

◀ DELIVERY STRATEGY



TO DELIVER A WORLD-CLASS
RAILWAY THAT FAST-TRACKS
THE PROGRESS OF LONDON

MOVING LONDON FORWARD

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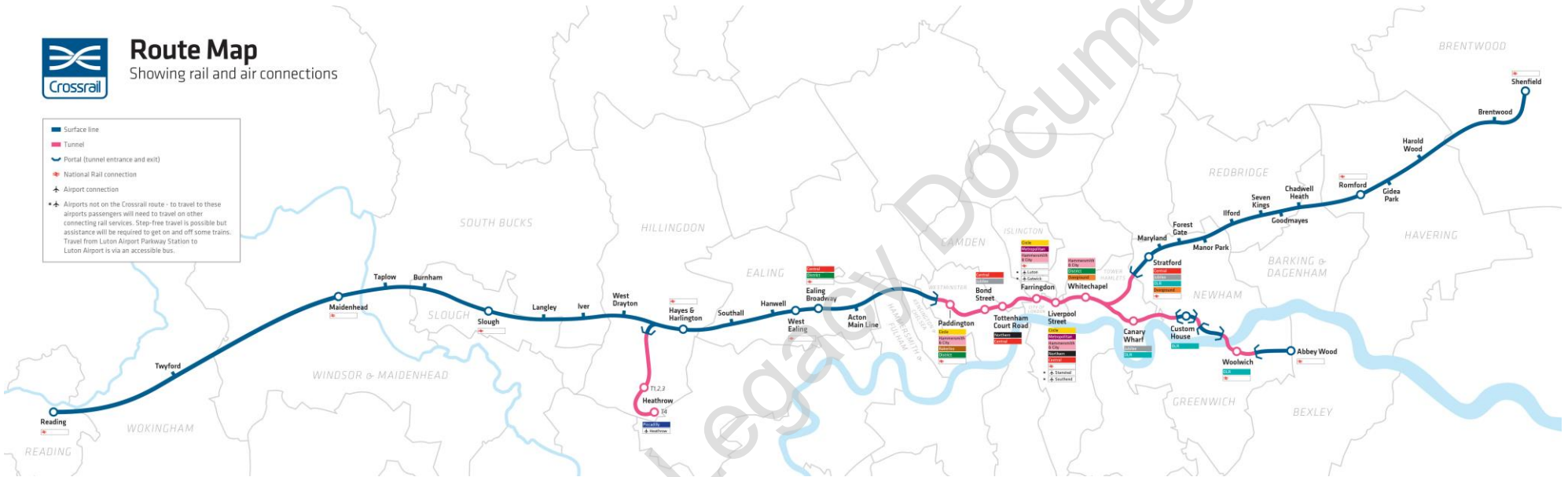
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Route Map

Showing rail and air connections

- Surface line
- Tunnel
- ⤵ Portal (tunnel entrance and exit)
- ⚡ National Rail connection
- ✈ Airport connection
- ✈ Airports not on the Crossrail route - to travel to these airports passengers will need to travel on other connecting rail services. Step-free travel is possible but assistance will be required to get on and off some trains. Travel from Luton Airport Parkway Station to Luton Airport is via an accessible bus.



March 2014

Learning Legal Document

Section 1: Introduction

Learning Legacy Document

1 Introduction

The Project Development Agreement (PDA) between Crossrail Limited (CRL) and its Sponsors (the Secretary of State and Transport for London) appoints CRL as the legal entity accountable for the management and implementation of the Crossrail Project (Crossrail).

This Delivery Strategy sets out the manner in which CRL intends to deliver Crossrail. In addition this Delivery Strategy provides the common definition of the Crossrail Project, its purpose and structure for everyone and every organisation, particularly CRL's staff and its Industry and Delivery Partners, involved in the delivery of Crossrail. It sets out Crossrail's scope, its overall objectives, what has to be achieved and the main risks to those objectives. It demonstrates that CRL has in place the organisation, strategies, controls and resources to manage Crossrail as a whole to successfully achieve Substantial Completion, Final Completion and Handover to the Operators.

The Delivery Strategy is Crossrail's primary management document which is underpinned by the Crossrail Management System (CMS) represented hierarchically in figure 1.2 below.

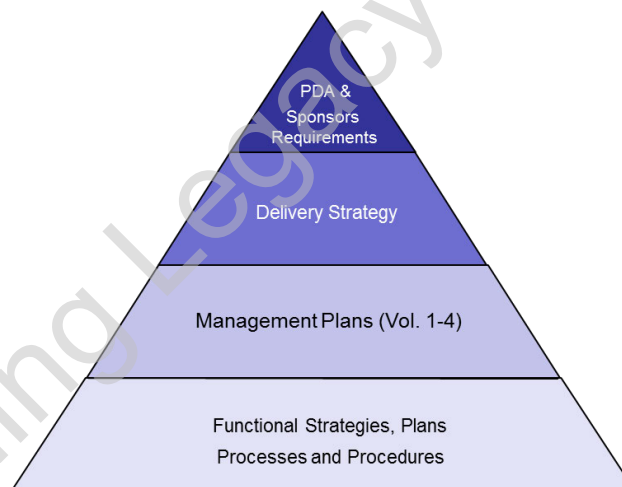


Figure 1.2 – Documentation hierarchy

The CRL Management Plans (Volumes 1 to 4) provide a description of the organisation and manner in which CRL implements its Delivery Strategy in order to meet the Sponsors Requirements for Crossrail.

The functional strategies, plans, processes, and procedures describe what is required in order to deliver the design, construction, testing, commissioning and trial operation phases of Crossrail.

The CMS is regularly reviewed to ensure it meets the needs of Crossrail. Documents referred to in this Delivery Strategy are listed in Appendix B.

Section 2: Vision, mission and objectives for Crossrail

Learning Legacy Document

2 Vision, mission and objectives for Crossrail

2.1 The vision for Crossrail

The ambition of the Government and the Mayor of London for Crossrail is to create the world-class transport infrastructure needed to support the economic growth of London and its regeneration areas, facilitate London's continued development as a World City, and sustain its position as the financial centre of Europe. The expectation of the Sponsors Requirements is that *"Crossrail will deliver a world-class, affordable railway, with a high frequency, convenient and accessible train service across the capital from 2017"*.

CRL has created a single vision statement which respects the original Sponsors Requirements statement, and embodies the ambition of the Government and the Mayor of London as stated above. CRL's vision statement for all parties involved in the delivery of Crossrail is *"Moving London forward"*.

2.2 The mission for Crossrail

The mission for Crossrail embodies the ambition that is to be shared by all those people involved in the delivery of Crossrail, and has been defined as *"To deliver a world-class railway that fast-tracks the progress of London"*

2.3 The objectives for Crossrail

The Sponsors Requirements sets out the high-level objectives for Crossrail i.e.:

1. The planning, construction, commissioning and implementation of service shall be consistent with the Government's overall approach to the provision of major transport infrastructure, and the Mayor's plans for the development of the capital's infrastructure;
2. The Project shall support the Secretary of State's plans for public transport provision, in particular in relation to the manner in which it interfaces with other existing and future transport schemes, and shall be integrated with the Mayor's transport and sustainability strategies;
3. Value for money shall be provided at every stage of the Project;
4. Robust cost control mechanisms shall be in place throughout the lifetime of the Project;
5. Subject to other requirements in these Sponsors Requirements, CRL shall ensure that the design and delivery of the Project shall be such as to achieve a service capacity of 24 TPH utilising 200m Trains in the Normal State of Operation in the Central Section at the Final Delivery Date;
6. The Project shall be developed, designed and constructed in a way that optimises whole life cost on the basis of an appraisal period of 50 years from the Target Final Delivery Date and using TfL Business Case Development Manual assumptions as to methodology and discount rates, except that such analysis in respect of On-Network Works shall be undertaken with reference to Network Rail's equivalent procedures and parameters;

7. Quality assurance, environmental assurance, safety and security regimes shall be established to be implemented during the phases of design, construction, commissioning and service operation;
8. In all circumstances the design of the Crossrail Project shall comply with all Applicable Laws and Applicable Standards including, but not limited to, those pertaining to safety, security, interoperability, the environment and provision for those with disability;
9. World-class levels of performance and reliability shall be delivered;
10. CRL shall co-ordinate the activities of parties to the Crossrail Project to deliver pro-active and consistent communications and relations with stakeholders, the media and local communities; and
11. All outputs shall be achieved for a minimum of 50 years from the Target Final Delivery Date, and allowing for increased use of the system and the requirements for maintenance and renewal of Crossrail Assets over this time period.

The statement of objectives for the Crossrail Project set out in Appendix 1 of the Sponsors Requirements is included in Appendix A.

CRL have set their corporate objectives and values which are further described in section 4.

Learning Legacy Document

Section 3: Crossrail Definition, Funding and Schedule

Learning Legacy Document

3 Crossrail Definition, Funding and Schedule

3.1 Definition of the Crossrail Project

Crossrail is one of the largest infrastructure projects in the UK and the largest single addition to the London transport network for over 50 years. The extent of Crossrail is defined in the PDA:

The **Crossrail Project** means ‘the project for the development, design, procurement, construction, commissioning, integration and completion of a railway transport system that is capable of operating services from Reading in the County of Berkshire and from Heathrow Airport in the London Borough of Hillingdon through central London to Shenfield in the County of Essex and Abbey Wood in the London Borough of Greenwich in accordance with the Sponsors Requirements’;



This definition is augmented by the obligations and requirements set out in the following documents:

- Crossrail Act 2008 and associated commitments including the Environmental Minimum Requirements and the Undertakings and Assurances;
- Crossrail Project Development Agreement and associated Sponsors Requirements;
- Crossrail Programme Functional Requirements (CRL’s detailed interpretation of the Sponsors Requirements), and;
- Industry Partner and other Agreements

This definition is broken down into sub sections which are used to describe the various component parts of the project i.e. the:

1. Crossrail Network
2. Central Operating Section
3. Central Core Area
4. On-Network Sections
5. Depot and Rolling Stock

6. Other Works

1. Crossrail Network

Crossrail Network means the railway routes, depots and stations forming part of the Crossrail Project;

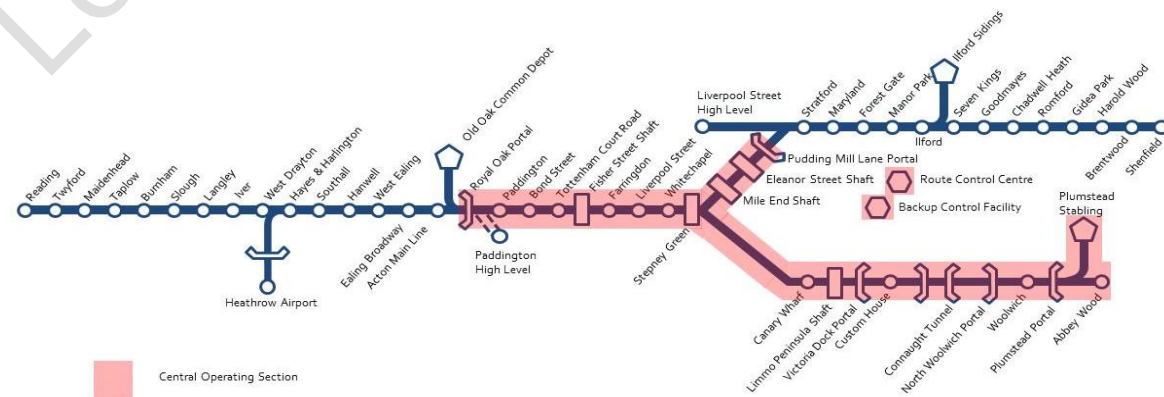


2. Central Operating Section

Central Operating Section means the part of the Crossrail Network (i) between Royal Oak (in the City of Westminster) and Pudding Mill Lane (in the London Borough of Newham) and (ii) between Royal Oak (in the City of Westminster) and Abbey Wood (in the London Borough of Greenwich), the exact parameters of which shall be determined pursuant to the Sponsors Requirements;

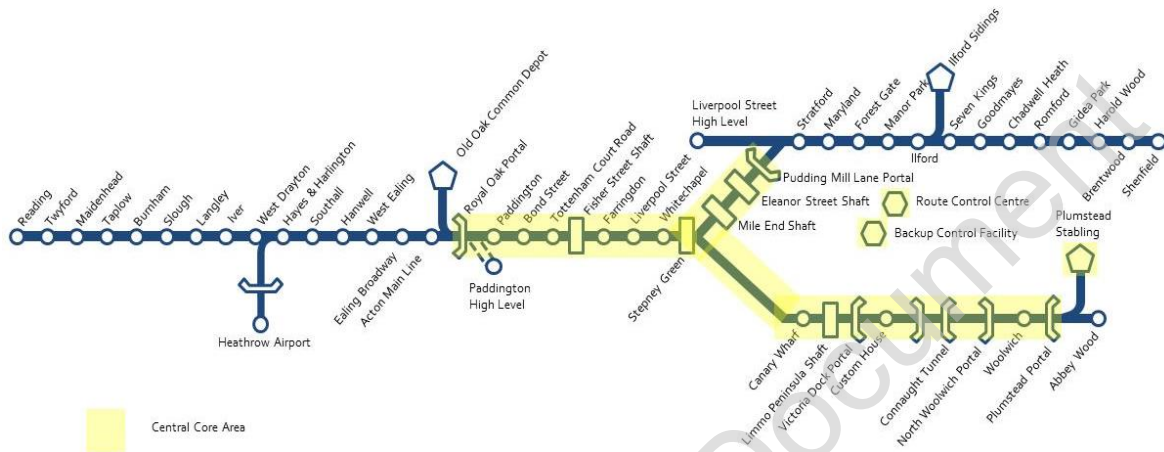
Central Operating Section Stations means:

- (a) the new sub-surface stations at Paddington, Bond Street, Tottenham Court Road, Farringdon, Liverpool Street, Whitechapel and the Isle of Dogs referred to in the Sponsors Requirements;
- (b) the existing station at Custom House that is to be upgraded and that is referred to in the Sponsors Requirements; and
- (c) if commissioned and fitted out (which it is acknowledged is outside the scope of this Agreement as at the date of this Agreement) the station at Woolwich for which the Woolwich Station Box is being constructed;



3. Central Core Area

Central Core Area means that part of the Central Operating Section between (i) Royal Oak (in the City of Westminster) and Pudding Mill Lane (in the London Borough of Newham) and (ii) Royal Oak (in the City of Westminster) and Plumstead (in the London Borough of Greenwich);



4. On Network Section

On-Network Sections means those sections of the Crossrail Project outside the Central Core Area;



All of the works on the national rail network including infrastructure modifications and enhancements, station modifications and upgrades, signalling and control and stabling.

- Crossrail Surface West - The western section on the Great Western Main Line between Reading, Heathrow and Portobello Road;
- Crossrail Surface East - The eastern section on the existing electric suburban tracks of the Great Eastern Main Line between Pudding Mill Lane Junction and Shenfield; and
- Crossrail Surface South East – between Plumstead portal and Abbey Wood, including works to the existing electric suburban tracks of the North Kent line.

5. Depot and Rolling Stock

New rolling stock fleet and depot, including stabling, maintenance facilities and accommodation.

6. Other Works

London Underground is also delivering works outside the Crossrail programme but without which Crossrail could not open with full functionality. These are congestion relief works at Bond Street and station upgrade works at Tottenham Court Road (including a new ticket office, escalators and interconnecting passageways). London Underground will fund these works outside Crossrail’s approved funding envelope and deliver them as a Nominated Undertaker under the Crossrail Act.

3.2 Approved funding

The approved funding envelope for Crossrail as at April 2016 is provided as shown below in figure 3.1:

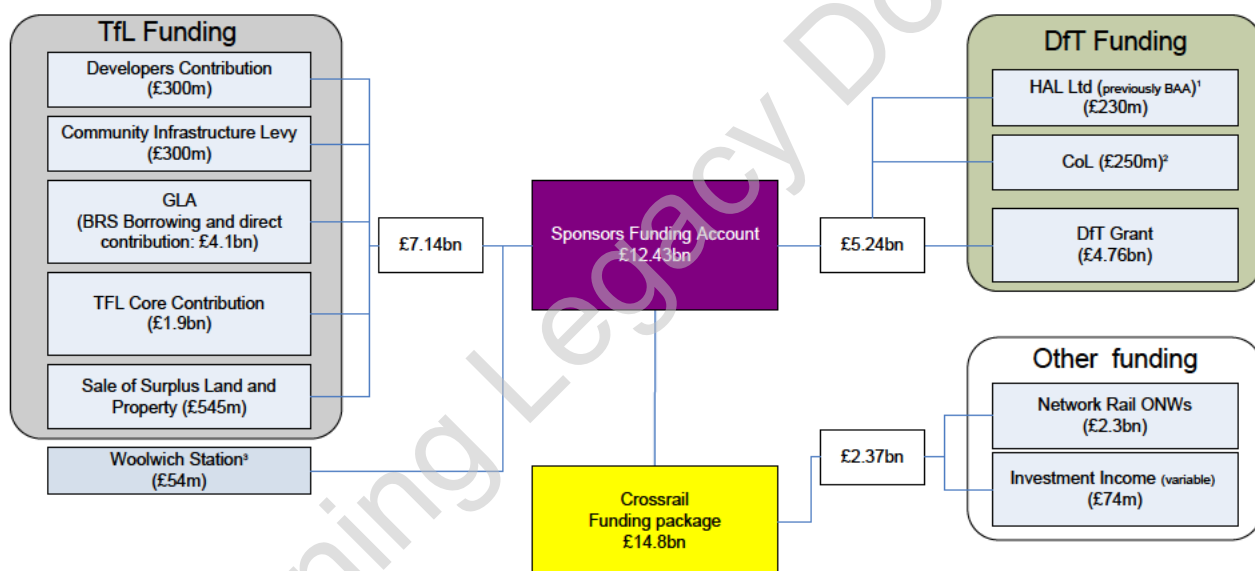


Figure 3.1 – Funding overview (April 2016)

Notes:

1. The amount the DfT originally expected Heathrow Airport Ltd to pay in 2008 (then BAA) was £230m. However, this was subject to Civil Aviation Authority (CAA) approval. In 2014 the CAA determined that HAL should contribute £70m. The DfT is responsible for any shortfall.
2. In addition to the £250m, the DfT’s agreement with the City of London originally included £100m of planned voluntary contributions from businesses. This is now unlikely to be received due to alternate funding of the CRL Arts Foundation. The DfT is not responsible for any shortfall.
3. The original scope for Crossrail did not include funding for an operational station at Woolwich. In July 2013, Berkeley Homes, the Royal Borough of Greenwich and Transport for London agreed to provide £54m towards the cost for the station.
4. Crossrail benefits from interest income on the money held in the Sponsor Funding Account. This is calculated in the Crossrail Investment Model every period, and varies depending on forecast interest rates. The figure quoted is from P13 FY2016/17.

3.3 Schedule

Crossrail services will be introduced progressively from May 2017 to December 2019. CRL has an obligation to either agree (using the Affirmation Process) each opening stage with Sponsors, or in any event provide Sponsors with 24 months notice of the date on which Crossrail Services shall start for each stage. Table 3.1 shows the affirmed assumptions for the opening of each stage, which is based on the 'Variant 2' Opening Strategy that formed part of the Review Point 4 baseline:

SR stage	CRL stage	Description	Target Date*
A	1	Liverpool Street High Level to Shenfield Progressive introduction of new Crossrail trains on existing suburban services into Liverpool Street by substitution.	May 2017
C	2	Paddington High Level to Heathrow On-Network Works between Heathrow and Paddington [†] Substantially Complete with Crossrail Services running at a frequency of 4 TPH into Paddington (high level)	May 2018
D	3	Paddington Low Level to Abbey Wood Crossrail Services running from Paddington (low level) to Custom House/Abbey Wood allowing a nominal 3 months for Trial Operations on that Part	Dec 2018
E	4	Paddington Low Level to Abbey Wood & Shenfield Through running of Crossrail Services from Paddington (low level) to Shenfield and to Custom House/Abbey Wood.	May 2019
F	5	Reading** & Heathrow to Abbey Wood & Shenfield Full Crossrail Services from Reading and Heathrow through the Central Section to Shenfield and Custom House/Abbey Wood	Dec 2019

* where possible, the date within each month shall be the date on which changes to the national rail network timetable are implemented.

[†] for the avoidance of doubt, this excludes the Westbourne Park train reversal facility and the new junction at Portobello Junction to permit access to the Central Section.

** The Crossrail railway has been extended to Reading, as per Sponsor Change Notice: CCN0017

Table 3.1 – Summary of staged opening dates for Crossrail services

The high level schedule in figure 3.2 shows the key elements of the lifecycle for Crossrail in response to the Sponsors Requirements for completion and operation. The detail of this high level schedule is produced and maintained in the Project Delivery Schedule, known internally as CRL’s Master Operational Handover Schedule (MOHS).

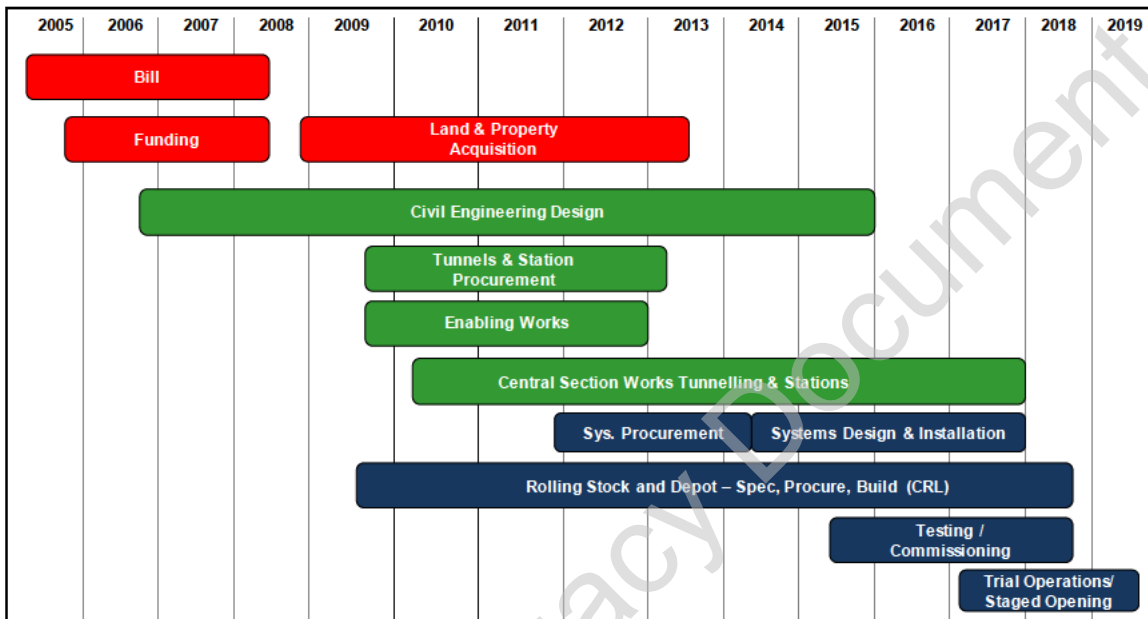


Figure 3.2 – High level schedule (Based on Crossrail Master Operational Handover Schedule Level 0, dated December 2015)

Section 4: Crossrail Project Delivery

Learning Legacy Document

4 Crossrail Project Delivery

This section sets out the adopted 'model' for the delivery of Crossrail and includes details on CRL as an organisation, the parties engaged in the delivery, how it is structured and the governance framework adopted.

4.1 Crossrail Limited

CRL has been established as a limited company with the sole purpose of managing and delivering Crossrail.

At a high level the PDA (clause 3.2) states that CRL will manage and deliver the Crossrail Project as follows:

- So as to satisfy the Sponsors Requirements;
- In accordance with the CPFR;
- In accordance with the terms of the PDA and the other Principal Project Documents to which it is a party;
- In a manner consistent with the Delivery Strategy;
- In a manner that will oblige the Operators to accept Handover of assets and systems in accordance with the Handover Strategy and Plan procedure and as referenced in PDA (clause 16.2);
- Using all reasonable endeavours to meet the Project Milestones and so that the Final Delivery Date occurs on or before the Target Final Delivery Date and, in any event, on or before the Longstop Date; and
- In accordance with any additional conditions that are imposed by the Sponsors as a result of the Project Review.

CRL's primary task is to manage the programme of interrelated projects and ensure that they are integrated to provide the operational capability required by the Sponsors. CRL is also responsible for the overall integration and assurance of systems to deliver the functions described in the CPFR.

CRL is a wholly-owned subsidiary of TfL and consequently is subject to TfL governance. However, certain controls are held by the Sponsors jointly and exercised through the Sponsor Board. Consequently CRL's governance must comply with a number of existing defined arrangements.

CRL must also comply with company law and with a range of other directives concerning the behaviour of public bodies.

The PDA stated that TfL will delegate authority to make decisions in relation to the delivery of Crossrail to CRL after the Delivery Strategy has been accepted. A previous version of the Delivery Strategy was accepted by Sponsors at Review Point 3, and the TfL Board progressively delegated authority to the CRL Board leading to a full delegation of procurement authority with effect from 17 May 2010. Certain decisions remain subject to Sponsor approval in accordance with the PDA.

CRL operates within an environment which is in part determined by the legal and commercial framework defined by its Agreements. There are a number of key documents from which the delivery arrangements must flow. Overviews of these key documents are set out below:

– **The Crossrail Act 2008**

The Crossrail Bill received Royal Assent in July 2008, becoming the Crossrail Act 2008. The Crossrail Act gives the Secretary of State for Transport powers to acquire land, and to construct and maintain Crossrail. The Secretary of State has delegated those powers to CRL as the principal Nominated Undertaker, save those delegated to London Underground for the works at Bond Street and Tottenham Court Road. The Crossrail Act places requirements on CRL through the 'Undertakings' to Parliament and petitioners and 'Assurances' made to petitioners and generally. One of the Undertakings is that the Secretary of State will comply with the Environmental Minimum Requirements (EMR), a suite of documents including the Crossrail Construction Code which defines constraints on noise, dust, settlement and other matters.

– **The Project Development Agreement (PDA)**

In December 2008 the Sponsors Agreement, TfL Shareholder Agreement and PDA were signed. These agreements govern the relationship between TfL and DfT as joint Sponsors, regulate the composition of the CRL board and set out CRL's obligations. The PDA prescribes how the Sponsors will engage CRL to deliver Crossrail.

– **The Sponsors Requirements**

The Sponsors Requirements are an integral part of the PDA and describe the objectives and functional requirements for Crossrail. CRL's detailed interpretation of these requirements is set out in the Crossrail Project Functional Requirements (CPFR).

– **Existing rail industry duty holders**

The parties who already operate or maintain the infrastructure and facilities that will form part of Crossrail, Network Rail, London Underground and Rail for London (RfL), will have roles and responsibilities in the operation and maintenance of the completed project.

– **The agreements between CRL and its Industry Partners.**

There are many agreements that set out the relationships with and responsibilities of the Industry Partners. The primary agreements are listed below.

- Network Rail – Regulatory Protocol, Implementation Agreements and Protective Provisions Agreement;
- London Underground – Development Agreement;
- Docklands Light Railway – DLR Documents;
- Canary Wharf Group – Canary Wharf Group Agreement;
- Berkeley Homes – Woolwich Station Box Deed;
- Canal & River Trust (formerly British Waterways Board – BWB) documents; and
- Heathrow Airport Limited (formerly British Airport Authority– BAA) documents.

The following figure outlines the contractual relationships between the main parties described above.

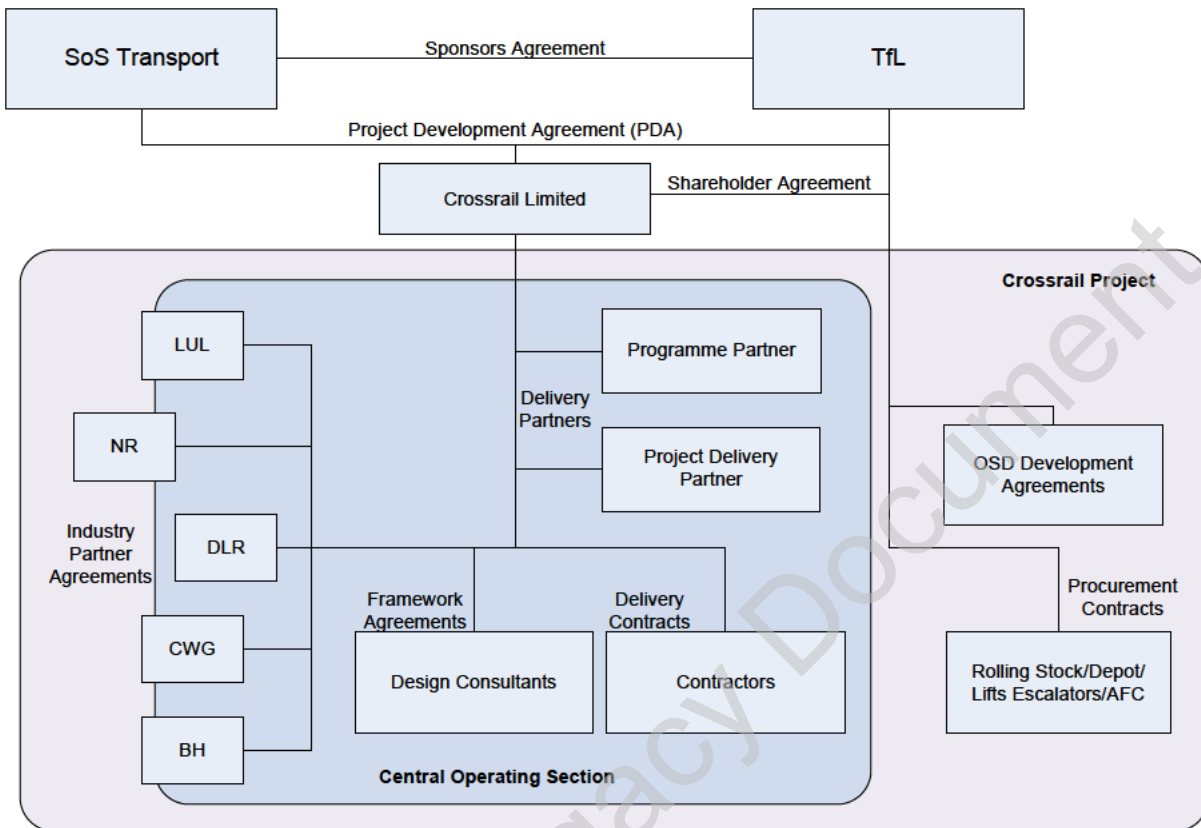


Figure 4.1 – Contractual relationships

– The funding arrangements

The provision of funding outlined in section 3.2 and associated agreements outlined above place certain responsibilities on many of the parties in relation to the delivery of the works, for example;

- Network Rail in its stewardship of the national rail network funds Crossrail Surface and recovers the costs by adding approved expenditure to the Regulated Asset Base;
- Berkeley Homes part-finances and constructs a station box at Woolwich according to the terms of the Woolwich Station box Deed; and
- Canary Wharf Group part finances and constructs the station at Canary Wharf according to the terms of the Canary Wharf Group Development Agreement.

4.2 CRL's corporate objectives

CRL has developed an overarching set of corporate objectives in order to govern and control the delivery of the programme, these are:

1. Deliver the project safely;
2. Deliver a quality railway;
3. Deliver to schedule;
4. Maintain financial control (deliver within funding envelope, manage risk, value management, cost management);
5. Procure the railway effectively and efficiently;
6. Establish and maintain good stakeholder relationships; and
7. Manage the development of the CRL organisation, its people and its partners.

Each year, a set of annual objectives are derived from these corporate goals to focus attention on the key deliverables for the forthcoming twelve months.

4.3 Core values

CRL has been established as a special purpose delivery vehicle to execute Crossrail and to discharge the responsibilities as set out in the PDA. CRL's Executive Team has set out the values which they wish its people and partners to adopt in order to support the successful delivery of Crossrail. These are:

- Safety
- Inspiration
- Collaboration
- Integrity
- Respect

4.4 Crossrail Parties

The main parties involved in the delivery of Crossrail are as follows:

- **DfT and TfL** (the Sponsors) report to the Secretary of State for Transport and the Mayor of London respectively; **Transport for London** (TfL) and the **Department for Transport** (DfT) are the joint **Sponsors** and have established a **Sponsor Board** supported by a **Joint Sponsor Team** (JST) which acts as the main interface with CRL. The JST has appointed Jacobs as a **Project Representative** (PRep) to support them and provide additional technical expertise in relation to their oversight role;
- **CRL** is the principal Nominated Undertaker as defined in the Crossrail Act and, through the PDA, is accountable for the development and delivery of the whole of Crossrail including all of its component projects. In fulfilling this role CRL has to provide an overall programme management role and has duties in relation to the delivery of the Central Section Works and other projects.
- **Rail for London (RfL)** has three main roles as follows:
 - The asset owner and maintainer of the Crossrail stations at Paddington, Canary Wharf, Custom House, Woolwich and Abbey Wood;
 - The Infrastructure Manager for the running tunnels and end-to-end railway systems for the Central Operating Section; and
 - The procurer of the Crossrail Train Operating Company (CTOC) to operate Crossrail services and owner of the operating cost model.

In these roles, RfL is engaged in the technical assurance process and will manage the train operator concession.

- **Mass Transit Rail [Crossrail] MTR[C]** is the Crossrail Train Operating Company (CTOC) and has been awarded a seven-year concession to operate Crossrail services. It is the Infrastructure Manager of the Crossrail (RfL owned) stations at Paddington, Canary Wharf, Custom House, Woolwich and Abbey Wood.
- **The Industry Partners** are existing industry bodies who will be involved in the development, delivery, operation and maintenance of Crossrail and defined in the PDA:
 - **Network Rail (NR)** which has three primary roles in Crossrail:
 - To undertake Crossrail Surface works;
 - To undertake works directly for CRL at the interfaces between Crossrail Surface and the Central Section Works; and
 - To act as Infrastructure Manager for Crossrail Surface routeway assets

- **London Underground (LU)** has three primary areas of involvement with Crossrail:
 - To undertake the works within the existing Underground curtilage, the delivery of the congestion relief works at Bond Street and Tottenham Court Road and the Bakerloo Line Link, and integration of Crossrail systems within its existing Station Operation Rooms (SORs);
 - To undertake the protection of London Underground's assets from Crossrail works in the vicinity; and
 - To act as the Infrastructure Manager for five stations (Bond Street, Tottenham Court Road, Farringdon, Liverpool Street and Whitechapel).

There is an opportunity for CRL and London Underground to integrate Crossrail works with LU investment projects to deliver the best overall economic outcome.

- **Docklands Light Railway (DLR)** works with CRL to modify Docklands Light Railway's existing infrastructure to enable the development and operation of Crossrail alongside the Docklands Light Railway, particularly at Pudding Mill Lane and Custom House but also at other locations;
- **Canary Wharf Group (CWG)** is responsible for the part-financing, design and construction of the Crossrail station box in the North Dock at Canary Wharf;
- **Berkeley Homes (BH)** is responsible for the part financing, design and construction of the station box at Woolwich in accordance with the terms of the Woolwich Station Box Deed;
- **Canal & River Trust** is the freehold owner and statutory harbour authority for West India Dock North and, following transfer of the Canary Wharf Station site, will, subject to any subsequent arrangement, retain ownership of the air and water space for the oversite development; and
- **Heathrow Airport Limited (HAL)** HAL owns the Heathrow Spur from Airport Junction on the Great Western mainline and, through its subsidiary Heathrow Express Operating Company, operates train services between Paddington and Heathrow. HAL is providing a funding package of £70m¹ and when Crossrail services start, the number of stopping services available to passengers to Heathrow will increase from 2 to 4 trains per hour.

¹ This HAL funding package of £70m was originally shown as a BAA contribution of £230m in December 2010 as part of the overall DfT funding commitment of £5.2bn to the Crossrail Project. It should be noted that the HAL's contribution is an element of the funding guaranteed from the DfT and therefore has no impact on the overall Crossrail funding envelope.

- The **Programme Partner** (Transcend, a joint venture between Aecom, CH2M Hill and the Nichols Group) has been appointed to support CRL through the formation of an integrated programme delivery team bringing specific skills which are necessary to ensure that the Sponsors Requirements will be met;
- The **Project Delivery Partner** (Bechtel supported by Halcrow and Systra) employed by CRL to support the delivery of the Central Section Works and the utilities and enabling works;
- **Design consultants** employed under framework agreements (known as the Framework Design Consultants – FDCs) and managed by the integrated Crossrail organisation to design the Central Section Works;
- **Works package contractors** for the Central Section Works employed by CRL and managed by Crossrail's Delivery team;
- **Bombardier - Rolling stock and Depot Service Provider** who design, build, supply and maintain the train fleet and depot - wholly funded by TfL but separate from the Sponsor funding of Crossrail;
- **Utility companies** who have a significant involvement in Crossrail as suppliers (e.g. of electrical power), and as contractors in carrying out diversions and in relation to the many interfaces with the main works;
- **The City of London Corporation** has agreed to make a direct contribution of £200m to the Crossrail project. In addition, the City of London Corporation will seek contributions from businesses of £150m, and has guaranteed £50m of these contributions; and
- **Oversite developers** who will work with CRL and TfL in the design and planning of oversite schemes in order to maximise the potential opportunities. This is further described in Section 6.4.

4.5 Organisation & Structure

4.5.1 Structure Principles

CRL must have an organisation that:

- Leads and manages the delivery of Crossrail as a whole in accordance with the Crossrail Act 2008, Project Development Agreement and the Sponsors Requirements; and
- Is compliant with all legal, contractual, regulatory and statutory obligations; and
- Discharges its appointment as the Nominated Undertaker pursuant to the Crossrail (Nomination) Order 2008; and
- Is aligned with the Crossrail objectives and vision; and
- Can demonstrate a compliant and effective Assurance Process as defined in the PDA; and
- Is structured, and continues to be structured, in such a manner to manage:
 - The Crossrail scope
 - Crossrail's stages of development – Design, procurement, construction, commissioning, integration, operation and completion;
 - The geography of the Crossrail routeway;
 - The complexity of the introducing of major new infrastructure into London;
 - The ever changing macro and micro economic climate;
 - The Crossrail procurement strategies;
 - Its Agreements with the Parties, Industry Partner's, Delivery Partners, Oversight Developers, and 3rd Party Stakeholders;
 - The relationships with the Operators

4.5.2 Management Structure for Delivery

The principles outlined above provide the basis for the management structure of CRL. CRL has created an integrated structure in order to embed a “One team, One target” ethos. This is intended to drive behaviours and create ways of working that characterise success for the programme.

Over time the size and structure will continue to evolve to suit the nature and stage of the project works. Each major phase of the project works requires a different focus from CRL's management and delivery teams. The diagram below sets out key points along Crossrail's timeline and recognises future organisation changes.

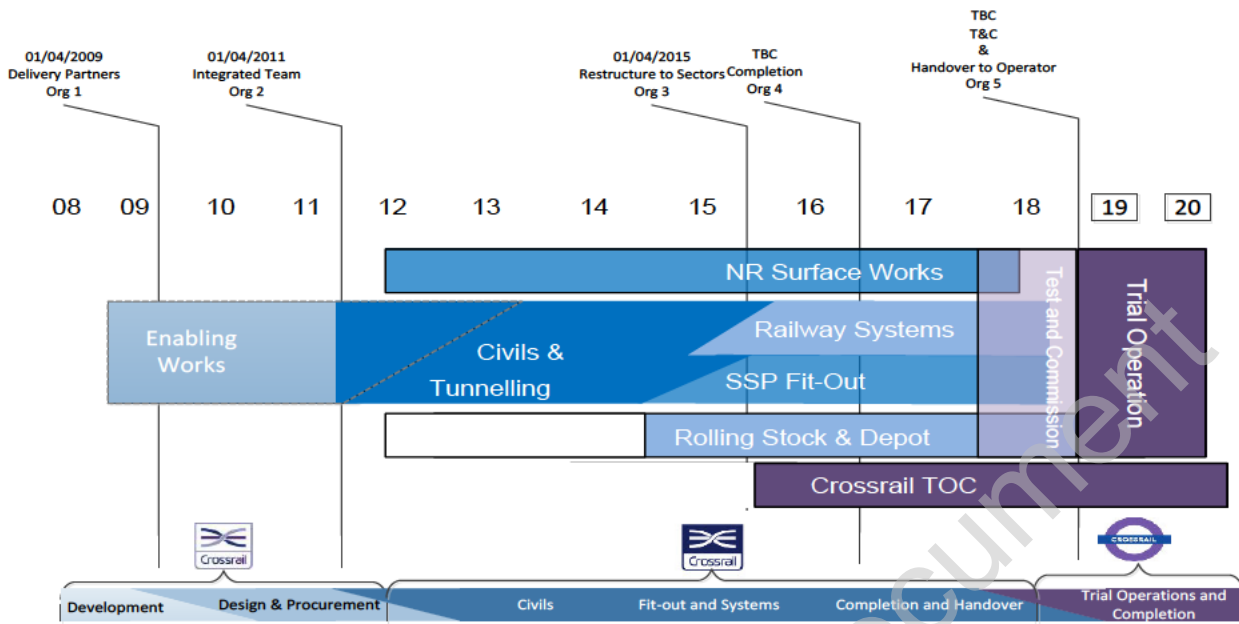


Figure 4.2 CRL Org changes to time/works

CRL has adopted an Overall Programme Management structure to organise, manage and co-ordinate the delivery of each of the different Elements of Crossrail. This matrix management approach is in line with clause 6.2 of the PDA and provides sufficient flexibility to deal with the ever changing scale and complexity of a major project delivery environment.

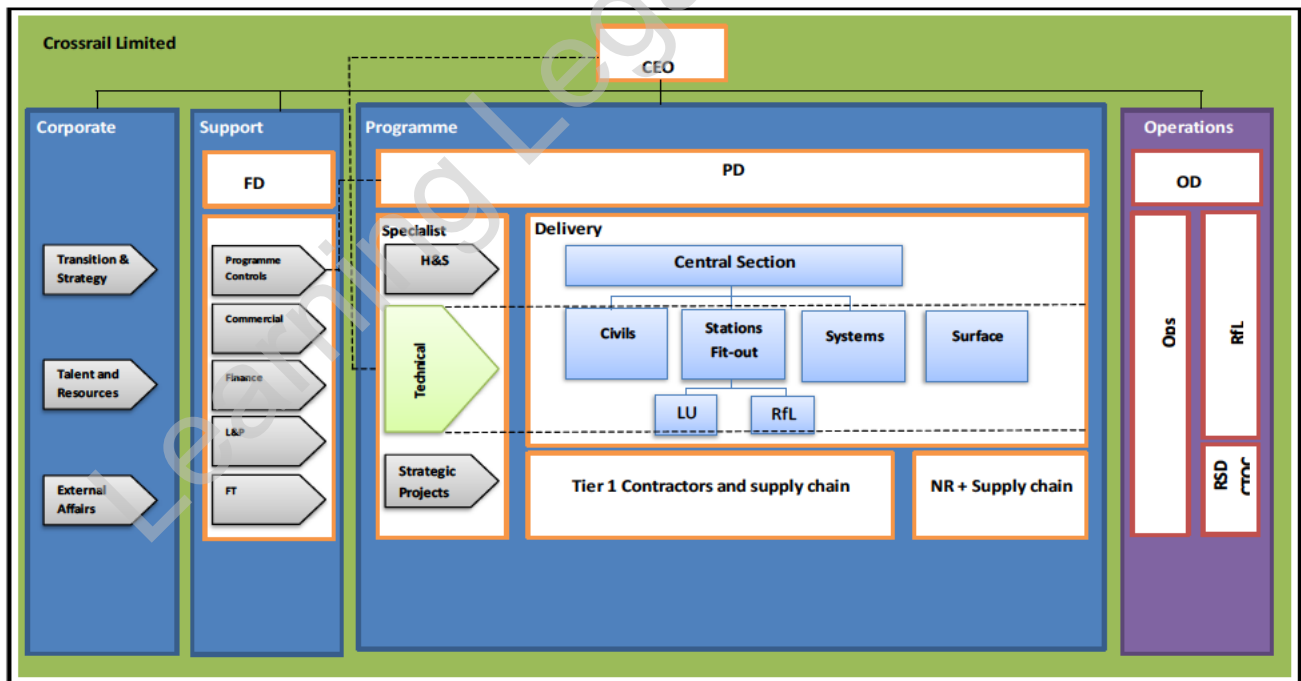
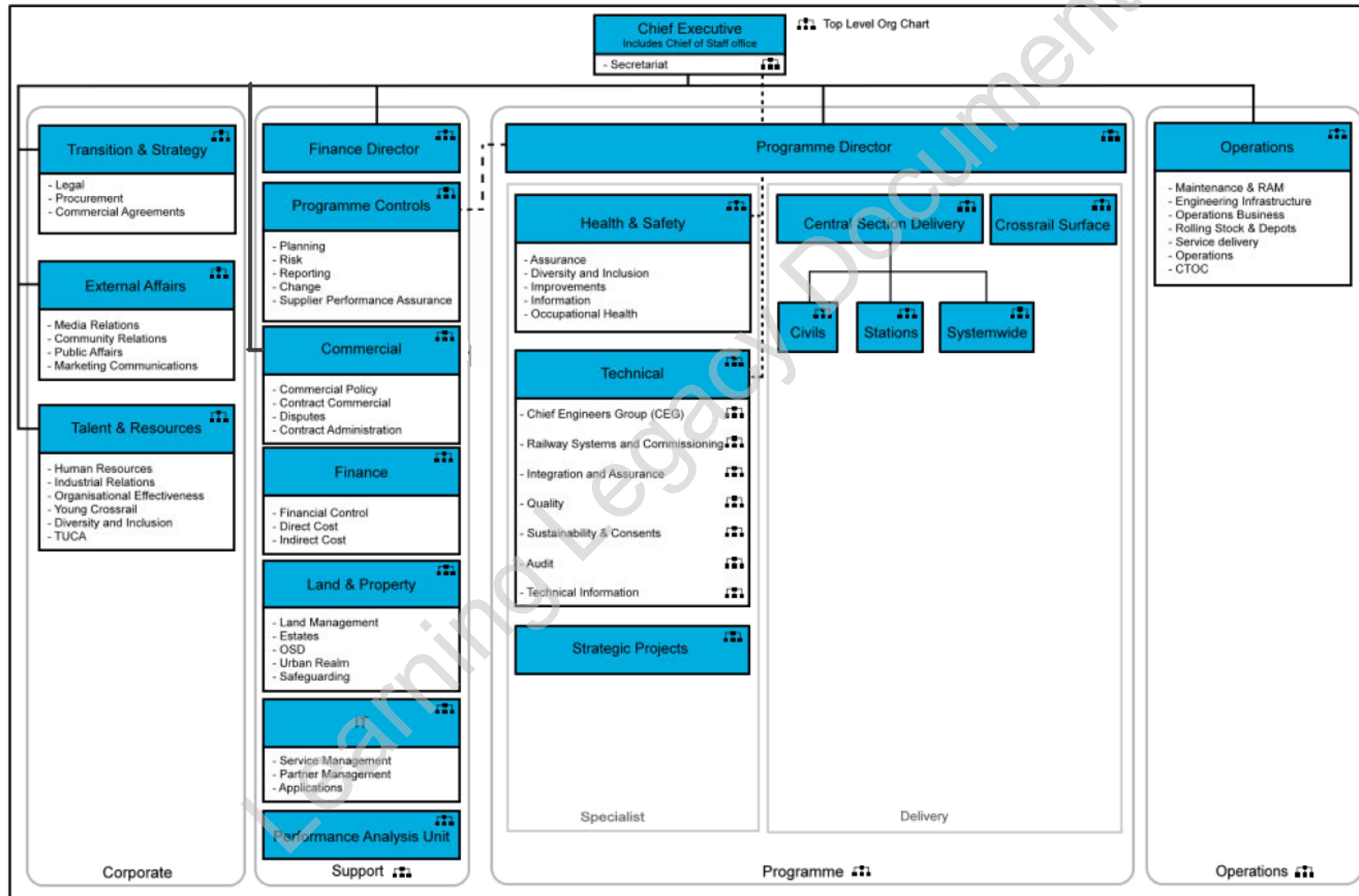


Figure 4.3 CRL High Level Organisation structure

Details of their structure and teams are controlled via their Management Plans. The current division of responsibility is set out on the organisation chart on figure 4.4 overleaf.

Figure 4.4 – Crossrail Organisational Structure



4.6 Governance

4.6.1 Governance Framework

The CRL governance regime:

- Defines the arrangements to ensure compliance with CRL’s statutory and contractual obligations;
- Defines the relationship between the Sponsors, the Board, its Committees and Sub-committees, and the delegated decision-making structure within Crossrail;
- Defines the processes by which CRL makes decisions, and the controls on those decisions; and
- Provides arrangements to verify that processes are followed and controls are effective.

The following figure illustrates the external governance arrangements for Crossrail.

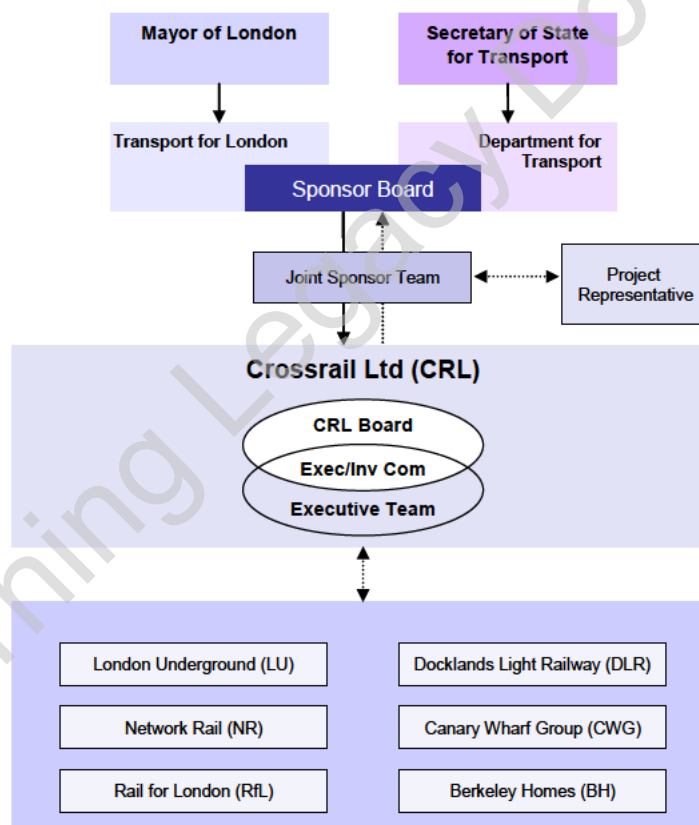


Figure 4.5 – CRL Governance Structure

The CRL Board

The CRL Board and the CRL governance structure have been developed in accordance with the requirements of the Sponsors Agreement and the TfL Shareholder Agreement including TfL’s Standing Orders and the Memorandum and Articles of Association adopted when the company became a wholly owned subsidiary of TfL.

CRL has established an autonomous Board with independent Non-Executive Directors, and has separated the roles of Chairman and Chief Executive in line with “The UK Corporate Governance Code” principles. The CRL Board is responsible for the overall direction and management of CRL to deliver Crossrail in accordance with the PDA and other programme agreements. It is also the role of the Board to ensure that CRL’s organisation, processes and resources are appropriate to deliver Crossrail on time and on budget, and are performing effectively. In accordance with good practice, the Board reviews the way it carries out its role annually with a view to making improvements where appropriate.

The Board Regulations set out the arrangements for the conduct of its business.

The CRL Board meets twelve times a year on a twenty-eight day cycle (no meetings are held in August). The Board currently comprises three Executive Directors, five independent Non-Executive Directors (including the Chairman) and two nominated Non-Executive Directors (appointed by the Sponsors).

The CRL Board is ultimately responsible for providing assurance to the Sponsors. The ability to provide this assurance comes from the structures, procedures and processes which the CRL Board establishes. In particular, the CRL Board has established Board committees and Sub-committees to which some decision-making authority is delegated. An appropriate organisational structure below the Board has been identified, and is set out in the following section.

CRL Board committees

The Board has established and will maintain committees to make board-level decisions in more specialised areas as shown below in figure 4.6.

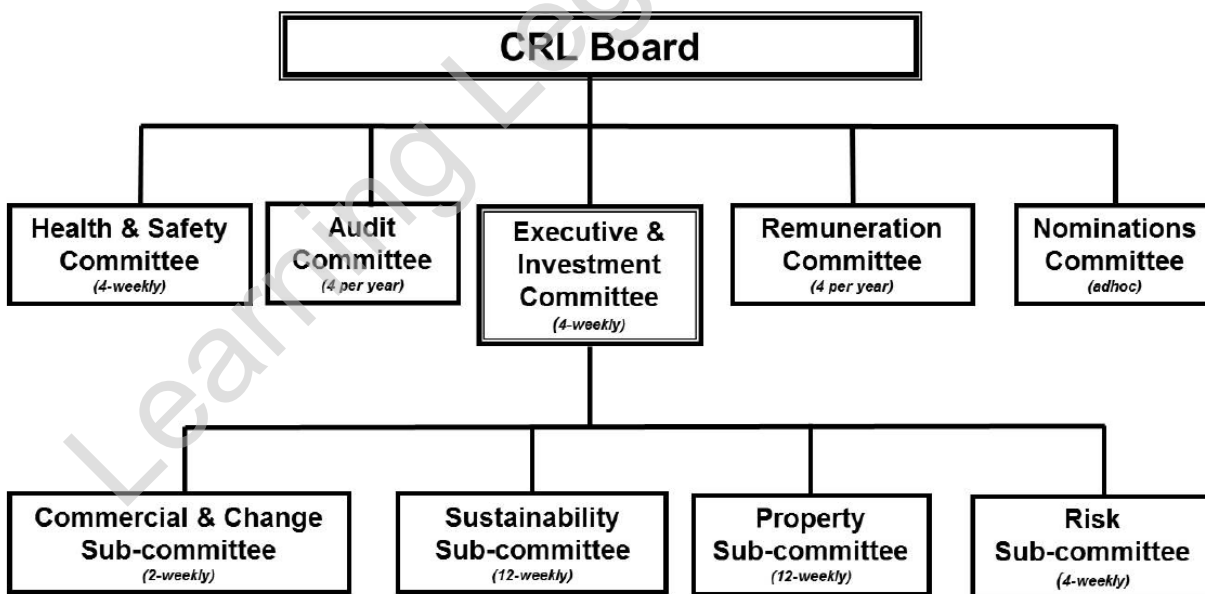


Figure 4.6 - Crossrail Board committees

The committees report regularly to the Board, and also review their performance annually. Terms of reference for each committee have been approved by the CRL Board.

The current Board committees are:

- Audit Committee;
- Executive and Investment Committee;
- Health & Safety Committee;
- Nomination Committee; and
- Remuneration Committee.

CRL Executive & Investment Sub-committees

Four Sub-committees subordinate to the Executive and Investment Committee have been established to make decisions in more technical areas. These Sub-committees report regularly to the Executive and Investment Committee and also review their performance annually. Terms of reference for each Sub-committee have been approved by the Executive and Investment Committee. The current set of sub-committees is:

- Commercial and Change Sub-committee;
- Sustainability Sub-committee;
- Property Sub-committee; and
- Risk Sub-committee.

In addition, a programme governance framework has been established to control the leadership, decision-making, reporting and management of the Crossrail Project, as described below.

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4.6.2 CRL Programme Governance

Within CRL’s corporate governance framework, the Programme Directorate has implemented a further framework for governing Crossrail’s delivery to ensure compliance with CRL’s obligations.

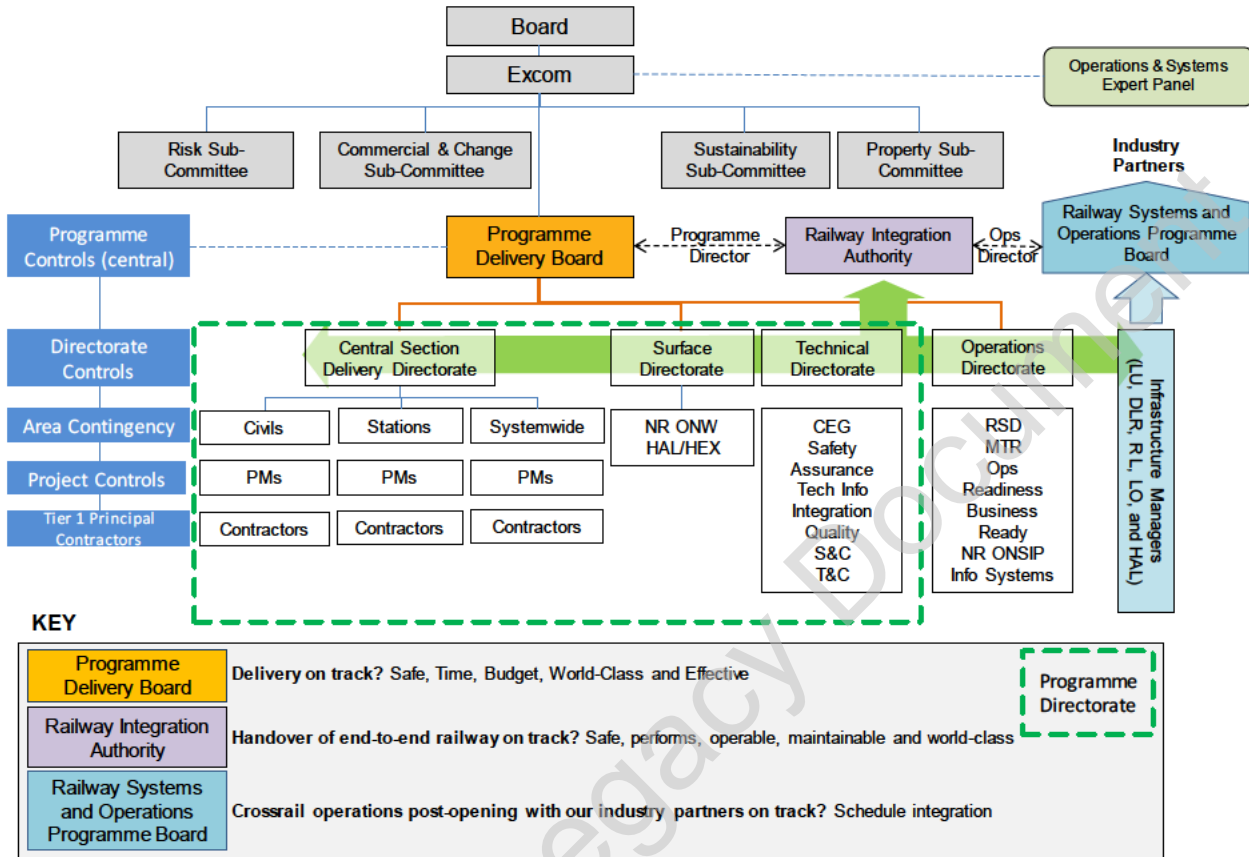


Figure 4.7 – Programme Directorate governance framework

Programme Delivery Board

A Programme Delivery Board (PDB) has been established as the main review body for delivery performance, financial, contractual, and commercial matters in connection with delivery of the Crossrail Programme. It reviews, interrogates and critiques delivery performance across all key projects within the CRL Programme, and assures that contracts and agreements are delivered in a manner consistent within CRL’s financial constraints, commercial objectives, legal obligations, strategies, policies and procedures. The terms of reference of the PDB are approved by the Programme Director and the Finance Director.

Railway Systems and Operations Programme Board

A Railway Systems and Operations Programme Board (RSOPB) has been established comprising the integrated Crossrail team together with Network Rail, London Underground, Rail for London and DLR (the Industry Partners responsible for delivering the most extensive contributions to the Crossrail programme). Other members of the programme team and the Project Representative are routine invitees and other Industry Partners are invited to attend as appropriate. The RSOPB functions primarily as a liaison group, and has the key aim of highlighting and resolving industry interface issues relating to operational readiness for Crossrail opening, and ongoing operations post opening. The terms of reference of the RSOPB have been approved by the members. CRL has established a clear hierarchy of arrangements for subsidiary meetings with individual Industry Partners to resolve more routine matters. It should be noted that the Railway Systems and Operations Programme Board (RSOPB) was renamed from the Programme Board (as referenced within the NR protocol) in December 2014.

Railway Integration Authority

A Railway Integration Authority (RIA) has been established that comprises the integrated Crossrail team, together with Network Rail and the Infrastructure Managers. The remit of the RIA is to ensure that the railway systems, rolling stock and infrastructure, combined with operations and maintenance requirements, deliver a safe, operational and maintainable end-to-end railway that performs to and meets the Sponsors Requirements. The RIA reviews railway integration issues, assesses their impact and makes recommendations as to the best way forward, thereafter monitoring progress to a successful conclusion. However, it does not act as an Assurance body and has no change authority. The terms of reference for the RIA are approved by the Programme Director.

4.7 Delegation strategy

As a subsidiary of TfL, CRL is subject to TfL's Standing Orders. Following delegation of authority to CRL Board by TfL Board, the Standing Orders were amended to reflect the new arrangements. CRL has established a Scheme of Authorities which sets out the delegations from the CRL Board.

The Scheme of Authorities sets appropriate levels of authority delegated to committees and post holders to ensure the efficient and effective discharge of CRL's responsibilities in line with the agreed governance structure, and authorises the post holders to act on its behalf up to these levels. Delegations at lower levels to named individuals are made by the CRL Chief Executive and are recorded in the Delegated Authority Register to ensure clear accountability.

Authorities are generally delegated to the lowest level considered consistent with adequate control. Levels of authority are consistent with the needs of a project of the scale of Crossrail.

Levels of delegation vary between categories of authority, and have been clearly communicated. For cost control purposes, dual signatures are required above appropriate levels of commitment. In general single sign-off will be expected elsewhere in line with the relevant accountability.

As far as possible the business systems which will be used for entering and recording approvals are being set up to verify that authorisers have sufficient delegated authority, and to provide an audit trail for this.

Delegations by the CRL Chief Executive are consistent with the Scheme of Authorities, and Board Committee and Sub-committee terms of reference.

4.8 Multilateral decisions

Multilateral meetings (for example, RSOPB) are and will continue to be advisory only. Formal decisions made at such meetings are considered to be made by individual members with the appropriate delegated authorities. Arrangements for dealing with multilateral issues where no agreement can be reached are as laid down in the relevant agreements.

4.9 Standards of behaviour

CRL recognises that it is a public body and is in the public eye. It has a Business Ethics Policy and endorses the Seven Principles of Public Life developed by the Nolan Committee. CRL expects high standards of integrity from its staff. Internal audit monitors transactions for signs of any departure from these standards.

