CROSSRAIL: THE PERFECT STORM (A)

"What we've here is in a lot of ways a perfect storm!" Andy Mitchell said bluntly at the board meeting late in 2009. Andy had been recently appointed to the post of Programme Director at Crossail Limited (CRL), the public agency in charge of delivering the £15.9bn (outturn costs) Crossrail megaproject. Crossrail's primary objective was to deliver a high-capacity railway connecting East and West London. The scheme's first major milestone had been met in August 2008, a year prior to Andy's arrival, when the U.K. parliament had passed the Crossrail Act. This Act formally committed public funding to Crossrail and allowed detailed design and construction work to commence. Crossrail had the support of two key sponsors, the Department for Transport (DfT) and Transport for London (TfL)[1], who had led the scheme through a hybrid bill process beginning in February 2005.[2] With the bill process gaining royal assent in 2008, Cross London Rail Links Ltd (CLRL) the public organisation that had for almost ten years promoted the scheme was shut down. The sponsors then formed a new organization to lead the project delivery phase, Crossrail Ltd (CRL)., and spent several months recruiting a top management team. Andy brought a wealth of experience to CRL's leadership having formerly been a director of Network Rail's £5.5bn Thameslink Programme - a major upgrade to the north-south commuter route through London. Andy's new role in Crossrail was to ensure that Crossrail was delivered on time and within budget. But only a few months into the job it was clear that the scheme was in trouble.

[1] Transport for London (TfL) was the local government body responsible for most aspects of the transport system in Greater London. Created in 2000 as part of the Greater London Authority (GLA), TfL's role was to implement the transport strategy and to manage transport services across London.

[2] The Government has traditionally used hybrid bills to obtain powers for major projects. They mean the project is government policy, and once powers are in place, it usually gets built. The principle is accepted by the hybrid bill, but individuals and bodies materially affected can lodge a petition opposing the bill or seeking its amendment. The defence comes in the form of legal debate. A Committee hears the arguments of both sides before making a recommendation to the government. Should the government choose to ignore the Committee, the bill faces a rougher ride in Parliament.

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Crossrail, after a number of false starts, had gained government support during the UK's economic boom in the early 2000's. The programme had been created under the banner of a "world-class, affordable railway". But now, in 2009 CRL's executives found themselves mired by a global financial crisis. The U.K. was approaching an election year in 2010 and much of the political rhetoric, played out through the media, focused on the size of the U.K.'s budget deficit and the dire straits of the public finances. This made large public works like Crossrail liable to become targets for the media's ire; Crossrail could ill afford to be labelled another "white elephant". The Conservative Party, the lead party in opposition, had promised a rigorous public spending review should they be elected in 2010. And, worryingly for CRL, the Conservatives had refused to give unequivocal backing to Crossrail. For Crossrail to survive, Andy and his team would have to demonstrate Crossrail was offering value for money to taxpayers.

An internal review of Crossrail, carried out by CRL's delivery partner, had projected the overall costs of the scheme to be around £18bn (outturn costs) – approximately £2bn more than had been allotted in public funding. And it seemed increasingly unlikely that CRL would be able to hand over an operating asset by the initial 2017 deadline. Andy said:

We've a mismatch of cost forecast, a schedule that obviously we're struggling with, an incoming comprehensive spending review, and a culture within the industry, and almost within the media and pub conversation, that there is no money: 'We're shutting down school programmes, we're doing this, we're doing that'.

Undoubtedly sceptics, both internal and external to the programme, expected Crossrail to fail. How could Andy help get Crossrail back on stronger footing? And how could he prompt CRL to respond to its new environment? Especially when some of CRL's employees had been working on the scheme for a decade prior to the Crossrail Act and were likely to resist attempts to change strategy.

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THE HISTORY OF CROSSRAIL

The idea of building a cross London railway had been mooted as far back as the 1940s. But with the U.K.'s economy struggling to recover from World War II, the plans for both a North-South line and an East-West line across the city were set aside. The U.K. government revisited the concept in 1974 with the publication of the London Railway Study Report. The aim of this early scheme was, at first glance, simple—build an underground tunnel across central London with a few new stations. But with an estimated outturn cost of £300m, the plan was deemed too expensive at the time, especially given that London's existing underground transport infrastructure was far from reaching its capacity limit.

Lobbyists from the rail industry sought to reignite the Crossrail debate in 1980 when the now defunct British Rail, a nationalised organization that operated the majority of railways within the U.K., published a leaflet promoting "a cross-London rail link" which would reduce commuter time across the city. But it was not until 1989 that Crossrail regained substantial momentum when, alongside two other possible transport schemes, it featured as a viable suggestion in the government's new Central London Rail Study. British Rail and London Transport (now Transport for London) developed the scheme to the point that it gained significant backing from the U.K. Government in 1990. The idea for a 9km long twin tunnel across central London between Paddington and Liverpool Street plus five new stations received strong backing from the City of London. Following this, in 1991, the government submitted a private bill to Parliament which estimated the costs of the scheme to be around £1bn with a completion date in 2008. The private bill was needed to grant key legal powers to the organisation delivering the scheme; most notably to compulsory purchase the land required for the route.

Though the bill received considerable support at the time, the U.K. was once more hit by an economic downturn. This resulted in a significant drop in the

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number of rail passengers, the collapse of the London commercial property market, and the bankruptcy of Olympia and York Canary Wharf Ltd – the owner of London's new business district. In 1994 with this austere backdrop the Bill failed to pass through parliament. And an attempt to push through the plans under the guise of the existing 1992 Transport and Works Act failed. In 1996, a year before the next election, the Government formally withdrew its support for the scheme. But the failed attempts (estimated to cost around £144m) left hope for Crossrail's supporters - the land required for the scheme's alignment under central London would now be protected by legal safeguarding. This meant that any new developments that interacted with the potential route of Crossrail would have to be negotiated with representatives of the Crossrail scheme.

In 1997, a newly elected Labour government came to power and, during its first four-year term, efforts were again made by lobbyists[3] to rally support for Crossrail under a 100% private finance scheme. By this point the Crossrail scheme was projected to cost around £2.1bn in 1997 prices (including rolling stock) and would produce an annual return of 15% for investors. But with other major rail works running concurrently in the city – including a problematic extension of the existing underground Jubilee line through Canary Wharf to Stratford Station that was £144bn over budget – Crossrail did not gain traction with Government representatives. Despite this the Corporation of London, representing local businesses, continued to lobby on behalf of Crossrail. And by 2000, with another election year approaching, the Government invited the Shadow Strategic Rail Authority (sSRA), a public body tasked with developing a strategy for rail, to undertake a study of passenger capacity in London. The output was the "London East-West Study" which recommended two new underground services. One, an underground line running across London from Paddington to Liverpool Street (the genesis of the future Crossrail) [**Exhibit 1**]

[3] For example, the City Corporation of London, Canary Wharf Group, BAA Ltd (owner of Heathrow airport), LondonFirst, London Chamber of Commerce, trade union UCATT, Railway forum

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And a second running southwest between the London Boroughs of Hackney and Chelsea which could be developed after opening Crossrail, referred to by some as "Crossrail 2". For Crossrail, sSRA estimated the programme would take between 10 and 11 years to complete; this would include time for feasibility and definition studies, obtaining powers by way of a hybrid bill, and 5 years for construction. With an opening date of around 2011, high level estimates pointed to a total cost of £2-4.5bn (2000 prices, capital and rolling stock) [**Exhibit 2**].

In 2000 the governance of the city of London was restructured through the creation of a mayoral post. The new Mayor would have significant executive powers to influence London's infrastructure development through a new body called the Greater London Authority. Simultaneously a new organization, Transport for London (TfL), was created (replacing London Transport) with a remit to manage the city of London's transport network. TfL was to be part of the new Greater London Authority and as such would report to the Mayor of London. One of TfL's first initiatives was to form a 50-50 joint venture with the central government's Strategic Rail Authority to further study Crossrail. This joint venture named Cross London Rail Links Ltd (CLRL) had an initial budget of £154m and 45 core staff with which to undertake a feasibility study of alternative routes, engage with stakeholders, as well as further project definition work. The feasibility study conducted by CLRL and its network of consultants [4] estimated that an intra-city Crossrail would cost around £3bn plus. Soon after the scheme was denounced by London's business leaders who claimed that the plans were inadequate as they did not extend Crossrail to London's critical new financial district at Canary Wharf or to London's main airport - Heathrow.

The public denouncement seemed to have the right effect, as shortly afterwards the government's Transport Minister stated that Crossrail should be extended. As the Transport Minister who had backed Crossrail in the early nineties said in

[4] For example, Maunsell, Gibb, Mott MacDonald, Parsons Brinckerhoff and Booz Allen Hamilton.

