

BIM Process Consistency: **Towards a Common Framework for** **Digital Design, Construction and Operation**

Overview Report





Australasian BIM Advisory Board (ABAB)

In May 2017, the Australasian BIM Advisory Board (ABAB) was established by the Australasian Procurement and Construction Council (APCC) and the Australian Construction Industry Forum (ACIF), together with NATSPEC, buildingSMART Australasia and Standards Australia. This partnership of national policy and key standard-setting bodies represents a common-sense approach that captures the synergies existing in, and between, each organisation's areas of responsibility in the built environment. It also supports a more consistent approach to the adoption of Building Information Modelling (BIM) across jurisdictional boundaries.

The establishment of the ABAB is a first for the Australasian building sector with government, industry and academia partnering to provide leadership to improve productivity and project outcomes through BIM adoption.

The ABAB is committed to optimal delivery of outcomes that eliminate waste, maximise end-user benefits and increase the productivity of the Australasian economies. The ABAB has evolved from a previous APCC–ACIF collaboration established in 2015 at a BIM Summit. This summit produced resource documentation to support BIM adoption (refer to www.apcc.gov.au for copies).

Members of the ABAB have identified that, without central principal coordination, the fragmented development of protocols, guidelines and approaches form a significant risk that may lead to wasted effort and inefficiencies, including unnecessary costs and reduced competitiveness, across the built environment industry.

www.abab.net.au



What is Building Information Modelling (BIM)?

BIM is a digital form of construction and asset operations. It brings together technology process improvements and digital information to radically improve client and project outcomes and asset operations. BIM is a strategic enabler for improving decision-making for both buildings and public infrastructure assets across the whole life cycle. It applies to new build projects and crucially, BIM supports the renovation, refurbishment and maintenance of the built environment – the largest share of the sector. [EU BIM Taskgroup Handbook, 2018]

What is BIM process consistency?

BIM process consistency is the consistent use of proven methods, techniques, standards, templates, workflows and tools within and across the public sector. BIM process consistency improves the performance of BIM adoption and implementation.

BIM Process Consistency: Towards a Common Framework for Digital Design, Construction and Operation

This Overview Report was developed by a small, dedicated Technical Working Group whose visions for BIM span beyond their usual domains. The Australasian BIM Advisory Board (ABAB) acknowledges the immense contribution given by the following individuals.

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Government leadership for national standards in BIM consistency

Government organisations can provide leadership to encourage the untapped opportunity for savings and benefits of digital design and construction, and in turn, provide better public services and better value for public expenditure. The vision is to build a BIM process consistency framework, together with the private sector, that sets the national standard. Encouraging BIM process consistency represents the construction sector's greatest opportunity to realise the benefits of BIM.

This Overview Report by the Australasian BIM Advisory Board (ABAB) Technical Working Group 1 is a first step towards developing BIM process consistency for the digital design, construction and operation of an asset – A Common Framework.

The Report reflects the collective experience of a limited number of public capital works delivery agencies, public policy makers, and asset operators from across Australia. Their experience, learnings and knowledge are critical to shaping BIM common practices and standards to be applied across Australia. Proven practices will establish the benchmark for BIM adopters, thereby enabling greater levels of BIM process consistency in the application of BIM across the construction sector and the supply chain. Ideas were also sought from leading practitioners.

Members of the Technical Working Group have either whole-of-government policy and strategic implementation responsibilities or experience on multiple major projects that have utilised BIM. This collective knowledge-based positions the Group as the leading source of BIM advice.

A Common Framework will help governments and industry adopt, implement and align the use of BIM on public projects. In doing so, government and industry will have greater control over quality and achieving financial and strategic expectations. A Common Framework will drive savings and efficiencies, and support small to medium enterprises (SMEs) transition to the BIM environment – the new way of doing business in the construction industry.

This Overview Report should not be read as a technical guide to BIM technology, its applications or standards as this information can be found in some other informed sources, including NATSPEC and buildingSMART resources. The use of other reports and documents from related BIM initiatives (such as the BIM Knowledge and Skills Framework from ACIF and APCC and the National Guidelines for Infrastructure Project Delivery from the Federal Government) is highly recommended in pursuit of a consistent approach for industry. This document points to, and encourages, the use of these standards and applications to encourage wider benefits across the supply chain from a public client perspective.

A Common Framework will help governments and industry adopt, implement and align the use of BIM on public projects. This will lead to increased productivity and competitiveness, greater quality control, and support for SMEs in transitioning to the new BIM environment. It will help governments provide better public services and better value for public expenditure.

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Vision for a national standard

Government organisations can provide leadership to encourage the untapped opportunity for savings and benefits of digital design and construction, and in turn, provide better public services and better value for public expenditure. The vision is to build a BIM process consistency framework, together with the private sector, that sets the national standard.

