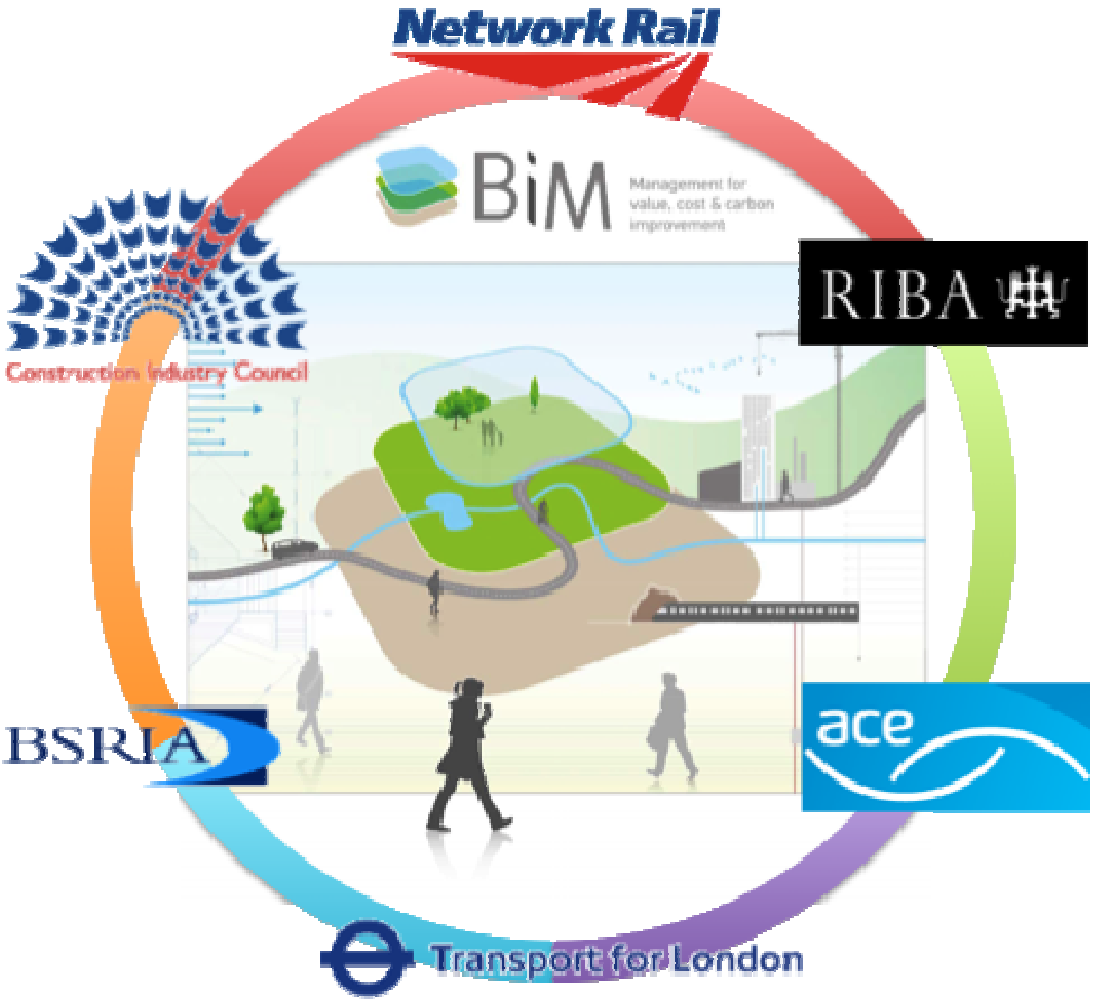
Cross-discipline design deliverables for BIM

Phase 1 report – Strategy Document



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1 Introduction

1.1 BIS BIM Strategy Paper

The BIM Working Party Strategy Paper published by BIS in June 2011 has set out the UK Government's strategy for adopting building information modelling across a large proportion of public sector capital construction projects by 2015. The Government's reason for proposing the adoption of BIM is to reduce the cost of capital projects by improving the design and construction process for buildings and infrastructure. The agreed strategy for adopting BIM is a twin-track approach as is illustrated in Figure 1. Public sector client 'pull' will come from clearly stated client requirements for the industry to provide BIM data at various points during the design and construction process. An initial suggestion of these requirements is included in Appendix 9 of the BIM Strategy Paper. This 'pull' will be complemented by supply chain 'push' coming from leading edge members of the supply chain improving their competitiveness by increasing the efficiency of their design and construction processes.

Figure 1 Push and pull of BIM implementation

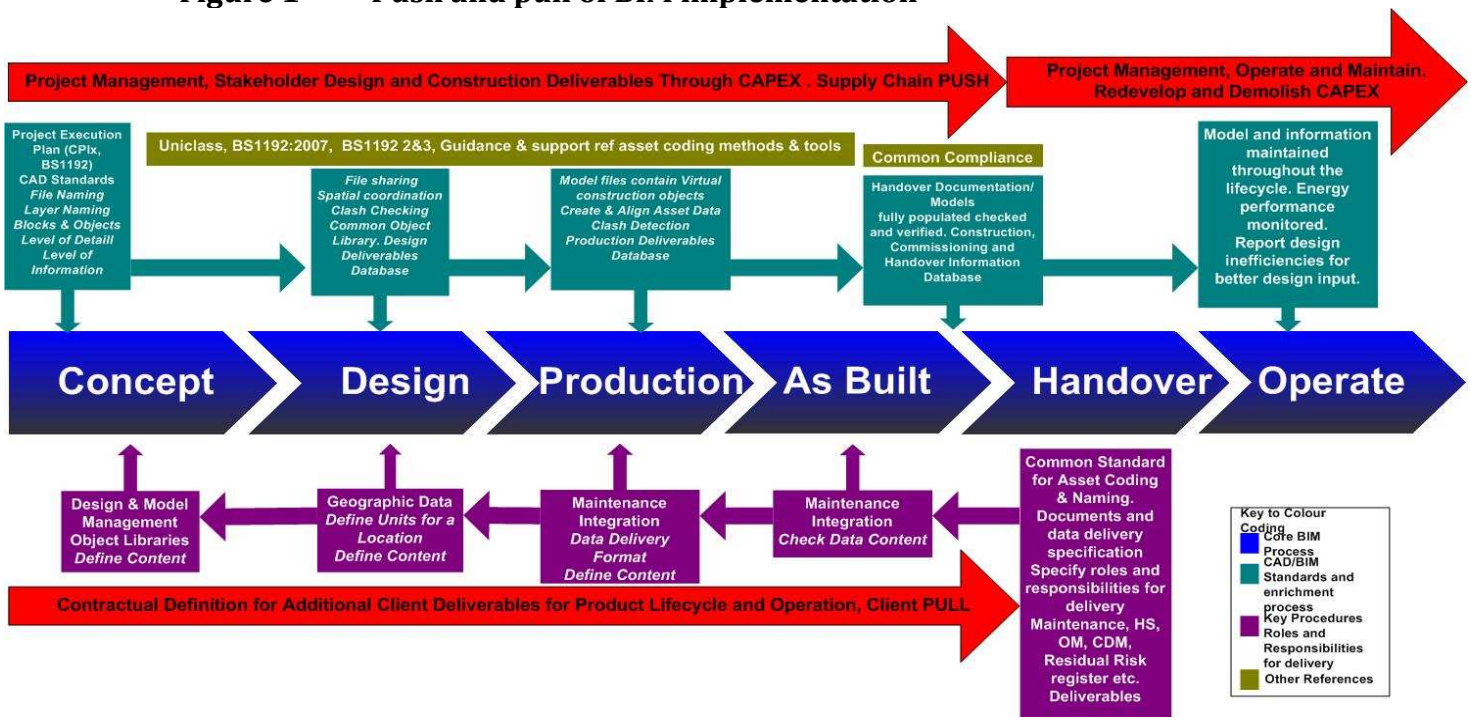


Diagram courtesy of Mervyn Richards.

1.2 Purpose of this document and its target audience

This Strategic Response document reports on initial work funded by BIS and the Construction Project Information committee that has started looking at the practicalities of defining a single set of 'data drops' during design and construction across both building and civil engineering projects. This is based on an assessment of the existing state of alignment between the various plans of work that have been defined by different design disciplines or client groups. This document sets out the findings of this initial work and also suggests some follow-

on work to complete the definition of a common set of 'data drops' that will reflect as much of current plans of work as is practicable.

This document is aimed primarily at public sector clients, to explain to them the kind of guidance that will be prepared over coming months. However, it is also relevant to private sector clients, for use on their own projects, and to the supply chain to explain what their clients will be expecting from them in the future.

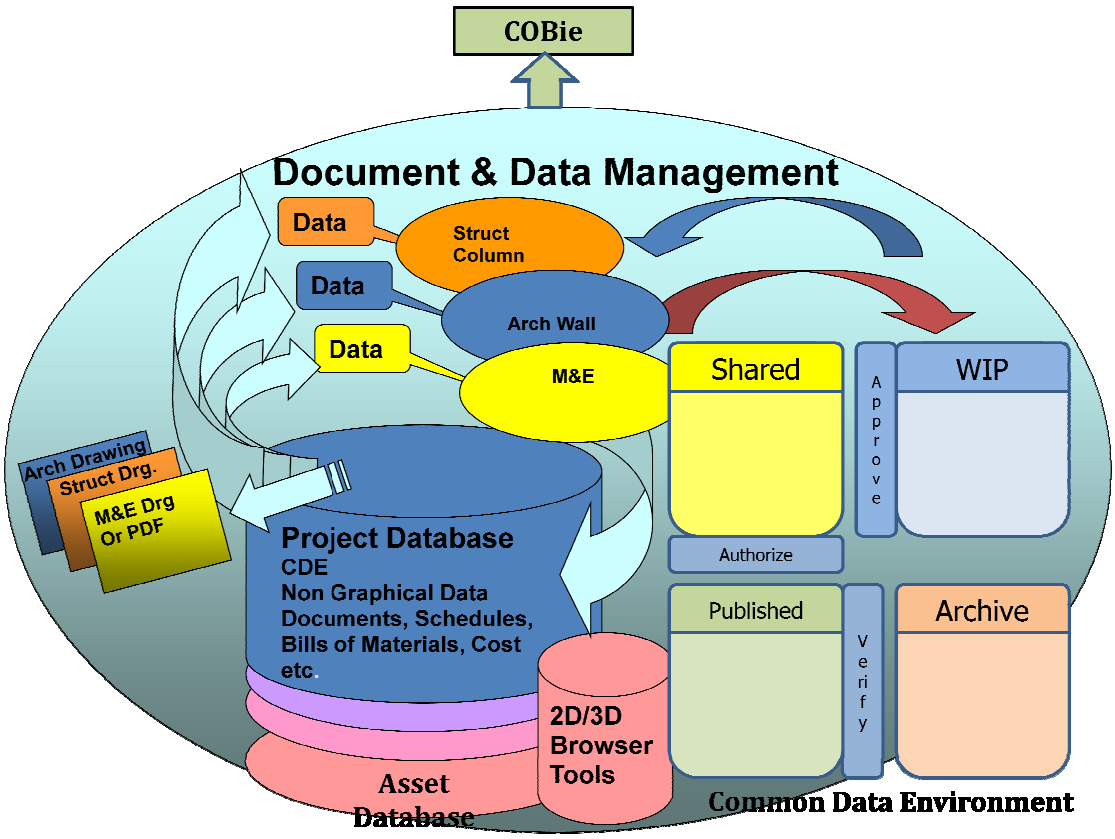
2 Alignment of existing plans of work

Successful implementation of building information modelling across a multi-disciplinary design and construction team requires that any definition of design deliverables for a project using BIM is appropriate and relevant to each design discipline. This means that the deliverables are defined as far as is possible to align with the existing plans of work used by each discipline.

2.1 Document and data management

This alignment between different design disciplines should also mean that the management of project data and documentation through the mechanism described in BS1192:2007 is easier to apply, since it will help different designers to reach compatible stages of their design work at the same time. Figure 2 shows the BS1192:2007 common data environment of WIP-Shared-Published-Archive linking to project and asset databases which can be viewed through 2-d and 3-d browser tools. The ultimate outputs from the data management process would still need to include drawings for construction and installation on site.

Figure 2 BS1192:2007 Common Data Environment linking to project and asset databases



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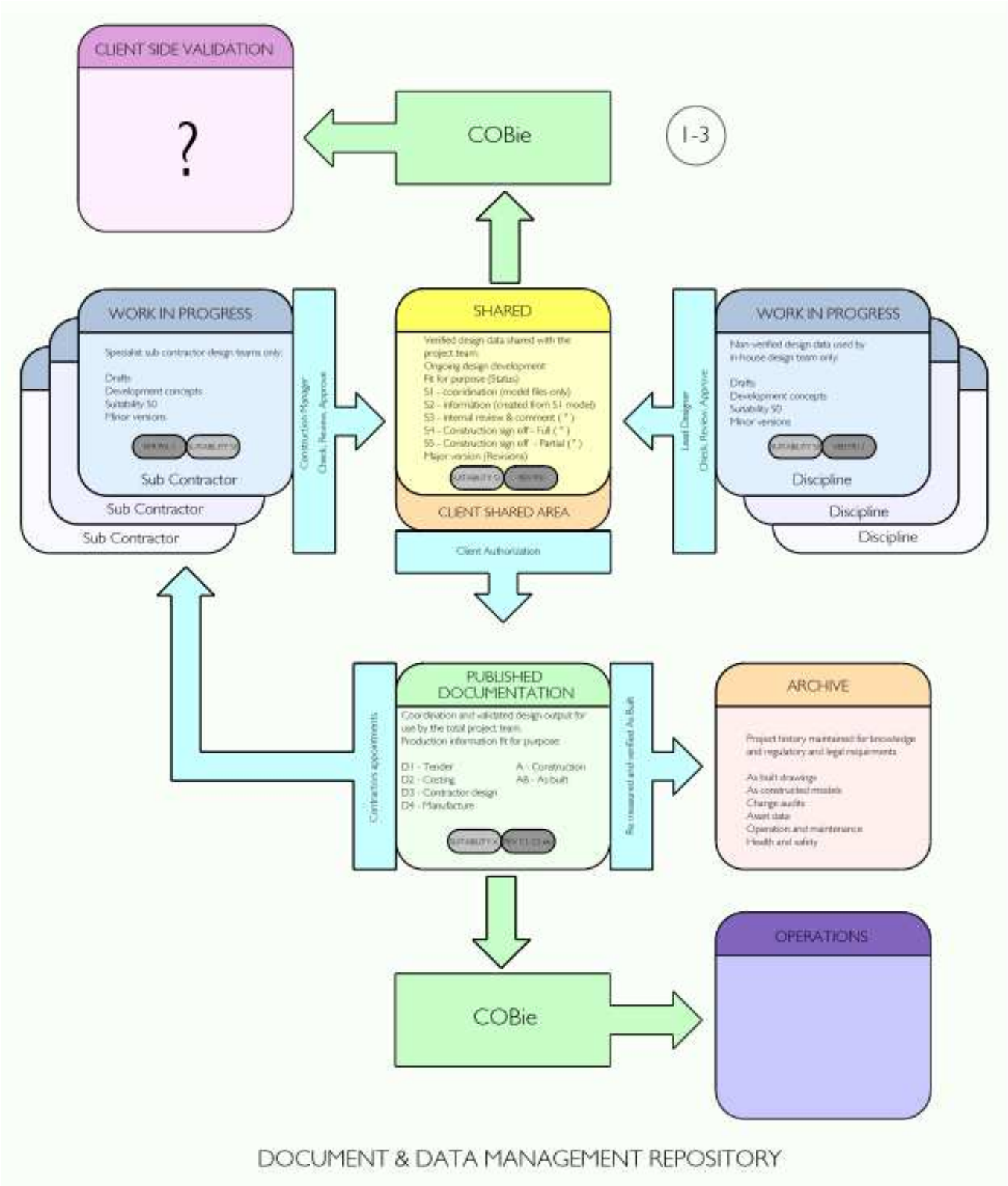
A modified version of the BS1192:2007 process for co-ordinating design work between different members of the project team is shown in Figure 3. This extends the original BS1192:2007 process is to include the explicit step of sub-contractor Work in Progress design. This links from the Published Documentation area, which is the information handed over to the main contractor, back into the Shared area. This was always implicit in the original process but has now been made much more visible.

A second change in the revised process is to include the links through the COBie protocol into Client Side Validation and Operations.

Figure 3 Updated version of BS 1192:2007 process for document and data management



2.2 Alignment of plans of work

Figure 4 shows two versions of an alignment of the existing plans of work. The version at the top of the figure is the diagram included in the BIS BIM Working Group strategy paper. The version at the bottom of Figure 4, shows the alignment based on a detailed examination of the different plans of work, and also includes two other frameworks not includes in the original – the ACE Agreement stages and the BSRIA Design Framework.

The plans of work have been shown only from a design development point of view. This means that any stages related to contractor selection have been omitted, primarily RIBA Plan of Work stages G and H. The RIBA Plan of Work itself acknowledges that Stages G and H do not necessarily come directly between Stages F and J, depending on the procurement route. This also means that TfL CGAP Gates C and D appear at the same point, since these two gates mark the start and end of contractor selection.

In addition, the LU PMF and the TfL CIMM plans of work include activities that are prior to CIC Stage 1/RIBA Stage A, and also activities that go beyond CIC Stage 6/RIBA Stage L, and these have been shown in the revised plan of work alignment. OGC Gateway 5 (Benefits realisation) is a recurring gateway during the life of the facility/project, but only the first pass is shown in the figure.

The conclusion from this more detailed analysis is that there is only one point where all the plans of work align. This is at the completion of CIC Stage 6, which is variously designated as Project Close, Post Practical Completion, Completion. This takes into account the fact that the standard ACE services conclude at practical completion (end of CIC Stage 5), unless extended by optional services.

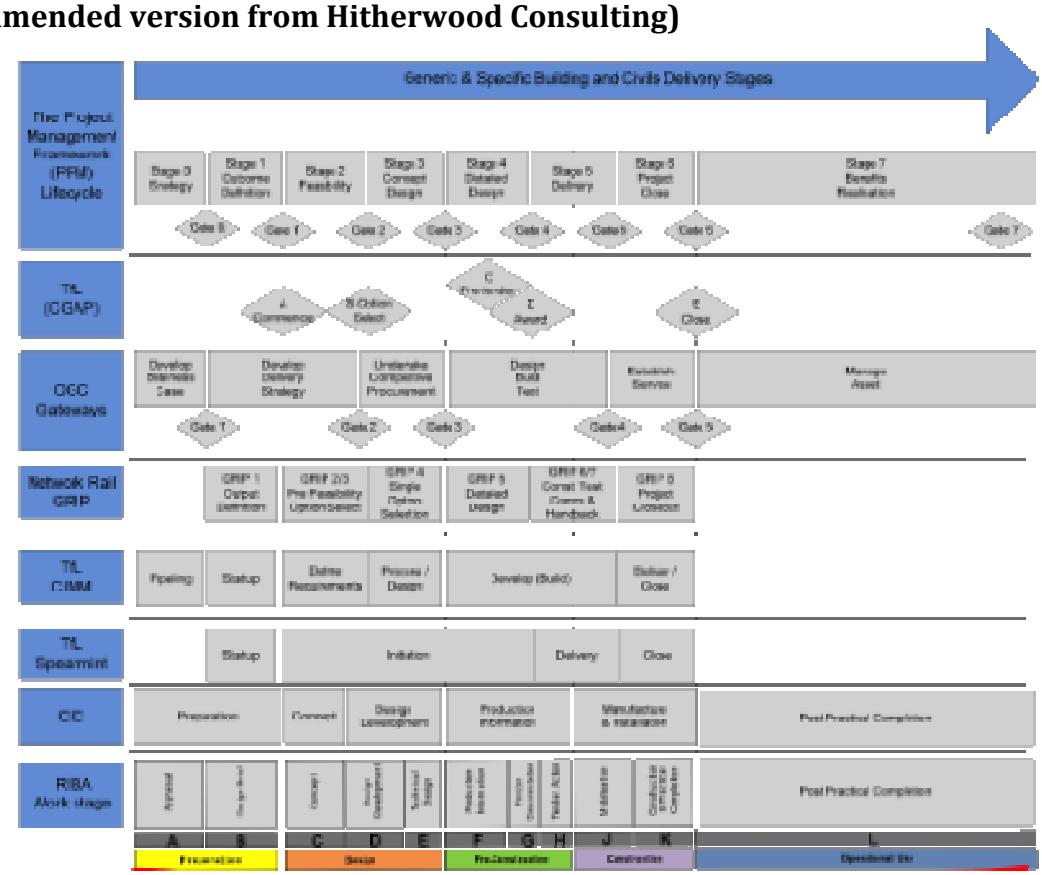
There are several points at which many of the plans of work align:

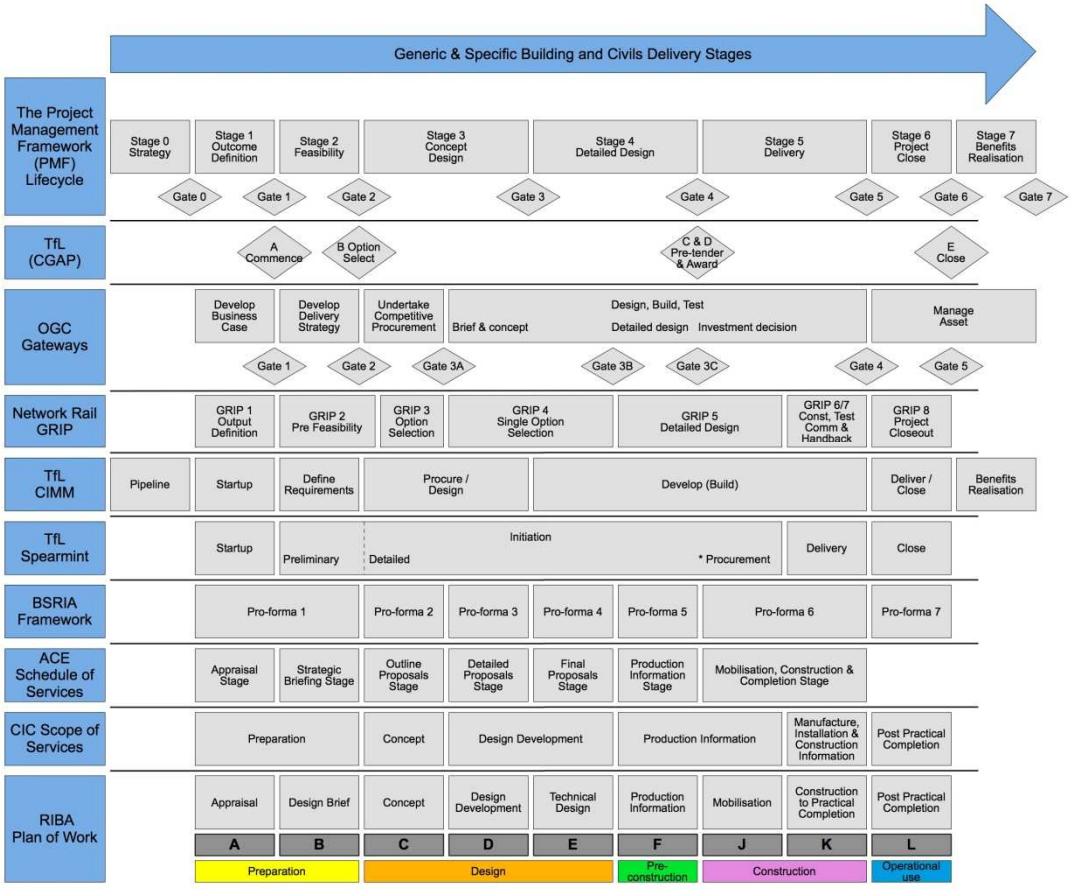
- Mid-point of CIC Stage 1/BSRIA Proforma 1 which ties in with end of RIBA Stage A, ACE Appraisal Stage, GRIP Stage 1, CIMM/Spearmint/PMF Stage 1 and OGC/CGAP Gate 1.
- End of CIC Stage 1, which aligns with most other plans of work except GRIP where Stage 2 carries over slightly into CIC Stage 2.
- End of CIC Stage 5, which aligns with every other plan of work except TfL CGAP

There is no clear alignment of many plans of work between the start of CIC Stage 2 and the end of CIC Stage 4, which is when most of the project design is taking place. For example:

- OGC, GRIP and CIC align at the end of Gate 2, Stage 3 and Stage 2 respectively
- LU PMF and TfL CIMM align at the end of their Stages 3 and also with the end of RIBA Stage D, but other plans do not (except ACE and BSRIA which also align with RIBA Stage D)
- GRIP Stage 4 aligns with the end of CIC Stage 3 and RIBA Stage E (which therefore also align with ACE and BSRIA).

Figure 4 Alignment of existing plans of work (BIS original and amended version from Hitherwood Consulting)





Information about the OGC gateways was drawn from other alignment studies rather than from the source definitions of the gateways. The detailed analyses of the plans of work are included in Appendix B.

2.3 Plans of work and project process maps

The differences between existing plans of work have probably arisen because of their different focuses. There is no inherent reason why a plan of work for the rail industry should align neatly with a plan of work for building. Apart from the technical differences, there are also very wide variations in the amount of detail in the various plans of work. The BSRIA Design Framework for Building Services and the RIBA Architect's Job Book are probably the most detailed explanations of design activities and deliverables. In general, plans of work do not just concern themselves with deliverables. Many of them give detail on the design activities that lead to deliverables and some indicate how design activities link together in process diagrams.

There is also a fundamental difference in the way that different plans of work approach the project process. Some, such as RIBA and CIC, define a project in terms of the work content within each stage of the project. Others, such as OGC or CGAP, define a project in terms of the audit gateways it has to pass through to progress. There also seems to be a major difference between building oriented plans of work that acknowledge that some design work continues after construction has started, and infrastructure oriented plans of work which imply that all design is completed when the project goes out to tender.

Finally, there are other plans of work that have not been included here, such as the Salford Process Protocol, but which could be included in a more detailed analysis if this was believed to be helpful to the industry and its clients.

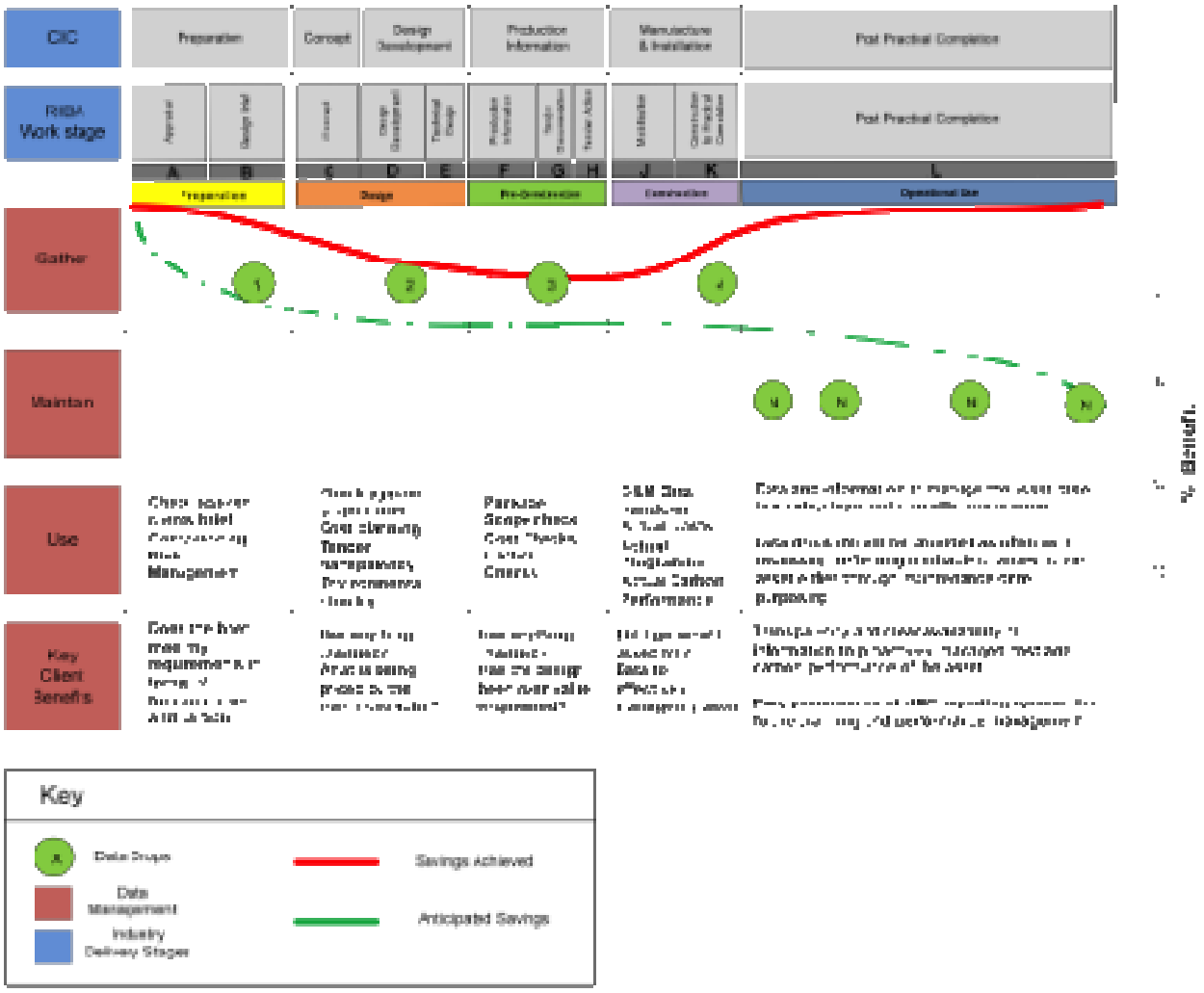
3 Design deliverable stages ('data drops')

3.1 Working Party Strategy Paper proposals

The Government's Construction Client Group BIM Working Party Strategy Paper proposes some 'data drops' during the design and construction stages of a project. These are points at which the client requires defined deliverables from the project team. The Working Party strategy paper proposed four 'data drops' as indicated in Figure 5.

One of the objectives of this Strategy Document is to confirm the number and timing of these 'data drops' and to propose content for them based on an initial review of the plans of work and on the COBie2 templates. From this initial analysis the document then sets out a more detailed plan for refining and finalising the descriptions of these data drops together with exemplar illustrations of what a compliant Building Information Model would contain at each of these points.

Figure 5 Data drops and data management processes from Working Party Strategy Paper



The BIM Working Party Paper identifies further 'data drops' during the operation and maintenance of the facility, but these are not considered further here. Following completion and publication of the CAPEX 'data drop' deliverables, it is expected that a similar exercise will be undertaken to define OPEX 'data drop' deliverables.

3.2 Data drops based on analysis of plans of work

Based on the analysis of existing plans of work, summarised above, the following BIM data drops are suggested for clients to check on the progress of their project teams against pre-determined deliverables. These are described in more detail in Appendix A, including reference to client deliverables and the appropriate COBie2 references.

