



National Audit Office



Crossrail – a progress update

Department for Transport, Transport for London
and Crossrail Limited

REPORT

**by the Comptroller
and Auditor General**

SESSION 2021-22

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HC 299

Key facts

£18.9bn

Crossrail Ltd's current forecast cost of completing the programme, including Network Rail costs, but excluding the new trains and depot.

£1.9bn

the forecast cost increase since we reported in May 2019

Jan 2022 to Jun 2022

Estimated range for when train services are expected to start running on the central section. This is up to 20 months later than when we last reported in May 2019

£18.8 billion

current funding package to complete the Crossrail programme

28%

nominal cost increase to build the railway from the 2010 budget of £14.8 billion

At least 3 years

than the original December 2018 opening date – current expected timing for services to start running on the central section of the Elizabeth line

May 2023

current expected date for full services to run on the Elizabeth line

Three

out of 10 new stations built as part of the programme transferred to the maintainer and ready for operational use, as at the end of May 2021

500,000

Crossrail Ltd's estimate of the number of individual assets needed for the Elizabeth line, such as platform screen doors

200,000

Crossrail Ltd's estimate of the number of assurance documents that must be produced in order to demonstrate the central section can operate safely

£1.37:£1

the sponsors' most recent estimate of the transport benefit-cost ratio in March 2020. This increases to £1.88 when wider economic benefits are included

Summary

The Crossrail programme

1 Crossrail is a complex major programme to run new, direct rail services between Reading and Heathrow Airport at the western ends of the railway, to Shenfield in Essex and Abbey Wood in south-east London at the eastern ends. When complete, the railway will be around 73 miles (118 kilometres) long, stopping at 41 stations, including 10 new stations and 26 miles (42 kilometres) of new tunnels. Once Crossrail is open, it will become part of Transport for London's (TfL's) underground and overground rail network and be known as the Elizabeth line.

2 We last reported on the programme in May 2019.¹ We found that there were ways in which Crossrail Ltd, the body responsible for delivering the programme, had been managing the programme that drove unnecessary cost. In particular, Crossrail Ltd had no realistic plan to complete the programme and had chosen a contractual model that made it more complex to deliver. Even when the programme repeatedly missed milestones, the previous Crossrail Ltd management continued to believe it was possible to meet the December 2018 opening date. It compressed the schedule and changed its contractual model resulting in a loss of pressure to control costs. We concluded that the government needed to complete the programme and that Crossrail Ltd needed support and time to develop and deliver revised plans to completion.

3 When we last reported the funding package stood at £17.6 billion and the forecast cost was £17 billion, with the central section due to open between October 2020 and March 2021.² The current funding package agreed in December 2020 is £18.8 billion. This followed announcements in November 2019 and August 2020 that Crossrail required more funding and that the opening date would be delayed. Crossrail Ltd now expects services to run through the central section between January and June 2022. This is 10 to 20 months later than planned when we last reported, and up to three and a half years later than originally planned. Full Elizabeth line services are currently expected to run from May 2023.

¹ Comptroller and Auditor General, *Completing Crossrail*, Session 2017-2019, HC 2106, National Audit Office, 3 May 2019.

² The funding package for Crossrail, and the forecast costs, exclude the cost of procuring new trains and maintenance depot, which TfL funded and has cost around £1.1 billion.

4 The Department for Transport (the Department) and TfL are jointly sponsoring the Crossrail programme (the sponsors). Crossrail Ltd is responsible for delivering the programme. Mass Transit Railway (MTR), a transport operating company based in Hong Kong, will run rail services as MTR Elizabeth line (MTREL) on behalf of Rail for London (RfL), which is responsible for operating the Elizabeth line. Rail for London Infrastructure (RfLi), London Underground and Network Rail, will be responsible for maintaining the different parts of the Elizabeth line. Crossrail Ltd, RfL, RfLi and London Underground are all part of TfL.

5 In late 2018, in response to the significant cost increase and schedule delay, the sponsors appointed a new Chair and Chief Executive of Crossrail Ltd and strengthened their oversight of the programme. Our February 2019 memorandum sets out the governance arrangements at that time.³ In October 2020, the sponsors revised the governance arrangements to streamline decision-making and give TfL greater responsibility for overseeing completion, in line with its role as the long-term operator. TfL's Transport Commissioner is now ultimately accountable for completing Crossrail and delivering the high-level objectives. TfL created new decision-making and oversight boards. Crossrail Ltd is now a management unit within TfL. The Department's role is now principally as the funder of the programme, but it continues to have a role in monitoring and oversight of the programme. It also has a role in approving some changes to the programme, including any that affect the anticipated benefits, and is responsible for work delivered by Network Rail and ensuring integration with other operator services on the wider rail network. We consider it appropriate for sponsors to amend governance arrangements to reflect the stage of the programme.

