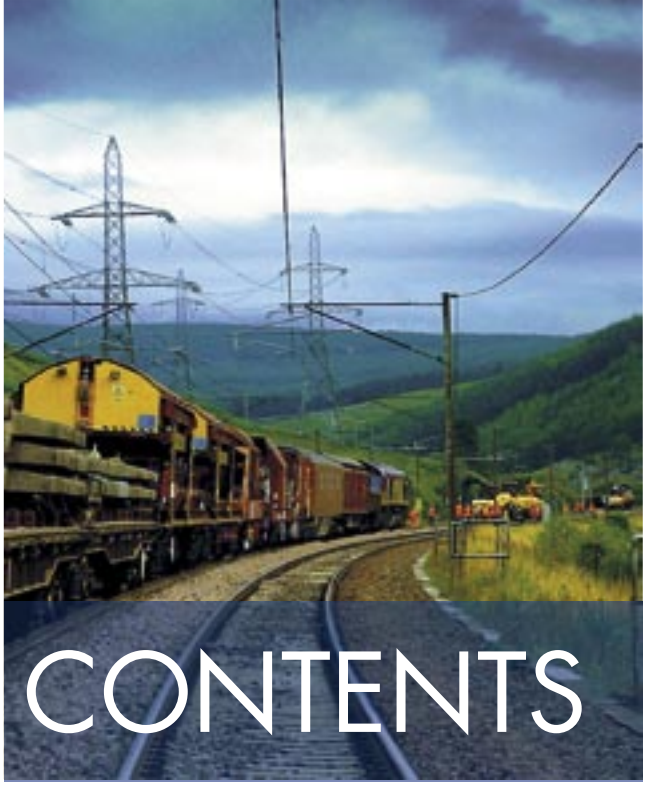

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16 November 2006

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SUMMARY

1 In January 2002, the Secretary of State instructed the Strategic Rail Authority to intervene and find a way forward for the programme to renew and upgrade the West Coast Main Line **(Figure 1)**. The upgrade was being undertaken under a 1998 agreement between Railtrack, the private sector owner and operator of rail infrastructure, and Virgin Rail Group, which operates the West Coast passenger rail franchise, and involved the introduction of new signalling technology to allow improved services delivered by new trains running at 140 miles per hour. By 2001, neither the rail infrastructure upgrade nor the new trains were on course for delivery as set out in the 1998 agreement. In October 2001, Railtrack went into Railway Administration and by May 2002 its projection of the programme's final cost had risen from £2.5 billion[1] (in 1998) to £14.5 billion, with the first stage of implementation in May 2006. Railtrack had spent £2.5 billion on the programme by March 2002, and had committed some £500 million of further works, but had delivered only a sixth of its scope. There had been substantial abortive costs to the programme, including £350 million of work developing new signalling and train control systems and the building of, and technology development for, a Network Management Centre that were de-scoped from the programme in 2002-03. Appendix 1 provides further background to the programme.

1 Unless otherwise indicated, this and other costs in the report are in 2005-06 prices to facilitate comparisons.

1 The West Coast Main Line is the busiest mixed-use railway in the UK

Physical features

- 640 route miles and 1,660 miles of track
- London to Crewe mainly four track (two fast and two slow lines)
- North of Crewe mainly two track
- 114 stations
- 13 major junctions
- 60 tunnels
- 2,800 signals
- 10,000 bridge spans

The route is used by

Train operators	Freight operators
Arriva Trains Wales	Direct Rail Services
Central Trains	English, Welsh & Scottish Railway (EWS)
First Scot Rail	Freightliner
Northern Rail	Freightliner Heavy Haul
Silverlink	GB Railfreight
TransPennine Express	
Virgin Cross Country	
Virgin West Coast	

Use of line

Passenger train miles per year: 22 million
Freight train miles per year: six million

Source: National Audit Office analysis of Network Rail information

2 The Strategic Rail Authority clarified the direction, scope and expected outputs of the programme in the June 2003 *West Coast Main Line Strategy*[2] and engaged stakeholders in support of the programme. The Strategy brought forward the delivery of train speed and frequency enhancements, to September 2004 and December 2005, to match with Virgin's revised programme for the introduction of its new tilting trains. Delivery to a tight timetable put pressures on costs and the Rail Regulator took this into account, when determining, in December 2003, the efficient cost of delivery of the remaining outputs and setting Network Rail's overall funding for the period between 2004-05 and 2008-09, including funding for the programme.[3] The Regulator's funding determination implied an overall programme budget of £8.3 billion. This assumed Network Rail could achieve efficiencies totalling £940 million[4] and was £2.5 billion below the £10.8 billion[5] upper limit approved by government when it accepted the 2003 Strategy. Both Network Rail and the Strategic Rail Authority considered this efficiency assumption was very challenging.

2 West Coast Main Line Strategy, June 2003: http://www.sra.gov.uk/pubs2/strategy_policy_planning.
3 Network Rail replaced Railtrack-in-Administration in October 2002. The Regulator, who was succeeded by the Office of Rail Regulation in July 2004, determined the efficient price for Network Rail's work and the level of access charges and network grant funding that train operators and the Strategic Rail Authority/DfT needed to pay to meet Network Rail's costs from 2004-05.
4 Equivalent to £863 million in 2002-03 prices, as set out in the Rail Regulator's Final Conclusions to the Access Charges Review 2003.
5 Equivalent to the £9.9 billion, in 2002-03 prices, set out in the SRA's April 2004 Progress Report on the programme.

3 The Authority's June 2003 *West Coast Main Line Strategy* set out three delivery phases and five key objectives **(Figure 2)**.

4 So far, Network Rail has met the key infrastructure delivery and performance milestones and Virgin West Coast has introduced into service its new fleet of Pendolino tilting trains. By April 2006, 77 per cent of the physical work in the programme was complete, with the key remaining projects being the enlargement of Milton Keynes and Rugby stations and the widening of the Trent Valley route. From April 2009, following completion of the modernisation programme, ongoing work to renew and develop the route will be undertaken as part of Network Rail's normal business.

What we examined

5 This report examines how effectively the Strategic Rail Authority/Department for Transport[6] and Network Rail turned around the West Coast programme between 2002 and 2006 in terms of delivering outputs and expected outcomes in line with the schedule and targets set by the government in the *West Coast Main Line Strategy* in June 2003 and the expenditure assumed by the Rail Regulator in December 2003. We examined:

- how the Strategic Rail Authority/Department and Network Rail addressed the weaknesses in programme management before 2002 to achieve delivery to schedule (Part 1);
- whether costs have been brought under control (Part 2); and
- whether the programme is delivering its anticipated benefits (Part 3).

2 The 2003 Strategy set out three delivery phases and had five key objectives

Phase 1

27 September 2004

Track upgraded to enable introduction of a new, and more frequent, timetable incorporating 125 mph tilting trains operating between London and Manchester, Birmingham and Crewe (Stage 1A).

Phase 2

10 December 2005

Track upgraded to enable journey time improvement from 110 mph to 125 mph from Preston to Glasgow under tilting train operation working to a new timetable, after the start of 125 mph operations between Crewe and Preston from 12 June 2005 (Stage 1B).

Phase 3

31 December 2008

Major renewals and enhancements to complete the upgrade and the increase in capacity to achieve overall 80 per cent more long distance passenger trains and 60-70 per cent more freight paths than before September 2004.

The Programme's five key objectives

1 Address the major backlog of maintenance and renewals on the route, ensuring value for money.

2 Provide an improved level of performance, safety and reliability, which will in turn help the railway regain lost market share and increase the role it can play in the national and regional economies.

3 Provide capacity for anticipated growth in passenger and freight business over the next 20-30 years, with substantially faster and more competitive journey times.

4 Establish sustainable and cost effective maintenance regimes.

5 Achieve these objectives on a 'working railway' while allowing for the continuation of key freight and passenger traffics during the rebuilding and enhancement work.

Source: National Audit Office review of the Strategic Rail Authority's June 2003 West Coast Main Line Strategy

6 The Department for Transport took over the Strategic Rail Authority's responsibilities for sponsoring major rail investment projects and letting and monitoring operator franchises from July 2005, following the abolition of the Strategic Rail Authority under the Railways Act 2005. In this report, we use the phrase Strategic Rail Authority/Department to signify sponsorship of the programme by the Authority to July 2005 and by the Department thereafter.

6 We interviewed key personnel in the West Coast teams of the Strategic Rail Authority, Network Rail, the Department and the Office of Rail Regulation, and reviewed and analysed supporting documents and data. As case studies, we examined three completed and three current key projects within the programme (Appendix 3). We also interviewed train and freight operators affected by the programme and, jointly with Network Rail, commissioned QinetiQ to review the risk of obsolescence for the West Coast Main Line's signalling systems. A detailed explanation of our methods is at Appendix 2.

Key findings and conclusions

7 The Strategic Rail Authority and Network Rail, which replaced Railtrack in October 2002, turned around the programme by providing clear direction through an industry-supported Strategy, reducing technology risk through reliance on conventional signalling for most of the upgrade, and by tightening controls over changes to scope and over the management of the programme and contractors.

8 The 2003 Strategy appropriately removed from the programme the European Rail Traffic Management System (ERTMS), new signalling technology, and the Network Management Centre, on which Railtrack had spent £350 million, to reduce these major risks to programme delivery. Continued ERTMS development, to address European Union requirements, became a separate national programme. But some new technologies were not removed from the programme and there have been implementation problems with two of these since 2002: axle counters and computer-based interlocking signalling. These have increased costs to Network Rail by over £35 million.

9 Network Rail's control over costs has improved, particularly from 2004-05, but our analysis of its reported and forecast expenditure shows that final programme spend is likely to be £8.6 billion[7], bringing overspending to around £300 million,[8] or 10 per cent, on the Regulator's £3 billion[9] allowance for the control period 2004-05 to 2008-09. As Network Rail's forecast expenditure on renewal work on the route carried out outside the programme (regional renewals) is £390 million under its funding allowance of £1,025 million, Network Rail is within its overall funding allowance for expenditure on the route. For the programme, it is on course to achieve around 70 per cent of the £940 million cost efficiencies assumed by the Rail Regulator. achieve around 70 per cent of the £940 million cost efficiencies assumed by the Rail Regulator. Inefficiencies existed in the contracting arrangements to 2005 (inherited from Railtrack). High demand pushed up rates for signalling work. Booked possessions of the track for renewal work were not fully used. Eight per cent of programme expenditure by Railtrack/Network Rail has been on programme and project management, including annual payments to Bechtel Ltd, programme managers appointed by Railtrack, in return for which it has supplied its expertise, with around 140 staff in mid-2004. Between January 2002 and April 2006, Bechtel was paid £165 million (in 2005-06 prices).

10 West Coast track renewal unit costs were 60 per cent above the network average in 2003 but fell from 2004. They remain 14 per cent higher than the network average, mainly because of the line's particular features such as the high intensity of traffic, the narrow spacing of the original track, and the high specification for the renewals work. Network Rail has measured unit costs within the programme for two activities, track renewals and switches and crossings, which comprise 25 per cent of annual expenditure. Its data are difficult to compare across projects and regions. Network Rail is working to increase the coverage of its unit costs and develop methods to normalise rates for distorting factors, such as the mix and difficulty of work.

11 In 2002, the Strategic Rail Authority suspended the original terms of the franchise agreements with Virgin Rail Group to operate the West Coast and Cross Country routes – because of the Group's high costs (including the lease costs of the new Pendolino trains) and lower than anticipated revenues (resulting from the lasting effects of the disruption following the Hatfield derailment and from the failure to deliver the service improvements set out in the 1998 Passenger Upgrade Agreement, PUG 2). Thereafter, the Strategic Rail Authority has set subsidies on an annual basis, following detailed review of the operators' costs and revenues. As a result, between 2002-03 and 2005-06 the government paid Virgin West Coast £590 million more subsidy than planned under its original franchise agreement. This amount represents a payment needed to maintain train services and lies outside the £8.6 billion expected final cost of the programme.

7 This £8.6 billion in 2005-06 prices is equivalent to the £8.1 billion expected final programme cost reported on page 19 of Network Rail's Business Plan 2006. The difference arises because Network Rail's total involves a mixture of current prices, for spend before 2005-06, and 2005-06 prices for spend from 2005-06.

8 We calculated the 2004-05 to 2008-09 projected programme overspend after first deducting expenditure for work on the West Coast route, outside the programme, which was funded by third parties and the EU. In its Business Plan 2006, Network Rail projected it had a funding shortfall on the programme of £246 million, with some of the overspend already funded from Network Rail's other budgets.

9 £2.8 billion in 2002-03 prices.

12 Although approximately 80 per cent of the work in the programme has been renewals, under the terms of the Network Code, Network Rail has paid 95 per cent of financial compensation to train operators for track access lost to engineering work as compensation for enhancements work. This has been because in part the renewals have contributed to enhancements of the network. Compensation paid to train operators under the Network Code can be twice as much as the amounts paid for similar access for standard renewals. Two-thirds of access compensation has been paid to Virgin West Coast, under provisions in its track access contract and special arrangements agreed in its 1998 upgrade agreement with Railtrack. The Department has protected taxpayers' interests by taking these amounts into account when determining its annual subsidy payments, since 2002.

13 The business case and appraisals of the West Coast Programme, carried out in 2003-04, were not conventional, as the programme was already underway, with substantial sunk and committed costs, which were excluded from the appraisals. The 2004 business case showed a positive benefit:cost ratio of 2.5:1, which hinged on delivery of non-financial benefits, chiefly passenger journey time savings and road decongestion. The project has delivered journey time improvements and other passenger benefits in line with, and in some cases beyond, its business case. The programme has reduced journey times in line with the 2003 Strategy, with train timetables since September 2004 providing for a 22 per cent reduction in the fastest journey time between Manchester and London, to 125 minutes. Punctuality and train reliability on the West Coast route have improved from 2005 and are close to the interim targets set in the 2003 Strategy. Passenger satisfaction with train services on the route has improved. The Department has not monitored whether the increase in passenger journeys has resulted in road decongestion benefits.

14 In 2005-06, passenger journeys on Virgin West Coast grew by over 20 per cent, which was ahead of forecast, and in 2006 some parts of the route were operating at or near capacity. The remaining work on the programme, to 2009, will increase passenger train and freight capacity, but the consensus in the rail industry is that by around 2015 to 2020 the line will have insufficient capacity to sustain current levels of growth in passenger and freight traffic, should these growth levels continue.

15 Network Rail expects the investment in the West Coast will reduce the additional maintenance costs which would normally result from increased use and higher train speeds on the line. There is a risk that some of the signalling equipment on the upgraded route could become obsolete before its planned renewal date of 2026. Given the level of investment in signalling, a one year shortfall in the average expected life of equipment would cost Network Rail some £12 million. Network Rail recognised the risk from early obsolescence of its signalling equipment and we jointly commissioned the consultants QinetiQ to review Network Rail's processes for managing obsolescence. QinetiQ confirmed that Network Rail's lack of formal management of the risk of obsolescence left it at risk and found obsolescence issues needing to be addressed in relation to four of the seven systems it reviewed. Network Rail does not have the cost information required to estimate its overall exposure from this risk. It will need to meet the costs of obsolescence from its future maintenance and renewals budgets.

Overall conclusion

16 The Strategic Rail Authority's intervention from 2002 turned around the West Coast Programme. It worked with Network Rail and the industry to develop a deliverable Strategy and establish appropriate programme management. Network Rail improved the management of the projects and, so far, has delivered the Strategy outputs to schedule. The Strategy has delivered passenger benefits from a modernised track. But value for money for the programme in its entirety has not been maximised: there were substantial early abortive costs to Railtrack in the programme to 2002 and the need for additional franchise support for Virgin Rail Group from 2002, to keep train services running; Network Rail is likely to overspend its programme budget for 2004-05 to 2008-09 by around 10 per cent, although together with West Coast regional renewals it is within its funding allowance; and there remains uncertainty about the expected lifespan of some of the equipment on the upgraded line.