1 CONTEXT: ADOPTION OF BIM

The Australian construction sector is the largest non-services sector of the Australian economy, accounting for 8.1% of GDP. Construction employs 1.1 million Australians. A further 100,000 jobs are projected to be added by the sector over the four years to 2022, with employment growth forecast at 10.9% (Source: Digital Foundations Report, StartupAUS).

Building Information Modelling (BIM) is a very effective tool that promotes project collaboration through clear, more accurate, up-to-date communication by consolidating currently disparate project information, allowing all team members to contribute to the establishment and population of the databases underpinning the planning, design, construction, and operation of the asset. [ACIF and APCC, *The Case for Project Team Integration, 2014*]

At the same time, the use of BIM assists Project Team Integration (PTI) by dissolving the barriers between team members through the sharing of knowledge and closer collaboration throughout the project life cycle. [ACIF and APCC, *A Framework for the Adoption of Project Team Integration and Building Information Modelling, 2014*]

BIM has the potential to revolutionise the Australian construction sector and is transforming the process by which buildings and infrastructure are designed, constructed and maintained. As a significant player in the construction of new assets for public use, the benefits to Government from using BIM in procurement will be dramatic.

BIM contributes to significant savings of time and money while increasing project quality and productivity, through significant reduction in variations and associated delays, improved delivery scheduling and more effective construction and life cycle management.

BIM supports more effective management of information through the whole life cycle of a built asset, and allows design, construction and operation teams to communicate using a 3D virtual construction environment.

The positive impact that efficiency improvements from the effective use of digital technology can have on the competitiveness of the building and construction industry are considerable. Reports estimate the financial opportunity for digitalising engineering, construction and operations processes to be in the range of 10%–20% of capital expenditure across vertical construction (buildings) and infrastructure projects [BCG, *Digital in Engineering and Construction: The Transformative Power of Building Information Modelling, 2017*]. With an estimated construction spend in Australia of \$207 billion in 2016–17, a 10% productivity improvement driven by BIM would result in \$20.7 billion savings each year.

BIM is at the centre of a digital transformation of the construction sector and the built environment. Across Australia, governments and public procurers are recognising the value of BIM as a strategic enabler for cost, quality, sustainability, health and safety, and policy goals. To secure the economic, environment and social benefits, the majority of government agencies and public procurers are taking proactive steps to foster the use of BIM in public asset delivery and operations.

Process consistency is necessary to maximise BIM's ability to stimulate economic growth and competitiveness while delivering value for public expenditure. The introduction of BIM process consistency eases implementation costs, reduces waste, and drives successful project outcomes.

The wider adoption of BIM is only possible through a consistent way of working. BIM process consistency is the consistent use of proven methods, techniques, standards, templates, workflows and tools within and across the public sector. BIM process consistency will improve the performance of BIM adoption and implementation.

Adoption of BIM needs to be at scale, with a skilled workforce equipped with the digital competences and capacity to operate across the value chain and projects of differing size, complexity and type. This will help to address the current fragmented approaches across different organisations and different sectors.

Process consistency is necessary to maximise BIM's ability to stimulate economic growth and competitiveness while delivering value for public expenditure.

2 INTRODUCTION

This Report is the first step in developing a common framework for BIM process consistency. The framework will give industry the opportunity to learn from leading government practices in the procurement, digital engineering methods, supporting document suites, digital workflows, software capabilities, and the skills needed to support a higher level of performance and alignment.

Government procurement is a powerful lever to shift the construction industry towards the untapped opportunity of digital design, construction and asset operation, and in turn, provide better public services and better value for public expenditure. However, governments working together with industry and academia increases the likelihood of achieving the required change in commercial models, BIM education, skills development, SME engagement, and changes to current practices and organisational structures.

The introduction and implementation of BIM by public clients represent a change management initiative that requires: goals, leadership, collaboration, resources, people, developments, momentum, successes and time. To align these elements across the diverse sectors of construction, a consistent approach that assists government to deliver robust and effective BIM programs is immediately required.

Through government, industry and academia working together to develop a consistent approach to BIM processes, only then will the full potential benefits of BIM be realised. The ABAB's leadership role represents the construction sector's greatest opportunity to realise the benefits of BIM.

This Report identifies:

- a clear definition of BIM process consistency
- the underlying principles for BIM process consistency
- the main elements of BIM process consistency
- requirements for BIM process consistency.

Audience for this Overview Report

While the Overview Report encompassed public sector agencies, the identified common practices can be applied industry-wide, therefore, accommodating use by private sector adoption of BIM. The vision is for a standard practice throughout industry.

The Overview Report will be useful for the following audiences:

- government agencies with BIM strategy responsibility
- national and local public clients/procurers
- government, operators and owners with built asset responsibilities
- private sector construction industry consultants
- other stakeholders across the life of the built asset or environment.

Adoption of BIM needs to be at scale, with a skilled workforce equipped with the digital competences and capacity to operate across the value chain. This will help to address the current fragmented approaches across different organisations and different sectors.

