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CWG-002 BIM Management Plans

Introduction

In August 2013 the second collaborate working group was formed to discuss and formulate an industry consensus on the use of BIM Management Plans in Australia and New Zealand. There was a variety of documents in use ranging from custom developed plans, overseas plans and the NATSPEC BIM Guide released in September 2011.

It was agreed within the group that focus should be given to the NATSPEC BIM Guide and Management Plan – as it was the predominate plan in use and the industry would benefit from some guidance on its use.

The goal:

To provide NATSPEC with industry feedback on its suite of documents based on “real world use”

The group’s hope is that NATSPEC takes on board these industry comments and includes them when revising the documents.

The following people contributed to this document and Collaborate thanks them for their time, expertise and input.

Group custodian

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Suite of documents to be reviewed

The NATSPEC BIM suite is made up of 5 documents

Document	version
Project_BIM_Brief	v1.0_Sep_2011.doc
BIM_Management_Plan_Template	v1.0_Sep_2011.doc
NATSPEC_National_BIM_Guide	v1.0_Sep_2011.pdf
NATSPEC_BIM_Object-Element_Matrix	v1.0_Sep_2011.xls
NATSPEC_BIM_Reference_Schedule	v1.0_Sep_2011.pdf

CWG-002 approach

The Collaborate working group took a “reductivist” approach to the review of the NATSPEC documents. Consolidation, coordination between documents and “plain language” mantra was applied at all times in this review.

Google docs was used to enable multiple authors to edit in real time. The group set about “unpacking” the BIM Management Plan documents and our approach was as follows:

1. Focus on the BIM Management Plan template review first in concert with the BIM Guide as these are the primary documents used to define a BMP
2. The Project BIM Brief would not be reviewed as it is essentially a table of contents defining which sections from the BIM Management Plan are to be included
3. The Object element matrix would not be reviewed (see collaborate **CWG001 – LOD paper**)
4. The bulk of the Reference Schedule document would not be reviewed as it is a reference document, however
 - i. This list could reside on the NATSPEC website and a single hyperlink contained in the Executive Summary document (aka Project BIM Brief)
 - ii. The list could be a website which is maintained and kept up to date as it has hyperlinks which would infer an internet connection such as buildingSmart BIM Guides Wiki <http://bimguides.vtreem.com/bin/view/BIMGuides/Guidelines>
 - iii. Clash Detection colours should be moved to a Technical - Appendix A and have RGB colours defined rather than white, blue etc
 - iv. Other documents as per 4i above



General Findings

Terminology

Issue:

There is some confusion in industry over the terms used in a BIM Management Plan, also there are many names used to define a management plan for BIM (BXP, BEP, BMP, BIP)

Recommendation:

1. Industry adopts “plain language” and avoids Technical jargon in these documents – particularly in the Executive Summary and Design BIM Management Plan
2. Industry settle on a single name for the BIM Management Plan (BMP) as opposed to a company’s internal BIM Implementation Plan (BIP)

Contractually binding

Issue:

The group often finds the primary issue on a BIM project is a BMP is developed but never included as a contractually binding document. This creates problems as it is seen as a “guide” and parties can’t be held to comply with it.

The secondary issue is that the client/owner/facilities manager requirements are not well defined or often not included in the development of the Design BMP. This limits the use of the model for the owner and more importantly the data flow from design into operations. A common approach is to “update” the BMP as these information requirements are known. This also causes problems due to “scope creep” for consultants or variations imposed on the client/employer further increasing the perception of “increased cost” for them to undertake BIM.

The final issue is the BMP maybe worked to define the requirements of design consultants, but is not kept “up to date” as things change during the course of the project. This limits its usefulness as a verification document to determine if what is in the BIM, was actually scoped and agreed.

Recommendation:

The BMP should form part of the Contract, or an addendum, similar to the Project Management Plan, drawings, schedules and specifications. It should be referred to in the Professional Services Agreement to all stakeholders and be a deliverable of the project. Linking the programme to the BMP will assist in defining the Level of Development required within the model at particular stages e.g. a simple massing model at Schematic Design is all that is required (typically LOD 100). The typical party responsible for leading the development of the Design BMP (Design/Bid/ Build) would be the lead consultant (or nominated client BIM Manager) in consultation with the client/owner and require inputs from all stakeholders as early as possible, ideally before contracts are agreed to and signed so each party understands their responsibilities in BIM. Once the project is ready for tender the Contractor would be able to review the Design BMP along with the model to facilitate more accurate pricing and also understand the information requirements of the Client.



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Cross referencing

Issue:

It became apparent that the cross referencing between the National BIM Guide and the BIM Management Plan and the Project BIM Brief was not consistent and thus made the review complex – this was made even more difficult when used on a project where some parties are new to BIM.

Recommendation:

As the NATSPEC BIM Guide is used to determine which sections of the BMP/PBB are to be included, the documents would benefit from having matching cross referencing throughout. This would increase usability tremendously and aid in editing/modifying for different projects.

Consider cross referencing to well adopted national Revit/BIM standards, e.g. ANZRS, AMCA BIM MEPAus. Also cross reference to existing “philosophies” such as the NATSPEC LOD guide. Include information and diagrams explaining workflow across disciplines. Refer to **Appendix B** of this document.

Graphics vs. text

Issue:

The documents are extremely text heavy with very few graphics or diagrams. This can be an issue when trying to explain somewhat complex issues to people that are new to BIM and BIM processes.

Recommendation:

Typically people working in the design/construction industry are much more graphically biased and the documents would benefit from visual aide especially “process maps” of workflows (see **Appendix B**) and the interactions between parties – rather than words

Format: If the document could be structured so that you “tick” the section you require in the Executive Summary. This would insert the relevant sections into the Management Plan and Appendices. This would improve useability by gradating the level of complexity – especially for the time poor.

Formatting: Headers do not stand out; including an appendix in the document will keep the technical detail in one place, avoid confusion and save time.

Schedules within the document

Issue:

The group found that the imbedded schedules (meetings, software in use, etc) and the formatting of them in a word document was difficult to manage – particularly as these schedules would be edited by more “technical” staff.

Recommendation:

The document would benefit from these schedule being collated into a spreadsheet application (excel) into multiple worksheets as an appendix. Ideally these would be “hosted”



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on the internet/document management system for contributing parties to edit the relevant sections to them.

Guidance notes

Issue:

The guidance notes are useful but could be better displayed to assist the reader especially those new to BIM.

