TEMC – 2016
BIM

Opportunities & Challenges When Implementing a New Methods of Working on Construction Projects

September 2016

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UNIVERSITY OF WELLINGTON

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Gateway

Introduction

BIM Meaning:

Design

"Building Information Modelling" – Autodesk 2002 - emphasis on model development and collaboration

Develop

"Building Information Management" – emphasis on quality information through the project lifecycle

Operate

"Better Information Management" – Recent UK definition, emphasising both vertical building and infrastructure

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Gateway Project, VUW

- A purpose-built, 12,500m^2 Biological Sciences Building
- PC 2 Labs and Teaching Labs – Flexible and Adaptable
- A challenging Site – tight development controls
- Construction beneath and over the main vehicle entry
- Construction in an operational Campus environment
- Complex services & innovative seismic design
- Project Team:
  - Architect: Warren & Mahoney with Jackson Architecture
  - Project Manager: RCP
  - Building Services: Beca
  - Structure: Dunning Thornton
  - Fire: Holmes Fire
  - Main Contractor: Fletcher Construction

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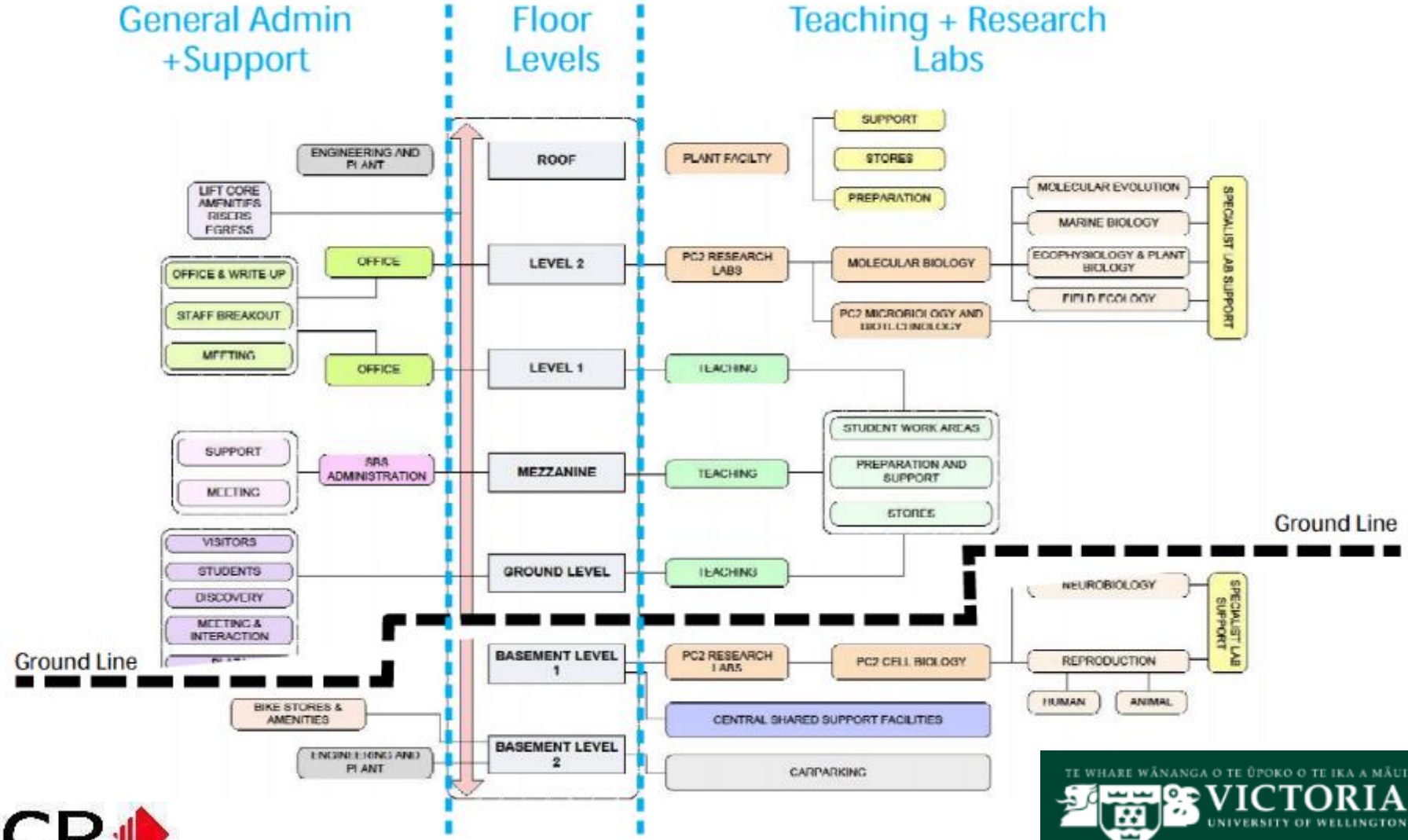
Briefing: Stacking plan