Scope and purpose of this report

6 This report examines:

- progress on the programme, and the underlying reasons for the cost and schedule increases that have occurred since we last reported.
- the main risks that the sponsors and the Crossrail team must manage to open the Elizabeth line successfully. Our report focuses on opening the central section between Abbey Wood and Paddington.
- what needs to be done to realise benefits from the investment in Crossrail.

7 This report makes recommendations for Crossrail Ltd and the sponsors as the programme nears completion. Appendix Four builds on the learning we set out in our *Lessons learned from major programmes* report, particularly around resetting programmes which have run into difficulty.

³ Comptroller and Auditor General, *A memorandum on the Crossrail programme*, Session 2017-19, HC 1924, National Audit Office, 28 February 2019.

8 This report is not a detailed assessment of the entire programme. It focuses on the most important issues the programme faces to complete the central section and to open the full Elizabeth line. Therefore, we do not examine in detail cost increases and delays on the Network Rail elements of the programme.

9 This report is based on our review of Crossrail Ltd and sponsor documents, assessments by external reviewers and interviews with key figures involved in the delivery and oversight of the programme. The majority of our fieldwork was conducted between November 2020 and April 2021 and was done remotely due to the national lockdowns and social distancing rules in response to the COVID-19 pandemic.

Key findings

10 While the programme has been delayed further since we last reported, significant progress has been made since 2019. The majority of major construction work is complete. Crossrail Ltd is now transferring assets, such as stations, to RfLi and London Underground who, along with Network Rail, will maintain and operate different parts of the railway. MTREL has been running services on the eastern and western ends of the line using new Elizabeth line trains (under the brand name ‘TfL Rail’) since June 2017 and May 2018, respectively and Network Rail has improved accessibility at seven stations.⁴ On 10 May 2021, Crossrail started the first stage of operational testing, known as trial running. It will gradually run up to 12 trains an hour through the tunnels, testing trains, systems and signalling. Crossrail Ltd plans for the second stage of operational testing, trial operations, to begin in autumn 2021 at the earliest. This stage tests how the trains and stations operate in real-world conditions. Once this stage is complete, the railway will be ready to begin services (paragraphs 1.16 and 1.17, and Figure 2).

Reasons for the schedule slipping and cost increasing

11 The revised schedule and budget agreed between Crossrail Ltd and the sponsors in April 2019 was unachievable because the programme was further from being complete than they understood. The new management team hired in November 2018 had to start largely from scratch when setting a revised plan to complete the programme. The programme repeatedly missed milestones throughout 2019 and into 2020 because Crossrail Ltd continued to uncover problems or identify new required work. Despite contractors meeting around 30% of milestones on average throughout 2019 and early 2020, Crossrail Ltd continued to base its plans on more optimistic levels of productivity. In August 2020 Crossrail Ltd produced a revised plan and it continues to work towards the cost estimates and schedule set out in that plan (paragraphs 1.9, 2.3, 2.9 to 2.12, 2.22 and 3.19, and Figures 7, 8 and 9).

⁴ MTREL introduced new trains on the western end in stages between May 2018 and July 2020.

12 The COVID-19 pandemic added further cost and delay, but Crossrail Ltd took the opportunity to improve its planning of remaining work. Crossrail Ltd estimated it paused construction activity for nine weeks from 24 March 2020, following the announcement of the first national lockdown. It estimates that £228 million (15%) of the £1,510 million increase in Crossrail Ltd's costs since April 2019 is a direct result of social distancing and other COVID-19 factors. In response to the delays caused by the pandemic, and the measures required to make its sites and workspaces safe, Crossrail Ltd worked closely with its contractors to plan and re-sequence remaining work, including using dedicated periods of 24-hour a day construction, known as blockades. In August 2020, Crossrail Ltd reported around 2,000 people on work sites, less than 50% of the pre-COVID-19 complement. Contractors met around 90% of milestones on average between September 2020 and April 2021, compared with pre-COVID-19 where around 30% of milestones were met (paragraphs 2.28 to 2.30).

13 Neither Crossrail Ltd, the sponsors nor the contractors appreciated how complex it would be to bring together all of the separate systems and assets required and assure them as safe and working, or how long it would take. The Elizabeth line will be the first fully digital railway to be built and operated in the UK. Bringing it into service requires Crossrail Ltd and its contractors to complete and integrate around 500,000 physical and digital assets, such as fire safety systems or platform screen doors. They must be assured as safe and operational both individually and in combination. There must also be digital operating manuals, guidance and processes for individual elements and the railway as a whole. The work to bring the railway into service was made more complex by the high number of contracts, bespoke designs and a lack of standardisation throughout the programme, as well as needing to integrate three different signalling systems with trains (paragraphs 2.13 to 2.17).

14 Crossrail Ltd did not have sufficiently effective commercial levers with its main contractors to prevent further cost and schedule increases, despite trying a number of initiatives. When we last reported, Crossrail Ltd had begun negotiating fixed-price contracts with its existing contractors for some of the remaining work to improve certainty on costs. Crossrail Ltd needed to incentivise contractors to deliver the work in a timely and efficient manner. Fixed-price contracts can be suitable when the contractor is best placed to manage risks to cost and schedule. However, because the amount of work required kept growing, because contracts were interdependent, and because contractors missed milestones, the incentives Crossrail Ltd put in place during 2019 to encourage productivity could not prevent further cost and schedule increases. Since we last reported, the total costs of the 19 main works contracts still in place have increased by £1.3 billion. As Crossrail Ltd now has a more stable project plan, it has been able to use the plan to set a new commercial strategy, including incentives which better reflect the interdependencies between contracts (paragraphs 2.18 to 2.22, 3.25 and Figure 8).

15 It took longer than Crossrail Ltd expected to fill critical staff vacancies. In our last report, we said that to manage programme risks and contractual arrangements effectively, Crossrail Ltd needed to rebuild its capability and capacity. We also noted that it had found it hard to recruit the skills it needed. It has continued to experience difficulties recruiting certain skills. Crossrail Ltd told us this was because of the specialist nature of the skills required. Senior leadership appointments since our last report have further improved Crossrail Ltd's approach, particularly on the plan to transfer assets to RfLi and London Underground and limiting unnecessary re-work (paragraphs 2.23 to 2.27).

Bringing the Elizabeth line into service

16 Several organisations are now responsible for bringing the Elizabeth line into service, which adds complexity. As the central section approaches the start of passenger services, responsibility for completing, maintaining and operating the Elizabeth line is shared between Crossrail Ltd, London Underground, the newly created RfLi, Network Rail, RfL and MTREL. While Crossrail Ltd, London Underground, RfLi and RfL are all part of TfL, they are legally required to be separate management units with specific responsibilities. Network Rail and the Department, working with TfL, are responsible for integrating Elizabeth line services into the national rail network. We often see programmes have problems when roles and responsibilities change, and when they are shared between different bodies (paragraph 3.2 and Figure 10).

17 Crossrail Ltd has achieved a key milestone by starting trial running, but completing the remaining work during trial running and trial operations is complicated, and creates new risks to cost and schedule. On 27 March 2021 RfLi became legally responsible for the central section routeway, which allowed Crossrail Ltd to begin the trial running stage of testing. This was a significant milestone for the programme and was achieved by the target date. However, Crossrail Ltd must now plan and agree all works taking place on the routeway in advance with RfLi and contractors, rather than planning in isolation, making it more complicated to complete outstanding works. It has decided to do some non-safety-critical work alongside trial running and trial operations, and hand over stations in stages. There is a risk that so much completion work is going on in parallel that it undermines the purpose of moving to trial running. Trial running began on 10 May, and is six weeks behind the 'best case' target date, but is still within the range of dates as set out in the revised August 2020 schedule. (paragraphs 3.3 and 3.6 to 3.12).

18 The current programme cost estimate exceeds available funding. In August 2020, Crossrail Ltd confirmed a further estimated cost increase of between £800 million and £1.1 billion. In December 2020, the Department agreed £825 million of funding. As at May 2021, Crossrail Ltd's cost estimate has increased, although remains within the upper limit of the range announced in August 2020. The current cost estimate is between £30 million and £218 million above the current available funding to complete the programme, with a middle estimate of £120 million over. Crossrail Ltd expects the full line to open in May 2023, but estimates that current funding will be exhausted between July and September 2022. Crossrail Ltd and its contractors are still identifying new tasks that need to be done, which, alongside tasks taking longer than expected to complete, are increasing forecast costs. To better control costs, Crossrail Ltd, is reviewing all new work tasks, and has developed a plan to close some main works contracts sooner by contracting another supplier to complete some of the more straightforward work. It has also agreed with RfLi and London Underground that some residual work to complete the line can be done after it opens. Crossrail Ltd will transfer funding for this work. However, it is not yet clear how much it will ultimately cost, whether the funding is sufficient, or whether this work needs to be done at all. The current middle estimate of the total cost to complete the programme and deliver full east-west services, including Network rail costs, is £18.9 billion, £1.9 billion more than when we last reported (paragraphs 2.3, 3.22 to 3.27, and Figure 7).

19 There are still significant issues that could affect the cost and schedule.

Paragraphs 17 and 18 summarise the amount of work remaining and the challenges Crossrail Ltd and RfLi face to complete it. In addition, an important software update to the train signalling and control systems, which is necessary to start the next phase of operational testing, trial operations, is likely to be delayed by between three and eight weeks. Operational testing could also identify problems which can take time to be addressed. There is also work outstanding to complete and hand over stations to RfLi, which is on the critical path to opening the central section. Crossrail Ltd has put in place activities to try to address programme risks. It is currently updating its modelling of potential opening dates and forecast costs, taking into account progress and delays on the programme. It is also reviewing its staged opening plan to try to bring full opening of the Elizabeth line forwards (paragraphs 3.13, 3.14, 3.16, 3.17, 3.19 and 3.21).

Achieving value for money from the Elizabeth line

20 Changes in people’s travel patterns may affect the expected transport benefits of the Elizabeth line. When the Elizabeth line opens, there will be a railway with all the expected stations and interchanges, and train services to support the benefits set out in the business case in terms of improved capacity and connectivity in London and the South East. However, these benefits were based on predicted increases in population and travel demand set in 2011 and 2015, which may be less likely to occur, at least in the short term. Increases in passenger demand have slowed since 2015-16, and the COVID-19 pandemic may have more long-reaching impacts on travel. Opening the line and getting passengers to use it is critical to TfL’s financial planning. TfL’s January 2021 scenario planning indicated an 18% drop in demand for rail by 2031, with a potential longer-term revenue risk of around £150 million a year if demand for the Elizabeth line grows more slowly than expected (paragraphs 4.2 and 4.7 to 4.9).

21 The sponsors need to do more to plan for and deliver wider benefits from the Elizabeth line, such as supporting economic growth. The 2011 Crossrail business case set out a series of wider aims for the completed railway. These included supporting economic growth and regeneration, environmental benefits through people shifting from cars to public transport, and building an accessible railway. It also included benefits it aimed to achieve during construction, such as long-term skills development. The context within which the Elizabeth line will open is different from 2011 – the increase in flexible and remote working being one indicator of change. Economic growth and moving people from cars to the Elizabeth line will require sustained effort and vision over a long period of time. For local regeneration, local stakeholders will need to take a lead. The sponsors have identified and measured benefits achieved during construction. They have also established a series of evaluation studies to help them monitor and evaluate the impact of the line when complete. TfL has a plan for integrating the line into its transport network. We can see some London boroughs thinking about how they will make the most of the line. However, TfL does not yet have a strategy that brings the work it has done together, and a plan for how it realises and maximises all the benefits of the Elizabeth line (paragraphs 4.3 and 4.11 to 4.18).

Concluding remarks

22 Despite efforts to control costs and schedule in 2019, the programme was further from completion and more complicated than Crossrail Ltd or the sponsors understood. This, and the COVID-19 pandemic, resulted in a further forecast cost increase of £1.9 billion and 10 to 20 months of delay since we last reported. There are encouraging signs that the programme is now in a more stable position with a better understanding of the total amount of work required. However, there is still a significant volume of work to complete alongside testing trains, signalling and other assets. Completing the programme relies now on Crossrail Ltd, RfLi, MTREL, TfL, Network Rail and the Department working closely.

23 Major infrastructure projects take years to deliver, during which time there are inevitably economic and societal changes which affect the benefits case for the project. In this case, the Elizabeth line still has the potential to achieve the benefits in the latest approved business case from 2011, but TfL and the Department have not fully thought through how to realise those benefits. In light of the uncertain impact on travel patterns that were already changing before COVID-19, TfL and the Department need to consider what is required to maximise the return on the almost £19 billion cost of constructing the Elizabeth line.

Recommendations

- a TfL should identify the skills and individuals it needs to retain to complete the programme, and those it thinks it will need to retain to run the Elizabeth line effectively once in service.**
- b Crossrail Ltd should work with RfLi to set out a clear plan for handing the Elizabeth line over to RfLi.** The plan should include what work is being transferred into operational testing, what work is being deferred until the Elizabeth line is in service and who is responsible for it, and a process to monitor and report on progress of these tasks, including how much it has cost to complete the railway.
- c TfL and the Department should set out a benefits realisation strategy and plan for the Elizabeth line which they update over time.** This should:
 - set out clearly the intended benefits of the Elizabeth line, including those identified during construction and a way of identifying other benefits not originally identified in the business case.
 - bring together the work they have already done on benefits in one place.
 - set out how benefits will be monitored and measured over time.
 - identify who is responsible for delivering different benefits, and where this is another organisation, who is responsible for influencing that organisation.
 - assess the risks to achieving benefits and the steps TfL and the Department can take to mitigate them.
 - set out governance arrangements for the strategy, including how benefits management will be included in TfL's corporate management information to ensure a strong focus on benefits beyond the delivery phase of the programme.
- d The Department and TfL should examine the types of benefits realised by the Crossrail programme and Elizabeth line, and those benefits expected but not achieved, and take account of their learnings in the business cases and benefits strategies for other major transport programmes.**
- e RfLi should set out a plan to realise and monitor the benefits of running a fully digital railway.**