Recommendation:

A simple objective and purpose would suffice. Incorporate an “information” sidebar such as the recent LOD paper issued by NATSPEC and similarly the blue “key tasks” from the New Zealand BIM Handbook. Having aligning sections between the National BIM Guide and the BMP would allow easy cross referencing, negating the need to direct the reader to the relevant section as they align by section number.

Document break up

The working group has found that working with the default NATSPEC document can be a little cumbersome and overly detailed in some sections such as Analysis, whilst too little detail in others Cost planning and Estimating. Fortunately David Mitchell from Mitchell Brandtman was in this review group and he has supplied their in-depth Cost Planning, clash and coordination information relating to BIM in **Appendix C**. *Note: Appendix C & D is copyright and permission must be sought from Mitchell Brantman before using.*

Most members have “tailored” a version that they reuse on multiple projects and adjusted to suit. This was always the intention of the NATSPEC BMP; however what is also apparent is that different team members need to define different information at different times when developing a BMP.

The group suggests the document be broken into several sections

1. **Strategic** Executive Summary
2. Design BIM **Management** Plan
3. Construction BIM **Management** Plan
4. Facilities Management BIM **Management** Plan
5. **Technical** Appendix A = Schedule and tables (LOD/MEA matrix, discipline colours for coordination, software to be used/tested etc)
6. **Technical** Appendix B = Each company’s internal BIM standards to meet the above requirements

The theory behind this approach follows in Table 1

The current NATSPEC sections could be reorganised with little effort into this format. The Collaborate BMP group has developed an overview in the following pages which shows how this could be achieved **in red**.



	Document	Description	Developed by	Primarily Used by
Strategic	Executive Summary	2pg high level BIM document defining the “why” the BIM is being developed and contractual uses of the BIM	Client, Principals of each major Consultant, Owner and/or Operator	The Project team to refer to the “why” and to determine the “what” in the Design, Construction and Facilities BMP
Management	Design BIM Management Plan	Develop and document the “what, where and when” (process/workflows) between each contributing party during Design phases with inclusion of key aspects of Construction BIM and FM/AM BIM	Design Team QS Contractor (if available) Facilities Manager Operator	Design Team QS Contractor (if available)
	Construction BIM Management Plan	Develop and document the process and workflows between each contributing party during Construction phases with inclusion of key aspects of FM/AM BIM	Design Team QS Contractor Facilities Manager Operator	Contractor Design Team Facilities Manager Operator
	Facilities Management BIM Management Plan (potential future document)	Develop and document the process and workflows for using the data and BIM for FM/AM. This includes issuing information back to design teams when refurbishment is required	Facilities Manager Operator	Facilities Manager Operator Subsequent Design & Construction Teams
Technical	Appendix A	Technical tables Amalgamate all schedules for the project team into 1 core document	Design Team QS Contractor (if available) Facilities Manager Operator	Design Team QS Contractor (if available) Facilities Manager Operator
	Appendix B (would be combined with Appendix A on Collocated team or IPD project)	Internal company BIM standards (drawing styles, templates, parameters, internal workflows, roles, CAD export settings etc)	Each party independently to suit their business processes	Each party independently to suit their business processes

Table 1



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1. Executive Summary

- To be developed by the Client/Owner/Employer/FM operator and the lead consultant/nominated client representative to determine the strategic BIM goals of the project (similar to the Employer Information Requirements from the UK BSI PAS1192-3 document)
- These strategic goals from the basis of the detailed “Management” sections within the Design, Construction and FM Management Plans.
- The “Technical” sections for actually creating the BIM to meet this strategic goals would reside in the Appendix A or B for the Model Author’s to reference
- To facilitate model sharing and IP/Copyright issues, include a general (legal?) disclaimer to cover 'all' model and data exchange within project teams and the subsequent distribution of models in electronic format or nominate that this resides in the contractual agreements.
- Diagram of how the documents interrelate
- States why the BIM is being developed i.e. Model map diagram, Model uses and critical information reliability uses for
 - Design
 - Construction
 - Facilities Management/Operations
- Contractual issues around the delivery method/requirements
 - BIM for 2D Drawings – Design Intent up to LOD 300
 - BIM for Construction - Design Intent (LOD300) for Contractor (LOD 400)
 - BIM for FM - Design Intent (LOD300) for Contractor (LOD 400-500) and FM (LOD 200)
- **NATSPEC sections covered**
 - **1 PROJECT INFORMATION**
 - **1.1 Identification**
 - **1.4 Project procurement**
 - **2 BIM MANAGEMENT**
 - **2.1 General**
 - **3 COMMUNICATION, COLLABORATION AND COORDINATION PROCEDURES**
 - **3.1 General**
- Collaborate review of the above NATSPEC sections for Executive Summary
 - **1 PROJECT INFORMATION:** This should be in a table format. It should also include shared coordinates. Refer Example Table 4 in **Appendix A** of this document
 - **1.4 Project procurement -** Suggest including Procurement Strategy to establish if a single or multiple BMP's are required and when/how the responsibility is handed over. Refer NATSPEC National BIM Guide page 9 - table 4.1



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- 2 BIM MANAGEMENT
 - 2.1 General – Should be high level goals for the project. Using terms like “increase Cost certainty” which would then infer that 5D and Cost Planning from the BIM would be a requirement of the design and construction teams.
- 3 COMMUNICATION, COLLABORATION AND COORDINATION PROCEDURES
 - 3.1 General – Suggest creating a proposed table of collaboration meetings: i.e., Client Briefing, Consultants kick-off meeting, methods of communication and design review BIM meetings. Table should include matrix of LOD vs. Stakeholder (Architect vs. MEP, Architect vs. Structure, and Structure vs. MEP) and agree on formal model issue processes and model reliance with level of coordination.
- 4 MODELLING
 - 4.1 General – Suggest Legal status of the Design Model be “elevated” into contractual agreements (not placed in the BMP) and a reference in the BMP refers design and construction teams to those agreements.