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2002: "'We cannot simply submit the same application that failed last time; it's got to be a lot more than a central London tunnel".[5] This led to difficult issues around the ownership of Crossrail. If Crossrail was not going to be just a simple extension to London's underground system but rather a major high-capacity train system partly running on Network Rail's network, should Crossrail still be wholly owned by TfL? And who should operate Crossrail? As TfL and DfT debated the issues, consensus started to surface that Crossrail should extend to Maidenhead and Heathrow on the West and, on the East, to Abbey Wood via Canary Wharf (Isle of Dogs) and to the soon to be redeveloped area of Stratford which was the focal point of London's bid to host the Olympic Games in 2012 [**Exhibit 3**]. The increasing scope of Crossrail – by now a 165km railway linking East and West London to carry 40,000 passengers per hour with 24 trains running in central London – was of course accompanied by a large increase in costs. In early 2002 the costs were estimated to be somewhere between £4.5 and £7bn in report by consultant Halcrow for the City of London Corporation. And by late 2002, the estimated costs had risen to £10.3bn (2002 prices) including a £3bn contingency. This increase ruled out using private finance, and led to conflicting views over how to fund the scheme. The most likely option for a finance package seemed to be a mixture of Treasury funding, TfL underwritten bank loans, increased rates on London private businesses[6], and private finance.

While the U.K's Transport Minister voiced central government's support for Crossrail, he cautiously ordered another study to review the scheme's deliverability and financing. Amid cost escalation problems with the delivery of Eurotunnel, the UK Treasury in particular had become nervous about committing to a project that could turn into a black hole funded by the tax-

[5] NCE (2002). Longer Crossrail route looks for public funding. New Civil Engineering. 14 March

[6] Crossrail was expected to bring 120,000 commuters a day, and meet the huge demand from big business for a direct link from London's financial hubs in the West End, the City, and Canary Wharf to Heathrow.

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payer.[7] By mid 2004 the review of the £154M government-funded study carried out by CLRL was finished and the route had been pin down to run from Maidenhead to Abbey Wood, with spurs to Heathrow and Stratford. Ongoing value engineering struggled to bring down the estimated cost. For example, the original design was based on 8-car trains, each 23m-long with provision for future extension to 12 cars, whereas the new design planned services based on 10-car trains, each 20m long.[8] On balance, the impact to cost was negligible. What had begun as a 9km central underground railway had evolved into a 118km east-west rail across greater London with over ground services, 16km of tunnels, and eight underground stations. This was an expensive undertaking which raised concerns with numerous stakeholders that needed to be mitigated in order to garner political support for the project. Still, CLRL thought, rather optimistically, that the £9-10bn scheme could get Royal Assent by the end of 2006 if the Government accelerated the introduction of the Bill to Parliament. But the government, DfT and Treasury in particular, remained sceptical of the cost estimates and wary of committing to the scheme. Doug Oakervee, who was appointed executive chairman of CLRL in 2005 to break the impasse, said:

'There was a great reluctance for government departments to talk to Treasury. They just don't trust Treasury, and they are frightened to tell them the truth. And of course that has the downside of Treasury often relying on speculation and rumour rather than fact and knowledge.'

Much of the Crossrail scheme outside of central London would focus on renovating existing stations and tracks which were managed by Network Rail, the railway infrastructure owner. Agreeing the extent Network Rail should be involved in financing and delivering Crossrail was not trivial. Likewise, London Underground was concerned with the disruption costs to their operations. Many of London's local Councils wanted noise mitigation measures in place to reduce

[7] When a government initiates a hybrid bill process, it is assumed funding has been resolved which means the government cannot go ahead without first acquiring support from the Treasury.
[8] The platforms would still be designed with a total length of 240m to allow for future lengthening of trains to 12 cars (Berryman, K. 2004, Lengths to suit on Crossrail. New Civil Engineering, Sept 04).

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blight on property. And interfaces with utilities added yet more uncertainty into the scheme. Though some supporters had hoped that work could begin on building Crossrail by 2007, allowing the railway to open it in time for the Olympics 2012, this date was gradually pushed back as CLRL struggled to garner political support for the scheme. Under the leadership of its politically adept executive chairman, politicians started to feel confident enough that CLRL's £10bn price tag for the scheme would not edge upwards. And a funding deal started to emerge too. To complement DfT funding, the Mayor of London would raise funds through levies on businesses, council tax increases, and a bond issue. Network Rail in turn would fund the modernization of its own infrastructure, and private funders stepped forward too. In February 2005, the government finally introduced to the Parliament the Bill[9], whilst giving CLRL a further £100M for development during the parliamentary process. A House of Commons representative declared:

"Although promoted by the Secretary of State as a matter of public policy, it [Crossrail] adversely affects the private interests of certain individuals and organizations, who may therefore be entitled to have their objections considered by a select committee under a quasi-judicial procedure akin to that for private bills."[10]

Passing a hybrid bill is a challenging process as there is no limit to the number of public and private opponents that can plead their case against the bill, or request amendments, because they feel materially impacted by the bill's content. The Crossrail bill received 367 petitions to deal and rebut. Opponents were given the opportunity to alter Crossrail's plans by pointing out perceived flaws in either the design of the scheme or the plans to build it. Each petition was debated, often by barristers on behalf of their parties, in front of a specially created Select Committee of politicians. The result of this 3-year long process was an extensive 'Register of Undertakings and Assurances' which were

[9] The original plan was to start construction in 2008, but once London was awarded the 2012 Olympic games, multiple voices started expressing doubts the two megaprojects could unfold concurrently, suggesting the need to delay Crossrail completion date to at least 2015-16

[10] First Special Report of Session, House of Commons – Select Committee on the Crossrail Bill, 2006 – 07, p.5

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incorporated into the Crossrail Act, and specified a number of legal conditions that Crossrail would have to meet during its design, construction, and operation. Many of these conditions would apply across the entirety of the Crossrail programme and would add considerable overheads. For example, concerns over cyclists in London meant that Crossrail was required to ensure that every HGV driver provided by suppliers undertook training about the dangers of 'vulnerable road users' and that all HGVs were fitted with safety equipment such as sidebars and cycle detection equipment.

To handle the challenging hybrid bill process, CLRL's strategy was to delineate and assign responsibilities. The chairman, Doug Oakervee, was responsible for lobbying on behalf of the project by 'walking the back corridors' of Parliament. Doug said:

'Engineers were all sort of project-focused "oh, we're gonna build this job". You really had to get the message over to them that unless you've got the politics right and then the funding or financing right, the project wouldn't go nowhere.'

In contrast, Keith Berryman, CLRL chief executive, dealt directly with the select committee and held ultimate responsibility for the technical and commercial details of the deals being hammered out. As new scope or costly procedures were added, the two executives kept looking for top-down, innovative ways to keep the estimated costs under control reduce costs, e.g., change tunnelling strategy, or find cheaper control and signalling systems. Crossrail's bill had its first and second reading in the House of Commons in 2005 and the Crossrail Bill Committee began the petition process in January 2006, which due to the volume of petitions lasted 22 months. Although Crossrail was inching closer to gaining approval, conflict over the route continued to plague the parliamentary process. In June 2006 Crossrail's train depot, which had been located in Romford, was relocated after the Member of Parliament (MP) for the area argued that:

'The decision [to locate the depot in Romford] is ill thought-out and has not taken into consideration the negative effect the development and subsequent use of this depot will have on the quality of life of those who live in the surrounding area."

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Ultimately, CLRL reviewed its depot strategy, and scrapped the plans to build a depot at Romford after an opportunity emerged to expand a depot elsewhere. Furthermore, negotiations were on-going surrounding the scale of some of the stations including demands from the Corporation of London for a second ticket hall at Liverpool Street Station (estimated to add £23m to the project costs) against CLRL's proposal for Crossrail passengers to share Liverpool Street Tube Station. In October 2006, a row emerged after CLRL on behalf of the government refused to reconsider plans to drop a £300m station at Woolwich which CLRL insisted had never been part of the scheme. The Committee said it was 'extremely disappointed, actually amazed' with the decision which was also challenged by the MP for Woolwich & Greenwich who argued the station was vital to regenerate the area. But with the scheme perceived to be on a financial knife edge, CLRL executives refused to give ground. The chairman explained:

'We're in a unique position to do one of two things: either confirm that we are unable to undertake mega projects, on time and on budget, or dispel the myth once and for all. I'm certainly in the last camp.... If you entertain scope creep, programme and cost go out the window, and that's why you never finish a job on time or in budget ... This has to be a world-class railway, but an affordable railway.' [11]

Still, in March 2007, the government agreed with the demand to add a £186M station at Woolwich if it could be privately financed. And Berkeley Homes, a private property developer, agreed in principle to put up capital to fund the Woolwich station which would improve the value of their property development in the area. Elsewhere, other MPs were trying in vain to argue that the route should be extended further to Reading or Ebbsfleet. In turn, Kensington & Chelsea and Hammersmith & Fulham councils were lobbying for stations in west London, and other Councils demanded more noise mitigation along the route. As new deals were ironed out, pressure on the estimated costs kept increasing. By mid 2006, costs were estimated at £16bn (outturn costs), including a £5bn

11 Owen, E. (2006). Crossrail's cost crusader. New Civil engineer, 9 November

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contingency[12]; an extra £1bn would be needed for rolling stock. CLRL's chairman insisted that the project would be lost or won in planning, and insisted on freezing the scheme's scope — "the word affordability in our strap line is not there as a joke".