Recommendations

17 For future major infrastructure projects it sponsors, the Department's business cases should model and appraise the costs and benefits for different options for the timing of delivery and fully consider the impact on franchises of delays in delivery of the project. The project and risk management plans should include a franchise management strategy and should address the pre-2002 key weaknesses in West Coast programme management we have identified in Part 1 (paragraphs 1.1–1.12, 2.4, and 3.2–3.4).

18 The Department and the Office of Rail Regulation should further develop standard definitions for costs for different stages and elements of transport projects, such as scoping/design, construction/delivery and programme/project management, so that cost information (for example on project management) can be collected and compared across transport projects (paragraphs 2.6–2.7 and 2.13).

19 The Office of Rail Regulation should ensure that Network Rail draws on the experience of contracting on this programme and wider lessons, for example from BAA Terminal 5[10] or the Highways Agency, in its contracting strategies for major projects, and that Network Rail publishes its general approach to contracting and, for major projects, the key elements of its contracting strategy (paragraphs 1.8, 2.8–2.10, Appendix 3 and Appendix 4).

20 New technology can bring significant benefits, but its development involves significant costs and risks. Where projects propose new technology or technology new to the UK at significant cost, the Department or Office of Rail Regulation should ensure that Network Rail draws up a supporting business case drawing on previous development and testing of the technology, and addressing costs, benefits, the challenges of technology transfer and risks, along with a supporting implementation and maintenance strategy (for example, covering training requirements for engineers) and submits these to all-industry challenge (paragraphs 1.10 and Appendix 5).

21 The Office of Rail Regulation should ensure that Network Rail develops the targets it sets, monitors and reports for its efficient use of possessions of the track for engineering work and that these include a target for the proportion of booked time effectively used (paragraph 2.11).

22 The Office of Rail Regulation should review the case for continuing with two separate possessions compensation regimes and how to make rates paid more predictable, transparent and more closely aligned to costs and losses borne by train operators, and to generate appropriate incentives (paragraphs 2.18–2.21) .

23 The Office of Rail Regulation should ensure that Network Rail progresses its plans and adopts best practice in obsolescence management. The approach should include establishing a company-wide strategy, addressing whole life costs in its investment appraisal/project business cases, improved recording of maintenance and renewals costs for its equipment and clarifying the responsibilities of its suppliers in its procurement and support contracts (paragraphs 2.26–2.31 and Appendix 6).

10 *Ministry of Defence: Using the contract to maximise the likelihood of successful project outcomes* (National Audit Office, HC 1047, Session 2005-06, Figure 9, page 9).

PART ONE

The Strategic Rail Authority and Network Rail turned around delivery of the West Coast programme

1.1 In this Part of the report, we examine how the Strategic Rail Authority/Department and Network Rail turned around the West Coast Route Modernisation programme to achieve delivery to schedule through addressing key weaknesses in the programme's management to 2002.

The Strategic Rail Authority clarified governance arrangements and, as sponsor, provided clear direction to the programme

Key Weakness 1: A lack of clear governance arrangements and direction for the programme

The programme lacked direction and leadership before 2002. Railtrack had been both commissioner and contractor and did not have a delivery strategy and central point for responsibility and communication across the programme.

Lack of direction and leadership contributed to delay and cost overrun.

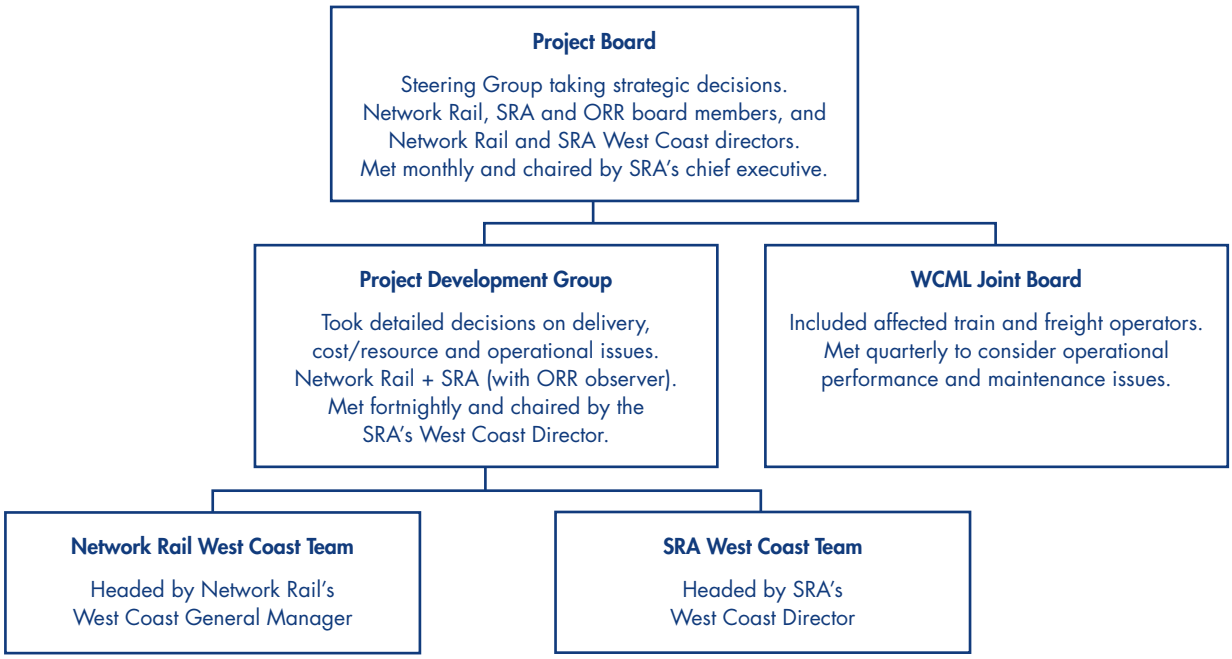
Source: National Audit Office analysis of March 2002 and June 2003 reports by Bechtel Ltd and Oakleigh Consulting Ltd on early programme delivery, and interviews with key stakeholders.

1.2 From 2002, the Strategic Rail Authority (and from July 2005, the Department) became the programme's sponsor and set a clear direction for the project, in its June 2003 *West Coast Main Line Strategy*, specifying what it wanted to achieve. Railtrack-in-Administration/Network Rail became its prime contractor. Having accepted the Authority's Strategy as the basis for the reasonable requirement for the industry, the Rail Regulator was responsible for determining the efficient cost and timing for Network Rail's work (in the context of Network Rail's overall funding requirement) and for then ensuring that Network Rail carried out renewals and enhancements in a timely, efficient and economical manner, in accordance with Condition 7 of its Network Licence.

1.3 This distribution of responsibilities was supported by clear programme governance structures **(Figure 3)**. The Project Board took key decisions, while detailed decisions on delivery were taken by a Project Development Group, chaired by the Strategic Rail Authority's/Department's West Coast Director, which had day-to-day responsibility for programme delivery. We found a consensus that the arrangements had worked well and concluded that this resulted from:

- the board-level membership of the Project Board giving the programme visibility and engagement at a senior level;
- continuity of leadership: both the Strategic Rail Authority/Department's programme sponsor/director and Network Rail's West Coast Team general manager remained unchanged from early 2002;
- the Strategic Rail Authority/Department having a small, but high calibre, team dedicated to the programme, peaking at 11 full-time equivalents in mid-2003; and
- the Rail Regulator/Office of Rail Regulation acting as an independent observer on the Project Development Group and with expert advice from an independent reporter challenging Network Rail monthly on its delivery of the programme.

3 Programme governance arrangements (in December 2002)



Source: National Audit Office review of information supplied by the Department

NOTE

From 2005, the Project Board met quarterly and the Project Development Group monthly and the Department took over the roles previously held by the SRA.

The Strategic Rail Authority engaged stakeholders in support of the programme

Key Weakness 2: Failure to engage stakeholders in support of the programme

There was a lack of openness and communication of the programme to interested parties before 2002 and a lack of stakeholder management. With the exception of a 19 day blockade in 2000 at Proof House Junction, Birmingham, for re-modelling work, Railtrack had been unable to persuade train and freight operators to agree to blockades and its engineering access had typically been confined to seven hour overnight and 20-36 hour weekend possessions.

Poor stakeholder management constrained construction progress and added to costs.

Sources: National Audit Office analysis of March 2002 and June 2003 reports by Bechtel Ltd and Oakleigh Consulting Ltd on early programme delivery, and interviews with key stakeholders.

1.4 To achieve 'buy in' to decisions on scope, access and timetables, the Strategic Rail Authority consulted widely, both formally and informally, to achieve a Strategy which better balanced interests between high-speed long distance trains, local and regional passenger services and freight. The Joint Board kept operators and passengers informed as the programme progressed and the Authority and subsequently the Department kept wider stakeholders informed on progress.[11] The Authority benefited from the experience and contacts within the industry of its programme director.

11 The Strategic Rail Authority and subsequently the Department have reported progress against the Strategy in 2004 and 2006: http://www.sra.gov.uk/pubs2/strategy_policy_planning; and http://www.dft.gov.uk/stellent/groups/dft_railways/documents/page/dft_railways_611705.pdf

1.5 Stakeholder engagement facilitated the more intrusive regime of obtaining possession of the track for engineering work through extended blockades in 2003 and 2004 along those parts of the route south of Crewe where diversionary routes existed for travellers from key stations, such as Stoke. These blockades were crucial to delivery of Phase 1 by September 2004 as access had been the programme's key constraint and one of the key cost drivers.[12] The Authority developed and promoted alternative transport arrangements[13] for users of affected stations and made adjustments to meet local circumstances, as illustrated in our case study on the Stoke blockade (Appendix 3).

1.6 Overall, train and freight operators were satisfied with the Strategic Rail Authority's consultation over the 2003 Strategy and subsequently, although some train operators would have liked the opportunity to comment on issues such as the choice of technologies. Operators told us that Network Rail's liaison needed to be better when it sought possessions at short notice[14] or faced possession overruns. They remained concerned about the impact of the rest of the work on the services they provide. The need to obtain operators' co-operation is a key risk for the final stage of the project.

Tight specification and change control have prevented scope creep

Key Weakness 3: There had been 'scope creep', arising from a lack of tight specification and change control

Scope changes arose because Railtrack did not have a programme with an agreed specification which matched required outputs with inputs; and had poor knowledge of West Coast asset condition. Railtrack had worked with its contractors in "Alliances", which designed and scoped projects on a cost-reimbursable basis and delivered them to agreed target costs. Alliancing can promote innovative and efficient delivery solutions since contractors and client share, as profit or loss, any difference between delivered and target cost. It did not work well on West Coast because Railtrack lacked the engineering expertise to be able to participate in Alliances as an informed and equal partner and to challenge contractor-developed scope.

Scope changes drove up programme costs.

Sources: National Audit Office analysis of March 2002 and June 2003 reports by Bechtel Ltd and Oakleigh Consulting Ltd on early programme delivery, and interviews with key stakeholders.

1.7 The Strategic Rail Authority developed a clear, measurable set of programme outputs, along with more detailed infrastructure requirements, through 11 expert cross-industry teams[15] providing bottom-up 'constructive challenge' to the detailed baseline produced for Railtrack by Bechtel Ltd in May 2002. The teams identified opportunities to reduce the programme cost by over £4 billion. For example, the challenge teams identified that faster running north of Preston could be achieved without the need to replace the signalling; and helped identify a better value solution to the upgrade of the route's power supply (Appendix 3).

1.8 Network Rail abandoned Railtrack's approach of relying on Alliance contractors to develop the engineering scope for its projects and gradually closed down the Alliance contracts by 2005 (Appendix 4). In November 2003, it set up West Coast Engineering, a 60-70 strong team of engineers (drawn principally from other parts of the organisation) to write specifications, and to review and approve project designs (developed by design consultants) and completed work. From 2005, Network Rail's approach was, where possible, to approve base designs, fixing scope, and then invite contractors to tender to complete detailed designs and deliver the work to a fixed price, as illustrated in our case studies of Rugby station re-modelling and Trent Valley four-tracking (Appendix 3).

1.9 Network Rail developed a series of functional specifications to translate the programme's scope into detailed requirements, which were approved by the Strategic Rail Authority/Department. Changes have been controlled through systematic change control and monitoring procedures which required authorisation from within Network Rail and from the Authority/Department.

12 Productivity is low in 7 hour overnight track possessions and 20 hour weekend possessions as it takes 3 hours typically to safely set up and close down a worksite. A longer closure of the route, known as a blockade, allows round-the-clock working, increasing productivity.

13 The Authority set up an alternative London to Manchester high-speed hourly service via Leicester (known as Project Rio) to ensure that between May 2003 and September 2004 there was a service available during temporary closures of other key parts of the main line. Network Rail funded this project, at a cost of £90 million.

14 For train operators, a short-notice possession is one sought by Network Rail with less than 12 weeks' notice. Under Condition 9 of its network licence, Network Rail must make accurate timetable information available to train operators at least 12 weeks in advance as train operators' franchise contracts require them to open reservations nine weeks ahead of the date of travel.

15 The constructive challenge teams comprised experienced former rail industry engineers and officials from the Strategic Rail Authority, Railtrack and the Rail Regulator.

Technology risk was reduced, although not eliminated

Key Weakness 4: The use of untried and unproven new technology

Technology issues, in particular Railtrack's decision to replace conventional signalling with unproven moving block signalling, introduced major risk into deliverability and cost before 2002.

Technology issues caused scope changes and programme delay.

Sources: National Audit Office analysis of March 2002 and June 2003 reports by Bechtel Ltd and Oakleigh Consulting Ltd on early programme delivery, and interviews with key stakeholders.

1.10 The 2003 Strategy determined that, to reduce delivery risk, the programme should move towards greater reliance on established and proven technology and that the European Rail Traffic Management System (ERTMS) should be removed from the programme and developed as a separate national initiative (Appendix 3). Some new technology was used. Absolute track geometry, a method which fixes the track position to enable the trains to tilt and run fast around curves within existing structures, was developed during 2003 by Network Rail's track engineers, after reviewing good practice on Swiss railways. It meant that the September 2004 timetable could be achieved with substantially less track renewal than first planned. Network Rail, however, underestimated the risks and challenges of two new technologies, computer-based interlocking and axle counters, which generated significant commissioning and implementation problems. These problems cost Network Rail over £35 million (Appendix 5).

Railtrack-in-Administration brought in Bechtel to drive forward programme delivery

Key Weakness 5: Failure to effectively manage and monitor programme delivery through contractors

Oakleigh Consulting reported "major issues concerning organisation and management controls" over the West Coast programme before 2002. Railtrack's programme management was weak, with a lack of senior management skills, too many changes in personnel and ill-defined and fragmented roles and responsibilities. Railtrack had a 630-strong London-based team, but did not have an integrated delivery plan and had limited oversight of its Alliance contractors.

Poor management of contracts added to costs.

Sources: National Audit Office analysis of March 2002 and June 2003 reports by Bechtel Ltd and Oakleigh Consulting Ltd on early programme delivery, and interviews with key stakeholders.

1.11 In early 2002, Railtrack-in-Administration appointed Bechtel Ltd to provide "leadership, direction and clarity" to the management of programme delivery. The Bechtel-led West Coast programme management team grew from around 700 people in early 2002 to more than 1,100 in mid-2004, comprising a core of around 140 staff from Bechtel and around 540 from Network Rail, with the remainder coming from other consultancies and agencies. Programme organisation was re-structured, so that decisions could be taken more quickly and closer to key worksites in the regions, aligning West Coast and Network Rail's general maintenance and renewals organisation, and enabling closer control over commissioning and delivery of work for track sections. At the same time, Network Rail employed increased numbers of support and technical services staff on the ground.

1.12 In 2002, the Bechtel-led West Coast team developed the programme's first ever integrated master delivery plan, covering the programme's 80 active projects, hundreds of work packages and over £1 billion annual expenditure. The Project Development Group and programme management team could then make decisions informed by knowledge of the trade-offs between projects and work could be prioritised. Our case study of the line upgrade in 2005 between Preston and Glasgow illustrates how integrated planning enabled coordinated delivery of 28 separate projects by two areas to achieve the Phase 2 milestone (Appendix 3).

1.13 Network Rail, with the support of Bechtel Ltd, also moved from risk analysis to risk management and mitigation. From August 2004, it developed an improved measure of work done[16], based on applying weightings to different activities. This was supported, from May 2005, by improved outturn forecasting tools which enabled managers to develop action plans to bring projects back on track. The West Coast team reported key programme risks to the Department/Strategic Rail Authority and the Office of Rail Regulation on a regular basis.

16 This was known as 'earned value'.

PART TWO

Control over costs has improved, but the programme has been expensive

2.1 This Part of the report examines the cost of the West Coast Route Modernisation programme. It examines Network Rail's control over costs within the context of the priority of delivery to a fixed and tight schedule. It also examines the additional costs arising from the programme's impact on train operators.

Programme expenditure is over £7 billion

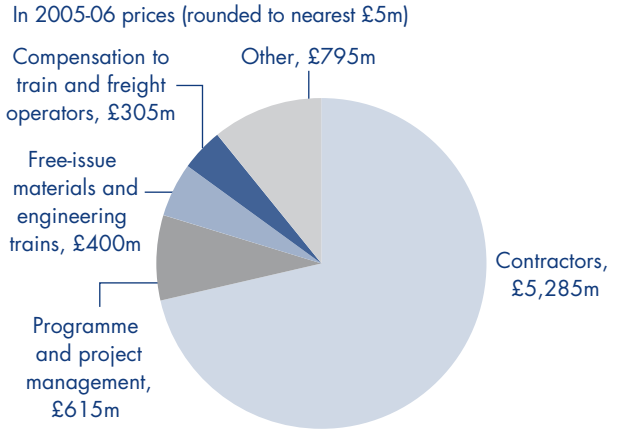
2.2 By April 2006, Network Rail and Railtrack had spent £7.4 billion on the programme.[17] Almost three-quarters of this expenditure was on contractors, eight per cent on central programme and project management (by Railtrack and Network Rail), five per cent on engineering haulage trains and key construction materials[18] and four per cent on possessions' compensation to (mainly) train operators **(Figure 4)**. The amounts paid to individual contractors have been substantial: the ten leading contractors have received more than £3 billion for their work on the programme (Appendix 4).

The Rail Regulator and Strategic Rail Authority recognised that delivery to a tight schedule would put pressure on costs

2.3 In his December 2003 conclusions to the access charges review, the Rail Regulator accepted that the programme was committed to delivering Phase 1 in September 2004, but reported that the programme's schedule-driven approach was creating inefficiencies. West Coast track renewal unit costs were 60 per cent higher and signalling unit costs 100 per cent higher than elsewhere on the network. Our review of the consultants' reports, that informed the access charges review, established a number of reasons for these high unit costs:

- target costs under the Alliancing approach had been agreed at rates much higher than network averages and costs had not been controlled;
- there had been limited analysis of unit costs;
- possessions planning had been insufficiently integrated with work planning; and
- Network Rail's and contractors' overheads comprised a large proportion of costs.

4 Seven-tenths of Railtrack and Network Rail's expenditure on the programme to April 2006 was paid to contractors



Source: National Audit Office analysis of programme financial data held by Network Rail

NOTES

1 Total programme spend to April 2006 was £7.4 billion in 2005-06 prices (or £6.8 billion in actual prices).

2 'Other' included £120 million spent on technical services management, £100 million on the Network Management Centre (which was de-scoped from the programme in the June 2003 Strategy), £95 million paid to electricity suppliers and £90 million on Project Rio.

17 In addition there has been expenditure by the Strategic Rail Authority and Department and the Rail Regulator/Office of Rail Regulation on programme sponsorship and monitoring.

18 Network Rail's National Delivery Service (formerly the National Logistics Unit) supplies its maintenance, renewals and enhancement projects with engineering haulage trains, which it obtains from the freight operating companies, and key materials, such as rails, sleepers, ballast and switches and crossings.

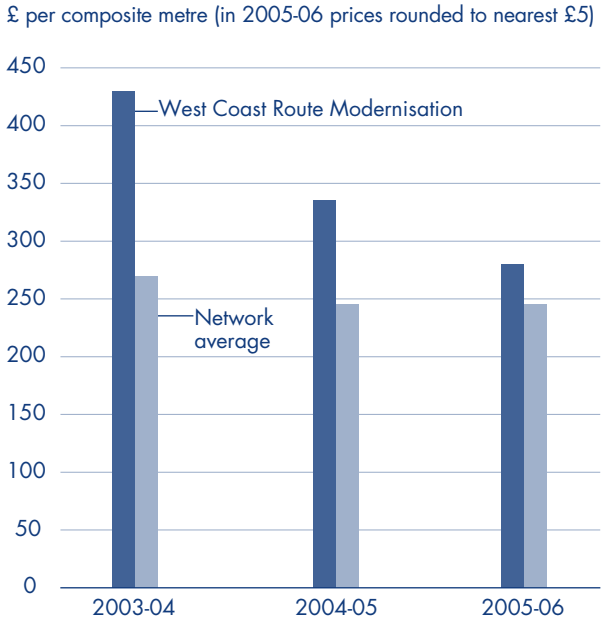
2.4 For Phases 2 and 3, the Regulator considered requiring a pause in the programme after September 2004 to enable delivery arrangements to be re-assessed and radically restructured. But the Strategic Rail Authority, Network Rail and train and freight operators strongly opposed this since it would delay delivery of important capacity outputs and income, and would involve substantial costs for demobilisation and remobilisation. Instead, the Regulator determined that it would be more efficient for Network Rail to delay, by 18 months, planned delivery of major remodelling work at Rugby and Stafford stations, and Nuneaton and Trent Valley four-tracking. This was to provide Network Rail more time to develop improved scheme designs and more efficient delivery arrangements, although it did mean that signalling work would cluster in 2007-08, creating a new risk to programme delivery. The Regulator accepted that cost of delivery before 2006 would be higher than might be achieved with less schedule pressure, but, in determining Network Rail's overall funding for 2004-05 to 2008-09, assumed that Network Rail would be able to halve the gap between West Coast and network track renewal rates by 2005-06. Thereafter, the Regulator assumed that Network Rail would be able to reduce West Coast unit costs at the same annual rate as for the rest of the network.

2.5 We reviewed the pressures on costs through looking at information held by Network Rail on unit costs, contracting strategy, possessions and management costs and we also looked at cost control in our case studies of specific projects.

West Coast unit costs fell from 2004, but are still above the network average

2.6 West Coast track renewal unit costs were nearly 60 per cent above the network average in 2003-04, despite delivery of a quarter of track renewals during 2003-04 through blockades.[19] Track renewal unit costs fell by a fifth in 2004-05, which Network Rail attributed to new national framework track renewal contracts. Unit costs fell a further sixth in 2005-06, but remained 16 per cent higher than Network Rail's own target and 14 per cent higher than the network average **(Figure 5)**. The Office of Rail Regulation considered that there were four main reasons why West Coast track renewal unit costs might be above the network average **(Figure 6)**. Network Rail had reduced the gap between the West Coast unit costs and the network average by more than the Regulator's advisers had suggested, but the Office considered further track renewal unit cost efficiencies to be possible on the West Coast.

5 The gap between West Coast and network-wide track renewal unit costs narrowed considerably between 2003-04 and 2005-06



Source: National Audit Office analysis of Network Rail data

NOTE

Track renewals can involve replacing different combinations of rails, sleepers and ballast. Work is measured in terms of composite metres, so that if all three activities are carried out on a metre of track this counts as three composite metres and, if just one, as one composite metre.

6 Four key factors have contributed to higher than average track renewal unit costs on the West Coast

- Its busy mixed traffic has reduced the opportunity to deliver productive shifts on midweek nights and has required work to be concentrated at weekends, with long jobs taking several weekends to complete, which has resulted in high overheads and set up costs.
- The substandard 10-foot spacing of the four track south of Crewe has meant that Network Rail could not utilise two track possessions to renew centre tracks, but had to use shorter possessions of three (and sometimes all) of the four tracks when working on the centre tracks, to maintain safe working conditions.
- The high design specification needed to increase the longer term durability of the infrastructure and needed for absolute track geometry, including the laying of heavy rails and an above average number of sleepers per rail length.
- All work has required isolation of the overhead line system.

Source: National Audit Office interview with the Office of Rail Regulation

19 Blockades enabled lower rates to be achieved because carrying out a large quantity of work in a longer period of time reduced overheads and also the proportion of the possession time lost setting up and closing down worksites.

2.7 For the West Coast programme, Network Rail has recorded unit costs for the renewal of switches and crossings, which, together with track renewals, have accounted for a quarter of annual programme expenditure. It has also calculated unit costs for signalling equivalent units from 2005-06. Differences in the difficulty and volumes of work mean, however, that the rates for switches and crossings and signalling cannot be accurately compared with those for the network. Over recent years, Network Rail has been developing a Cost Analysis Framework to systematically capture and analyse unit costs. This is improving the quality and usefulness of its unit cost data and aims to ultimately cover 80 per cent of renewal expenditure.

Delivery to a tight schedule added to costs in a number of areas

2.8 Delivery to a fixed and challenging timetable increased costs before 2005 because:

- To continue the work, the government provided loan funding for the programme from 2001 to 2002, and until April 2004 there were effectively no regulatory efficiency targets for Railtrack-in-Administration/ Network Rail.
- The timetable reduced opportunities to package enhancement and renewal work efficiently and accelerated some track, switches and crossings renewals from their natural renewal dates.
- Network Rail continued to rely on the Alliance arrangements, which it considered to be 'materially inefficient', because contract termination had financial risks and it did not have the time to set in place new arrangements.
- The high level of demand for construction work, between 2002 and 2006, occurred at a time when the construction price index was increasing at a rate twice that of the retail price index. Network Rail's key control against overpriced tenders was the independent cost estimate produced from first principles by its West Coast estimating team. For 2004-05, we found that contractors' tenders exceeded Network Rail's cost estimates by more than 10 per cent in 45 per cent of estimates and, overall, contractors' tenders exceeded Network Rail's estimate by 13 per cent. Network Rail provided us with evidence that it negotiated down many of the high tenders or re-scoped work to fit its budget. In two specialist areas, testing and commissioning personnel and signalling contractors, the West Coast programme's demand put particular pressures on supply with the bids for the large re-signalling projects for Bletchley/Milton Keynes, Rugby, Trent Valley and Nuneaton, for delivery between 2006 and 2009, coming in between 14 and 27 per cent above the Network Rail estimates. In some cases, only one contractor tendered for the work. In 2006, Network Rail negotiated national framework contracts with four suppliers to manage such risks for signalling work.
- Network Rail needed to book some haulage trains and track possessions at short notice. In 2004-05 and 2005-06[20], Network Rail paid a premium of £7 million to its logistics, purchasing and supply unit, the National Delivery Service, for booking more than 20 per cent of the engineering trains it needed with less than 22 weeks' notice.[21] In addition, wagons ordered at short notice were sometimes found to be unsuitable, contributing to longer possessions. At times, haulage trains were unavailable and the programme had to use road haulage vehicles, which added to costs as they needed construction of temporary slip roads.
- Network Rail sometimes overestimated its requirements for track access and engineering trains, leading to it later cancelling or not using some of these resources. In 2004-05 and 2005-06, West Coast paid the National Delivery Service £4.5 million for cancelled haulage trains. During this same period, it did not use around five per cent of the possessions it booked, because of adverse weather conditions, poor planning, infrastructure problems elsewhere on the network and resource issues. In addition to inconvenience caused to late night passengers, Network Rail paid train operators around £10 million for this unused access. In the course of our work, we also identified examples of waste at project level.

Network Rail improved its control over contractors' costs

2.9 Most contracts have been cost-reimbursable or target cost, which Network Rail has controlled through checks by its contract managers of reasonableness and conformity of claims, supported by verification of work progress by its project managers and field/cost engineers. But with over 2,000 active contracts, Network Rail's 50 contract managers have been unable to check in depth most claims. An internal review in 2004 found that some West Coast contractors had been accustomed to claiming all costs and that Network Rail identified as non-entitled only two per cent of amounts claimed. On other rail projects in Britain, however, around five per cent of claimed costs

20 Network Rail was unable to supply data for earlier years and in 2003-04 engineering trains were 'ring-fenced' for West Coast work and paid for at a fixed price.
21 The National Delivery Service charged a premium of 40 per cent for engineering trains booked with less than 22 weeks' notice and charged 50 per cent of the charge rate for cancellations of booked engineering trains.

were challenged as non-entitled. Since 2004, the level of challenge and disallowance of contractors' claims has risen to well above five per cent, as workshops and guidance have disseminated good practice to contract staff and contractors.

2.10 In addition to controlling the work of contractors more closely to check that they delivered work to agreed standards, Network Rail built in productivity incentives (case study – Preston-Glasgow upgrade Appendix 3) and, from 2005, let out work on fixed price contracts (Appendix 4).

Possessions have been used more intensively

2.11 Bechtel Ltd's March 2002 programme review identified the duration and use of possessions as key constraints on construction progress and priorities for improvement. Network Rail addressed these, with success in part:

- There have been longer possessions to reduce the length of time over which services are disrupted.
- Possessions have been used more intensively as measured by the number of work activities/sites per possession, with a doubling between 2002-03 and 2004-05 in contractor site hours per possession, and by work starting on time for more possessions.
- But there is still considerable unused possession time and problems with late hand backs. In 2005-06, contractors made use of 92 per cent of the booked possession time. Since 2003-04, there has been an increase in the proportion of possessions starting late, mainly due to the late running of last trains, and possessions overrunning. In 2005-06, 22 per cent of possessions started late and 14 per cent overran.

The scale of rail replacement services has been reduced to match demand

2.12 Network Rail meets the cost to train operators of providing alternative travel arrangements for passengers during blockades and possessions. Between 2000-01 and 2005-06, it paid out £30 million for rail replacement services.[22] Train operators specified the number and type of buses based on normal train loads between the affected centres. But this led to overprovision of between 30-40 per cent in many of the services before 2004, as fewer passengers sought to travel when services were affected by engineering works or chose to travel by their own means to the nearest station which ran normal services. The Authority identified savings through building up capacity in response to demand, improving revenue collection on buses, and brokering co-operative solutions when several train operators were affected by a possession/blockade. In 2006, the Department drew together lessons and produced a good practice guide to inform future provision of rail replacement services across the network.

Programme and project management costs have been substantial

2.13 Approximately eight per cent of programme spend has been on Network Rail's programme and project management, including the cost of managing possessions and land purchases. Comparisons with other major projects show this level of expenditure to be not out of line.[23] But currently the benchmarking of programme management costs both within and outside Network Rail remains underdeveloped, with no agreed definitions of project management costs. In mid-2004, Network Rail had a 1,100-strong programme management team, which oversaw 8,000 field-based and 1,000 office-based contractors' staff. In January 2006, Network Rail's programme management team still numbered 1,000, although the number of contractors' staff had fallen to 5,000. Following the transfer of renewals work to Network Rail's core teams in March 2006, the programme management team dropped to below 800.

2.14 From January 2002 to April 2006, around £165 million (in 2005-06 prices) was paid to Bechtel Ltd for providing skilled and experienced personnel in programme and project management to lead the programme from the centre and in the field. Bechtel has been paid an annual lump sum and earned performance-related fees for providing ongoing leadership, direction and clarity to the programme management team and to develop and implement a delivery plan so that key programme milestones were achieved.

2.15 The Department and Network Rail have been satisfied with the Bechtel team's performance in managing the programme, for example in bringing in additional staff when necessary to ensure delivery and in its willingness and ability to take on a greater role than originally envisaged, overseeing contractors. We noted that:

22 Network Rail also paid out £90 million to support the Project Rio alternative rail service between London to Manchester in 2003-04 (see Figure 4).

23 Our reports on the National Probation Service Information Systems Strategy and the Wembley Stadium project both calculated that 10 per cent of expenditure was on project management, while for Section 1 of the Channel Tunnel Rail Link it was 22 per cent. Also a Network Rail review in 2005 found that typically nine to ten per cent of its expenditure on enhancement projects was on project management and sponsorship, but that the proportion was typically lower for larger projects. *The implementation of the National Probation Service Information Systems Strategy* (National Audit Office, HC 401, Session 2000-01, Figure 7, p.28, with development costs included); *The English national stadium project at Wembley* (National Audit Office, HC699, Session 2002-03, Figure 9, p. 29); and *Progress on the Channel Tunnel Rail Link* (National Audit Office, HC77, Session 2005-06, Figure 6, p. 17).

- Bechtel Ltd provided support to Railtrack on the West Coast programme between January and March 2002 under an existing framework agreement, which had been awarded in 1999 following competitive tender, and was then awarded the programme management contract in September 2002, without open competitive tender. Network Rail has no information showing how Railtrack-in-Administration established the fees it agreed to pay Bechtel. The Department's external financial advisers found that the service definition in Railtrack's agreement with Bechtel Ltd was unclear, did not specify the Key Performance Indicators which were to be used to assess Bechtel's performance and recommended that similar large contracts should not be awarded without tender for future major projects. The contract was confirmed, however, because Railtrack told the Department that there were no viable alternatives to Bechtel and it needed formalisation of the contract. The Department was assured that the Bechtel contract would be tied to the delivery of the programme's scope and Strategy when it was resolved later, in the agreement of the Strategy and the Regulator's funding determination in December 2003. Railtrack/Network Rail and Bechtel agreed key performance milestones and deliverables to be achieved each quarter. These related to delivery to schedule, safety and cost and changed as priorities changed over the course of the programme.
- Unlike Bechtel's contract for the Channel Tunnel Rail Link, Bechtel did not share with Railtrack/Network Rail financial risk for cost overruns. In large part, this was because Bechtel did not have ultimate control over costs, with scope development, design approval and procurement of materials and contractors specifically reserved to Network Rail staff.
- In December 2004, Network Rail extended the contract with Bechtel Ltd to cover the remainder of the programme to 2009. It considered the options of allowing the contract to expire in June 2005 or negotiating shorter extensions, but rejected these as it considered they would compromise delivery of Phase 2 of the programme.

Network Rail anticipates achieving 70 per cent of assumed efficiency savings, but overspending £300 million on the programme from 2004

2.16 The gap between cumulative expenditure on the programme and work quantities delivered narrowed considerably between 2003 and 2005 **(Figure 7)**, reflecting improving efficiency, but a slight widening in 2005-06 indicates that cost pressures continue. Our analysis of Network Rail's reported expenditure on the programme and its forward forecast, as set out in its April 2006 business plan, indicates that the programme is likely to cost around £8.6 billion[24] and that Network Rail is likely to overspend by around £300 million, or 10 per cent, of the £3 billion the Rail Regulator assumed for West Coast expenditure between 2004-05 and 2008-09. This means that it is likely to achieve around 70 per cent of the £940 million efficiency savings the Rail Regulator assumed it could achieve, when making his overall funding determination in December 2003. The Rail Regulator's 2003 funding decision can be reopened if Network Rail's costs for the West Coast programme and for renewals on the route carried out outside the programme (regional renewals) over the period 2004-05 to 2008-09 exceed the funding determination by more than 15 per cent. In April 2006, forecast spending on West Coast regional renewals to 2008-09 was £390 million less than the funding allowance of £1,025 million, so Network Rail remains under its overall West Coast funding allowance.

Project costs have included train operators' compensation for engineering access but have not included costs to the Department from changes to operators' franchise terms

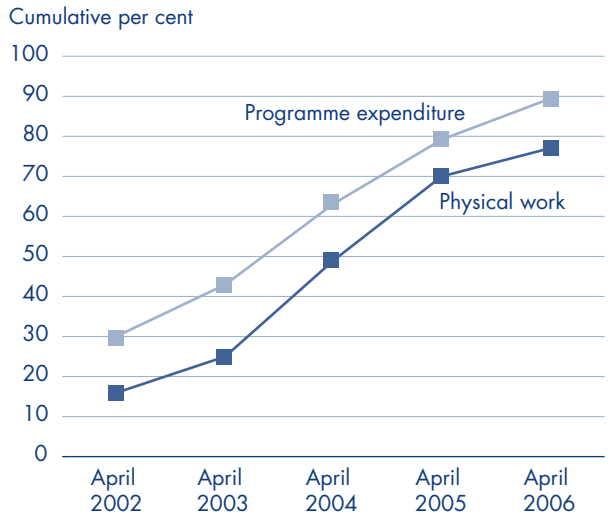
2.17 To April 2006, Network Rail (and Railtrack)'s costs included £305 million in compensation paid to operators for possession of the track for engineering work, mostly to passenger train operators. In addition, in July 2002 the Strategic Rail Authority suspended the franchise agreement with Virgin Rail Group and the Authority/Department subsequently paid out higher levels of subsidy, under annual agreements. This increased subsidy does not form part of the West Coast programme costs as it was needed to sustain train operations irrespective of the solution to the upgrade project.

Network Rail has provided high levels of compensation to operators for their costs and lost revenues from engineering work

2.18 Passenger train operators receive compensation from Network Rail for revenue loss arising from track possessions for renewals under Schedule 4 of their track access agreements, in accordance with an agreed formula. Where a possession involves a significant restriction of use, lasting more than a specified number of hours[25], and involves costs to train operators of more than £10,000, Network Rail also pays compensation for the direct costs

24 See footnote 7.
25 Over a weekend, public holiday and possessions of 60 hours or longer.

7 The gap between cumulative expenditure on the programme and work quantities delivered narrowed considerably from 2003 to 2005



Source: National Audit Office analysis of Railtrack and Network Rail data

NOTE

Expenditure has been calculated as a percentage of the £8.3 billion budget implied by the Rail Regulator's December 2003 programme funding determination. Physical work is based on the prevailing Baseline, so the April 2002 and April 2003 figures relate to a baseline which was de-scoped later in 2003.

the operator incurs on replacement buses or taxis, publicity and train planning. If the possessions are related to improvements to the network, for example, by increasing line speed, or if the engineering work is for enhancements, train operators can claim compensation under Part G of the Network Code. Known as Network Change, this compensation is based, not on a formula, but on a train operator's claim for all its reasonable costs and losses and takes account of likely future revenue gains or losses.

2.19 We found that while around 80 per cent of West Coast construction work has been renewals, 95 per cent of West Coast track access compensation has been under Network Change arrangements, and this has increased the cost of possessions. It has not always been clear cut under which regime possession compensation falls. Network Rail told us that train operators have typically made claims under Network Change and provided us with examples where Network Change compensation was more than double that applicable under Schedule 4, despite allowing for the future increased revenue flows receivable by the operator. During 2005-06, Network Rail negotiated down operators' Network Change compensation claims by seven per cent on average, and for some train operators by 15-17 per cent. Network Rail has disputed train operators' claims where it considered the claims to be unreasonable, using the industry's dispute process, although none have required adjudication by the Office of Rail Regulation. The Office told us that it would not expect material differences between compensation paid under Schedule 4, where there is a significant restriction of use and direct costs are compensated, and under Network Change.

2.20 Two-thirds of the programme's possessions compensation has been to Virgin Rail Group. This compensation has been high because it has been provided in accordance with an early track access contract and special arrangements agreed with Railtrack in the West Coast upgrade agreement, which do not provide for the netting off of future revenue benefits likely to arise from the enhancement. However, under the Letter of Agreement between the Strategic Rail Authority/Department of Transport and Virgin Rail Group there is a clawback arrangement to ensure that possessions compensation is netted off when the Department calculates the subsidy payable.

2.21 In 2005, the Office of Rail Regulation initiated a whole-industry review of the efficiency of possessions and the most appropriate compensation arrangements. This includes a review of the sufficiency of Schedule 4 compensation for possessions that make permanent improvements to the network and the case for compensating freight operators. The Office will consider the case for compensating all possessions, including those for enhancements, under formula arrangements provided for in Schedule 4.

Between 2002-03 and 2005-06 the Strategic Rail Authority and the Department paid £590 million in additional subsidy to Virgin West Coast partly because the West Coast upgrade was not delivered as envisaged in Virgin's franchise bid

2.22 Between 2002-03 and 2005-06, the Strategic Rail Authority and the Department paid Virgin West Coast around £360 million in subsidy,[26] whereas, under its 1997 franchise agreement, Virgin West Coast had been expected to pay the government £230 million in premium. Virgin Rail Group told us that in 2001 it was seeking to negotiate with Railtrack compensation and revised outputs to enable it to deliver its franchise obligations. With Railtrack going into Railway Administration in October 2001, Virgin Rail Group recognised it would not be able to make franchise premium payments and therefore decided to seek additional franchise support from the Strategic Rail Authority. This additional subsidy has been paid under the terms of a Letter of Agreement introduced in July 2002, when the terms of

26 These are subsidy payments after stripping out the effect of adjustments related to changes in track access charges and performance payments.

Virgin Rail Group's original franchises were suspended. The Letter of Agreement allowed the Authority to set subsidies on an annual basis, following detailed review of the operators' costs and revenues, and has restricted Virgin West Coast to a pre-tax profit margin of two per cent of revenue and ten per cent of Network Change compensation. The £590 million in net additional subsidy paid to Virgin West Coast between 2002-03 and 2005-06 was needed because rolling stock costs were high, as they included costs of the Pendolinos on top of the cost of existing trains, and because passenger revenues were lower than expected.[27] The increased subsidy also reflected other factors, such as the lasting effects of the October 2000 Hatfield derailment, including the loss of some long-distance passengers to the airlines. The Department considered the Letter of Agreement and the suspension of claims under the 1998 Passenger Upgrade 2 agreement facilitated Railtrack being brought out of Railway Administration, kept train services running and retained Virgin's expertise for the management of the introduction of the Pendolinos. Subsidy payments would have been higher if the West Coast programme had been aborted or delivery of Phase 1 had been delayed from 2004 until 2005 or 2006, as Virgin West Coast revenues would have been at a lower level for a further year and subsequent growth would have been deferred.

2.23 Virgin Rail Group continues to provide passenger services under the Letter of Agreement and the Passenger Upgrade 2 track access agreement. In 2006, the Department has been in negotiation with Virgin Rail Group to re-establish a West Coast franchise on a more conventional footing and Network Rail has been negotiating a new track access agreement. Until these negotiations are completed, there remains a small risk that Virgin Rail Group may choose to 'walk away' from this Agreement and cease West Coast Trains rail operations and seek reparations from Network Rail, as Railtrack's successor, under the Passenger Upgrade 2 agreement.[28]

Network Rail expects the investment will reduce the additional maintenance and renewal costs which would normally result from increased use and higher train speeds on the line

2.24 Both the 2003 and 2004 business case appraisals considered the enhanced, more frequent services on the West Coast route would result in additional future maintenance and renewal costs. One of the Strategy's objectives was to establish sustainable and cost effective maintenance regimes.

2.25 In 2004, Network Rail estimated that maintenance costs might increase by up to £8 million a year as a result of the increased number of trains, and the need for higher standards to support their increased speed and tilt operation. Its 2006 Business Plan forecasts, however, that overall its future maintenance costs for the line will fall due to general efficiency improvements. Network Rail also expects that the increase estimated may be offset by reductions in costs from using heavier rails; using absolute track positioning, which needs less frequent maintenance tamping; and the new Pendolino rolling stock, which spreads the weight of its heavy traction equipment through the train. In addition, it expects costs to be reduced as a result of making future maintenance and renewals easier by building diversionary routes, simplifying layouts, increasing the distance between the tracks and laying down additional tracks, and providing bi-directional signalling. Network Rail expects to establish firm maintenance costs as experience is gained with the new train service and infrastructure. Network Rail is also working with train operators to establish a maintenance strategy to apply from 2009 which will allow increased access for train operations, particularly at weekends, while still meeting its access requirements for maintenance and renewal work, and generate a net increase in revenue from the route.

Electronic signalling equipment on the West Coast Main Line may become obsolete significantly earlier than expected

2.26 The West Coast Main Line signalling renewals and enhancements, which Network Rail told us accounted for around £0.5 billion of programme spend, are not expected to be due for replacement until 2026. Based on this level of investment, a one year shortfall in the average expected lifespan of the equipment would cost Network Rail some £12 million. Network Rail recognised the risk from early obsolescence of its signalling equipment and we commissioned jointly with Network Rail a review by QinetiQ of Network Rail's processes for managing obsolescence. The review aimed to quantify any risk to Network Rail through examination of seven systems on the West Coast main line and consideration of the financial consequences of any obsolescence issues identified. The systems reviewed are used across the rail network, so the conclusions apply more generally to Network Rail.

27 It had been anticipated, when the West Coast franchise was let, that net revenues would increase by £315 million between 2002-03 and 2004-05 as a result of delivery of Phase 1 of the line upgrade in 2002. In practice, however, over these three years rolling stock costs increased by £200 million and passenger revenues did not increase.

28 The Cross Country franchise terminates in November 2007 and the tender is open for competition.

2.27 QinetiQ concluded that:

- Network Rail's approach of only using equipment from an approved list, keeping strategic spares and relying on its suppliers to identify and mitigate future obsolescence risks leaves it exposed to financial risk from obsolescence;
- Network Rail's procurement and approval processes do not require consideration of obsolescence issues from the outset, although its approach of obtaining equipment with "lifetime" supplies of spares and providing for dual sourcing for some critical equipment reduces the risks;
- Network Rail's data systems are not sufficient to ensure it has good information on the numbers and locations of spares held; and
- Network Rail's suppliers are not under any contractual obligation to identify and address obsolescence issues on Network Rail's behalf and bear none of the risk themselves.

Network Rail considers that, with its older equipment, obsolescence earlier than planned has not resulted in operational difficulties but it could not provide repairs and cost information to confirm that its equipment had lasted as long as expected with appropriate maintenance and renewals costs.

2.28 QinetiQ concluded that the risk to Network Rail from not formally considering and addressing the risk of obsolescence in its procurement of equipment and its approach to maintenance is likely to increase substantially. Historically, signalling equipment was less sophisticated and more robust. Increasingly Network Rail is using more off-the-shelf systems, with short production lives, and more systems containing proprietary software-driven devices. There are risks to Network Rail from not being able to obtain components for the repair of their systems and from not having staff with knowledge of systems to support them. Although Network Rail can deal with obsolescence through the redesign and production of new systems, this increases costs substantially (Appendix 6).

2.29 QinetiQ identified obsolescence issues needing to be addressed in four of the seven systems it reviewed, demonstrating the risks to which Network Rail is exposed (Figure 16, Appendix 6). QinetiQ's review could not investigate all seven systems in full detail, because of the failure of two of Network Rail's suppliers, Westinghouse and Alstom, to provide detailed information on their equipment's individual components. However, from the work they could carry out, they identified components which are already obsolete and others which are likely to become so within the next three to five years, as well as items which are specific to the system involved, for which there is only one supplier. Network Rail considers it can address the risks to its older system. It considers it can support the solid state interlocking systems in place and continue its renewals programme despite the limited supply of the current system through accepting the risk of using alternative components identified by one of its suppliers and urgently progressing the approval of a modern version of the system. It has established a support agreement with the supplier of the computer-based interlocking system and recognises the need to address with urgency its exposure to the future risk from obsolescence to elements of the other new system covered by QinetiQ's review, the high performance switch actuator, and also on the new axle counter systems it has installed on the West Coast, which were not within the sample of systems reviewed in detail by QinetiQ.

2.30 Network Rail recognises its exposure to financial risks from premature obsolescence of its systems and the risk that suppliers may seek higher charges for taking some of the risk of premature obsolescence if this is addressed in negotiations outside of the normal procurement phase. Network Rail is developing plans to address QinetiQ's recommendations, including developing an overarching policy and strategy for managing the risk, developing detailed plans for projects and equipment and introducing specific requirements into supply and support contracts.

2.31 The Office of Rail Regulation also considers that Network Rail needs to be more proactive in managing the risks of obsolescence in its procurement processes and should develop obsolescence strategies for high-tech systems. It considers Network Rail should use a modular approach to the design of systems to enable components to be readily replaced and upgraded and set clear specifications for the purpose of the equipment within a system, with detailed performance requirements and standardisation to industry-wide specifications.

PART THREE

The programme is delivering its projected benefits

3.1 This Part of the report examines the business case for the West Coast programme and the extent to which the expected benefits have been delivered.

The Strategic Rail Authority demonstrated a positive business case for continuing the project to enhance the line

3.2 The Strategic Rail Authority's business case for the West Coast Strategy gave a positive benefit:cost ratio for the enhancements element of the programme of 2.5:1 **(Figure 8)**. The business case was prepared to support the decision to continue with the enhancement project beyond 2002, and therefore examines only the additional costs and benefits beyond this date. It does not reflect the costs and benefits of the project as a whole.

- The infrastructure costs of £1.4 billion covered only enhancement expenditure for the remainder of the project, although most West Coast renewals contributed to increasing line speeds. The Authority excluded the cost of renewals from the appraisal on the grounds that they could not be avoided, as they were needed to keep the West Coast Main Line a "going concern". The appraisal assessed the costs against the benefits from the enhancements to the track.
- Leasing charges, amounting to a present value of almost £1.5 billion over the 35-year period to 2038, for the Pendolino trains, which had already been ordered by Angel Trains for the Virgin Rail Group and which were in the course of delivery, were excluded from the appraisal on the grounds that they were sunk and committed costs and were not relevant to the consideration of the case for proceeding with further upgrade of the track.

3.3 The business case for the continuation of the programme hinged around the non-financial benefits, chiefly savings in passenger journey times and benefits to road-users from freight being carried by rail rather than road and from reduced road congestion. In financial terms, the projected direct costs were almost twice as great as the projected revenues. The journey time benefits were calculated using standard methods and are very sensitive to small changes in journey times and service frequencies. The benefits to road users depend on the assumption that some additional passengers and freight would otherwise have used the roads. Environmental dis-benefits of £53 million were included, reflecting the cost of extra pollution created at power stations to meet the electricity requirements for the additional trains.

3.4 Sensitivity analysis of key assumptions is important in appraisals. As part of its business case appraisal, the Strategic Rail Authority carried out sensitivity tests on the key assumptions underpinning it: for example, on capital costs, passenger demand and revenues. These showed a benefit:cost ratio of less than one only when pessimistic outcomes were assumed across all scenarios. We tested the cost benefit further and calculated that if a 25 per cent lower value is assumed for journey time benefits and the full costs of leasing the Pendolinos had been included in the appraisal the overall benefit:cost ratio would have been 1.7:1.

8 The Strategic Rail Authority's 2004 business case appraisal gave a 2.5:1 benefit:cost ratio for the enhancement element of the programme

	Present values (£ million)	Per cent share
Costs		
Infrastructure costs	1,414	25
TOC passenger operating costs (including profit margin)	2,410	43
Freight operating costs	1,752	31
A: Total costs	**5,576**	**100**
Benefits		
Financial		
TOC passenger revenue	2,427	17
Freight revenue	1,231	9
Disruption costs	(25)	0
B: *Total financial benefits*	***3,633***	*26*
Non-financial		
Journey time benefits	6,222	45
Crowding benefits	733	5
Freight non-user benefits	1,829	13
Passenger non-user benefits:		
road decongestion benefits	1,293	9
accident benefits	224	2
Environmental benefits	(53)	0
C: *Total non-financial benefits*	***10,248***	*74*
D: Total benefits (B+C)	**13,882**	**100**
Summary		
E: Benefit:cost ratio (D/A)	**2.5**	
F: Net financial benefits (B-A)	**(1,943)**	
G: Net present value (NPV) of benefits less costs (D-A)	**8,306**	

Source: National Audit Office analysis of April 2004 West Coast Strategy Business Case Appraisal

NOTES

1 The appraisal was based on an assessment period of 35 years (to 2038-39) at a discount rate of 3.5 per cent. We have converted all values to 2005-06 prices.

2 The initial, June 2003, appraisal of the Strategic Rail Authority's West Coast Main Line Strategy had a benefit to cost ratio of 2.4:1. The 2004 appraisal of the programme, as revised following the Regulator's December 2003 determination of Network Rail's overall funding, included lower costs and higher passenger demand forecasts, and lower freight revenue and non-user benefits because of the deferral by up to two years of some schemes, principally the Trent Valley four-tracking.

The Programme is delivering benefits to passengers in line with projections

3.5 The Department has not re-visited the 2004 business case appraisal, but monitors key indicators of costs, train operators' revenues, passenger journey times, service frequencies, passenger numbers and train punctuality to confirm that the programme is on course to deliver its expected benefits to passengers. The journey times and train frequencies achieved from September 2004 and expected from December 2008 are summarised in **Figure 9 overleaf**. These exceed the targets set out in the 2003 West Coast Strategy. For passenger numbers and train punctuality, we compared outturn performance against the forecasts underpinning the appraisals.

Growth in passenger numbers is exceeding expectations

3.6 In 2005-06, following Phase 1 of the West Coast programme, annual passenger journeys on Virgin West Coast grew by more than 20 per cent on the previous year and were four per cent ahead of the business case forecast for that year. Passenger journeys on Virgin West Coast have also grown at a greater rate than that experienced by its nearest comparator train operating company, Great North Eastern Railway. In 2006, some parts of the route were operating at or near capacity. The Department predicts further growth in passenger journeys in 2006-07 and expects growth of around 10 per cent per annum between 2006-07 and 2012-13, which is higher than the growth of three per cent assumed in the business case. Higher than expected passenger growth should have the effect of increasing passenger revenues and journey time benefits compared to the business case appraisal. Completion of enhancements at Rugby and Trent Valley in 2008 and at Stafford in 2012-15 will ease capacity pressures, but there is an industry consensus that the line will have insufficient capacity to sustain growth in passenger and freight traffic beyond 2015 to 2020 if current levels of growth continue. Increases in capacity could be achieved through investment in longer trains, although some infrastructure works, including platform and depot lengthening, may be required to achieve this, or more radical options such as moving block signalling might be considered, if available.

9 The programme is delivering journey time and train frequency improvements, through revised timetables

Fastest train times (based on timetable)	**Before September 2004**	**After September 2004**[1]	**Expected December 2008**[1]
Birmingham to London	1 hour 39 minutes	1 hour 21 minutes	1 hour 18 minutes
Manchester to London (via Stoke)	2 hours 41 minutes	2 hours 5 minutes	1 hour 59 minutes
London to Glasgow	5 hours 6 minutes	4 hours 24 minutes[2]	4 hours 12 minutes
Number of fast line train services to/from London per hour			
Peak time	9	12	13
Off peak	6	8.5	11
Train Seats[3]			
Peak hour	4,756	5,880	6,327
Off peak hour	3,136	3,376	4,493

Source: National Audit Office analysis of Department's data

NOTES

1 The 2003 West Coast Strategy had anticipated, for 2005, indicative fast journey times to/from London which were one minute more from Birmingham and Manchester and to Glasgow and which would be three minutes more from Manchester and six minutes more to Glasgow in 2008. It planned for 11-12 peak time and nine off peak trains per hour in 2008.

2 After December 2005.

3 Other measures also show increases in capacity: towards the end of 2005-06 there were almost 70,000 Virgin West Coast trains operating on the West Coast route a year (measured as a moving annual total), an increase of around 12,000 trains a year (20 per cent) compared to before September 2004, a lower increase than for trains per hour because it includes weekend services, which are still substantially affected by closures for engineering works.

3.7 Reduced journey times since September 2004 have helped Virgin West Coast to increase its share of the growing London to Manchester rail/air market. The number of monthly passenger rail journeys between London and Manchester increased by 55 per cent between September 2004 and April 2006, to 194,000. Over the same period, monthly journeys by air between London and Manchester fell by eight per cent to 154,000. Rail's share of the London Manchester rail/air market stood at 56 per cent in April 2006, up from 40 per cent in September 2004.

Punctuality has improved since September 2004

3.8 A key Strategy target is that, by December 2008, 90 per cent of long distance passenger journeys should arrive within 10 minutes of the advertised time. This target is measured as a moving annual average using Virgin West Coast's Public Performance Measure (PPM).[29] In the year to January 2006, Virgin West Coast achieved a moving annual average PPM of 80 per cent and by September 2006 this had increased to just over 86 per cent compared to an interim target of 87 per cent to be achieved by December 2006. In September 2006 on average Virgin West Coast trains have been delayed by nine and a half minutes,[30] a 43 per cent improvement on the average delay of 17 minutes in September 2004.

29 The Public Performance Measure (PPM) is the percentage of scheduled trains that arrive at their destinations within 10 minutes of their planned arrival times. The PPM takes account of late running, as well as cancelled, trains. The moving annual average measures the average level of performance over the previous year to smooth out seasonal fluctuations.

30 Delay per planned train and measured on a moving annual average basis.

3.9 Punctuality performance has also improved on Silverlink, the other main user of the West Coast Main Line. Passenger Charter punctuality data, which measures the percentage of peak time trains arriving within five minutes of their advertised arrival time, shows that the moving annual average for Silverlink's County services between London and Northampton was 89 per cent at September 2004 and 95 per cent by September 2006.

Passenger satisfaction has improved

3.10 The latest National Passenger Survey results, for Spring 2006, indicate that overall passenger satisfaction with Virgin West Coast rail services has increased from 76 per cent at the time of the September 2004 timetable changes to 90 per cent. Satisfaction with Silverlink County train services has increased from 70 per cent to 84 per cent.

It is too early to assess whether non-passenger benefits will be delivered

The modernisation programme is not scheduled to begin delivering major freight benefits until 2009

3.11 A key objective of the government's strategy for transport is to increase rail freight's share of the freight market, and the 2003 West Coast Strategy provided for an increase of 60 to 70 per cent in the number of freight paths on the line. The delivery of this capacity enhancement was, however, put back following the Rail Regulator's 2003 decision that deferring key aspects of the programme would be more efficient, deferring the benefits from increased freight operating company revenues and from road traffic decongestion until 2009.

3.12 Freight operating companies are confident benefits will be delivered from the increased freight paths available on the upgraded route from 2009. Some of the modernisation improvements that have already been implemented, such as enhanced clearances and improved power supplies, should already be delivering benefits. The Department only has data on freight use provided by Freightliner, the second largest freight operating company operating on the rail network, which shows that "high gauge" container traffic, which requires greater clearances, increased threefold on the routes to Manchester between September 2004 and January 2006.

The Department is not monitoring whether the programme is delivering passenger non-user benefits

3.13 The business case estimated, drawing on the Department's models for modal shift, that the upgrade would generate almost £1.5 billion worth of passenger non-user benefits, from reductions in road traffic congestion and road traffic accidents resulting from the transfer of travellers from road to rail. The Department has not monitored the delivery of these benefits and has no plans to assess their realisation in the future.

The Programme is delivering economic regeneration benefits

3.14 The business case also considered benefits attributable to economic regeneration and the environmental benefits resulting from the switch of passengers from air and road to the railways but did not quantify them. The Department reported, in its May 2006 West Coast Main Line Progress Report,[31] that the programme has helped catalyse redevelopment around key stations along the route, including Manchester Piccadilly.

31 *West Coast Main Line: Progress Report May 2006*, Department for Transport.

APPENDIX ONE

Background to the West Coast modernisation programme

1 The West Coast Modernisation Programme involves the renewal and upgrading of the UK's busiest mixed-use rail line: the route links London Euston to Birmingham, Manchester, Liverpool and Glasgow and is used by more than 2,000 trains a day, carrying both passengers and freight.

The West Coast Route Modernisation began as a private sector programme

2 Built in stages over three decades from the 1830s, the West Coast Main Line was electrified in the North West in the 1960s and to Glasgow in the 1970s. The route needed renewal in the 1990s because, with its infrastructure ageing, train service reliability was deteriorating. In 1998, two private sector companies, Railtrack, which owned and was responsible for operating, maintaining, renewing and developing the rail infrastructure, and Virgin Rail Group, which held the franchise[32] to operate long-distance passenger trains as West Coast Trains, agreed a renewal and upgrade programme known as Passenger Upgrade 2 (PUG2). This Passenger Upgrade agreement was approved by the Rail Regulator. The original aim was to upgrade the line, in two phases, in 2002 and 2005, using new 'moving block' signalling technology[33], to increase capacity and train speeds at low cost. Virgin Rail Group ordered a fleet of new tilting trains that would be capable of running at 140 mph, with delivery planned for May 2002.

3 The programme quickly ran into difficulties. Railtrack's estimates of the expected final cost increased rapidly **(Figure 10)**. Dissatisfied with progress on the programme, in November 1999 the Rail Regulator took enforcement action against Railtrack, under section 57 of the Railways Act 1993, requiring Railtrack to come up with coherent plans for the project. In December 1999, Railtrack decided not to use moving block signalling, as the technology was not sufficiently mature. The October 2000 Hatfield derailment and subsequent speed restrictions and increased level of repairs and renewals needed on the network, along with other factors, including West Coast contract liabilities, created a financial crisis for Railtrack which resulted in October 2001 in the High Court, on the application of the government, putting it into Railway Administration. Virgin West Coast's procurement of its new tilting trains rolling stock also fell behind schedule.

In early 2002, the government invited the Strategic Rail Authority to intervene to take the programme forward

4 The Strategic Rail Authority first began to review options for the way forward for the West Coast programme in July 2001, five months after it was formally set up by the government in February 2001.[34] In shadow form it had not reviewed the programme as until the establishment of the full Strategic Rail Authority it had no locus over infrastructure matters. The Authority commissioned consultants to carry out an economic study of the route and in December 2001 reviewed passenger and freight operators' needs. In January 2002, the Secretary of State orally instructed the Authority to intervene, assess the position on the West Coast programme and find a clear way forward. Railtrack had already spent over £2 billion on the programme and many items of forward build and funding were committed, totalling some £500 million. The principal reasons for the government's intervention were:

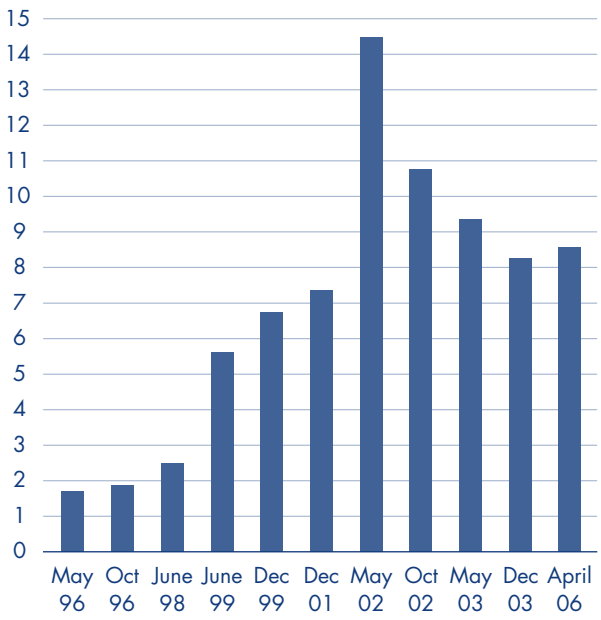
32 Awarded to it in 1997 by the Office of Passenger Rail Franchising (OPRAF), along with a franchise to operate Cross Country Trains. Both franchise terms were to 2012.
33 In which trains are controlled in a moving rather than a static block, using GSM (Global System for Mobile Communications) communications technology.
34 The Strategic Rail Authority was preceded by the Shadow Strategic Rail Authority, which the government set up in July 1999 to replace the Office of Passenger Rail Franchising (OPRAF), which awarded and monitored passenger rail franchises from privatisation in the mid-1990s.