2. Design BIM Management Plan (DBMP)

- To be developed and used by the lead consultant and design team to determine the management of the BIM to meet the strategic BIM requirements of the project
- Sections need to correlate to the Executive Summary (i.e. use same numbering to allow easy cross referencing)
- Process maps to show the interaction between different stakeholders at different stages
- Highly graphical to suit the demographic of the reader/contributor
- NATSPEC sections covered
 - 3 COMMUNICATION, COLLABORATION AND COORDINATION PROCEDURES
 - 3.3 Coordination
 - 5 MODEL SHARING
 - 5.6 Model development protocols
 - Diagram
 - 6 SPECIFIC USES OF BIM
 - 6.1 General
 - 6.2 Modelling existing conditions (NBG clause 7.1.1)
 - 6.23 Facilities Management/As-built models (NBG clauses 7.7.1 & 7.7.2)
 - 6.3 Site analysis (NBG clause 7.1.2)
 - 6.4 Space and equipment validation (NBG clause 7.1.3)
 - 6.5 Architecture – spatial and material design models (NBG clause 7.2.1)
 - 6.6 Design visualisation for communication (NBG clause 7.2.2)
 - 6.7 Design visualisation for functional analysis (NBG clause 7.2.2)



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- 6.8 Code checking (NBG clause 7.2.3)
- 6.9 Sustainability evaluation (NBG clause 7.2.4)
- 6.10 Structural modelling and analysis (NBG clause 7.3)
- 6.11 Energy analysis (NBG clause 7.4.1)
- 6.12 Virtual testing and balancing (NBG clause 7.4.2)
- 6.13 Lighting analysis (NBG clause 7.4.3)
- 6.14 Other engineering analysis (NBG clause 7.4.4)
- 6.15 Quantity take-off and cost planning – 5D (NBG clause 7.5)
- 6.16 Clash detection/coordination (NBG clause 7.6.1)
 - Clash detection procedures:
 - Colour's by discipline see Schedules
- 6.24 Security assessment and planning (NBG clause 7.7.3)
- 4.1 Strategy for migrating the BIM model(s) used for design/documentation to those used for construction:
- Collaborate Review of above NATSPEC sections
 - 3 COMMUNICATION, COLLABORATION AND COORDINATION PROCEDURES
 - 3.3 Coordination – ideally this is overlaid on the “process maps” (see examples in **Appendix B**) Clash detection schedule should be a table in the Technical - Appendix A. Suggest referring to tools required for collaboration and coordination to be the actual name of hardware and common software i.e., large projector screen, LCD screen, Navisworks Simulate / Manage (version), 3D Printer, etc. Refer to Example Table 3 in **Appendix A** of this document
 - 5 MODEL SHARING
 - 5.6 Model development protocols – suggest this is diagrammatic and defines what the primary elements are being coordinated first, then moves to secondary and tertiary.
 - 6 SPECIFIC USES OF BIM
 - 6.1 General - Include workflow diagrams. Refer to **Collaborate Working Group 003 – Interoperability**. Refer to NATSPEC Project BIM Brief Clause 1.5. Perhaps the same table could be used with additional rows for the details? That would affect the layout of 7.1 - 7.24. It may make the initial document longer but it's easy to delete unnecessary content rather than jump between the BMP and the NBG.
 - 6.2 Modelling existing conditions – too many cross references, should give basic guidance such as “existing conditions modelled to LOD 200 based of laser scanned point cloud information”
 - 6.3 Site analysis – list in NBG should include easement, utilities
 - 6.4 Space and equipment validation – give basic examples room name and number, etc rather than cross reference several external documents – this is a trigger for the design team to research what the clients requirements are



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- 6.5 Architecture spatial and material design models – suggest this is creating unnecessary paperwork...
- 6.6 Design visualisation for communication – suggest this is defined in the Professional Services Agreement i.e. 6 x A0 full colour renderings rather than in the BMP. Points under Visualisation need to be updated to reflect current software abilities
- 6.7 Design visualisation for functional analysis Update list to comply with Australian council requirements and terminology.
- 6.8 Code checking - many firms don't have specialist software for this. Suggest provide example of checking without specialist software.
- 6.10 Structural modelling and analysis - Suggest this section needs to be expanded to include all elements that a Structural engineer would perform, having only 3 items for them is understating their involvement/input
- 6.15 Quantity take-off and cost planning – 5D – see **Appendix C** for appropriate level of requirements for Cost planning. *Note: Appendix C is copyright and permission must be sought from Mitchell Brantman before using.*
- 6.16 Clash detection/coordination - prefer this section to document critical & minimum elements to be coordinated e.g. Structure vs. Architecture see **Appendix D**
 - Clash detection procedures:
 - Colour's by discipline (in RGB values) should be added to Technical - Appendix A document

3. Construction BIM Management Plan (CBMP)

- Process maps
- Highly graphical
- **NATSPEC sections covered**
 - 4.1 Strategy for updating and coordinating changes made during construction into the final BIM model deliverable files
 - 5 MODEL SHARING
 - 5.6 Model development protocols
 - 6 SPECIFIC USES OF BIM
 - 6.16 Clash detection/coordination (NBG clause 7.6.1)
 - Clash detection procedures:
 - Colour's by discipline see Schedules
 - 6.17 Construction system design
 - 6.18 Digital fabrication (NBG clause 7.6.3)
 - 6.19 Planning construction scheduling and sequencing – 4D (NBG clause 7.6.4)
 - 6.20 Communication of construction scheduling and sequencing – 4D (NBG clause 7.6.5)
 - 6.21 Site utilisation planning (NBG clause 7.6.6)



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- 6.22 Lift planning (NBG clause 7.6.7)
- Collaborate review of above NATSPEC sections
 - 6 SPECIFIC USES OF BIM
 - 6.16 Clash detection/coordination - prefer this section to document critical elements to be coordinated by the contractor/sub contractors see **Appendix D**
 - Clash detection procedures:
 - Colour's by discipline (in RGB values) should be added to a Technical - Appendix A

4. Technical - Appendix A

- To be developed by the technical teams to avoid “overloading” the Executive Summary and Design BIM Management Plan with “jargon”
- The sections need to correlate to the Executive Summary and DBMP (i.e. use same numbering to allow easy cross referencing)
- The majority of all schedules should reside in this document, hence it could be created using a spreadsheet application rather than tables in a word processing application
- NATSPEC sections covered
 - 1 Project Information
 - 1.2 Project team contacts
 - 1.3 Project team responsibilities
 - 3 COMMUNICATION, COLLABORATION AND COORDINATION PROCEDURES
 - 3.2 Meetings
 - 9.1 BIM meeting schedule
 - 3.4 Coordination facilities
 - 4 MODELLING
 - 4.1 General Amendments to the project spatial coordinates
 - 4.1 strategy for importing Program for Design (PFD) information
 - 4.2 Model quality control
 - 5 MODEL SHARING
 - 5.1 Model exchange
 - 9.2 Model exchange schedule
 - 7 INFORMATION TECHNOLOGY
 - 7.2 Project software
 - 9.11 Project software schedule
 - 7.5 File formats
 - 7.3 Software compatibility testing
 - 9.12 Software compatibility testing schedule
 - 5.2 CAD exchange
 - 7.5 File formats
 - 9.3 CAD exchange schedule
 - 5.6 Model development protocols
 - Federated model management:



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- Protocols for model development:
 - LOD/MEA Matrix
 - 5.3 Model element responsibilities
 - 5.5 Model development
 - 5.4 Modelling permissions
 - 9.4 Legend for Model element responsibilities schedule
 - 9.5 Model element responsibilities schedule
 - 9.6 Legend for Modelling permissions schedule
 - 9.7 Modelling permissions schedule
 - 9.8 Legend for model collaboration matrix
 - 9.9 Model collaboration matrix
 - 10.2 Appendix B – Model collaboration matrix (UniFormat alternative)
 - 6 SPECIFIC USES OF BIM
 - 6.16 Clash detection/coordination (NBG clause 7.6.1) see **Appendix D**
 - Clash detection rules:
 - Clash detection colours:
 - Clash selection sets:
 - 9.10 Clash detection schedules
 - 7 INFORMATION TECHNOLOGY
 - 7.1 Data sharing
 - 7.4 Software updating
 - 7.6 File exchange
 - 8 DELIVERABLES
 - 8.1 General
 - 8.2 Deliverables formats
 - 8.3 Submission response period
 - 9.13 Deliverables schedule
 - 10 APPENDICES
 - 10.1 Appendix A – Project Guidelines checklist
 - Application-specific items
 - Project-specific items

5. Technical Appendix B (internal company standards)

- This document would differ between firms
- Provides guidance to new or inexperienced staff on the internal company standards
- This is often referred to as a BIM manual
- It would show the companies Documentation Standards
- How to interact with a Outsourcing partner collaboration guide
- Would probably be linked to QA/QS Systems



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Conclusions

NATSPEC was instrumental in assisting the Australian construction industry in defining a “standard” BIM Management Plan in early 2012. The suite of documents, or modified variants, has been used on many completed BIM projects. NATSPEC has helped to raise not only the awareness of “the requirements of the BIM” but also assisted in allowing people to better understand BIM and its integrated processes.

As BIM has become the standard project delivery process for many firms, Collaborate would like to see NATSPEC revisit the NATSPEC BIM Management Plan, Project BIM Brief and BIM Guide.

It is our hope that the documents could be further simplified, be easily cross referenced between and worded/structured in such a way to target the proposed audience, for the stage they are required. Beginning with a high level in the Executive Summary (to facilitate scope and fees) then gradually increasing in requirements to inform project design teams, to ultimately provide the contractor a clear understanding of the requirements for operations.

If NATSPEC can modify their suite of documents so BIM can be “debunked” for clients, use “plain language” terms to assist in the first time reader’s comprehension and understanding of BIM, the easier the “decision makers” and “end users” time will be when defining and working with the BIM goals and requirements for a project.

Collaborate would be pleased to work with NATSPEC on this important task.



Appendix A

Example Table 2: Section 1.3 Project team responsibilities

<i>Project Manager</i>	<i>Manages and coordinates project execution and BIM to meet procurement strategy and cost containment.</i>	<i>Oversight.</i>	<i>Contact Info</i>
<i>Design Team Project Manager</i>			
<i>(Design Team or Construction) BIM Manager</i>			
<i>Lead BIM Coordinator</i>			

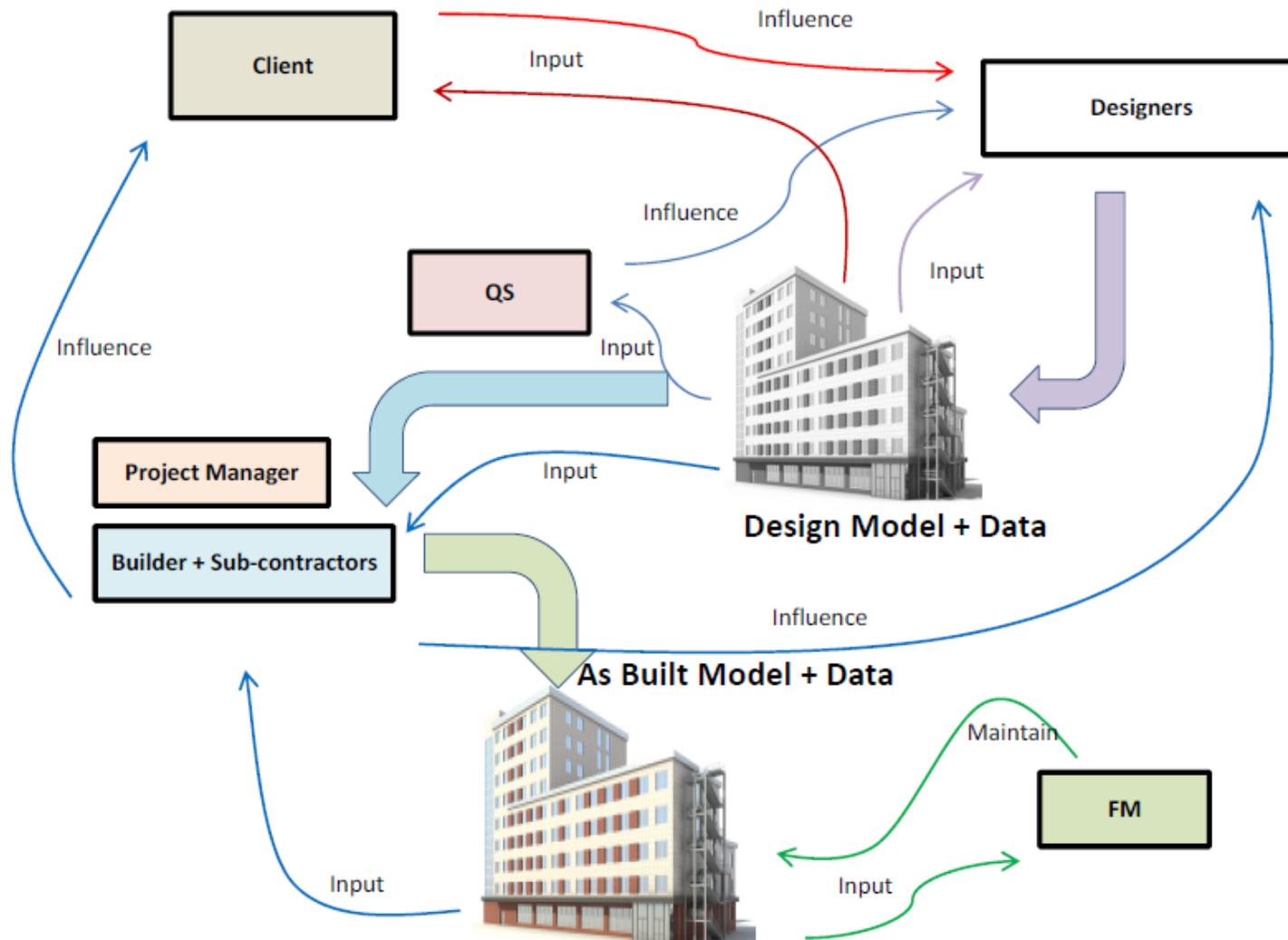
Example Table 3: Section 3 Communication, Collaboration and Coordination Procedures.

