SECORA

BIM-Enabled Lean Construction

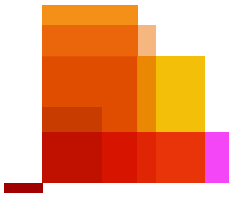
Building Construction Authority

Build Smart Conference

Singapore, October 2014

pwc

Introduction to Secora and PwC Capital Projects



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What We Do…

- Concept to implementation of capital project delivery support, focused on:
  - Project strategy and planning;
  - Project risk assessment and management;
  - Project services and controls;
  - Technology enabled project delivery management.

SECORA

What We Do…

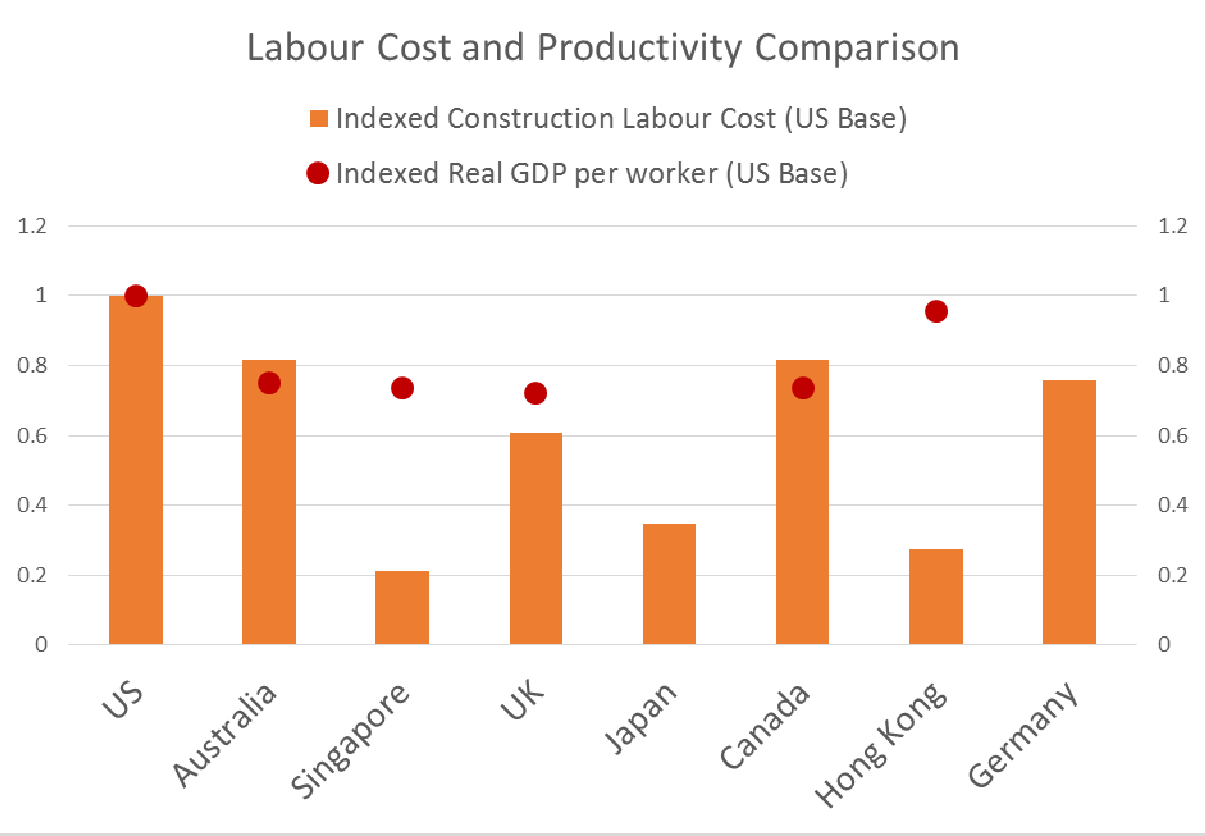
- We specialise in process optimisation across diverse range of industry sectors, utilising 4 phases:
  - **Understand** the client's unique environment
  - **Analyse** the data and translate it into useful insights
  - Support **Implementation** and realise benefits
  - **Train** and embed Lean culture within an organisation

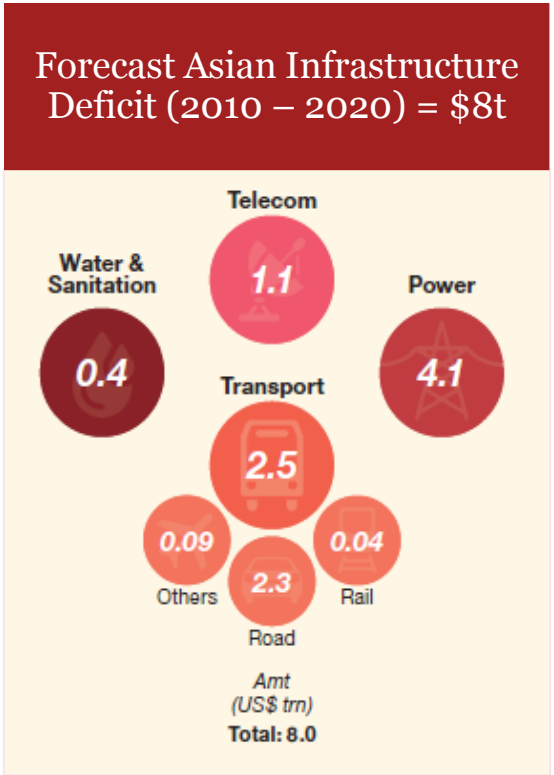
Key Messages – Drivers of Change

- Lean and BIM are both established stand alone capabilities.
- Opportunity to combine and integrate to improve construction productivity and reduce labour requirement.
- Integration of Lean and BIM is gaining momentum
- The push to invest in BIM-enabled capital projects opens the way for increased BIM-enabled Lean Construction.
- Important now as productivity growth continues to fall, SEA labour costs continue to rise and infrastructure deficit in the region grows.

Increasing labour cost content and productivity

Global construction challenge: Increasing Labour costs and falling productivity growth

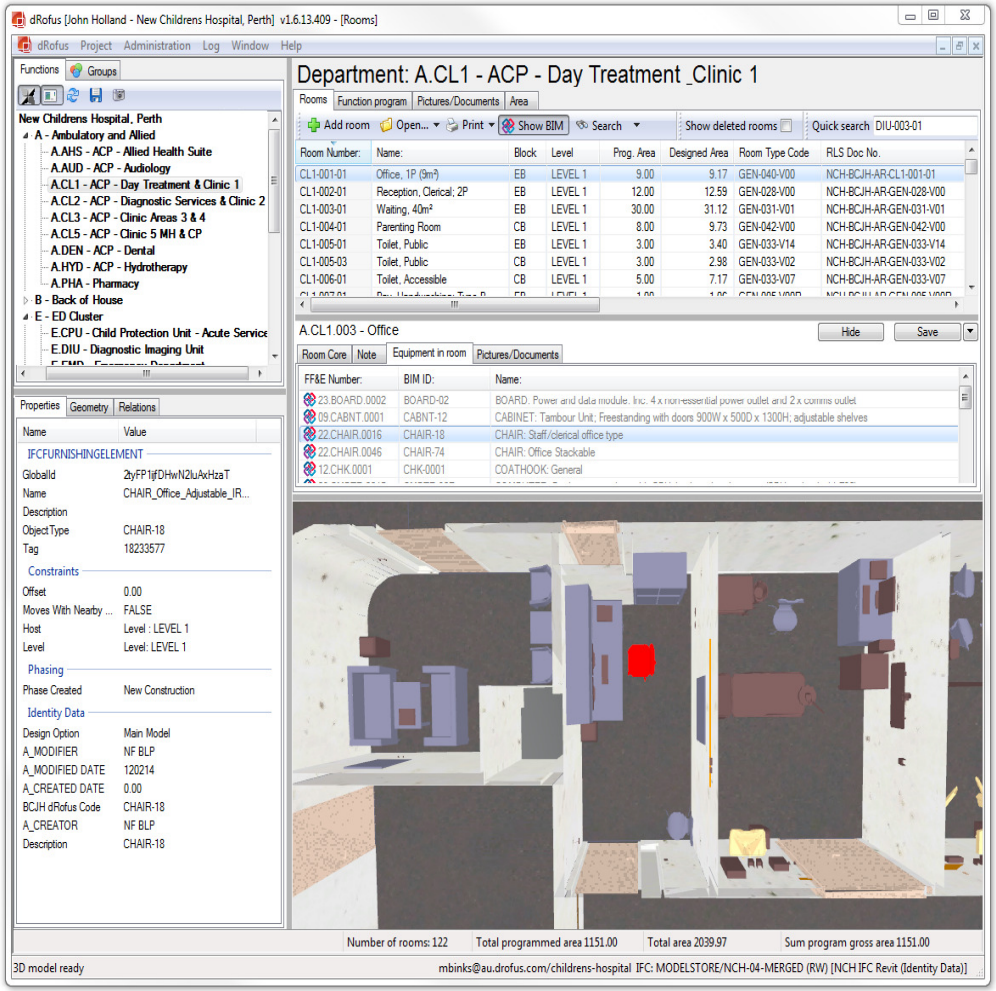




What is BIM?

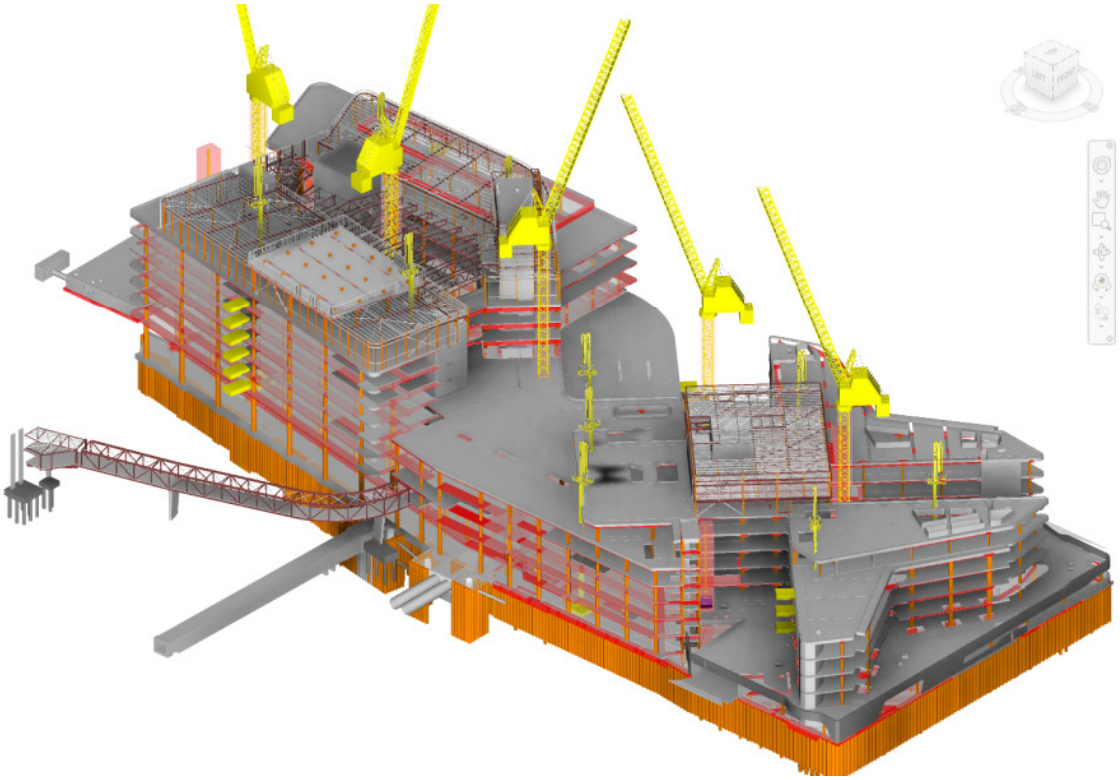
BIM is the integrated use of a knowledge management platform that forms the single point of truth within a project.

- BIM is the integrated use of a knowledge management platform that forms the single point of truth within a project.
- It is a process, not just a database.
- It enables collaboration across all key stakeholders in the design and construction process
- It drives better design, enhanced construction efficiency and improve the performance and productivity of an assets.
- It is based on the use of data-rich models in three or more dimensions.



What is BIM? – Benefits?

BIM can deliver a wide range of benefits during design, construction and, importantly, during asset management during the asset life.

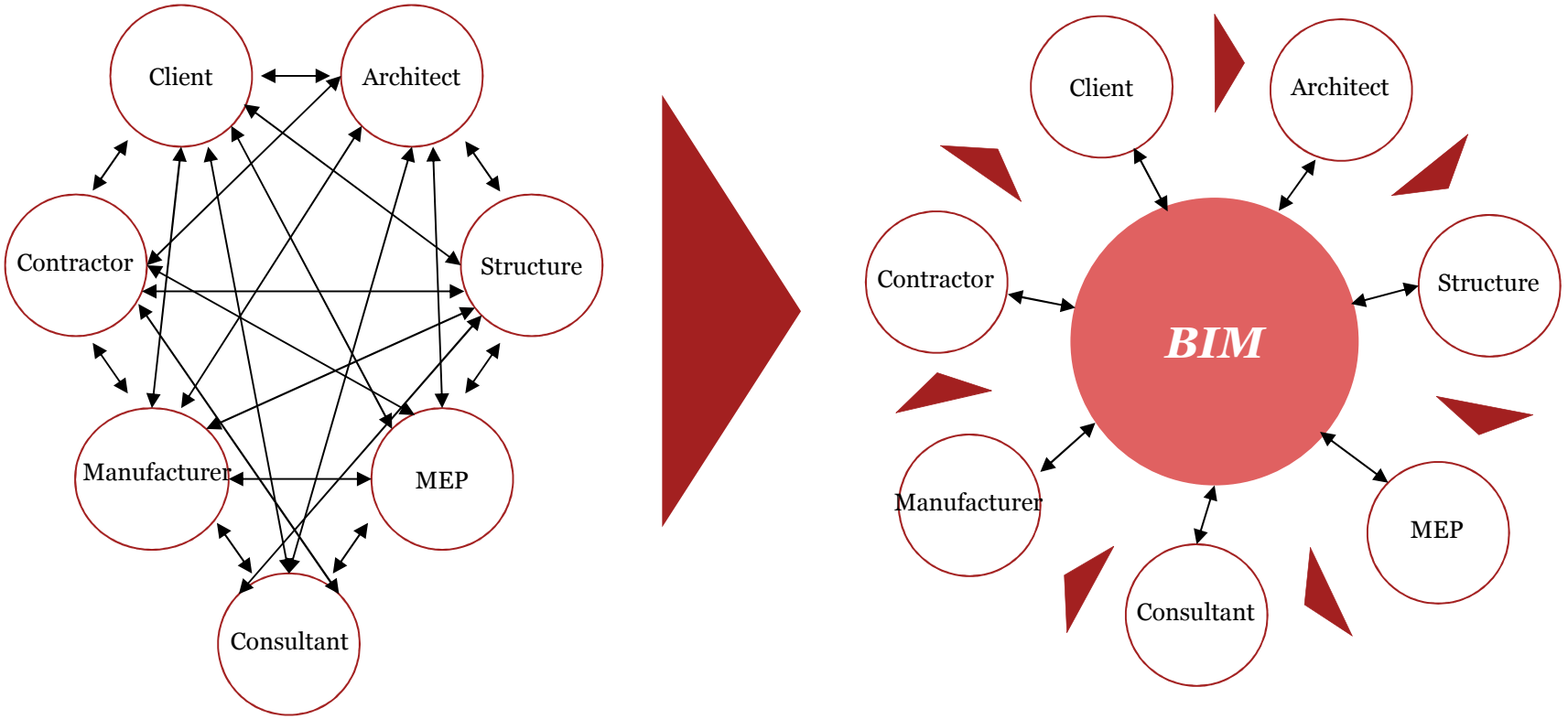


BIM is being used for:

- Visualisation and simulation;
- Work flow design/LEAN;
- Simulation & Clash Detection;
- Costing & Scheduling of Works;
- Design Management;
- Facilities Management;
- Reporting;
- FF&E Management;
- On site set-out;
- Issues Management;
- Records Management.
- Asset registry.

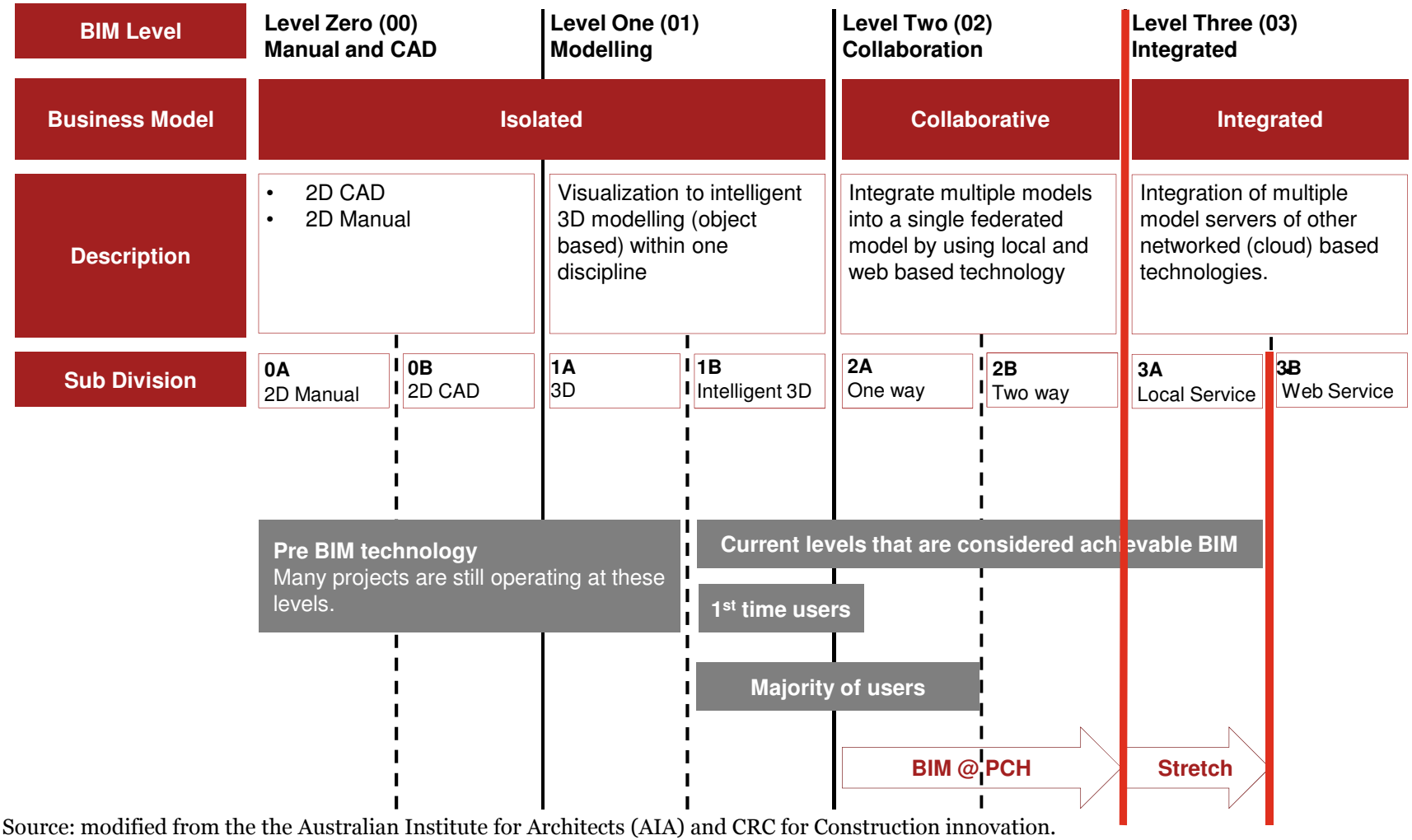
What is BIM? – BIM Drives Collaboration

A key benefit of a well establish BIM system and associated business processes is its ability to drive much increased levels of stakeholder collaboration, delivering functional outcomes better aligned to user needs and more efficient buildings to build and operate.



BIM Maturity Model

BIM means many things to many people, but there is a maturity model emerging as the approach (tools and process) are increasingly integrated into project delivery.



Source: modified from the the Australian Institute for Architects (AIA) and CRC for Construction innovation.

TG1

Lean Construction

- Lean construction seeks to apply Lean thinking to improve project performance and outcomes by:
  - Removing sources of waste
  - Identifying repetitive processes and improve process flow
  - Each process step should be:
    - **Valuable** to the customer,
    - **Capable** of producing a good quality result all the time,
    - **Available** when needed,
    - **Flexible** to shift between different products or service requirements?

The key question to determine value

"Would the customer be prepared to pay for this?"

Slide 9

TG1 Tim Griffin, 14/10/2014

Lean Construction Maturity

Lean Module	LC Project Tool	Description and Benefits
Business Improvement Culture	• Succession Planning • Permanent Positions	• Embedded culture where performance is the sum of it's individuals habits. • A unified culture based on the "never ending pursuit of perfection".
Lean Management	• Recognition Systems • Value Engineering • Constructability Reviews	• Improvement implemented with people not to people. Integration into early phases of Project Management Framework. • Lean becomes the philosophy by which the business is run.
Process Excellence	• Value Stream Mapping • Line/ Work Stop • Six Sigma • Kaizen • FMEA	• Improvement using analytical tools on defined controlled processes. • Mindset shift from reactive improvements to proactive excellence.
Employee and Equipment Development	• Team/ individual/ group meetings • Team training • Specialist trade management	• Methods of working that empower all team members via effective communication, training for tasks and management of specialties • Improved baseline performance through superior equipment and people.
Logistics and Inventory Management	• Pull Planning • Six week look ahead • Resource • FIFO Management	• Utilising Lean techniques of flexible, on demand processes focused on a project's supply chain, to better deal with disruption and change.
Standardised Work	• Modularisation • Spaghetti diagrams	• The most efficient construction method. It breaks down the work into elements, which are sequenced, organized and repeatedly followed.
Problem Solving	• Benchmarking • Target value design • Root cause analysis • Fishbone	• Techniques used to rapidly define problems, empower participants, determine root causes and identify solutions.
Workplace Organisation	• 5S • Quick changeover	• Systems used to identify and eliminate waste that causes searching for tools, equipment, information, etc, to improve people and equipment utilisation
Visual Management	• Colour Coding • Optical Signals • Information centres • Noticeboards and scoreboards	• Time saving, useful information or clues that flow naturally with the value adding steps of the product or service you are providing. • Transparency of operations; Better flow of materials and manpower.

Lean Productivity Drivers – Overview

Eight key drivers of efficiency form the core of Lean value delivery, each of which can benefit from the application of BIM tools and process integration.

Lean Productivity Drivers – Lean and BIM Inputs (1 of 2)

	Lean Input	BIM Input
Standardisation/Optimisation	• Process mapping • Functionality review	• Process design and simulation • Design object library/ standardisation
Modularisation / Off-Site Fab	• Process map construction process • Design for Manufacturing/ Assembly	• Modular transport and assembly design, simulation, categorisation, tracking.
Supply & Site Logistics	• FIFO • Inventory minimisation • Value stream mapping • 5S • Spaghetti mapping	• Pre-delivery tagging (RFID etc) • Schedule-driven supply sequencing simulation/ optimisation • Site delivery & build sequence simulation • Site logistics visualisation /Virtual Design & Construction
Scheduling / Sequencing	• First-run studies • Concurrent design • Critical Path Method • Flow-line scheduling	• Simulation/ optimisation • Workforce density mapping • Crane clash/ utilisation analysis

Lean Productivity Drivers – Lean and BIM Inputs (2 of 2)

	Lean Input	BIM Input
Waste Minimisation	• Reduced labour requirement • On-site process optimisation • Workflow / sequence optimisation to minimise rework	• CAD driven estimation • Pre-cut supply • Detailed design to reduce estimation margins • Workflow simulation
Unforseen Events	• Pull Planning • Workforce meetings	• BIM supported risk workshops • BIM supported reporting & rescheduling
Knowledge Management	• Specialist skills management • Training	• Single point of truth data base, including sequencing, costs, asset data etc.
Safety Management	• Non-value added work reduction (e.g. rework, transport, over-production)	• Workforce density mapping, crane clash, high density workspace design, BIM-enabled risk workshops

Case Study – Lean BIM at PCH – Project Scope

The Perth Children's Hospital project has been a successful demonstration of the benefits of BIM and Lean principles, that has at the same time shown that much more is possible.

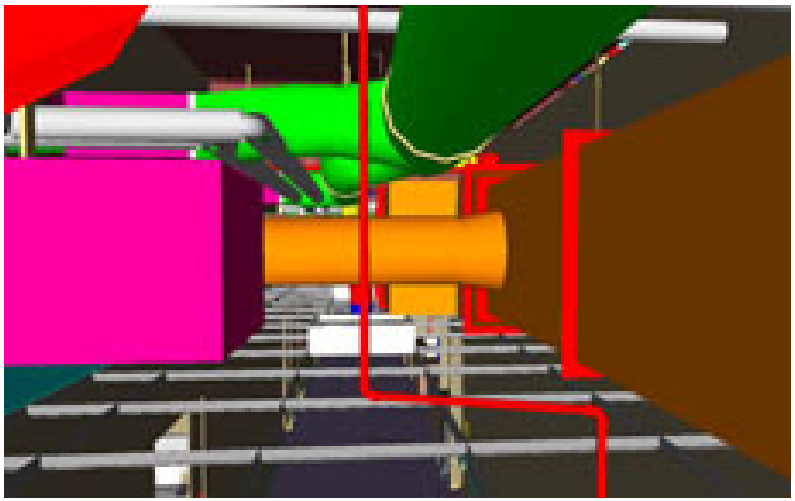
Project Overview

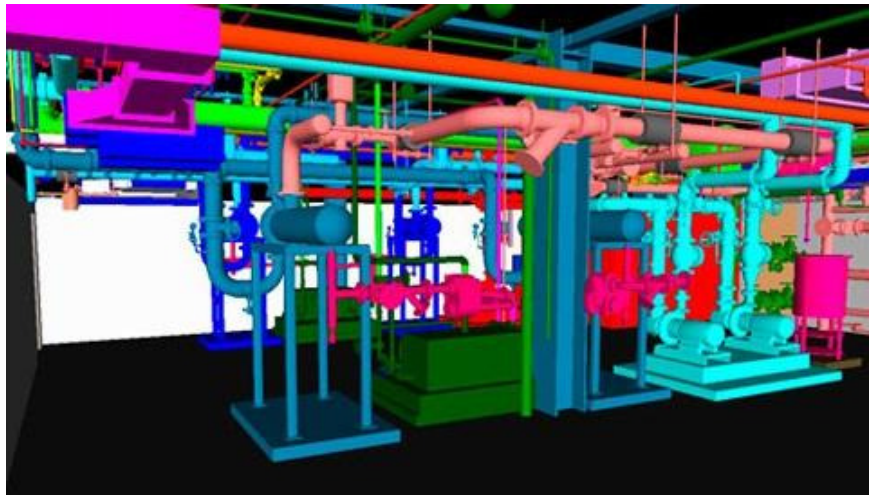
- **Client**: Western Australian Department of Health
- **Cost**: AUD $1.2 billion
- **Scheduled Opening:** Late 2015
- **Contractual Delivery Model:** