



National Audit Office

Report

by the Comptroller
and Auditor General

Department for Transport and Network Rail

The Sheffield to Rotherham tram-train project: investigation into the modification of the national rail network

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Department for Transport and Network Rail

The Sheffield to Rotherham tram-train project: investigation into the modification of the national rail network

Report by the Comptroller and Auditor General

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Commons in accordance with Section 9 of the Act

Sir Amyas Morse KCB
Comptroller and Auditor General
National Audit Office

29 June 2017

This report investigates the cost increases and delays on the Sheffield to Rotherham tram-train project, and explains the roles of the Department for Transport and Network Rail in implementing the project.

Investigations

We conduct investigations to establish the underlying facts in circumstances where concerns have been raised with us, or in response to intelligence that we have gathered through our wider work.

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Key facts

401%

increase in the anticipated final cost of Network Rail's modification works, compared with the budget agreed in May 2012

May 2018

current expected completion date for Network Rail's modification works, more than two years later than originally expected.

2

the number of times the Department for Transport assessed whether to continue with the project

£15 million the budget agreed between the Department for Transport and Network Rail in May 2012. Network Rail initially estimated costs of £18.7 million but thought efficiency savings were possible

£75.1 million Network Rail's anticipated final costs for the national rail modification works, as at June 2017

2.5 years the expected delay in completing the tram-train scheme. The Department originally expected the scheme would be completed by December 2015. In October 2013, Network Rail reset the project timetable following integration of its project with the tram-train vehicle procurement project. It expected to complete its works by March 2016.

1.0 the benefit–cost ratio for the programme when it was approved in May 2012. The business case was based on benefits to local transport users. The Department approved the project on the basis of the 'strategic' business case. Wider industry and economic benefits were considered 'very uncertain'

0.31 the Department's estimated benefit–cost ratio – based on the local public transport case – as at October 2016

What this investigation is about

1 The Sheffield to Rotherham tram-train scheme is intended to provide the first transport service in the UK to use both the street tramway and national rail network. The Department identified that tram-train schemes offered the potential to reduce the cost of transport services and create growth by improving access to city centres, but that such schemes could pose complex technical and delivery challenges.

2 In 2009, the Department for Transport (the Department) announced a pilot project to trial the technology in the UK and assess the potential to extend it to other cities. It wanted to test the operational issues and costs of running tram-trains from the national rail system onto the tramway, and to develop new industry standards. This was the first project of its kind in the UK and required Network Rail to test and secure industry approvals for a number of technical components, including track, signalling, and power configurations.

3 The Sheffield to Rotherham programme involves modifying the existing national rail infrastructure, modifying the tram network and depot, and purchasing vehicles capable of operating on both networks. Three main bodies are involved:

- Network Rail is responsible for the infrastructure project to modify the national rail network to allow tram-trains to run. It designed and is managing the works to modify the national rail tracks, signalling and stations.
- The Department approved the tram-train project and is responsible for overseeing the project and setting the requirements for the tram-train service. It provided part of the funding for Network Rail's works. It also provided most of the funding to purchase the tram-train vehicles and modify the tram network, via two capital grants.
- South Yorkshire Passenger Transport Executive is responsible for modifying the tram network and buying the new tram-train vehicles. It also provided part of the funding to buy the vehicles and modify the tram network.

Stagecoach Supertram, which holds the concession to operate the tram network, is preparing to introduce the new vehicles on the existing tram system and will work with Network Rail to introduce the vehicles across the whole tram-train route when it becomes available. Our report focuses on the modification of the national rail network, which the Department part-funded and Network Rail managed.

4 In May 2012, when ministers approved the programme, the Department expected Network Rail's modification of the national rail network to cost £18.7 million and the tram-train scheme to be completed by December 2015. By December 2016, the cost of these works had quadrupled to £75.1 million and Network Rail's project is now expected to be completed in May 2018. This investigation covers:

- the Department's decision to approve the project;
- cost increases on the national rail infrastructure works and the Department's decisions to continue the project; and
- plans for realising the project's aims.

This investigation does not look at the modifications to the tram network or the procurement and testing of the tram-train vehicles. These are managed by bodies which fall outside the National Audit Office's remit.

5 The report is based on documents received from the Department and Network Rail, interviews with officials and information in the public domain. Our methodology is summarised in Appendix One.

Summary

Key findings

1 The pilot project aimed to test the viability of operating tram-trains in the UK. The Department for Transport's (the Department) approval was based on the wider strategic benefits of rolling out schemes to other cities. The Department wanted to introduce a new service in the UK to reinvigorate under-used rail lines, better penetrate city centre markets and release capacity at mainline railway stations. The Department and Network Rail agreed that a pilot project was the best way to test whether the tramway technology could be extended onto national rail lines, and to develop new industry standards.¹ The project's aims were to test the costs and operational issues of the tram-train technology, and capture this information to assist promoters of similar schemes (paragraphs 1.3 to 1.6).

2 The Department accepted the project's wider financial benefits were uncertain. The business case for the proposed tram-train scheme was based on the benefits to local transport users, such as reduced journey times. The benefit–cost ratio (BCR) of 1.0 fell into the Department's 'low' value-for-money category, using its standard criteria for assessing transport projects.² The Department considered the wider benefits of the pilot, such as lower industry costs and economic benefits, to be 'very uncertain'. In May 2012, HM Treasury approved the project "on an exceptional basis" to allow a more detailed evaluation of the value-for-money of tram-train schemes (paragraphs 1.9 to 1.13).

3 The Department and Network Rail initially agreed a budget of £15 million to modify the national rail infrastructure. In May 2012, Network Rail estimated the project would cost £18.7 million but expected to make efficiency savings that would reduce costs to £15 million. The Department added the project to Network Rail's 2014–2019 rail investment programme. Network Rail was an independent body at this time and intended to fund the works within its permitted borrowing limit (paragraphs 1.14 and 1.15).

¹ The project aimed to test the viability and cost of providing a new service on national rail and tram networks. These have different track, signalling and power configurations.

² The Department categorises projects with a benefit–cost ratio of less than 1.5 as 'low' value for money.

4 On 14 November 2014, Network Rail reported that costs had increased to £44.9 million, an increase of 199% against budget. During detailed design work, Network Rail found the planned works were more complex and the condition of existing assets was worse than initially expected. In July 2012 the Department announced the national rail line would be electrified after 2019, and asked Network Rail to extend the project's scope as additional works were needed to adapt the tram-train service (at an estimated cost of £5 million)³ (paragraphs 2.5 to 2.6).

5 The Department gave approval for the project to continue in order to achieve the pilot's objectives. On 28 November 2014 the Permanent Secretary concluded the project's rationale had not changed – it was a pilot to test the issues, costs and opportunities of introducing the tram-train concept in the UK. He also recognised that cancelling the project would cause reputational damage. The Department did not recalculate the impact of cost increases on the BCR, but acknowledged that this would reduce (paragraphs 2.8 and 2.9).

6 The Department agreed to provide cash funding, capped at £45.3 million. Before September 2014, when the Office for National Statistics reclassified Network Rail as a public body, Network Rail was able to finance efficient cost increases on projects within its permitted borrowing limit. Following reclassification, the Department capped the amount Network Rail could borrow.⁴ As Network Rail had incurred cost increases on its rail investment programme, it could no longer fund the tram-train project in this way. In June 2015, the Department agreed to provide cash funding for all of Network Rail's national rail modification works in the 2014–2019 rail investment period (paragraphs 2.10 and 2.11).

7 In 2015, the Department introduced new arrangements to strengthen its governance of the project. In April 2015, a review commissioned by the Department identified concerns with the way the project was set up and governed. Some of these concerns focused on the way Network Rail had managed the design phase; for example, the lack of specialist expertise and the integration with other parts of the programme. The Department brought the project into line with its revised governance arrangements for overseeing Network Rail projects and appointed a senior responsible owner (paragraphs 2.12 and 2.13).

8 In June 2016, Network Rail reported that forecast costs had risen further, by up to £25 million (to £73.6 million): a cumulative increase of nearly 400% against the original budget. Network Rail established that the works were more complex than it anticipated at the design stage, that it had incurred additional costs in dealing with the condition of assets and the technical innovations required more time than originally expected. At the start of the project, Network Rail did not have a full understanding of the costs, and revised its forecasts as it identified the technical challenges involved in testing the technology (paragraphs 2.15 and 2.16).

³ In July 2012 the Department announced the Sheffield to Doncaster railway line would be electrified in the next rail investment period, starting in 2019. Network Rail added to the works so conversion between power supplies could be done with minimal disruption. The current status of this electrification project is unclear.

⁴ Following reclassification in September 2014, the Department agreed a capped loan facility for Network Rail to borrow directly from government.

9 In July 2016, the then Permanent Secretary recommended stopping further work on the project. The Department's Rail Investment Board, with the endorsement of the Permanent Secretary, recommended stopping the project as many of the lessons of using tram-trains in the UK had already been learned. The Board stated that this would release at least £20 million from the Department's budget but the majority of the £25 million already spent by Network Rail would be lost. The Department did not prepare or request a revised business case at this point (paragraphs 2.17 and 2.18).

10 The Rail Minister did not accept the Accounting Officer's recommendation and asked Network Rail to meet the funding shortfall. In addition to the option to cancel the project, the Board presented the Minister with three options to continue. In September 2016 the Minister gave his approval for the project to continue but without increasing the departmental funding cap. Instead, he asked Network Rail to propose alternative funding solutions. The Minister's decision was based on the need for the lessons learned from a fully completed pilot to be available for the development of further schemes. The Accounting Officer did not seek a ministerial direction. In October 2016, the Department re-calculated the BCR to provide assurance that the decision could be defended on value-for-money grounds. In line with HM Treasury guidance, it calculated the BCR of remaining works was 1.49, when treating committed expenditure as a sunk cost. It also recalculated that the BCR of the whole scheme had fallen to 0.31, in terms of the local public transport case (paragraphs 2.19 to 2.21).

11 Network Rail agreed to fund the remainder of the project. It allocated £4.6 million from its renewals budget to address issues with the poor condition of existing assets. It proposed to complete the remaining construction works by re-prioritising funding from its wider enhancement programme and re-allocating approximately £21.9 million to the tram-train project. Network Rail reallocated funding that would not be spent before March 2019, the end of the funding period. The Minister endorsed the approach in March 2017 (paragraphs 2.22 and 2.23).

12 The Department and Network Rail now expect the works to cost £75.1 million, an increase of 401% on the original budget. Network Rail revised its plans in December 2016 and increased its estimate of project costs. It now expects to complete the works in May 2018, allowing the tram-train service to begin in summer 2018. As at June 2017, Network Rail had achieved a number of significant construction milestones, including installing new track, the power supply and a tram-train platform at Rotherham Parkgate. It also changed the way it is managing the project. For example, it appointed a project director, added new expertise to the project team and created a new schedule of works (paragraphs 3.2 to 3.4).

13 The Department and Network Rail have learned lessons from the pilot but it is too early to determine whether the project will realise the wider strategic benefits. The Department and Network Rail have begun to capture the operational issues involved in using tram-trains in the UK and have, for example, established new technical standards for the signalling. Network Rail has shared lessons learned with other tram-train promoters. The Department has not yet evaluated the value for money of the pilot project or the extent to which it will reduce the costs of introducing similar schemes in other cities (paragraphs 3.6 to 3.11).

Part One

The introduction of the scheme

1.1 The Sheffield to Rotherham tram-train scheme is intended to provide the first transport service in the UK that operates on both the existing street tramway and national rail network. The programme consists of modifying the national rail infrastructure and tram network, and buying new tram-train vehicles. The main bodies involved are:

- the Department for Transport (the Department), which is the project sponsor and responsible for overseeing progress;
- Network Rail, which is responsible for the project to modify the national rail network to allow the tram-trains to run; and
- South Yorkshire Passenger Transport Executive, which is responsible for modifying the tramway section and buying new vehicles.

1.2 Stagecoach Supertram, which holds the concession to operate the tram network, is preparing to introduce the new vehicles on the existing tram system and will work with Network Rail to introduce the vehicles across the whole tram-train route when it becomes available. The tram-train scheme involves interdependencies between the modification of the rail infrastructure and the design of the tram-train vehicles. Our report focuses on the project to modify of the national rail network. This part explains the origin of the scheme and its aims, the Department's rationale for approving the project and the initial funding arrangements.

The origin of the scheme

1.3 Tram-trains are multi-functional vehicles capable of operating on national rail and tram networks. Tram-trains were first introduced in Karlsruhe in 1989 before changes to the European rail safety regime, and other European cities have since designed and implemented similar schemes. The Department first expressed an interest in trialling the tram-train technology in its 2007 Rail Technical Strategy. The potential benefits include reinvigorating under-used rail lines, reducing the costs of operating less successful routes, improving access to city centres and easing congestion at city centre railway stations.

1.4 The Department and Network Rail agreed a pilot project was the best way to test whether the tramway technology could be extended onto national rail lines, and to develop new industry standards. A pilot would enable Network Rail, and the bodies involved in other parts of the scheme, to test the viability and cost of providing a new service on national rail and tram networks. Network Rail needed to test and secure industry approvals for a number of technical components, including track, signalling, and power

configurations. The proposed scheme differed to a number of European schemes as it would operate between two different rail networks. Appendix Three provides more detail on the technical challenges involved.

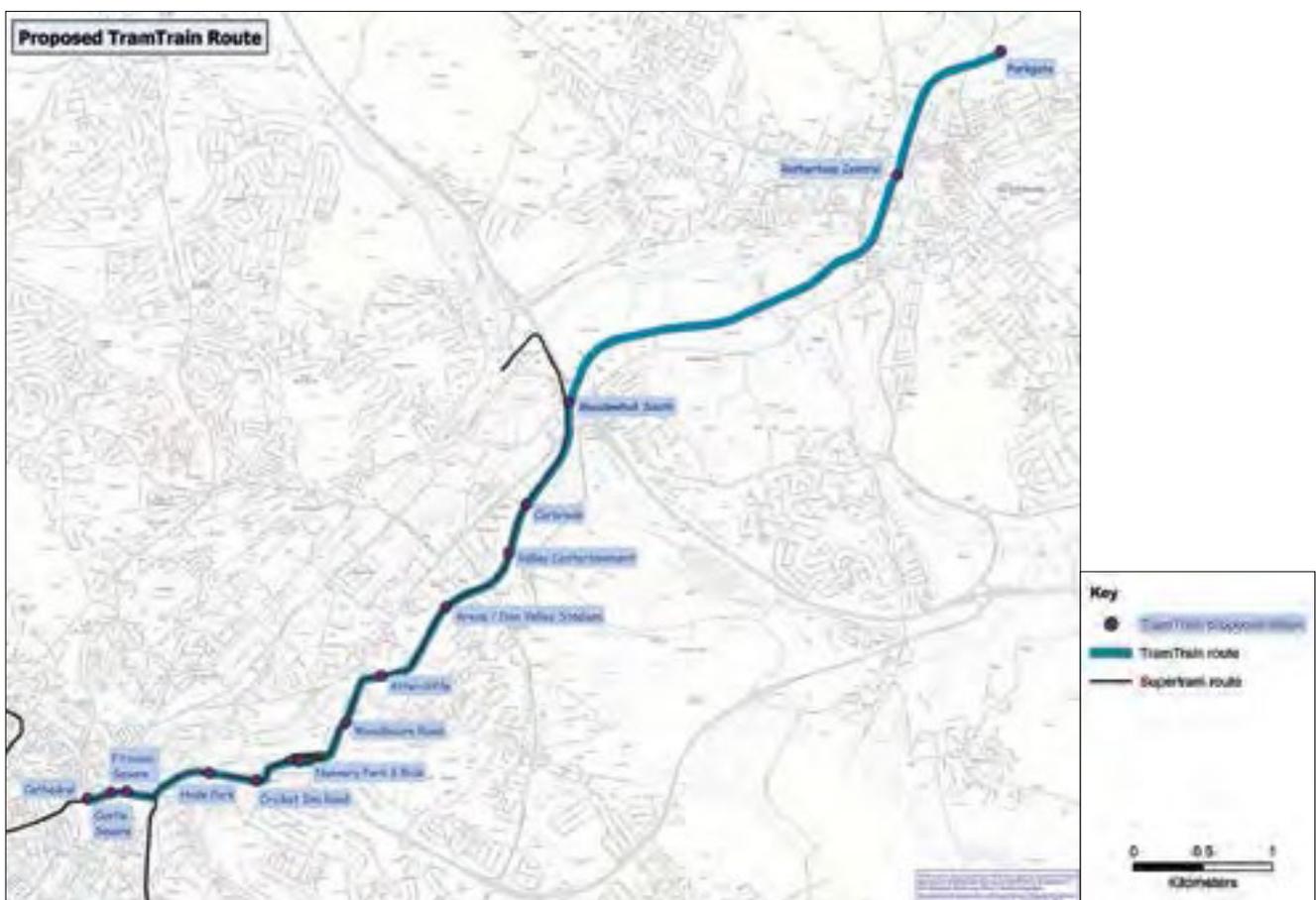
1.5 In July 2008 Network Rail assessed potential locations for the trial. It considered six existing tramways and 22 national rail routes, and recommended a phased approach to testing the technology. The Department decided not to proceed with the first phase of the project (Sheffield to Huddersfield) as, at the time, purchasing the necessary diesel-powered vehicles was not a viable option.

1.6 In September 2009, the Minister announced the Sheffield to Rotherham pilot project should go ahead (**Figure 1**). The Minister chose the Sheffield to Rotherham route as, compared with other sites, it cost less, involved less disruption to existing services and provided a good test of the interaction between tramway and franchised national rail services.

Figure 1

The Sheffield to Rotherham tram-trains route

The project will provide a new service between Sheffield and Rotherham



1.7 In March 2010 the Department and other bodies involved in the programme agreed the client requirements, which outlined the aims of the project and its specifications (**Figure 2**). They agreed the main requirements of the tram-train service, including the operational service and modifications to the national rail infrastructure, stations and new vehicles. The main project outputs included developing industry specifications and safety approvals, identifying industry costs and learning lessons to enable similar schemes to be rolled out across the UK.

1.8 The Department led a Project Board with representatives from other bodies involved (**Figure 3**). Network Rail was responsible for delivering the client requirements on the national rail network. The Board's role was to deal with issues escalated by delivery partners or interdependencies between different parts of the project. The Board has met monthly.