Lines of responsibility.	
Modes of communication	
Reporting procedures.	
Approval and Sign-off procedures.	
Information management and exchange protocols.	
Model sharing protocols	
Model coordination procedures.	
Model and drawing versioning procedures.	

Example Table 4: Location and Coordinates

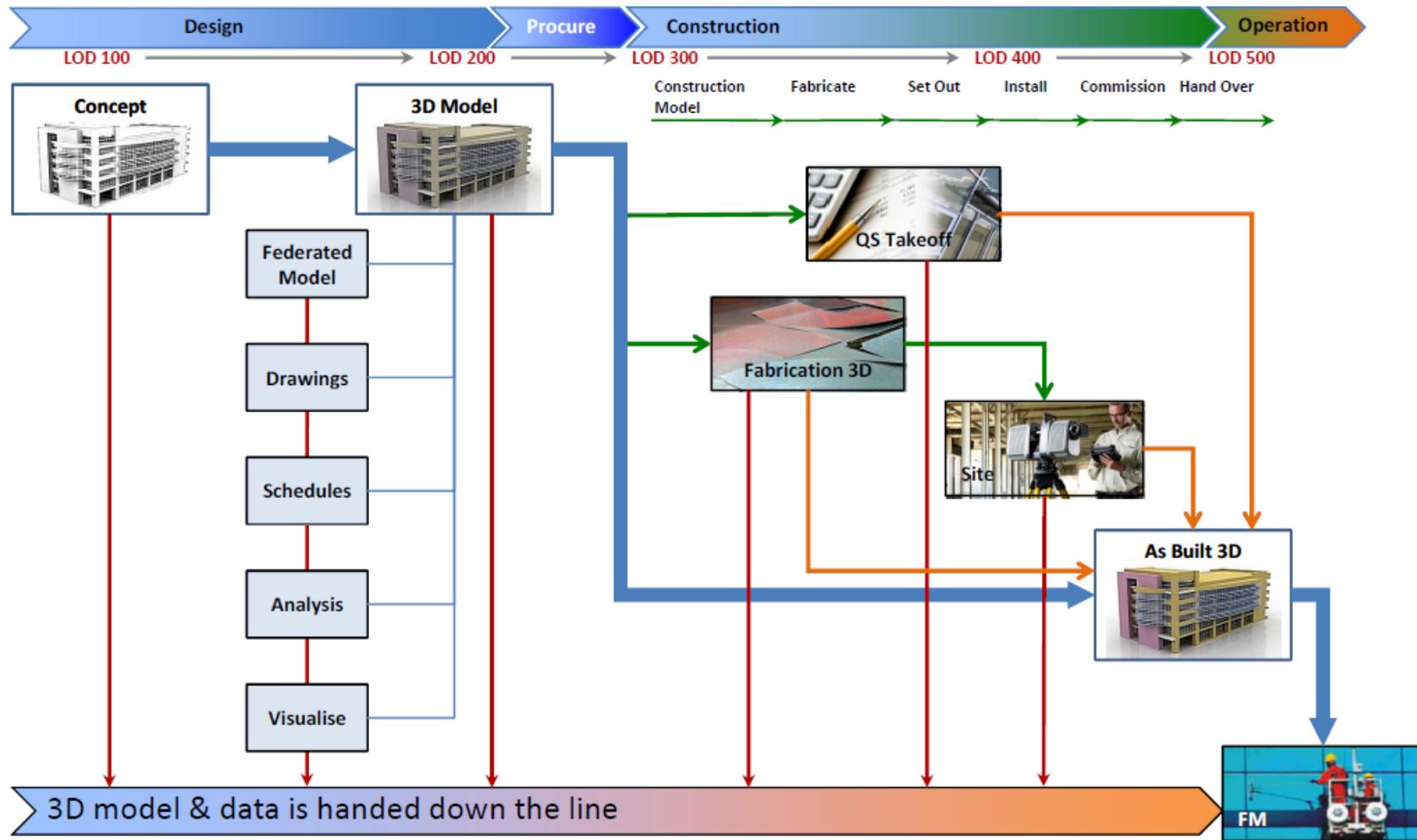
Location	Longitude	[Enter Value]	Latitude	[Enter Value]
Height Reference	Australian Height Datum		[Enter Value]	
	Australian Geodetic Datum		[Enter Value]	
Grid Datum	(GDA)			
	Local Grid Reference		[Enter Value]	
Project Datum	N/S		[Enter Value]	
True North vs. Project	deg		[Enter Value]	
Reference Grid	[Enter Value]		[Enter Value]	
Reference Survey	[Enter Filename]			

The BIM Stakeholders





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Appendix B – Overview of process map (with BIM requirements)



RIBA Plan of Work 2013

Tasks

Core Objectives

RIBA

The RIBA Plan of Work 2013 organises the process of briefing, designing, constructing, maintaining, operating and using building projects into a number of key stages. The content of stages may vary or overlap to suit specific project requirements. The RIBA Plan of Work 2013 should be used solely as guidance for the preparation of detailed professional services contracts and building contracts.