Planning Adjacencies & Efficiencies



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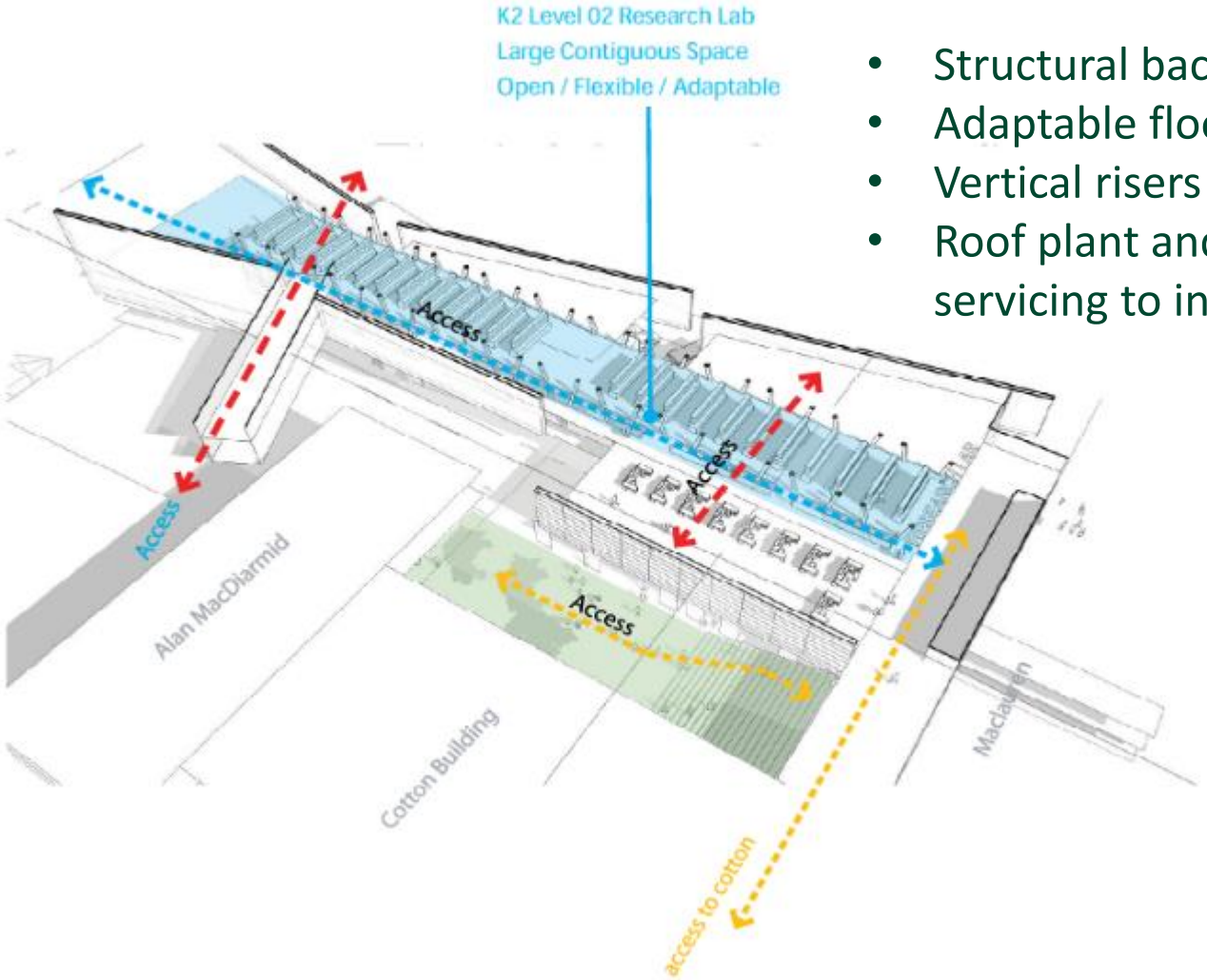
Concept



- Structural backbone
- Adaptable floor plan
- Vertical risers at each end
- Roof plant and top down servicing to intensive areas

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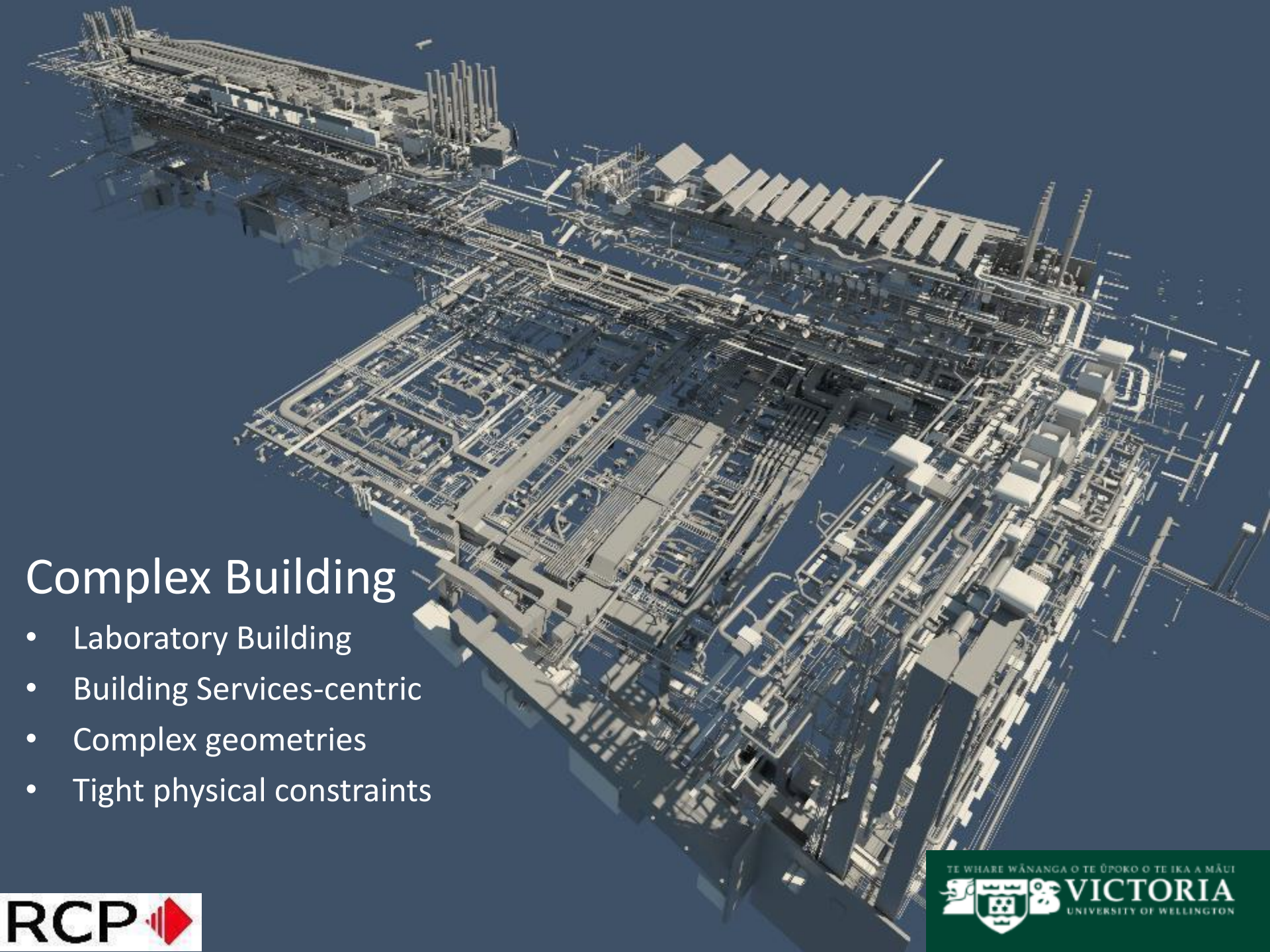

Complex Building

- Laboratory Building
- Building Services-centric
- Complex geometries
- Tight physical constraints

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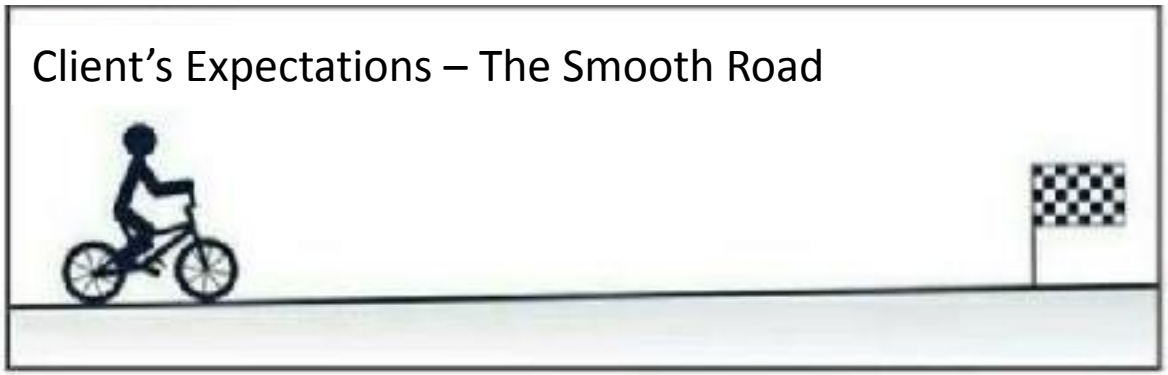
BIM Opportunities



- Ability to coordinate complex geometry
- Clash reduction to minimise variations
- 4D BIM for programming and staging
- Cost certainty
- Team collaboration
- High stakeholder engagement throughout design
- Use of the BIM model to the greatest extent practicable to support AM and FM data acquisition (validation of data) and asset tagging processes

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BIM Challenges

- Success would be reliant on industry maturity at each phase:
  - Design - Construction - Operational Phase
- There has been a shortage of available BIM skills in the industry
- Collaboration is the goal - difficult to achieve if traditional contractual behaviours do not change
- BIM to FM and AM requires clear objectives and agreed work flow for data acquisition

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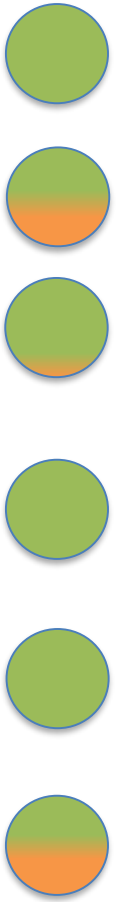
Expectations

General Expectations

- **Design:** Well-coordinated models and design documentation to reduce on site clashes (earlier model federation would assist)
- **Procurement:** BIM capable supply chain, reduce misunderstanding
- **Project Controls:** Cost certainty and confidence in the Programme
- **Construction:** Reduce the effort necessary to develop shop drawings
    - Spatial clash detection to minimise physical clashes on site and reduce variations
    - Improved quality of construction on site/ less re-work or variations
- **BIM to FM and AM objectives:** Leverage the model data for future development. Data acquisition and Asset tagging compatible with BIM



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Project Control and Briefing

- Design management processes and coordination would be supported by BIM
- Validating design outcomes with the brief
- Improved quality on overall project phases
- Agree on common objectives on a multi-disciplinary level
- Create a clear and achievable plan of deliverables
- Understand model use and specialist model integration
- Allows monitoring of supply chain capability
- Improved certainty about the programme and cost of the project

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Design Phase

- Improved visualisation for stakeholder engagement throughout the design process
- Fully coordinated, high quality design documentation
- Fully integrated BIM modelling supporting downstream uses
- Spatial clash detection throughout the design process to minimise physical clashes on site
- Documentation delivered to programme to support tendering and For Construction activities

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ECI and Procurement

- A BIM capable supply chain – ready and motivated to innovate and offer savings
- Clarity in the scope of the project to reduce the spread of Sub-trade pricing
- 4D BIM to assist the Staging and Sequencing
- ECI involvement to clarify the type and priority of model information to support construction activities