- DD1 Mid-way through CIC Stage 1 (Preparation). At this point the deliverables are about supporting the project appraisal and the client's requirements, and feeding into estate-wide strategic considerations.

- DD2 Mid-way through CIC Stage 3 (Design Development). At this point the deliverables are an outline design of the selected technical solution – suitable either for continued development within the existing design team or for handing over to a contractor for design and build proposals. This data drop would also test the Guaranteed Maximum Price coming from the main contractor.

- DD3 Towards the end of CIC Stage 4 (Production Information). At this point the deliverables are a detailed and coordinated design – suitable for issuing for tender to a contractor who would need to have minimal design input, or for ratifying a developed D&B design before construction and installation works start. This data drop would test the prices coming back from the contractor supply chain.

- DD4 At the end of CIC Stage 5 (Manufacture Installation and Construction). At this point the deliverables relate to the handing back of the facility to the client, completed apart from rectification of defects. This data drop tests that the essence of the brief has been achieved.

- DD5 At the end of CIC Stage 6 (Post Practical Completion). At this point the deliverables are focused on supporting the operation and maintenance of the facility. This data drop is also the first of the OPEX data drops.

3.3 Summary of deliverables defined by existing plans of work

Deliverables from the building information model can be divided into two broad types: graphical information and non-graphical information. Graphical information is generated from the 3-d model and may be viewed as 3d or 2d representations on screen or printed onto paper (analogous to traditional drawings). A collation of current drawing definitions, from various references, is included at Appendix C.

Non-graphical information is generated from the database underlying the 3-d model by querying the data held within or attached to the objects in the model. The results are analogous to documentation such as materials schedules, bills of quantities, etc.

The various plans of work already define some of these graphical and non-graphical deliverables in different levels of detail, and this is a starting point for defining the level of detail and the level of information expected within a building information model at a particular project stage. Summaries of these levels of detail and information are included in the Data Drop definitions in Appendix A.

4 The next steps in defining cross-discipline design deliverables

This initial work has shown that it should be feasible to define a set of BIM deliverables that align across the design disciplines, with relatively small amounts of amendment to the separate plans of work. The deliverables are defined in two stages – CAPEX deliverables that focus on the initial design and construction processes and OPEX deliverables that focus on the facility operation and management processes. This aligns with the development of BS1192: Parts 2 and 3 which will cover CAPEX and OPEX respectively.

Table 1 Suggested contents for CAPEX and OPEX guides

CAPEX guide (design, procurement, construction and commissioning)	**OPEX guide (handover, operation and maintenance)**
Terms and references	Terms and references
Managing collaboration processes	Managing collaboration processes
Managing information libraries	Managing information libraries
Managing models through information status	Managing models through information status
Information owners and their responsibilities	Information owners and their responsibilities
Classification of objects	Classification of objects
Geospatial referencing	Geospatial referencing
Capturing information from the brief	The impact of different FM strategies
The impact of different procurement processes	Data input processes
Data input processes	Required deliverables during operation
Required client deliverables	Deliverables for end of life
Optional project team deliverables	Health and safety file information
Commissioning processes	
COBie2 handover information	

In the meantime, the suggested data drops described in Appendix A can be used by clients and their project managers to ask for project deliverables in such a way as to be broadly consistent with the emerging collective response to the BIS BIM Strategy document. Doubtless there will be some need to tailor the generic requirements given here for particular types of projects, but this interim strategic guidance should provide both the client and the supply sides of the industry with an 80%-satisfactory starting point.

David Churcher, Hitherwood Consulting Ltd for CPIC and BIS
December 2011.

Appendix A Initial definition of data drops during capital works

These data drops have been defined based on early analysis of the design discipline plans of work, the COBie2 templates and the client data requirements indicated by the BIS Working Group considering BIM deliverables, chaired by Nigel Fraser.

Data Drop 1 – mid-way through Preparation stage

Alignment with existing plans of work

RIBA Plan of Work/Job Book	end Stage A : Appraisal
CIC Scope of Services	mid-Stage 1 : Preparation
BSRIA Design Framework	mid-Pro-forma 1
Network Rail GRIP	end Stage 1 : Output Definition
TfL CGAP	Gate A : Commence
TfL SPEARMINT	end Start up
TfL CIMM	end Stage 1 : Start up
LU Project Management Framework	end Stage 1 : Output definition

Proposed design deliverables

The completed Project Brief based on:

- information from the client/project sponsor about project need, constraints associated with project funding, long-term operating cost, project timing, environmental assessment, technical compliance
- initial studies and surveys to collect information about the proposed development, usage scenarios, site locations, energy strategy, operation and maintenance strategy.

Proposed level of development and level of information in a Building Information Model

A model used to visualise the finished project in its surroundings, with possible elevation, plan and section treatments. Information in the model describes the performance outcomes. Objects are generic visualisations only whose main purpose is to convey scale and style to stakeholders whilst acknowledging that engineering development may require significant changes.

COBie2 cross references

- Contact worksheet created
- Facility worksheet created for each site/option being considered (classified to Uniclass Table D or E)
- Document worksheet created to list clients project brief and initial studies and surveys

Data Drop 2 – mid-way through the Design Development stage

Alignment with existing plans of work

RIBA Plan of Work/Job Book	end Stage D : Design Development
CIC Scope of Services	mid-Stage 3 : Design Development
BSRIA Design Framework	end Pro-forma 3
Network Rail GRIP	Part-way Stage 4 : Single Option Selection
TfL CGAP	Between Gate B : Single Option Selection and Gate C : Pre-tender
TfL SPEARMINT	Part-way Initiation
TfL CIMM	end Stage 3 : Procure/Design
LU Project Management Framework	end Stage 3 : Concept design

Proposed design deliverables

The signed-off Design Brief relating to the chosen single solution. Elemental cost plan. Occupation/coming-into-use plan. Performance specifications suitable for going out to tender to design and build contractors. All design information from other solutions is archived but accessible if required.

Plans, sections, elevations and perspectives showing proposed architectural form and quality, sketches of engineering systems showing design principles, rule of thumb calculations, structural design includes primary structure and allows for dead and live loadings.

Proposed level of development and level of information in a Building Information Model

A model to convey the design concept for the chosen solution, with generic objects at a low level of definition such as rectangular solids indicating overall size envelope and any required access space. Information attached to objects is focused on performance specifications and system connections in line with the design philosophy. Objects for non-changeable components are low or medium level manufacturer objects.

COBie2 cross references

- Facility worksheets for rejected options archived
- Floor worksheet created to describe each floor in the design with Name, Category, Description and Elevation columns completed
- Space worksheet created to describe each room/space in the design with Name, Category, Floor, Description, UsableHeight, GrossArea and NetArea columns completed (classified to Uniclass Table F or G)
- Zone worksheet created if appropriate to collect Spaces into zones within the facility, with Name, Category, SpaceNames and Description columns completed
- Document worksheet extended to list the design brief, cost plan, occupation plan, performance specification, data-drop BIM model
-

Data Drop 3 – end of Production Information stage

Alignment with existing plans of work

RIBA Plan of Work/Job Book	end Stage F1 : initial Production Information
CIC Scope of Services	towards end Stage 4 : Production Information
BSRIA Design Framework	end Pro-forma 5
Network Rail GRIP	end Stage 5 : Detailed Design
TfL CGAP	Gate C : Pre-tender
TfL SPEARMINT	end Initiation
TfL CIMM	part-way Stage 4 : Develop/Build
LU Project Management Framework	end Stage 4 : Detailed design

Proposed design deliverables

Completed design, detailed and coordinated, suitable for construction, manufacture and installation.

All technical specifications, detailed design and coordinated working drawings (based on provisional plant selections where these are likely to be refined by the contractor/supply chain).

Simulations of operational energy use, operational vehicle & people movements, emergency situations (fire, smoke, evacuation).

Proposed level of development and level of information in a Building Information Model

A model showing the detailed and co-ordinated design, with all physical clashes resolved based on selection of generic objects where future contractor's proposals are permitted or high-level manufacturer objects where such proposals are not permitted. Information attached to objects conveys detailed engineering parameters, dimensions, weights, system connections, materials where relevant.

COBie2 cross references

- Type worksheet created to describe the pre-traditional-tender choices of fitted and movable components in the design, with Name, Category, Description, AssetType columns completed (classified to Uniclass Table G, H, J or K as appropriate). The Manufacturer and ModelNumber columns will be completed for any asset where "equal and approved" substitution by the contractor will not be permitted.
- Component worksheet created to place instances of the assets defined in the Type worksheet in particular spaces in the facility, with Name, TypeName, Space and Description columns completed.
- System worksheet created to collect particular components from the Component worksheet into systems (for example heating, electrical, plumbing), with Name, Category, ComponentNames columns completed.
- Document worksheet extended to include references to: product data sheets for all specified components; technical specifications; all drawings.

Data Drop 4 – end of the Manufacture Installation and Construction stage

Alignment with existing plans of work

RIBA Plan of Work/Job Book	end Stage K : Construction
CIC Scope of Services	end Stage 5 : Manufacture Installation and Construction
BSRIA Design Framework	end Pro-forma 6
Network Rail GRIP	end Stage 7 : Hand Back
TfL CGAP	Between Gate D : Contract Award and Gate E : Project Close
TfL SPEARMINT	end Delivery
TfL CIMM	end Stage 4 : Develop/Build
LU Project Management Framework	end Stage 5 : Delivery

Proposed design deliverables

Facility with Practical Completion achieved. As-built drawings, operation and maintenance manuals, log-books and user guides for facilities managers and occupiers.

Proposed level of development and level of information in a Building Information Model

A model showing the facility as delivered at practical completion, incorporating any changes made to the co-ordinated design during construction and installation. Information attached to objects focuses on describing the components and elements actually installed, references to service and maintenance manuals.

COBie2 cross references

- Type worksheet extended to include all fitted and movable components delivered at Practical Completion (classified to Uniclass Table G, H, J or K as appropriate).
- Component worksheet extended to include all instances of assets from the Type worksheet.
- System worksheet extended to include final fitted components in each system in the facility.
- Document worksheet extended to include references to: data sheets from all actual components installed; as-built drawings; commissioning certificates; operation and maintenance manuals; migration plans.

Data Drop 5 – end of the Post Practical Completion stage

Alignment with existing plans of work

RIBA Plan of Work/Job Book	end Stage L : Post Practical Completion
CIC Scope of Services	end Stage 6 : Post Practical Completion
BSRIA Design Framework	end Pro-forma 7
Network Rail GRIP	end Stage 8 : Project Closeout
TfL CGAP	Gate E : Project Close
TfL SPEARMINT	end Close
TfL CIMM	end Stage 5 : Deliver/Close
LU Project Management Framework	end Stage 6 : Project Close

Proposed design deliverables

Facility with initial and early-stage occupation completed. As-built drawings, operation and maintenance manuals, log-books and user guides for facilities managers and occupiers, all amended according to any fine-tuning of building systems or any rectification of construction defects.

Proposed level of development and level of information in a Building Information Model

A model showing the facility as amended by any early-stage occupation fine-tuning, suitable for onward operation and facility management.

COBie2 cross references

- Spare worksheet created to describe all spare part sets required for the installed components, with Name, Category, TypeName and Suppliers columns completed.
- Resource worksheet created to describe all resources needed for maintenance works (materials, tools and training), with Name, Category and Description columns completed.
- Job worksheet created to describe all the maintenance tasks needed to operate and maintain the facility, with Name, Category, Status, TypeName, Description, Duration, StartDate, Frequency, FrequencyUnit, TaskNumber, Priors, ResourceNames columns completed.

Appendix B Tabulation of deliverables from separate plans of work

B.1 ACE Detailed Design and MEP Performance Design

CIC Scope of Services	**ACE Schedule of Services (Detailed Design) C&S (Part a) and MEP (Part b) unless noted**	**ACE Schedule of Services (Performance Design) only applies to MEP (Part c)**
Stage 1 : Preparation Client Brief (from client at start of Stage) Initial studies and information for preparation of business case (from team) Strategic Brief (from team)	**Appraisal Stage** Initial statement of requirements (from client at start of Stage) Requirements for site staff (from consultant)	**Appraisal Stage** Initial statement of requirements (from client at start of Stage) Requirements for site staff (from consultant)
	Strategic Briefing Stage Information reasonably available on existence and extent of public services (from consultant) C&S: Site limitations due to topography, previous uses, contamination (from consultant) C&S: Limitations due to road/transport access during construction and thereafter (from consultant) Comments on physical site restrictions affecting the engineering options (from consultant) C&S: Desk study of site [possibly include geotechnical investigation from Outline Proposals Stage] (from consultant) Initial recommendations on technical viability of the works (consultant in collaboration with other consultants)	**Strategic Briefing Stage** Information reasonably available on existence and extent of public services (from consultant) Comments on physical site restrictions affecting the engineering options (from consultant) Initial recommendations on technical viability of the works (consultant in collaboration with other consultants)

Stage 2 : Concept	**Outline Proposals Stage**	**Outline Proposals Stage**
Strategic Brief (from client at start of Stage) Initial proposals on design, technical and budget viability (from team) Initial Design Programme and Construction Programme (from team) Desk Study relating to site (from team) Primary functional requirements and design criteria (from team) and initial cost estimate (from QS) Schedules of floor areas (from team) Strategy for use, cleaning, maintenance and subsequent construction (from team) Design options (from team) Preliminary design information/concept design model for preferred option [sketches, design notes, drawings, performance specifications – to describe scope, scale, form & character of works] (from team) Concept report and initial cost plan (from team)	C&S: Geotechnical investigation of site (advised by consultant) Topographical or dimensional surveys of site, surveys of adjacent sites (advised by consultant) Consultation with local authority on matters of principle regarding design of works (from consultant) Alternative outline solutions (from consultant) Develop client's brief into full brief for the works (consultants in consultation with others) Advice, sketches, reports, outline specifications for outline proposals (from consultant) MEP: Approximate costs based on unit volume or area (from consultant)	Topographical or dimensional surveys of site, surveys of adjacent sites (advised by consultant) Consultation with local authority on matters of principle regarding design of works (from consultant) Alternative outline solutions (from consultant) Develop client's brief into full brief for the works (consultants in consultation with others) Advice, sketches, reports, outline specifications for outline proposals (from consultant) Sketches, drawings, specifications, calculations for preparation of cost plan (consultant and others) Sketch drawings showing structural planning requirements of services (from consultant) Preliminary schedules of power, heating and cooling loads (from consultant) Analyse preliminary heat gains/losses for initial sizing of HVAC systems/plant (from fabric/envelope thermal performance standards) Outline specifications and sketch drawings (from consultant) Documentation and drawings for tender (from consultant)

<table>
<tr>
<td rowspan="2">Stage 3 : Design Development

Setting out dimensions (from design lead)

Develop design approach to achieve required quality, is co-ordinated within the team, and conforms to Project Definition (from team)

Updated cost plan and initial cash flow forecasts (from QS)

Design options for elements of the work (from team)

Strategy for use, cleaning, maintenance (from team)

Calculations to verify and facilitate design development (from team)

Finalise design criteria (from team)

Value management (from team)

Define critical construction details, tolerances (from team)

Design development drawings/model [detailed form function & character of works – primary components in overall size and typical detail – GAs, sections, elevations, details to show design intent] (from team)

Outline specifications for components of works [performance and quality] (from team)

Design Development Report [drawings + specifications or model] (from team, approved by client)</td>
<td>Detailed Proposals Stage

Programme for whole of design and construction (in liaison with other consultants)

Detailed proposals (from consultant)

Sketches, drawings, specifications, calculations for preparation of cost plan (consultant and others)

MEP: Sketch drawings showing structural planning requirements of services (from consultant)

MEP: Preliminary schedules of power, heating and cooling loads (from consultant)

MEP: Analyse preliminary heat gains/losses for initial sizing of HVAC systems/plant (from fabric/envelope thermal performance standards)</td>
<td>Detailed Proposals Stage

Monitor evolution of system design from specification and sketch drawings (consultant of contractor)</td>
</tr>
<tr>
<td>Final Proposals Stage

MEP: Calculations, schematic drawings, schedules, specifications for final proposals (from consultant)

C&S: Calculations, drawings, schedules, specifications for final proposals (from consultant)

Co-ordinating the design into the overall works

MEP: Builders work information (from consultant)

MEP: Revised cost estimate based on unit volumes or unit areas (from consultant)

Integrate any specialist sub-consultant/contractor requirements into the works (from consultant)

MEP: Pre-tender documents and drawings and quotations</td>
<td>Final Proposals Stage

<<No specific deliverables>></td>
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</table>

	for equipment (from consultant)	
Stage 4 : Production Information Develop production information (from team) Value management (from team) Integrate specialist/supplier design & requirements into Project Definition (from team) Define structural support builders work (from team) Drawings/model and calculations including info from suppliers & specialists (from team) Submissions to statutory authorities (from team) Production information drawings/model and schedules [sufficient for construction or preparation of manufacturing and installation drawings] (from team) Drawings with dimensions from setting out information (from design lead, and team) Detailed specifications for components of the works [performance, quality, operating and maintenance requirements] (from team)	**Production Information Stage** C&S: Calculations, drawings, schedules, specifications for tender documentation (from consultant) Calculations and details related to statutory submissions excluding planning approval, and for MEP excluding building regulations (from consultant) MEP: Detailed design drawings (from consultant) C&S: Further drawings, including reinforced concrete GA drawings and non-standard details, excluding coordination drawings, temporary works designs/drawings, shop and fabrication drawings (from consultant) MEP: Specifications	**Production Information Stage** Monitor production of Co-ordination and Installation drawings (consultant of contractor)
	[Mobilisation is part of Stage 4 in CIC, but part of Construction/Completion in ACE]	
Stage 5 : Manufacture, Installation and Construction Information Co-ordinated manufacture and installation drawings, integrated with manufacture and installation drawings (from team)	**Mobilisation Construction and Completion Stage** MEP: Installation drawings (from contractor/sub-contractor with consultant information where needed, consultant checks for compliance with design intent/performance criteria) MEP: Proposals for commissioning and testing (from	**Mobilisation Construction and Completion Stage** Examine results of commissioning and testing (from consultant) Record defects (consultant in conjunction with site staff)

Building Log Book (from team) O&M manuals/model, record drawings and schedules of design criteria (from team) Initial information for health and safety file (from team)	contractor/sub-contractor, consultant reviews) MEP: Record drawings and O&M manuals (prepared by contractors and commented on by consultant) C&S: Detailed designs, shop fabrication drawings, standard details, bar bending schedules and specifications (from contractor/sub-contractor and examined by consultant for conformity with design, structural adequacy, compliance with performance criteria) Record of defects (from consultant)	
Stage 6 : Post Practical Completion Finalise health and safety file (from team)	**[Completion is Stage 6 in CIC but part of Mobilisation/Construction in ACE]**	

B.2 BSRIA Design Framework

CIC Scope of Services	BSRIA Design Framework
Stage 1 : Preparation Client Brief (from client at start of Stage) Initial studies and information for preparation of business case (from team) Strategic Brief (from team)	**Proforma 1 : Appraisal and Design Brief** Design Brief (usually led by lead consultant) Plan for initial occupation period Initial review of an existing health and safety file
Stage 2 : Concept Strategic Brief (from client at start of Stage) Initial proposals on design, technical and budget viability (from team)	**Proforma 2 : Concept** Initial recommendations for development of an operating and maintenance strategy Energy strategy studies [generic thermal modelling]

Initial Design Programme and Construction Programme (from team) Desk Study relating to site (from team) Primary functional requirements and design criteria (from team) and initial cost estimate (from QS) Schedules of floor areas (from team) Strategy for use, cleaning, maintenance and subsequent construction (from team) Design options (from team) Preliminary design information/concept design model for preferred option [sketches, design notes, drawings, performance specifications – to describe scope, scale, form & character of works] (from team) Concept report and initial cost plan (from team)	Programme for design activities Building services philosophies for heating/cooling, electrical and public healthReport on building services issues including desk study on matters affecting design options and adequacy of utilities supplies Information for early-stage life-cycle cost studies Outline performance specifications for mechanical, electrical and public health services if required depending on procurement strategy Outline cost plan for building services based on floor area/building type/system assumptions
Stage 3 : Design Development Setting out dimensions (from design lead) Develop design approach to achieve required quality, is co-ordinated within the team, and conforms to Project Definition (from team) Updated cost plan and initial cash flow forecasts (from QS) Design options for elements of the work (from team) Strategy for use, cleaning, maintenance (from team) Calculations to verify and facilitate design development (from team) Finalise design criteria (from team) Value management (from team) Define critical construction details, tolerances (from team) Design development drawings/model [detailed form function & character of works –	**Proforma 3 : Design Development** Indicative mechanical/public health plant and riser sizes and electrical plant locations Sketch drawings for preferred preliminary design Sketch schematic drawings for preferred preliminary design Programme information on design and construction issues Energy statement for planning submission Report on building services issues Performance specifications for m&e services if required by procurement route **Proforma 4 : Technical Design** Strategy for fire safety Initial overall spatial coordination Essential performance requirements of systems [nominal capacities, range of

primary components in overall size and typical detail – GAs, sections, elevations, details to show design intent] (from team) Outline specifications for components of works [performance and quality] (from team) Design Development Report [drawings + specifications or model] (from team, approved by client)	operating duties] Initial schedule of cast-in/formed builders work openings that are structurally significant Information for detailed life-cycle cost studies Refined cost plan for building services Detailed schematic drawings Technical drawings [conveying spatial allocation in risers and floor/ceiling voids and horizontal distribution routes]
Stage 4 : Production Information Develop production information (from team) Value management (from team) Integrate specialist/supplier design & requirements into Project Definition (from team) Define structural support builders work (from team) Drawings/model and calculations including info from suppliers & specialists (from team) Submissions to statutory authorities (from team) Production information drawings/model and schedules [sufficient for construction or preparation of manufacturing and installation drawings] (from team) Drawings with dimensions from setting out information (from design lead, and team) Detailed specifications for components of the works [performance, quality, operating and maintenance requirements] (from team)	**Proforma 5 : Production Information** Detailed design drawings Builders work information Materials and workmanship specifications Equipment schedules Review of maintainability of plant and equipment [adequate working space and access] Draft construction programme Detailed cost plan Detailed specifications (if relevant) Coordinated working drawings Final coordinated reflected ceiling plans Schedules to cross reference cables to containment systems Commissioning specification

	Proforma 6 (part) : Mobilisation Final installation details and wiring diagrams Installation drawings Builders work details Shop and fabrication drawings
Stage 5 : Manufacture, Installation and Construction Information Co-ordinated manufacture and installation drawings, integrated with manufacture and installation drawings (from team) Building Log Book (from team) O&M manuals/model, record drawings and schedules of design criteria (from team) Initial information for health and safety file (from team)	**Proforma 6 (part) : Construction** Record drawings Log books Planned preventative maintenance schedules Operation and maintenance manuals Commissioning report Schedules of spare parts required and tools required Building Users Guide
Stage 6 : Post Practical Completion Finalise health and safety file (from team)	**Proforma 7 : Post Practical Completion** Outturn cost analysis As constructed calculations for Part L and EPC

B.3 TfL CGAP and TfL CIMM

CIC Scope of Services	**TfL CGAP**	**TfL CIMM Deliverables**
Stage 1 : Preparation		**Stage 1 : Start up**

Client Brief (from client at start of Stage)		Project brief containing initial scope and objectives (prepared by project manager) Outline business case User requirements (required business functionality) Performance, endurance and resilience requirements not related to user functional requirements Estimates of project cost and timing
	Gate A : Project commencement Definition of the problem Value for money appraisal Development funding affordable from budget Implementation funding affordable from business plan	
Stage 1 : Preparation (continued) Initial studies and information for preparation of business case (from team) Strategic Brief (from team)		**Stage 2 : Define requirements** Business case quantifying the cost/benefit analysis Project Initiation Document (developed from Project Brief) Agreed procurement strategy High level design of options Project options appraisal
	Gate B : Single option selection Identification and examination of a range of options Single technical option selected providing best value for	

	money Feasibility of technical solution has been proven Funding allocated within budget and business plan for development and implementation respectively	
Stage 2 : Concept Strategic Brief (from client at start of Stage) Initial proposals on design, technical and budget viability (from team) Initial Design Programme and Construction Programme (from team) Desk Study relating to site (from team) Primary functional requirements and design criteria (from team) and initial cost estimate (from QS) Schedules of floor areas (from team) Strategy for use, cleaning, maintenance and subsequent construction (from team) Design options (from team) Preliminary design information/concept design model for preferred option [sketches, design notes, drawings, performance specifications – to describe scope, scale, form & character of works] (from team) Concept report and initial cost plan (from team) **Stage 3 : Design Development** Setting out dimensions (from design lead)		**Stage 3 : Procure/Design** Detailed design for the technical infrastructure Detailed design to deliver user functionality First draft of support arrangements in service

Develop design approach to achieve required quality, is co-ordinated within the team, and conforms to Project Definition (from team) Updated cost plan and initial cash flow forecasts (from QS) Design options for elements of the work (from team) Strategy for use, cleaning, maintenance (from team) Calculations to verify and facilitate design development (from team) Finalise design criteria (from team) Value management (from team) Define critical construction details, tolerances (from team)		
Stage 3 : Design Development (continued) Design development drawings/model [detailed form function & character of works – primary components in overall size and typical detail – GAs, sections, elevations, details to show design intent] (from team) Outline specifications for components of works [performance and quality] (from team) Design Development Report [drawings + specifications or model] (from team, approved by client) **Stage 4 : Production Information** Develop production information (from team)		**Stage 4 : Develop/Build** Detailed designs and specifications

Value management (from team) Integrate specialist/supplier design & requirements into Project Definition (from team) Define structural support builders work (from team) Drawings/model and calculations including info from suppliers & specialists (from team) Submissions to statutory authorities (from team) Production information drawings/model and schedules [sufficient for construction or preparation of manufacturing and installation drawings] (from team) Drawings with dimensions from setting out information (from design lead, and team) Detailed specifications for components of the works [performance, quality, operating and maintenance requirements] (from team)		
	Gate C : Pre-tender Procurement strategy agreed Technical risks assessed and mitigated Market testing Consents achieved	
	Gate D : Contract award Supplier management processes in place Supplier selected on basis of best value for money	

Stage 5 : Manufacture, Installation and Construction Information Co-ordinated manufacture and installation drawings, integrated with manufacture and installation drawings (from team) Building Log Book (from team) O&M manuals/model, record drawings and schedules of design criteria (from team) Initial information for health and safety file (from team) **Stage 6 : Post Practical Completion** Finalise health and safety file (from team)		**Stage 4 : Develop/Build (continued)** New software developed Performance, endurance, resilience and integration tests conducted Migration plans developed Developed service model Developed handover/migration plan **Stage 5 : Deliver/Close** Consent to operate obtained Contracts arranged for support and operation End of project report Lessons Learned report
	Gate E : Project close Benefits achieved and reported Project transferred to Operations All funding issues closed out All statutory obligations complied with	
		Stage 6 : Benefits realisation Measured benefits detailed against expectations (hard e.g. cost, headcount and soft e.g. image)

B.4 Network Rail GRIP

CIC Scope of Services	**Network Rail GRIP**
Stage 1 : Preparation Client Brief (from client at start of Stage) Initial studies and information for preparation of business case (from team) Strategic Brief (from team)	**Stage 1 : Output Definition** Definition of the problem including success criteria (from Sponsor) Timescale, cost & quality constraints, including phasing requirements (from Sponsor) **Stage 2 : Pre-feasibility** Description of asset condition Potential options to deliver the Development Remit/Sponsor's Brief Definition of options Evaluation of capital and operating costs Sensitivity analysis Outline business case for each option
Stage 2 : Concept Strategic Brief (from client at start of Stage) Initial proposals on design, technical and budget viability (from team) Initial Design Programme and Construction Programme (from team) Desk Study relating to site (from team) Primary functional requirements and design criteria (from team) and initial cost estimate (from QS) Schedules of floor areas (from team) Strategy for use, cleaning, maintenance and subsequent construction (from team)	**Stage 2 : Pre-feasibility (continued)** Description of proposed technical solution with maintenance & performance effects and requirements and development timetable **Stage 3 : Option Selection** Maps, drawings, site survey, geotechnical investigations, asset data and preliminary designs Operational facility diagrams [e.g. signalling scheme sketch] Operational modelling and calculations Evaluation of technical options [construction and staging, risks and hazards, costs, project programme]

Design options (from team) Preliminary design information/concept design model for preferred option [sketches, design notes, drawings, performance specifications – to describe scope, scale, form & character of works] (from team) Concept report and initial cost plan (from team)	Description of technical and construction solution Risk assessment on programme and construction proposals Evaluation of revised staging and construction strategy options Assessment of functional specification on future maintenance Baseline asset management plan Recommendation for the Project Design Specification Effect of functional specification on operation and control Control and control technology requirements Option selection report [definition & feasibility, maintenance/performance/operation & control strategies, constructability/safety/environmental assessments, signalling schemes sketch] Validated Project Design Specification
Stage 3 : Design Development Setting out dimensions (from design lead) Develop design approach to achieve required quality, is co-ordinated within the team, and conforms to Project Definition (from team) Updated cost plan and initial cash flow forecasts (from QS) Design options for elements of the work (from team) Strategy for use, cleaning, maintenance (from team) Calculations to verify and facilitate design development (from team) Finalise design criteria (from team) Value management (from team) Define critical construction details, tolerances (from team)	**Stage 4 : Single Option Development** Developed Technical Workscopes showing packages of work (maybe large schemes only) Scheme Designs (to RIBA Stage D) for each workscope Construction Plan [detailed cost estimate, project schedule, risk assessment, risk management plan, contingency estimate, assumptions log, issues log] Asset Management Plan [includes project methodology, commissioning processes, sign-off processes for coming-into-use, acceptance criteria, maintenance strategy, need for Pre-Works Survey] Operations Management Plan [includes migration plan, training plan] Reference Design [all the above] (end of stage deliverable)

Design development drawings/model [detailed form function & character of works – primary components in overall size and typical detail – GAs, sections, elevations, details to show design intent] (from team) Outline specifications for components of works [performance and quality] (from team) Design Development Report [drawings + specifications or model] (from team, approved by client)	
Stage 4 : Production Information Develop production information (from team) Value management (from team) Integrate specialist/supplier design & requirements into Project Definition (from team) Define structural support builders work (from team) Drawings/model and calculations including info from suppliers & specialists (from team) Submissions to statutory authorities (from team) Production information drawings/model and schedules [sufficient for construction or preparation of manufacturing and installation drawings] (from team) Drawings with dimensions from setting out information (from design lead, and team) Detailed specifications for components of the works [performance, quality, operating and maintenance requirements] (from team)	**Stage 5 : Detailed Design** Completed Design [cross-checked to Reference Design] Issued Design for Construction [endorsed by contractor's Responsible Engineers in relevant disciplines] Notification of Asset Change for maintenance of new or existing assets (during project?)
Stage 5 : Manufacture, Installation and Construction Information Co-ordinated manufacture and installation drawings, integrated with manufacture and installation drawings (from team) Building Log Book (from team) O&M manuals/model, record drawings and schedules of design criteria (from team) Initial information for health and safety file (from team)	**Stage 6 : Construction, Test and Commission** Temporary works designs Site work method statements [including emergency plans] Inspection Certificates [including list of defects] Defects Record Test Certificates for signalling, civil & track engineering infrastructure, track

	infrastructure Practical Completion Certificate Record of Conformance to Design
Stage 6 : Post Practical Completion Finalise health and safety file (from team)	**Stage 7 : Scheme Hand Back** Project Acceptance Certificate Notice of completion of making good defects **Stage 8 : Close Out** Notice of completion of making good defects

B.5 London Underground PMF

CIC Scope of Services	**London Underground PMF**
Stage 1 : Preparation Client Brief (from client at start of Stage) Initial studies and information for preparation of business case (from team) Strategic Brief (from team)	**Stage 1 : Output Definition** Business case and draft of project requirements Project Execution Plan including appointment of key roles, high level assessment of technical approvals required, outline plan of timeline/whole life costs/resources High level procurement strategy Risk management strategy External stakeholder management and communications plan **Stage 2 : Feasibility** The developed procurement strategy (recommended approach, key options considered, compliance with EU and TfL policies) Options evaluation and selection of preferred option including sensitivity analysis

	where appropriate Verification Activity Plans (to monitor performance of suppliers activity)
Stage 2 : Concept Strategic Brief (from client at start of Stage) Initial proposals on design, technical and budget viability (from team) Initial Design Programme and Construction Programme (from team) Desk Study relating to site (from team) Primary functional requirements and design criteria (from team) and initial cost estimate (from QS) Schedules of floor areas (from team) Strategy for use, cleaning, maintenance and subsequent construction (from team) Design options (from team) Preliminary design information/concept design model for preferred option [sketches, design notes, drawings, performance specifications – to describe scope, scale, form & character of works] (from team) Concept report and initial cost plan (from team) **Stage 3 : Design Development** Setting out dimensions (from design lead) Develop design approach to achieve required quality, is co-ordinated within the team, and conforms to Project Definition (from team) Updated cost plan and initial cash flow forecasts (from QS) Design options for elements of the work (from team) Strategy for use, cleaning, maintenance (from team)	**Stage 3 : Concept Design** Safety Case Stakeholder consultation Detailed plans to minimise disruption to operations and customer service Technical risks identified and evaluated. Assessed as to whether they should be mitigated by further design development, handed to the supplier to manage or retained as a client responsibility Conceptual Design Statement including technical approvals required for implementation Consents Plan developed Procurement Plan setting out key options considered, key responsibilities, comparison with similar projects For Design and Build projects – audit trail demonstrating compliance with EU procurement rules Contract Management Strategy

Calculations to verify and facilitate design development (from team) Finalise design criteria (from team) Value management (from team)	
Stage 3 Design Development (continued) Define critical construction details, tolerances (from team) Design development drawings/model [detailed form function & character of works – primary components in overall size and typical detail – GAs, sections, elevations, details to show design intent] (from team) Outline specifications for components of works [performance and quality] (from team) Design Development Report [drawings + specifications or model] (from team, approved by client) **Stage 4 : Production Information** Develop production information (from team) Value management (from team) Integrate specialist/supplier design & requirements into Project Definition (from team) Define structural support builders work (from team) Drawings/model and calculations including info from suppliers & specialists (from team) Submissions to statutory authorities (from team) Production information drawings/model and schedules [sufficient for construction or preparation of manufacturing and installation drawings] (from team) Drawings with dimensions from setting out information (from design lead, and team) Detailed specifications for components of the works [performance, quality, operating	**Stage 4 : Detailed Design** Further development of items started during Stage 3: • Stakeholder consultation • Detailed plans to minimise disruption to operations and customer service • Technical risks identified and evaluated • Consents Plan • Procurement Plan • Contract Management Strategy For Design then Build projects – audit trail demonstrating compliance with EU procurement rules **Stage 5 : Delivery** starts after CGAP Gate C (Pre-tender) and includes Gate D (Contract award) and RIBA Stage J (Mobilisation)

and maintenance requirements] (from team)	
Stage 5 : Manufacture, Installation and Construction Information Co-ordinated manufacture and installation drawings, integrated with manufacture and installation drawings (from team) Building Log Book (from team) O&M manuals/model, record drawings and schedules of design criteria (from team) Initial information for health and safety file (from team)	**Stage 5 : Delivery (continued)** Testing/UAT, commissioning Delivery into service, deliver training Execute VAP Resolution of snagging items Completion of health and safety information and maintenance information
Stage 6 : Post Practical Completion Finalise health and safety file (from team)	**Stage 6 : Project close** Handover plan, including anticipated future benefits Final project close report, including final accounts settled with all suppliers
	Stage 7 : Benefits Realisation Post-implementation review

B.6 RIBA Plan of Work (Multi-Disciplinary Services) and Job Book

CIC Scope of Services	**RIBA Plan of Work**	**RIBA Job Book**
Stage 1 : Preparation Client Brief (from client at start of Stage) Initial studies and information for preparation of business case (from team)	**Stage A : Appraisal** Initial statement of requirements (from client at start of Stage) Site appraisal and surveys for each site (from team)	**Stages A-B** Feasibility report addressing client's requirements [environmental assessment, options, recommendations, possibly conceptual drawings & diagrams]

Strategic Brief (from team)	Design studies for each option (from team) Selection of preferred solution (from client) Outline planning submission Outline business case for preferred solution (from client and team) **Stage B : Design Brief** Draft and final Design Brief (draft from client, comments from team, final from client)	Cost appraisal (suitable for a cost strategy) Condition report on fabric of existing building Proposals suitable for outline planning application Final Design Brief (see Job Book pp63, 66-67 for contents list)
Stage 2 : Concept Strategic Brief (from client at start of Stage) Initial proposals on design, technical and budget viability (from team) Initial Design Programme and Construction Programme (from team) Desk Study relating to site (from team) Primary functional requirements and design criteria (from team) and initial cost estimate (from QS) Schedules of floor areas (from team) Strategy for use, cleaning, maintenance and subsequent construction (from team) Design options (from team) Preliminary design information/concept design model for preferred option [sketches, design notes, drawings, performance specifications – to describe scope, scale,	**Stage C : Concept** Design Brief [from client at start of Stage) Concept Design (outline proposals for structural and building services systems and outline specifications] (from team) Initial cost plan (from QS) Procurement route (from team) Propose options for occupation and FM (from team) Define targets for O&M capital/revenue spend, energy use, environmental performance (from team)	**Stage C** Partially developed Project Brief Outline proposals sufficient to allow client to comprehend, comment and approve [diagrammatic analysis of requirements, use of site, functional and circulation arrangements, massing, construction and environmental methods] Estimate of construction cost sufficient to allow cost plan to be prepared [element cost, cost per m2, % of whole] D&B Employers Requirements [… functional nature of building(s), schematic layouts, room data sheets, equipment schedules, special programme requirements …] D&B Contractors Proposals [… A3 site layout/floor plans/elevations/principal sections, foundation & structure GA, mechanical duct/pipe layouts & schematics, electrical floor layouts …]

form & character of works] (from team) Concept report and initial cost plan (from team)		
Stage 3 : Design Development Setting out dimensions (from design lead) Develop design approach to achieve required quality, is co-ordinated within the team, and conforms to Project Definition (from team) Updated cost plan and initial cash flow forecasts (from QS) Design options for elements of the work (from team) Strategy for use, cleaning, maintenance (from team) Calculations to verify and facilitate design development (from team) Finalise design criteria (from team) Value management (from team) Define critical construction details, tolerances (from team) Design development drawings/model [detailed form function & character of works – primary components in overall size and typical detail – GAs, sections, elevations, details to show design intent] (from team) Outline specifications for components of works [performance and quality] (from team) Design Development Report [drawings + specifications	**Stage D : Design Development** Elemental cost plan (from QS) Develop design [services space requirements, preliminary room layouts, means of escape, fire compartments] (from team) Develop occupation and FM strategies Project Brief (signed off by all) Detailed planning application	**Stage D** Project Brief Detailed proposals [co-ordinated design intentions, site layout, planning/spatial arrangements, elevations, construction & environmental systems, buildability] Firm cost plan and cash flow forecast Proposals sufficiently developed to allow full planning application Design development presentation [orthographic plans, elevations, cross sections, perspectives, model (physical or computer) to show architectural quality, form, colour, landscape setting, building details, interior arrangements, spaces, furniture]
	Stage E : Technical Design Final layouts [positions for integration of services terminals, ceiling layouts, major builders' work for services] including sizing of all structural elements and sizing of all services elements and components (from team) Update cost plan and cash flow projection (from QS) Technical Designs and specifications [sufficient to co-ordinate all components and elements] (from team and frozen)	**Stage E** Detail design drawings Specification notes on materials and workmanship (prescriptive or performance) Full Plans submission for Building Regulations approval Non-production information (e.g. for dealings with landlords, tenants, funders, 3rd parties) D&B Employers Requirements [detail design information]

or model] (from team, approved by client)		D&B Contractors Proposals [design development drawings extent depends on 1 or 2 stage D&B]
Stage 4 : Production Information Develop production information (from team) Value management (from team) Integrate specialist/supplier design & requirements into Project Definition (from team) Define structural support builders work (from team) Drawings/model and calculations including info from suppliers & specialists (from team) Submissions to statutory authorities (from team) Production information drawings/model and schedules [sufficient for construction or preparation of manufacturing and installation drawings] (from team) Drawings with dimensions from setting out information (from design lead, and team) Detailed specifications for components of the works [performance, quality, operating and maintenance requirements] (from team)	**Stage F : Production Information** Co-ordinated production information [location drawings/GAs, assembly drawings, component drawings, schedules, specifications, calculations] (from team) Update cost plan (from QS) Building services information [schematic drawings, detailed design drawings, co-ordination drawings, builders' work and fixing schedules, specifications, design criteria and calculations] (from services engineer) **Stage J : Mobilisation** Complete outstanding production information [review info from sub-contractors, specialists] (from team)	**Stage F** Production information [location, component & assembly drawings, drawn schedules, BoQ/spec/ schedules of work] Information for issue to specialist sub-contractors and suppliers Non-production information (e.g. for dealings with landlords, tenants, funders, 3rd parties) **Stage J** Drawings, schedules etc for contract issued which comply with SMM rules [Block Plan, Site Plan, plans, sections & elevations, information about ground water level, trial pits, features retained, live under/overground services, Component drawings, Dimensioned drawings as part of BoQ]
Stage 5 : Manufacture, Installation and Construction Information Co-ordinated manufacture and installation drawings, integrated with manufacture and installation drawings (from team)	**Stage K : Construction to Practical Completion** Further production information [contractor's proposals, method statements, installation/shop drawings, builders' work details, manufacturer's data] (from team) Building Users' Guide [principles of design & construction, furniture etc, security, access, local	**Stage K** Further information for the contractor 'As built' drawings, manuals and maintenance information Maintenance programme information