In December 2006, the Strategic Rail Authority, joint backer of the Crossrail scheme, was closed by the Government and much of its powers transferred to the central Department for Transport (DfT). This meant the work of passing the Crossrail's bill through parliament and agreeing funding would now be split between the TfL and DfT. This was not an easy relationship as TfL and DfT did not always agree about which party should control Crossrail's development. Martin Buck, a Treasury representative working with CLRL, explained:

'Any project that is a JV [Joint Venture]between capital and national governments is a complete bloodbath in the sense both politicians believe they've a mandate, national or city-wide, over the project. Crossrail is a bit schizophrenic as it connects to 3 parts of the national railway network, so it's both a London project and a national project, and stakeholder interests get complicated....If [local and national government] are aligned, funding tends to flow, if they are not funding is more difficult.'

By July 2007, the House of Commons Select Committee had completed its review process and there was significant pressure for Crossrail's backers to finalise a funding package before the Government's next comprehensive spending review due in October. Without a funding deal, the project could potentially be delayed a further three years. But by October 2007, a deal over the funding package was achieved and DfT and TfL published a 'Heads of Terms' document [**Exhibit 4]**. Crossrail outturn costs were fixed in £15.9bn. The CLRL chairman said:

'Crossrail would not have gone ahead unless it was affordable. ...We came to the £15.9bn after very careful analysis of process and risk design and scope and have agreed that is the sum of money that has adequate contingency and inflation built in....We won't go beyond £15.9bn.'

[12] Around 2005, after discussions with the Treasury, CLRL started to report figures in terms of estimated outturn costs (factoring in inflation and VAT) rather than 2002 prices, insisting that £16bn outturn costs were largely equivalent to the £10bn at 2002 prices

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The funding and financing package was built on four pillars – fare box revenues, government grants, direct contributions from businesses along the route, and a supplementary business rate applying to all London businesses with a rateable value over £50,000[13]. The details of the government's spending review revealed that £7.7bn of Crossrail's budget was set to be underwritten by TfL in the form of debt, most of which was to be earned back through taxes on local businesses and ticket revenues. Another £5.1bn was to be underwritten by DfT. Network Rail in turn would raise £2.3bn in debt which would be used solely to redevelop the over ground stations and tracks outside of central London. Network Rail would be a key delivery partner to Crossrail's success as they controlled the train schedule for much of the U.K. – with Crossrail now extending into the Greater London area it would be intersecting with a number of Network Rail controlled routes. In the early days of Crossrail there had been a debate as to whether CLRL should manage the design and delivery of the entirety of Crossrail's route. That would require CLRL to construct both underground and over-ground lines across the Greater London area, as well as the accompanying stations. But this was soon dismissed as the management of the over-ground routes nationwide was already a task being performed by Network Rail. Thus an agreement was made that Network Rail would take charge of all works on the existing over-ground network. London Underground, a subsidiary of TfL, in turn would manage Crossrail's interfaces with London underground facilities. This would allow CLRL to focus primarily on the new works in the critical central section which was expected to deliver 80% of Crossrail's total revenue.

A portion of Crossrail's funding would be provided by private organizations which were engaged with CLRL in preliminary talks. These included the Canary Wharf Group and Berkeley Homes. But negotiations on the exact details of the funding were ongoing. Elsewhere, the City of London Corporation, and the

[13] On this point, primary legislation was still required to allow the supplementary business rate to be levied on London firms to raise funds

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British Airport Authority (BAA), the owner of Heathrow airport, had committed £500m to the scheme. The Prime Minister Gordon Brown said [**Exhibit 5**]:

'If others are prepared to play their part, the necessary funding from the government will be provided in the forthcoming Comprehensive Spending Review....I want the project to go ahead, subject to the satisfactory conclusion of detailed negotiations for additional contributions from all the beneficiaries. The City of London in particular will need to make a significant contribution.[14]'

Worryingly for Crossrail's supporters, the drawn-out process of acquiring planning consent was risking valuable opportunities to generate value for Greater London. In 2005 construction was planned to begin a 2007 but with the hybrid bill taking years to move through Parliament this start date had been postponed. Meanwhile work was beginning on the construction of London Olympics' venues. With the need to complete the Olympic park by 2012 there were concerns about the number of megaprojects that the construction industry would be able to support simultaneously. In short there was a very real risk that, with two megaprojects seeking to procure construction works from similar supply chains, increased demand would lead to a spike in prices [**Exhibit 6]**. As Norman Haste, CLRL's chief executive put it: "*It's naive to think it will not put up construction costs*"[15]. Upon this backdrop, London's businesses with the support of the city's Mayor lobbied actively for Crossrail's construction to start as soon as Royal assent was awarded. With London's transport network being overwhelmed by a rising number of commuters, these groups feared that economic growth in London would stagnate unless the rail infrastructure was improved by 2016. Furthermore, Crossrail's development was expected to have an economic spill-over into the wider London region – increasing property prices, and spurring private developments, by bringing a further 1.5 million people within an hour of the city. A study by Voltera consultants in 2007 suggested that delays to Crossrail would cost the U.K's economy £1.5bn a year through a loss of investment.

[14] NCE (2007) £16bn Crossrail to go ahead after last minute deal. New Civil Engineer. 3 October

[15] Norman Haste speaking at the second hearing of the Crossrail Bill at the House of Commons

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In July 2008, having passed through the House of Lords, the Crossrail Bill finally gained Royal assent and became the Crossrail Act. The excitement of the CLRL and its sponsors was patent. CLRL's executive chairman, Doug Oakervee, said:

"Royal Assent is the most significant milestone in the history of Crossrail...After years of planning and discussion, we are ready to move into the delivery phase of a project that will benefit London, the south east region and the UK as a whole."

And Transport secretary Ruth Kelly added*: "Crossrail has been talked about for decades, so I am delighted that now we have secured both the funding package and parliamentary approval."*[16]

With that, the CLRL organisation morphed from being a successful project promoter into becoming a megaproject delivery agent for a £15.9bn project (outturn costs) to be completed by 2017. This estimate excluded the cost of procuring rolling stock, amidst divergences between government and TfL as to whether rolling stock should be done through private finance (the government's preferred option) or not (TfL's preferred option). To mark the beginning of this new era, CLRL was disbanded, and replaced on legal terms by Crossrail Ltd (CRL). CRL received Compulsory Purchase Powers (CPO) stemming from the Crossrail Act which allowed the organization to acquire over 13,000 titles. In November, a CRL non-executive chairman was selected and soon after in December, CRL became a wholly-owned subsidy of Transport for London. Although CRL was to be a subsidiary it was intended to act as an independent body with its own board of directors. The reasoning behind this was to protect the Crossrail scheme from further political interference. The board of directors included at four independent non-executive directors and three executive directors (programme director, chief executive, and finance director). In addition the programme's primary sponsors, the Mayor of London (via TfL) and

[16] McKenna, J. (2008). Parliament gives Crossrail all clear. New Civil Engineer, 23 July.

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the Department for Transport, each retained the right to add one further non-executive director.

In 2008, plans were in place to open Crossrail by 2017, with enabling works predicted to begin in 2009 [**Exhibit 7**]. These would be followed by station construction and tunnelling works throughout 2010-11. Crossrail's construction was set to be the largest construction project in Europe requiring a staggering 14,000 construction workers at peak on site [**Exhibit 8**]. The railway would stretch for 118km encompassing 21.5km of double-bore tunnels under London, running from Heathrow and Maidenhead in the East to Shenfield and Abbey Wood in the West. There would be eight new stations in the central section, including Paddington, Bond Street, Tottenham Court Road, Farringdon, Liverpool Street, Whitechapel, Woolwich and Canary Wharf. According to CRL projections, upon completion, Crossrail would add £30bn to the UK economy by increasing the number of commuters that could reach London's business heartland.