3 BENEFITS OF BIM PROCESS CONSISTENCY

The consistent adoption of BIM across Australia provides an important opportunity within a broad and dynamic digital economy for the built environment, where accurate advice provided at the right time can positively shape and influence quality private sector and government community outcomes. Positioning Australia as BIM leaders in the region will help us compete in the global infrastructure marketplace where BIM is widely supported and utilised.

With the growing uptake of BIM, Australia has a timely window of opportunity to develop a common framework for BIM process consistency that is based on existing principles and proven methods, standards, workflows and toolsets. To achieve increased productivity and competitiveness across the construction industry, the public sector needs to become a role model and catalyst for BIM design, construction and operation in public assets.

The many small and medium-sized enterprises (SMEs) require strategic and operational support in mastering the transition to BIM. For this purpose, the main elements of BIM process consistency across the industry were identified, reflecting a breadth of government and public procurement perspectives across Australia.

Encouraging process consistency through government leadership and public client transparency represents the construction sector's greatest opportunity to realise the benefits of BIM. Through collaborative working and sharing of common practice, the construction industry can accelerate BIM initiatives by learning from others. Wasted effort and investment can be minimised through the re-use of existing developments and knowledge.

Sharing of proven BIM practices will assist governments and private procurers adopt, implement and continue to align the use of BIM on public projects. The benefits of BIM process consistency across Australia include:

- encouraging greater adoption of BIM to realise its benefits
- assurance to industry that government processes enable a level playing field
- providing guidance to companies introducing BIM
- supporting SMEs to transition to BIM
- easing BIM implementation costs
- reducing waste, including in re-learning and mistakes
- maximising productivity gains from BIM
- greater control over quality
- ability to benchmark and optimise design information across projects
- consistent approach to risk allocation and management
- increased confidence and certainty to the market
- clarification of capability requirements
- improvements to asset lifecycle management
- creation of a flexible framework that cultivates certainty and confidence.

This Overview Report will contribute to a wider dialogue across the public sector and private industry about the main elements of BIM process consistency and how, together, they can better support the industry's transition to a digitalised construction sector.

Principles for BIM process consistency

The ABAB Technical Working Group 1 recommends the following seven principles for BIM process consistency to support the adoption, implementation and continued maturity of BIM.

1. A more consistent application of BIM in public infrastructure should be actively encouraged and supported by government at a level appropriate to the size and complexity of the asset.
2. BIM data formats, standards, protocols, systems and tools should be open and harmonised across governments, where possible, to facilitate greater consistency in engagement with industry.
3. BIM data formats, standards, protocols, systems and tools should be harmonised across whole-of-asset life cycle management processes, where possible, to ensure secure data built up through the design and construction phases of a project is fully utilised in the asset management and operations phases.
4. Governments should work to ensure BIM approaches complement existing project design and development systems and interface with Geographic Information Systems (GIS) to graphically display and visualise relevant information captured as part of the BIM process.
5. Governments should work collaboratively across state and territory jurisdictions and with the private sector to drive best practice in the application of BIM in public infrastructure development and management.
6. Governments should seek to actively incorporate lessons learned from all sectors and international experiences in the application of BIM in public infrastructure development and management.
7. Governments should work to build capability, including developing BIM applications that support sustainability, work health and safety, and heritage conservation within the public sector BIM and, where practicable, enable an increase in private sector capability and capacity to optimise the application of BIM.

4 REQUIREMENTS FOR BIM PROCESS CONSISTENCY

Australian public agency BIM specifications

Common practice established across the public agencies approached includes a suite of documents that specifies BIM standards. This consists of a combination of the following five documents.

1. Organisational BIM Requirements for Projects (OBRfP)
2. Project BIM Brief (PBB)
3. Design BIM Management Plan (DBMP)
4. Construction BIM Management Plan (CBMP)
5. Organisational Asset Management/ Facility BIM Management Plan (OAM/FMBP)

The goal of the BIM Standard Document Suite is to provide clarity in the requirements for BIM deliverables for each state agency's projects. The document suite is typically structured according to the higher-level Organisational BIM Requirements for Projects document, from which the Project BIM Brief, Design BIM Management Plan, Construction BIM Management Plan and Organisational Asset Management/ Facility BIM Management Plan are derived.

Achieving process-oriented consistency

The overall process for the implementation of the BIM program or initiative of the public procurement agency should be described in a BIM Standard document suite that accounts for the agency's approach to the following.

- Organisational BIM Requirements for Projects (OBRfP)
- Project BIM Brief (PBB)

The process for the production of the required data for a project is to be defined in the BIM Management Plan (BMP), specifying all necessary roles, functions, processes, interfaces, interactions, as well as the technologies used.