- the private sector companies involved in the West Coast upgrade – Railtrack and Virgin Rail Group – did not deliver the rail infrastructure upgrade and new trains as set out in their agreement;
- the importance of the West Coast Main Line upgrade to the delivery of the government's Transport 10 Year Plan targets for rail passenger and freight growth and improvements in punctuality and reliability; and
- to assist Railtrack to come out of administration as quickly as possible and to give a measure of certainty to enable the rail industry to plan its business.

5 The Authority coordinated discussions between the main industry parties involved, and engaged the management consultants Oakleigh Consulting Ltd to report on lessons arising from delivery of the programme to 2002. Concurrently, in January 2002, Railtrack-in-Administration appointed the engineering, construction and project management consultants, Bechtel Ltd, to review the programme and, from April 2002, take on its management. The Authority's review found that: the programme was over ambitious; there were no firm timescales for delivering improvements to the route infrastructure; and projected costs were soaring, with the latest estimate, made by Bechtel in May 2002, projecting a final cost of £14.5 billion[35] and delivery of the first passenger benefits unlikely before the May 2006 timetable change.

6 The Strategic Rail Authority decided that the programme needed a formal strategy. The Authority concluded that abandoning the programme was not a viable option because four-fifths of the work involved renewals that were needed to replace the route's ageing infrastructure. Moreover, stopping work already contractually agreed would have incurred Network Rail, which took over from Railtrack-in-Administration in October 2002[36], substantial financial penalties from contractors and from Virgin West Coast, for whom Angel Trains had ordered 53 high-speed Pendolino trains, with a present value of £1.5 billion for leasing charges over the 35-year period to 2038. Instead, the programme was re-scoped, to bring down its projected cost and focus on key outputs. The Authority's June 2003 *West Coast Main Line Strategy* set out three delivery phases, with the first passenger benefits brought forward to September 2004, and five key objectives (Figure 2).

10 Estimates of the likely final cost of the programme increased sharply to 2002



Source: National Audit Office analysis of cost estimates across the course of the programme

NOTES

1 These expected costs relate to different scopes/expected outputs.

2 May 1996 – Core Investment Programme (CIP); October 1996 – CIP+PUG 1; June 1998 – CIP+PUG 2; June 1999 – Baseline 1; December 1999 – Baseline 2; December 2001 – Revised Baseline 2; May 2002 – Baseline 3; October 2002 – Upper limit accepted by government for WCML Strategy; May 2003 – Baseline 5; December 2003 – Implied by Rail Regulator's funding conclusions; April 2006 – Spend to date and Network Rail Business Plan forecast spend.

3 The estimates unadjusted to 2005-06 prices (i.e. for the price bases used at the time) were: May 1996 – £1.3bn; October 1996 – £1.5bn; June 1998 – £2.1bn; June 1999 – £4.8bn; December 1999 – £5.8bn; December 2001 – £6.3bn; May 2002 – £13.2bn; October 2002 (upper limit) – £9.9bn; May 2003 – £8.8bn; December 2003 – £7.6bn; and April 2006 – £8.1bn (see footnote 7).

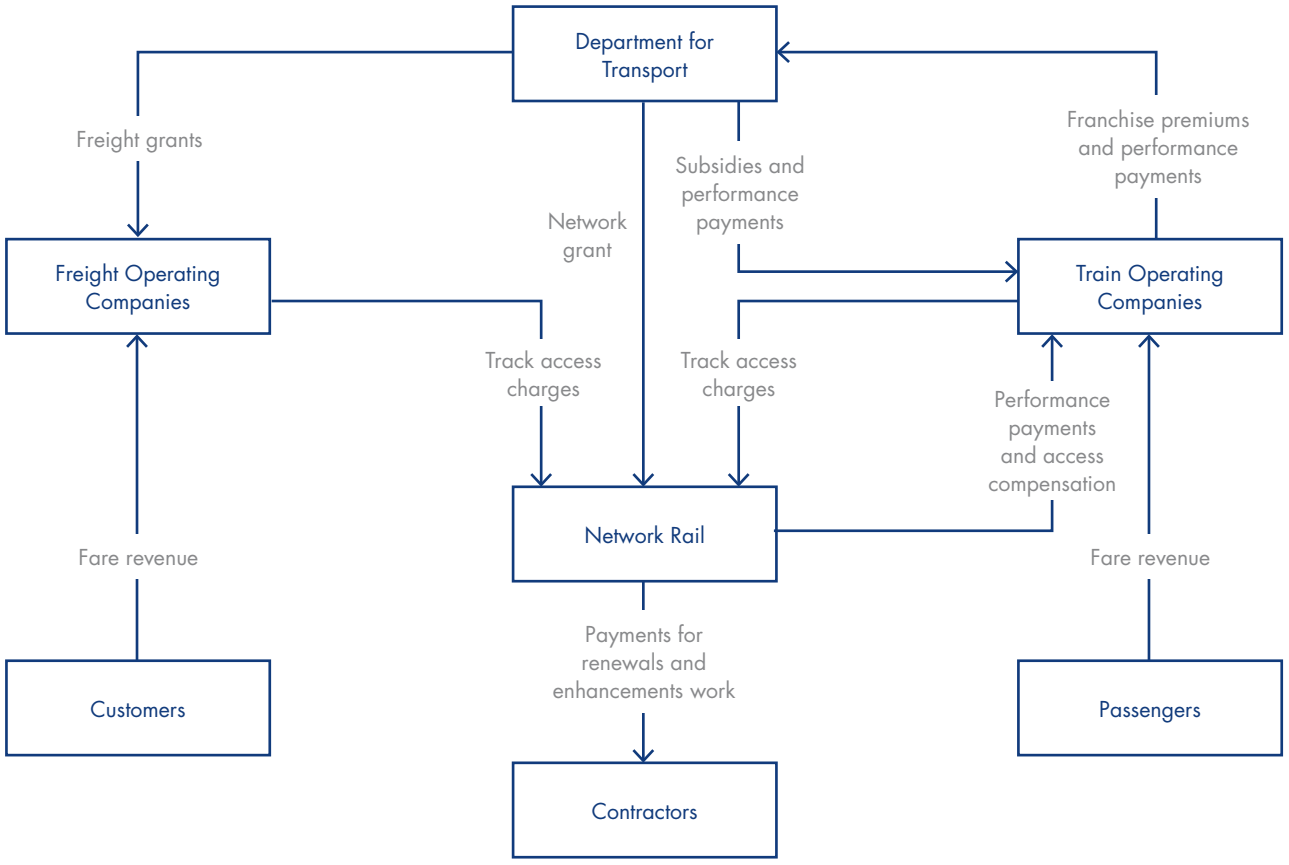
35 This estimate, known as Baseline 3, was £13 billion in prices at the time and included a £3 billion allowance for risk and contingency.
36 It is a private company limited by guarantee and without shareholders. *Network Rail – Making a Fresh Start* (National Audit Office, HC 532, Session 2003-04, May 2004).

Passengers and government have funded the programme

7 Initially, the programme was financed by Railtrack from its borrowings. The agreement between Railtrack and Virgin Rail Group provided for the cost of the enhancement programme to be funded from future increased revenues, which were to be shared. From October 2001 to March 2002, the government provided loan funding for the programme through the Administrators. Since March 2002, it has been funded by Railtrack-in-Administration/ Network Rail loans, serviced by receipts of network grant (from the Strategic Rail Authority/Department) and track access charges paid by the train operating companies, from their fare revenues and government subsidies **(Figure 11)**. Track access charges are set by the Office of Rail Regulation (and the Rail Regulator to 2004) for five-yearly 'control periods' based on the Office's assessment of how much it should cost for Network Rail to efficiently operate, maintain and renew the track.

8 By December 2003, around £4.8 billion had already been spent. In his December 2003 conclusions to the access charges review for the 2004-05 to 2008-09 control period, the Rail Regulator accepted the Strategic Rail Authority's June 2003 Strategy as the basis for what outputs should be delivered. But, informed by the work of consultants who evaluated a range of options, the Regulator determined that re-phasing delivery of some major schemes would reduce programme costs and be more efficient, whilst delaying related outputs and their benefits. The Regulator's December 2003 determination of funding from 2004-05 meant that, with £5.2 billion having been spent on the programme by March 2004, the final assumed expenditure for the programme was £8.3 billion. This assumed Network Rail could achieve £940 million of efficiencies and was £2.5 billion below the total budget cap set by the government for the 2003 Strategy.

11 Funding flows for the West Coast Programme



Source: National Audit Office analysis

APPENDIX TWO

Study methodology

1 We scoped our fieldwork around eight issues-based work packages:

i The background to the programme and the case for Strategic Rail Authority intervention.

ii Assessment of the West Coast Main Line Strategy and arrangements to deliver it.

iii Network Rail's management of the programme.

iv The business case and costs of the programme.

v The programme's outputs and benefits.

vi The programme's impact on the rail industry.

vii External assessment of obsolescence risk with signalling technology.

viii Future arrangements for the management of the programme.

2 For each work package, we used a variety of methods to collect sufficient, reliable and relevant data to answer key audit questions. We carried out the bulk of the fieldwork between October 2005 and July 2006, with scoping interviews between December 2004 and spring 2005.

Interviews with key organisations

3 We used semi-structured interviews with key people we identified at the Strategic Rail Authority, Network Rail, the Department and Office of Rail Regulation and we obtained and reviewed supporting documents, files and management information to corroborate, challenge and triangulate the interview evidence.

Strategic Rail Authority

Who we interviewed: The Authority's chairman and chief executive (during initial planning for the study in May 2003) and, during fieldwork, the West Coast programme director and assistant programme director, other members of the Authority's West Coast Team, and the Authority's engineering adviser.

Topics covered: The Authority's intervention in 2002; development of the West Coast Main Line Strategy; consultation with stakeholders; rail replacement services; Project Rio; and monitoring programme delivery.

Network Rail

Who we interviewed: The director of planning and regulation and, from the Bechtel-led West Coast Programme Management team: the general manager (B); the directors of programme investment, implementation (B), planning and operations, human resources, contract administration (B), commercial, finance, major projects (B) and programme controls (B); the area directors for the Midlands (B), North (B) and Scotland; the West Coast Engineering team's chief engineer; and the heads of the estimating, performance measurement, timetable planning and risk management teams [those from Bechtel Ltd are designated by (B)]. We also interviewed Area level project and implementation managers for our case studies.

Topics covered: The 2002 Bechtel Ltd report on programme delivery to 2002; the appointment of and payments to Bechtel; organisational and monitoring arrangements; contracting strategy and oversight of contractors, the possessions strategy; compensation to train operators; risk management; estimating; Six Sigma performance improvement; cost control; programme expenditure; human resources; performance benefits; timetable planning; scope control; and the role of West Coast Engineering.

The Department for Transport

Who we interviewed: The Director of the Railways Department, the Head of Major Rail Projects, the West Coast programme's director and sponsors, the business case team, and the relevant franchise directors.

Topics covered: The Department's current and earlier role in the programme; we also covered the business case for the programme, risks to programme delivery, and franchise payments to West Coast train operators.

The Office of Rail Regulation

Who we interviewed: The former Rail Regulator and key officials who have had involvement in the West Coast programme, including the director of rail policy, the head of network regulation, the director of industry monitoring and analysis, and the Office's track and signal engineering advisers. We also met with the independent reporter for the West Coast programme, Mouchel Parkman.

Topics covered: The Office's role and involvement in the programme; the Office and independent reporter's monitoring of the programme's delivery; unit costs; the projected overspend; Network Rail's asset register; and compensation and the continuing Possessions Review.

Passengers' representatives

Who we interviewed: The Rail Passengers' Council North West.

Topics covered: Passengers' perspectives on consultation over the upgrade; the impact of disruption caused by engineering work; and passenger benefits from the upgrade.

Train and freight operators

Who we interviewed: Arriva Trains Wales; Central Trains; English, Welsh and Scottish Railway Ltd (EWS); Freightliner; Northern Rail; Scotrail; Silverlink; Virgin Cross Country; and Virgin West Coast.

Topics covered: Consultation with the Authority and Network Rail; possessions and blockades; rail replacement services; temporary speed restrictions; timetables; compensation; benefits of West Coast Route Modernisation; future risks to the programme; and lessons learnt. A standard interview template was used for these interviews to collect information on the same basis.

Consultants

Who we interviewed: Oakleigh Consulting Ltd, Steer Davies Gleave and Booz Allen Hamilton.

Topics covered: Oakleigh's June 2003 *Lessons Learned* report and the 2003 and 2004 business cases for the West Coast Main Line Strategy.

Analysis of information

4 We obtained and analysed information. The Department and Office of Rail Regulation provided full access to their files and lists of files on the programme. Network Rail provided copies of key documents and management information.

Factual information on programme delivery reviewed to test interview evidence

From Network Rail: The March 2002 Bechtel Ltd report; programme baselines and functional specifications; four-weekly (period) executive reports and area review packages (containing high level detail on the programme's progress and key delivery problems); project management guidance; contracting strategy papers; and a variety of project specific and monitoring documents.

From the Department: Project Board and Steering Group minutes; the Oakleigh Consulting Ltd lessons learned report; Strategic Rail Authority and Department files covering their involvement in the programme from 2001, including files on the 2003 and 2004 business cases, passenger handling strategies, rail replacement services and monitoring of efficiencies.

From the Office of Rail Regulation: The Office's (and Rail Regulator's) programme files, consultants' reports (on programme efficiency and unit costs) for the 2003 access charges review and the independent reporter's four-weekly analyses of programme spend/efficiency.

We also analysed the annual financial statements for Cross Country Trains, Virgin Rail Group Ltd, Virgin Rail Group Holdings Ltd and West Coast Trains, obtained from Companies House, and the twice yearly National Passenger Surveys for trends in passenger satisfaction with West Coast train operators.

Management information used to produce new analyses

From Network Rail: Performance during track possessions, spend by project and contractor, payments to Bechtel Ltd, West Coast infrastructure and train reliability, punctuality and causes of delays. We had wished to also produce analyses showing the changing average length of possessions and compare rates of compensation for possessions under Schedule 4 and Network Change over time, but Network Rail was unable to supply us with the necessary information.

From Companies House: The annual financial statements for Cross Country Trains, Virgin Rail Group Ltd, Virgin Rail Group Holdings Ltd and West Coast Trains to identify trends in the profitability of Virgin Cross Country and West Coast and the changing levels of government subsidy.

On passenger satisfaction with West Coast train operators: The twice yearly National Passenger Surveys.

Case studies

5 To obtain a more detailed insight, we examined six key projects: two underway before 2002; two started in 2003 with delivery in 2004-05; and two started in 2005 for 2008-09 delivery. For case studies 1-3, we interviewed relevant members of the West Coast programme management team and reviewed papers held by Network Rail and the Department. For case studies 4-6, we met with the Area implementation teams in Glasgow and Manchester and the Major Projects team in Lichfield and Rugby, interviewed the Area implementation director and senior project managers, and reviewed reports from project key stages and a range of contract and monitoring reports. Findings from these case studies which illustrate key points in the report are set out in Appendix 3.