www.ribaplanofwork.com

	0 Strategic Definition	1 Preparation and Brief	2 Concept Design	3 Developed Design	4 Technical Design	5 Construction	6 Handover and Close Out	7 In Use
Core Objectives	Identify client's Business Case and Strategic Brief and other core project requirements.	Develop Project Objectives , including Quality Objectives and Project Outcomes, Sustainability Aspirations, Project Budget , other parameters or constraints and develop Initial Project Brief . Undertake Feasibility Studies and review of Site Information .	Prepare Concept Design , including outline proposals for structural design, building services systems, outline specifications and preliminary Cost Information along with relevant Project Strategies in accordance with Design Programme . Agree alterations to brief and issue Final Project Brief .	Prepare Developed Design , including coordinated and updated proposals for structural design, building services systems, outline specifications, Cost Information and Project Strategies in accordance with Design Programme .	Prepare Technical Design in accordance with Design Responsibility Matrix and Project Strategies to include all architectural, structural and building services information, specialist subcontractor design and specifications, in accordance with Design Programme .	Offsite manufacturing and onsite Construction in accordance with Construction Programme and resolution of Design Queries from site as they arise.	Handover of building and conclusion of Building Contract .	Undertake In Use services in accordance with Schedule of Services .
Procurement *variable task bar	Initial considerations for assembling the project team.	Prepare Project Roles Table and Contractual Tree and continue assembling the project team.	The procurement strategy does not fundamentally alter the progression of the design or the level of detail prepared at a given stage. However, Information Exchanges will vary depending on the selected procurement route and Building Contract . A bespoke RIBA Plan of Work 2013 will set out the specific tendering and procurement activities that will occur at each stage in relation to the chosen procurement route.			Administration of Building Contract , including regular site inspections and review of progress.	Conclude administration of Building Contract .	
Programme *variable task bar	Establish Project Programme .	Review Project Programme .	Review Project Programme .	The procurement route may dictate the Project Programme and may result in certain stages overlapping or being undertaken concurrently. A bespoke RIBA Plan of Work 2013 will clarify the stage overlaps. The Project Programme will set out the specific stage dates and detailed programme durations.				
(Town) Planning *variable task bar	Pre-application discussions.	Pre-application discussions.	Planning applications are typically made using the Stage 3 output. A bespoke RIBA Plan of Work 2013 will identify when the planning application is to be made.					
Supported Key Support Tasks	Review Feedback from previous projects.	Prepare Handover Strategy and Risk Assessments . Agree Schedule of Services, Design Responsibility Matrix and Information Exchanges and prepare Project Execution Plan including Technology and Communication Strategies and consideration of Common Standards to be used.	Prepare Sustainability Strategy, Maintenance and Operational Strategy and review Handover Strategy and Risk Assessments . Undertake third party consultations as required and any Research and Development aspects. Review and update Project Execution Plan . Consider Construction Strategy , including offsite fabrication, and develop Health and Safety Strategy .	Review and update Sustainability, Maintenance and Operational and Handover Strategies and Risk Assessments . Undertake third party consultations as required and any Research and Development aspects. Review and update Project Execution Plan, including Change Control Procedures . Review and update Construction and Health and Safety Strategies .	Review and update Sustainability, Maintenance and Operational and Handover Strategies and Risk Assessments . Prepare and submit Building Regulations submission and any other third party submissions requiring consent. Review and update Project Execution Plan . Review Construction Strategy , including sequencing, and update Health and Safety Strategy .	Review and update Sustainability Strategy and implement Handover Strategy , including agreement of information required for commissioning, training, handover, asset management, future monitoring and maintenance and ongoing compilation of 'As-constructed' information. Update Construction and Health and Safety Strategies .	Carry out activities listed in Handover Strategy including Feedback for use during the future life of the building or on future projects. Updating of Project Information as required.	Conclude activities listed in Handover Strategy including Post-occupancy Evaluation , review of Project Performance, Project Outcomes and Research and Development aspects. Updating of Project Information , as required, in response to ongoing client Feedback until the end of the building's life.
Sustainability Checkpoints	Sustainability Checkpoint – 0	Sustainability Checkpoint – 1	Sustainability Checkpoint – 2	Sustainability Checkpoint – 3	Sustainability Checkpoint – 4	Sustainability Checkpoint – 5	Sustainability Checkpoint – 6	Sustainability Checkpoint – 7
Information Exchanges (at stage completion)	Strategic Brief .	Initial Project Brief .	Concept Design including outline structural and building services design, associated Project Strategies , preliminary Cost Information and Final Project Brief .	Developed Design , including the coordinated architectural, structural and building services design and updated Cost Information .	Completed Technical Design of the project.	'As-constructed' information.	Updated 'As-constructed' information.	'As-constructed' information updated in response to ongoing client Feedback and maintenance or operational developments.
UK Government Information Exchanges	Not required.	Required.	Required.	Required.	Not required.	Not required.	Required.	As required.

*Variable task bar – in creating a bespoke project or practice specific RIBA Plan of Work 2013 via www.ribaplanofwork.com a specific bar is selected from a number of options.



Appendix C

7.5 Quantity Take-off and Cost Planning

- a. Use agreed specialised model-based applications.
- b. Define the classification system for model elements that will apply for cost management and reporting.
- c. Define the scope using the following table:

Tasks & Deliverables		Phase Requirements				
		CO	SD	DD	CD	CN
OBJECTIVE	The 5D objective during design (CO, SD, DD and CD) is to create a living cost plan that provides a transparent framework for making early and continued cost decisions. The living cost plan must be able to be revised and shared (on a weekly / fortnightly / or monthly cycle) using the current building information model.					
	The 5D objective during construction (CN) is to provide a transparent framework for letting and administering construction contracts. The model map which created the cost plan becomes more detailed as the model LOD progresses to become the basis for quantity take-off for letting and tendering, the valuation of variations, change orders and progress payments during construction and replacement work during operation of the building.					
	The 5D objective on completion (FM) is to create a cost integrated as built model that can be synchronised with the FM system to transfer replacement costs, base dates, expected and effective lives, estimated running and maintenance costs.					
	The model disciplines and minimum level of development (LOD) that are to be used for 5D at each project stage are as follows:					
	Architectural	LOD100	LOD200	LOD300	LOD300	LOD300

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Tasks & Deliverables		Phase Requirements					
		CO	SD	DD	CD	CN	FM
Structural				LOD200	LOD300	LOD350	LOD350
Mechanical				LOD200	LOD200	LOD400	LOD400
Electrical				LOD200	LOD200	LOD400	LOD400
Hydraulic				LOD200	LOD200		LOD500
Fire				LOD200	LOD200	LOD400	LOD500
Transportation						LOD400	LOD500
Civil			LOD100		LOD300	LOD350	LOD350
Temporary and false work						LOD400	
The model map will be capable of dissecting quantities by:							
Element			✓	✓	✓	✓	✓
Trade or work package					✓	✓	✓
Level		✓	✓	✓	✓	✓	✓

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Tasks & Deliverables		Phase Requirements					
		CO	SD	DD	CD	CN	FM
	Space	✓	✓	✓	✓	✓	✓
	Work break down structure			✓	✓	✓	
	Activity				✓	✓	
1.0	ESTIMATING & COST PLANNING						
1.1	<p>Prepare estimates utilising the agreed 5D authoring tool, classification system and cost breakdown structure;</p> <ul style="list-style-type: none"> map the model information into the elemental estimate template in such a way that the first estimate becomes the basis for value management and recompiling to consider alternative designs during conceptual design (CO); alternative designs, construction methods, materials and engineering systems during schematic design (SD); alternatives, options and cost studies for improved designs, alternative construction methods, materials and engineering systems during developed design (DD) and contract documentation (CD). <p>Each estimate type will state the following:</p> <ul style="list-style-type: none"> CO - elemental unit, rate and quantity. SD - generic construction materials, finishes, services specifications, elemental unit, rate and quantity. DD - specific construction materials, finishes, services specifications, sub-elemental unit, rate and quantity. CD - specific construction materials, finishes, services specifications, sub-elemental and trade units, rate and quantity. The CD estimate is to be capable of presentation in trade format as an alternative to element. 	✓	✓		✓	NA	✓
1.2	Identify any work that is not modelled and supplement 3D measurement with 2D measurement to establish the entire project scope.	✓	✓	✓	✓	NA	✓

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Tasks & Deliverables		Phase Requirements					
		CO	SD	DD	CD	CN	FM
1.3	Validate the federated model and identify inconsistencies and incomplete model extents for the purposes of estimating and contract administration. Create a report and circulate to the design team for resolution. (This action is for the purpose of estimating only and does not replace design and clash detection).	NA	✓	✓	✓	✓	NA
1.4	Suggest cost savings and drive functional efficiency by benchmarking the concept design against other projects.	✓	✓	✓	✓	NA	NA
1.5	Revise and recompile estimates for every alternative design.	✓	✓	✓	✓	NA	N'
1.6	Progressively re-estimate, conduct cost checks (in whole or in part) during design to maintain budget limits. Coordinate the budget to include the total cost of the project scope and provide reports that indicate the cost implications and variances at completion of each design phase.	✓	✓	✓	✓	NA	
1.7	Create a data set of elemental codes, sub-elemental codes, functional codes, trade codes, cost codes and other project specific classifications and coding systems that can be round-tripped into the native model files utilising the agreed workflow.	NA	NA	✓	✓		✓
1.8	Attend design and coordination meetings and produce reports with executable reader versions of each estimate that allows visualisation of the estimated quantities and provide transparency at dimension, work book and rate library level.	✓	✓	✓	✓		NA
2.0	LIFE CYCLE COST ANALYSIS						
2.1	Utilise the model map to perform life cycle cost analyses (LCCA) for comparison of selected alternatives to refine the design and enable selection of the design that will provide the lowest overall cost of ownership consistent with its quality and function.	NA	NA			NA	NA
2.2	Attend value management meetings and produce reports with executable reader versions for each LCCA that allows visualisation of the estimated quantities and provide transparency at dimension, work book and rate library level.	NA	NA		✓	NA	NA
3.0	CASHFLOW & 4D INTERFACE						
3.1	Create a data set of work breakdown structure codes and other project activity coding that can be round-tripped into the native model files utilising the agreed workflow.	NA		✓	✓	✓	NA
3.2	Calculate the estimated cost of each activity within the project program, maintain and progressively revise the project cash flow and produce a cash flow animation for each revision.		✓	✓	✓	✓	NA
4.0	QUANTITY TAKE-OFF AND CONTRACT LETTING						

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Tasks & Deliverables		Phase Requirements					
		CO	SD	DD	CD	CN	FM
4.1	Review proposed professional services agreements and contract conditions and suggest amendments (in consultation with the project commercial manager) to provide a contractual framework for the permitted uses, responsibilities, liabilities, warranties and delivery of a federated "for construction" model (incorporating executable 4D sequencing and critical path information).	✓	NA	NA	✓	NA	NA
4.2	Develop the model map and prepare a Bill of Quantities (BQ) or progressive Trade Packages (TP) including all architectural, structural, civil, mechanical, electrical and plumbing trades (unless excluded in the attached list).	NA	NA	NA	✓	✓	NA
4.3	Identify any work that is not modelled and supplement 3D measurement with 2D measurement to establish the entire contract scope.	NA	NA	NA	✓		NA
4.4	Progressively validate the federated model and identify inconsistencies and incomplete model extents for the purposes of quantity take-off and contract administration. Create weekly reports and circulate to the design team for resolution. (This action is for the purpose of quantity take-off only and does not replace design and clash detection).	NA	NA	NA			NA
4.5	Revise and recompile the BQ and / or TP to match the "for tender" models and any tender addenda and issue as a tender document. Provide instructions or host workshops so that each tenderer can visualise the quantities and test the accuracy of the quantities at dimension and work book level.	NA	NA	NA		✓	NA
4.7	Maintain elemental codes, sub-elemental codes, functional codes, trade codes, cost codes and other project specific classifications and coding systems and create a data set that can be round-tripped into the native model files utilising the agreed workflow.	NA	NA		✓	✓	NA
4.8	Attend tender opening, letting coordination, budget control and review meetings, provide cost advice and report on tender assessment, evaluation criteria and committed costs.	NA		NA	✓	✓	NA
5.0	CONTRACT PRICED BQ & BASELINE PROGRAM						

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Tasks & Deliverables		Phase Requirements					
		CO	SD	DD	CD	CN	FM
5.1	Check, analyse, assess and agree the rates within the contract priced BQ or TP. Utilise the agreed 5D authoring tool to produce an executable reader version of the priced BQ by trade, level and zone for the financial administration the contract.	NA	NA	NA	NA	✓	NA
5.2	Replace the pre-contract work breakdown structure, activity and sequence codes and create a data set of the contract baseline information that can be round-tripped into the native model files utilising the agreed workflow.	NA	NA	NA	NA	✓	
5.3	Calculate the forecast cost of each activity within the baseline program, maintain and revise the anticipated cash flow versus the actual cash flow animation on a monthly cycle using the current federated model.	NA	NA	NA	NA	✓	
6.0	CONTRACT ADMINISTRATION						
6.1	Maintain revised elemental codes, sub-elemental codes, functional codes, trade codes, cost codes, work breakdown structure, activity and sequence codes and create a data set that can be round-tripped into the native model files utilising the agreed workflow.	NA	NA	NA		✓	NA
6.2	Develop the model map with each model revision and prepare revisions to the priced BQ as a basis for measurement, valuation and negotiation of variation orders, claims, proposed variations and provisional quantity adjustments to the contract. Produce executable reader versions of each variation and issue to the contractor. Attend variation meetings and negotiate use visual quantities at dimension and work book level to agree the quantities and final cost of each variation.	NA	NA		NA	✓	NA
6.3	Utilise the developed model map and attend the site to assess progress payments; and submit payment certificates and schedules.	NA		NA	NA	✓	NA
6.4	Utilise the developed model map to calculate the current quantity of work within each activity and zone in any revised construction programs and issue to the contractor.	NA		NA	NA	✓	NA
6.5	Calculate the forecast cost of each activity within the baseline program, maintain and revise the anticipated cash flow versus the actual cash flow animation on a monthly cycle using the current federated model.		NA	NA	NA	✓	NA
6.6	Attend site, design and construction coordination meetings, maintain and distribute variation, site instruction, requests for information and extension of time registers that record the status and action for each issue.	NA	NA	NA	NA	✓	NA

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Tasks & Deliverables		Phase Requirements					
		CO	SD	DD	CD	CN	FM
6.7	Attend project control, budget control and review meetings, provide cost advice and prepare monthly cost monitoring and cash flow reports.	NA	NA	NA	NA		
6.8	Prepare a budget statement of final costs.	NA	NA	NA	NA		✓
6.9	Prepare, agree and submit a certified statement of final cost under the contract.	NA	NA	NA		NA	✓
7.0	COST INTEGRATED CONSTRUCTION MODEL						
7.1	Finalise the model map for each of the final models and revise the priced BQ to represent the as built design excluding demolition, rework or disruption costs. Produce an executable reader version as a tool to calculate future replacement and maintenance work.	NA	NA		NA	NA	✓
7.2	On completion of validation and synchronization between the as-built models and the FM system, create a data set of the project FM cost information that can be pushed into the native model files utilising the agreed workflow.	NA		NA	NA	NA	✓

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Appendix D

7.6 Construction Models

7.6.1 Clash detection/coordination

General:

- It is the Construction Team's responsibility to conduct and manage an adequate and thorough Clash Detection process so that all major interferences between building components will have been detected and resolved before construction. It shall be the goal of the Construction Teams to reduce the number of changes during construction due to major building interferences to zero.
- The BIM Manager shall assemble a federated model from all of the model parts of each design discipline for the purpose of performing a visual check of the building design for spatial and system coordination. Vertical shafts shall also be reviewed to ensure that adequate space has been allocated for all of the vertical mechanical systems (including access space for service and maintenance) and that all of the shafts line up floor to floor. Prior to each scheduled coordination meeting, an updated Clash Report will be issued by the BIM Manager to the technical discipline consultants.
- The approach to coordination/clash detection will depend on the project. On a multistorey project, for example, the models may need to be split on a level by level basis for Mechanical Electrical Plumbing Fire service (MEPF) coordination. If a floor is particularly large, it may also need to be split by zones to reduce file size. Typically, 3D clash detection/coordination continues on a single floor until building systems are fully coordinated, and then continues on the next floor up.
- Coordination software shall be used for assembling the various design models to electronically identify, collectively coordinate resolutions, and track and publish interference reports between all disciplines. The technical disciplines shall be responsible for updating their models to reflect the coordinated resolution.
- The team shall review the model and the Clash Reports in coordination meetings on a regular as-needed (generally weekly) basis throughout the design phases until all spatial and system coordination issues have been resolved.
- During the construction phase, the accuracy of fabrication models shall be verified. Prior to each fabrication submittal for approval, fabrication contractors shall submit their models to the Contractor's BIM Manager for integration and clash detection/coordination and resolution.



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- Internal Clash Resolution: Design Consultants and Subcontractors who are responsible for multiple scopes of work are expected to coordinate the clashes between those scopes prior to providing those models to the BIM Manager for spatial and system coordination.
- Spatial Coordination Verification: Verification and tracking of resolved conflicts of all trade coordination issues which could result in variations or site conflicts shall be provided to the client during project milestone dates, and should be fully resolved before bidding.
- For ease of identification during the 3D Clash Detection/Coordination process, elements are to be represented by the colours shown in the Clash Detection Colour Coding Standard.

Minimum requirements for spatial coordination and clash detection:

- a. **Architecture + Structural:** Below-grade spaces, proposed floor plates with major penetrations, floor-to-floor heights, beam clearances, heavy utilities locations, floor loads, core and vertical shafts, beam depths and required clearances, soffit-mounted equipment, slab thickness, columns, column caps and seismic bracing. Provide adequate space for construction and maintenance access to structural elements, building equipment, and distribution systems.
- b. **Architecture + MEPF:** Structural and space elements, flow and isolation requirements, proposed functional area configurations, floor-to-floor heights, fire containment, vertical and horizontal transportation. Possible future expansions shall be considered in consultation with the client and shall be clash-free.
- c. **MEPF/HVAC + Architecture, Structure, and Telecommunications:** Main distribution and collection systems, configurations and sizes for piping, duct, conduit, power wiring, fans; diffusers; intakes, large compressors. Clearance reservations for equipment maintenance, filter removal and equipment removal and replacement shall be modelled with the equipment, and sign-off on the adequacy of the space reservations shall be obtained from the Facility Manager where one has been appointed.
- d. **Architecture + Life Safety Fire Protection:** Safe zone and fire suppression pipe location, egress paths and exit distance requirements, equipment, and pipe penetrations.
- e. **Major Non HVAC Equipment + Architecture, MEPF, HVAC, Structural:** Major equipment positioning and location requirements, specialist service distribution and waste collection, e.g. medical gases and cryogenic supply piping, public communications and building controls. This includes major equipment adjacencies and guards, barriers, pipes, venting and air intake locations and other limitations.
- f. **Architecture/HVAC + Interiors:** Merges shall include ductwork and piping + ceilings and Furniture, Fixtures & Equipment (FF&E) + HVAC.



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- g. **Space Validation:** There shall be no space gaps. Bounding boxes used to represent room and zone spaces shall match with architectural requirements and data values, and all shall be coordinated with values given in the Program for Design.
- h. **General Model Quality Checking:** All walls shall be properly joined to prevent “space leaks” in areas defined by enclosing walls. Bounding boxes shall not conflict.
- i. **Security:** Security setbacks + structure + site.
- j. **Accessibility Compliance:** Wheelchair pathways and clearances + structure. (If using rules-based model checking software such as Solibri Model Checker, accessibility compliance can be checked automatically.)