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Construction Phase

- Contractor and Specialist Trades able to leverage the Design Consultant's BIM Models, adding specialist information (geometry and data) and reducing the effort needed for Shop Drawings
- Model Development from LOD 300 to LOD 400
- Spatial clash detection to minimise physical clashes on site and reduce variations
- Improved quality of construction on site
- Construction model, controlled by the Contractor and updated to maintain relevance during construction
- Construction efficiencies shared with the client

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Operational Phase

- A virtual model, capable of providing AM/FM information
- Reduction in double-entering of information
- Model to follow the naming convention and asset hierarchy of VUW's BEIMS data structure to enable efficient data capture
- Client end uses for data generally defined
- The project to provide a road map for the capture and of data and asset tagging and potential leverage of the BIM process for future projects

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Long term: BIM to FM & AM Process

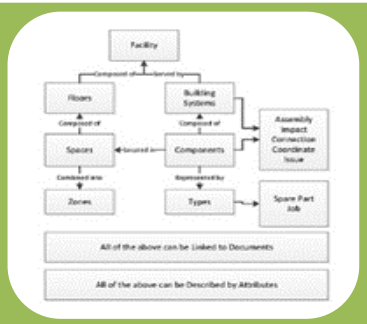
Fully integrated process - Validated, reliable FM & AM data

Pre-Completion

Data capture and Interface with 3D model

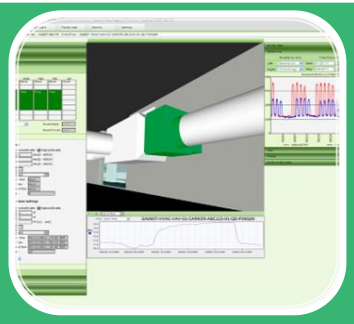
Completion Phase

Validate the plant and equipment information



Handover Phase

Interface with Operational functions: AM and FM



Operational Phase

Performance monitoring and Operational interface

Progression of the capture and validation of Asset information for key plant and equipment

Baseline asset information about key plant and equipment (Spreadsheet data) is included in set data fields in the BIM model

Spreadsheet data is refined following the review of sub-trade submissions & as-builts and verified at completion

As-builts, O&M Manuals, Warrantees & Commissioning information is linked to FM/AM database

Performance data from the BMS is linked to the central data repository for all relevant asset information (spreadsheet data)

Data fields in model

Data validation

Project link to BAU

Operational efficiencies

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Observations

Design Phase – Observations

On the Gateway Building, the following was observed:

- Spatial clash detection and clash avoidance principles were implemented
- Multi-disciplinary design co-ordination reduced on site variations
- The design programme milestones were met for tender using BIM and traditional means – this meant additional work was required to capture tender and VM initiatives in the IFC documents
- The design discipline models were LOD 300 – largely clash free but still some coordination required by Contractor (the word ‘Accurate’ removed from definition by AIA)
- The Contractor would have preferred LOD 350 design discipline models for Building Services to streamline the Shop Drawing process
- We have since observed that consultants are preferring to issue LOD 250 models - considered more appropriate. This requires earlier input by the Specialist Trades to innovate

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Design Documentation programme

The nature of the BIM process changed the traditional design documentation programme in ways that were not clear at the start of the project:

- BIM processes affect the order and type of information required at different design stages
- More effort is required during the early design phases
- Additional time was required for the Developed Design Stage and even more time would be useful during Detailed Design for multi-disciplinary coordination
- It was important to agree what is required by whom, to what level of detail, and by when
- BIM requires a high level of competency “aggregating”/ federating models – consultants are often reluctant to bear that responsibility - If not the design team, then who?
- BIM does not supplant smart thinking – sometimes the diagram is more powerful way of presenting the idea

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Construction

Construction Methodology

- BIM assisted staging and sequencing in the live campus environment
- Safe and logical decisions were supported by the visualisation and 4D BIM

Construction Phase - Observations

- The installation of building services is well coordinated/ tidy
- Model spatial clash detection supported this process
- Construction sequencing is facilitated by the BIM model
- However, contracting behaviours are challenged (who goes first)

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Construction Phase - Observations

- The Contractor and Specialist Trades had different expectations from the Consultant team about how much work would be necessary to develop a “Construction” model and which elements to focus on (model for construction purposes) – This is an overall supply chain issue
- It was often more efficient for the design team to update the model – good to identify these requirements in the RFP process
- BIM has assisted the Seismic Bracing process, but this process is not without its challenges – this is an industry issue that needs addressing (responsibility for coordinating bracing)

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Operation
Handover
AM/FM
Data Capture

Data Acquisition and Asset tagging

- VUW has a comprehensive data capture and asset tagging process
  - Data capture – for future funding and replacement schedule purposes
  - Asset tagging – used for preventative maintenance
- Likely to be between 2000 to 3000 physical items to be bar coded (allowing for on-site scanning)
- The other assets will receive a virtual code/ unique asset code (1,000's of elements)
- The BIM model is being used to validate the quantity and location of the assets that do not possess a physical code
- This process is both manual and digital (verifying Technical Submission information, and mapping spreadsheets to the BIM model for validation)
- The BIM model can be used in the future
- Protocols for updating Models and referencing archival models need careful consideration
- Technical competency for model management is generally outsourced

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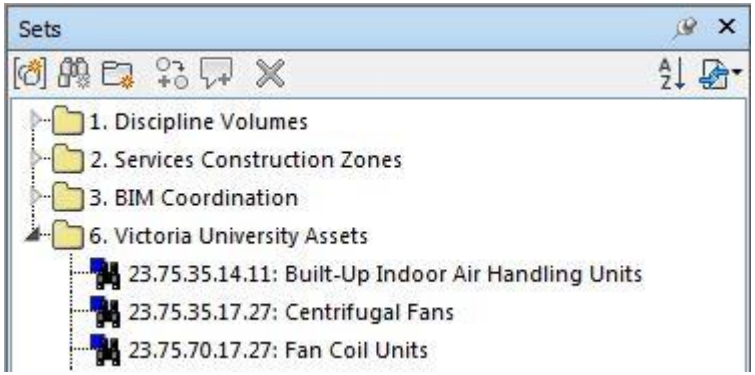
AM/FM Phase – data exchange

Asset Database
(Excel)

FLOW OF DATA

AM/FM Model
(Navisworks)



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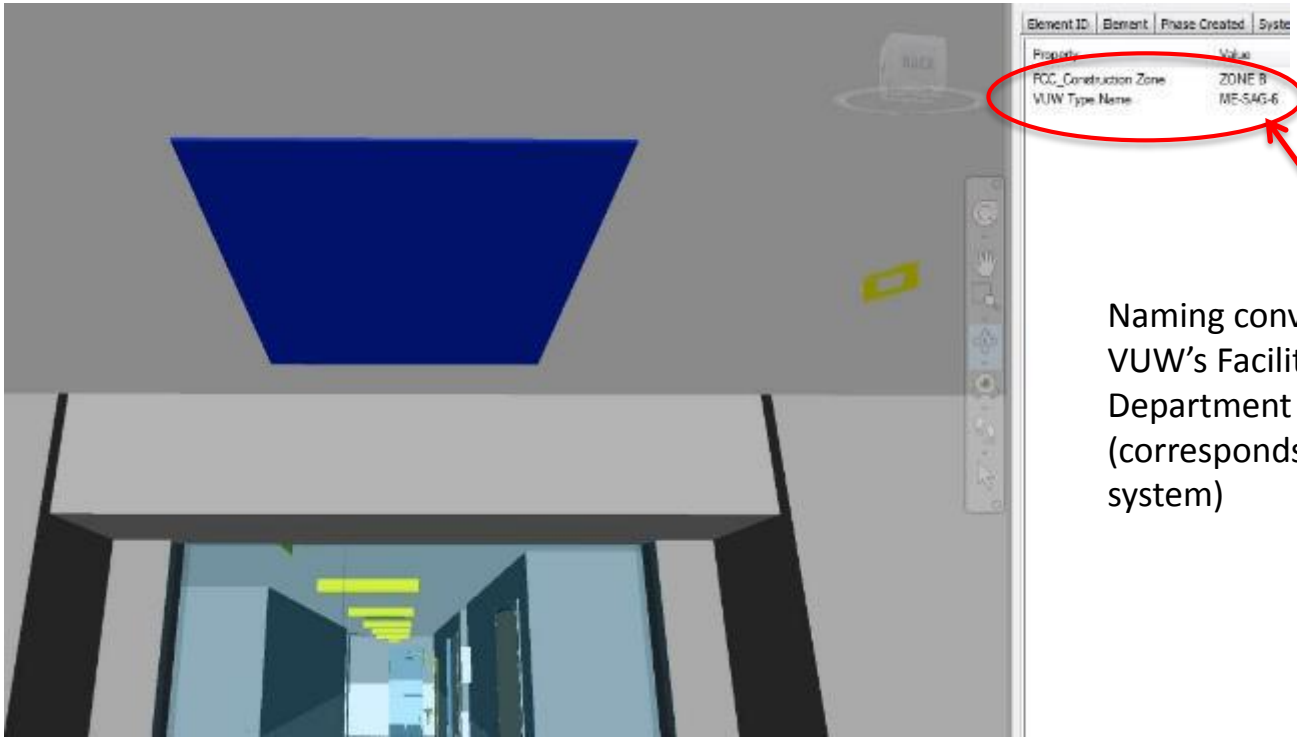
Access data via model



Naming convention as per VUW's Facility's Management Department requirements (corresponds with internal system)

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Access data via Asset Database (excel)

Name	Category	Description	AssetType	Manufacturer	ModelNumber	Supplier	Asset Categor	Asset System	Asset Sub Syst
ME-SAG-1	23.75.70.21.27.11: Diffusers, Regist	Ceiling Radial Diffus	Fixed	Holyoake Industries	CFPP600/30	Holyoake Industries	MECVGR	SER	MEC
ME-SAG-2	23.75.70.21.27.11: Diffusers, Regist	Register Single Defle	Fixed	Holyoake Industries	SDL20	Holyoake Industries	MECVGR	SER	MEC
ME-SAG-3	23.75.70.21.27.11: Diffusers, Regist	Ceiling Slot Diffuser	Fixed	Holyoake Industries	CSD253	Holyoake Industries	MECVGR	SER	MEC
ME-SAG-4	23.75.70.21.27.11: Diffusers, Regist	Wall Displacement D	Fixed	Holyoake Industries	DS	Holyoake Industries	MECVGR	SER	MEC
ME-SAG-5	23.75.70.21.27.11: Diffusers, Regist	Jet Diffuser c/w Mo	Fixed	Holyoake Industries	JD250	Holyoake Industries	MECVGR	SER	MEC
ME-SAG-6	**23.75.70.21.27.11: Diffusers, Regist**	**Perforated Ceiling D**	**Fixed**	**Holyoake Industries**	**CPS**	**Holyoake Industries**	**MECVGR**	**SER**	**MEC**
ME-RAG-1	23.75.70.21.27.11: Diffusers, Regist	Perforated Return A	Fixed	Holyoake Industries	RLPRC	Holyoake Industries	MECVGR	SER	MEC
ME-RAG-2	23.75.70.21.27.11: Diffusers, Regist	Ceiling Slot Return A	Fixed	Holyoake Industries	CSDR253	Holyoake Industries	MECVGR	SER	MEC
ME-EAG-1	23.75.70.21.27.11: Diffusers, Regist	Perforated Return A	Fixed	Holyoake Industries	RLPRC	Holyoake Industries	MECVGR	SER	MEC
ME-EAG-2	23.75.70.21.27.11: Diffusers, Regist	Perforated Return A	Fixed	Holyoake Industries	RLP	Holyoake Industries	MECVGR	SER	MEC
ME-TAG-1	23.75.70.21.27.11: Diffusers, Regist	Perforated Return A	Fixed	Holyoake Industries	RLP	Holyoake Industries	MECVGR	SER	MEC
ME-HEX-1	23.75.10.34.21: Heat Exchangers	Heat Exchanger, hea	Fixed	Alfa Laval	TL6-BFM	Aurora Process Equipm	MECHEHC	SER	MEC
ME-MCC-1	23.75.10.34.21: Distribution Boards	Mechanical Services	Fixed	Joule Products Ltd	MCC-0A-G	Joule Products Ltd		SER	MEC
ME-MCC-2	23.75.10.34.21: Distribution Boards	Mechanical Services	Fixed	Joule Products Ltd	MCC-0B-G&U	Joule Products Ltd		SER	MEC
ME-MCC-3	23.75.10.34.21: Distribution Boards	Mechanical Services	Fixed	Joule Products Ltd	MCC-0B	Joule Products Ltd		SER	MEC
ME-MCC-4	23.75.10.34.21: Distribution Boards	Mechanical Services	Fixed	Joule Products Ltd	MCC-BD-G	Joule Products Ltd		SER	MEC
ME-TH-1	23.75.70.17.14: Convectors	Trench Heater	Fixed	Minib	PT80	Central Heating New Zealand		SER	MEC

Asset information capture either during construction phase or retrospectively entered by VUW FM Department – or a combination of both

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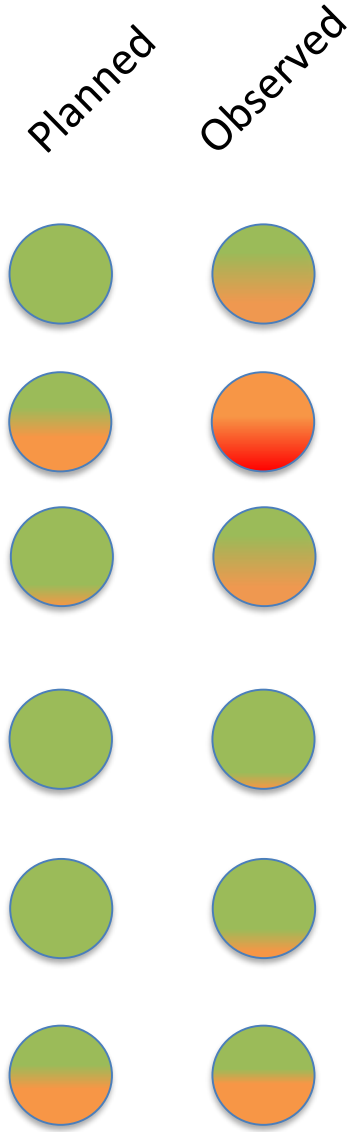
Score sheet

Score Sheet



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BIM
Lessons Learned

Briefing and Design

- BIM introduces accountability and cooperation between consultants that can be challenging:
- Collaboration is the goal - difficult to achieve if traditional contractual behaviours do not change
- Success is heavily reliant on the maturity of the construction industry through each phase: Design - Construction - Operational Phase
- Develop a clear BIM Brief with your client - Work with the “end in mind”
- Consistent contractual requirements are needed at RFP stage “everyone on the same page”
- Establish modelling expectations for development of models and metadata requirements
- Design timeframes need to be extended to take the additional process steps into account
- Be clear about the responsibilities and protocols for clash detection process and model coordination/sharing e.g. common software, timing for model issues, level of development
- Federate models during design – identify who, and how often
- Be clear about what information can be shared, how it can be used, and the reliability of the information for others

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Procurement & Construction

- There is a shortage of available skills and lack of depth of understanding in the supply chain
- This shortage can necessitate the assistance of specialist 3rd Party BIM modellers
- ECI process and the BIM process need to be carefully managed (won't fly on autopilot)
- Contractor engagement with the BIM process is key
- Clarify what level of model development is actually needed for the Contractor and Specialist Trades
- Clarify who maintains the Federated model during construction and keep the model relevant
- Provide an effective process for the end of the building's life cycle (50 years) whether it is to be demolished or repurposed and BIM's integration into that end process.
- Establish Construction Milestones through BIM and a clear plan of deliverables
- Provide access to the BIM model on site

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Operational Phase - AM/FM

- Check that the Client's AM/FM goals and data requirements are clearly defined
- Tailor the design and construction process to capture relevant information needed from the Client's goals
- Understand the market's capability to deliver the Client's goals
- Specify the type of information that is required (2D and 3D) e.g. Excel spreadsheet/Working Asset Model?
- Understand the Client's minimum requirements and aspirational requirements for As-Builts and Operation & Maintenance manuals
- Establish correct Data naming conventions for AM/FM operability & compatibility with existing AM/FM systems
- BIM to AM and FM (validation of data) is achievable, but requires clear objectives and agreed work flow for data acquisition and transfer to the end User


Questions