The Department's decision to proceed

1.9 In November 2011, South Yorkshire Passenger Transport Executive produced a business case for the whole tram-train programme, with input from the other bodies. Based on the scope of work in the business case and following some initial feasibility work, Network Rail estimated the cost of modifying the national rail network would be £18.7 million. The whole programme had a benefit–cost ratio (BCR) of 1.87 when assessed as a new local transport service between Sheffield and Rotherham.

Figure 2

The project's aims

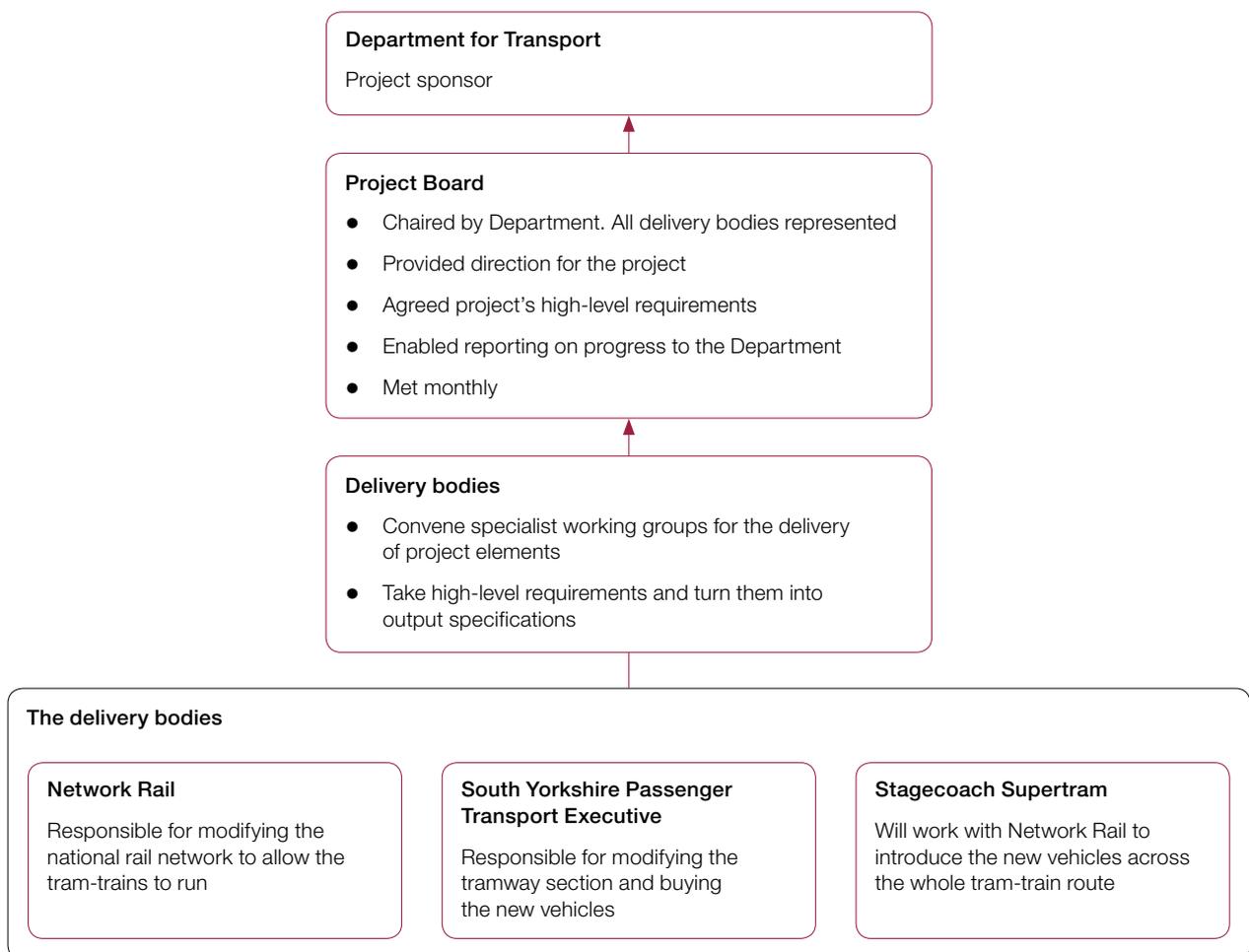
- Understand the changes to industry costs of operating tram-trains on the national rail network.
- Determine changes to the technical standards required to allow tram-trains to run.
- Gauge passenger perception and acceptance.
- Determine the practical and operational issues of extending tram-trains from the national rail system to a tramway system.
- Consider how the project would move from a trial to longer-term operation.
- Deliver the project within an agreed budget to be determined by the Department.
- Gain experience of the processes that would allow tram-train technology to be utilised in other cities.

Source: Tram-train project client requirements, March 2010

1.10 The Department assessed a range of scenarios using its standard project appraisal methodology. Its central estimate of the BCR of the tram-trains pilot project was 1.0. The Department acknowledged that – against its own criteria – the project fell into the ‘low’ value-for-money category when considered as a local public transport scheme. The pilot project aimed to test the viability of extending the tram-train technology and the Department considered the potential savings to the industry. An independent assessment conducted on behalf of South Yorkshire Passenger Transport Executive estimated the potential industry benefits at £42 million. The assessment did not use the Department’s standard methodology for calculating benefits and it considered these to be ‘very uncertain’. The Department also considered the wider potential economic benefits of extending the tram-train technology to other cities to be ‘very uncertain’.

Figure 3
Project management and governance arrangements

A project board monitored delivery of the project



1.11 In March 2012 the Department wrote to the then Parliamentary Under-Secretary of State (Norman Baker) recommending he authorise the project. It emphasised the pilot offered the potential for wider strategic benefits if rolled out to other cities and already had a high public profile. In seeking approval, the Department acknowledged:

- the uncertainty that potential benefits would be achieved, and this would not be known until after the pilot had been completed and other schemes implemented;
- while the proposal had a low BCR, it offered the potential to pilot the technology at far lower cost and risk compared with other potential sites;
- if the pilot was successful, there was scope for greater benefits in other areas; and
- the project already had a high public profile and was mentioned in the Department's public documents.