National Audit Office case studies

Case study		Focus of the case study
1	European Rail Traffic Management System (ERTMS)	Why did the Strategic Rail Authority remove ERTMS from the programme in 2003 and how much had been spent on its development for the West Coast Main Line?
2	Power supply upgrade	The contribution of constructive challenge to the Strategic Rail Authority's adoption of the autotransformer option.
3	Stoke summer 2003 blockade	Planning the blockade; securing stakeholder buy-in; contractual arrangements; monitoring delivery during the blockade; unit costs; and planning and operation of rail replacement services.
4	Preston–Glasgow track renewal in 2005	Planning and coordination; contractual strategies; monitoring delivery by contractors.
5	Rugby station remodelling	Project design and scope control; contractual and delivery arrangements.
6	Trent Valley four-tracking	Project design and scope control; contractual and delivery arrangements.

6 In response to concerns raised by a member of the public, we also examined, through interviews with Network Rail and review of project papers provided by Network Rail, the 2004 project to replace Banbury Lane level crossing with a road bridge.

Work by QinetiQ on obsolescence management

7 Jointly with Network Rail, we engaged QinetiQ, which has expertise in obsolescence management, to review obsolescence management for signalling systems on the West Coast Main Line and identify future risk of obsolescence. The work was carried out between January and April 2006. Further details on this work are set out in Appendix 6.

APPENDIX THREE

Illustrative findings from our case studies[37]

CASE STUDY 1

The European Rail Traffic Management System (ERTMS)

Description of project

Railtrack's plan to adopt, initially, moving block signalling (ERTMS level 3) and, from December 1999, in-cab signalling (level 2 ERTMS).

Background to project

EC Directive 96/48/EC requires Member States to operate compatible signalling systems for upgrades of high-speed lines on the European network. European signalling suppliers developed, in response, the European Rail Traffic Management System (ERTMS), combining automatic train protection and train control to deliver safety, capacity and performance benefits. ERTMS operates at three levels:

- Level 1: equivalent to the Train Protection Warning System but using newer technology.
- Level 2: involves in-cab (as opposed to lineside) signalling, with instructions sent to the cab by GSM radio.
- Level 3: as for Level 2, but with remotely operating points and self-reporting trains which can increase the capacity and improve the performance of the routes.

Railtrack planned initially to adopt level 3 ERTMS (moving block signalling) for the West Coast upgrade and signed a contract with GEC Alstom in 1998 on the basis of an estimated likely cost of £0.5 billion.

Removal from the West Coast programme (paragraph 1.10)

In December 1999, finding the technology insufficiently developed, Railtrack abandoned level 3 and adopted level 2 ERTMS, which was needed to achieve the 140 mph running specified in PUG2. Railtrack estimated the cost of level 2 ERTMS for West Coast at £1.9 billion, as it would need to replace conventional signalling. In June 2002, the Strategic Rail Authority convened an industry-wide workshop which recommended that ERTMS be removed from the West Coast programme and its development work migrated to a national ERTMS development programme. In January 2003, the Health and Safety Commission accepted the Authority's advice that ERTMS was not sufficiently reliable for the West Coast and was a major risk to programme delivery and the Project Board approved its removal from the programme. By this date, Railtrack and Network Rail had spent £250 million from the West Coast programme budget on developing ERTMS.

37 This appendix elaborates issues raised in the main parts of our report, rather than presenting a summary of all findings from each case study.

CASE STUDY 2

The power supply upgrade

Description of project

A collection of projects to renew and enhance overhead line equipment and power systems to increase the electric power supply to the West Coast to meet later 2000s' capacity needs.

Challenging and controlling scope (paragraph 1.7)

In October 1999, Railtrack set up an overhead line equipment (OLE) and power supply upgrade Alliance, with representatives from Railtrack and two partners: a design joint venture, comprising WS Atkins and Balfour Beatty, and a construction joint venture, comprising GTRM (now wholly-owned by Carillion) and Balfour Beatty. The Alliance's task was to convert Railtrack's outline plans to upgrade the OLE and traction power system into a deliverable plan and then implement it. Its contract involved three elements of work: upgrade of existing life-expired OLE infrastructure; modifications to the infrastructure in support of 125 mph operation; and, increasing the capacity of traction power supply in anticipation of 2020 timetable requirements. Railtrack's outline plan was to introduce an autotransformer system, as used previously on French high-speed lines and then on the Channel Tunnel Rail Link (which opened in 2003), to provide a step-change in power supply. The Alliance pursued this initially and developed plans which would require replacement of a significant number of overhead masts north of Crewe. In June 2001, Railtrack decided to retain a classic booster transformer feeder system throughout the route for several reasons: the estimated cost of this autotransformer option were too high; the risk of disruption on a live railway (by comparison with a greenfield railway such as the Channel Tunnel Rail Link); and the risk to a tight programme for 125 mph operations. In 2002, the Strategic Rail Authority and Railtrack (then in Administration) re-assessed this decision. The Authority's electrification Constructive Challenge Team identified that a booster transformer system would have insufficient capacity to meet the power demands of future increases in traffic and that an autotransformer system was needed, but that this system could be delivered at a cost considerably below that previously estimated by the Alliance because most overhead masts would not need to be replaced. New cables could instead be attached to existing overhead line masts, supported by re-configured sub-stations. In September 2002, Railtrack decided to proceed with an autotransformer system with design and management of the project within the West Coast Route Modernisation project team. In early 2006, the project was re-phased to introduce autotransformer capacity in relation to the expected growth in power demand. By April 2006, £680 million had been spent on the three elements of the power supply upgrade described above, including the upgrade of OLE infrastructure to support the introduction of 125 mph operation along the route, and the estimated final cost up to December 2008, at £930 million, was £300 million below the May 2002 Baseline 3 estimate.

CASE STUDY 3

The May–October 2003 Stoke blockade

Description of project

Delivery of £195 million of Phase 1 renewals and line-speed enhancement of the line between Colwich and Cheadle Hulme (via Stoke) through a five-month blockade.

Obtaining stakeholder buy-in (paragraph 1.5)

The Authority brokered a consensus among train and freight operators and passenger user groups that the blockade was needed and would deliver benefits, as it would in future become the main line between London and Manchester and be able to accommodate wide gauge freight trains. Inter-city passengers were accommodated on the parallel diversionary route from London to Manchester via Stafford. To meet local circumstances, construction work at Stoke coincided with local factories' peak holiday fortnight and freight trains were allowed limited access to the line. The Authority also worked with train operators and passenger representatives to develop and promote alternative travel arrangements by bus for local passengers, at a cost (to Network Rail) of £2.5 million.

Monitoring delivery by contractors (paragraph 2.9)

With only eight months to plan and prepare for the blockade, Network Rail was unable to follow the detailed design followed by fixed price tender delivery approach used later in Rugby and the Trent Valley. Instead, it used mainly Alliance contractors for delivery, but monitored their work with a 75-strong team of field and cost engineers and project managers.

Early construction progress was slow and at the end of the first six weeks only 22 per cent of work had been completed as against a planned 33 per cent. In response, Network Rail shifted work away from one of its key permanent way contractors, who was underperforming, to the other. But by week 12, the gap between actual and planned work completed had extended to 14 per cent, so it increased the number of workers on site to, by week 18, more than 1,000 compared with a planned 400. Despite this, some work was not completed on time and the blockade had to be extended two weeks, while some remedial work was also later needed. Network Rail spent £6 million on managing this £195 million project, but its post-project review identified a lesson arising as the need for even closer future supervision of contractors.

Contracting strategy (paragraph 2.10)

Network Rail used existing Alliances to deliver much of the work, with quantities of work split between contractors on the basis of Network Rail's assessment of their capability to perform it and monitoring of work done by a locally-based project management team.

CASE STUDY 4

The Preston–Glasgow track renewal in 2005

Description of project

May to December 2005 delivery of £130 million of Phase 2 renewals and line-speed enhancement, through co-ordinating a range of projects overseen by the Scotland and North West areas.

How integrated planning worked (paragraph 1.12)

This work involved 28 separate projects, delivered by the West Coast North West area and Scotland team and working towards a shared Phase 2 Strategy objective of achieving 125 mph train running to Glasgow for the December 2005 timetable change. Integrated planning, supported by open communication between teams, was crucial to make sure that work was delivered in the correct sequence and to schedule. Control was through a master schedule, which set out possessions and work planned for each week, and which was linked to plans for seven commissioning sections, headed by a delivery manager, and for discipline-based projects, such as overhead line equipment and line-speed enhancements, with work delivered by contractors overseen by Network Rail project managers.

Generating competition among contractors (paragraph 2.10)

High-speed tilting trains require a stable and fixed track alignment, which involves tamping work to compact the ballast under the concrete sleepers. In 2004-05, this work was carried out between Crewe and Preston under a national framework track renewals contract. Network Rail paid on the basis of shifts worked rather than output achieved. In total, 150,000 yards were tamped, with an average of 400 yards each shift.

The Phase 2 track upgrade between Preston and Glasgow required the tamping south of the Scottish border of 560,000 yards within 26 weeks during 2005 and a tripling in contractors' productivity to 1,200 yards a shift. To achieve this, Network Rail brought in a second contractor and split the work between them, introduced incentive/penalty payments for achieving/missing target yardages, and provided for the transfer of work to the other contractor if one under-performed. These arrangements worked well. The contractors exceeded their productivity targets so that work did not need to be transferred. Network Rail plans to adopt this approach elsewhere on the network where similar tamping is needed.

Contracting strategy (paragraph 2.10)

A variety of types of contracts and strategies were used, including Alliances (for switches and crossings renewals and overhead line equipment work in England), national framework contract (for switches and crossings and track renewals in Scotland), fixed price contracts (for level crossings and linespeed signage), cost-reimbursable with target cost (for junction remodelling and track renewals) and cost reimbursable with delivery incentives (for tamping work – see above).

CASE STUDY 5

Rugby station remodelling

Description of project

Four main West Coast routes converge in the Rugby area, which, with a current line speed of 75 mph, has become a bottleneck section of the line. This project will renew the track and signalling and remodel the Rugby station area to increase capacity, sustainability and line speed, and has an estimated final cost of £190 million.

Controlling scope through detailed design (paragraph 1.8)

In 2002, joint work by the SRA, Network Rail and train operators identified through 'constructive challenge' an improved scheme with better outputs than Railtrack's previously proposed scheme. In 2004, Network Rail and the SRA, in conjunction with train operators, developed a further improved scheme which did not require demolition of the station and brought down the project's planned cost from the original £350 million to £190 million. Delivery is scheduled by December 2008 and Network Rail has adopted a 'traditional contracting' strategy which separates out procurement for the outline design and the detailed design and construction phases. Network Rail developed a base design, to fix the broad scope of the project. It then invited tenders to carry out, to a fixed price, detailed design (subject to Network Rail review and verification), construction and testing for approval in principle by Network Rail prior to the letting of contracts for the final stage of the project, in 2007-08.

Signalling bids (paragraph 2.8)

Network Rail had planned to renew the signalling by means of a five-day blockade of three of the four tracks at Rugby in Easter 2007. But in 2005, only one signalling contractor tendered to complete the detailed design and to implement the work, with delivery one year later than Network Rail had specified. The bid was later revised to a price 15 per cent above Network Rail's estimate. Network Rail subsequently re-scheduled commissioning of the signalling from Easter 2007 to Christmas 2007 and is currently reviewing this further.

Contracting strategy (paragraph 2.10)

To develop base designs, fixing the scope, and competitively tender for delivery of detailed design and implementation in work packages to fixed prices.

CASE STUDY 6

Trent Valley four-tracking

Description of project

A programme with an estimated final cost of £360 million to increase capacity on the route in the Trent Valley through widening it to four tracks. It is scheduled for delivery in 2008-09.

Controlling scope through detailed design (paragraph 1.8)

Network Rail adopted a similar design and contracting approach to that for Rugby station remodelling and, in this case, used for the first time computerised 3D modelling of the design, which can be updated to accommodate scope changes.

Contracting strategy (paragraph 2.18)

To develop detailed scope and designs and competitively tender for delivery of work packages to fixed prices.

APPENDIX FOUR

Network Rail's contract strategy

1 Network Rail inherited Alliance contracts, and related work-in-progress, from Railtrack-in-Administration. These involved contractors working in partnership with Network Rail, to scope and design the engineering work, agree a target cost for the works, and deliver them. There were five main Alliance contracts **(Figure 12)**.

12 The West Coast Programme's five main Alliance contracts

Name of Alliance	Activity	Main contractors	£ million value of works billed	Last date of Alliance works
Overhead line equipment	Overhead line equipment renewals and certain power upgrade renewals	Carillion, Balfour Beatty and WS Atkins	540	2005
Track	Track renewals	Jarvis	535	2005
Watford Bletchley	Geographical renewals and line speed enhancements	Balfour Beatty and Westinghouse	260	2005
Train Control Systems	New Technology for train control systems	Alstom (train control systems) and Marconi (communication system)	205	2003
Rugby	Geographical renewals and line speed enhancements	Carillion and WS Atkins	170	2005

Source: Network Rail

NOTE

Values are rounded to nearest £5 million. There were many much smaller Alliances.

2 Network Rail initially continued to use the Alliance contracts because it would have faced financial penalties if it had unilaterally ended the agreements. Network Rail did not establish a formal contracting strategy for the project, but gradually moved to a position where it used its own engineers to write specifications and review and approve project designs and invited contractors to tender to deliver the work for a fixed price; and introduced framework contracts for signalling work. Ten key contractors worked for Railtrack and then Network Rail under Alliance contracts and subsequent contracts **(Figure 13)**.

13 Amounts received, to April 2006, by the 10 leading West Coast contractors, working under Alliances and other contracts

£ million received	Contractor	Key activities
Between £501-1,000	Jarvis	Track renewals
	Balfour Beatty	Overhead line equipment renewals
Between £251-500	Carillion	Overhead line equipment renewals
	Grant Rail	Tamping
	WS Atkins	Overhead line equipment renewals
	Alstom	Signalling, train control systems
Between £101-250	Birse Rail	Structures work
	Westinghouse	Signalling, line speed enhancements
	Edmund Nuttall	Structures work
	Marconi Communications	Communication systems

Source: National Audit Office analysis of Railtrack/Network Rail cost data

APPENDIX FIVE

The risks and lessons learned from two innovative technologies employed on the West Coast

14 Computer-based interlocking (CBI)

Why needed?

A modern computer-based signaling system, with greater capacity and potentially quicker and cheaper to configure than existing solid state interlocking systems during infrastructure changes. It also had the advantage of expanding the signalling supply base.

Where used?

On the Crewe–Sandbach–Wilmslow–Cheadle Hulme section where the signalling system was life-expired.

Identified risks

Computer based interlocking was a proven technology in Italy, Germany and Sweden, but there had been software problems in earlier trials in England on the Dorset Coast (where it was commissioned) and at Horsham (where it was abandoned). The key challenge was to convert the software programming developed by Ansaldo for Italian railways to meet British operating and safety requirements. It was a Railtrack local zone, rather than the West Coast Programme team, which took the original decision to introduce CBI on this section of the West Coast Mainline. Network Rail last reviewed this decision in Spring 2004 and decided to continue with the project as it had a Christmas 2005 blockade slot booked, it would take up to two years to replace the life-expired signalling with conventional signalling, and Network Rail believed that the supplier had solutions in place to deal with identified problems.

Outcome

To reduce risks, Network Rail introduced CBI in two phases and on what was no longer the main line between London and the northwest. It successfully installed phase 1 CBI between Cheadle-Hulme and Macclesfield in 2003. But phase 2, which involved more complex functionality, including bi-directional signalling and 110 mph operation, had a succession of problems in testing of the computer systems and from changes to functional requirements. Phase 2 was initially planned for completion in spring 2006, following a 11 December 2005 to 27 March 2006 Sandbach–Wilmslow line blockade. But these problems meant that the blockade had to be extended to 25 June 2006, after which the line was re-opened as a basic two-track railway, with restricted passenger and freight services. Network Rail expected to commission the full-system in Easter 2007, needing a further blockade in Christmas 2006. Network Rail has estimated that these specification and commissioning problems are likely to increase the cost of the Sandbach–Wilmslow remodelling project by around £32 million to £265 million, including increased compensation payments to train operators of over £5 million.

Lessons learned

Network Rail told us it has recognised the need to be more critical about the transferability of the safety coding from other European railways, to estimate better the amount of testing needed for modern software-critical systems and to ensure that its requirements are clear, robust and meet the operational need. Ansaldo told us that it would hope to have early involvement in future schemes so that it could do more to make sure requirements and specifications are clear and fit for purpose.

Source: National Audit Office interviews with Network Rail and analysis of management information

15 Axle counters

Why needed?

A modern train detection system which confirms whether a train has cleared a section of track through counting its axles. Network Rail considers it potentially between two and four times more reliable than track circuits and with half the whole life costs. It does not require insulated rail joints, needs less trackside equipment, is not affected by leaf-fall and is quick to install.

Where used?

On all new signalling systems (that is on much of the line south of Crewe).

Identified risks

The need to amend train running rules and make sure that engineering and maintenance staff understand the system and how to reset axle counters after an engineering disruption.

Outcome

In 2004-05, expected benefits were only partly achieved and the level of West Coast incidents and delays caused by train detection problems did not decline. Between June 2004 and October 2005, there was a monthly average of 35 West Coast axle counter failures, resulting in more than 5,000 delay minutes a month at an average monthly cost to Network Rail of around £300,000. Part of these problems derived from a set of faulty cards, which the manufacturer replaced between November 2005 and March 2006. From late 2005, the level of delays reduced as the maintenance team became more experienced in identifying and fixing faults and after Network Rail obtained safety approval to move from manual re-setting of the system through running a sweep vehicle after engineering work to re-setting by the signaller. The use of axle counters, thereby eliminating the insulated rail joints required for track circuits, has contributed to a reduction in broken rails on the route, improving safety.

Lessons learned

Network Rail has issued a good practice manual on installing axle counters and recognises the need to provide maintainers and track engineers more time and training on introducing and using axle counters.

Source: National Audit Office interviews with Network Rail and analysis of management information

APPENDIX SIX

Review of Network Rail's management of the risk of obsolescence of its electronic signalling equipment

Scope of the work

1 Network Rail identified the risk from early obsolescence of its signalling equipment and the National Audit Office jointly with Network Rail commissioned QinetiQ to:

- assess Network Rail's processes to identify their suitability for managing obsolescence at key points in design, procurement and maintenance;
- identify the extent to which obsolescence was considered at these critical points;
- examine and make a technical assessment of system elements to assess risks of future obsolescence of the elements analysed and the related costs of maintenance; and
- identify obsolescence risks to the systems, to the West Coast Main Line project as a whole and to Network Rail's renewals and maintenance budgets.

Findings

2 In relation to Network Rail's management systems, QinetiQ found:

- Network Rail has no specific obsolescence management procedure or processes;
- Network Rail has been reactive in managing obsolescence, it has relied on suppliers to tell it of obsolescence problems and on field engineers to identify when spares become difficult to obtain;
- Network Rail's suppliers are under no obligation to inform Network Rail of obsolescence problems and as a matter of course do not involve Network Rail in their management of the obsolescence problems that do arise;
- From Network Rail's point of view, its holding of strategic spares has given protection against obsolescence, and it has not yet caused them any major operational problems;
- Loss of knowledge of old systems will impact on Network Rail's ability to meet its customers' requirements and could cause systems to be replaced earlier than planned;
- Network Rail realises that it must be more proactive in its approach to obsolescence management as new proprietary and software-driven systems with short production lives contain increased risks of obsolescence; and
- Development of a pro-active approach to obsolescence management by interested individuals is at an early stage.

3 QinetiQ aimed to review the electronic components in seven system elements. They reviewed the components from two older systems based on their analysis of the equipment drawings (time division multiplex 69 and non-vital frequency division multiplex). They reviewed the components of the new Ansaldo computer-based interlocking system by taking a sample item apart and recording the device types. They analysed all the components from the high performance switch actuator, on their database tool Q-Star, using component lists supplied by the manufacturer. The two suppliers of solid state interlocking systems would not supply component lists to enable QinetiQ to review on Network Rail's behalf the risk of obsolescence of the three elements of these systems, on the grounds that they wanted to protect their intellectual property rights. They presented to QinetiQ their systems for monitoring obsolescence.

4 From their work QinetiQ identified issues to be resolved on four of the seven systems reviewed, as set out in **Figure 16 overleaf**.

16 The obsolescence risk of four of the seven signalling systems reviewed by QinetiQ

System	Risk identified	Scale of the risk
Time division multiplexes 69 A data transmission system.	Key critical components are obsolete and others have short predicted availability.	These are older technology which are no longer manufactured or supported. But they are potentially critical items.
Solid state interlocking signalling equipment A signal control system which prevents conflicting train movements by controlling the interlocking between signals and points. It locks points in place to ensure a safe route is available.	Component level information not provided to Network Rail by suppliers. The suppliers informed the review that there is component level obsolescence with no more of the components available in the market. One supplier has a stock of the components, the other will need to use alternative components to continue to supply Network Rail.	This is a safety critical system. Network Rail's needs for these pieces of equipment for its renewals programme can only be met, prior to new replacement systems coming on line, if it accepts the use by one supplier of similar, but not identical, components to those that are now no longer available. Network Rail believes there is limited risk to the maintenance of systems already in commission because it obtains "lifetime"[1] spares when it buys these systems. It would expect to upgrade elements of the systems in commission over their lifetime, drawing on spares released from the early replacement of other systems. Network Rail has not established the budget requirement for any such upgrading required.
Computer based interlocking A computer-based signal control system which prevents conflicting train movements by controlling the interlocking between signals and points.	This system includes components which are no longer in production and for which the alternative available is also predicted to have a limited remaining period in production. Some of the other components in the system are special to the type of system.	This is safety critical equipment. It is new technology which is being installed only on the West Coast Main Line. Network Rail did not establish a budget for the support and upgrade of the system when it decided to procure it and did not establish a support contract as part of its procurement contract.
High performance switch actuator A point machine, providing safe reliable actuation, locking and detection of point switch blades and crossings.	This system includes electronic components within the control unit which are no longer in production and for which no alternative is available. The supplier told us that its supplier had confirmed no problems sourcing its components, but QinetiQ told us it was concerned over continued availability of the components in the future. Some of the other components in the system are special to the type of system, are produced by one supplier and replacements would need to pass through Network Rail's approvals process.	This is new technology, and Network Rail obtains lifetime spares when it buys these systems, but considers this will not address the needs for upgrade of the control unit identified by the QinetiQ work. The supplier is currently able to continue to supply and support existing systems, but may need in the future to substitute components or redesign an electrical control board. These will need to go through Network Rail's approvals process.

Source: QinetiQ report and Network Rail

NOTE

1 Network Rail buys spares amounting to some 10 per cent of the active components, based on its experience of equipment's lifetime spares requirements.

Network Rail response

Network Rail intends to address the risk to this through its existing approach of relying on strategic spares and system renewal.

Network Rail aims to rely on its suppliers to supply the systems it requires, to require them to confirm that the alternative components would not alter the functionality of the equipment and to put the systems through the necessary approvals process.

It is also establishing whether the new replacement systems could be available more urgently if required for its renewals programme.

Network Rail recognises the need to address the risk of obsolescence with the supplier. Network Rail established a support contract, in June 2006, which would provide for the upgrading of elements of the system over its lifetime, for example to address obsolescence issues.

Network Rail recognises the need to address the risk of obsolescence with the supplier. There is a technical support contract in place, but Network Rail is considering including additional arrangements to allow it to take ownership of the intellectual property rights to the equipment should the supplier decide not to support the equipment any more.

5 Network Rail could not provide QinetiQ with detailed information from which to calculate whole life costs of equipment and the impact that the earlier than expected upgrade or replacement of equipment had had historically. However, Network Rail identified order of magnitude cost data for one illustrative example: where replacing an item like for like would have cost £1,000 but the need to redesign, test and install a replacement item had cost £50,000.

Recommendations

6 QinetiQ made the following key recommendations, that Network Rail should:

- Develop an overarching obsolescence policy and strategy;
- Make an individual responsible for obsolescence management at a senior level;
- Develop detailed obsolescence plans for projects and equipment;
- Introduce obsolescence requirements into supply and support contracts currently under review;
- Mandate obsolescence management requirements in new contracts where appropriate; and
- Establish with suppliers whether they have the ability to support current systems for the remainder of their planned service life.

GLOSSARY

Absolute track geometry	A method for tightly controlling track position. This is essential for tilting fast train-running around curves at high speeds and brings benefits elsewhere.
Alliance	A form of construction delivery based on a partnership between Railtrack and several contractors, which designed and scoped projects on a cost reimbursable basis and delivered work to a target cost.
Axle counters	A modern train detection system which replaces electric track circuits.
Baseline	The costed schedule for delivering the programme's functional specification.
Blockade	Closure of a section of route to allow engineering work to proceed on a 24/7 basis.
Computer-based interlocking	A modern computer-based signalling system.
Constructive challenge	Fundamental challenge of programme scope by expert cross-industry teams set up by the Strategic Rail Authority in 2002-03.
Core investment programme	Railtrack's April 1996 plan to renew the West Coast route to provide for train running at 110 mph.
Department for Transport	The Department for Transport is responsible for overseeing the delivery of Britain's transport system. Following the abolition of the Strategic Rail Authority (SRA) under the Railways Act 2005, from July 2005 it took on the SRA's strategic and franchising roles in relation to the railway.
European Rail Traffic Management System (ERTMS)	An advanced train control system that also provides automatic train protection (i.e. automatic application of the brakes on a train to prevent it passing a stop signal).
Franchise agreement	The agreement between the Department (and formerly the SRA or OPRAF) and the Train Operating Company setting out the terms and conditions on which the TOC can operate train services.
Functional specification	A document which translates the programme's detailed scope into detailed technical requirements.
Health and Safety Commission	The body responsible for health and safety regulation in the UK.
Independent Reporter	Civil engineers who advised the Rail Regulator/Office of Rail Regulation on Network Rail's progress in delivering the West Coast programme. The Reporters have also provided advice to Network Rail and have a joint duty of care.

Moving annual average (MAA)
A measure of the average level of performance over the previous year, which smoothes out seasonal fluctuations.

Moving Block Technology
A modern signalling technology in which trains are controlled in a moving rather than a static block, using Global Systems for Mobile Communications technology.

National Delivery Service
Formerly known as the National Logistics Unit, the National Delivery Service is a dedicated unit within Network Rail which supplies its track maintenance, renewals and enhancement projects with engineering haulage trains and key materials, such as rails, sleepers, ballast and switches and crossings. The Service obtains haulage trains from the freight operators EWS and Freightliner.

National Passenger Survey
A survey carried out since 1999 every six months by consultants commissioned and funded, from 2005, by Passenger Focus (the national rail passengers' consumer watchdog), and previously by the Department/Strategic Rail Authority, to monitor passenger satisfaction with train services. It is based on a sample of between 25,000 and 30,000 self-completed questionnaires from across the country.

Network Change
Arrangements, under Part G of the Network Code, for compensating train operators for loss of track access for engineering work that involves permanent changes to the network, for example one which involves an enhancement element. This compensation covers costs, expenses and direct losses, including revenue loss and the cost of replacement buses or taxis.

Network Code
Formerly the Railtrack Track Access Conditions, the code is a common set of rules applying to all parties to regulated track access contracts with Network Rail.

Network Rail
The owners and operator of Britain's rail infrastructure and owner of stations. It is a private company limited by guarantee and without shareholders. It took over from Railtrack in October 2002.

Office of Passenger Rail Franchising (OPRAF)
A non-ministerial department, which awarded the franchises to run passenger rail services by March 1997. It was superseded by the Shadow Strategic Rail Authority in July 1999.

Office of Rail Regulation (ORR)
A non-ministerial government department staffed by civil servants, including a team of experienced railway operational and engineering staff, which regulates Network Rail's stewardship of the national rail network. The ORR, which receives general guidance from the Secretary of State for Transport, aims, through independent, fair and effective regulation, to achieve improvement of a safe, well-maintained and efficient railway which meets the needs of its users and to facilitate investment in capacity. It replaced the Rail Regulator in July 2004.

Overhead line equipment (OLE)
Infrastructure to transmit electric power from a supply sub-station by overhead wires to an electric train or locomotive.

Pendolinos
High-speed tilting trains used by Virgin West Coast on the West Coast Main Line.

Possession
Where part of the rail infrastructure is closed to passenger and freight traffic and taken over by contractors, or others, for engineering work.

Project Rio
An alternative London to Manchester rail service, via Leicester, during 2003-04 to make sure passengers could still travel by rail from London to the North West during periods of engineering construction on the West Coast Main Line.

Public Performance Measure (PPM)	The measure of train punctuality, setting out the percentage of scheduled trains that arrive at their destinations within 10 minutes of their planned arrival times.
Rail Regulator	The independent regulator of the railway industry operating to July 2004 under powers granted by the Railways Act 1993, the Competition Act 1998 and the Transport Act 2000.
Rail Replacement Services	Bus/coach services provided by train operators (and paid for by Network Rail) for passengers affected by closure of the route for engineering work.
Railtrack	The private company responsible between 1996 and 2002 for the operation and ownership of Britain's rail infrastructure. It went bankrupt in October 2001, and was in Railway Administration until it was replaced by Network Rail in October 2002.
Schedule 4	Arrangements for compensating train operators for loss of track access for engineering work purely for renewals. Schedule 4 applies to maintenance, renewals and temporary speed restrictions, but not currently to enhancements. Schedule 4 compensates for revenue loss using an industry standard formula. Discounts apply the earlier that Network Rail informs the train operator(s) of the possession. Where a possession involves a significant restriction of use – for example, over a weekend and public holiday – Schedule 4 compensation also covers direct costs, such as the costs to train operators of replacement buses or taxis, publicity and train planning, if over £10,000.
Schedule 8	Arrangements for compensating train operators and incentivising Network Rail and operators to minimise lateness and cancellations of their services, including where this is caused by an overrunning possession.
Shadow Strategic Rail Authority (sSRA)	The body which, in July 1999, replaced OPRAF, pending legislation to create the SRA.
Six Sigma	A process improvement system which identifies ways of improving efficiency based on a systematic approach of measure, analyse, improve and control.
Solid state interlocking (SSI)	A signal control system which prevents conflicting train movements by controlling the interlocking between signals and points.

Strategic Rail Authority (SRA)	The Transport Act 2000 set up the SRA to provide strategic direction and leadership for Britain's railway, let and manage passenger franchises and freight grants, disburse public funds, develop and sponsor major infrastructure projects, and to be responsible for some aspects of consumer protection. It operated under Directions and Guidance (D&G) from the Secretary of State for Transport, the Scottish Minister for Transport and the Mayor of London. It formally came into being on 1 February 2001 and was abolished by the Railways Act 2005.
Subsidies	Sums paid by the Department (and formerly the Strategic Rail Authority) to certain Train Operating Companies to support their provision of rail services.
Tamping	The compacting of ballast around railway sleepers to hold rails firmly in position.
Track Access Agreement	Agreement between a train operator and Network Rail setting out conditions for use of the network. The Office of Rail Regulation regulates the agreement.
Track Access Charges	Payments made by train operators to Network Rail meet its cost of operating, maintaining and renewing rail infrastructure. The Office of Rail Regulation determines the level of charges for five-year control periods after an Access Charges Review.
Train Operating Companies (TOCs)	The 24 Train Operating Companies are responsible for providing passenger rail services in the UK. The TOCs operate under franchise agreements with the Department (and formerly the Strategic Rail Authority).
Train path	A slot in a timetable for running an individual train.
West Coast Main Line	The main rail route between London Euston, Birmingham, Manchester, Liverpool, North Wales, the North West, Glasgow and Edinburgh.

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The Modernisation of the West Coast Main Line

A report by the Comptroller and Auditor General

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