- Design BIM Management Plan (DBMP)
- Construction BIM Management Plan (CBMP)
- Organisational Asset Management/ Facility Management BIM Management Plan (OAM/FMBP) (where relevant)

The BMP is submitted to the client by the project team in response to the client's OBRfP, PBB and Exchange Information Requirements (EIR) for review and approval. While the development of the BMP is the responsibility of the project team, the process is facilitated by doing this in consultation with the client.

- The BMP specifies when design meetings and clash-detection runs of the combined model are to take place, which parts of the design work have to be delivered by when and in how much detail, and to what extent visualisations, determinations of quantities, simulations of technical facilities, life cycle assessments, etc. have to be carried out.
- The BMP is the backbone for every BIM project covering the creation, sharing, and management of data.

A common data environment (CDE) or project database that all participants can access should be established for the organised storage and exchange of all data created in the design and construction process.

- The CDE/ Project Database forms the basis for the processes outlined in the BMP.
- Common standards and rules for the efficient use of BIM within this data environment are currently being developed in the form of an ISO standard (ISO 19650).

While the implementation of BIM processes will vary depending on the public agency and individual project, it is possible to define a generic 'BIM process' framework which describes the work phases of a project in a consistent manner, including the use of BIM and the preparation of the BMP.

Achieving information-centric consistency

Exchange Information Requirements (EIR), digital deliverables, data conformity and verification, non-proprietary data exchange formats, software and hardware availability, and data rights are fundamental to achieving consistency in BIM-enabled projects.

The client should provide precise specifications of which data it needs, at what time, in its EIRs.

- In particular, information on when, in how much detail, and in which format, the requested data are to be delivered to enable the client to make necessary decisions.
- The requested data should include the geometry and the attributes of the asset and/ or its components with relevance for the client, such as the construction materials along with their properties (e.g., thermal transmittance, sound insulation properties or ecological footprint) and asset management properties.
- The client should specify that a digital description of the construction process and a detailed breakdown of the costs (5D model) be included. When preparing the EIRs, close collaboration with the future user and/or operator of the asset is essential.
- All deliverables should be provided in digital form by working with discipline-specific 3D models (e.g., plans, schedules, hand-over documentation).
- If 2D plans continue to be prepared, these must be derived from 3D models which are to be provided to the client.
- The principle of designing in separate disciplines is maintained, and the distinct authoring disciplines develop their respective discipline-specific models.
- The discipline-specific models are to be merged to form a coordinated model and checked for consistency.

The data delivered by members of the supply chain should be tested for conformity with the EIRs.

- The client should contractually agree on the test criteria and procedures so that the members of the supply chain can use these test procedures for their validation purposes and quality improvement.

The invitation to tender should require the provision of non-proprietary data exchange formats to facilitate the exchange of data.

- It is also possible to require a combination of non-proprietary formats, as long as a clear assignment to components, spaces or facilities is ensured.

When awarding design services in accordance with the BIM method, it must be ensured that the hardware and software necessary to fulfil the requirements described are available.

- Since the software industry is following international standards, such as IFC, more and more closely, this condition is already met in many cases.
- The award of services must be non-discriminatory.
- Prescribing specific software products is not permitted. The public sector clients, too have to be equipped with appropriate software and hardware.

Where BIM is included in the contract as the designed instrument to be used, the contract should contain arrangements concerning the rights of use the client has regarding the 3D discipline-specific models.

- From the standpoint of the potential liability issues, the respective responsibilities have to be laid down in detail.
- Since design takes place in separate discipline-specific models in BIM, all disciplines, in principle, remain responsible for their part of the design work.

Achieving competency-based requirements

As part of the procurement process, members of the supply chain must have the BIM-related competencies needed for implementation and be ready to work collaboratively. Relevant BIM skills and capabilities should, therefore, be considered when awarding the contract.

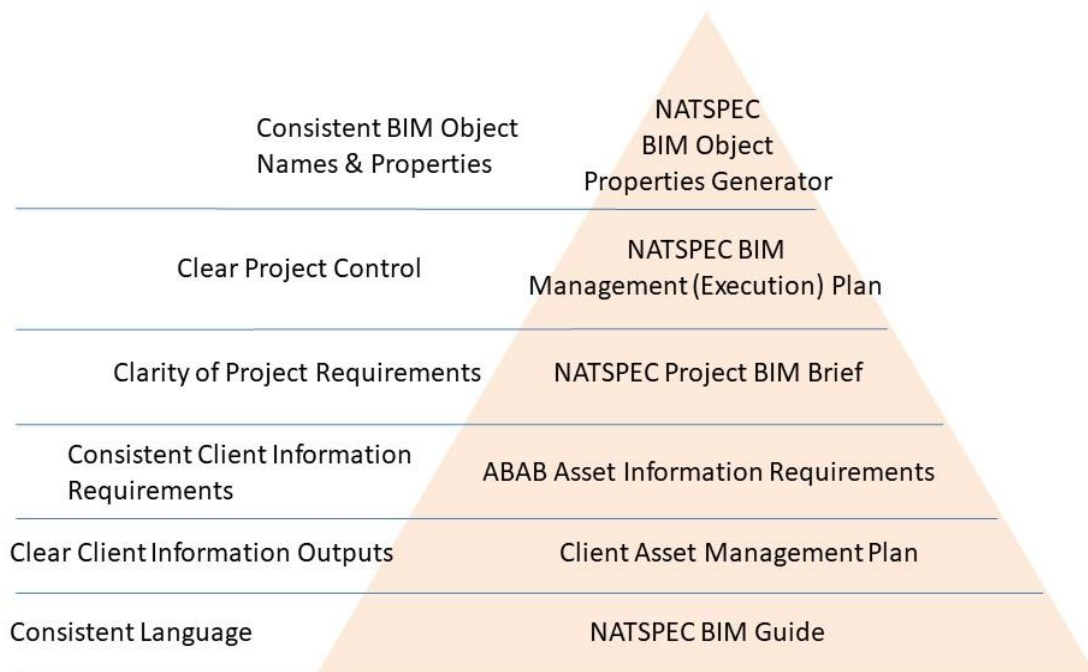
BIM skills and experience are also required on the client side to enable them to draw up proper tender documents and evaluate the incoming bids.