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Section 5: Crossrail Project Delivery Responsibilities

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5 Crossrail Project Delivery responsibilities

The extent of Crossrail has been broken down into assets and systems which constitute an “Element” as defined by the PDA. The breakdown is represented in the table below:

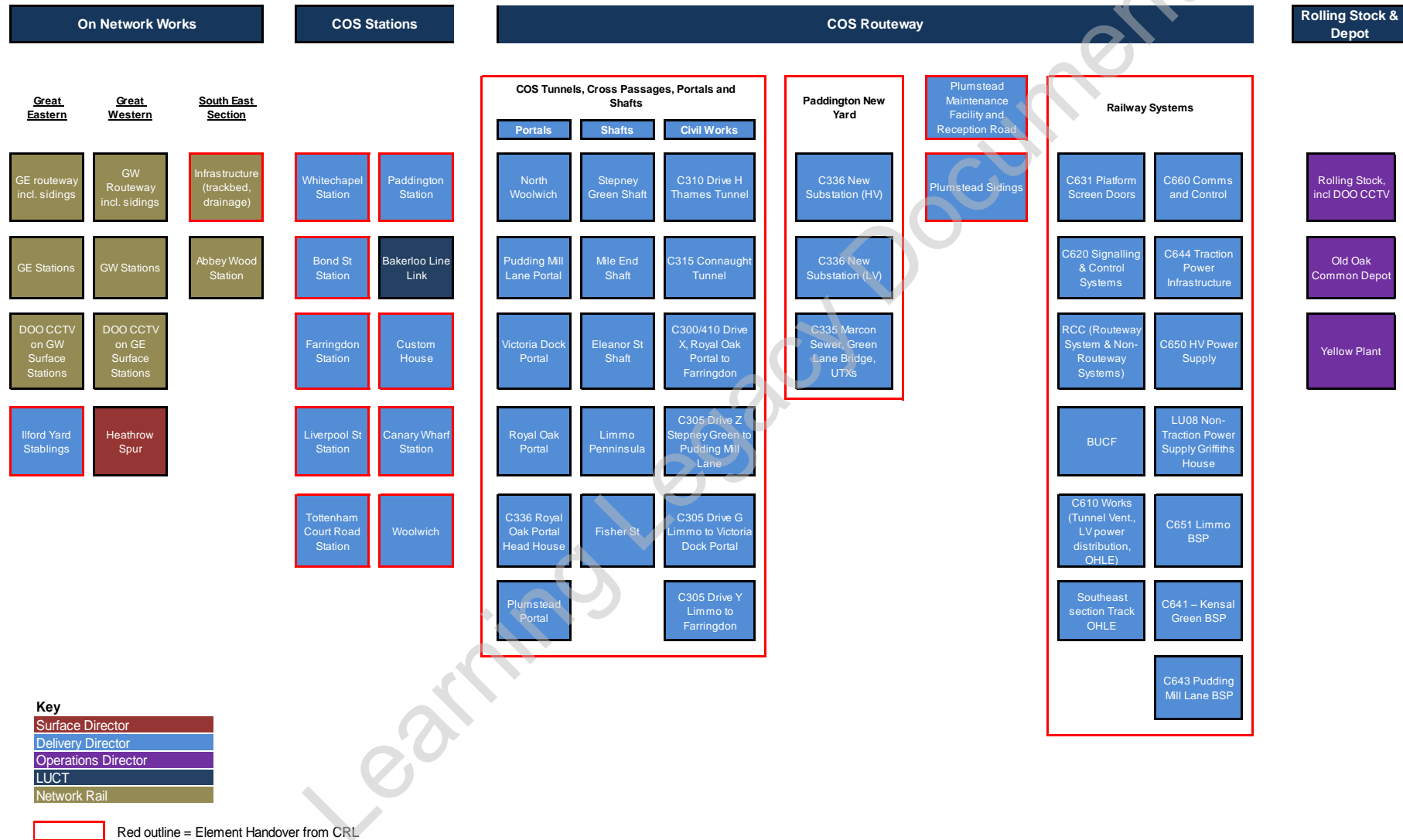
	Group of Elements (Acceptance of Crossrail end-to-end)	Element	Delivered By	Party that receives handover	Future Operator (e.g IM under ROGS)	Asset Maintainer	Stage Req'd For	
Crossrail Project (“Railway”)	1	Railway Systems	CRL	RfL	RfL	RfL	3	
	2	COS Tunnels, Cross Passages, Portals & Shafts	CRL	RfL	RfL	RfL	3	
	3	Abbey Wood Section Railway Infrastructure	NR/CRL	RfL	RfL	RfL	3	
	4	Paddington New Yard	CRL	NR	NR	NR	3	
	5	Plumstead Maintenance Facility and Reception Road	CRL	RfL	RfL	RfL	3	
	6	Plumstead Sidings	CRL	RfL	RfL	RfL	4	
	7	Paddington Station	CRL	RfL	MTR	RfL	3	
	8	Canary Wharf Station	CRL (CWG)	RfL	MTR	RfL	3	
	9	Custom House Station	CRL	RfL	MTR	RfL	3	
	10	Woolwich Station	CRL (BH)	RfL	MTR	RfL	3	
	11	Abbey Wood	Abbey Wood Station	NR	RfL	MTR	RfL	3
	12	LUL Central Operating Section (COS)	Liverpool Street station	CRL	LUL	LUL	LUL	3
	13		Bond Street Station	CRL	LUL	LUL	LUL	3
	14		Tottenham Court Road Station	CRL	LUL	LUL	LUL	3
	15		Farringdon Station	CRL	LUL	LUL	LUL	3
	16		Whitechapel Station	CRL	LUL	LUL	LUL	3
	17	Great Eastern	Early on-network works	NR	RfL	MTR	RfL	1
	18		On-network works routeway	NR	NR	NR	NR	4
	19		GE Stations	NR	RfL/MTR	MTR	RfL	4
	20		Ilford Yard	CRL	Bombardier / NR / Abellio	Bombardier / NR / Abellio	Bombardier / NR / Abellio	1
	21	Great Western	On-network works routeway	NR	NR	NR	NR	5
	22		GW Stations	NR	NR/SFO	GW Franchisee	NR	5
	23		DOO CCTV Works on stations	NR	RfL	MTR	RfL	2
	24	Heathrow	Heathrow	NR	HAL	NR	HAL	2
	25	Rolling Stock and Depots	Rolling Stock	RfL	RfL	MTR	TfL	1
	26		Old Oak Common Depot	RfL	RfL	Bombardier	Bombardier	2
	27		Yellow Plant	Bombardier	RfL	RfL	RfL	3

¹“Railway” means the railway transport system, as delivered by the Crossrail Project, once commissioned and accepted.

Table 5.1 – Crossrail scope breakdown and ownership

The responsibility for delivery of the Elements is set out in figure 5.2 overleaf.

Figure 5.2– Element delivery responsibility



5.1 Central Section Works – Delivery Directorate

As outlined in section 4.4, the Delivery Directorate is responsible for managing the delivery of the Central Section Works. This includes management of all necessary contracts and the management of interfaces between the Central Section Works and other programme works as well as with other stakeholders including consent granting bodies. The scope of works of the Central Section Works is as described in section 3.1 and includes asset protection and implementation works in relation to the interfaces with Network Rail, London Underground and Docklands Light Railway assets and as described in sections below.

As outlined in figure 4.3, the Delivery Directorate receives functional support from the following areas:

- Technical Directorate – including quality, assurance, design management, systems integration, technical information, planning, environmental and traffic and highway consents, utilities and ensuring compliance with Undertakings and Assurances and with third party agreements in accordance with the Crossrail Act (including ensuring that designers and contractors comply with the undertakings and assurances);
- Health and Safety;
- Programme Controls - including planning, cost, schedule and estimating, change control and risk management, and project reporting;
- Financial, commercial, legal and procurement; and
- HR Talent & Resources, External Affairs, and IT

5.1.1 Network Rail Interface Works

CRL has engaged Network Rail under an industry standard framework Implementation Agreement to undertake changes to its assets to enable the construction of interface works between Central Section and existing rail network.

Network Rail will also protect its assets as Crossrail performs its works at the interfaces under an industry standard Asset Protection Agreement (APA). All interface works are included in the Central Section Works and are a direct cost to CRL. CRL is directly accountable for the delivery of the interface works.

5.1.2 London Underground interface works

The Sponsors Requirements include general requirements in relation to transport integration and specific requirements for Crossrail to interface and integrate with London Underground at existing stations along the Crossrail route.

The London Underground Agreement sets out the scope of work relating to London Underground infrastructure as follows:

- Crossrail works to be passed to London Underground as the future Infrastructure Manager for Bond Street, Tottenham Court Road, Farringdon, Liverpool Street, and Whitechapel stations facilities. London Underground will also be the station operator for these stations with overall accountability for

incident management; the Crossrail train operator will manage train despatch from Crossrail platforms;

- Crossrail works on or affecting London Underground property or systems, including the creation of new combined operational facilities, such as stations operations rooms; and
- Crossrail works in the vicinity of London Underground property or systems such that infrastructure protection is required.

In general these works will all be procured and managed by the Delivery Directorate except where it is more appropriate for London Underground to do so. For example, relocation of safety-critical systems and interaction with single-source PFI equipment or where there is synergy with other London Underground projects. The works will need to be delivered in such a way to achieve acceptance by the future Infrastructure Manager.

CRL will work together with London Underground in relation to:

- Standards and Assurance – London Underground standards (S1-538) will apply to any modifications to existing London Underground infrastructure; appropriate standards will apply to all other works, subject to acceptance by the future Infrastructure Manager that all safety requirements are satisfied;
- Physical interfaces – interface works cover direct interaction with London Underground assets and systems as well as protection and/or monitoring of works adjacent to London Underground property. CRL and London Underground have developed an interface schedule which describes each interface. This will form the basis, subject to change control as Crossrail designs mature, for planning of design and implementation activities; and
- Access – London Underground and CRL will work together to plan Crossrail works in the least disruptive and most efficient way practicable, recognising the importance of keeping London moving during an intensive period of upgrading of the London Underground network. This will include working with London Underground Strategy and Service Development Events and Closures to identify synergies with other London Underground works.

5.1.3 Works associated with Docklands Light Railway

Realignment of the Docklands Light Railway network is required to enable construction of the Central Section Works, most notably at Pudding Mill Lane, Royal Victoria Dock and Custom House. An agreement is in place with Docklands Light Railway under which CRL will undertake all the heavy civil and building work. Docklands Light Railway, through the Central Section Works undertaken by CRL, is responsible for the signalling changes at CRL's cost and risk.

5.1.4 Utility diversions

The construction of Crossrail requires utility diversions, utility protection works and other enabling works.

In order to coordinate these works effectively and to ensure that conflicts with non-Crossrail works are avoided, CRL has established a framework for liaison with key utility providers. A Memorandum of Understanding sets out the basic obligations and objectives of CRL and the utility partners (Thames Water, National Grid, EDF Energy and BT Openreach) in working together.

In 2011, CRL and Thames Water entered into a Framework Agreement to facilitate the execution of utility diversions and other works.

5.1.5 Power supply

Under the PDA, CRL is required to deliver a railway with a resilient permanent energy infrastructure connection and supply network and to provide the energy to be consumed during the works programme together with the necessary metering, up to Handover to the operator.

From a technical perspective, the connections, supply network and energy procured must provide for:

- Temporary power supplies to;
 - Construction sites including distribution cabling, associated works and metering;
 - Support the enabling works; and
 - Power tunnel boring machines.
- Traction power for Crossrail Rolling Stock; and
- Non-traction power for high voltage supplies to signals and controls systems, stations, tunnels, shafts, buildings and sidings.

5.2 Canary Wharf Station – Canary Wharf Group

The Secretary of State and CRL have a Development Agreement with Canary Wharf Properties (CWP) (Crossrail) Limited (guaranteed by Canary Wharf Group Plc) to develop finance and part fund the new Canary Wharf (Crossrail) Station. The Agreement includes provisions for CRL and CWP to agree the plans and for CWG to provide access for the main tunnelling and subsequent railway works.

On completion the Secretary of State for Transport may buy the station at a fixed price or take a lease.

In addition to an overarching requirement to deliver the whole programme as described in the PDA, CRL is responsible for:

- Maintaining the overall programme interface with CWG to ensure that design, execution and ultimately testing and completion are properly planned and coordinated to meet the project timetable;
- Specifying the railway requirements and for systems integration;
- Design and install of railway systems, not included in CWG scope; and
- Exercising due diligence over the CWG progress and likely outturn cost of the station and related oversite development works.

5.3 Woolwich station – Berkeley Homes

An agreement with Berkeley Homes for the design, construction, finance and part-funding of a Woolwich Station box (the Woolwich Station Box Deed) was signed in February 2011. The agreement with Berkeley Homes provides for future arrangements to be made for the fitting out of an operational station.

Following receipt of a Sponsors change notice in July 2013, CRL is delivering the fit-out of an operational Crossrail station at Woolwich.

CRL is responsible for:

- Maintaining the overall programme interface with Berkeley Homes to ensure that design, execution and ultimately testing and completion are properly planned and coordinated to meet the project timetable;
- Specifying the railway requirements and for systems integration across the Crossrail route;
- Fit-out of the station box and the railway systems; and
- Exercising due diligence over the Berkeley Homes progress and likely outturn cost of the station box.

5.4 On Network Works - Network Rail

CRL is accountable to the Sponsors for the delivery of the whole of Crossrail. As such, CRL is the customer of Network Rail who delivers the On Network Works and other support services (together referenced as the Network Rail Programme). The Sponsors have designated CRL as the programme manager and systems integrator for Crossrail and CRL will perform its responsibilities and discharge its accountabilities in relation to the Network Rail Programme in accordance with the Regulatory Protocol. CRL also has duties in its role of Nominated Undertaker for Crossrail and compulsory purchase agent for the On Network Works. While CRL retains the accountabilities, the required activities will be undertaken by the integrated Network Rail Crossrail Delivery Team.

In its role as Overall Programme Manager and systems integrator CRL:

- Specifies, amends and owns the Network Rail Client Requirements. These are the requirements to deliver the Sponsors Requirements and cover infrastructure capability requirements (informed by railway system performance modelling) and schedule requirements;
- Prepares and issues CRL procedures documenting the interfacing arrangements agreed with Network Rail in relation to project control, assurance, dynamic testing and trial running;
- Owns an integrated delivery plan which co-ordinates On Network Works with the work in the Central Section, the rolling stock and depot elements and the Infrastructure Managers;
- Reviews and approves Network Rail's baseline plans including target costs;
- Monitors and reports progress to the Sponsors on expenditure and delivery of Crossrail Surface through regular reporting by Network Rail;
- Manages the interfaces between NR and other elements of Crossrail including interfaces where relevant with London Underground, RfL, TfL, Docklands Light Railway and HAL (Heathrow); and

CRL leads the systems integration of the network and satisfies itself of the deliverability of the Railway System Model outputs and required infrastructure capabilities for the central operating section. In its role as systems integrator CRL is responsible for ensuring the integration of the various elements and systems of Crossrail to deliver the Sponsors Requirements, and will develop procedures for systems integration including the support and engagement reasonably required from Network Rail.

In its role as Nominated Undertaker, CRL is responsible for satisfying itself that On Network Works are specified, developed and implemented in accordance with the Crossrail Act, the Register of Undertakings and Assurances, the Environmental Minimum Requirements and related documents and formally submits applications for consent under the Crossrail Act.

In its role as compulsory purchase agent CRL arranges for the permanent acquisition of land for On Network Works; arranges easements and other new rights over land not compulsorily purchased but affected by the permanent layout of On Network Works and, where applicable, deals with land compensation claims.

5.5 Rolling stock and depot facility – TfL, RfL and CRL

In accordance with the PDA and on behalf of RfL, CRL has procured the contract for provision of the Rolling Stock and Depot facilities, including appropriate long term maintenance arrangements. This was undertaken as a single bundled procurement in accordance with the Sponsors' Commercial and Operational Requirements and the Sponsor approved Rolling Stock and Depot Procurement Strategy.

The rolling stock fleet has been specified in accordance with the Sponsors Requirements. The rolling stock output specification includes requirements for passenger loading, interconnecting gangways between carriages, accommodation for passengers' luggage and require appropriate air conditioning, heating and ventilation.

The location of the Crossrail depot is at the Old Oak Common site west of the Royal Oak tunnel portal. The depot output specification incentivises the delivery of economic and efficient whole life cost maintenance services for the rolling stock to ensure reliable provision of Crossrail services.

In addition, stabling sidings and a maintenance facility is being provided at Plumstead.

The PDA sets out the process for TfL, RfL and CRL to cooperate to manage the procurement, project works and related interfaces at a programme level and to the project timetable for the Rolling Stock and the depot.

CRL is responsible for:

- Determining the operations and performance requirements with RfL as the long term Operator;
- Leading the Rolling Stock and Depot procurement process in close consultation with Sponsors;
- Ensuring that design, manufacture, testing and completion are properly planned and coordinated to meet the project timetable;
- Assuring the railway requirements are met and systems integration; and
- Exercising due diligence over the construction progress and likely outturn cost.

It should be noted that the Sponsor's original commercial strategy envisaged private funding of the Rolling Stock and Depot. That changed during the bid phase. The capital cost of the Rolling Stock and Depot is wholly funded by TfL. The contract is in the name of and is managed by RfL.

5.6 Managing interfaces

The effective identification and management of complex interfaces is critical to the success of Crossrail as interfaces are a major source of potential risk. Typically interfaces exist at boundaries between organisations, projects or sub-projects and include:

- Physical connections or the proximity of structures (structural interface);
- Logical and functional connections between systems and components (systems interface);
- Ergonomic features of a system and its user (user interface);
- A timing or schedule relationship (programme interface); and
- An information or specification relationship (data interface).

Many interfaces will be routinely managed but some will need to be dealt with through formal interface management processes. Interface management will be undertaken at two levels:

- At programme level by CRL to ensure that interfaces with Industry Partners have been identified and responsibilities properly assigned; and
- At project level by Delivery teams and Industry Partners:
 - to ensure that interfaces within their scope have been identified and responsibility assigned; and
 - to meet their assigned obligations for interfaces between their scope and other Industry Partners.

CRL and the Industry Partners will manage interfaces through a variety of mechanisms including:

- Interface risk management – CRL has established an interface management regime in order to reduce interface risks by:
 - Ensuring that all interfaces are identified and indexed;
 - Defining and managing the risks at interfaces;
 - Documenting and controlling interfaces through interface control documents;
 - Assigning responsibility for the specification and management of interfaces to Crossrail roles or to the Industry Partners, as appropriate; and
 - Ensuring that the interface owner discharges these obligations in conjunction with the interfacing party.
- Systems architecture - CRL has developed a programme level systems architecture which shows the decomposition of the rail system solution into major elements delivered by the Industry Partners. The purpose of this architecture is to clarify interfaces between Industry Partners.
- Infrastructure Manager's Progress Review Group (IMPRG) has a specific role to consider interface areas and the acceptance of submissions affecting more than one Infrastructure Manager.

A small number of complex interfaces have also been identified for which dedicated leadership has been put in place through the integration team.

Section 6: Delivery strategies

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6 Delivery strategies

6.1 Introduction

This section outlines some of the key challenges CRL faces in the delivery of Crossrail and then describes the strategies it has adopted in tackling them. They include:

Management of risk - Risk management is enshrined in Crossrail’s core values. The effective management of risk will be crucial to the success of Crossrail. This Delivery Strategy and the strategies in this section set out how CRL will address some of the most important risks that Crossrail faces.

Developing and maintaining control – CRL is committed to establishing a sound basis for measuring, controlling and predicting the future performance of the programme. This means that there must be a clear and explicit relationship between the core products that define the programme at any time (requirements, scope, schedule, risk and cost etc.) allowing change to be managed effectively.

Achieving value for money – CRL will embed a culture of active value management across Crossrail in order to achieve the objectives of delivering best value for money, ensuring that all solutions are affordable, fit for purpose, are sustainable and take account of aspirations for minimising whole life costs.

The core functions for the delivery of Crossrail are structured on a version of the ‘generic’ Crossrail life cycle as set out in figure 6.1. It is not intended to cover the full range of CRL’s activities but focuses on those which are directly related to meeting the objectives for Crossrail and address the main risks.

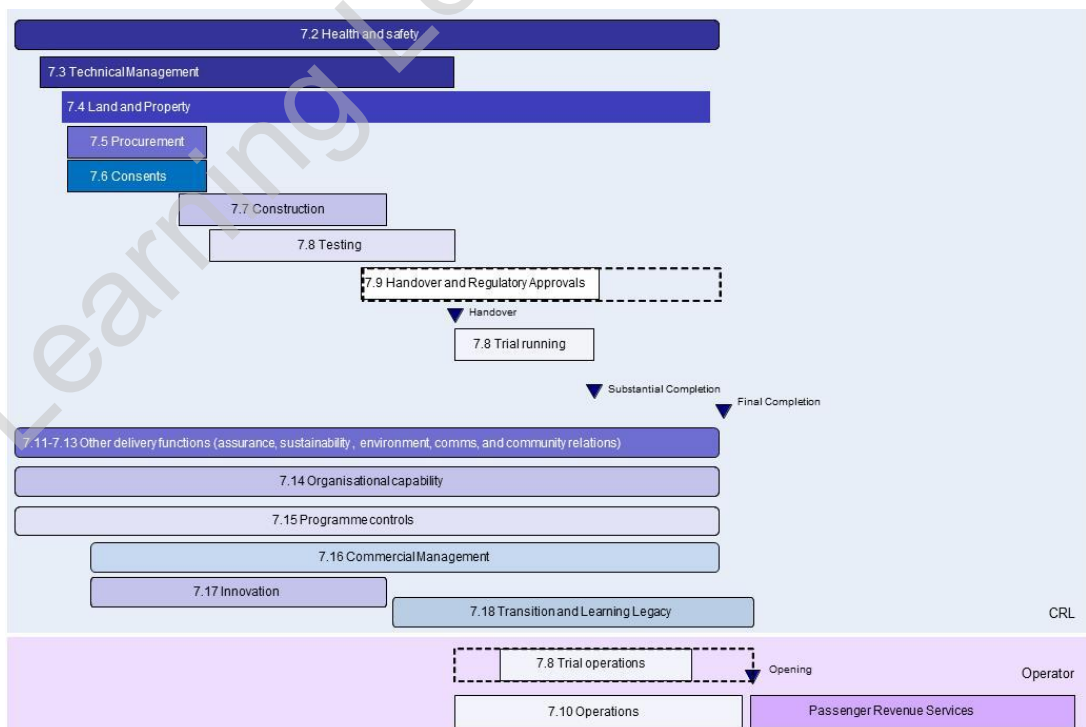


Figure 6.1 – Crossrail life cycle

6.2 Health and safety

This section outlines the framework for CRL’s role in providing leadership and oversight of the health and safety requirements for the design, construction, testing, commissioning and operation of Crossrail.

6.2.1 Objectives

CRL has committed to ‘putting health and safety first’ and this means:

- Creating a zero accident/ill health culture and showing ‘excellence’ as a client;
- Ensuring exemplary health and safety performance from everyone involved in Crossrail;
- Continually promoting a positive health and safety culture across Crossrail; and
- Delivering proactive management in the design of the railway which ensures health and safety hazards are designed out wherever practicable prior to being realized in construction, operation and maintenance of the railway.

CRL management will ensure that the recognition that all incidents are preventable becomes the driving force for health and safety management in Crossrail.

CRL management believes and will work to ensure that each individual’s fundamental right to work in a properly controlled environment and to finish each shift unharmed is core to the way we work.

CRL management’s commitments to health and safety excellence are detailed in the Health and Safety Policy (January 2016) which is the foundation for the overall health and safety management system.

CRL’s approach to health and safety is consistent with PDA Clause 12 Health and Safety.

6.2.2 Risks

Some of the key challenges faced in meeting the health and safety objectives are the:

- Magnitude and complexity of Crossrail;
- Proximity of construction to the public and to operational railways;
- Extent of Delivery Partner and infrastructure interfaces and the need for all parties to work collaboratively;
- High volume of contractors anticipated on Crossrail and ensuring that they are sufficiently aware of CRL’s safety values; and
- High visibility and profile in a capital city.
- Type of construction works – tunnelling, and energised railway environment

6.2.3 Approaches

Target Zero – Aspiring for a Zero Incident Culture

Developing a zero incident culture is a key component of the health and safety strategy. CRL has developed and implemented a ‘branded’ health and safety ethos which encompasses various elements of health and safety management system. These elements include:

- A programme of activities focussing on health and safety leadership and behaviours;
- Raising risk and hazard awareness;
- Development and implementation of health and safety management systems;
- The constant measurement of key performance indicators; and
- Regular reviews of all processes.

‘Target Zero – A State of Mind’ encompasses CRL’s approach to improving health and safety across the programme. The programme is based on legislative compliance and three guiding principles;

1. We all have the right to go home unharmed every day
2. We believe that all harm is preventable
3. We must all work together to achieve this

This foundation supports a defined series of requirements that drive improvements in health and safety management and behaviours. A fundamental set of rules, ‘The Golden Rules’ have been developed to reflect the core health and safety behaviours that are required by everybody working on Crossrail. These are communicated to all workers through a range of methods and are regularly updated.

Focusing on risk

CRL management will maintain and promote a strong focus on risk and risk management. A construction risk profile for each stage of the project has been developed which is regularly reviewed to ensure a constant focus is maintained on controlling appropriate hazards and the assessment and mitigation of risk at each level of CRL and its supply chain. Health and safety risks are integrated into the risk management regime to ensure that decisions are made in the context of the overall management of Crossrail.

Health and safety management system

CRL’s Health & Safety Directorate has developed a health and safety management system which has been certified as compliant to the BS OHSAS 18001 standard. This is well regarded internationally as one of the highest standards for the effective management of health and safety.

The development of the health and safety management system has taken account of best practice from other major projects including London 2012 Olympic and Paralympic Games. It aims to meet the requirements of the Health and Safety Executive’s (HSE) strategy to ensure that company standards make a noticeable difference to actual health and safety at worksites.

Operational safety requirements

The operational safety requirements of the Railway will be considered throughout the whole lifetime of the Crossrail Project. Decisions made in design and construction will impact future maintenance and operation and the health and safety principles need to be clearly worked through.

To support this, an operational safety risk model has been developed which will mirror the expected safe operation of the Railway, and allow potential changes to be reviewed for impact on the eventual safety of the Railway. The Engineering Safety Management (ESM) process sets out the approach mandated by CRL for the reduction of safety risks in the design, testing and potential future operation of the Railway to as low as reasonably practicable, in compliance with legal requirements, for all “users” of the Railway, including passengers, workforce, maintainers, adjacent railways, neighbours and members of the public.

ESM will enable the Railway to be handed over and accepted by the Infrastructure Managers and the Operator (the “Duty Holders”) to put into service and, in conjunction with their own Safety Authorisation and Certification, to comply with the Railway (Interoperability) Regulations (RIR) and Railways and Other Guided Transport Systems (Safety) Regulations (ROGS) and provide part of the evidence that the Sponsors Requirements have been met.

Occupational health and hygiene

CRL management believes that an exemplary standard of occupational health across the project is essential in delivering the CRL Health and Safety policy commitments. To ensure this high standard of occupational health is achieved, CRL has established an Occupational Health Standard which requires all members of the supply chain to register with Constructing Better Health and implement constructing better health standards for fitness for work assessments and health surveillance. All construction staff must also be registered with Constructing Better Health. In addition, Principal Contractors are required to have in place; medical services, treatment services, well being programmes, lifestyle screening, alcohol and drugs testing and occupational hygiene support to reduce hazards in the working environment. These services will release the dependency on local national health services as well as ensuring individuals are fit for life, fit for work and fit for tomorrow.

Communication and competence

Leadership tours will be undertaken by CRL management to ensure visible commitment is present from the senior teams.

Forums to ensure CRL employees and contractors have an opportunity to discuss health and safety issues will be established and reviewed to ensure they are working effectively.

CRL will work in accordance with the TfL health and safety competence standards and put in place appropriate training modules to meet the requirement of these standards and to support the Target Zero objective.

Emergency and contingency planning

Incident response procedures are in place for addressing foreseeable emergencies. A resilience plan to identify potential scenarios and mitigate their consequences has been developed. A programme of ‘table-top’ exercises will be run throughout the life of Crossrail, and will involve all relevant parties.

Relationship with partners

Delivery of an exemplary level of health and safety across Crossrail requires close working with Crossrail’s Delivery Partners, Industry Partners, utilities companies and the Supply Chain.

Industry health and safety forums have been established to ensure strong networks are in place to communicate key health and safety messages and to encourage joint working. Examples of the relationships that have been established include:

- Safety and Health Leadership Team (SHELT);
- Constructing Better Health Forum;
- Principal Contractor H&S Forum;
- Regular liaison with the Institution of Occupational Safety and Health (IOSH) and the British Safety Council (BSC); and
- Collaboration on research projects with TfL, IOSH, Middlesex University and the Institute for Occupational Medicine.

These relationships will continue to support the project throughout the final years of Crossrail. Additionally, CRL will endeavour to forge new relationships to ensure continual learning and improvement and also to enable others to learn from the experiences of Crossrail.

The focus of health and safety until substantial completion will be supporting construction and testing and commissioning activities. For the Central Section CRL is Client for works under the Construction Design and Management regulations (CDM), and in the majority of instances also the Principal Designer. Fulfilment of these roles will be undertaken by Delivery Project Directors and their teams, with support from Technical and Health and Safety Directorates. London Underground, Network Rail, Canary Wharf Group and Berkeley Homes are the Clients for their own controlled works.

Key CMS documents include:

- Health & Safety Management Plan: CR-XRL-Z7-STP-CR001-50004
- Construction (Design and Management) Procedure: CR-XRL-03-GPR-CR001-00001
- Golden Rules and High Risk Activity Procedure: CR-XRL-Z7-GPD-CR001-50012
- Health & Safety Manual: CR-XRL-Z7-GMN-CR001-0001

6.3 Technical management

This section outlines the key technical risks that need to be addressed in delivering Crossrail in accordance with the Sponsors Requirements to create a 'world-class affordable railway'.

The Crossrail Technical Directorate sets out and manages the environment within which CRL, and its Industry Partners, undertake the detailed engineering, technical delivery and integration of the outline design and requirements that have been established and assures delivery of these in accordance with CRL's Agreements.

6.3.1 Objectives

Within the Sponsors Requirements there are a number of clauses that relate to the broad requirement captured in the vision for Crossrail to be a world-class affordable railway.

The Technical Directorate acts as the Technical Authority for Crossrail and is responsible for discharging CRL's technical obligations under the PDA and Sponsors Requirements. Its main accountabilities are:

- CRL Employer's Requirements, and scope;
- Railway performance and capability;
- End-to-end Railway and systems integration
- Engineering and Design Management (civil and structural, MEP, architecture, and rail systems);
- Technical Assurance;
- Technical excellence;
- Environmental Management and Sustainability;
- Testing and commissioning strategy;
- Engineering Safety Management; and
- Technical services, including technical data and information management.

CRL's technical functions assure delivery by the Industry Partners and the Delivery Directorate of a world class affordable railway for Crossrail that:

- Meets the Sponsors Requirements, and;
- Obliges the Operators to accept at Handover;

It is CRL's responsibility to demonstrate that the end-to-end Railway is safe, operable, maintainable and will deliver the required capability and performance.

6.3.2 Risks

The main technical risks to meeting these objectives include:

- The scale and complexity of Crossrail;
- The scale and complexity of the systems integration task which arises from having multiple delivery partners, future Infrastructure Managers and Operators;
- Achieving a resilient and reliable service on a mixed system that incorporates an on network section to the west and east of a new railway in the Central Operating Section; and
- The elements of contractor design within CRL's works contracts.

6.3.3 Approaches

The Technical Directorate function within CRL includes:

- Defining and managing a baseline of requirements that meet the Sponsors Requirements;
- Providing clear direction on technical issues of strategic importance when they arise to mitigate their impact on the risk profile of the programme;
- Supporting, challenging and contributing to risk and value management initiatives;
- Providing leadership in programme level systems integration and technical decision making;
- Being the principal advocates of technical excellence across the programme;
- Supporting partners in satisfying the Sponsors Requirements;
- Discharging CRL's obligations for Consents and Environmental Management;
- Delivering the objectives of the Crossrail Sustainability Strategy;
- Ensuring that there is the necessary technical capability and competence in key technical disciplines to enable the proper discharge of technical responsibilities across the programme; and
- Compliance with the Railways (Interoperability) Regulations for the Central Operating Section.

In fulfilling these responsibilities and addressing these challenges CRL is implementing the following approaches:

Design management

The Technical Directorate is responsible for design management for civil and structural works to RIBA Stage F, and for mechanical, electrical and architectural works to RIBA Stage E. This involves managing the Framework Design Consultants (FDCs) in the development of the Employers' design, other technical information that supports all ITT documentation, as well as assuring the design outputs of the Contractors. The Technical Directorate also provides engineering support to the Delivery Directorate and the project managers in their management of different elements of the Crossrail Project. The participation of future Infrastructure Managers in design development is defined in CRL's assurance and management plans.

Scope and requirements management

The Technical Directorate is responsible for ensuring that the Crossrail Programme Functional Requirements (CPFR) align with the Sponsors Requirements and that the functional requirements within the CPFR are appropriately disaggregated into the component parts of the CRL Project. In addition, it is responsible for assuring that the individual project technical specifications collectively meet the overall programme requirements. CRL has created and is using a project information model as shown in figure 6.2 to manage this process.

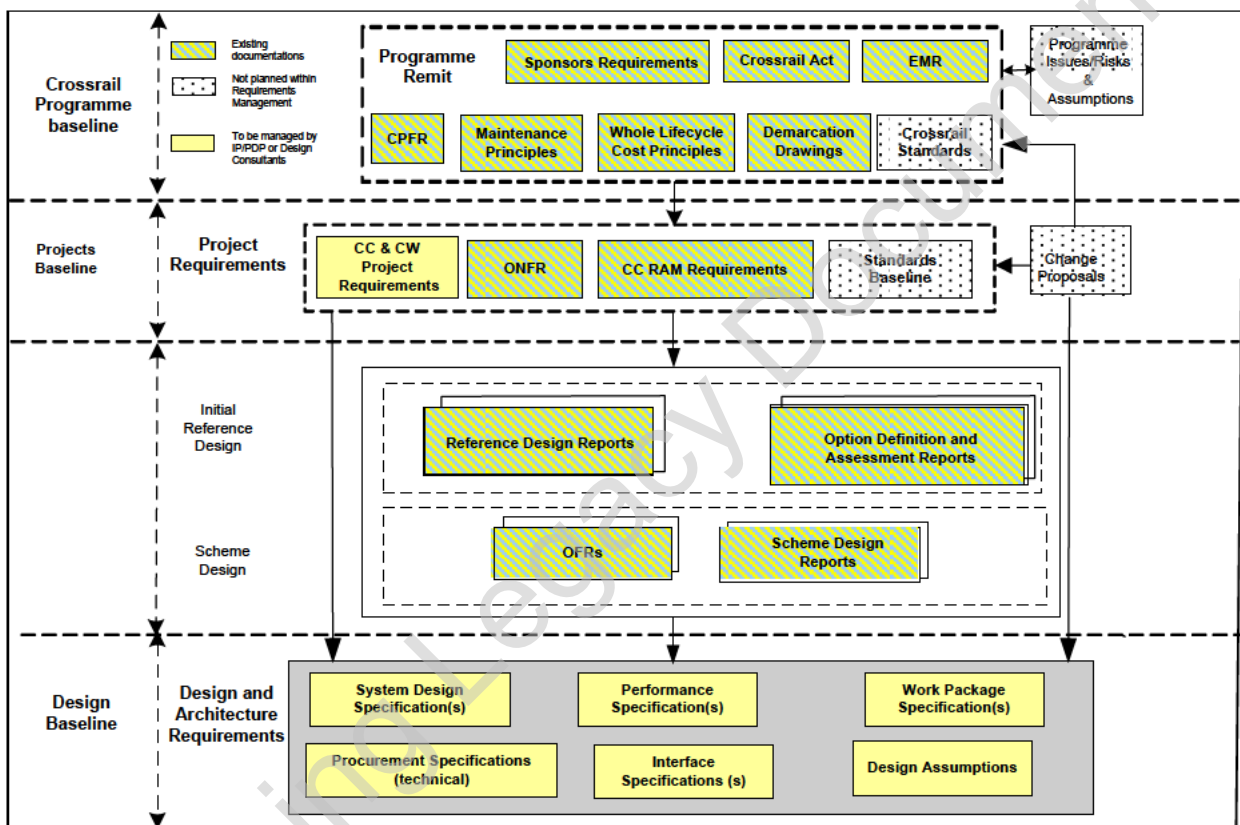


Figure 6.2 – Key document hierarchy

Operations and maintenance

CRL has worked with the Sponsors, future Infrastructure Managers and Operators to establish a small number of programme requirements that ensure consistency of interpretation by the Delivery Partners.

CRL has also developed an Operational Concept to assist CRL in meeting the Sponsors operational requirements. The Operational Concept defines the expected operations of Crossrail as a complete system. It describes the system in terms of the user needs it will fulfil, its relationship to existing systems and how it will work in normal, degraded and emergency modes. It underpins the overall Safety Case for the railway in both engineering and operational terms.

Processes and standards

CRL works with its Industry Partners in the establishment and implementation of technical strategies, procedures and processes for the management of technical risks and promotes the use of best practice to enable best value to be achieved throughout Crossrail.

The Technical Management Plan provides the over-arching description of the role and responsibilities of the Technical Directorate and its relationship with the Delivery Directorate and the Industry Partners during the design, implementation, integration, testing and commissioning and assurance of the delivery of Crossrail.

CRL has taken the lead role in the development and agreement of a suite of technical standards to be used by the Industry Partners and the Delivery Directorate.

Leadership of systems integration at programme level

The Project Development Agreement gives CRL the role of systems integrator for CRL. Systems integration is applicable to all stages of the lifecycle, all contracts and all work by Industry Partners that form part of CRL. Integration activities start in requirements and design of the systems architecture, and continue through implementation, testing and commissioning and trial operations.

At the programme level, within Crossrail, systems integration can be defined as detailing and apportioning the Sponsors’ Requirements into components or sub-systems that can be designed and built, and then bringing together these components into Elements that function as an integrated system. The Elements are tested against the four pillars of assurance; collectively maintainable, collectively safe, collectively operable, and collectively performs; to assure that a compliant railway has been delivered that performs to the Sponsors Requirements.

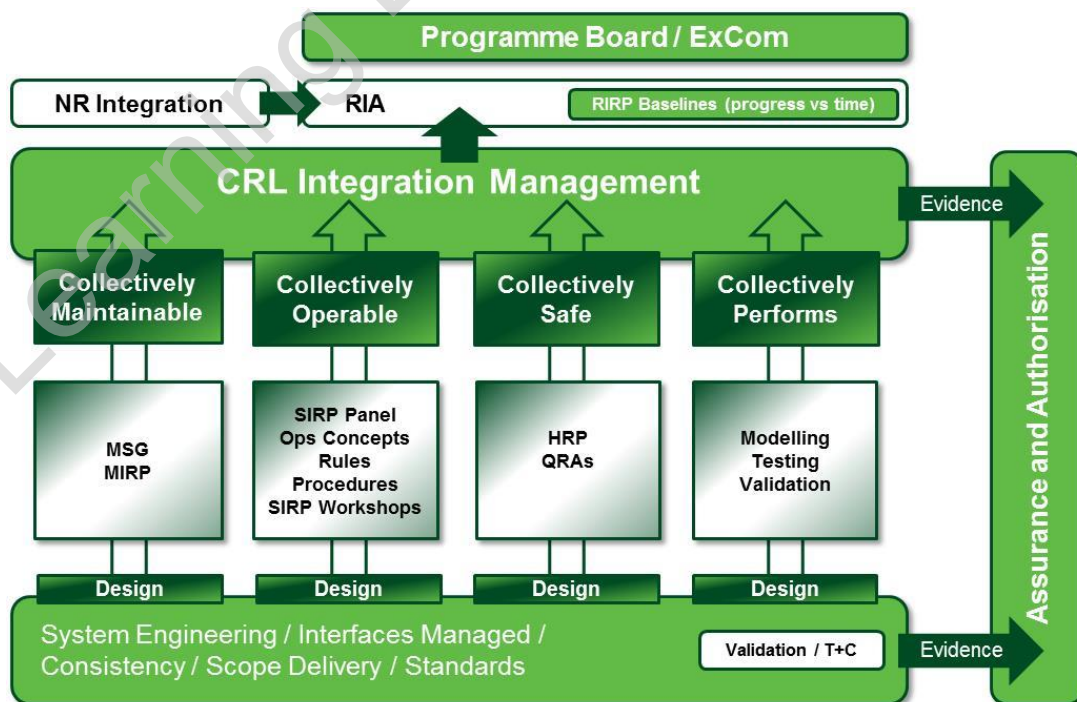


Figure 6.3 – Systems Integration ‘4 Pillar approach’

If one or more sub systems is delayed or cannot be integrated with other parts of the rail system there is a risk that CRL will not deliver its operational and business objectives or that Crossrail will be delayed in being brought into operation. In order to minimise integration risk CRL has defined, agreed and is managing the interfaces and integration between the scope of the Central Operating Section, On Network Works and the Industry Partners – e.g. LU interface works.

Systems integration management provides assurance that requirements, particularly those of the Sponsors and stakeholders, have been met, and that integration risk has been eliminated or reduced to an acceptable level.

Progressive technical assurance

Technical Assurance describes the processes CRL uses to accept both the design and the built assets, and progressively deliver the technical assurance evidence to the Infrastructure Managers. This evidence will support acceptance by demonstrating that a safe, operable, maintainable, railway - that achieves the required levels of performance and capacity - has been delivered.

Technical assurance applies across the whole of Crossrail, including its end-to-end interfaces, until such time as the Infrastructure Managers and the CTOC obtain Safety Certification for the necessary authorisations for passenger service on the Crossrail route.

CRL has defined review points within Crossrail, such as prior to works package contracts being let, and prior to the issue of drawings for construction, when it reviews the work of the Delivery Contractors and Industry Partners to provide assurance that the Sponsors Requirements are being met. These review points are the verification and validation activities in order to provide evidence in a progressive manner that Crossrail will meet the Sponsors Requirements, as shown in figure 6.4.

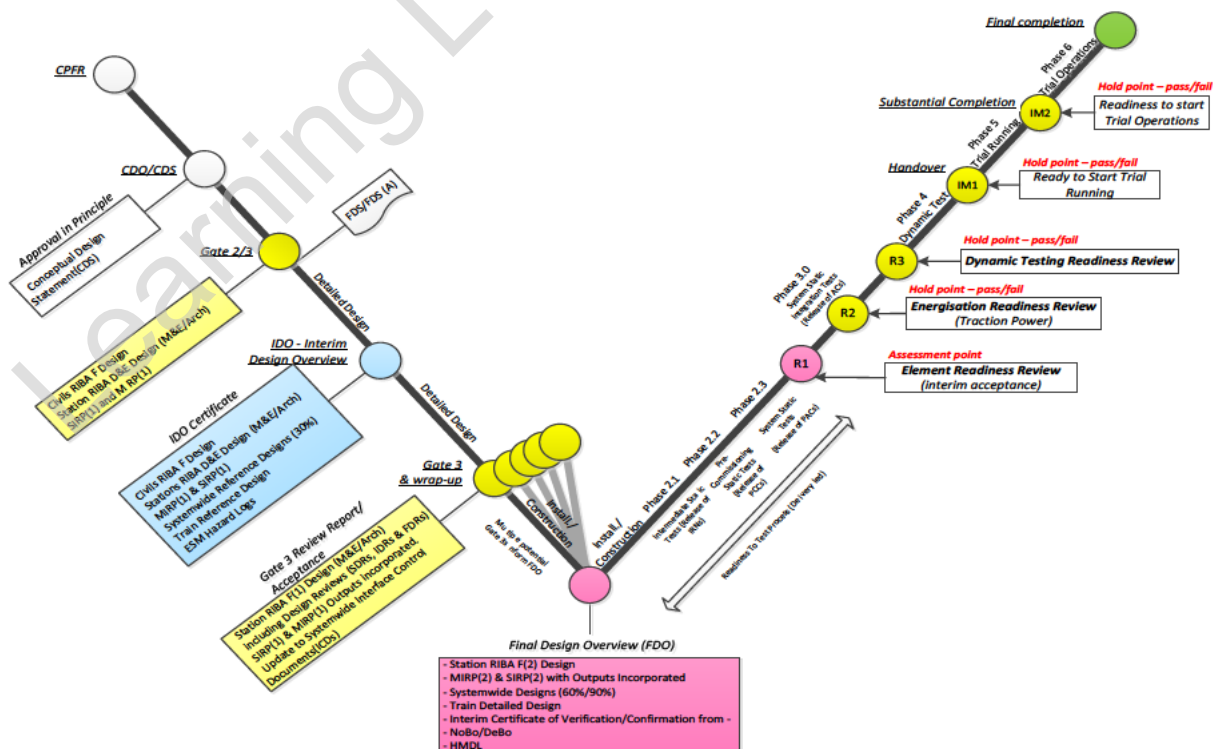


Figure 6.4 – Assurance V Life-Cycle

Engineering Safety Management

In parallel with progressing the design, implementation and testing of the Central Operating Section, safety justification information will be developed by the Framework Design Consultants and the Delivery Contractors.

The Technical Directorate will provide leadership of this process called Engineering Safety Management, as defined in the Systems Safety Plan.

Engineering Safety Management is the process by which the railway is demonstrated to be capable of operation to control the safety risks to future users to As Low As Reasonably Practicable (ALARP). It is applied to all scope within the Central Section. To ensure progressive assurance, and to facilitate the acceptance of future safety justifications, CRL will draft Interim Safety Justifications based on the Design Engineering Safety Justification from Stations and Infrastructure and on the 60% Design Stage Gate ESM report from Systemwide Contractors. This will form part of the Final Design Overview (see figure 6.4) and help demonstrate that Systems, Stations and Infrastructure are safely integrated.

This will ensure that CRL effectively manages the production of technical safety justification that will be required to support authorisation (regulatory approval) and handover to the Operators.

6.4 Land and Property

6.4.1 Land Management

The Land Management Team is responsible for both the permanent and temporary acquisition of all the land and property required for the construction of Crossrail. The Crossrail Act 2008 provided powers to acquire land, or rights in land, within the limits of deviation set out in the Act, in return for appropriate compensation. Before compulsory purchase powers have expired in 2013, the acquisition team served more than 11,400 notices during 2008 – 2013 to secure on behalf of TfL all the land within powers required by the project. This will deliver more than 150 hectares of surface land and 10 million cubic metres of subsoil. Properties may still be acquired by agreement or private treaty, if deemed appropriate. The current anticipated final cost for land acquisition is approximately £850 million.

CRL has taken possession of the majority of the land and property interests required for the construction and operation of the railway and negotiation for the formal transfer of the land and payment of compensation will continue until all claims have been settled. The team's focus is on closing out claims, ensuring we have clear title to land along the route and managing any additional acquisitions required outside of powers.

6.4.1.1 Objectives

The Land Management Team has two principal objectives:

1. To complete the acquisition process and settle claims as quickly as possible while also ensuring that the cost of compensation is controlled within the budget provision that has been made.
2. To pull together all necessary property information for TfL, RfL and LUL, as well as completing an assurance process that demonstrates to RfL and LUL that all of the property rights necessary for operation of the railway have been acquired.

6.4.1.2 Challenges

CRL occupies several sites across the route on a temporary basis. If the occupation of these sites extends beyond the originally forecast duration then the cost of occupation will increase. The same applies for temporary rehousing, where worksites that continue to exceed noise trigger levels will generate increased costs in the provision of alternate housing.

A risk remains of claimants demonstrating an entitlement to compensation in excess of that forecast either in the course of negotiations or in legal proceedings before the Land Tribunal.

6.4.1.3 Approach

The PDA places a responsibility on CRL to act as agent for the settlement of all compensation claims and to defend all legal proceedings relating to property acquisition. It discharges this role using the services of TfL Operational Property to conduct the negotiation of compensation claims, with the intention of settling those claims within the available budget.

The Land Management team is working with the CRL Technical Information team and RfL to complete as built drawings for the whole route. This process will produce plans that allow comparison of land acquired with constructed Crossrail assets, providing the foundation for the assurance process with RfL and LUL. The process will identify any remaining property agreements that are required to be put in place by CRL before handover of the land to the Infrastructure Managers.

6.4.2 Oversight Development

The Crossrail Act provides powers that only relate to the construction and maintenance of the railway. On completion opportunities for Oversight Development (OSD) will exist. The Secretary of State gave an Undertaking to bring forward OSD planning applications within two years of the commencement of work on site.

This Undertaking has been implemented by CRL. In relation to those sites which are subject to collaboration agreements with property developers, joint planning applications for the OSDs have been made by the developers and CRL.

There are five properties acquired for Crossrail which have a single owner and the Secretary of State has entered into collaboration agreements with the owners. The agreements provide for a joint venture approach to redeveloping these sites with a shared return.

There are seven other sites with multiple owners where CRL has progressed development opportunities directly by procuring scheme designs and planning consents.

6.4.2.1 Objectives

CRL's objective is to work with the landowners to optimise the uplift in development values in ways that are consistent with, and do not prejudice, Crossrail's objectives or the operational requirements of the railway. The economic benefit of the uplift will be realised by TfL which has underwritten project funding on the basis of raising £545 million by this process.

6.4.2.2 Challenges

The principal challenge is to ensure that the OSDs yield the best value for money and optimise the benefits for both CRL and TfL, and that the designs for both elements are properly integrated. This has to be achieved within relatively challenging timescales for complex sites with many interfaces, design and construction constraints and with many stakeholders.

6.4.2.3 Approach

In accordance with the PDA, CRL and TfL have agreed a protocol for the handling of development opportunity. The protocol sets out how the design and the 'returns' to TfL are optimised, and it provides a framework to be applied in each of the developments. CRL's Oversight Development Management Plan sets out how the Crossrail OSD Team will implement policies, undertakings and objectives with respect to Development Opportunities.

Where collaboration agreements exist the developer has procured and paid for design work and will, in conjunction with CRL, submit a joint planning application. In this situation CRL has ensured that the design of the OSD is properly integrated with the Crossrail design being undertaken by the FDCs and the Tier 1 Contractors.

For sites where there is no collaboration agreement, CRL has progressed development opportunities directly and will seek developer interest. CRL has procured the design required for the planning application through the FDCs and the work has been managed by the Technical Directorate in collaboration with project delivery teams. This has ensured that the OSD work and Crossrail work is properly coordinated, planned and integrated and that the design for both parties can be 'optimised'.

In June 2014 the CRL Board approved a policy that OSD construction should be planned to commence immediately following sectional completion with OSD and Urban realm completion ideally being timed to precede the opening of Crossrail in December 2018. By taking control of OSD activities now CRL has the best chance of avoiding logistical and commercial risks towards the end of the project. Accordingly, CRL's Land & Property Team has developed a collaborative strategy for the effective delivery of the OSDs and urban realm improvements.

The OSD programme provides for commercial and residential development across 12 sites - a development pipeline of 3,250,000 sq.ft gross, with a Gross Development Value of c.£2.5 billion - and potentially more than £500m value to TfL.

Critical OSDs integral to station entrances	Important OSDs, adjacent to station entrances	OSDs removed from station entrances
<ul style="list-style-type: none"> • Bond Street West • Bond Street East • TCR West • TCR East • Farringdon West • Farringdon East 	<ul style="list-style-type: none"> • Liverpool Street West: 101 Moorgate • Liverpool Street East: 1 Liverpool St/Blomfield Street 	<ul style="list-style-type: none"> • Paddington PIP/LUL station • Fisher Street • Woolwich East • Limmo site

Figure 6.5 – Oversight Developments

From 2016 CRL and TfL will commence developer partner selection for the six sites where a collaboration agreement with an existing development partner is yet to be put in place. CRL will support TfL in putting in place Development Agreements with all of the collaboration partners.

Current property market projections remain positive over the next few years, with TfL returns potentially being maximised by early development starts. The Crossrail construction contracts for sites where there is an OSD contain options for CRL to take back sites (the sectional completion handover date) prior to the completion of the works at no additional cost to CRL. This means that the station roof slab and any identified OSD areas will be made available for OSD construction at the same time as the stations are being fitted out and commissioned. Early development of the OSDs immediately following sectional completion and handover should maximise TfL returns and mitigate the risk of Crossrail appearing unfinished when the stations are opened.

Completion of the developments in time for the opening of Crossrail will not be achievable in every instance. Where it is not achievable (or desirable), CRL will first aim for early commencement, with a view to reaching shell and core construction with completion of cladding and scaffolding removed by the date of Crossrail opening. But, as CRL/TfL cannot force a developer to start development, “Olympics” style clauses will be inserted in development contracts, enabling TfL to require the developer to suspend OSD construction works and to make areas clean and tidy at and around the time of station opening.

There are three conceptual delivery models for OSDs:

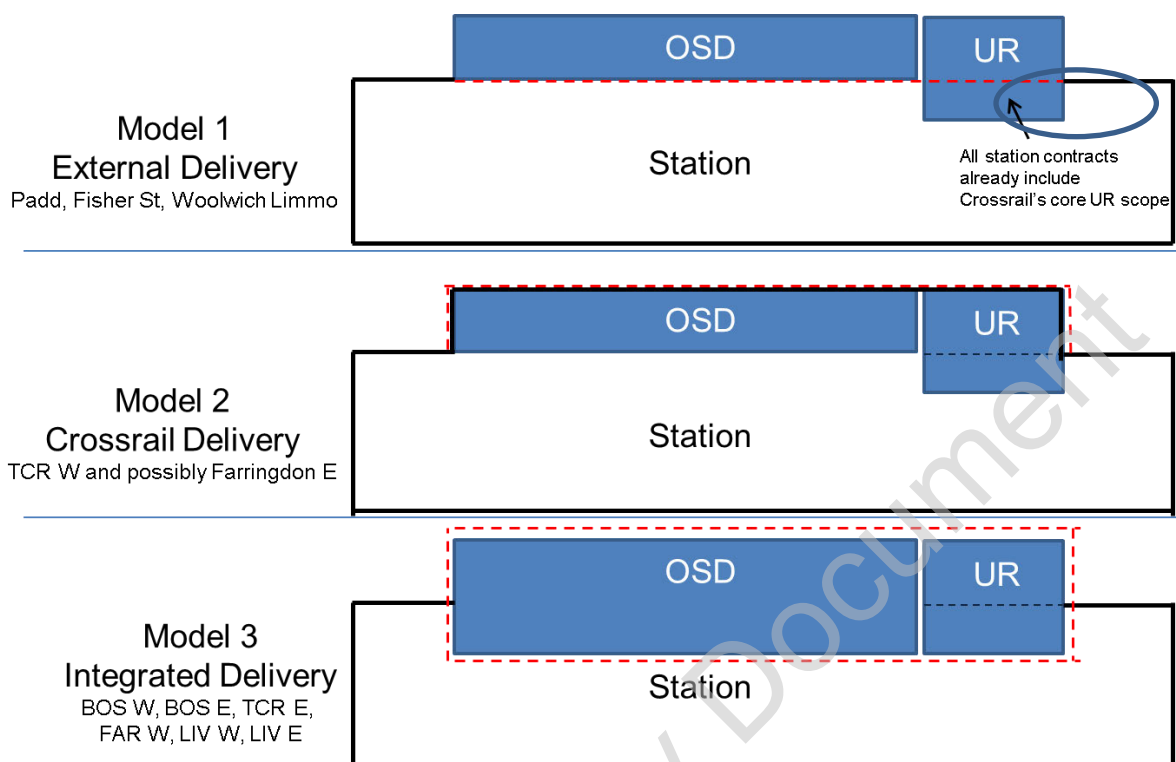


Figure 6.6 – Oversight Development – conceptual delivery models

Health and safety

To ensure an effective focus on health and safety, the developer partners will be appointed as CDM elected clients to deliver the OSD from RIBA D onwards. Developers will be invited to mirror Crossrail's Target Zero ethos along with regular monitoring and reporting to check compliance. Design assurance will be provided through planning development control and the building regulations approvals, managed via an Approved Inspector Regime.

Design and development control

The contractual development controls provided in the model Development Agreement and Lease give CRL/TfL absolute control over the developer partner in relation to their Stage D design through pre-construction and build-out to practical completion:

- Technical Interface Parameters (TIP) documents clearly define the physical and functional interfaces between the station and OSD and have been jointly produced and signed off by our station teams;
- Construction Interface Control Documents (CICDs) must also be prepared by developers for approval by our station teams, detailing how contractors working in close proximity can ensure safe and efficient implementation; and
- An Asset Protection regime will aim to ensure safe OSD construction alongside the operation of the railway, with the developer acknowledging that in the event of any conflict on safety and security matters, railway interests are paramount and will prevail at all times.

Moreover, although the developer gets exclusive use of the OSD site on handover, the lease is not granted to them until the developer has fulfilled their performance obligations under the contract.

In addition to the contractual controls and the Asset Protection regime, each OSD will be subject to independent development monitoring via a third party appointed by TfL. The Development Monitors will provide regular site inspection during construction, attend monthly project progress meetings and provide a periodic report to CRL/TfL covering project finances, contractual obligations (e.g. discharge of planning conditions, building control, CDM adherence) and monitoring progress against schedule, quality and other targets. This report will feed into the periodic dash-board produced for each OSD project.

Progress and exceptions will be reported by the Station project manager to the Programme Delivery Board, which is, chaired by the Programme Director.

6.4.3 Estates Management

6.4.3.1 Property Management

CRL’s Estates technical team continue to supply a wide range of essential works to support the main delivery programme. This has enabled the project to progress without the risk of delay or major cost variation. Examples of works undertaken include basement tanking, rendering, settlement repairs, major double glazing installations, masonry repairs, office refurbishment and provision of hotel accommodation in noisy residential work areas.

The Estates technical team will continue in future years to support the project by further providing respite accommodation, Canary Wharf Station interim maintenance and supporting the fit out as well as Facilities Management at Liverpool St and Westferry Circus. The team will also continue to keep all Crossrail retained property safe and secure.

6.4.3.2 Estates Legal and Commercial

CRL will maintain a management tracker of all known occupational lease and licence agreements across the project. CRL will continue to ensure rent, rates and other commercial liabilities for occupation are correct and where applicable paid on time.

6.4.3.3 Estates Management

The computerised Estates Management System will continue to collate, track and report on each transition between one contractor leaving and another entering Crossrail land to manage and account for all land acquired. Estates will continue to manage all exchanges of property through to the final handback stage on completion of the project where the estate is handed back to the end user.

Where vulnerable unprotected areas are identified outside the main works programme then estates will continue to secure and protect the estate to ensure corporate risk is either transferred or mitigated.

6.4.3.4 Access management

In 2016/17 the Access team will manage property access into over 3,000 properties across London to decommission and remove settlement monitoring equipment now tunnelling and spray concrete lining work is complete.

6.4.4 Urban Integration

The proposed urban realm and transport interchange improvements outside the Crossrail stations will have a crucial impact on the utility and first impression of the new stations. The quality and extent of the improvements will determine whether this first impression is favourable or otherwise and whether arrivals and onward journeys are easy experiences.

The statutory requirements for the reinstatement of worksites are set out in the Crossrail Act 2008. Schedule 7 para 11 (2) states that the nominated undertaker shall, when the use of a worksite in connection with scheduled works is complete, ‘restore the site in accordance with a scheme agreed by the local authority’. A similar requirement exists if the construction site falls under Schedule 5 of the Act.

The urban realm designs which CRL and, on the surface section, Network Rail (NR), will be implementing have been drawn up in line with these statutory requirements. The designs have been developed with the individual local authorities and TfL to ensure that when a scheme is submitted for its formal Schedule 7 restoration consent it will enjoy the benefit and status of prior collaborative working with the local planning authority.

6.4.4.1 Objectives

The objectives for Crossrail’s urban realm are to: gain formal planning consents from local authorities; full design development of the Central Section to RIBA F; co-ordinating funding from third parties; and co-ordination and implementation of urban realm plans with third parties so that the improved areas are as extensive as possible.

6.4.4.2 Challenges

The challenge for the Crossrail elements of the urban realm designs is to gain consents for the urban realm and to complete the design which includes the gate assurance process. For the improvements being delivered on the surface section by NR, and on the surface and central sections by the local authorities, the challenge is to co-ordinate the funding and the implementation programmes. At some locations where Crossrail and NR’s improvements are being supplemented by local authority improvements over a wider area, the challenge is to pursue an optimal delivery arrangement of one agency managing the implementation of the improvements.

6.4.4.3 Approach

The approach to the urban realm consents is set out in the Crossrail Act under the site restoration clauses. The Memorandum of Understanding on the Urban Realm and Transport Interchanges agreed with local authorities, DfT and TfL in 2010, sets out the principles of partnership working and joint funding of the designs that have been followed to date and will continue to be adhered to as the designs are progressed by the various parties.

Procurement

The Procurement Strategy for Crossrail is an integral component of the Delivery Strategy, though it has been developed to act as a stand-alone document.

Purpose

The Procurement Strategy describes the principles, the options and the processes which the integrated Crossrail organisation uses for procuring the different elements of Crossrail. It is supported by the Programme Procurement Plan which is a separate document and describes packaging and procurement planning. The Programme Procurement Plan is a living document that has developed over time as the Category Procurement Strategies and work package procurement planning process have developed.

Focus on cost and risk

CRL management's approach in developing the Procurement Strategy was to place cost and risk management at the centre of the process. CRL's aim has been to challenge cost and mitigate risk in every phase of the work, and at every level within the project, whilst being alert to opportunities where they exist.

Strategic risks

CRL management recognises that strategic risks, such as funding and other investments beyond Crossrail, are being managed by the Sponsors, Industry Partners and other stakeholders. The strategy provides for all Category Procurement Strategies and work package procurement plans to take account of these, and to identify opportunities for mitigation or other opportunities for flexibility where they exist.

Appraisal

Each element of the project has been appraised through the development of a Category Procurement Strategy and/or work package procurement plan. The appraisal has been undertaken in accordance with the principal considerations set out in section 3 with option selection based on ensuring best value.

Procurement process

Procurement processes have been undertaken in accordance with CRL's procurement management processes, compliant with all relevant European procurement legislation, UK Government regulations and TfL procurement policies.

Industry Partners

The strategy for procuring those elements of Crossrail related to Industry Partners has been substantially determined by the incumbent positions of those partners and the agreements already in place. CRL management continues to work collaboratively with its Industry Partners to ensure it has visibility of the respective procurement processes and is able to assure the adequacy of Industry Partner activities at every stage of the process. CRL management is proactively engaged with Industry Partners to identify and mitigate risk through the procurement process.

6.5 Consents

Construction can only commence with the relevant consents in place. All consents necessary for the works and related activity must be obtained in advance of any construction commencing, primarily planning consents through Schedule 7 of The Crossrail Act.

Submissions for consents must be made sufficiently early to allow time for extensive pre-application consultations, post-application negotiation and for appeals when necessary. Typically this could be six to nine months before the scheduled start of construction. It can be a challenge obtaining sufficient detail of the plans and construction methods from design teams in a timely manner.

The Crossrail Act varies legislation relating to a number of consents, usually to simplify and speed up the process. Some consent granting bodies are resistant to these changes to their normal regimes and seek to obtain further details or impose conditions not permitted under the Crossrail legislation.

CRL management will work closely with delivery partners to track the emerging information for submissions against the consents registers which should be constantly monitored and updated by them to reflect the construction schedules.

CRL management will also seek to build strong, constructive relationships with the consent granting bodies by a combination of openness and transparency whilst also managing their expectations, in particular through the Crossrail Planning Forum.

6.6 Construction

The management and direction of the construction of Crossrail is the responsibility of Crossrail Delivery teams for the Central Section works and the Industry Partners for their sections of the work. Crossrail has produced a construction management plan which sets out in detail how it manages the delivery of the Central Section Works. Network Rail has also produced its project execution plan for Crossrail Surface. Construction arrangements for other Industry Partners are set out in the appropriate agreements.

CRL management's role is to provide leadership and support in relation a number of programme wide activities including health and safety (section 7.2) and logistics and security which are covered in this section.

6.6.1 Logistics

Logistics play an important role in the delivery of Crossrail by helping to minimise the impact on the environment, the community and London and in achieving efficiencies in the geographically fragmented construction activities.

6.6.1.1 Objectives

Crossrail has developed a project wide logistics strategy which coordinates all logistics activities to maximise the potential efficiencies and benefits. The integrated Crossrail organisation has also established a core logistics capability to deliver the strategy. The objectives are to:

- Achieve zero accidents for the public, 3rd parties, employees and contractor in relation to logistics activities;
- Ensure project-wide compliance with the Crossrail Act 2008 Environmental Minimum Requirements (EMR) and other relevant legislation with respect to logistics activities;
- Meet Crossrail’s sustainability objectives and targets for the beneficial re-use of excavated material; and
- Support the delivery of Crossrail on time and within budget through logistics led construction efficiencies.

6.6.1.2 Challenges

The logistics challenges include:

- Managing the large number of vehicle movements within central London from many suppliers to many sites;
- Establishing ways of working within the limited amount of space available for the storage of material at worksites in heavily congested urban areas; and
- Ensuring that contractors implement a logistics solution to ensure and demonstrate compliance with undertakings and assurances.

6.6.1.3 Approaches

Logistics plan

A Logistics Plan for the Central Section Delivery Area has been produced. The aim of the logistics plan is to set-out the requirements for logistics activities in the Central Area.

Disposal and re-use of excavated material

To ensure beneficial re-use of excavated material CRL signed an agreement with the Royal Society for the Protection of Birds (RSPB) to create a wildlife habitat at Wallasea Island. This minimised risk and reduced road transport as the vast majority of the material was taken by marine transport to this site.

Management of vehicle movements

A Traffic Co-ordination Centre (TCC) has been implemented to co-ordinate vehicle movements in central London. The Contractors are also required to produce Logistics Plans to demonstrate how they will minimise vehicle numbers by the use of rail or water where practical, or by other techniques such as consolidation.

CRL is running a Lorry Driver Training programme to train frequent visitors to Crossrail sites to minimise the risks they bring. This is based on a driver training programme developed for the TfL Fleet Operator Recognition Scheme (FORS). The course is designed for frequent lorry drivers who work on the Crossrail programme and, in particular, any Large Goods Vehicle (LGV) driver. The course focuses heavily upon lorry drivers’ awareness of sharing London’s roads with vulnerable road users.

6.6.2 Security

CRL management has established a specialist security team - consisting of a Security Manager, Security Advisor and a Police Liaison office – who are responsible for helping to define the security requirements, and potential security solutions, to meet the range of challenges posed by the differing environments of Crossrail.

CRL has developed an overarching Security Policy – consisting of a security standard, security procedure and an assurance programme – that focuses on providing a secure working environment by protecting people, assets and operations against risk of injury, loss or damage from criminal, hostile or malicious acts, and delivers a world-class secure environment for Crossrail.

CRL management works with its partners to develop the most appropriate solutions related to construction stage security. Work focuses on establishing best practices in relation to people, assets, information and operations.

CRL management has worked closely with all the stakeholders in order to develop the Crossrail security guidelines, directives and best practices that have clear business justification and enable security operating procedures to be implemented by those responsible for the delivery and, ultimately, operation of Crossrail. These security requirements are incorporated within the Works Information for all of the delivery contracts.

The security function is transparent and subject to review and assurance.

6.6.3 Management

The Central Section Delivery Organisation is structured around three Delivery Sectors. The division of responsibility is split as follows:

- Stations Sector - includes all new Crossrail Stations between Paddington and Woolwich;
- Civils Sector – includes all remaining civils works such as tunnels, portals and shafts (excluding Stations and Systemwide) between Old Oak Common and Plumstead and Ilford Yard; and
- Systemwide Sector – includes the specification, procurement and the project management of the Design & Build Contracts and their interfaces in order to deliver a completed and fully tested safe railway to the Operators for passenger service, to quality, to time and budget.

Construction management describes the organisation structure, roles and responsibilities, processes and tools required to mobile site activities, and manage them to maintain the integrity of the assured design, through to completion and close out.

It applies to main works construction; advance works site activities and off site production facilities under the control of the Crossrail Central Section Delivery team and includes the approach to Health & Safety, Environment and Security and is founded on Target Zero and Golden Rules.

Construction packages are arranged to capture specific elements of scope or geographical boundaries. Each Construction Package is identified by a Contract number (CXXX) (e.g. C330 – Royal Oak Portal) and the Central Section Project Scope map (below) details the contract packages and their interfaces.

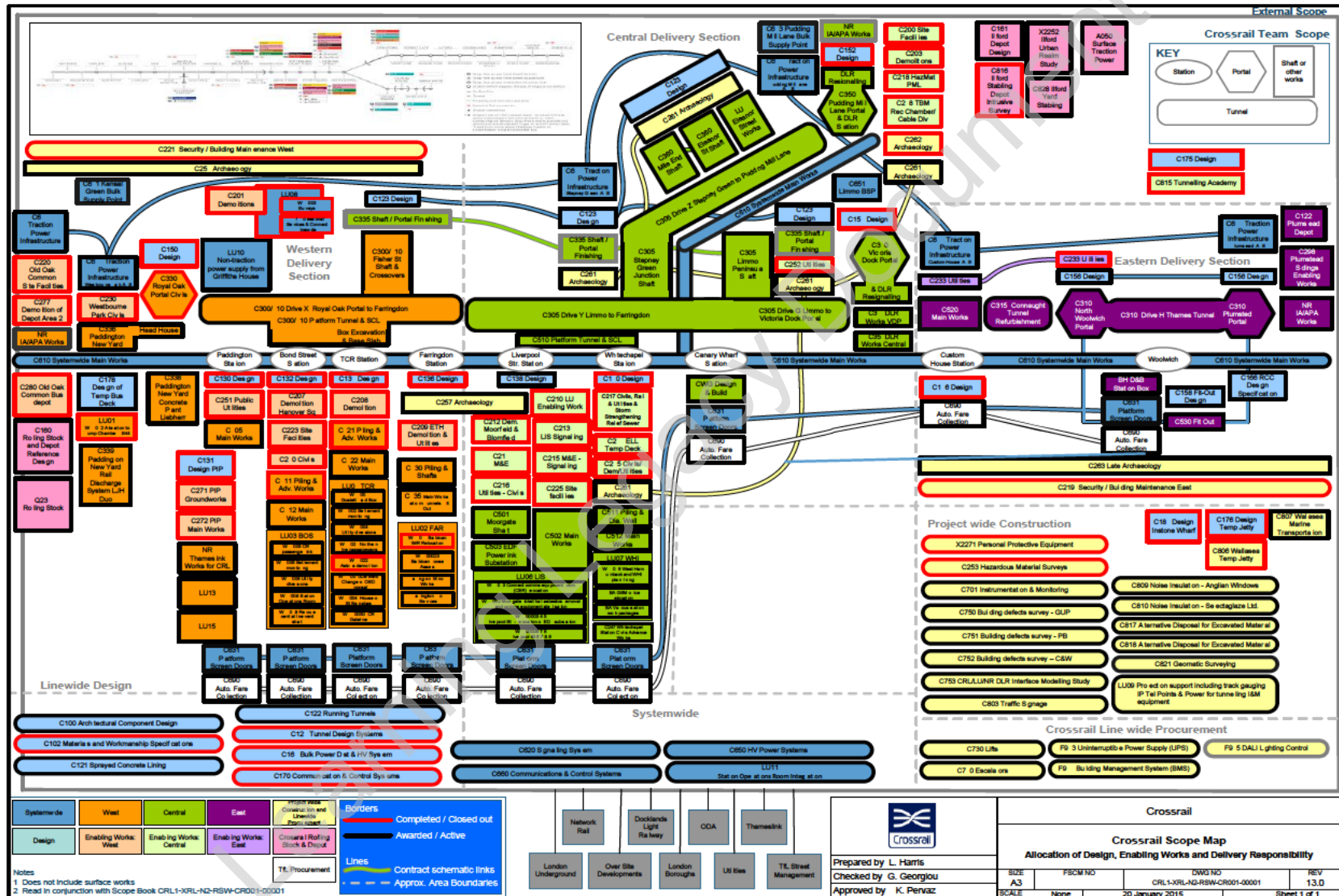


Figure 6.7 – Crossrail Scope Map

The Construction Management Plan describes, in particular, how the specific duties of *Project Manager* and *Supervisor* (as defined by the NEC3 form of contract) and of *CDM Coordinator* as defined in the CDM Regulations (2015) will be executed. In broad terms, the responsibilities are split as follows:

- **Project Manager** duties (cost and programme) are executed by the Project Manager undertaking the role of the Project Manager’s Representative and the Construction Management Team;
- **Supervisor** duties (technical, quality and quality certification) are executed by the Supervisor Rep (Project Field Engineer) and the Field Engineering Team; and
- **CDM Coordinator** - the Project Manager shall be the nominated representative to carry out the duties of CDM Co-Ordinator in accordance with Crossrail’s CDM Responsibilities Matrix.

The Central Section Delivery Organisation and reporting lines shall continue to be updated in line with any changes to the overall Crossrail Delivery Strategy.

6.6.4 Quality

Quality in construction shall be achieved through planned self-certified activities in accordance with the Contractor’s Quality Management System (QMS) and subject to monitoring and surveillance by the Crossrail Central Section Delivery team. The oversight, monitoring, surveillance and audit of the Contractor’s activities - in addition to the compliance monitoring performed by the Central Section Delivery team - is the fundamental basis for demonstrating the delivery of quality in construction.

The basis for delivering this quality is the use of a QMS that complies with the version of ISO 9001 current at the Contract date. This will include for competent resources, appropriate procedures, adequate planning, suitable equipment and tools, current project drawings and specifications, and appropriate supervision and technical direction in accordance with sound construction methods, techniques, and practices.

Technical and quality requirements are established in design documents prepared by competent designers under the management of the Technical Directorate Engineering Managers and documented within the Works Information. The Contractor shall develop these requirements for the Project Manager’s acceptance.

Verification of product quality in construction will be achieved through planned inspection, examination, surveillance, testing, and monitoring of work activities. Documented evidence of the results and checks shall form the basis of the Contractor’s self certification of quality.

The Crossrail Central Section Delivery team will lead the review and acceptance of construction deliverables, observations, inspection and surveillance on-and-off site, management and administration of nonconformities, snagging and outstanding works process and also monitor the compliance and progressive compilation of certificates and quality records. This ensures appropriate quality related documents are being delivered to programme and being complied with and implemented on site. The team also ensures the sequencing of activities does not impact on product quality and that working level programmes identify both primary quality documentation and any quality issues relevant to follow on works. The Supervisor Rep reports directly to the Technical Directorate on any technical queries during implementation for changes that may impact the assured design.

6.7 Testing, trial running and trial operations

6.7.1 Objectives

The processes for bringing the complete railway into operation are established in Section 16 of the PDA which describes the relative responsibilities of CRL and the future Infrastructure Managers to ‘carry out, or procure the carrying out of, the activities necessary to achieve Substantial Completion and Final Completion’. Schedule 11 sets out the framework for integration and bringing into service, which includes a standard template and definition of stages to incrementally integrate and bring sections of the railway into service through the following steps and as shown in figure 6.8.

- Testing and Dynamic testing;
- Handover;
- Trial running; and
- Trial operations.

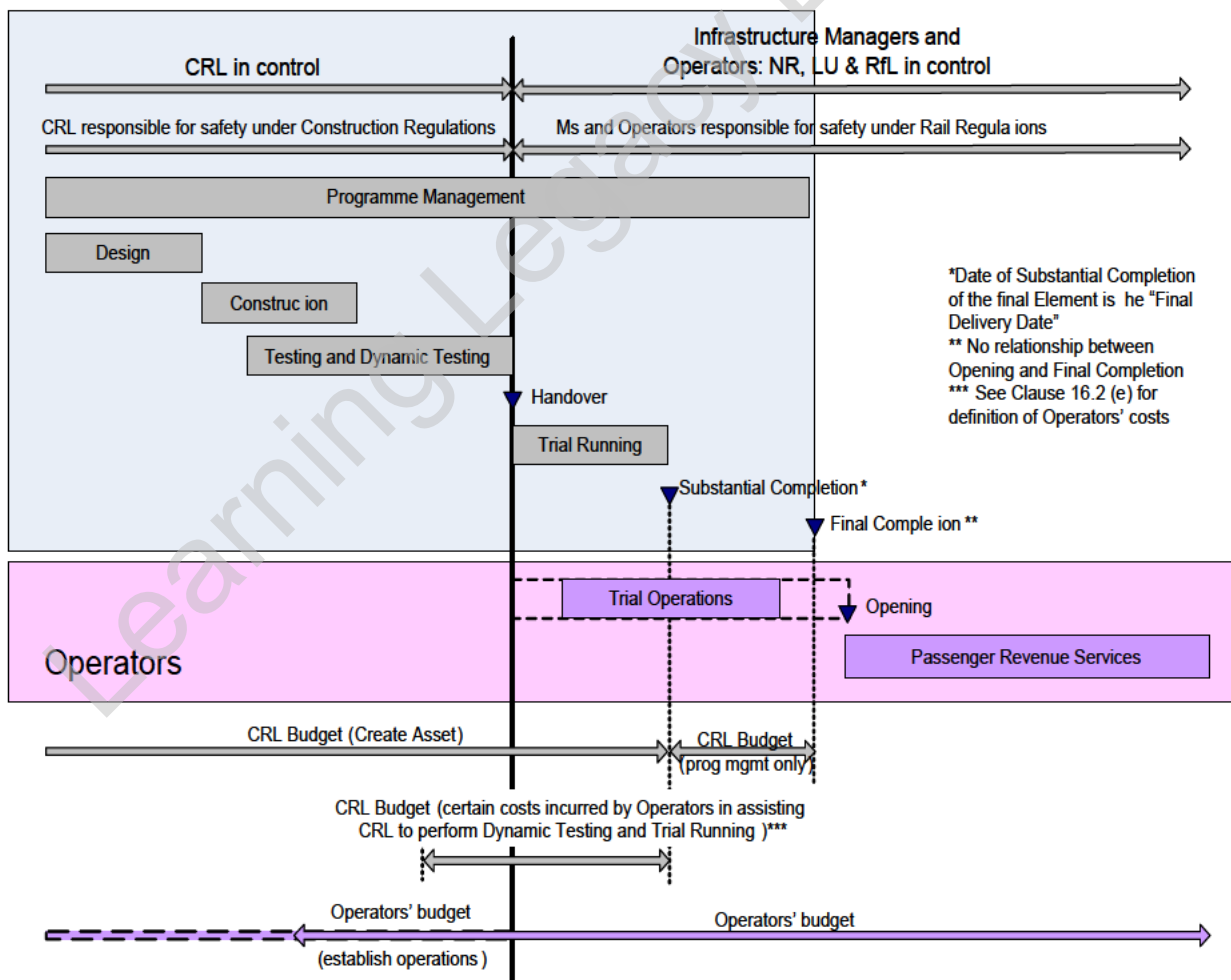


Figure 6.8 – Staged handover (PDA Schedule 11 - Handover, completion and opening)

This figure also shows the respective responsibilities of CRL, the future Infrastructure Managers and the operators. Each section of the railway will be brought into passenger service incrementally through a series of stages, as defined in the Sponsors Requirements (see table 3.1). This approach means that the whole of the integration risk can be incrementally managed in stages and each stage has specific integration objectives to achieve.

For example Stage 1 (previously Stage A) is designed to address the integration of the new rolling stock with the existing infrastructure. Figure 6.9 shows the staging proposed by CRL at the Spending Review.

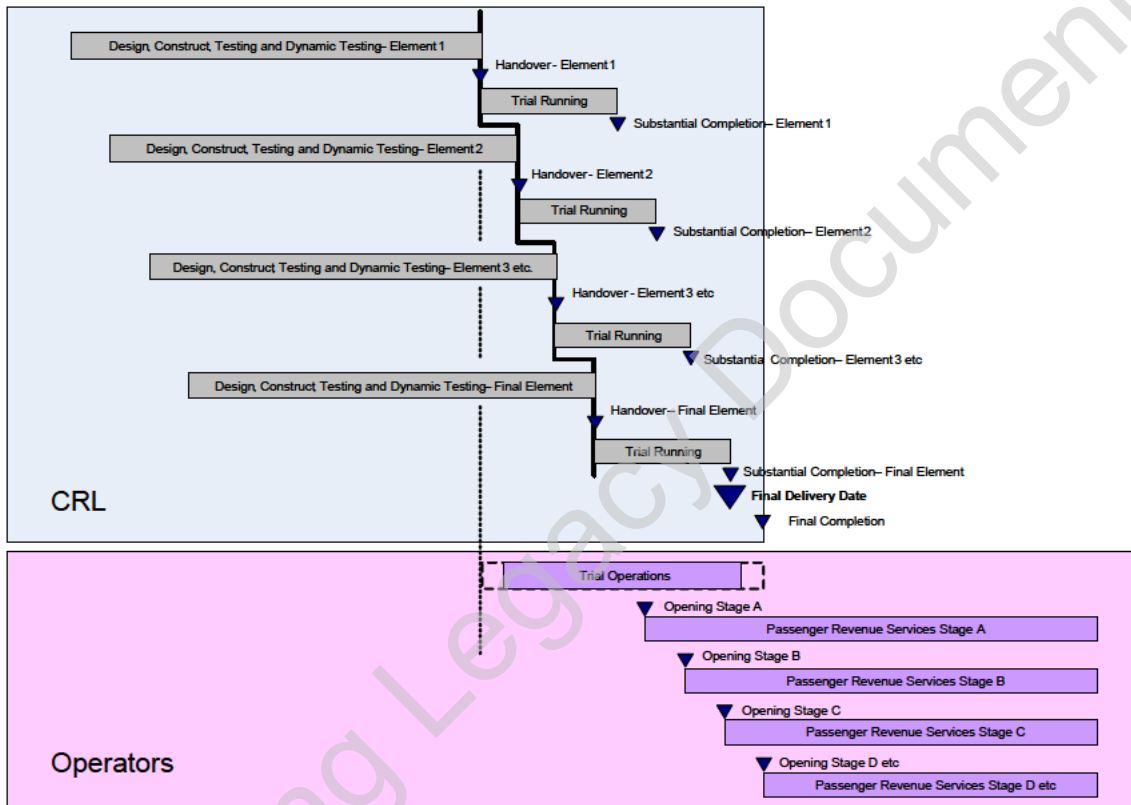


Figure 6.9 – Phased opening (PDA Schedule 11 - Phased Opening of the Railway)

The current schedule of stages is illustrated below:

SR stage	CRL stage	Description	Target Date
N/A	0	Liverpool Street High Level to Shenfield Crossrail Train Operator commences operation of Greater Anglia services planned to become Crossrail services using existing (Class 315) rolling stock - Already complete	May 2015
A	1	Liverpool Street High Level to Shenfield Progressive introduction of new Crossrail trains on existing suburban services into Liverpool Street by substitution.	May 2017
C	2	Paddington High Level to Heathrow On-Network Works between Heathrow and Paddington Substantially Complete with Crossrail Services running at a frequency of 4 TPH into Paddington (high level)	May 2018
D	3	Paddington Low Level to Abbey Wood Crossrail Services running from Paddington (low level) to Custom House/Abbey Wood allowing a nominal 3 months for Trial Operations on that Part	Dec 2018
E	4	Paddington Low Level to Abbey Wood & Shenfield Through running of Crossrail Services from Paddington (low level) to Shenfield and to Custom House/Abbey Wood.	May 2019
F	5	Reading & Heathrow to Abbey Wood & Shenfield Full Crossrail Services from Reading and Heathrow through the Central Section to Shenfield and Custom House/Abbey Wood	Dec 2019

This sequence of service openings and associated schedule is designed to minimise the risk in integrating the end to end Crossrail services following completion of the Central Section Works, by opening successive stages once earlier ones have stabilised.

6.7.2 Challenges

The principal challenge arises from the integration, testing and commissioning of many systems and the rolling stock, and the scale and complexity of the undertaking.

6.7.3 Approaches

CRL management's approach is to proactively manage integration risk at all stages of the programme lifecycle. The ownership of and responsibility for managing the integration of testing and commissioning activities for Crossrail and Industry Partners is clarified within the Project Testing and Commissioning Strategy

Project Testing and Commissioning Strategy

CRL has developed a Project Testing and Commissioning Strategy, and a Programme Testing and Commissioning Management Plan which clarifies, for each stage of service opening, the responsibilities of the various parties (CRL, Industry Partners and operators) for managing or supporting each of the above Stages.

These responsibilities will be based on the following principles:

- Responsibility for dynamic testing of each major component will be managed by the relevant delivery partner:
 - Network Rail for Crossrail Surface;
 - Crossrail Delivery teams for Central Section Works;
 - Rolling stock/depot delivery partner for the rolling stock and depot; and
 - MTR Crossrail as the Operator - the Crossrail Train Operating Company (CTOC)
- Dynamic testing will be used to validate that integration between the major components has been achieved prior to commencement of trial running. It will commence in the east between Canary Wharf and Abbey Wood before progressively extending through to Paddington.
- As set out in PDA Schedule 11, trial running should normally commence after passing the acceptance gate. CRL will manage an acceptance gate prior to commencement for this purpose.
- The “T minus” protocol has been adopted to review the state of readiness from 52 weeks out from each Stage tracked through the Crossrail Operational Readiness Steering Group.

6.8 Handover and Regulatory Approvals

6.8.1 Handover

In accordance with clause 16.2 of the PDA, the Crossrail scope has been categorised into Elements, each of which will go through Handover to support the five key stages of opening. As agreed under the Handover Strategy and Plan there are 27 Elements, 16 of which CRL will Handover to the final owner (either Rail for London or London Underground). Figure 6.10 illustrates the break down of the 27 Elements according to the party responsible for delivering, and the party receiving Handover.

Crossrail Handover Scope Map

Version 1.0 November 2015

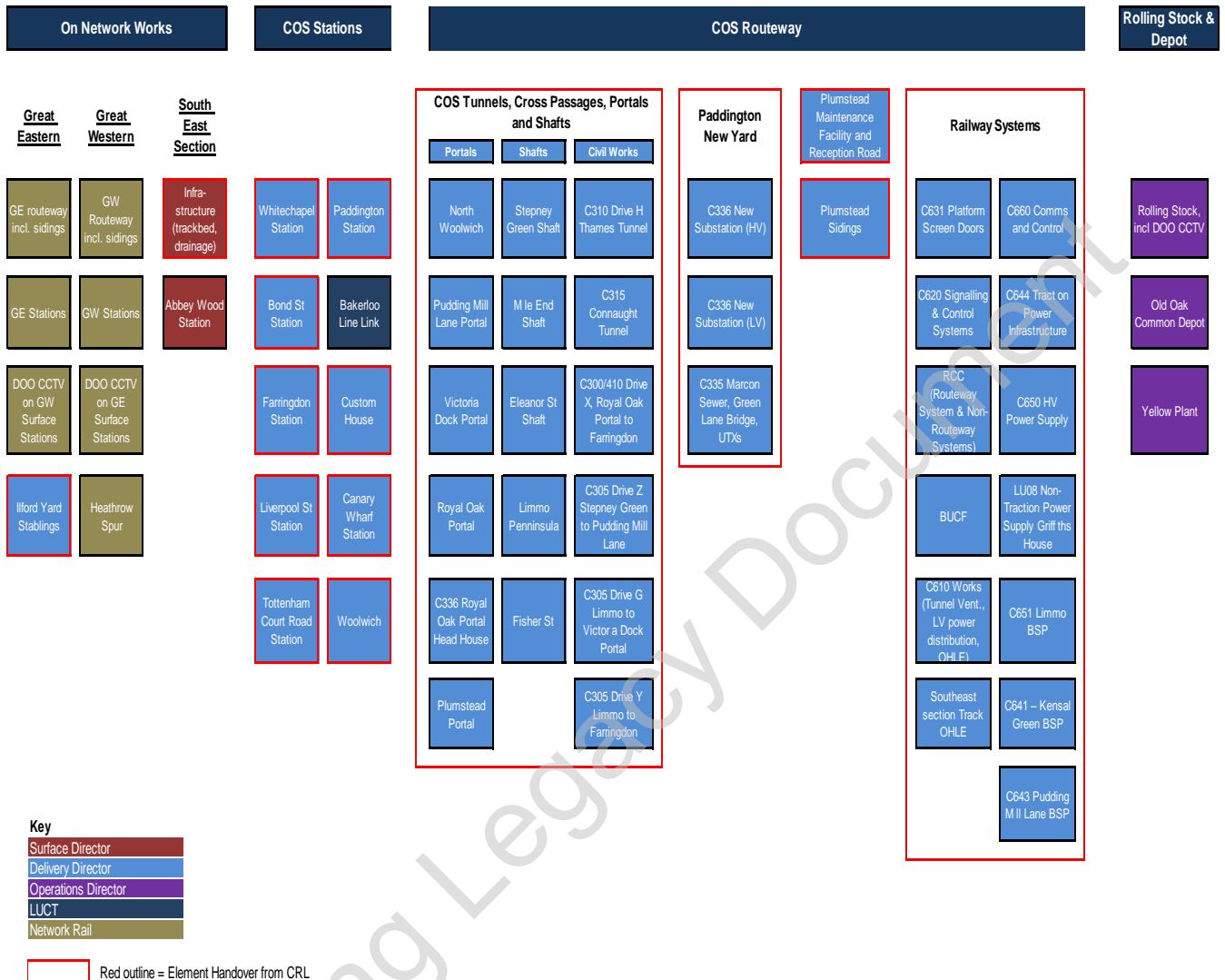


Figure 6.10 – Handover of Crossrail Elements

There are nine key requirements that must be met to achieve Handover, as agreed under the Handover Strategy and Plan:

- ✓ Element Completion and Handover Report (ECHR) completed
- ✓ Handover documentation transferred to the Infrastructure Manager
- ✓ Agreements in place (Commercial, Land & Property, Undertakings & Assurances, Regulatory Approvals, Licences)
- ✓ Works are complete
- ✓ Training has been delivered by CRL to the Infrastructure Manager
- ✓ Spares and equipment procured and available
- ✓ Warranties and defect liabilities defined, agreed and handed over
- ✓ Infrastructure Manager asset databases are populated and ready to use
- ✓ Infrastructure Manager readiness to accept

CRL shall have a dedicated team to manage Handover of the 16 Elements from CRL to RfL and LU. The team will report to the Delivery Director, and will be responsible for developing a 'toolkit' to manage the nine requirements for Handover, as well as resource to support the project teams in delivering against the toolkit. The toolkit will include procedures, reporting, a framework for readiness meetings, and an integrated programme. A Handover Delivery Working Group will be formed of technical/discipline leads from CRL, RfL and LU, as well as an MTR-C representative (for consultation purposes). The Handover Delivery Working Group will work together to develop and endorse the toolkit.

Works delivered by CRL that involve Handover to an Operator other than RfL or LU will be managed locally by the project team according to the specific requirements of that Operator. Handover to Operators of assets delivered by CRL will transfer responsibility from an ownership, maintenance and operations point of view. It is therefore in CRL's best interests to complete Handover as early as possible, to enable demobilisation of the CRL workforce.

CRL will also monitor the progress of the other parties responsible for Handover.

6.8.2 Regulatory Approvals

Each of Stages 1 to 5 of commercial opening of the Crossrail system requires the approval and deployment of new assets, in some cases by a new (or substantially changed) Operator also requiring regulatory authorisation.

Approval of new assets and their deployment is governed by two sets of regulations implementing European Union legislation: the Railways (Interoperability) Regulations, which require project entities (including CRL, Bombardier and NR) to obtain ORR authorisation to place equipment into service, and the Railways and other Guided Transport Systems (Safety) Regulations (or "ROGS"), which require Operators (including RfL, MTR Crossrail and NR) to hold a safety authorisation or safety certificate, granted by the ORR following submission of a safety management system meeting regulatory requirements.

A safety review committee established by each Operator conducts safety reviews and acceptance activities in accordance with the requirements of its safety management system. Operators have a duty to co-operate with one another, with the party initiating changes to equipment or operations required to obtain the agreement of others affected.

The Crossrail regulatory approvals programme recognises that successful start-up of the end-to-end railway requires each of the many parties involved to act in a co-ordinated manner to obtain authorisation for, accept and deploy assets. The ORR and all other parties have supported the principle that RfL has a role as lead duty holder, co-ordinating the efforts of the parties but not diluting the obligations of each of them under the law. The programme team, currently working within CRL but on behalf of RfL, as well, is acting to align the expectations and programmes of each of the parties, to share information concerning issues and progress, and to facilitate the delivery of necessary submissions and approvals.

6.9 Operations

The CRL Operations Directorate champions and leads the operation and maintenance of Crossrail so that the railway will deliver a high performing service safely following each staged opening in compliance with the Sponsors Requirements.

The Operations Directorate is led by an RfL employee on behalf of CRL and RfL and comprises RfL and CRL personnel working collaboratively to deliver the opening strategy.

This reflects TfL's best practice learned from projects it has previously delivered. Activities within the Operations Directorate comprise activities that the team is accountable for, putting in place/delivering directly, or which relate to being prepared and content to "receive" deliverables from others. This includes providing professional guidance on operational matters during the design / development phase of Crossrail.

Although led by RfL the Operations Directorate is an integral part of CRL and is the professional entity within CRL informing operational matters during the design and implementation phase for the duration of the project. To the extent that CRL is responsible for rules and procedures during Dynamic Testing and Trial Running this will be informed by the Operations Directorate who will rely heavily upon their RfL colleagues for advice and 'lessons learned'.

Learning Legacy Document

6.10 Assurance Process

6.10.1 Quality and Assurance

6.10.1.1 Objectives

The aim of CRL's assurance process is to help provide an appropriate organisation with high-quality plans and processes for CRL to confidently deliver a world-class railway, and, against these plans, assure that all requirements in the agreements with the Sponsors and other stakeholders are being met.

The objectives set out in CRL's Quality Policy are to:

- Achieve CRL's vision and values, including the delivery of a world class affordable railway;
- Manage all functions in an effective and efficient manner;
- Set realistic, measurable objectives and targets for all activities, to assist delivery of performance and progress;
- Apply the principles of 'right first time' and continual improvement to our performance;
- Ensure compliance with legislation, regulatory requirements, and relevant codes of practice and standards;
- Place accountability for quality with those best placed to act; and
- Implement audit, surveillance and review programmes to monitor compliance with requirements and assess the effectiveness of the system.

Assurance is the provision of confidence to those who need to receive it that the Crossrail Project will be delivered:

- In compliance with the Crossrail Act 2008 and all Sponsors Requirements;
- Using controlled processes; and
- By competent persons.

Our objective on assurance is to establish and maintain an Assurance Process that provides the CRL Executive, CRL Board and the Sponsors with evidence that delivery of the programme is progressing in compliance with all requirements.

One of those requirements is to provide progressive assurance. The PDA (Clause 15.2) states that '*CRL shall develop an assurance process that will enable it to demonstrate compliance with Clause 3.2 to the Sponsors and other interested parties as necessary, including the Operators and any independent review bodies appointed by CRL (the 'Assurance Process'. The Assurance Process shall form part of the Delivery Strategy.*'

6.10.1.2 Challenges

The principal challenges for quality and assurance are:

1. Achieving strong alignment between all Crossrail functions and between Crossrail Delivery Teams and the Industry Partners;
2. The number of parties involved in Crossrail, and their differing assurance requirements, which pose a significant risk to the timely delivery of Crossrail. There is a potential overload and suffocation of the programme if assurance is unconstrained, uncoordinated and inefficient; and
3. The extent to which the Integrated Crossrail Team has management control or influence over the Industry Partners' assurance processes.

6.10.1.3 Approach

The Assurance Process (see figure 6.11 below) has been established in order to meet the requirements of the PDA and includes:

1. An assurance process for Sponsors to meet the requirements of Clause 3.2;
2. Assurance for various Government bodies and other 3rd parties; and
3. A technical assurance process for future Infrastructure Managers and Operators of Crossrail.

Within CRL, the responsibility for assurance is as follows:

- The CRL Board is accountable for providing assurance to the Sponsors;
- The Executive Committee (ExCom) is responsible for providing assurance to the CRL Board; and
- The Programme Director is responsible for providing assurance to the Executive Committee with regard to the delivery of the Crossrail Project, in terms of cost, schedule and meeting the performance levels specified in the Sponsors Requirements.

The Programme Director is also responsible for:

- Monitoring performance and alignment of the organisation in the effective and efficient delivery of Crossrail; and
- Setting out the way that the organisation works and how its activities are carried out in a manner consistent with the Delivery Strategy.

6.10.2 Crossrail's Programme Assurance Strategy

CRL's approach to assurance is described in Crossrail's Programme Assurance Strategy. It is based on the assurance chain as shown in figure 6.11.

1. The CRL client, acting through the functional departments, sets the project requirements in compliance with the Sponsors Requirements. This is shown as '**Assured Delivery**'.
2. The delivery of these requirements is shown as '**Delivery**' which is the process by which the requirements are provided by the Tier 1 Contractors and their supply chains and managed by the Crossrail Central Section Delivery team.

3. Establishing the quality requirements in the contracts awarded by CRL, monitoring the quality performance of Contractors, and maintaining the Crossrail Management System (CMS) to ensure Crossrail’s BS EN ISO 9001 certification is maintained is also the responsibility of the CRL client. This is shown as ‘**Assured Quality**’;
4. Assuring that Crossrail will meet its Project Milestones, Staged Opening Dates, and that its forecast remains within the limits of available funding and the funding profile is the responsibility of the CRL Client within the Programme Controls department. This is shown as ‘**Assured Controls**’.
5. Auditing that CRL is complying with its documented CMS, that Principal Contractors are complying with the Works Information and that the governance structure and financial controls developed to mitigate risk to the Project are effective is the responsibility of the Crossrail Internal Audit team. This is shown as ‘**Internal Audit**’.
6. Independent Assurance is provided by audits carried out by TfL and by third parties as well as surveillance activities conducted by the Project Representative for the Sponsor, KPMG (financial audits), LRQA (management system certification audits) and the National Audit Office. This is shown as ‘**Independent Audit**’.

This model will be applied to all assurance requirements wherever they arise within the Crossrail Project:

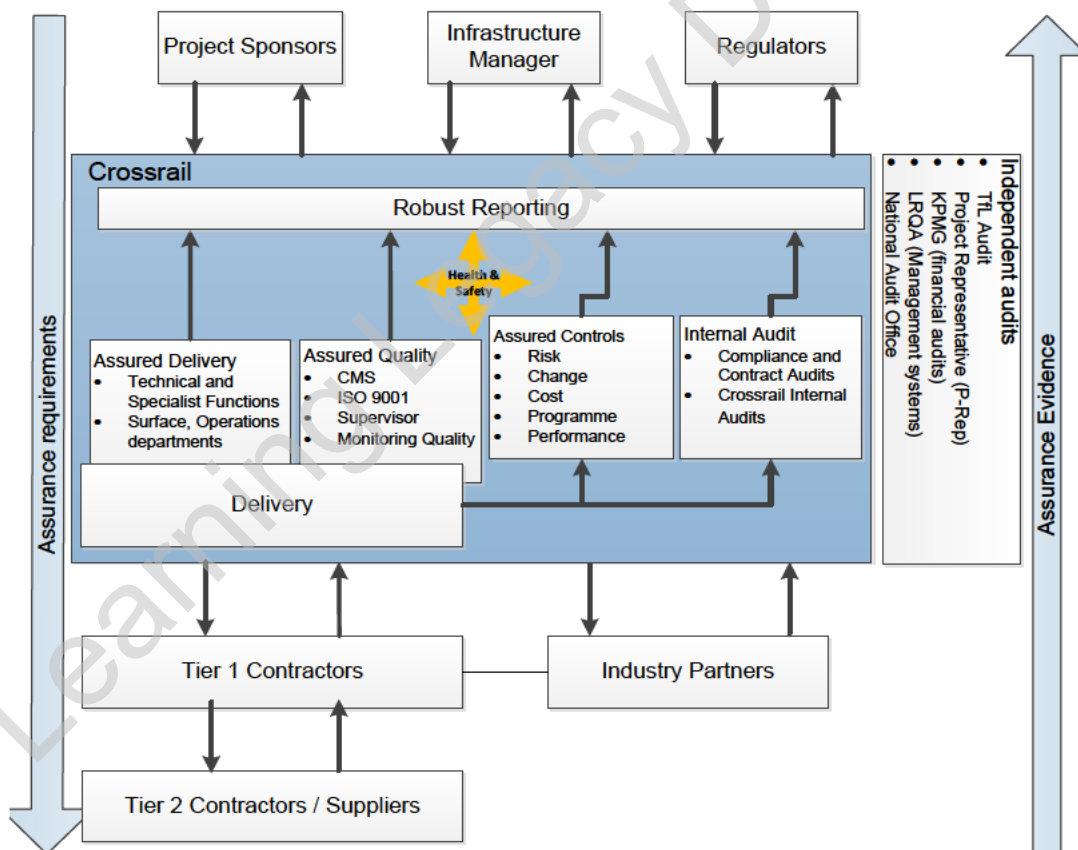


Figure 6.11 – Crossrail Assurance Chain

The CMS demonstrates and communicates to the programme and project teams through the Management Plans, processes and procedures, how the strategy for delivery of the programme described in this Delivery Strategy is to be implemented. This includes the assurance processes identified in CRL’s Programme Assurance Strategy.

6.10.2.1 Meeting the PDA Requirements for Assurance

The following table sets out the requirements of Clause 3.2 in the PDA and the relevant assurance process that will be used to demonstrate that each requirement is met.

Source	Requirement	Relevant Assurance Process
PDA 3.2 (a)	To satisfy the Sponsors Requirements.	Affirmation (that the CPFRR satisfy the Sponsors Requirements) as agreed in the Sponsors Requirements Validation Procedure.
PDA 3.2 (b)	In accordance with the CPFRR.	Certification of designs as compliant with CPFRR (and of construction as compliant with designs).
PDA 3.2 (c)	In accordance with the terms of this Agreement and the other Principal Project Documents. In accordance with the necessary consents.	The Agreements Compliance Procedure. Consent tracker and contract requirements.
	In accordance with the Environmental Minimum Requirements.	The Environmental Management System.
	In accordance with the Undertakings and Assurances.	The Compliance with Commitments procedure.
PDA 3.2 (d)	In a manner consistent with the Delivery Strategy.	The CRL Management Plan and the supporting management system (CMS).
PDA 3.2 (e)	In a manner that will oblige the Operators to accept the Handover of assets and systems.	Technical assurance, at present through the CRL technical assurance processes ,the Infrastructure Managers’ own assurance processes, and the Handover Strategy and Plan.
PDA 3.2 (f)	To meet the Project Milestones and so that the Final Delivery Date occurs on or before the Target Final Delivery Date and, in any event, on or before the Longstop Date.	CRL Programme Controls processes. See section 5.11 for more details.
PDA 3.2 (g)	In accordance with any additional conditions that are imposed as a result of the Project Review.	CRL Change Control process. See section 5.11.6 for more details.
PDA 12 & 3.8	Health and Safety.	The Health & Safety Management System.
PDA 17.1	Assurance that Crossrail is forecast to be completed within the limits of available funding and the funding profile.	Programme Controls and financial audit procedures.

Table 6.2 – PDA Requirements and relevant assurance process

These relevant assurance processes are developed and implemented and disseminated as part of the Crossrail Management System. They are also supported within Crossrail by:

Integration Assurance

The Crossrail Integration and Assurance team monitors the completeness of the assurance framework, and the effectiveness of the individual assurance processes, in the following areas so as to avoid unnecessary duplication, omission, incompatibility or confusion:

- Requirements Assurance: owning the CPFR and ONFR, including compliance, and the overall strategy for validation and verification (V&V);
- Railway Integration Assurance: managing the railway integration process; integration co-ordination, strategy and reporting; and leading integration issues resolution, as required
- Technical Assurance: owning the Technical Assurance Plan and gate review process, ensuring it is adhered to, and assembling the assurance evidence for submission to the IM's; and
- Engineering Safety Management: Managing the overall process and Crossrail's independent safety and interoperability assurance through the NoBo, DeBo and AsBo teams.

Internal Audit

Internal audit is the assurance provided by activities that both verify compliance with the documented management system and assess the suitability and effectiveness of the documented management system to deliver the works in compliance with the specified requirements.

6.10.2.2 Assurance for Government bodies and other 3rd parties

Independent Assurance is provided through audits carried out by TfL and by third parties as well as surveillance activities conducted by the Project Representative for the Sponsor.

Independent Audit

The CRL Board has an Audit Committee, which provides assurance on systems of internal control, control and management of corporate risk, and oversight of corporate governance and the audit process.

CRL will cooperate with third parties that have various rights and obligations to carry out audit/assurance activities on Crossrail. TfL has established the Crossrail Integrated Assurance Group (CIAG) to coordinate such activities and thus minimise their impact on the programme.

Whilst assurance will be provided through implementation of the processes identified in the Assurance Plan described above, a second line of assurance will be provided through a programme of audits to confirm that processes are fit-for-purpose, efficient and implemented effectively. An annual integrated audit programme will be established which focuses on those areas that present the highest risk to delivery of the Crossrail programme. Findings are reported to the CRL Audit Committee.

A key risk is the suffocation of the programme through the number of assurance entities, interfaces and interventions. In order to mitigate this risk CRL management will work with the assurance stakeholders to minimise the volume of active, direct assurance, within the constraint of the project agreements, and maximise the extent to which passive, indirect assurance can meet requirements such as stakeholders' reports to CIAG

Expert Panels

To ensure that best practice is available to Crossrail, CRL will continue to subject certain engineering and architectural matters to peer review from expert panels. As the project focus shifts from civils to systems and operations the continuation or formation of panels will be reviewed. The expert panels report to CRL in an advisory capacity. Reviews cover infrastructure for Crossrail and the effect on third party infrastructure and systems. The technical panels are as follows:

- The Operations and Systems Expert Panel has a remit to carry out high level peer reviews of systems and reports independently to the Crossrail Executive Committee;
- The Engineering Expert Panel had a remit to carry out high level peer reviews of the civil engineering tunnelling and subsurface works, and is no longer active;
- A Procurement Expert Panel had a remit to encourage best value for money procurement within the requirements of public procurement legislation, but is no longer active.

6.10.2.3 Technical Assurance for future Infrastructure Managers and Operators of Crossrail

CRL management will provide leadership in the form of progressive technical assurance to ensure that the Sponsors Requirements are met by the Industry Partners and Crossrail Delivery teams throughout the programme. The scale of Crossrail and the number of delivery partners and future Infrastructure Managers makes this a substantial task.

Evidence for technical assurance will be prepared by the supply chain, checked and collated by Crossrail Delivery teams, assured by the CRL Client and the Industry Partners and submitted to RfL and LU. For the Central Section works the Infrastructure Managers' Progress Review Group (IMPRG) supports and co-ordinates the submission and approval process. Where an assurance submission affects more than one IM, CRL will identify and agree with the IMs the route for acceptance.

For the Central Section works CRL has established IMPRG to support the approval process and to facilitate progress to acceptance on issues affecting more than one Infrastructure Manager or the interfaces between them. The remit of IMPRG is therefore to support the designated Infrastructure Managers to discharge their responsibilities. This approach to progressive technical assurance is summarised in figures 6.12 and 6.13.

CRL has defined, agreed and documented clear boundaries and interfaces with the Infrastructure Managers for maintenance and operational responsibilities. This simplifies the design and assurance processes for the Central Section Works, because the future IM will be consulted on maintenance and operational aspects by the delivery teams during the design process. It will also demonstrate how progressive assurance will be presented to the Infrastructure Manager for acceptance. Assurance evidence for interfaces (boundaries) will be presented to the future IM for acceptance.

The Railway Assurance Board [Crossrail] (RAB[C]) will assure that the Crossrail end-to-end railway is safe. It will act as:

1. CRL's Safety Review Panel (SRP) – for all Central Operating Section assets;
2. RfL's Infrastructure Manager Safety Review Panel (SRP) – independently assuring that RfL can accept assets “into use”; and
3. Co-ordinator of Duty Holders – acting as Lead Duty Holder with accountability for satisfying itself that RfL's operational and maintenance activities are integrated between all other Duty Holders (e.g. CRL/NR/LU) and MTR[C] (the CTOC) across the end-to-end railway.

The purposes are complementary with much of the safety assurance reviewed both through (1) as CRL's SRP and (2) to allow acceptance of the assets by RfL from SRP. Where the roles differ is in authorising the railway infrastructure to be brought into use. In this case, RAB [C] is additionally required to review and approve RfL's demonstration/evidence of Operational Readiness and Maintenance Readiness (3).

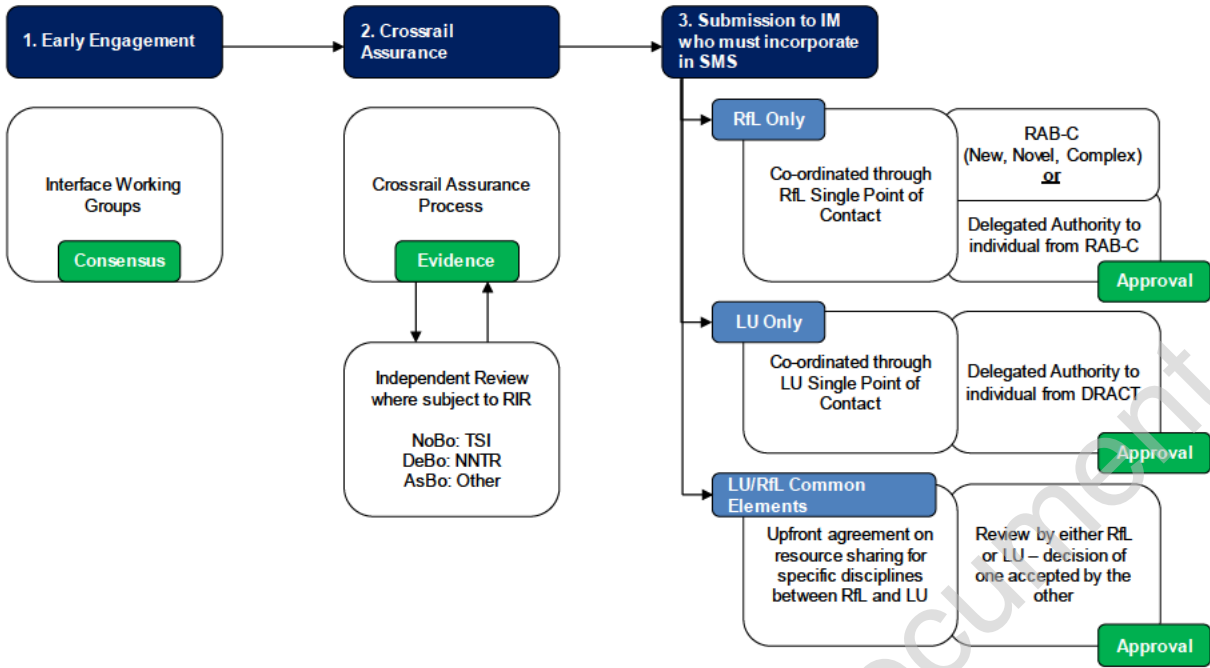


Figure 6.12 – Working Principles for progressive technical assurance - Management of LU/RfL Interfaces

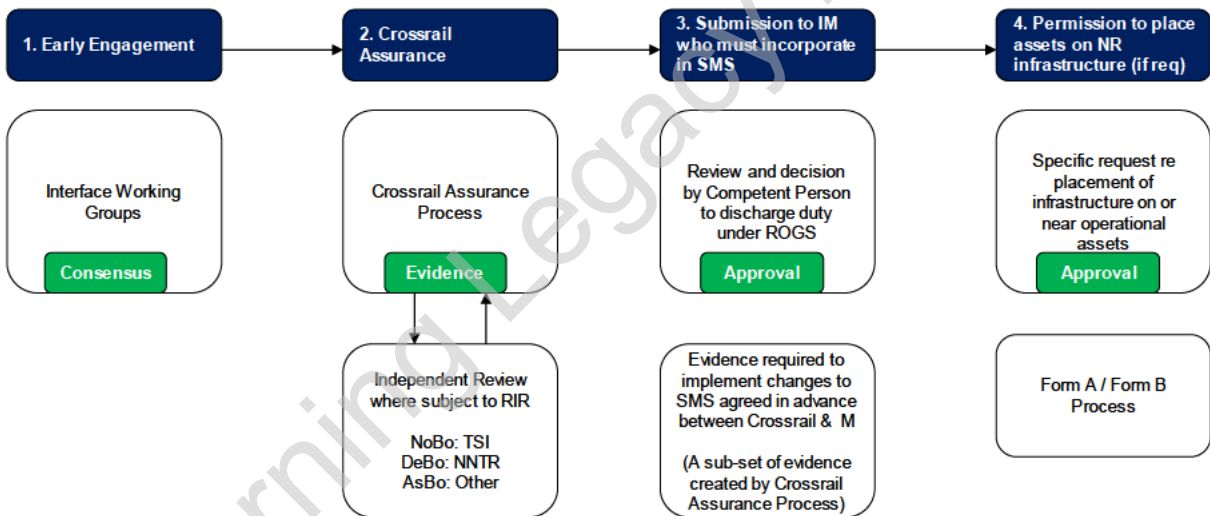


Figure 6.13 – Working Principles for progressive technical assurance - NR/RfL Interfaces

6.11 Environment, Undertakings and Assurances and Sustainability

6.11.1.1 Objectives

CRL management will:

- Aim for Crossrail to have a minimal impact on the environment through construction activities by ensuring operational controls are robust so as to promote the principles of pollution prevention;
- Aim for environmental excellence in our own activities and promote exemplary environmental performance from designers and contractors;
- Provide effective environmental leadership on the programme in order to promote a positive environmental culture and engage management and workforces in continuous improvement; and
- Provide proactive management and assurance of the environment in design and construction, including the requirements of the Crossrail Act and Environmental Minimum Requirements (EMR).

The EMR are set out in several documents namely the General Principles, Crossrail Construction Code, Environmental Memorandum, Planning & Heritage Memorandum and the Crossrail Register of Undertakings and Assurances. The EMR, inter alia, set out standards of environmental mitigation during construction and in the design of the final works. Compliance with the EMR is a commitment given by the Secretary of State to Parliament and hence a requirement under the PDA. CRL management is therefore contractually bound to comply with the controls set out in the EMR by which means the Secretary of State has discharged their commitment.

A key requirement of the Sponsors is that Crossrail should support the Secretary of State's plans for public transport provision; in particular it shall be integrated with the Mayor's transport and sustainability strategies. The Crossrail statement of objectives within the Sponsors Requirements state that Crossrail should support the transport, planning, social and environmental objectives contained within the Mayor's Strategies for London.

6.11.1.2 Challenges

The EMR are wide ranging and must be disseminated to all parties delivering Crossrail works. Ensuring their compliance requires the clear assignment of responsibilities, processes and working methods, supported by adequate resources.

The Undertakings & Assurances (U&A) are numerous and diverse (there are 743 entries on the Register of Undertakings and Assurances which on further disaggregation total around 3,500 individual commitments), posing similar challenges to the rest of the EMR in ensuring compliance. The PDA requires CRL to manage a process to allocate the U&A and to assure the Sponsors of compliance, including compliance by London Underground.

The definition of sustainability is inclusive and far-reaching. It includes corporate and social responsibility and by drawing on the TfL sustainability framework, Crossrail will address seven themes:

- Economic progress: maximise competitiveness and productivity of economy;

- Sustainable consumption and production;
- Address climate change and energy;
- The physical environment: natural resource protection and environmental enhancement;
- Improve health, well-being and happiness;
- Protect peoples safety, security and health; and
- Promote greater equality of opportunity and social inclusion.

The aim of this is to create a sustainable approach to all aspects of the programme lifecycle, optimising opportunities wherever practicable to facilitate economic growth, environmental protection and social progress.

6.11.1.3 Approach

An Environmental Management System (EMS), consistent with the principles of BS EN ISO14001, will help ensure compliance with the environmental aspects of the EMR.

The key principle of the EMS in relation to development of procedures is to incorporate environmental requirements in core procedures where this is feasible. This minimises duplication and makes the requirements easier to determine for the relevant stakeholder. This approach will be adopted as implementation procedures are developed, implemented and maintained.

A dedicated team has established and implemented appropriate management processes for the assignment of U&A to the Industry Partner, Crossrail Delivery teams, or Crossrail function best placed to take the actions that ensure compliance. Any issues arising associated with compliance will be highlighted in the periodic reports. On completion of Crossrail, the team will hold evidence of compliance with all the U&A.

CRL has established sustainability management groups at executive and working level to ensure delivery is integrated with Mayoral strategy.

Crossrail publishes information demonstrating delivery against its sustainability strategy annually. The Strategy identifies a set of sustainability initiatives and indicators designed to address the sustainability elements with the greatest relevance, impact, risk and opportunity; including, for example, reducing energy consumption, resource use in construction and whole life costs, and increasing local workforce employment and social inclusion.

6.12 Communications and community relations

6.12.1 Introduction

The key elements of the Crossrail Communications Strategy are:

- The framework by which the CRL working with Industry Partners, Sponsors and contractors will manage relations with local stakeholders, including businesses, community groups and individual property owners, along the whole Crossrail route during the progress of construction and the delivery of the Crossrail service;
- The process of communicating future activities and progress on the Crossrail programme, and managing public issues as they arise, to the media and all those third party stakeholders who have a close interest in Crossrail's delivery; and

6.12.2 Communications Strategy

The Crossrail Communications Strategy has been developed: *"To have established and continue to maintain an outstanding reputation amongst key audiences enabling the successful delivery of Crossrail."*

This aim is supported by the following objectives which set out what the strategy delivers and how the External Affairs team supports it. The External Affairs team is made up of Community Relations, Media Relations & Digital Media, Public Affairs, Marketing Communications and the Art Programme.

'WHAT' OBJECTIVES:

- **Tell the story of Crossrail's progress** - people are excited by what we are doing;
- **Promote Crossrail's wider benefits** - people are inspired by our sustainability story; and
- **Support the delivery of Crossrail, safely, on time and on budget** - we have anticipated, managed and mitigated the risks to our reputation.

'HOW' OBJECTIVES:

- **Devise, develop and deliver innovative campaigns** - prioritising sustainability; 'the railway is coming'; learning; health & safety; innovation and the digital railway and OSD/urban realm;
- **Collaborate with project teams, our sponsors and others** – work as one team across the project, developing our contribution to the ongoing learning legacy at Crossrail and passing on the learnings to other projects e.g. Thames Tideway Tunnel and HS2, share information, ensuring there are 'no surprises'. Instigate virtual campaign management teams across External Affairs departments, to liaise with colleagues internally and develop integrated communications plans for our campaigns and corporate narratives; and
- **Deliver an integrated proactive approach to communications** - deliver an industry leading service to the business, treat our stakeholders with respect and 'do the right thing', with integrity.

The majority of communications activity regarding Crossrail is currently focused on the construction phase. The focus is around how the railway is being built, what the construction benefits are as well as the wider benefits of the project. However, as the project is not static the story of the project develops over time. The public, future customers and stakeholders are increasingly interested in what the operational railway will be like, and how TfL will operate the service.

The Communications strategy has been developed to cover the five phases of communications set out below:

	Up to May 2015	Up to Jan 2017	From Jan 2017	Up to Dec 2018	Up to Dec 2019
Infrastructure	<ul style="list-style-type: none"> Celebrate the 'end of tunnelling' Canary Wharf station opening 	<ul style="list-style-type: none"> Station fit-out Surface works & station upgrades Images etc. of the central stations 	<ul style="list-style-type: none"> Continuing delivery of station and systems installation Refreshed 'Crossrail is coming' hoardings Viewing platforms 	<ul style="list-style-type: none"> Central section opens 'Landmark' stations complete 'Thank you' for bearing with us during the disruption 	<ul style="list-style-type: none"> Railway infrastructure 'finished' Over-site developments
Rail Service	<ul style="list-style-type: none"> Prepare for the introduction of TfL Rail Position Crossrail services as part of a vision for improving rail services in London to meet rapid population growth 	<ul style="list-style-type: none"> Design, manufacture and testing of rolling stock Developing capability of TfL Rail – transforming customer experience as a precursor to Crossrail Outer station service improvements 	<ul style="list-style-type: none"> Introduction of new TfL run rolling stock Crossrail as an operational brand 	<ul style="list-style-type: none"> TfL run Crossrail service introduced in central London Transformed customer experience and disabled access in London 	<ul style="list-style-type: none"> Full Crossrail service embedded in TfL's integrated network Further improvements to disabled access across Greater London

Table 6.3 – Communications Strategy – five phases

These phases are intended to inform the communications approach to show the changing story of Crossrail as the construction continues and as interest in the service offer increases. Given the complexity of the whole Crossrail programme it is intended that these phases are flexible to ensure that the communications are appropriate to the timing.

CRL will continue to tell the 'infrastructure' story, with increasing development and delivery of the 'service' story by all parties until 2017. The arrival of the rolling stock at Stage 1 and first public use of the Elizabeth Line in the Central Section at Stage 3 will be key moments when the 'service' story will begin to take precedence.

The Crossrail Communications Steering Group meets every period and aims to coordinate and share all external communications from Crossrail Ltd, TfL, DfT, Network Rail and City Hall.

6.12.3 External communications

The other key element of Crossrail public communications is the delivery of a combination of proactive and reactive communication activities promoting Crossrail to third party stakeholders who have a direct interest in Crossrail but may not be immediately located around construction sites. This includes the preparation and

issue of press releases, the provision of an appropriate, accurate, and rapid response to media requests and enquiries and the establishment of positive relationships with key publications and journalists to encourage positive coverage on all aspects of the programme.

Developing and maintaining a good reputation effectively gives Crossrail its licence to operate, enabling the effective delivery of the project on time and on budget. The aim of the External Affairs team is to support the business by offering a world class support service, effectively managing a wide range of external stakeholder groups to protect and enhance Crossrail’s reputation.

6.12.4 Community Relations Strategy

It is a requirement of the Crossrail Construction Code which is part of the Environmental Minimum Requirements that CRL produces a Community Relations Strategy. Consequently, the strategy is in itself a Parliamentary undertaking and is binding on all Crossrail parties. The Strategy has been agreed by Sponsors and also agreed by all 22 route local authorities represented in the Crossrail Planning Forum.

The Strategy reflects the:

- Requirement for all parties to comply with Crossrail Parliamentary undertakings;
- The structure Crossrail and its partners and contractors will use to directly manage local community relations;
- Complaints-handling processes and the role of the Independent Complaints Commissioner;
- Requirement for regular local information dissemination;
- Undertakings on local employment initiatives;
- Function and operation of the Crossrail Small Claims Scheme;
- Procedures for liaison with local communities in emergencies;
- Establishment and requirement for local visitor information centres; (“one stop shops”);
- Requirement for reporting to Sponsors and other partners regularly on progress in implementing the strategy; and
- Establishment of local resident/business liaison panels along the route.

6.13 Organisational capability

Effectively mobilising a high performing team for a project like Crossrail is a significant challenge. CRL has a role to play in developing its own organisation for delivery and supporting the wider construction industry. This section outlines how CRL is addressing this challenge through the Crossrail People Strategy.

6.13.1 Crossrail People Strategy

The Crossrail People Strategy aims to ensure the Crossrail project has a diverse workforce with the right people, at the right time, suitably skilled, motivated and engaged to deliver the Crossrail project. The Strategy sets out the approach to leadership, people management and engagement and describes how this will be delivered throughout the lifetime of the project. The Strategy has been aligned to the vision, mission, values, priorities, constraints and the broader employment policy and legislative environment.

The Strategy focuses on five priority areas:

- Driving our safety culture
- Simplifying our organisation and how we work;
- Building on and sustaining our integrated organisational model and promoting joint working where it makes good business sense;
- Maintaining our focus on effective and efficient working and managing workforce-related costs; and
- Building a diverse workforce.

The Crossrail People Strategy outlines seven key themes for managing organisation capability, which are described below.

Organisational design

This theme focuses on ensuring that the organisational structures are the right size and shape, have the right skill composition to meet the needs of the programme, both functionally and financially, and that focus is maintained on successfully demobilising people and functions in the final stages of the project. It includes identifying areas of role/function overlap; areas requiring change, and planning accordingly; and planning for and implementing demobilisation.

Resourcing

This theme ensures that high calibre individuals continue to be attracted to Crossrail and their skills and experience are used efficiently and effectively. This includes developing and implementing resourcing plans aligned to business plans and work schedules; proactively planning recruitment activity for new or vacant roles; developing and implementing retention strategies for key positions; successfully supporting the organisation through organisational change; and effectively demobilising the organisation.

Leadership

This theme focuses on ensuring that the organisation is motivated and inspired by their leaders. This includes: clearly defining the Crossrail leadership capabilities required; effectively engaging with leaders across the Crossrail family and Tier 1 contractors; and having visible leaders across the project.

Talent Management & Succession Planning

Talent management and succession planning is critical to ensuring that CRL is able to attract and retain the skills necessary to deliver the project. The talent management and succession planning theme includes: identifying talent and mapping development opportunities; continuing succession planning processes which are reviewed regularly; identifying key roles required for successors; assurances from partner organisations that talent is managed and succession plans are in place.

Performance Management & Development

This theme is focused on ensuring that individuals and teams have the opportunity to develop further and deliver world class performance. This includes: aligning goals and objectives across the Crossrail family; consistently and effectively managing performance; providing employees and line managers with the tools and knowledge required to deliver in their roles; ensuring assurance mechanisms are in place for performance management from partner organisations.

Employee Engagement

Strong and effective employee engagement is important for the delivery of the Crossrail project. This theme focuses on ensuring that employees are emotionally and intellectually committed to delivering the Crossrail project. This includes: building organisation wide internal communication and employee engagement plans; maintaining organisation integrity through the communication of the Crossrail Values; effectively delivering employee engagement messaging through targeted communication channels, and the process of managing internal communications throughout the Crossrail "family".

Incentivisation & Reward

This theme ensures that employees are rewarded fairly and recognised for high performance in both financial and non-financial terms. This includes: access to a fair and reasonable pay and reward framework, including employee incentives; and the identification and implementation of non-pay incentives, such as development and role enhancement.

6.13.2 Tunnelling & Underground Construction Academy

CRL established the Tunnelling & Underground Construction Academy (TUCA) at Ilford in 2011 to address a critical shortage of tunnelling and underground construction training facilities in the UK. The establishment of TUCA means that CRL, contractors and the industry have access to relevant and industry-leading training to ensure that their workforces have the skills required to complete tunnelling and underground construction projects. Responsibility for TUCA will pass to TfL in 2016.

6.13.3 Skills & Employment

The successful delivery of Crossrail is dependant on CRL and its contractors being able to access the right people, with the right skills at the right time. The Crossrail Skills and Employment Strategy sets out Crossrail's approach to addressing the skills and employment challenges across the project. The Strategy outlines four key objectives of: maintaining safety; inspiring future talent; supporting local labour; and revitalising the skills base. Since being published in 2010, CRL has implemented policies and procedures to support CRL and its contractors in meeting the objectives of the Skills and Employment Strategy. The Skills and Employment Strategy and the initiatives implemented by CRL will be shared with industry as part of the Crossrail Learning Legacy Programme.

Learning Legacy Document

6.14 Programme Controls

This section describes the overall approach to programme controls and outlines the main functional elements including: planning, cost management, risk management, commercial management, change control, contingency management and reporting. These functions are regularly reviewed in detail to ensure that this critical function remains appropriate for the stage of the project.

6.14.1 Introduction

The primary purpose of the Programme Controls Function is to support all groups and disciplines within the Crossrail Programme, particularly the Crossrail Delivery Teams, to meet the objectives for Crossrail.

The strategy for controlling the Programme was borne out of the following stimulus:

- Comprehensive Spending Review targets for cost efficiency;
- The Big Dig Survey, working to eradicate role duplication, man-marking, lack of joined-up thinking and lack of unity; and
- The Case for Change in Controls by embracing change as part of the project lifecycle and progressively moving from design, through procurement to construction.

These strategic requirements in turn gave rise to a need to:

- Provide integrated and consistent processes and systems;
- Promote efficiency and effectiveness in terms of Controls functions;
- Employ a highly skilled resource base; and
- Be the “conscience” for the Programme Delivery Team.

6.14.1.1 Objectives

The Programme Controls function must satisfy the following objectives:

- Establish and maintain a comprehensive baseline against which CRL management and its partners will deliver Crossrail;
- Set the standards to provide functional leadership of all Controls disciplines including Planning, Cost Management, Risk Management, Change Control and Cost Verification, Commercial Assurance and Reporting;
- Provide decision makers and members of the Executive, the Board and the Sponsors with reliable and timely information on the current and projected status of the programme;
- Provide assurance to all stakeholders (Sponsors, Crossrail Board, Executives, Programme and Sector Directors as well as Project Delivery teams) that the Programme has appropriate Controls commensurate with the scale of the Programme and consistent with its Delivery Strategy;
- Establish integrated management information in support of CRL’s reporting needs, including progress status and forecasting report information to provide key knowledge for all functions at Programme and Sector level in a coordinated manner; and

- Provide foresight and advice alongside providing this key information, analysis and reporting to assist clear decision-making.

CRL also has specific key obligations to the Sponsors as set out in the PDA that relate to programme controls. At the highest level CRL must:

- Present programme controls information at agreed gateway Review Points, monthly reports and Semi-Annual Crossrail Reports (SACRs);
- Provide regular forecasts for Intervention Point assessments (schedule 3 of PDA) - addressed through the SACRs;
- Provide information about programme milestones linked to stakeholder funding points (schedule 3) - addressed through the SACRs;
- Process the notification, appraisal and implementation of changes with the Sponsors (schedule 4); and
- Satisfy requirements of government reviews.

6.14.1.2 Approach

Integrated programme baseline

CRL has established an integrated programme control baseline based on a coherent set of programme control products which collectively define Crossrail.

The programme control baseline is used to:

- Manage potential changes to requirements, scope, schedule or cost;
- Manage transfer of funding allocations and contingency via approved changes; and
- Capture programme level cost and schedule assumptions and manage these through to validation.

CRL management has also established a series of programme management processes to control the programme against the baseline, and to maintain the baseline over time. The objective of these processes is to:

- Provide a clear basis for identifying, translating, apportioning and instructing the programme requirements to the appropriate delivery and design functions;
- Communicating commitments and ensuring that they will be met;
- Supporting the management of and control of the delivery costs, schedule and performance objectives;
- Managing risks and opportunities effectively; and
- Providing decision makers (including the CRL Board and Executive) with accessible, timely and reliable information on the current and projected status of the programme

Programme controls systems

CRL will produce a vast amount of programme controls data on a regular basis over the life of the programme. This data needs to be validated, integrated, interpreted and reported on in order to provide useful information for option analysis, decision making and for assurance.

CRL management has established the programme controls systems as a means of managing and using the data related to the progress and performance of Crossrail. The control systems comprise a cross functional reporting team, agreed processes and procedures and a centralised system containing programme controls data. Being open and visible with how information is collected and processed provides credibility, reporting consistency and facilitate efficient auditing.

Common data format

CRL has established a high level set of principles for the collection and integration of data in the data repository. All partners are required to supply data and updates in a prescribed format. The format will, wherever possible, be compatible with the established practice of the partners such that each party can utilise their own systems to manage their projects whilst satisfying CRL's requirements for reporting via controlled processes.

Integrated work and cost breakdown structures

CRL has defined an integrated programme-wide work breakdown structure (WBS), as a basis for defining control elements and reflecting commercial packaging, for which cost, schedule and risk data will be integrated. The WBS is based on geographical area, industry / delivery partner, asset type, location and function / phase. This structure is the main integration element for all controls processes and disciplines.

Earned value management

CRL management uses Earned Value Analysis (EVA) as one of the methods for reporting the performance of Crossrail; the other methods are stage gates, key milestones and trending.

EVA is considered to be best practice in assessing project status. EVA provides an objective methodology for understanding schedule and cost performance against a set baseline.

Stage gates and milestones

CRL has established stage gates to control and track component projects through their lifecycles. These stage gates are based on recognised project lifecycles such as Royal Institute of British Architects (RIBA) and Network Rail's Guide to Rail Investment Projects (GRIP). In addition, a Key Interface Milestone tracking process will monitor the difference between planned, forecast and actual dates to evaluate delivery trends as a means to verify the accuracy of the EVA trending.

6.14.2 Programme Controls Responsibilities

The responsibilities of Programme Controls are to:

- Provide management information and analysis in support of the Delivery Strategy and Crossrail Management Plans;
- Provide a reliable source of Controls data for Crossrail and its Sponsors, as allowed for within the various Industry Partner agreements;

- Maintain a strong data link with the Crossrail Finance Directorate and its Strategic & Business Planning team, and operate within Crossrail’s governance processes;
- Maintain strong liaison with Crossrail’s Industry Partners to support Project Managers in the management of third party obligations;
- Manage CRL’s overall Controls Management Plan for Controls;
- Define and implement Controls systems (electronic and physical) and procedures, including ensuring that any new software or system requirements are communicated to the IT function to maintain software and protocols across the Programme;
- Produce key programme management documents, processes and reports to satisfy the Sponsors, statutory and other requirements;
- Produce Programme-wide cost/schedule and resource forecasts;
- Co-ordinate evidence for Review Points or Semi Annual Crossrail Reports (SACRs) and draw upon evidence from routine assurance processes.

In establishing Programme Controls, CRL aims to adopt and adhere to the following core principles:

- Facilitate control by receiving planning, forecast and performance data from its Industry partners and Tier 1 contractors, integrating this into a programme-wide view;
- Provide the framework to integrate, validate, interpret and report on Controls data in order to provide useful and meaningful information for option analysis, decision making and assurance;
- Avoid duplication of effort in preparing and approving reports;
- Support the establishment of open, trusting and honest relationships across the Crossrail Programme, both organisational and commercial;
- Measure and report upon progress, such that timely decisions focused on successful project delivery can be made.

The Programme Controls interaction model looks at the way in which the Project Business Teams, the Sector Business Teams and the Central Controls Team interact and the different roles that they play. It provides a high level overview of Controls which is supported by more specific functional detail. Figure 6.8 below shows the reporting and information flow responsibilities of Controls and Delivery teams within the Programme including both direct and indirect obligations and reporting structures.

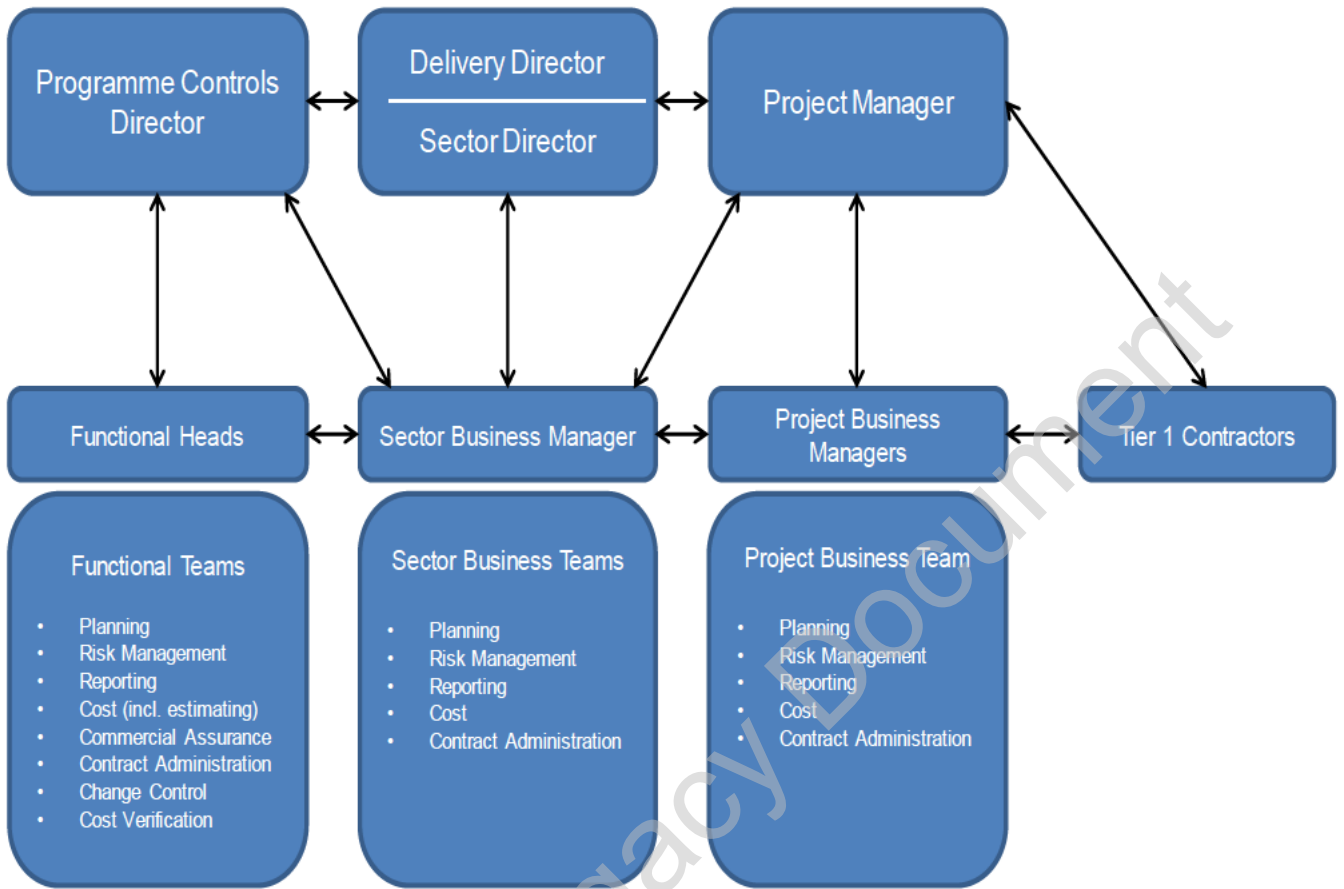


Figure 6.14 – Programme Controls Interaction Model

6.14.3 Planning (schedule management)

The scope of planning (schedule management) covers the creation, maintenance and application of an integrated Master Operational Handover Schedule² (MOHS) for Crossrail as a tool for both the proactive management and control of the programme and to provide assurance to internal and external stakeholders.

6.14.3.1 Objectives

The PDA mandates that 'CRL shall produce and maintain a schedule setting out the anticipated timetable for implementation of the Crossrail Project' and 'CRL shall periodically update the Project Delivery Schedule to take account of the circumstances at that time and so as to enable the Sponsors to monitor the overall progress of the Crossrail Project'.

The key objective is to produce an accurate schedule for the whole of Crossrail which integrates the schedules for all the component projects. In addition Planning has the following specific objectives to:

- Maintain integrity and timeliness of the Master Operational Handover Schedule (MOHS) through establishing an agreed Period Schedule Update Cycle, and regularly monitoring schedule data quality, accuracy and completeness;
- Ensure the MOHS has information related to design, procurement, construction, manufacture, installation, systems integration, testing and commissioning activities including all necessary approvals, consents, access requirements and railway possession;
- Periodically check and review the MOHS to observe the impact of the periodic update on the overall Programme forecast, including analysis of the critical path;
- Produce, maintain and promote programme schedule management, and planning, and ensure they are uniformly implemented.

² In April 2015, Crossrail introduced a Master Operational Handover Schedule to replace the Master Control Schedule.

6.14.3.2 Challenges

Apart from the overall challenge of integrating and managing all of the component projects and defining a very large number of interdependencies and interfaces, there are specific challenges including:

- Maintaining a single set of current data derived from several different sources that can be summarised to provide useful management information;
- Taking account of the procurement, manufacture, testing and commissioning and introduction of rolling stock;
- Accounting for the evolution of the project from “substantial completion” to an operating railway in accordance with the staged implementation programme (how the sections of the route are to be brought into operation) identified in the Sponsors Requirements; and
- Handling the substantial number of complex interfaces and interdependencies based on contractual, logical, technical, geographical and organisational boundaries and linkages.

6.14.3.3 Approach

Planning will support the effective delivery of the Programme and provide assurance to internal and external stakeholders. This will be achieved by:

Effective Programme performance and progress monitoring through:

- An integrated, four-level planning hierarchy; from detailed Tier 1 Contractor Schedules to a summary level Strategic Plan;
- A periodically reviewed and updated Master Operational Handover Schedule (MOHS);
- An agreed and change controlled Programme Schedule Baseline; and
- Clearly defined and change controlled Anchor Milestones; providing a representative view of the programme’s significant and important dates.

Consistent and comprehensive Planning processes and procedures in place and embedded across the programme, through:

- The Programme Schedule Management procedure; a high level document summarising Crossrail Planning processes and procedure;
- The Planning Manual; a detailed document describing the practical implementation of Crossrail Planning requirements and processes;
- Full utilisation of available data and software tools to produce reports and analysis to support other business functions which include Procurement, Asset Management, and Operational Readiness;
- Continuing to support and enhance the interface between Planning and other Controls functions such as Risk Management and Cost Management through support of their respective processes and information systems;
- Communication of the Crossrail plan to all relevant stakeholders; and
- Clear ownership through all levels of the Planning hierarchy and associated reporting processes.

Schedule hierarchy

CRL has created a schedule hierarchy that supports a higher level Strategic Plan. Crossrail schedules are structured in a three level Primavera hierarchical structure (levels 1-2 and 3) plus a graphical overall summary “Strategic Plan” (level 0). This is summarised in figure 6.9 below:

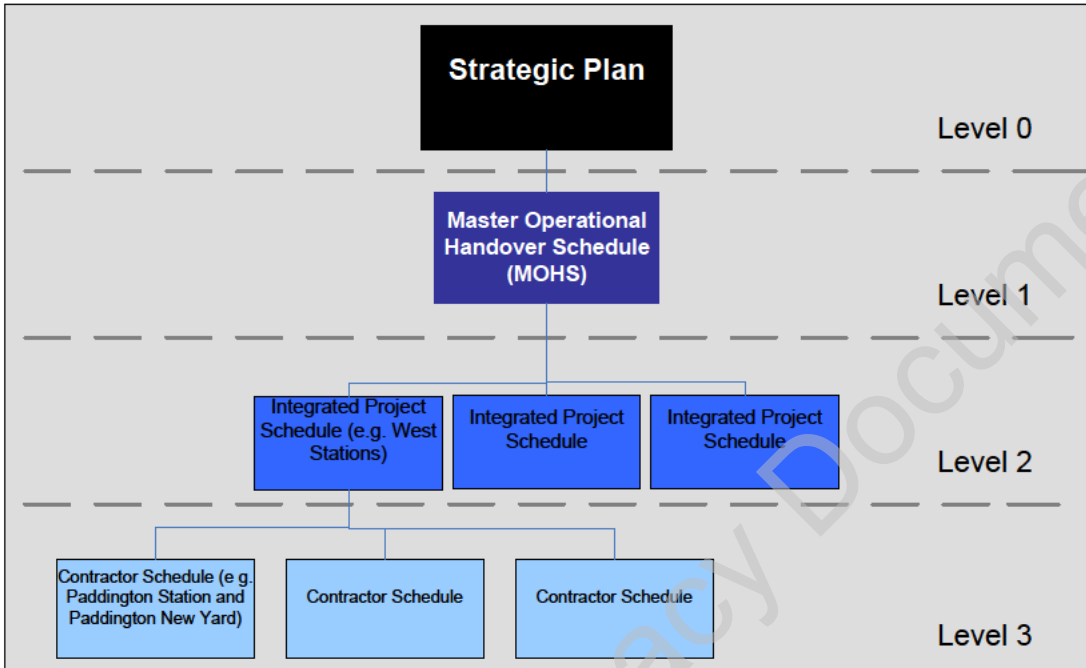


Figure 6.15 – Schedule hierarchy

Level 0 Strategic Plan:

The Strategic Plan is a one page schedule graphic that encompasses the entire scope of the Crossrail Programme. The Strategic Plan displays the start and completion of major activities. The graphic is based on information contained in the baseline Level 1 Master Operational Handover Schedule (MOHS).

The Level 0 schedule is updated with a status bar periodically.

Level 1 Master Operational Handover Schedule:

The MOHS is the formal schedule analysis and reporting critical path schedule (the MOHS is the Project Delivery Schedule, as defined by the PDA).

The MOHS includes information related to design, procurement, construction, manufacture, installation, systems integration, testing and commissioning activities including all necessary approvals, consents, access requirements and railway possessions.

The MOHS is a key product of the Crossrail baseline. It is updated on a pre-defined periodic basis in alignment with the bi-annual production of the Semi Annual Construction Reports (SACR) and is used to analyse performance at programme level by informing Earned Value Analysis and milestone trending. The MOHS is also used for scenario analysis, the modelling and analysis of schedule risk and the effects of change to major elements of Crossrail.

A key purpose of the MOHS is to ensure that the individual project schedules collectively meet the requirements of the programme and that all parties are working and committed to a programme-wide schedule.

The MOHS is the only schedule that represents the entire programme as integrated scope and cost activities with key milestones all logically linked.

The MOHS therefore comprises a summary of the detail and logic from the Level 2 Integrated Project Schedules and is updated with progress, logic changes and other information periodically. The Level 1 Schedule is also the source of Anchor Milestones and Key Event Milestones.

Level 2 Integrated Project Schedule:

The Level 2 Integrated Project Schedule is comprised of individual project level schedules and forms the detailed critical path schedule. The Level 2 schedule is informed by Level 3 schedules and Crossrail Project Team analysis.

Level 3 Tier 1 Contractor Schedule:

The Level 3 Tier 1 schedules are Contractor and Industry Partner schedules. These schedules are developed and maintained by the respective contractors and are submitted in accordance with contractual requirements.

Planning and Scheduling Handbook

Further details on the approach for managing the Crossrail Programme and the MOHS can be found in the Crossrail planning and Scheduling Handbook.

Learning Legacy Document

6.14.4 Cost management

The cost management function includes providing programme level aspects of cost planning, budgeting, estimating, forecasting, reporting, managing and controlling of all the costs. This is all associated with the planning, design, procurement, construction and commissioning Crossrail. It also includes developing and implementing the programme-wide estimating methodology, including pre-and parallel tender estimates, trend and value engineering estimates, measuring and forecasting cost risk, verifying estimates carried out by other functions and assisting in managing the interface between whole life costing and capital expenditure.

6.14.4.1 Objectives

The PDA requires CRL to *"manage the delivery of the Crossrail Project....so as to"*:

- Minimise the Anticipated Final Cost (AFC) in accordance with best value; and
- Ensure that Anticipated Final Crossrail Direct Costs (AFDC) do not exceed the Total Sponsor Committed Funding.

The objectives related to cost management are to:

- Provide a high level of confidence that Crossrail will be delivered within the proposed funding profile and, if not, to provide remedial actions;
- Ensure that the project is being developed, designed and constructed in a way that optimises whole life cost;
- Demonstrate that value for money is being provided at every stage of the project;
- Provide confidence that reported costs are accurately stated and forecasts are prepared properly and reliably on the basis of the best available information; and
- Ensure, as far as practicably possible, that robust cost control mechanisms are in place throughout the whole of Crossrail and all of its component projects.

6.14.4.2 Challenges

Many of the challenges relate to the management of a large volume of cost information and quantifying the constantly changing inherent risk and uncertainty in Crossrail and include:

- Management of a diverse and dynamic supply chain to meet the cost parameters, quality requirements and time based reporting constraints of Crossrail;
- Managing existing cost management systems and processes that allow costs to be pro-actively managed rather than simply monitored;
- Balancing the whole life cost objectives within the strict capital cost envelope; and
- Integrating cost management requirements with individual Industry Partner practices and ensuring that they delivery is in accordance with the Crossrail Sponsors Requirements.

6.14.4.3 Approaches

Cost estimating

CRL management has adopted both bottom-up and top-down approaches to estimating depending on the requirements, the information available and the timescales prescribed.

Estimates are reviewed, challenged and ultimately validated by the Delivery team and Industry Partners. The estimate submissions are then subjected to final review by CRL. This final review ensures consistency of estimating approach, assurance that all of the programme scope has been included, especially at interfaces, and provides reconciliation with the approved budget for the point estimate. Additional areas of cost are overlaid on the Delivery team and Industry Partner estimates in order to represent areas of direct expenditure by CRL such as for land, property and indirect costs.

The CRL programme cost estimating function is responsible for initial estimates associated with proposed changes and for supporting the change team in administering the change control process. Where applicable this is in consultation with the relevant Delivery team or Industry Partners.

Controlling costs in the delivery phase

Work packages are authorised for implementation with approved budgets and project level contingency allowances. Further contingency reserves are held at programme and board level. As work proceeds estimates to completion are updated regularly based on contractor's data. Contracts are “open book”, permitting full visibility and audit of cost data, progress and forecasts, allowing challenge and validation. Estimated final costs are monitored against the approved budget as a key element of management reporting. Early warning trend processes at project and programme level

The release of programme level contingency to work package budgets is subject to formal change control. The Programme estimate, known as the Anticipated Final Crossrail Delivery Cost is reviewed and updated periodically.

Prior to contracts being awarded the component estimates for the programme will be developed by the Delivery and Industry Partners and design consultants, and validated in detail by CRL. This validation will include a full reconciliation to the programme scope definition and benchmarking.

Pre-tender estimates for individual work packages will be produced during the course of the programme.

Cost assurance

CRL management use a variety of techniques such as parallel pricing, benchmarking and market testing to ensure that it has maximum confidence in the cost data received from the supply chain. CRL acts as the quality gatekeeper of all cost data to provide progressive cost assurance.

CRL has implemented a programme-wide financial software platform based on SAP. This system enables cost data to be captured in a common format and provides a single source for all programme cost information. The finance system incorporates a standard ‘purchase to pay’ system including authority and budgetary controls over commitments and payments.

CRL provides an audit and cost verification role to provide assurance of expenditure and value for money. This gives confidence in accruals, forecasting and ultimately in the Anticipated Final Cost for the project. It covers:

- Assurance that appropriate contract administration procedures and controls are in place to give confidence that the conditions of contract will be properly applied and managed;
- Assurance that contractor accounting systems are appropriate to properly capture, report and forecast costs in line with the contract conditions;
- Limited cost assurance that costs are being appropriately accrued and controlled by Network Rail on its On Network Works;
- Audit of actual costs and assurance that costs applied for are allowable expenditure under the contracts;
- Audit of reported progress and quantities; and
- Validation and challenge of forecast progress and costs to completion.

In order to avoid misinterpretation of the NEC3 Construction Contract requirements, CRL engages with the delivery supply chain to confirm requirements for data capture and actual cost substantiation and to provide explanations of disallowable costs.

This function is described in more detail within the Commercial Management chapter.

Cost reporting

All cost management reporting follows the four weekly period reporting cycle. It is integrated with schedule reporting. The reporting hierarchy begins at control account level, followed by contract level, project, sector and programme. The key cost data reported includes:

- Earned value KPIs - Cost Performance Indicators and Schedule Performance Indicators, earned schedule and schedule variance;
- Cost of work done compared to budget and forecast;
- AFC compared to budget;
- AFC changes and trending;
- Forecast extrapolations of ACWP based upon CPI efficiency levels (EAC)
- Contract target price compared to budget and AFC, target price changes instructed and pending; and
- Contingency drawn down and outstanding.

Cost reporting is aligned with the Sponsors' periodic requirements and defined project reviews.

Quantitative Risk Assessment (QRA)

The establishment of project contingency provisions will be based on Quantitative Risk Assessment (QRA). The QRA will include identification of risks, quantification of impacts, both in terms of the cost of the risk and the cost of the time associated with delay, allocation of risk to contract packages and risk allocation between Sponsor, CRL and supply chain as appropriate. The QRA establishes levels of contingency for the baseline estimate, and will be used to establish the level of central programme contingency to be retained against work packages which have been authorised for implementation.

Full review of Quantitative Risk Assessment is conducted on a quarterly basis with periodic reviews being conducted as required. QRA combines risk provision after modelling with unresolved trends, i.e. those costs identified by the project teams, but yet to migrate to the resolved trend forecast via the change process.

Risk management and quantification is a key part of the regular project management process, with risks reviewed and updated each period. QRAs are updated regularly from the latest risk assessments. Updated QRAs, adjusted for treated risks, will be used to re-assess required levels of contingency for comparison with expended and outstanding available contingency

Inflation

CRL uses economic specialists to assess the inflation indices to be used in the investment model for forecasting outturn costs. Inflation allowances are compared to actual rates of inflation, both in published indices and from the programme's experience in order to inform projections of future inflation.

Learning Legacy Document

6.14.5 Risk management

Managing risk is critical to the successful delivery of Crossrail. This section sets out how CRL and its partners manage the most significant threats and risks to the achievement of the objectives set out in the previous sections. It outlines the high level approach to risk management.

6.14.5.1 Risk management strategy

CRL's strategy for the management of risk can be summarised as follows:

- 1) Embed risk management in the programme;
- 2) Establish an integrated framework for the management of all categories of risk; and
- 3) Set targets for reducing risk to within acceptable (and funded) limits and put in place a Risk Reduction Plan to achieve the targets.

6.14.5.2 Objectives

CRL's risk management strategy is outlined in the Programme Controls Management Plan and establishes a clear allocation of risk across the programme and seeks to ensure that all partners and other relevant stakeholders possess the capability to manage their risks.

CRL's functional objectives in relation to the management of risk are to:

- Reduce risk exposure to within funding limits;
- Support the delivery of project objectives, to time quality and cost, by eliminating or reducing threats;
- Inform intelligent budget allocations through an understanding of the financial risk exposure;
- Improve decision-making by encouraging the identification and discussion of risks; and
- Provide clear evidence to all stakeholders that CRL recognises, understands and is controlling the risks associated with the programme.

6.14.5.3 Challenges

The main challenges to implementing effective programme-wide risk management are:

- Ensuring full and sustained engagement of project managers, Delivery and Industry Partners to recognise their responsibilities for risk reduction, and to accept accountability for successful delivery;
- Ensuring that risk management is understood and undertaken in a consistent, coordinated and structured way across the whole programme, moving from a relatively low level of risk management maturity to a high level in a short time frame; and
- Realising the benefits of the risk management process and ensuring that its contribution to project success can be recognised and recorded for continuous improvement.

6.14.5.4 Approaches

Embedding risk management in the programme

Managing uncertainty and risk is the responsibility of everyone working on Crossrail. The requirement to consider risks and take cost effective action to control and mitigate them has been embedded in the fundamental project management processes such as financial control, cost estimating, planning and design development.

CRL has established a set of principles which influence the way in which risk is managed. These principles are:

- Focus on uncertainty that matters, and distinguish between risks and issues;
- Ensure clear accountability for the management of risk;
- Provide the right information at the right time; and
- Facilitate a pragmatic risk management solution.

Risk management has been recognised as a key component of CRL's culture. The intention is that the proactive management of risk is accepted and adopted as a behaviour across the programme to support the vision and values. To this end, risk management is one of five key skill areas identified by the Organisational Development Plan.

CRL has published and communicated a Risk Management Policy and continues to communicate and raise awareness of risk management across the programme.

Maintaining an integrated risk management framework

CRL management integrates the management of all categories of risk, including health and safety risk, into its overall risk management process, however dedicated risk management processes for health and safety, business continuity, security and fraud, have been developed by the relevant specialist teams. CRL delivers the following outputs to:

- Report on key risks and progress with mitigations on a periodic basis;
- Establish strong accountability for managing risk and monitor the performance of accountable managers in managing their risks;
- Put in place risk reporting structures that are simple and effective;
- Establish procedures for escalating the management of risks appropriately; and
- Maintain Board-level engagement in the risk management process.

The Risk Management Strategy establishes a structured hierarchy of risk information defining Strategic, Programme and Project risk levels. Formal processes for managing risk have been developed at each of these levels. An integration risk model has been developed to map and report relationships between risks that could affect railway opening. A Programme Risk Panel has been established and meets periodically. An Executive Sub-committee for risk has been established and receives an update on risk management activity on a periodic basis. Review and reporting of risk information is now a well-established part of the programme's periodic cycle and the processes have been formally documented.

CRL has implemented Active Risk Manager (ARM) to support risk management across the programme. A central risk management database provides greater visibility of risk information, will encourage individual accountability for risk and will provide a greater level of assurance of the risk management process.

The risk management approach was developed jointly with Industry Partners through discussion at the Programme Board and coordination with industry partner risk representatives.

Developing risk reduction plans

CRL management sets targets for reducing risk to within acceptable (and funded) limits. A Risk Reduction Plan has been produced to identify the risk reductions required to achieve these targets. In this way the Risk Reduction Plan establishes a link between the assessment of risk exposure and risk management activity.

In order to measure performance against the Risk Reduction Plan, CRL employs QRA to evaluate the aggregate impact of the identified risks on the cost and schedule.

Processes and procedures

A consistent suite of documentation, illustrated in figure 6.16, has been developed to support CRL's risk management policy and process as it applies to the whole of Crossrail. This includes an overarching Risk Management Policy Statement and Plan, description of the Risk Management Process at the strategic, programme and project levels as well as documentation on other related risk management processes including, but not limited to, health and safety, security and business continuity.

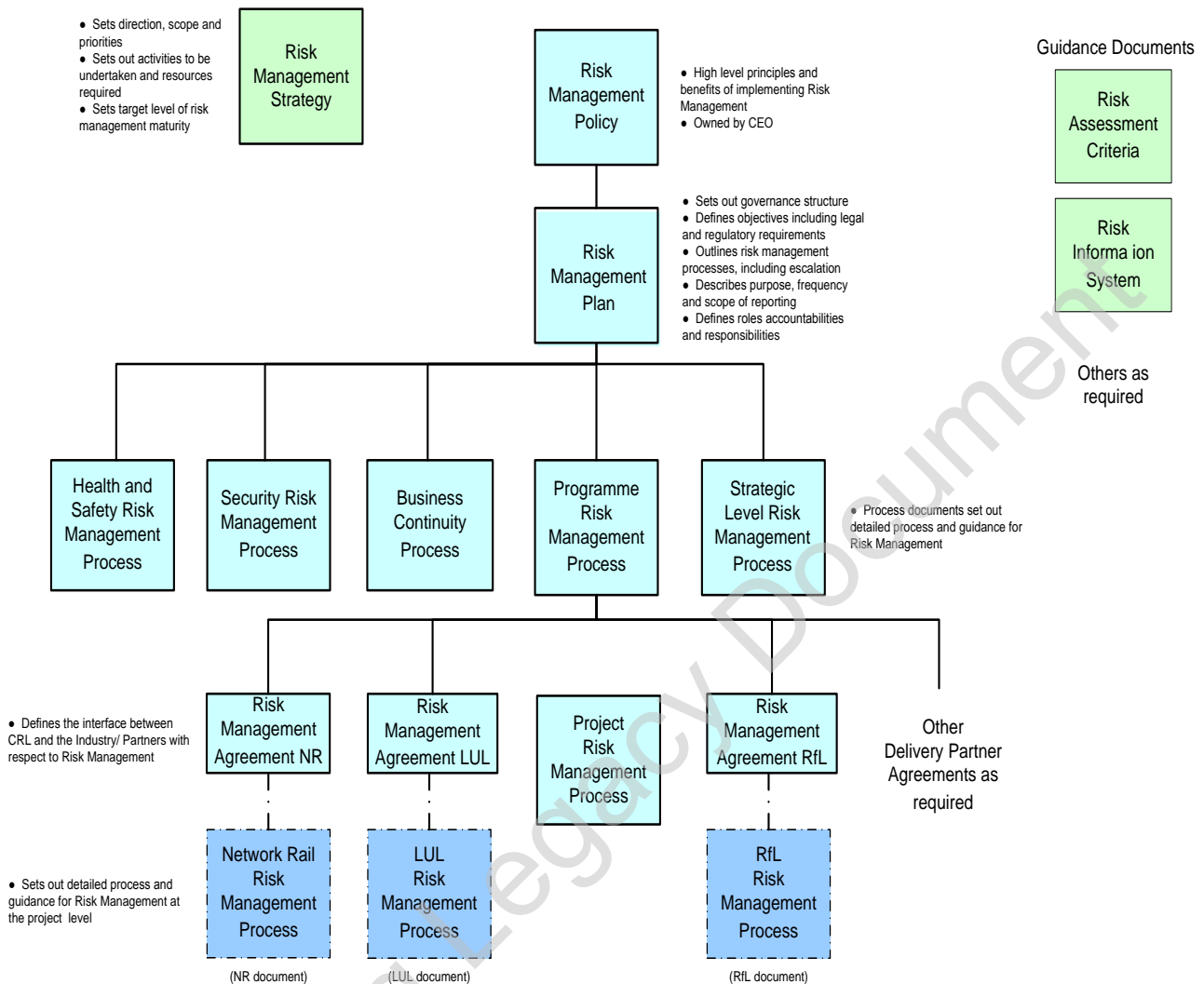


Figure 6.16 – Processes and procedures

Measuring success

A number of KPIs have been developed to allow the measurement and monitoring of risk management performance across the programme. The ultimate success will be measured by the delivery performance of the programme in terms of meeting its overall objectives within the funding and contingency position.

Having achieved an acceptable level of Risk Management Maturity as part of the journey to Review Point 4, CRL continues to identify and share best practice within the organisation and benchmark itself against independent maturity models and other large projects.

Accountabilities and responsibilities

The risk management strategy establishes a clear framework to manage risks at the correct level within Crossrail. It defines risk at three levels; strategic, programme and project. Establishing a hierarchy ensures that risks are managed at the most appropriate level. Although the principles of risk management for Crossrail are common, the processes for managing risks in each level of the hierarchy may be different.

Risk	Primary Purpose	Principal Owner(s)
Strategic risk	<ul style="list-style-type: none"> Risks to Crossrail’s strategic objectives Generally externally-driven and relate to political, funding, market and economic factors, industry and stakeholder relations. Also summarises key areas of risk within the programme Reported to the CRL Board, Sponsors and other Stakeholders 	CRL Chief Executive
Programme risk	<ul style="list-style-type: none"> Risks to Programme level objectives; Risks associated with coordination, interfacing and integration of projects; Significant risks which cannot be resolved within projects; or Risks to Crossrail Programme Functional Requirements 	CRL Programme Director
Project risk	<ul style="list-style-type: none"> Risks to Project level objectives; or Risks associated with the delivery of scope to meet defined requirements. 	Project Directors

Table 6.4 - Risk types

6.14.6 Value Management

This section outlines the approach to value management. Value management is an all-encompassing, team-based philosophy used in response to the need to deliver and demonstrate enhanced value on projects and programmes.

CRL's approach to value management is based on developing and driving a continuous awareness of value in the programme, focusing on objectives before solutions, and concentrating on function to enhance innovation. It combines within an integrated framework, a value focused management style, a positive approach to team-based solutions and the effective use of proven methods and tools.

Value management looks to ensure that the concept of value is understood and inherent in every decision to increase the likelihood of achieving requirements at optimum, whole life value for money.

6.14.6.1 Objectives

Embedding a culture of active value management across Crossrail contributes to the achievement of the vision and objectives and addresses CRL management's objectives of:

- Delivering best value for money;
- Ensuring affordability and developing fit-for-purpose solutions;
- Developing a value focussed culture across the programme;
- Creating sustainable and whole life value opportunities, not just cost cutting; and
- Establishing a performance measurement and reporting regime to demonstrate performance of value management.

The objectives in the Sponsors Requirements and the PDA state:

- Value for money shall be provided at every stage of the Project (Sponsors Requirements); and
- CRL has obligations to '*minimise the Anticipated Final Cost of the Crossrail Project in accordance with best value*' (PDA).

Value for money is defined by the Audit Commission as achieving the right balance between economy, efficiency and effectiveness - sometimes known as the 'value chain'. Whole Life Value is defined in the Procurement Strategy and is based on the optimisation of whole life costs on the basis of an appraisal period over a period of 50 years from the Target Final Delivery Date.

6.14.6.2 Challenges

The main challenges to meeting these objectives are:

- Obtaining corporate commitment from CRL, Delivery and Industry Partners, the supply chain and other stakeholders to support the value for money agenda throughout their ongoing activities and responsibilities and incentivising the right behaviours;
- Gaining senior management sponsorship to embrace, promote and encourage a value management culture focussed on delivering value and value for money; and
- Providing assurance to the Sponsors of the positive impacts of value management across Crossrail will require the willingness of all partners to commit to transparency regarding value management activity and reporting regimes.

6.14.6.3 Approaches

Executive sponsorship

Top-down sponsorship is vital to promoting and encouraging a focus on value and value for money within Crossrail. Accountability and ownership for the delivery of significant value opportunities will rest with the senior management of CRL. Functional heads, opportunity owners and partner organisations will be encouraged to create the appropriate 'value behaviours'. Executive level support and periodic reporting will help to maintain a high profile for value management.

Value delivery

Regular governance meetings will provide leadership, consider high value opportunities and potential changes requiring Sponsors' approval.

Value management targets have been set for the Programme and project levels to ensure initial cost estimates will be within budget for Crossrail, and to ensure value for money.

Rigorous cost estimating of value opportunities at an early stage will improve confidence in potential benefits and avoid abortive effort and as the basis of the input into the change control process.

Programme-wide framework

CRL has developed an integrated programme-wide Value Management Plan and Value Management Procedure and used them to drive value management principles throughout the programme and to provide transparency regarding CRL's progress in meeting this requirement. CRL uses the plan to fully establish the cohesive link between value management activities at corporate, programme, project and package levels.

Contractual requirements

The FDCs, Delivery and Industry Partners all have contracts or agreements that set out duties in relation to value for money objectives. CRL will support Delivery and Industry Partners in the achievement of value management opportunities and provide assurance that duties are being discharged effectively.

6.14.7 Change Control

Change control is the process by which any planned deviation to the requirements, scope, schedule or budget of the agreed programme control baseline is managed. The scope of change control covers the development and management of a programme-wide process for controlling change including the assessment of the costs and benefits arising from proposed changes and the review, approval and implementation of change. The process for managing change relates to the principles for the management of the baseline, the management and expenditure of contingency and the protocol for delegated authority.

6.14.7.1 Objectives

As Crossrail progresses change is inevitable: requirements may change, designs evolve and delivery challenges need to be overcome. Effective change control is critical to ensuring that the changes are robustly assessed and approved, so that Crossrail is delivered within the approved budget. The key objective of the change control strategy is to ensure that change proposals are fully considered with respect to the operating railway and are refined and released into the programme in a considered manner, such that the impacts (positive and negative) are optimised.

CRL's change control strategy and procedure is designed to ensure that:

- A baseline is maintained to provide a reference point for change control;
- All unnecessary and unaffordable change is avoided;
- There is clear delegation of authority in relation to differing value and types of change;
- There is an approach which deals with change relating to the requirements and change relating to development and construction activity; and
- The approach is consistent with the requirements of PDA Schedule 4.

6.14.7.2 Challenges

The principal challenges for managing change are:

- The size and complexity of the programme and the multitude of sources and types of change;
- The lack of direct control by CRL over expenditure decisions in the significant elements of the programme being undertaken by third parties such as Network Rail and London Underground; and
- Difficulty in obtaining visibility of third party changes.

6.14.7.3 Approach

CRL has created a detailed procedure for managing change. The principles of which are:

- Effective governance is exercised through the Change and Commercial Sub Committee, a sub-committee of the Executive and Investment Committee;
- The allocation of responsibility for managing scope, budget and contingency is clearly defined and controlled at different levels;
- All approval of change incorporates the provision of the requisite delegated financial authority and the management of contingency in an integrated process; and
- Integrated monitoring and reporting to the Executive Committee on the level of remaining contingency as quantified through QRA.

6.14.8 Contingency management

CRL is provided with finite funds to deliver the commitments and obligations set out in the Crossrail Act and the PDA. The funding provides CRL with a contingency allowance for costs arising from changes, variations in price, and design assumptions and for the significant risk across the programme. The management of the contingency fund is an important activity for CRL and in managing this fund CRL:

- Applies strong governance to the allocation and expenditure of contingency;
- Safeguards the allocation and expenditure of contingency through rigorous scrutiny and challenge;
- Provides timely and sufficient access to contingency for those managing delivery; and
- Ensures that the allocation and expenditure of contingency is transparent to the CRL Executive, Board and Sponsors.

A contingency management process has been established and is based on the following:

- A tiered structure for contingency supported by an approvals hierarchy as shown in figure 6.17;
- Clear allocation of responsibility and accountability for the management of contingency;
- A rigorous process for scrutiny and challenge, whereby budget holders will be required to provide justification for an allocation of contingency, including evidence that alternative mitigating options have been properly investigated;
- The allocation of contingency subsequent to the setting of authorised budgets through the investment authority and controlled through the core financial systems; and
- Requirements for the reporting of the allocation, expenditure and forecast expenditure of contingency.

Figure 6.17 shows the tiered structure for contingency management.

	Coverage	Process			
Sponsor Contingency	Costs in excess of Intervention Point 1.	Formal process, initiated by CRL Executive, endorsed by CRL Board and controlled by Sponsors			
CRL Board Contingency	All costs in excess of contingency levels below	Formal process, controlling change to the Baseline Budget, controlled by the Board, administered by CRL			
Programme Contingency	All programme wide costs in excess of the Project and Area level contingency as stipulated in the Scheme of Authorities	Formal process, controlling change to the budget and Investment Authority, controlled by the Executive, subject to transaction level limits administered by the programme team			IP2
Area/Sector Contingency	Costs for the incurrence of risk for project to project interfaces within a geographical are	Formal process, controlled by Area/Sector Directors, subject to transaction level control as stipulated in Scheme of Authorities	IP0	IP1	
Project Contingency	Costs in excess of the tendered total of the prices for contracted works	Formal process, controlled by Project Managers, subject to transaction level control as stipulated in Scheme of Authorities			

Figure 6.17 – Tiered structure for contingency

6.14.9 Reporting

High quality progress reports are an important factor in generating confidence in the performance of the programme and support management in timely and effective decision making and effective programme control.

CRL is required by the PDA to produce Periodic Programme Reports (4 weekly) and Semi Annual Construction Reports for the Sponsors. The PDA sets out the required scope of both reports.

The main objective of the reporting function is to generate high quality, relevant, credible, insightful and timely reports. CRL has adopted best practice approaches based on other major rail infrastructure projects and London 2012 Olympic and Paralympic Games, focussing on exception reporting.

CRL has developed in conjunction with the Sponsors a suite of reports to meet the requirements of the PDA for external users of information:

- The Board Report – periodic, detailed, progress report focused on effective delivery; and
- Semi Annual Construction Report (SACR) – submitted twice a year, less detailed, balanced between forward looking elements and retrospection.

The Board report combines information from the four measures of performance, On Time, On Schedule, Safety and World Class, and combines them in a narrative and engaging style to provide a balanced view of programme performance which serves as both part of the programme record, and to support management decision making.

Supporting these external reports is a wider spectrum of reports across the 4 performance themes, supporting management enquiry across, as illustrated below:

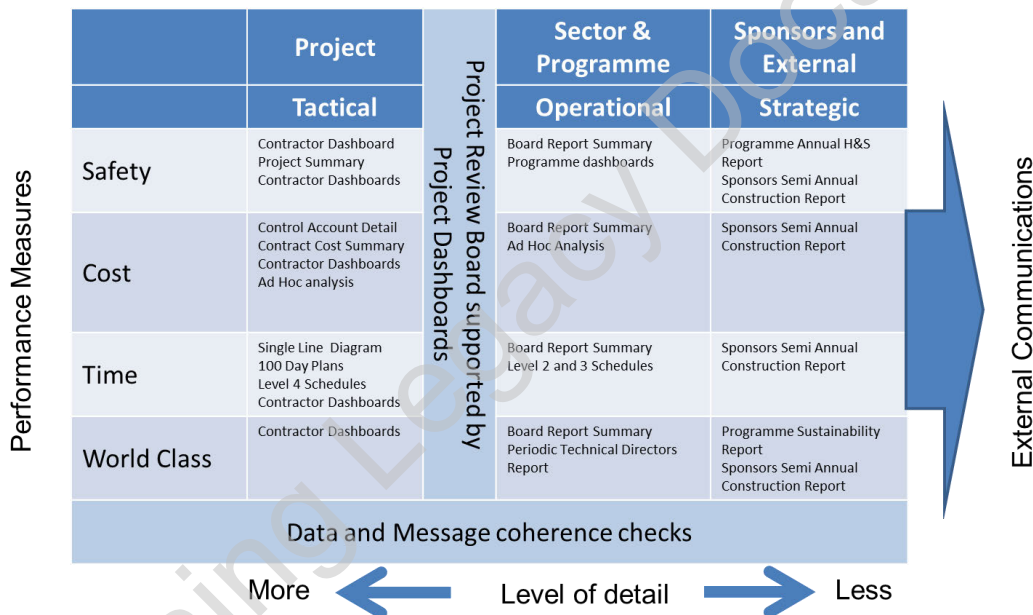


Figure 6.18 – Crossrail reporting approach

Reporting processes are supported by effective information systems used to hold, aggregate and summarise data from all of Crossrail component projects as a basis for analysis. Tacit knowledge is integrated with the data in project dashboards which are subject to interpretation reporting to aid decision making and then presented to the Programme Delivery Board at periodic Project reviews, where those responsible are subject to scrutiny, and are expected to advocate their position.

The Periodic Programme Board Report spans the Operational/Strategic space as it adds programme level analysis, and sets the context in which the individual project messages come together to supports external messaging.

Reports are categorised using the matrix to ensure consistency with the needs of the users at their particular level within the organisation, prevent overlap and ensure consistency of language and approach.

6.15 Commercial Management

The Commercial Directorate leads in the determination of CRL's commercial policy. This policy includes the establishment of corporate procedures for Commercial Management, including the development of the Contract Administration Manual (CAM) together with supplemental guidance notes issued from time to time to site teams.

6.15.1.1 Objectives

The Commercial Directorate acting as the Employer provides support to the project through a number of specific work streams:

- Development of commercial policy;
- Maintenance of contract record information;
- Provision of contract administration procedures and tools;
- Development of contract amendments;
- Cost verification of open book contracts;
- Commercial close out; and
- Dispute resolution

6.15.1.2 Challenges

Construction of Crossrail is undertaken primarily by contractors working on NEC3 based Target Cost contracts. However, there are also works being delivered through Industry Partners, most notably On-Network works delivered by Network Rail, or through bespoke agreements (such as Rolling Stock). A small number of contracts have been let through lump-sum or on a cost reimburseable basis. Design consultants are similarly engaged on NEC3 based professional service contracts.

The respective Sector Director acts as the NEC3 Project Manager, who then delegates contractual authority to representatives within the Delivery Directorate in accordance with the Scheme of Authorities. The CRL Head of Quality is appointed as the NEC3 Supervisor and similarly delegates contractual authority to project field engineers acting as the Supervisor's Representative.

A key challenge for CRL is the efficient and effective management of communications between the contracting parties and the maintenance of records. CRL has developed the project's document management system (eB) to create a fully integrated contract communications workflow (eBCA). The eBCA system provides:

- Consistency of approach across the project
- A fully auditable record of transactions
- Real time senior management overview of contract positions
- Governance control of transactions; and

- Full integration with technical documentation (drawings, reports, specifications)

The Commercial Directorate leads in the development of eBCA as the project lifecycle develops and through organisational change.

6.15.1.3 Approach

Contract Record Information

The Commercial Directorate tracks contract progress from procurement through to final account and closure. The Directorate maintains the register of Crossrail contracts, their status (planned, awarded, completed etc) and other key information as part of the Work Breakdown Structure. The records are maintained as core project information and controlled through the change control process.

Key commercial record information is maintained using eB and in a consistent format in preparation for future handover to RfL.

Provision of contract administration procedures and tools

The Commercial Directorate produces and maintains the CAM which sets out the governance by which those delegated with contract authority and their teams, manage the contract obligations. The CAM sets out the extent to which individuals can act on behalf of CRL and the way records are maintained. The CAM ensures a consistent approach to the administration of CRL contracts.

Cost verification of open book contracts

The majority of CRL's contracts are based on "open book" arrangements, whereby the Contractor is paid costs plus a fee. A target cost is agreed at tender, to which the final costs are compared. The difference between target and costs+fee is shared as pain or gain between CRL and the contractor. As such the contractor is incentivised to reduce actual costs.

The Commercial Directorate, through a dedicated in-house Cost Verification Team (CVT) carries out audits of contractors and their supply chain to verify compliance with contract obligations for Defined Cost. The team provide the Project Manager with advice on disallowed and unsubstantiated costs (matters which are ultimately decided by the Project Manager acting impartially).

Contract amendments (Supplemental Agreements)

A key challenge of the Crossrail project is the extent of interfaces and interdependencies between work sites and contractors. The NEC3 is a collaborative contract form, however the nature of the project dictates that supplemental agreements are sometimes required to clarify or re-baseline commercial positions. The commercial directorate, acting as Employer, leads in the development of such agreements.

Typical examples include the rescheduling of sectional completion dates to match the emerging MOHS programme. Supplemental Agreements are developed to align with programme wide objectives and reduce overall project risk. As the project moves into the systems integration phase, greater use of partnering agreements has been introduced through supplemental agreements.

Commercial Closure of Contracts

The Commercial Directorate acting as Employer co-ordinates with the Delivery Directorate on the commercial close out of contracts. For major contracts the process comprises three stages each of which culminates in a submission paper to the Commercial and Change Sub Committee (C&CSC).

- Stage 1 – Contract Commercial Close out Plan – A generally narrative style plan submitted by the Project Manager, 6 months ahead of planned completion. The plan identifies the key issues, opportunities and risks to completion;
- Stage 2 – Contract Commercial Completion Report – A generally factual statement provided by the Project Manager around 2-3 months after completion and co-incident with the resolution of most commercial issues. The report identifies the activities required through the defects period; and
- Stage 3 – Contract Commercial Defects Report – An update of the Stage 2 report with the additional confirmation that all defects and actions have been dealt with and the final account has been concluded. The report seeks authorisation from C&CSC to reconcile financial accounts and fix the final contractor performance (CPI, SPI).

A modified version of the above is undertaken for smaller or lower risk contracts. The determination of a final account in some instances is undertaken with the negotiation of a settlement agreement.

Commercial issues are considered at the fortnightly C&CSC.

Dispute Resolution

The contracts include a provision for managerial discussions where a notice of Dispute has been served. The Commercial Directorate acts for the Employer in such discussions and may undertake reviews of specific contract issues. The Commercial Directorate maintains a dialogue with senior representatives of Tier 1 contractors to facilitate resolution of common issues across multiple contracts.

In the event that formal adjudication is initiated, the Commercial Directorate supports the CRL legal department in the preparation and presentation of evidence to protect and defend CRL.

6.16 Innovation

CRL has established an Innovation Programme through its framework for delivery, Innovate 18.

6.16.1.1 Objectives

Innovation is generally defined as the commercialisation of ideas. For CRL, this translates to the delivery of value to the Crossrail Programme, through improvements in health and safety; sustainability; efficiency, all of these underpinned where possible through use of technology and digital integration.

6.16.1.2 Challenges

The key challenges in meeting Innovation objectives are:

- Securing collaboration throughout the programme, and across the supply chain;
- Sharing innovation and encouraging replication of successes;
- Managing delivery of a diverse portfolio of investments; and
- Delivering, measuring and monitoring value.

6.16.1.3 Approaches

Innovate 18 is the Crossrail framework through which innovation is undertaken on the programme. The approaches used to implement innovation across the programme include:

- Managing a network of Innovation Champions across the site and supply chain;
- Identifying challenges and opportunities aligned with Crossrail challenges as the project evolves;
- Delivering a Communications Strategy;
- Identifying a transition strategy to ensure industry benefits from the legacy beyond the lifetime of the Innovation project; and
- Employing appropriate project management and rigour in delivery of invested innovation.

6.17 Transition and Learning Legacy

CRL's Transition and Learning Legacy initiatives will deliver added value to UK plc from the investment being made in Crossrail. While protecting CRL's ability to deliver, these initiatives will close-down the CRL programme client, make the intangible assets available to TfL and others and create a learning legacy for future projects.

6.17.1 Transition

6.17.1.1 Objectives

Transition will ensure that the smooth handover to operations is accompanied by planned and effective management of the risks and opportunities arising from project close-down and absorption of the CRL programme client into TfL.

6.17.1.2 Challenges

Transition risk, using its broadest meaning, has already been significantly mitigated through the strategy to open Crossrail in Stages and through the project team and operators working together to achieve a successful Handover and to mitigate the risks of each opening stage.

The Transition Strategy therefore focuses on the risks and opportunities arising from demobilisation of the project and the assimilation of CRL within TfL:

	Risks	Opportunities
CRL	Unplanned loss of key people ahead of their project roles coming to an end	Efficiency gains through greater integration with TfL – drawing on TfL’s capability and/or transferring functions and people to achieve better utilisation. Access to commissioning and handover skills e.g. through secondments to CRL.
TfL	Difficulties in assimilating CRL in to TfL with impact on railway and business operations, ongoing commercial management and benefits realisation	Talent retention – absorbing expertise from CRL; and benefitting from CRL-developed information, processes and systems

6.17.1.3 Approaches

The approach to Transition is intended to address the overall challenge of bringing CRL and TfL, each with separate priorities, closer together to achieve a smooth transition.

Transition is managed through:

- A Transition Strategy, agreed with all relevant parties;
- A joint Transition Steering Group, with director-level representation from CRL, TfL, RfL and the Joint Sponsor Team, to oversee implementation of the strategy; and
- A team in CRL’s Transition and Strategy Directorate working collaboratively across CRL, RfL, and TfL to facilitate transition plans for individual directorates. Although initially led by CRL it is envisaged that the composition and leadership of the transition team will migrate over time to be led by TfL personnel.

6.17.2 Learning Legacy

The Learning Legacy concept aligns with the National Audit Office and Public Accounts Committee recommendations and the Infrastructure and Projects Authority’s objectives for Crossrail to share its learning.

6.17.2.1 Objectives

The Crossrail Learning Legacy objective is to collate and share lessons learned, best practice and innovation from the Crossrail project for the benefit of future projects and programmes, aimed at raising the bar in industry and show casing UK plc.

6.17.2.2 Challenges

- The Crossrail Learning Legacy programme needs to deliver within a limited budget and without distracting staff from delivering the programme;
- Crossrail Learning Legacy aims to build on the Olympics Learning Legacy by publishing in tranches while the project is still being delivered, and promoting the programme through current and previous staff on the programme as Learning Legacy Ambassadors, available to speak about Learning Legacy content they have provided.

6.17.2.3 Approaches

The Learning Legacy programme is managed through:

- A small team, augmented in the short term by consultancy resource from the person previously responsible for the Olympics Learning Legacy;
- Several Theme steering groups involving partners such as professional institutions, academic partners and successor projects; and
- An Executive Learning Legacy Steering Group providing governance

The team is working with champions within Crossrail, with CRL’s supply chain and with industry and academic partner organisations to produce, review and publish lessons learned and good practice material. A website is planned to be launched in early 2016 with initial content which will be added to throughout the remaining life of CRL.

Partner organisations will disseminate the learning legacy through regular and special events such as interactive seminars, conferences, webinars, social media and trade publications.

The team is working with the Infrastructure and Projects Authority, Major Projects Association and other project delivery organisations on a longer term project to establish an industry Knowledge Hub which is intended to be the long term home of the Crossrail Learning Legacy once Crossrail is complete.

Section 7: Appendices

Learning Legacy Document

7 Appendices

Appendix A: Crossrail Statement of Objectives (from Appendix 1 of Sponsors Requirements)

London is a world city - a world leader in financial and business services, an international shopping centre and a major tourist destination, as well as a focal point of government, business, tourism, culture and learning in the UK. London's role as a driver and gateway for the UK economy means its success is important both to Londoners and to the UK as a whole. London's growth over recent decades is set to continue.

London's rail network has played a vital role in London's development. The capital possesses one of the most extensive public transport networks in the world and this network has ensured that it has the access to the markets and labour needed to develop and sustain a strong and vibrant central core.

However, London's growth has driven demands on this network to an historic high. Rail and underground services have high levels of overcrowding and congestion, which not only causes discomfort to passengers but also causes service unreliability and carries a real economic cost.

These demands are likely to continue to grow over the next decade. London competes with other cities around the world for investment, trade and tourism, and must continue to develop if it is to maintain its attractiveness. The Government and the Mayor are committed to building on London's success and developing it as an exemplary, sustainable, world class city fit for the twenty-first century.

Analysis for the London Plan shows that there will be continued pressure for growth in business and housing. But the Government and the Mayor are committed to ensuring that this growth is both sustainable and equitable. They want it to be accommodated without encroaching on open spaces, by intensifying development and using brownfield sites. And they want this growth to promote access to opportunities in the areas that need it most.

To achieve these targets, the Government and Mayor have set out detailed plans to regenerate large areas of the capital and its hinterland, particularly the Docklands, Thames Gateway and Lea Valley, as well as building on the success of existing growth areas such as the Heathrow- Reading corridor. And they have set out ambitious policies to minimise car use and reduce environmental impacts.

These plans mean that rail movements into London and, in particular, east-west rail movements, will increase significantly. London urgently needs improved rail facilities to provide room for population and employment growth. And it needs new rail routes to meet the changing patterns of demand that regeneration of the most deprived areas of London implies - improved connections between the City and the new financial centre in the Docklands, between the city centre and regeneration areas such as the Thames Gateway, and between all these areas and the city's airports.

The Government and Mayor plan a new cross London rail link to address these demands: "Crossrail." The aim of the scheme is to create the transport infrastructure needed to support the economic growth of London and its regeneration areas, sustain its position as a financial, retail, cultural and tourist centre, and ensure that London remains competitive with other European cities.

Its key aims to support these objectives are to:

- Significantly increase rail network capacity *into* central London to relieve over-crowding and congestion on existing services, and cater for expected growth in demand for travel into the capital over the coming decades;
- Significantly increase rail network capacity *across* London to relieve over-crowding and congestion on the Underground, and cater for expected growth in demand for east-west travel across the capital over the coming decades.
- Create the transport infrastructure to support London's growth and, in particular, facilitate the delivery of regeneration policy in communities such as Docklands, the Thames gateway and the Lea Valley.
- Create transport infrastructure to facilitate access to central London's cultural, educational, historical and recreational facilities, and support the growth and dynamism of tourism and culture in the city.
- Significantly reduce cross-city journey times by creating new direct journey possibilities between points to the east and west of London and providing a high frequency, high speed service between stations;
- Improve access to opportunities for those living in some of the most deprived areas of east and west London
- Support the development of an integrated transport network across London and the South East by contributing to the creation of a network of strategic interchanges between transport modes;
- Facilitate the improvement of London's international connections by creating a new direct, high capacity rail link between Heathrow and central / east London, and improving connections to Luton, Gatwick, Stansted and international rail services;
- Support the wider transport, planning, social and environmental objectives of the Government's 10 Year Plan, the Mayor Strategies for London, the Strategic Rail Authority's Strategic Plan and Regional Planning Guidance, and successor documents;
- Deliver these objectives in a manner that ensures value for money for taxpayers and other contributors, and enhances the London and UK economy during the project's construction.

Appendix B: Referenced documents

Document	Version	Issue date/status
Affirmation Process Protocol		15 Jul 10
Agreements Compliance Procedure	CRL Exec Paper	4 Nov 09
Crossrail Programme Assurance Strategy	4.0	14 Sep 14
Berkeley Homes – Woolwich Documents		Feb 2011
Board Regulations		23 June 11
Board Committee Terms of Reference		Various
Executive & Investment Committee TORs		14 Jan 16
Heathrow Airport Ltd – BAA documents		11 Aug 10
Canal & River Trust – BWB documents		Various
BS OHSAS18001 – Occupational H&S Management Systems	Suite of approx 20 docs	Accredited Apr 10
Canary Wharf Group – Canary Wharf Group Agreement		19 Oct 10
Change Control and Budget Management Procedure	7.0	20 Feb 2015
Oversight Development Collaboration Agreements		Various stages of development based on future site handover dates to development partners
Crossrail Communications Protocol	2.0	27 Jun 14
Communications Strategy 2015/16	2.0	2 April 15
Community Relations Procedure, or	3.0	2 Nov 11
Construction Community Relations Strategy Framework	2.0	10 Jun 15
Construction (Design and Management) Regulations 2007		2007
Construction Code	7.0	31 Jul 08
Construction Management Plan	4.0	April 15
Construction Quality Plan	4.0	April 15
Crossrail Act 2008		2008
Crossrail Programme Functional Requirements	7.0	Nov 14
Docklands Light Railway (DLR) Overarching Agreement,		3 Dec 08
Works Agreement and Property Agreement		8 Feb 10
Engineering Safety Management		Process
Health and Safety Policy	5.0	28 May 15
HSE: Contractors & Industry Partners	2.0	Sept 10

Document	Version	Issue date/status
London Underground – Development Agreement		3 Dec 08
Maintenance Strategy	3.0	13 Oct 10
Management Plan Volume 1 – Corporate, Support and Specialist Function Directorates	4.0	13 Apr 15
Management Plan Volume 2 – Central Section Delivery	4.0	23 Mar 15
Management Plan Volume 3 – Surface Delivery	5.0	20 Mar 15
Management Plan Volume 4 – Operations	1.0	08 Jan 15
Master Control Schedule (now superseded by Master Operational Handover Schedule, April 2015)	6.0	1 April 2015 (refreshed every year)
NR Asset Protection Agreement	2.0	29 Mar 12
NR Client Requirements	6.0	22 June 12
NR Implementation Agreement		17 Aug 09
NR Programme Protocol	7.0	13 Aug 12
Operational Concept	Made up of various chapters	Various stages of development
Crossrail People Strategy	1.0	Jan 12
Oversite Development Management Plan	4.0	1 August 14
Project Representative Protocol	1.0	21 Aug 14
Procurement Strategy	2.4	Dec 10
Programme Controls Management Plan	6.0	3 Aug 11
Project Delivery Partner Appointment		17 Apr 09
Project Development Agreement		25 May 11
Quality Policy	4.0	28 May 15
Railways (Interoperability) Regulations 2011		2011
Railways and Other Guided Transport Systems (Safety) Regulations 2006.		2006
Rolling Stock and Depot Procurement Strategy	7.0	11 Apr 13
Sponsors Requirements	4.1	10 Mar 10
Sustainability Strategy	3.0	14 Aug 15
Systems Integration Management Plan	5.0	8 Jan 15
Technical Assurance Plan	4.0	Feb 16
Technical Management Plan	9.0	April 15
TfL Shareholders Agreement	1.0	3 Dec 08

Appendix C: Abbreviations

Abbreviation/ Acronyms	Explanation/Definition
AFC	Anticipated Final Cost
AFCDC	Anticipated Final Crossrail Direct Cost
APA	Asset Protection Agreement
BH	Berkeley Homes
CIAG	Crossrail Integrated Assurance Group
C-ICD	Construction Interface Control Document
CDM	Construction Design and Management
CPFR	Crossrail Programme Functional Requirements
CMS	Crossrail Management System
CRL	Crossrail Limited
CTOC	Crossrail Train Operating Company
CWG	Canary Wharf Group
CWP	Canary Wharf Properties
DfT	Department for Transport
DLR	Docklands Light Railway
ECHR	Element Completion Handover Report
EDF	EDF Energy Electricité De France (London Electricity)
EMR	Environmental Minimum Requirements
EMS	Environmental Management System
ESM	Engineering Safety Management
EVA	Earned Value Analysis
ExCom	Executive Committee
FDC	Framework Design Consultant
FORS	Freight Operator Recognition Scheme
GLA	Greater London Authority
GRIP	Guide to Railway Investment Projects
HAL	Heathrow Airport Limited (formerly part of British Airports Authority)
H&S	Health & Safety
IMPRG	Infrastructure Managers Progress Review Group
ITT	Invitation To Tender
JST	Joint Sponsor Team
KPI	Key Performance Indicator
KSI	Key Sustainable Initiatives
LB	London Borough (of)
MCS	Master Control Schedule
MPRG	Major Projects Review Group
MTR[C]	Mass Transit Rail [Crossrail]
NAO	National Audit Office
NR	Network Rail
ODA	Olympics Delivery Authority
OGC	Office of Government Commerce
ONFR	On-Network Functional Requirements
ONW	On-Network Works (known as Crossrail Surface)
ORR	Office of Rail and Road
OSD	Oversite Development
PDA	Project Development Agreement

Abbreviation/ Acronyms	Explanation/Definition
PDB	Programme Delivery Board
PP	Programme Partner
PRep	Project Representative
QMS	Quality Management System
QRA	Quantative Risk Assessment
RAB [C]	Railway Assurance Board [Crossrail]
RfL	Rail for London
RIA	Railway Integration Authority
RIBA	Royal Institute of British Architects
RIR	Railways (Interoperability) Regulations
ROGS	Railways and other Guided Transport Systems (Safety) Regulations
RP3/4	Review Point 3/4
RSOPB	Railway Systems and Operations Programme Board
RSPB	Royal Society for the Protection of Birds
SACR	Semi Annual Construction Report
SHELT	Safety and Health Leadership Team
SOR	Stations Operations Room
SoS	Secretary of State (normally for Transport in Crossrail's case)
TBM	Tunnel Boring Machine
TCC	Traffic Coordination Centre
TfL	Transport for London
TIP	Technical Interface Parameter
TOC	Train Operating Company
TPH	Trains Per Hour
U&A	Undertakings and Assurances
V&V	Verification and Validation
WBS	Work Breakdown Structure
WRAP	Waste and Resources Action Programme



Learning Legacy Document