1.12 On 4 April 2012, Norman Baker wrote to HM Treasury requesting approval to proceed. He advised the project should be seen as a genuine trial rather than being evaluated as a one-off project. The rationale for the project was based on the potential for future benefits if tram-trains could be rolled out across the UK to:

- reduce the cost of the railway with new operating standards and staffing grades; and
- create growth and cut carbon emissions in cities by reinvigorating under-used urban rail routes and enabling better penetration of city centres.

1.13 HM Treasury approved the Department's request on 21 May 2012. The then Chief Secretary (Danny Alexander) approved the pilot on an exceptional basis to allow a more detailed evaluation of the value-for-money of tram-train schemes. He was concerned, however, that the Department's own analysis showed the project offered poor value for money. Following HM Treasury's approval, the Minister announced the go-ahead for the project.

The initial funding arrangement

1.14 The Department specifies the high-level outputs that Network Rail is required to deliver over a five-year planning period and the funding available. The Department added the tram-train scheme to the 2014–2019 rail investment programme. Network Rail intended to fund the works by increasing borrowing within its permitted limit.⁵

1.15 The Department and Network Rail agreed a budget of £15 million. Network Rail estimated the cost would be £18.7 million, but agreed there was scope for efficiency savings. Network Rail was responsible for managing the national rail project and delivering it within budget. It obtained the funding needed in tranches as works were completed. To obtain funding, the Department approved the delivery of project milestones and the (then) Office of the Rail Regulator monitored the work to ensure it was being carried out efficiently.

⁵ Network Rail receives funding from train operators through access charges and from the Department via network grant. At this time, it could also finance enhancements by issuing debt underwritten by government guarantee. The 'efficient' cost of enhancements (as determined by the Regulator) is added to the regulatory asset base and determines the amount of revenue Network Rail will receive each spending period. For further information, see, National Audit Office, *PAC memorandum: Planning and delivery of the 2014–2019 rail investment programme*, October 2015. Available at: www.nao.org.uk/wp-content/uploads/2015/10/Planning-and-delivery-of-the-2014-2019-rail-investment-programme1.pdf

Part Two

The cost increases during design and implementation

2.1 Network Rail's modification works encountered cost increases and delays during the design and construction phases. In this part, we set out the reasons for the cost increases and explain the Department for Transport's (the Department) decisions to continue with the project.

The project design phase, from May 2012

2.2 In May 2012, when the Rail Minister announced the project, Network Rail was working on an outline design for the works. It signed an early engagement contract with Carillion in February 2013 to help design the works. Network Rail reported to the Department that it had completed the outline design stage (GRIP 4) in September 2013.

2.3 In October 2013, Network Rail reported that the anticipated final cost had risen from £18.7 million to £31.8 million, an increase of 70%. It identified additional tasks to meet the client requirements and additional works for the anticipated electrification of the national rail section of track.⁶ Network Rail intended to fund the project by increasing its borrowing. It also reset the project timetable after the Department entered into agreement with South Yorkshire Passenger Transport Executive to purchase the tram-train vehicles. At this point, Network Rail's project was integrated with the vehicle procurement project and it revised the completion date for the modification works to March 2016.

2.4 In August 2014, Network Rail updated the 'project requirements specification', laying out in detail the infrastructure work needed to meet the client requirements. Network Rail and Carillion began negotiations on the detailed design and construction contract in November 2014.

⁶ In July 2012, the Department announced the Sheffield to Doncaster railway line would be electrified in the next rail investment period, starting in 2019. This meant the tram-train vehicles would need to be dual-voltage to be capable of running on both tram and national rail power supplies. Network Rail added to the works so that conversion between the power supplies could be done with minimal disruption.

The first decision to continue, November 2014

2.5 On 14 November 2014, Network Rail informed the Project Board that, according to its interim estimate, the anticipated final cost of the project had risen to £44.9 million, an increase of 199% on the initial budget.⁷ Network Rail pushed back the completion date for the works to October 2016. Network Rail completed a formal cost estimate in December 2014, which set the anticipated final cost of the works at £48.6 million.

2.6 Network Rail established that cost increases were due to:

- additional works to allow future conversion to standard national rail power supplies (estimated at £5 million);
- aspects of the work were more complex than initially assumed;
- the condition of existing assets was worse than Network Rail's initial assessment, and needed to be renewed as part of the project;
- changes were made to the detailed project specification, such as signalling and traction power; and
- the confirmed characteristics of the tram-train vehicles differed from the agreed vehicle design assumptions used in Network Rail's early infrastructure designs, leading to redesigns and delays.

2.7 Sheffield City Region requested the government continue to fund the tram-train project. The Cabinet Office asked for an answer by 3 December 2014, before the Devolution Deal was announced in the Autumn Statement. The Department had three weeks – from Network Rail reporting the cost increases – to decide whether to allow the project to continue.

2.8 On 25 November 2014, the Department's Rail Investment Board recommended the project should proceed with full government funding, but concluded the final decision should be referred to the Permanent Secretary. The then Permanent Secretary (Philip Rutnam) cleared the project to continue on 28 November. He concluded the project's rationale was unchanged – it was a pilot to test the issues, costs and opportunities involved in introducing the tram-train concept to the UK. The Department also recognised the strong local interest and support from the light rail sector. It noted that cancellation would cause significant reputational damage.

⁷ This consists of £41.6 million in Control Period 5 and £3.3 million from Control Period 4.

2.9 At the time, the Department did not recalculate the impact of these increases on the local public transport benefit–cost ratio (BCR), but acknowledged that this would reduce. Its retrospective calculation showed the cost increases reduced the programme’s BCR from 1.0 to 0.49.

2.10 Network Rail initially intended to meet the cost increase within its rail investment portfolio, using underspends from other projects. However, as outlined in our Committee of Public Accounts memorandum: *Planning and delivery of the 2014–2019 rail investment programme*, “... important aspects of Network Rail’s investment programme were costing more and taking longer.”⁸ Following the Office for National Statistics’ reclassification of Network Rail as a public body in September 2014, Network Rail could not increase its borrowing to fund the further increases in the costs of the tram-train project.⁹

2.11 On 9 June 2015, the Department agreed to provide cash funding for all of the modification works in the 2014–2019 rail investment period (including costs incurred back to April 2014). It capped funding at £45.3 million. Network Rail had already spent £3.3 million in the previous investment period (ending March 2014), so the Department’s funding made up the balance of the forecast costs of £48.6 million. Network Rail developed a new programme of work to complete the project within the funding limit.

2.12 Following the reclassification of Network Rail and revised funding arrangements, the Department brought the tram-trains project under the oversight of its North of England Programme Board, which reports to the Department/Network Rail Portfolio Board. The changes were consistent with the Framework Agreement, which set out how the Department and Network Rail would interact in terms of corporate governance and financial management on all rail projects.¹⁰ As part of this change, the Department also appointed a senior responsible owner.

8 National Audit Office, *PAC memorandum: Planning and delivery of the 2014–2019 rail investment programme*, October 2015. Available at: www.nao.org.uk/wp-content/uploads/2015/10/Planning-and-delivery-of-the-2014-2019-rail-investment-programme1.pdf

9 In December 2013, the Office for National Statistics announced that Network Rail would be reclassified as a public body from September 2014. This meant that its debt would appear on the government’s balance sheet. As a result, the Department and HM Treasury capped the amount Network Rail was able to borrow, meaning that Network Rail had less flexibility to absorb cost increases.

10 The Framework Agreement was effective from 1 September 2014 when Network Rail was reclassified as a public body.

Project review and the start of construction

2.13 At the Department's request, UK Tram conducted a review of the whole tram-train programme.¹¹ It reported to the Department in April 2015 with recommendations on how to improve the management of the programme. Network Rail did not see the report until summer 2016. It contested some of UK Tram's findings and criticisms, but accepted the following:

- **Project design:** the initial project specification under-estimated the complexity of the project. Change control was not well managed and contributed to additional costs.
- **Project management:** the early involvement of Carillion in the design process did not work well.
- **Specialist expertise:** the project lacked the necessary expertise and suffered from high staff turnover, which meant that complex technical issues were not sufficiently understood.
- **Poor design integration:** Design integration was not managed well, especially for the interfaces between light and heavy rail systems and technologies.
- **The funding arrangement:** this drove high-risk 'value' engineering decisions but these did not achieve expected savings when looked at in detail.

2.14 In August 2015, Network Rail signed a construction contract with Carillion to undertake the infrastructure works. It planned to begin work that month. However, to implement a cost-saving measure, Network Rail required a planning order from the Secretary of State for its redesign of the Tinsley Chord (a short section of track linking the national rail section to the tram network). This was granted on 12 November 2015 and construction works began in January 2016.

The second decision to continue, September 2016

2.15 On 4 March 2016, Network Rail informed the Project Board that the works would not be completed on time or within budget. In June 2016, it estimated the anticipated final cost had risen further by up to £25 million (bringing total costs of up to £73.6 million). This represented a cumulative increase of 391% on the original budget. It also estimated that completion would be delayed by a further 18 months to May 2018. These were indicative estimates as Network Rail was revising its programme of works and had not finalised the changes.

¹¹ UK Tram is the trade body for all British Isles light rail and other guided transport systems. As the trade body for the industry, UK Tram takes the leading role for the industry in all matters.

2.16 Network Rail established that costs increased because:

- the original cost estimate had errors due to the under-developed design;
- the design stage had to be further extended because of the complex integration of national rail and tramway technologies;
- the electrification design and safety case work was more complex than expected;
- the costs of dealing with the poor condition of assets was higher than expected; and
- the technical innovation demanded by the project's objectives needed more time and expert resources than the original estimate. Network Rail had to deviate from 12 industry infrastructure design standards to accommodate the tram-train service.

2.17 On 28 June 2016, the Rail Investment Board considered a request from the Department's senior responsible owner to provide advice to ministers on whether to recommend cancelling the project. The Rail Investment Board concluded that "under normal circumstances there was no commercial justification to provide further funding to the project". On 7 July 2016, the Board wrote to the Permanent Secretary (Philip Rutnam) with this recommendation.

2.18 The Permanent Secretary agreed with the Board's recommendation, and wrote to the Rail Minister (Paul Maynard) for a decision on 25 July 2016. The Board recommended cancelling the project because many of the lessons about using tram-train vehicles in the UK had been learned and cancellation would release at least £20 million from the Department's budget. However, it did note that cancellation would mean the majority of the £25 million already spent by Network Rail would be lost and there would be "significant stakeholder and media criticism".

2.19 The Board presented the Minister with other options:

- continuing the project without providing further departmental funding. Network Rail would be responsible for covering the funding gap;
- continuing the project with additional departmental funding to cover the cost increase; and
- re-tendering the heavy rail infrastructure works, either taking the work away from Network Rail and Carillion or asking Network Rail to re-tender.

2.20 The Minister did not accept the Board's recommendation to cancel the project. He asked for the project to proceed but noted that Department had no further capital available beyond the funding cap set in 2015. The decision was based on potential wider interest from other cities and, locally, on providing improvements in connectivity in South Yorkshire. According to the Rail Investment Board, the decision reflected "the strong desire of the Minister to see the lessons learned from this pilot available for the development of further tram-train schemes with greater potential elsewhere in the country – such as Cardiff Valleys, Glasgow Airport and Manchester". On 14 September 2016, the Minister wrote to Network Rail confirming the pilot should continue and inviting it to consider funding options.

2.21 The Accounting Officer did not request a formal direction from the Minister as, in the Department's view, there remained a strong strategic business case for the project. The Department also conducted further analysis of the BCR to allay value-for-money concerns. On 27 October 2016, in line with HM Treasury guidance, it calculated the BCR of remaining works was 1.49 when treating committed expenditure as a sunk cost. It also recalculated the BCR of the overall programme had fallen to 0.31, in terms of the local public transport case.

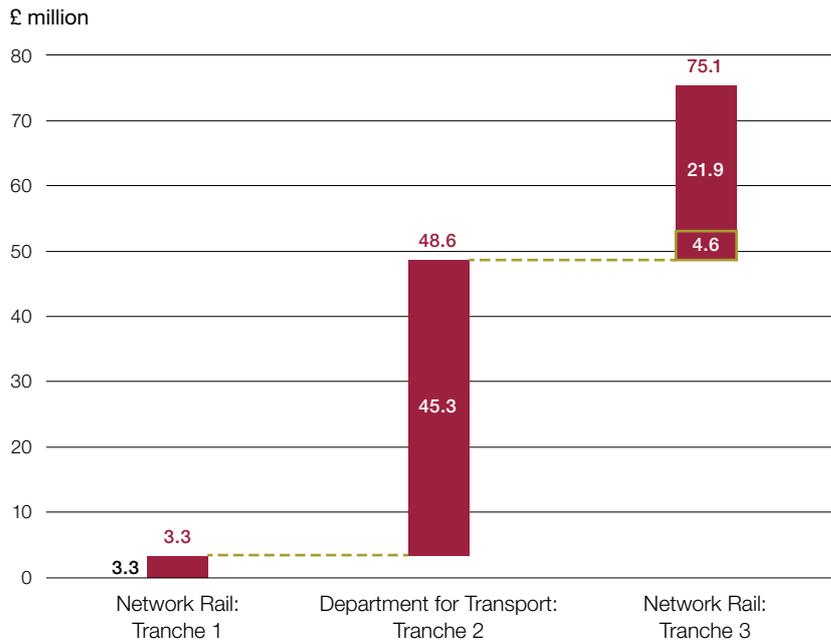
2.22 In November 2016, Network Rail proposed to fund the remainder of the project. It allocated £4.6 million from its renewals budget to address issues with the poor condition of existing assets. It proposed to complete the remaining construction works by re-prioritising funding from its wider enhancement programme and re-allocating approximately £21.9 million to the tram-train project (**Figure 4**). Network Rail reallocated funding that would not be spent before March 2019, the end of the funding period. The Rail Investment Board noted that, if this approach were approved, the transferred funding would need to be "re-balanced in Control Period 6".

2.23 The Department-Network Rail Portfolio Board approved this approach on 8 December 2016. The Department's Rail Investment Board and Permanent Secretary gave approval in January 2017. The Minister wrote to Network Rail on 30 March 2017 endorsing its proposed approach.

Figure 4

How Network Rail’s modification works were funded

The Department and Network Rail provided funding for the project



Notes

- 1 Tranche 1: At the start of the project, Network Rail funded the work through its usual mechanisms which included borrowing within its permitted limits.
- 2 Tranche 2: In May 2015 the Department agreed to fund all project costs in Control Period 5 – so Network Rail would be funded for all costs incurred on the project since 1 April 2014.
- 3 Tranche 3: Network Rail allocated £4.6 million from its renewals budget to address the poorer-than-expected condition of existing assets. It reallocated a further £21.9 million from its wider enhancements programme.
- 4 Figures in red show the cumulative total funding at each stage. Figures in standard text show the additional funding provided at each stage.

Source: National Audit Office analysis of Department for Transport papers

Part Three

Plans for completing the project

3.1 This part sets out the current position on the project and explains how the Department for Transport (the Department) and Network Rail are evaluating and disseminating the lessons learned from the project to modify the national rail network.

The position as at June 2017

3.2 Network Rail completed its revised schedule of works and costed plan in December 2016. It estimated final costs would be £75.1 million and the project will be completed in May 2018, allowing tram-train services to begin in summer 2018. This will also require the other elements of the tram-train programme to be completed within this timescale. These include vehicle acceptance and completion of the compatibility assessment to operate on the national rail system, driver training and operational readiness.

3.3 As at June 2017, Network Rail had achieved a number of significant construction milestones on the national rail network, including:

- installing new track, points and crossings (including the Tinsley Chord);
- installing more than 85% of equipment for overhead electrification;
- installing a new power supply for the signalling system; and
- completing the new tram-train platform at Rotherham Parkgate.

As at June 2017, Network Rail had completed 19 construction milestones and had 6 milestones remaining before May 2018, such as completing the electrification system.

3.4 Network Rail has also made changes to the way it is managing the project, by:

- appointing a dedicated project director and establishing action plans to manage construction works and escalate any potential issues;
- adding to the project team by recruiting engineering and technical specialists to manage the technical innovation and product approvals; and
- interacting more with other parts of the project to improve integration – using nominated contacts, agreed instructions and joint risk assessments.

In addition, Network Rail is implementing an ‘Enhancement Improvements Programme’ to strengthen its cost estimation, monitoring arrangements and governance across all of its projects.

3.5 The delays to the introduction of the tram-train scheme have led to additional costs for the Department. Stagecoach Supertram, which holds the concession to operate the tram network, claimed prolongation costs and loss of revenue from the Department because of the delays to starting the service. In May 2017, the Department and Stagecoach Supertram settled the claim for £2.5 million.

Learning the lessons from the pilot

3.6 The Department approved the scheme to test the viability of rolling out tram-train services in the UK. It aimed to test the costs and operational issues of the tram-train technology, and to gather and publish information to assist promoters of similar schemes. The project's aims have remained unchanged throughout its life.

3.7 In October 2013, the Project Board identified a series of tests to measure progress towards achieving the project's aims. The Board has established a suite of test and measurement specifications, which define the evidence to be gathered and related milestones. The Project Board also set up a sub-group to manage the 'lessons learned' process.

3.8 As at June 2017, in line with the project's aims, Network Rail had:

- developed the signalling design required for the tramway-railway interface – made available to industry bidders for the Wales & Border Franchise competition in March 2017; and
- identified the practical and operational issues involved in extending tram-trains from the national rail system to a tramway system – National Rail produced a series of documents between January 2014 and July 2015 assessing the whole-system safety risks of introducing new tram-train services.

3.9 Network Rail has liaised with tram-train promoters to share lessons learned. For example, it has been contracted to provide advice and support to the Glasgow Airport Access Project, and has held discussions with the West Yorkshire Combined Authority, the Welsh Assembly and Transport for Greater Manchester. It has also participated in industry events, coordinating with UK Tram. Some bodies have reported these arrangements are working well, and others would like a more structured approach to sharing the learning. The Project Board is seeking to address this by exploring an option to develop an online 'library' to provide third parties with direct access to data.

3.10 Network Rail is working with the other programme delivery bodies to continue to identify the lessons from the project. They plan to monitor the technical issues arising from the use of the technology for two years after the start of passenger service. Network Rail has committed to preparing an 'Industry Learning Report' by 2021.

3.11 When the scheme was approved in May 2012, the Department's financial assessment was based on the benefits to local transport users. It accepted the wider strategic benefits, in terms of lower industry costs and economic impacts, were 'very uncertain'. HM Treasury's approval was provided on an 'exceptional basis' to allow a more detailed evaluation of the value for money of tram-train schemes to be carried out. Other cities have shown interest in the technology and Glasgow City Region has prepared an outline business case for a tram-train-scheme, which references liaison with the Sheffield to Rotherham scheme on technical issues. The Department has not yet evaluated the value for money of the pilot project or the extent to which it will reduce the costs of introducing similar schemes in other cities. It plans to monitor the benefits realised from the project over coming years as local authorities assess whether to introduce equivalent schemes.

Appendix One

Our investigative approach

Scope

1 We conducted an investigation into how the Department for Transport (the Department) directed the Sheffield to Rotherham tram-train pilot project. We focused on how the Department approved the project and how, for Network Rail's element of the project, costs increased and funding arrangements changed. We investigated why ministers continued to support the project. The report considered:

- the Department's decision to approve the project;
- cost increases on the national rail infrastructure works and Department's decisions to continue the project; and
- plans for realising the project's aims.

Methods

2 We interviewed key individuals from the Department and Network Rail and reviewed documents obtained from both bodies. The documents included:

- a** the Department's Rail Investment Board papers, which explain its decisions to start and continue with the project;
- b** correspondence between the Department, the Rail Minister and HM Treasury covering key decisions to proceed;
- c** project documents – including Network Rail progress updates, project requirements, funding agreements between parties and cost schedules; and
- d** Network Rail documents explaining its processes for learning lessons from the project and evidence that these lessons are being shared.

We reviewed other documents relating to management and the financial status of the project at key milestones, including documents explaining the changing funding arrangements.

We drew on our previous published material to understand the evolution of the Department's and Network Rail's funding arrangements.

Appendix Two

Project chronology

Figure 5

History of the tram-train project

July 2007	The Department expresses interest in tram-train technology in its Rail Technical Strategy
July 2008	Network Rail assesses potential locations for a pilot to trial the technology in the UK
September 2009	Ministers announce the Sheffield to Rotherham pilot project
March 2010	The Department agrees the high-level client requirements with Network Rail, Northern Rail and South Yorkshire Passenger Transport Executive (SYPTTE)
April 2011	The Department sets a budget of £15 million for Network Rail's infrastructure works
November 2011	SYPTTE (with input from the other bodies) produces the business case for the local public transport benefits of the tram-train project. The whole project has a benefit–cost ratio of 1.87
March 2012	The Department advises the then Rail Minister (Norman Baker) that he should approve the project
April 2012	The Minister writes to HM Treasury requesting approval for the project, emphasising its value as a pilot
May 2012	HM Treasury's Chief Secretary (Danny Alexander) approves the Minister's request Ministers announce the go-ahead for the project
July 2012	The Department announces that the Sheffield to Doncaster line will be electrified after 2019, affecting both the tram-train vehicle procurement and the heavy rail modifications
February 2013	Network Rail signs an early engagement contract with Carillion to progress the design work
October 2013	Network Rail informs the Tram Train Board it has completed outline design and is ready to begin detailed design work. Its cost estimate for the heavy rail modifications has risen to £31.8 million and it planned to fund this from underspends elsewhere in its enhancement portfolio
November 2014	The Department's Rail Investment Board considers an urgent request from Sheffield City Region to confirm that the government will fully fund the tram-train project as part of the devolution deal to be announced in December. Network Rail reports the cost of works has risen to £44.9 million with a completion date of October 2016. The Rail Investment Board recommends that the project proceed with government funding, which the Permanent Secretary (Philip Rutnam) endorses on 28 November

April 2015	UK Tram issues its report on the project to the Department. The Department does not share these findings with Network Rail
June 2015	As a result of Network Rail's reclassification as a public body, its proposed method of funding the national rail modifications is no longer viable. The Department confirms that it will fund the work in full, capping its contribution at £48.6 million
January 2016	Construction work begins
June 2016	Network Rail reports that costs have risen further by up to £25 million and that the completion date for the heavy rail modifications has moved back to May 2018
July 2016	Following advice from the Rail Investment Board, the Permanent Secretary recommends to the Minister that the tram-train project should be cancelled. The Board concludes that there is no commercial case for the project and that cancellation would free £20 million from the Department's budget
September 2016	The Minister (Paul Maynard) does not accept the Board's recommendation and allows the project to continue
December 2016	Network Rail reports that the anticipated final cost will be £75.1 million
March 2017	The Minister approves Network Rail's proposal (endorsed at the Portfolio Board) to meet the funding shortfall by reallocating funds from its wider enhancement programme and renewals budget

Source: National Audit Office analysis of documents provided by the Department for Transport and Network Rail

Appendix Three

The technical challenges tested in the tram-train pilot project

1 The Department for Transport (the Department) and Network Rail used the pilot to test the viability of running a new service on both street tramway and national rail networks. There are a number of technical challenges as the two transport networks have different technical standards, safety standards and working practices.

2 The main technical challenges tested in the pilot include:

- the safe operation of lightweight tram-trains when running on heavy rail and the additional signalling protection needed to safeguard them;
- signalling and operating the interface between the unregulated light rail and the fully signalled heavy rail route;
- track alterations needed to address vehicle derailment risk caused by the different wheel profiles needed to run on light and heavy network;
- traction power supply required to run on both systems;¹²
- tram-trains' ride quality – the smaller light rail bogies and lower travel on their suspension can make tram-based vehicles more susceptible to problems with heavy rail tracks that are in a worn condition;
- the need for low platforms to match those on the Sheffield tram system and the consequent potential for trespass and possible hazard from exposed running gear of heavy rail trains next to low platforms; and
- various problems relating to the different loading gauges (maximum height and width for railway vehicles) of tram-trains and normal trains.

12 The tram-trains will initially use the tram system 750v Direct Current (DC) power mode on the tram lines and national rail section of the route. In future, the currently non-electrified national rail section will be upgraded to the standard Network Rail 25kv Alternating Current (AC) power mode. The national rail section will therefore need to be capable of switching to AC running. Network Rail needed to design and gain approval for a new range of products which could work using the DC and AC power modes.

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