5 BIM DOCUMENT SUITES AND STANDARDS

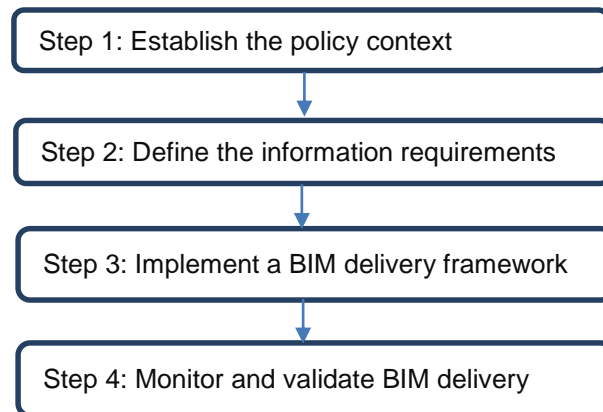
Discussions with consultants and contractors all agreed that the clients needed to understand and use a consistent language of BIM (NATSPEC BIM Guide). The clients need to be outcome-based and understand how the information will be used after project handover. This “information objective” is paramount for operational and maintenance savings. It is required at the start of the project so that the information can be added/linked to the model at the appropriate design and construction phase. It is incorporated into the Project BIM Brief (PBB), then expanded in the Exchange Information Requirements (EIR), and executed via the BIM Management Plan (BMP).

The majority of Australian public building projects have used the NATSPEC suite of documents which were developed at the request of government.

BIM Consistency Documents



Proposed flowchart



Step 1: Establish the policy context

Overview

The construction sector is undergoing an industry-led digital transformation through the application of BIM and other related digital technologies. This transformation has now reached a stage of maturity where governments and influential construction industry organisations need to establish consistent policies to prevent a growing fragmentation of approaches that will result in wasted effort in BIM implementation.

State and Federal governments are uniquely placed, as the biggest construction clients and asset holders, to drive an industry-wide harmonised approach to BIM. Policy consistency is essential to drive efficiencies for clients, while simultaneously providing confidence for industry to invest in developing their BIM capability.

Policy at the appropriate level

For the full benefits of consistency to be realised, policy should be determined at each appropriate level, while allowing flexibility for the inherent differences between various organisations and various projects, within the guidelines defined in the Australian BIM Strategic Framework:

- State BIM Policy
- Agency or Program-level Policy
- Specific Project/Asset Policy.

State governments, state-based agencies and companies within the construction industry must all make the case internally for adopting BIM and determine their approach to implementing BIM. The policy context will be different for different organisations, but there will be many common elements. These common elements are set out in this section.

Change management approach

Fundamentally, BIM adoption is a change management initiative that requires leadership and communicating a long-term vision to all stakeholders. The first and most critical step in establishing a policy is securing a long-term whole-of-organisation commitment to adopt BIM.

Following a commitment to adopt BIM, an organisation needs to establish the details of how it will implement that commitment. Policy matters to consider for the implementation of BIM should include:

- organisational resourcing and capability development
- alignment with relevant international and national approaches
- amendments to organisational policies to ensure BIM is incorporated into all necessary aspects of the full asset life cycle from planning and procurement to design and construction through to ongoing asset management
- data management, including storage, interoperability with existing processes and systems, and data accessibility
- the use of Open BIM to ensure the longevity and interoperability of data while encouraging innovation and competition in the BIM software industry
- the use of pilot projects or a phased implementation approach to trial BIM, refine the approach and build corporate knowledge
- measurement and reporting of the costs and benefits of using BIM
- stakeholder communications about the BIM approach.

The organisation's BIM implementation approach will, in turn, inform the development of its information requirements.

Step 2: Define the information requirements

Overview

Information requirements set out what information a client needs, how it is to be developed, when it is to be delivered, by whom and in what format. The information requirements should form part of the tender documentation when appointing consultants and contractors.

ISO/DIS 19650-1 and ISO/DIS 19650-2 outline an approach for identifying information needs and defining and agreeing information requirements. Further, the link between information requirements referred to in the ISO BIM standards and an organisation's business plan and asset management activities is described in ISO 55000 Asset Management – overview, principles and terminology.

There are several types of information requirements, often referred to collectively as Employer's Information Requirements or Exchange Information Requirements (EIRs). The term 'Employer' in this context refers to Client or Principal. The UK Publicly Available Specification (PAS) 1192 series and ISO 19650 series describe several information requirements that comprise the EIR:

- Organisational Information Requirements (OIR) identify the information an organisation needs to know about its assets in order to operate its business and achieve its strategic goals
- Asset Information Requirements (AIR) specify what information is required about specific infrastructure assets in order to answer the OIRs
- Project Information Requirements (PIR) set out the information required by the client for decision-making about the project over its duration
- Built Asset Security Information Requirements (BASIR) detail the specific information requirements around the handling of sensitive information, in particular the arrangements for, and overseeing of, the secure capture, handling, dissemination, storage, access and use of all data and information pertaining to these.

A government department or agency should provide precise specifications of what data it needs, at what time, in its EIRs. The requested data should not only include the geometry, but also further attributes of the asset and/or its components with relevance for the client, such as the construction materials along with their properties (e.g. thermal transmittance, sound insulation properties or ecological footprint). The client can, moreover, specify that a digital description of the construction process and a detailed breakdown of the costs (5D model) be included. When preparing the EIRs, close collaboration with the future user or operator of the asset is essential.

Asset register data, classification scheme and naming conventions

As part of its EIRs, the client, or the Asset Operator on behalf of the client, should develop and provide an Asset Register Template that contains details of the agency's required asset classification system. It is generally the responsibility of the contractor to provide asset data and it is, therefore, the responsibility of the contractor to request the most current version of the Asset Register Template when the contractor starts to compile the asset management information and the as-built model (when required by the project). This is to ensure that the most up-to-date classifications are used.

Processes should be specified to agree and review the format of the contractor's asset register data by the asset operator before compilation of the Asset Register. It is particularly important to review space naming and asset naming conventions to align with the Asset Operator's existing assets and asset management processes.

Should a government agency wish to specify a classification code to each appropriate object in a model (additional to, or an extension of, the unique classification schema of the agency), it is necessary to identify what classification schema to conform to and why. Omniformat and Uniclass classification schemas, for example, are both widely used for this purpose. However, it is necessary to specify what will need to be coded by the project team and what this information will be used for, e.g., Omniformat 2012, Table 21 – Elements or Uniclass 2015, table Ss – Systems, to a level of detail equal to Sub-group.

Format and extent of EIR deliverables

To improve the measurement and management of public assets, it is recommended that public agencies request information to be delivered by the supply chain using an established delivery format. Ideally, the public agency should be able to identify what facilities management system they will be using so that the deliverables for that system can be tailored to suit it.

Regardless of the delivery format of asset data, it should be geared towards insulating the government agency from process complexity, technology change and competitive issues, which remain in the supply chain. For an efficient approach to BIM that ensures the minimisation of implementation costs and a leaner approach to project execution, the excessive generation and processing of information and data should be avoided. The generation and processing of data should not be geared towards achieving all available technical possibilities. Rather, it should be aimed at the fulfilment of requirements for the operating phase.

When determining the EIRs, it must be ensured that the hardware and software necessary to fulfil the requirements are generally available. Since the software industry is following international standards, such as IFC, more and more closely, this condition is already met in many cases. Moreover, the award of services must be non-discriminatory. Prescribing specific software products should not be permitted, unless the client provides a software licence and appropriate access to training to the contractor or consultant. The clients, too, should be equipped with appropriate software and hardware and be familiar with their use.

In addition to the above, the EIRs should:

- require that a common data environment (CDE) be established for the organised storage and exchange of all data created in the design and construction process. Common standards and rules for the efficient use of BIM within this data environment are available in the ISO standard, ISO 19650.
- describe the procedures and protocols with respect to the progressive development and management of models. These should conform to an identified Modelling Standard, e.g., 2011 Australia NATSPEC National BIM Guide v1.0, or 2016 [AGC, BIMForum] Level of Development Specification v2016. In general, geometry should be modelled at a specified level of development (LoD) to guarantee the model components and associated data match the project phase expectation, and contribute to the critical path modelling strategy across all disciplines.

- require the delivery of both proprietary ('native') and non-proprietary data exchange formats (e.g. IFC) in order to facilitate the exchange of data. It is also possible to require a combination of non-proprietary formats, as long as a clear assignment to components, spaces or facilities is ensured.
- specify when and to what extent visualisations, determinations of quantities, simulations of technical facilities, life cycle assessments, etc. have to be carried out.
- set out any specified formats for data. An example specified information set is COBie, (or a piece of the COBie 'pie'), which is designed to deliver consistent and structured asset information useful to the owner-operator for post-occupancy decision-making.
- require that all deliverables are to be provided in digital form on the basis of working with discipline-specific 3D models (e.g. plans, schedules, hand-over documentation). If 2D plans continue to be prepared, these must be derived from 3D models which are to be provided to the client.

Step 3: Implement a BIM delivery framework

Overview

Even if capital project implementation processes vary depending on the individual government department, agency or project, it is possible to define a generic BIM delivery framework. The BIM delivery framework may be described within contractual agreements themselves, or within a separate set of documents that form part of the contractual reference set.

The BIM delivery framework should be based on the work phases of a project and be driven by mature and proven construction project management methodologies. The consistent application of a well-defined BIM delivery framework makes it possible to exploit the envisaged benefits of BIM, such as the improvement of planning certainty, quality assurance and control, project transparency and efficiency, cost-effectiveness and risk reduction.

Contractual inclusions

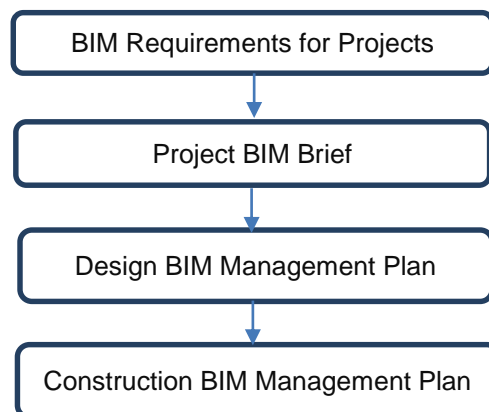
BIM should be identified in the consultant appointments and construction contract as the approach that is to be used for design and construction documentation.

The contract should contain arrangements concerning the rights of use the client has regarding the 3D discipline-specific models. With a view to potential liability issues, the respective responsibilities should be laid down in detail. It is recommended that the client government departments and agencies claim ownership over all data outputs, including 2D documents and 3D models and associated intellectual property. Since design takes place in separate discipline-specific models in BIM, all disciplines, in principle, remain responsible for their part of the design work.

If not already set out in contractual documentation, the client should establish rules for internal dispute resolution procedures and, where appropriate, also agree external dispute resolution procedures, so as to simplify cooperation within the framework of the application of BIM.

Structure

In addition to the contractual inclusions, BIM delivery frameworks commonly contain the following components:



The Design and Construction BIM Management Plans may alternatively be produced as a combined BIM Management Plan.

The purpose of each component is as follows:

Component	Purpose	Authorship and delivery
BIM Requirements for Projects	<p>Sets out the client's objectives in requiring projects to be delivered in a BIM environment, to include aspects of government policy context where appropriate.</p> <p>Describes generic, or non-project specific BIM requirements including EIR, PIR and AIR.</p> <p>This component is typically an agency standard that is consistently applied to all projects.</p>	Prepared by the client and provided with the tender documentation.
Project BIM Brief	Allows a client to identify additional, project-specific BIM requirements – for instance, if a partner agency has specific asset information requirements that need to be generated in parallel to the agency's own.	Prepared by the client and provided with the tender documentation.
Design BIM Management Plan (DBMP)	Requires the BIM manager for the design stages (typically the Architect) to respond to the BIM Requirements for Projects and Project BIM Brief, to describe how the EIRs will be delivered.	For optimised consistency, the client provides a template DBMP which is completed by the BIM manager. The completed document is provided to the client shortly after consultant appointment.
Construction BIM Management Plan (CBMP)	<p>Requires the BIM manager for the construction stages (typically the Contractor) to respond to the BIM Requirements for Projects, Project BIM Brief and DBMP, to describe how the Project Information Model (PIM) will be delivered in response to the Project Information Requirements (PIR), and the Asset Information Model (AIM) in response to the Asset Information Requirements (AIR).</p> <p>A particular focus is placed on delivery of as-built information.</p>	For optimised consistency, the client provides a template CBMP which is completed by the BIM manager. The completed document is provided to the client shortly after contract award.

For the successful generation of digital design and construction models using BIM, clearly defined collaborative processes are essential. The DBMP and CBMP are key documents in that they describe all necessary roles, functions, processes, interfaces, interactions, as well as the technologies to be used.

DBMP and CBMP documents should specify the following:

- procurement method for the project, e.g. (D&C) Managing Contractor etc.
- project program, and outline of key milestones
- how project goals and objectives are achieved through key milestones
- which organisation and individuals are taking on the role of the BIM manager
- accountability of each design discipline to ensure effective collaboration
- client side BIM management role and information manager who works with document controllers to maintain the CDE
- CDE setup, model uses, collaboration principles and information exchange procedures
- naming conventions for the project, including all documents, equipment, spaces and rooms
- any project specific schemas, classifications or data structuring as per project information requirements
- workflows to be followed by the project team
- when models and other BIM information should be delivered for federation and quality assurance activities:
 - What information needs to be specified, including file formats, and native formats?
 - What applications will be used?
 - Are they interoperable with the CDE?
 - Has everything been tested with each discipline?
- how frequently and when BIM coordination meetings and clash-detection runs of the combined model are to take place
 - What type of procedures are required?
 - Which parties are involved, how can everyone provide feedback and comments?
 - How are they captured?
 - What is the process for how issues are resolved?
- specific modelling approaches, including model exceptions, geographical location point, tolerances, and model component field access requirements etc.
 - What data requirements are needed within the models?
 - What are the modelling rules for each authoring discipline or subcontractor?
 - How is this level of detail and geometry being defined?
 - Will this be achieved via a Model Production Delivery table? Or an LOD table?
- data validation and review processes (explaining how information is reviewed and approved prior to reaching each milestone)
- how revision/ change management of drawings vs models will be handled
- what opportunities are there to use technology to innovate on the project.

Additional Items specific to the CBMP

- classification of model elements to help drive 4D, 5D, and 6D outputs
- common naming conventions of maintainable assets for extraction to Facilities Management systems
- mobility and accessibility of models
- procedures for maintaining as-built models (where required) for tenancy fit out changes.

Step 4: Monitor and validate BIM delivery

The data delivered by members of the supply chain should be tested for conformity with the EIRs. The government department or agency should contractually agree on the test criteria and procedures so that the members of the supply chain can use these test procedures for their own validation purposes and quality improvement.

Best practice recommends that the project team should 'prioritise' the checking process based on the model and data progression specification with models, components, assemblies and data sets available for analysis and subsequent delivery. Model validation and verification methods and tools to be used during milestone deliverable reviews should be specified to support the correction and updating of model errors, e.g., any space duplication, overlaps, space gaps, or space/ object interferences with other solid geometry.

Timing of the validation processes requires careful consideration. Key points for assessment include the handover of design intent information to contractors and handover prior to asset operations. For the latter in particular, any deficiencies found in asset information post-handover will limit the ability of building users to successfully commence operations and put effective maintenance plans in place. A staged validation in the lead up to handover is recommended.

Government departments and agencies should regularly review the outcomes of validation processes to identify common points of failure. These can be caused by issues such as onerous or unclear requirements, lack of industry capability or gaps in management processes. Outcomes can be used to improve client requirements or further develop wider strategies related to technology development and training.

The consistent adoption of BIM across Australia provides an important opportunity within a broad and dynamic digital economy for the built environment, where accurate advice provided at the right time can positively shape and influence quality private sector and government community outcomes.

Positioning Australia as BIM leaders in the region will keep us competitive in the global infrastructure marketplace where BIM is widely supported and utilised.

6 KEY LESSONS

This Overview Report incorporates the experience of a number of public agencies across Australia. Key lessons are provided from their BIM processes, document suites and standards.

Technical and process

- Requirements management – streamline requirements with what you need.
- Develop robust client audit options – include options for client audit and implement these regularly.

Organisational and cultural

- Undertake regular industry consultation – maintain a strong feedback loop with industry to ensure your requirements are making use of the most up-to-date methods and technologies, are deliverable, and will not have a negative impact on fees.
- Cultural change is occurring – with government demanding optimisation of its asset base, enabled by data capture improvements. Cultural change is easier when there is a champion.
- Evolving client-side expertise – as familiarity occurs, define the standards. BIM has only really worked or been implemented during the design and construction phase.
- Foster government advocates – it is necessary to identify BIM advocates and champions within the government.
- Lobbying government – lobbying generally relates to construction technology issues, but BIM is not a priority. There is more focus on infrastructure, but this is not linked to BIM.
- Managing expectations – government is looking at savings and efficiencies, while agencies are looking at the skills gaps and funding those gaps.

Agency-specific BIM standards

Each agency's BIM standards, supporting document suites and preferred toolsets were tightly coupled to its sector/agency procurement methods, contracts, project type/scale.

BIM standards were defined in the contracts for each project and, while there is an overall objective to achieve consistency, there was a continuous improvement philosophy reflected in the approach to major projects, i.e. BIM programs built on the prior performance and lessons learned from project to project.

The approach recommended by the ABAB Technical Working Group is to provide flexibility, so the BIM environment can be tailored to the requirements of each agency's procurement methods, contracts and project types.

One of the main challenges uncovered is the effective implementation of BIM in operations. One of the underlying barriers of this challenge is the standardisation of asset descriptions and built environment classification schemes.



BIM Process Consistency:

Towards a Common Framework for Digital Design, Construction and Operation



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