BUILDING THE CROSSRAIL DELIVERY ORGANIZATION

Delivering Crossrail was set to be a mammoth task even by megaproject standards. But the task was perhaps made harder by the unusual sequencing of events that unfolded in the early days of CRL's existence. CRL's senior management team, inherited from the now defunct CLRL, had a number of tasks that they attempted to run concurrently. First there were a number of private funding agreements to be confirmed. Amidst an economic downturn, progress on legislation to introduce a Supplementary Business Rate in London was slow. And hammering out the details of the deals with Canary Wharf, BAA and others was also going to take time. Second CRL's management were under pressure to begin identifying suppliers who would be able to advance Crossrail's detail design and on site construction in time to meet the programme's 2017 deadline. Third, CRL's management team needed to agree an operating strategy for Crossrail: should TfL and NR operate Crossrail? Should private finance be used

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to procure the train cars (reckoned to be a £1bn package, or more) and operate the railway? Should the railway infrastructure remain in the hands of the public sector at all? These were not easy questions. To complicate matters, there was a realisation that running CRL as a delivery organization in charge of a £15.9bn budget would require different management skills to running CLRL as a scheme promoter. Thus, Crossrail's sponsors began a recruitment drive to select a new executive team; bizarrely, this meant that CRL's interim executives were making critical project decisions while the scheme's sponsors were seeking to replace them. Eager to gain time, and even prior to the Royal assent, the sponsors had started to make decisions on the future CRL's governance and organization structure, splitting design packages, letting contracts to consultants for detailed design, and agreeing a procurement strategy for a delivery partner.

After Royal Assent, the CRL's interim executive team began by acquiring land, and establishing a Design Framework Agreement. This framework would guide the selection of consultants for the tunnels and shafts, stations, and railway systems. In December 2008, with a future chairman already selected but only taking post late in 2009, and with the recruitment process for the chief executive ongoing, CRL selected twelve consultants to become part of the design framework. The framework would run until the completion of the scheme, and firms would have to compete for packages of work as they became available. As part of the contract awarding process, CRL would monitor the framework participants to ensure that no single organization was taking on too much risk within the project.

In late 2008, three major funding deals were also finalised by CRL. The first deal, struck in November, was a £230m deal with BAA who committed to pay for the costs of building a Crossrail station at Heathrow airport. The second deal was a £400m funding package with the City of London Corporation. Whilst both the BAA and City of London Corporation ensured that Crossrail had access to vital funding, they had little impact on the overall design of the railway. In contrast a

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deal between the Canary Wharf Group and CRL was somewhat unique in that it greatly reduced CRL's control over the design and construction of the Canary Wharf Station. Originally, Crossrail's sponsors had approached the Canary Wharf Group, owners of a significant plot of the land in London's new financial district, to see if they would be willing to invest in Crossrail in exchange for a station that would vastly increase the amount of commuters to the area. This was an attractive proposition to the Canary Wharf Group as the area was expanding ahead of the pace of London's existing transport infrastructure. But as CRL began to further study the potential for a Canary Wharf station it became clear that there were some technical challenges to overcome. The key difficulty lay in the location of the station which would require tunnelling to be carried out underneath the river Thames [**Exhibit 9**]. Anticipating the difficulty in delivering the station, CRL had estimated that the works would cost up to £1bn to design and build. But with such a high cost estimate the Canary Wharf Group were reluctant to make an upfront investment.

Instead Canary Wharf Group requested Cliff Bryant, executive director of their subsidiary Canary Wharf Contractors Ltd, a 200-employee organisation, to convince Crossrail's sponsors to agree to a more cost effective plan. Cliff managed to negotiate a deal in which Canary Wharf Group would invest an initial £150m into the scheme and in return Crossrail's sponsors would invest a fixed £350m to build the station. As a condition to this, Canary Wharf Group's subcontractors would be solely responsible to manage the design and build of the station[17]. Whilst CRL's interim management hesitated to allow a contractor to take the risk of delivering a critical station at half price, the sponsors favoured the deal. With the deal agreed, Canary Wharf Station's design and construction moved out of CRL's control; Cliff Bryant insisted that there would be: "*No Crossrail people anywhere near us …it was very important to us in the negotiation of a development agreement that we were in control of the things"*

[17] The station design was still constrained by Crossrail's functional requirements, i.e. trains per hour, platform length, tunnel cross-section, etc. and construction had a fixed deadline set by CRL.

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With financial and supplier deals moving forward, CRL's interim management were keen to supplement their managerial capabilities through hiring in private sector specialists. In contrast to the single delivery partner model adopted by the Olympic Delivery Authority to deliver the Olympic park in 2006, CRL decided to hire two partner organizations for what was intended to be two distinct roles. One would be termed a 'Programme Partner' and the other a 'Project Delivery Partner' (PDP). The Programme Partner would bring programme management expertise to the megaproject. Much of the Programme Partner's role would be on the so called 'soft' aspects of managing Crossrail including stakeholder engagement and design negotiation. CRL envisaged a seamlessly integration with the Programme Partner. On the other hand, the project delivery partner would bring 'hard-nosed' project management skills into the megaproject. The PDP would remain a separate and distinct organization, tasked with managing the projects' supply chains. The CRL's interim Programme Director explained:

'The PDP will manage the design process and administer the construction contracts and as such will need a strong commercial capability. We [CRL] are giving the PDP a high degree of responsibility and accountability in design and construction.'[18]

By August 2008 shortlists for the tendering of both Programme Partner and PDP were released. Four organizations were invited to tender for the role of Programme Partner whilst five more were invited to tender for the role of PDP. In March 2009 the contracts were awarded. The £100m Programme Partner contract was awarded to the Transcend Consortium, a joint venture between Aecom (40%), CH2M Hill (40%) and the Nichols Group (20%). The PDP contract, worth £400m, was awarded to a joint venture between Bechtel (who had been CLRL's lead development partner), Halcrow, and Systra which became known as Crossrail Central. A month later, CRL announced an Enabling Works Framework Agreement. Like the Design Framework Agreement, the Enabling Works Agreement would allow CRL to tender packages of work to selected suppliers. Seventeen firms were offered the opportunity to compete for four year contracts

[18] CRL interim programme director, December 2008 in "Crossrail: Coming up with the goods", NCE, 15.12.2008

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to develop site facilities, demolition, civil structures, and utilities on Crossrail's central section. Whilst 75% of the detailed design still needed to be done, there was confidence that the project was within budget and could be completed by 2017. The interim procurement director said:

'This is the first public sector project where the decision has been taken on the outturn estimate. And that out-turn price has been produced and tested very rigorously by us, by our initial programme manager Bechtel, by the Treasury's Major Project Review Group and by TfL. ... the whole culture here is about delivering within the estimate... there will be change, but we have to ensure that when there is, it is one, completely justified and two, we match it with a saving.'[19]

In April 2009, with the framework consultants and delivery partners on board, the finance director was appointed, and the new chief executive, Rob Holden, took post. And by the Summer, Terry Morgan took finally his post as Crossrail's non-executive Chairman, and Andy Mitchell was appointed Programme Director. A key obligation for the new CRL executive board members was to ensure that CRL uphold the 'Project Development Agreement' a set of requirements set out by the Crossrail's sponsors. From the onset, the sponsors were unwilling to outrightly grant delegated authority to the CRL's board. Instead the DfT and TfL imposed a strict governance structure which required all high-level decision making to be approved by the sponsor's own board. Terry Morgan explained:

'The sponsors recognised that we needed to create governance [structure] that could represent us to the public. And at that time all of the key decisions, although we managed the process, had to be ratified by the sponsors. And we had to meet certain gateways in governance terms demonstrating that we had the confidence to manage a project like this'

Crossrail's governance structure was designed to ensure that CRL had the right "people, processes, and procedures" in place. If the CRL's directors could demonstrate competency then the sponsors would, after four formal review points spanning the early years of Crossrail's delivery, allow CRL to run almost entirely independently. Having Crossrail's sponsors holding the ultimate authority did come at a cost. Decision making was made slower as decisions

[19] December 2008 in "Crossrail: Coming up with the goods", New civil Engineer, 15.12.2008

were passed back and forth between the sponsor's board and the CRL board. Because the sponsors did not have the competences and time to understand all technical and commercial aspects of the scheme, they created a Joint Sponsor Team to manage the interface with the CRL board. And they also created a supporting body called 'Project Representative'. The Project Representative was tasked with reviewing project reports and technical designs to help inform the sponsor's decisions. The body would act as the sponsors' 'eyes and ears' within the scheme. In April 2009, a JV between Jacobs Engineering and account KPMG were appointed to the role of Project Representative for Crossrail.

In addition to the two boards, a Delivery Programme board was also created although without executive powers [**Exhibit 10**] – this would be used as a forum to allow Crossrail's many 'Industry Delivery Partners' to share information. Some of these were themselves partially funding Crossrail as was the case with the Canary Wharf Group, Network Rail, Berkeley Homes and BAA. Others, such as London Underground and the various utility providers owned assets that needed to be updated since they had direct interfaces with Crossrail.

But, unbeknown to its designers, Crossrail's delivery organization had a fatal flaw. The decision to have the PDP and Programme Partner operated by separate consortiums proved problematic. On paper the Programme Partner, Transcend, was intended to be integrated with CRL and as such would have authority over the Project Delivery Partner – Crossrail Central. This was an unusual situation for Crossrail Central, a consortium led by Bechtel, a firm many described as 'control freaks'. The arrangement was leading to heated conflicts surrounding roles and responsibilities as the Transcend's boss recognised:

'I wouldn't say we are bossing Bechtel. At the end of the day it is one team and one mission, and the challenge is to make sure everyone subscribes to because dissension or organisational disfunctionality does no-one any good....Yes, Crossrail

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Central does have exuberant characters, and it has very experienced characters. But so do we, and so does Crossrail[20].'

Ultimately the fractured working relationship left Transcend, CRL and Crossrail Central working with little integration. CRL's chairman Terry Morgan explained:

'There was an obvious sign of silo mentality and there wasn't what I would describe as a Crossrail team, there were three silos... I think with the right leadership you can make most organisational forms work, but we had dysfunctional behaviours where we were not in control.'

CROSSRAIL UNDER PRESSURE

With an entangled governance structure, and difficulties in managing the relationship between the two delivery partners, Crossrail's delivery organization was certainly having teething problems. But this didn't stop the design phase continuing apace. CRL was midway through the process of issuing compulsory purchase orders (CPOs) to acquire the need land. CPOs would allow CRL to forcibly purchase property at an estimated market rate. CRL intended to complete the acquisition of critical land in central London by December 2009.

As the project progressed, the CRL board continued to fend off lobbying for changes in scope. In response to pressure from the influential Kensington & Chelsea Council, the chief executive said "My team is tasked at [delivering to] this budget and if we can find savings to increase the scope of the project, that [adding a new station in West London] is one option[21]".

Two major developments were announced in May 2009; the first came from the government's Transport Minister who revealed that an extension to the Crossrail route to Reading had been safeguarded. Whilst no firm commitment was made to extend the route, the possibility was made more likely when DfT awarded Network Rail a grant to renovate Reading's existing station. The second major announcement in May was the commencement of construction at the

[20] Hansford, M. (2009). Jhan Schmitz.: Watching brief. New Civil Engineer. 24 Sept

[21] Barros, D. (2009). Crossrail ponders stop call. New Civil Engineer, 8 October

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Canary Wharf Station. Interestingly, the privately designed and constructed Canary Wharf Station was beginning its construction phase even before CRL had managed to tender its detail design contracts for the rest of Crossrail. These CRL-led design contracts were finally announced in phases through May 2009 and January 2010. To support the letting of these contracts two new CRL directors were appointed in June 2009; Martin Buck, who had worked with CLRL, was appointed Commercial Director and David Bennett, formerly of the Project Representative body, was appointed Implementation Director.

With an executive team finally assembled, and much of the supply chain engaged in the design with local stakeholders, Crossrail seemed to finally be heading forward after years of political uncertainty. But the newly appointed Crossrail executives had to take stock as the U.K's economy began to collapse. Andy Mitchell was all too aware that Crossrail's budget requirements had been quietly growing over. After the delivery partners gave a top-down look at the cost estimates, the costs appeared to bloat by a massive £2bn; To bring back the project cost to £15.9bn, CRL were now faced with sacrificing a large amount of their £5bn contingency whilst still in the design phase. And to keep to the 2017 target, the partners were saying CRL needed to use risk money to mitigate some concerns. Of course Andy needed to ensure games were not being played because a party had a vested interest in demonstrating it was a £17bn scheme to create a bigger window for incentives if Crossrail turned out less costly. Andy said:

'When I joined [CRL and Crossrail's boards] the forecast cost was several billion [pounds] higher than the maximum funds available. So it was fairly obvious that something needed to be done, because we didn't have an affordable project – and it wasn't even close'.

Concurrently, external pressure on the Crossrail executives was mounting; Hazel Blears Secretary of State for Communities and Local Government clashed with the Chancellor of the Exchequer and the Mayor of London over the local business tax that was to be used to generate £3.5bn in funding for Crossrail.

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Hazel Blears wanted to give businesses the right to vote on their contribution to the scheme, but her opponents feared that this would risk losing vital funding in an already difficult climate. Matters were made worse by an approaching election and the opposition parties were unwilling to publicly commit to any major projects started by the previous government. A spokesman for the opposition Conservative party said in a statement:

> *'We have clearly set out our principles: that all programmes must demonstrate value for money, and we will be seeking to get value for money in all spending.'*[22]

Still, the Mayor of London, Boris Johnson, himself a member of the Conservative Party remained stoutly in support for Crossrail telling The Times newspaper:

> *'This is one of those moments in politics when you reverse the usual rule and get in a hole - and keep on digging'*

The CRL non-executive chairman also sounded positive, when he said: '*Do I fear a Tory review of Crossrail? No. Do I have to ensure that we argue our case? Yes...The key for us is to present Crossrail as a high quality project, so that when people start looking at priorities they see that this is a project which, in terms of both necessity and quality, passes the test*[23]*'* But the budget wasn't Andy's only concern. Crossrail's schedule left little room to test and commissioning – let alone conducting value engineering to reduce costs. Andy reflected: *'[We're] making time-based decisions and not cost or value-based decisions.'* Matters weren't helped by ongoing pressure to expand the project's scope. Councillors in West London continued to lobby for a new station in their area. And as late as October 2009, the Government was extending Crossrail's safeguarding to include Gravesend in Kent. After years of planning and negotiation [**Exhibit 11**], Crossrail's designs had also acquired a lot of extra features and embellishments. There were urban realm works on the outer stations, car parks, £30m underground links between Crossrail and Tube stations, which Andy called

[22] Conservative party spokesman, "Crossrail faces review if Tories win next election", NCE, 14.05.2009

[23] Oliver, A. (2009). Terry Morgan: climbing on Board. New Civil Engineering. 24 Sep.

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'creeping elegance'. It was debatable whether many of the features offered commercial benefit. And unlike the sponsors' requirements, many of these additional features were not legally binding commitments.

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With only 8 months until the next election, how could Andy get Crossrail's budget back on track? Would it be possible to reduce the scope of Crossrail to cut costs or sacrifice part of the original contingency? Could CRL be sure that the delivery partners were not opportunistically inflating costs? Clearly, it would be impossible to remove key parts of the route or to alter the alignment of the railway. But there were parts of Crossrail's emerging designs which were not part of the functional brief given to CRL by its sponsors. Still, considering the project had taken more than 10 years in planning, descoping was going to take time. They could delay construction on a number of projects to give designers time to value engineer their proposals. But would a new government accept another setback to Crossrail's completion date? Or would Crossrail simply be made a scapegoat to show the public that the new government were serious about cutting the public spending deficit? And crucially, could CRL deal effectively with these challenges without fixing first its own internal organisational issues?