Building Log Book (from team) O&M manuals/model, record drawings and schedules of design criteria (from team) Initial information for health and safety file (from team)	controls for lighting/heating/cooling, energy & water efficiency] (from team) Commissioning and test procedures (from services engineer) Building Owner's Manual (from team)	Handover information [commissioning, testing, pre-completion checks, handover meeting
Stage 6 : Post Practical Completion Finalise health and safety file (from team)	**Stage L : Post Practical Completion** Final account (from QS) Recalculate capital and revenue target costs (from QS) Identify actual capital costs (from QS)	**Stage L** Certificate of Making Good of Defects Final Certificate EPC Building User Guide Results of feedback study with client or building users

B.7 TfL SPEARMINT

CIC Scope of Services	**TfL SPEARMINT**
Stage 1 : Preparation Client Brief (from client at start of Stage)	**Stage 1 : Start-up** Statement of requirements – development of the Brief Overview of available options to establish broad project viability
Stage 1 : Preparation (continued) Initial studies and information for preparation of business case (from team) Strategic Brief (from team)	**Stage 2.1 : Initiation (preliminary)** Identification of the single option Development of business case

	Development of project plan Development of Project Initiation Document
Stage 2 : Concept Strategic Brief (from client at start of Stage) Initial proposals on design, technical and budget viability (from team) Initial Design Programme and Construction Programme (from team) Desk Study relating to site (from team) Primary functional requirements and design criteria (from team) and initial cost estimate (from QS) Schedules of floor areas (from team) Strategy for use, cleaning, maintenance and subsequent construction (from team) Design options (from team) Preliminary design information/concept design model for preferred option [sketches, design notes, drawings, performance specifications – to describe scope, scale, form & character of works] (from team) Concept report and initial cost plan (from team) **Stage 3 : Design Development** Setting out dimensions (from design lead) Develop design approach to achieve required quality, is co-ordinated within the team, and conforms to Project Definition (from team) Updated cost plan and initial cash flow forecasts (from QS) Design options for elements of the work (from team)	**Stage 2.2 : Initiation (detailed)** Definition of project scope (e.g. specifications, performance criteria) Project design Project costing

Strategy for use, cleaning, maintenance (from team) Calculations to verify and facilitate design development (from team) Finalise design criteria (from team) Value management (from team) Define critical construction details, tolerances (from team) Design development drawings/model [detailed form function & character of works – primary components in overall size and typical detail – GAs, sections, elevations, details to show design intent] (from team) Outline specifications for components of works [performance and quality] (from team) Design Development Report [drawings + specifications or model] (from team, approved by client) **Stage 4 : Production Information** Develop production information (from team) Value management (from team) Integrate specialist/supplier design & requirements into Project Definition (from team) Define structural support builders work (from team) Drawings/model and calculations including info from suppliers & specialists (from team) Submissions to statutory authorities (from team) Production information drawings/model and schedules [sufficient for construction or preparation of manufacturing and installation drawings] (from team) Drawings with dimensions from setting out information (from design lead, and team) Detailed specifications for components of the works [performance, quality, operating	

and maintenance requirements] (from team)	
	Stage 2.3 : Initiation (procurement) Selected contractor (comes between CGAP Gates C and D)
Stage 5 : Manufacture, Installation and Construction Information Co-ordinated manufacture and installation drawings, integrated with manufacture and installation drawings (from team) Building Log Book (from team) O&M manuals/model, record drawings and schedules of design criteria (from team) Initial information for health and safety file (from team) **Stage 6 : Post Practical Competion** Finalise health and safety file (from team)	**Stage 3 : Delivery** Delivery of all objectives in the Project Initiation Document Handover to operational/support teams **Stage 4 : Close** End of project report including lessons learned

Appendix C Tabulation of drawing definitions

Buildings (architecture) (defns taken from RIBA Plan of Work or Working Drawings Handbook, Styles & Bichard)	**Building/Engineering Services (defns taken from BSRIA BG6)**	**Structural/Civil Engineering (defns based on PSA Drawing Practice Manual or Standard Method of Detailing Structural Concrete)**
Concept design proposal Includes outline proposals for structural and building services systems and outline specifications. Outline proposals show the design sufficiently developed for the client to comprehend, comment on and approve the proposals. A diagrammatic analysis of requirements, use of site, solutions to functional and circulation problems, relationship of spaces, massing, construction and environmental methods may be included. Includes Location block plan.		
Design Development proposals Drawings prepared as part of these proposals include: • Orthographic plans at all levels • Elevations and cross sections • Perspectives etc to give a realistic view of the building exterior • Computer-generated visual images or analytical diagrams Models at this stage include: • Presentation model to show architectural quality, form and colour, landscape setting	Sketch Line diagrams and layout indicating basic proposals, locations of main items of plant, routes of main pipes, air ducts and electrical distribution in such detail as to illustrate the incorporation of the engineering services within the project as a whole and with respect to any zoning.	

• Detail model of building part or particular feature • Interior arrangement models to show spaces, arrangements, furniture layouts etc • Computer generated models Other graphical information may include computer animations		
	Sketch schematic Line diagrams indicating main items of plant and their interrelationships in such detail as to illustrate the incorporation of the engineering services within the project as a whole.	
Drawn information for Stage E Site layouts, general arrangement plans, elevations and sections, draft assembly drawings, draft component drawings. Elemental information: • Substructure – excavation, foundations, floors beds (?), pile foundations • Structure (primary) – external walls, internal walls, floors and galleries, stairs and ramps, roofs, frames • Structure (secondary) – external wall openings, internal wall openings, floor openings, balustrades, suspended ceilings, roof openings • Structure (finishes) – external wall finishes, internal wall finishes, floor finishes, stair finishes, ceiling finishes, roof finishes • Services (piped and ducted) – refuse disposal, drainage, hot and cold water, gases,	Detailed schematic Line diagrams describing the interconnection of components in a system showing the engineering principles. The main features of a schematic drawing should be as follows: • The drawings should include all the functional components that make the system work, such as ducts, pipes, cables, busbars, plant items, fans, valves, dampers, control devices, strainers, terminals, electrical switchgear and components, security and fire sensors and control equipment • Symbols and line conventions should be in accordance with a recognised standard or a supplied legend • The drawings should be labelled with appropriate pipe, duct, busbar and cable sizes, pressures and flow rates (but may be subject to adjustment) • The drawings should indicate components which	Sub-structure plan Layout of foundation works (footings, pads, piles, ground beams) with respect to architecture or ground features, with key sections Drainage plan Layout of drain runs, manholes with invert levels at key points Roof plan Layout of roof members with spacing dimensions, and key sections

refrigeration, space heating, ventilation and air conditioning • Services (electrical) – power, lighting, communications, transport, security • Fittings (fixtures and loose equipment) – circulation, general room, culinary, sanitary, cleaning, storage • External – substructure, structure, finishes, services, fittings.	have a sensing control or measurement function • The major components indicated on the schematic drawing should be identified for cross-referencing purposes.	
Reflected ceiling plan Drawing showing the high-level details at each level: • Position of light fittings, fire and security sensors, HVAC terminal units (grilles, diffusers) and extracts • Arrangement of ceiling tiles/grid with respect to fittings, walls and partitions	Technical drawing A drawing showing the extent of the services installations. The main features should be as follows: • Plan layouts should be to a scale of at least 1:100 • Show the extent and type of service terminals visible within the occupied space • Show approximate locations of horizontal and vertical service runs • Show plant and distribution system sizes, particularly those affecting spatial allocation, while acknowledging that these may need some adjustment and refinement [at later design stages] • Pipework and electrical containment should be represented by single line payouts. Ductwork should be represented by either double line or single line layouts as required to demonstrate that the routes indicated are feasible. Symbols and line conventions in accordance with a recognised standard or a legend.	
Tender drawing Development of general arrangement plans,	Detailed design drawing A drawing showing the intended locations of plant	Reinforced concrete drawings A set of drawings and schedules detailing:

elevations and sections, component and assembly drawings that are co-ordinated with the bill of quantities.	items and service routes in such detail as to indicate the design. The main features are as follows: • Plan layouts should be to a scale of at least 1:100. Plant areas should be to a scale of at least 1:50, and should be accompanied by cross-sections • The drawing will not indicate the precise position of services, but it should be feasible to install the services within the general routes indicated. It should be possible to produce co-ordinated working drawings or installation drawings without major re-routing of the services.	• The layout of steel reinforcement (separate sheets for top and bottom reinforcement in slabs) • Sections and plans showing coordination of reinforcement in congested areas (column/slab/beam junctions) • Bending schedules for reinforcement Structural steelwork drawings A set of drawings and schedules detailing: • The layout and arrangement of steelwork (beams and columns) • Sections and plans showing fixing details at junctions and details at beam/slab junctions •
Production information drawings General arrangement drawings: • Strip sections at all points round building elevation where treatment changes, providing all important vertical dimensions and references to assembly details • Assembly drawings illustrating entire range of external wall conditions (door and window heads and sills, footing/ground floor junctions, eaves and parapet details), internal wall openings and junctions • Component drawings giving dimensioned elevations • Sub-component drawings showing construction details	Co-ordinated working drawings Drawings showing the interrelationships of two or more engineering services and their relation to the structure and building fabric. The main features are as follows: • Plan layouts should be to a scale of at least 1:50 and be accompanied by cross-sections to a scale of at least 1:20 for all congested areas. • The drawing should make allowance for installation working space and space to facilitate commissioning and maintenance • The drawings should be spatially co-ordinated and there should be no physical clashes between the system components when installed. Critical dimensions, datum levels and invert levels should be provided. • The spaces between pipes and duct runs shown	

	on the drawing should make allowance for the service at its widest point. Insulation, standard fitting dimensions and joint widths should have been allowed for • The drawing should indicate positions of main fixing supports where they have significance to the structural design or spatial constraints.	
Construction drawing	Installation drawing A drawing based on the detailed design drawing or co-ordinated working drawing with the primary purpose of defining that information needed by the tradesmen on site to install the works. The main features should be as per co-ordinated working drawings, plus: • Allowances should be made for inclusion of all supports and fixings necessary to install the works • The drawing should make allowance for installation details provided from manufacturers' drawings • Allowances should be made for plant and equipment. This includes any alternatives to the designer's original specified option that have been chosen.	•