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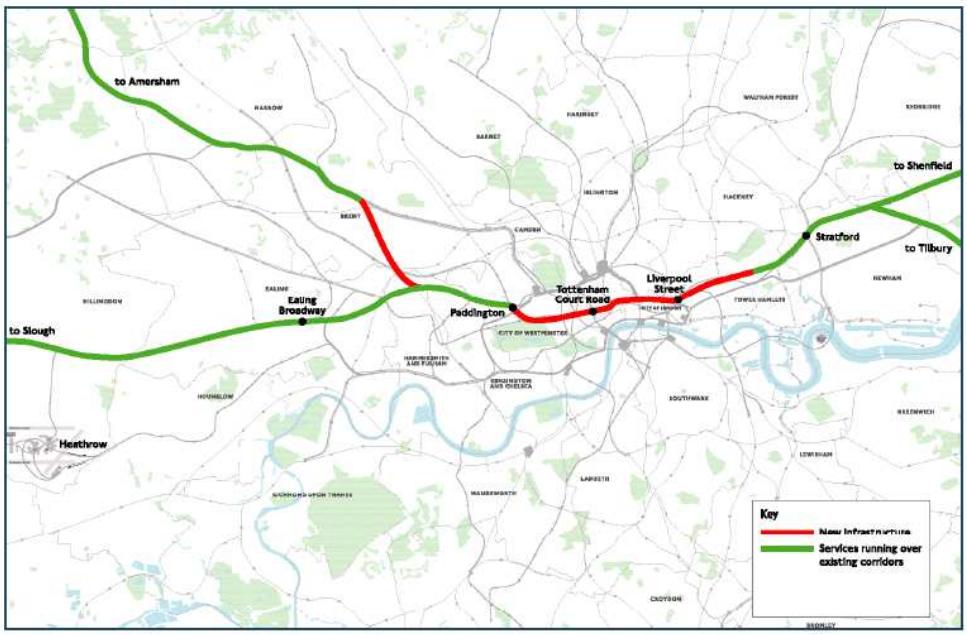
Exhibit 1 – Route options for the Paddington-Liverpool Street line (sSRA (2000). London East-West study. Shadow Strategic Rail Authority)

Option 1: Paddington to Liverpool Street – Regional Metro



Option 2: Paddington to Liverpool Street – Regional Express

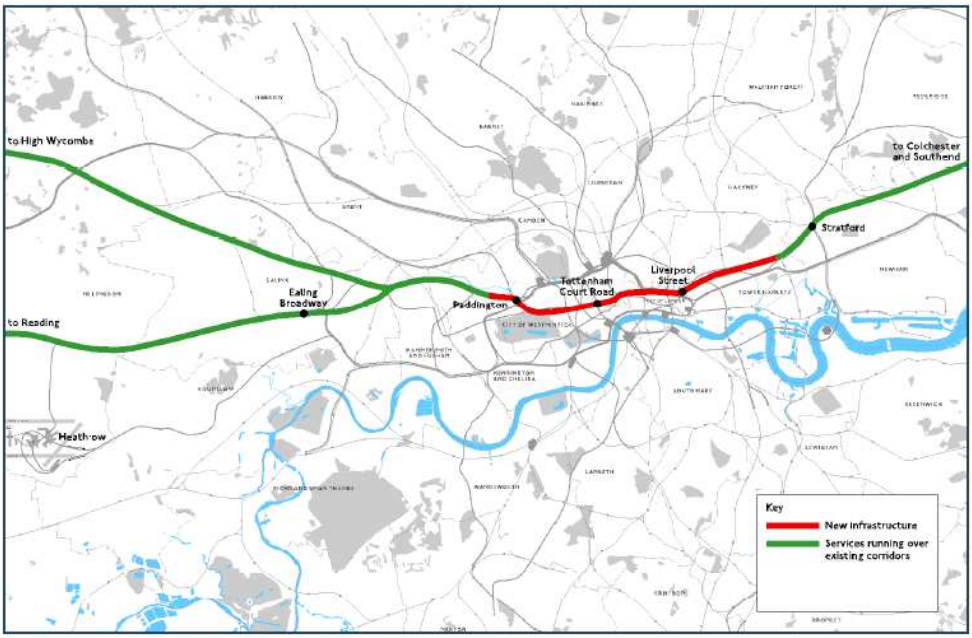


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Exhibit 2 – Route options for the Paddington-Liverpool Street line (sSRA (2000). London East-West study. Shadow Strategic Rail Authority)

Table 1 – Economic assessment (all figures are preliminary)
(All costs are in £ millions)

	Paddington-Liverpool Street		Wimbledon-Liverpool Street		Wimbledon – Hackney	
	Regional Metro	Regional Express	Regional Metro	Regional Express	Regional Metro	Regional Express
Option number	(1)	(2)	(3)	(4)	(5)	(6)
Capital Cost	£2,800	£2,300	£4,400	£4,200	£5,300	£5,300
Present value of Benefits (50 years)	£6,900	£6,800	£8,700	£8,900	£7,100	£8,200
Net Present Value (50 years)	£4,400	£4,500	£5,500	£5,300	£3,500	£4,100
Benefit Cost ratio (50 years)	3.2	3.8	2.9	2.9	2.1	2.2
Sensitivity check: 50 Year NPV if Capital Costs increase by 60%	£3,200	£3,600	£3,800	£3,800	£1,500	£2,100
50 Year NPV if there is a delay in timescales by three years	£3,800	£4,000	£4,800	£4,600	£3,000	£3,600

Notes:
The figures include the capital cost, the rolling stock costs and the operating costs.
Capital costs have been discounted at 6% per annum in calculating the NPVs.
The benefits include the direct and associated benefits and include time saving for existing users, reduced congestion on trains, revenues from generated travel, relief of road congestion and in road accidents.
The capital costs are high level estimates and as such are likely to have an accuracy of –10% to +60%
The Net Present Value is the net economic benefit (ie total benefits less total cost).
Option 1 does not include the cost of a tunnel from Old Oak to Neasden that would be required for services to Amersham. We have not included this cost in the calculations in order to allow a like-for-like comparison of the Regional Metro and the Regional Express options. The cost of the tunnel and the associated works is £600 million. A decision on the need for this and the actual services will form part of the project definition stage.
Additional notes on the assumptions and the models used for the forecasting and high level assessment are contained in Appendix 2.

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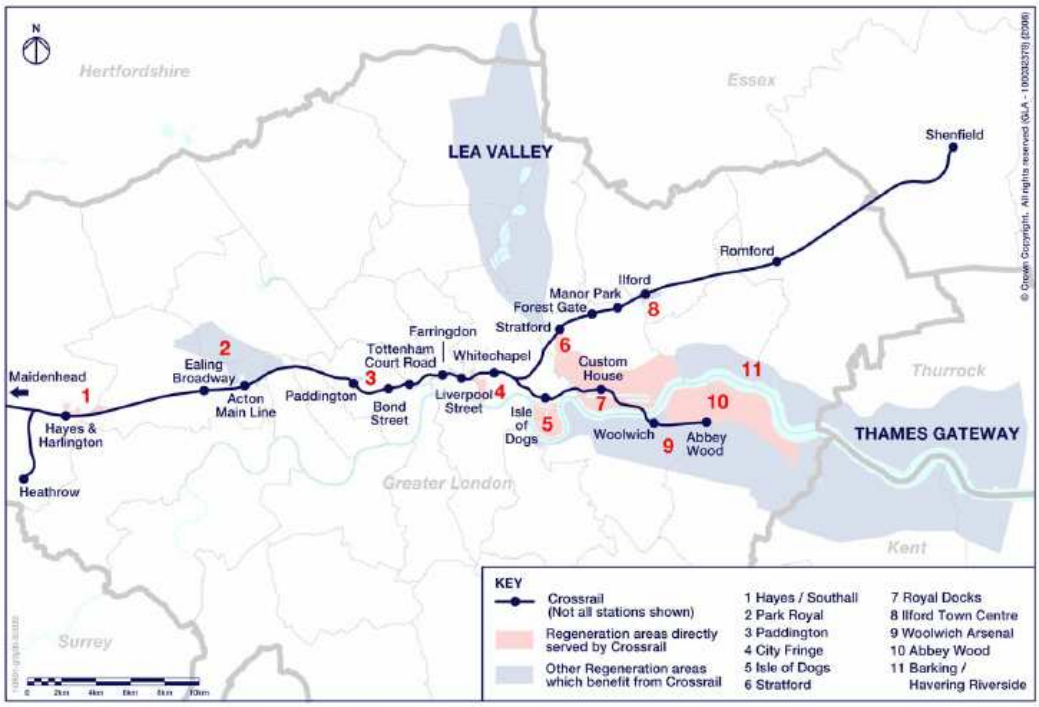
Exhibit 3 – 2002 Route for Crossrail



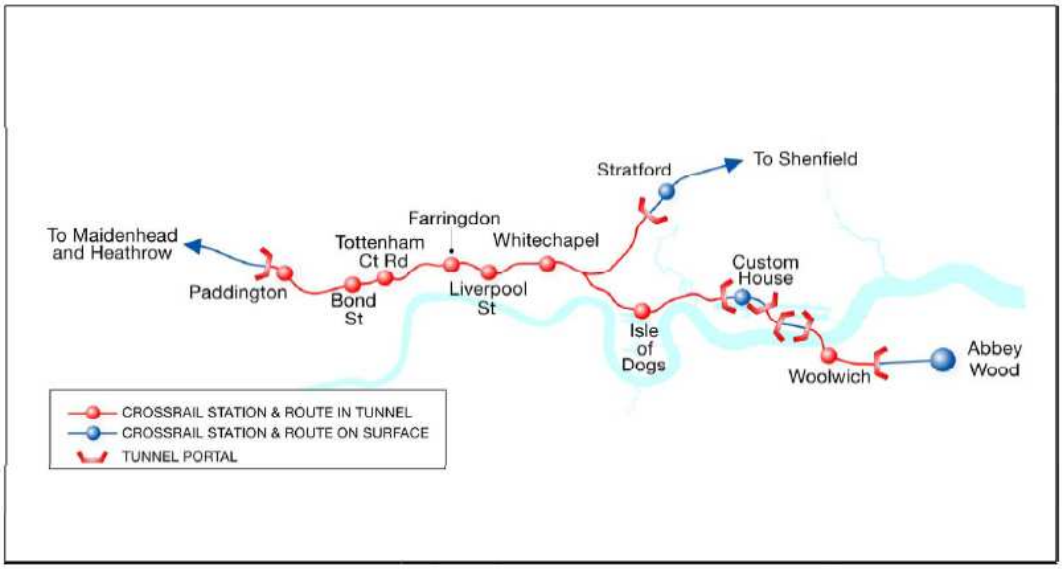


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Exhibit 4 – Funding plan (published in "Heads of Terms in relation to the Crossrail Project", November 2007, DfT Secretary of State and TfL)

Figures in GBP billion (nominal)

USES OF FUNDS:	
Estimated capital cost (including contingency)	15.9
Total Uses	**15.9**
SOURCES OF FUNDS:	
TfL underwritten	
GLA (NNDR debt)	3.5
TfL - core contribution	2.7
LU Interface savings	0.4
Sales of surplus land and property	0.5
Developer contributions	0.3
London Planning Charge	0.3
	7.7
DfT underwritten	
DfT grant contribution	5.1
BAA / City Corporation (guaranteed)	0.5
	5.6
Other (incl unguaranteed)	
Network Rail (ONW)	2.3
Depot (operating lease)	0.5
City Corporation (additional)	0.1
Less other residual costs	(0.4)
	2.5
Total Sources	**15.9**

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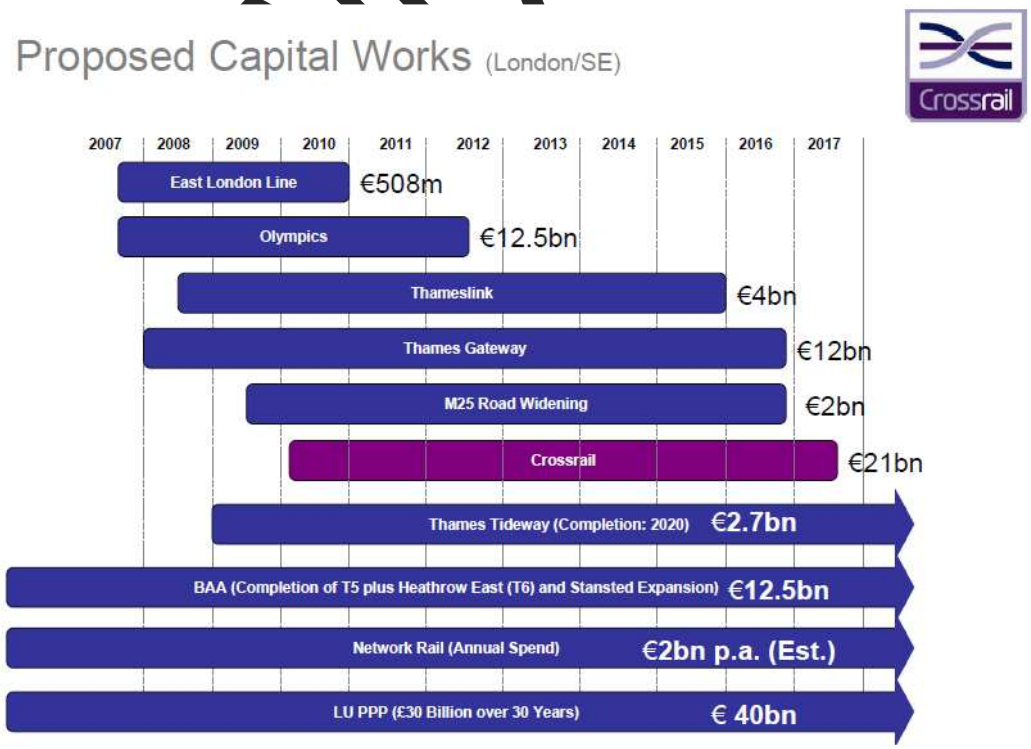
Exhibit 5 – UK Government announces that the Funding Package for Crossrail has been agreed, and the project will proceed (from left to right, Doug Oakervee, Crossrail chairman, Gordon Brown, UK prime minister, Ken Livingstone, London Mayor, and Transport Secretary, Ruth Kelly)

Exhibit 6 – Proposed Capital Works (CLRL Chairman presentation in 2008)



Professor Nuno Gil with doctoral student Colm Lundrigan prepared this case. The case does not intend to serve as endorsement or illustration of effective or ineffective handling of an administrative situation. We are grateful for the contributions of Franziska Drews and all the professionals interviewed. The authors are solely responsible for any factual inaccuracies.

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Exhibit 7 – Summary Programme as of 2008 (CLRL Chairman presentation)

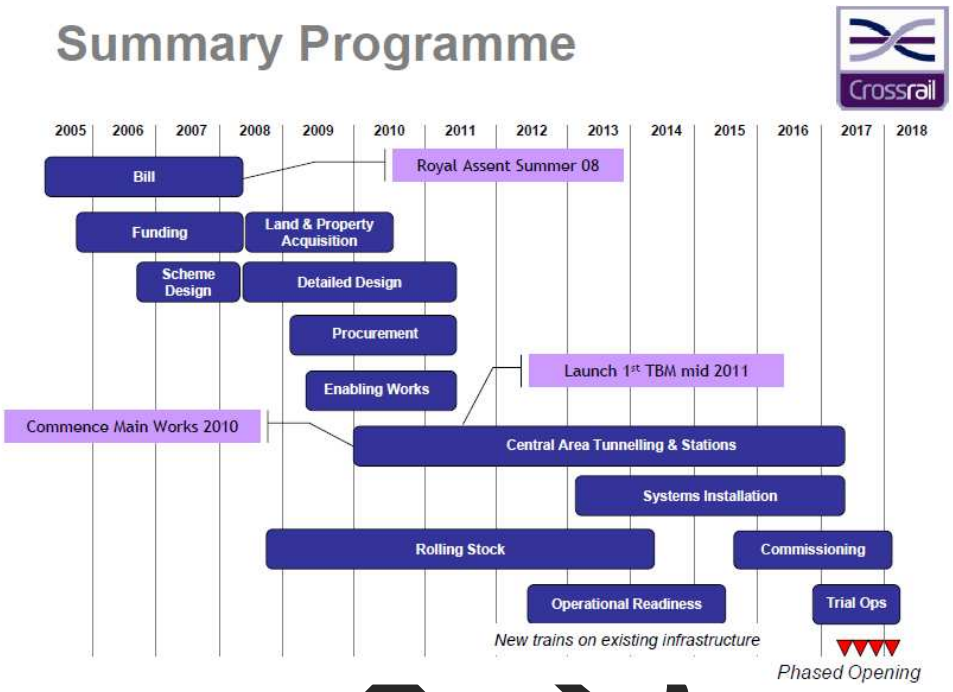

Exhibit 8 – Crossrail Estimate of Personnel Requirements (CLRL Chairman presentation)

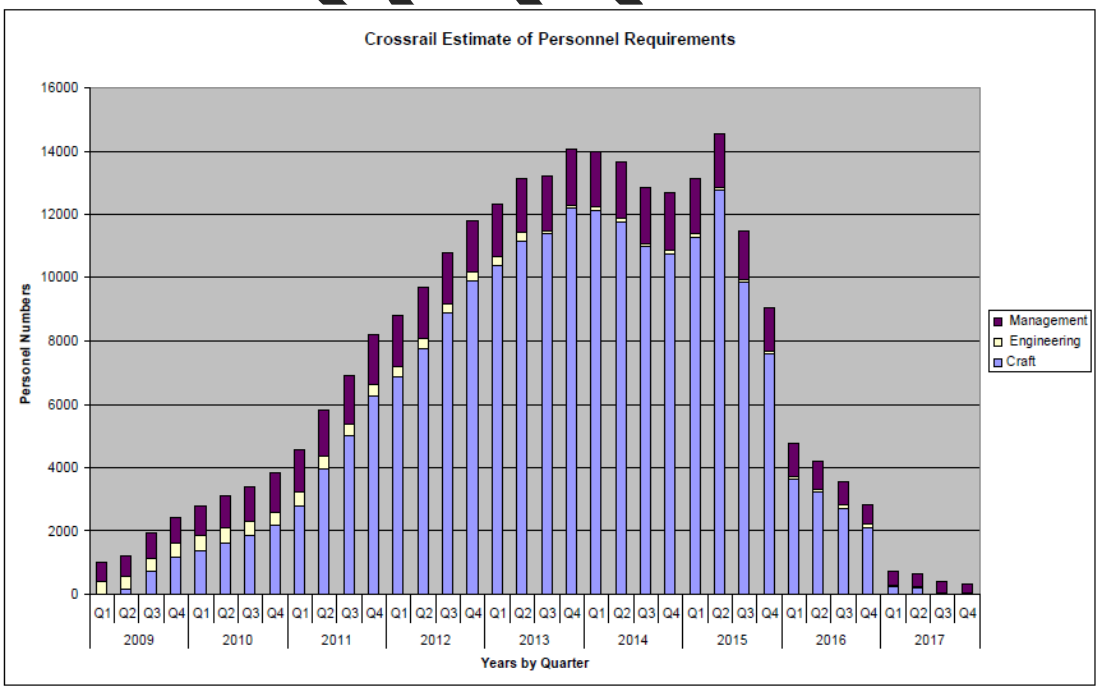

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Exhibit 9 – Canary Wharf Crossrail station (rendering from CRL)

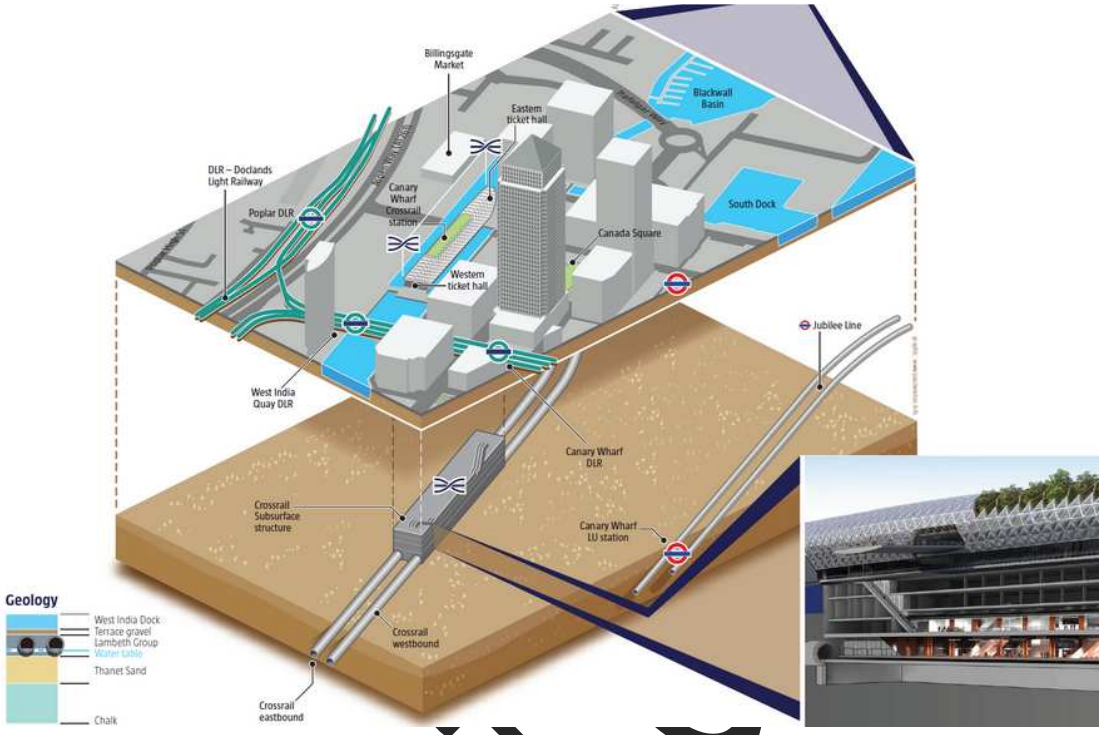

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Exhibit 10 – Crossrail's Governance Structure (2008)

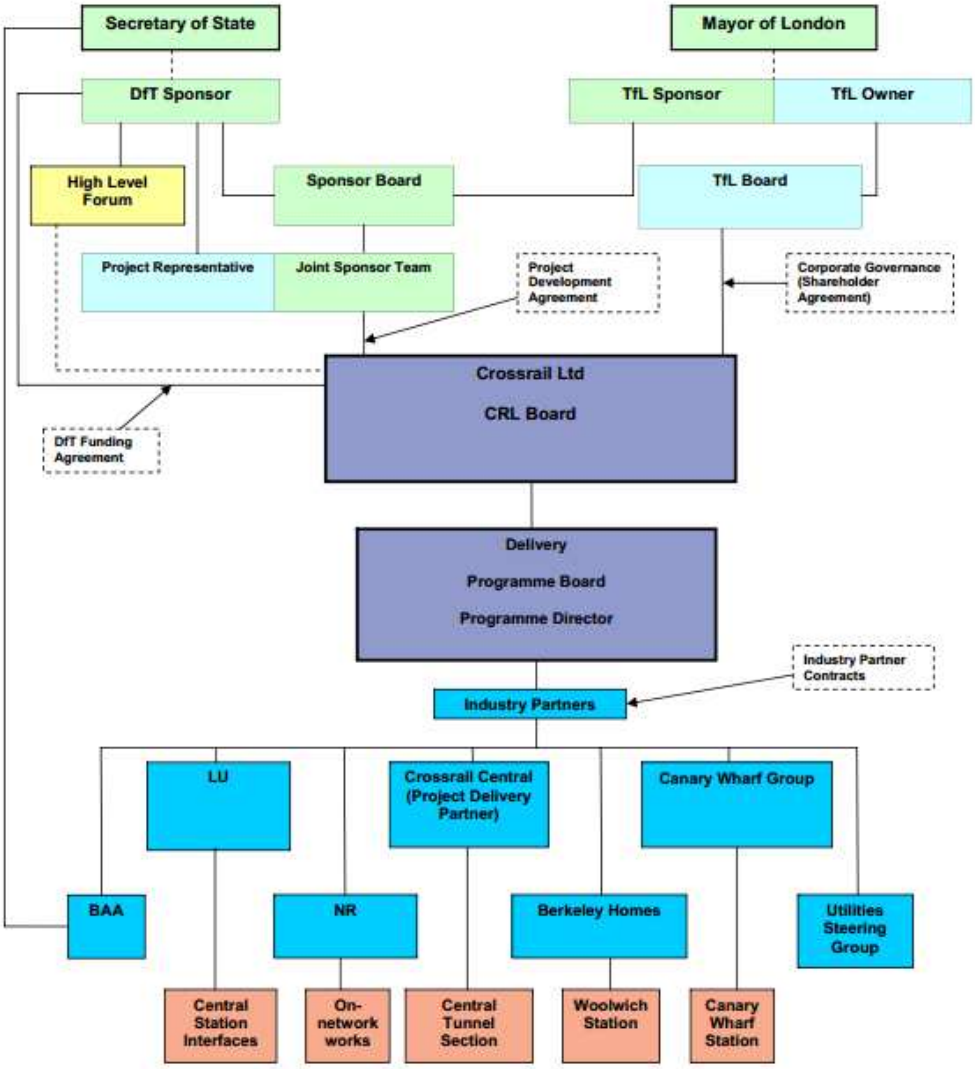

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Exhibit 11 – Timeline of Crossrail 1974 – 2009

- 1974 – London Rail Study published suggesting tunnel to connect east and west London rail lines
- 1989 – Central London Rail Study published suggesting Crossrail for first time
- 1991 – Crossrail introduced to parliament as private bill
- 1994 – Crossrail bill fails in House of Commons, route is safeguarded
- 2002 – CLRL founded and new project definition and feasibility studies launched
- 2003 – CLRL submits final business case, Secretary of Transport orders review
- 2004 – Review finds Crossrail to be viable (£9bn cost estimate)
- 2005 – Crossrail Bill introduced to House of Commons as Hybrid Bill by the Secretary of Transport (£15-16bn cost estimate)
- 2006 – House of Commons Select Committee starts hearing petitions against Crossrail
  Business and Mayor increase pressure to build Crossrail to support economic growth of London
- 2007 – House of Commons Select Committee concludes
  Plan for financing Crossrail agreed upon (£15.9bn total costs)
  Bill read in House of Lords
- 2008 – Royal Assent, Crossrail Act established
- 2009 – Contracting starts for e.g. project delivery partner (Crossrail Central), programme partner (Transcend)
  Crossrail executive and non-executive board members are selected
  Construction officially launched with start of construction in Canary Wharf

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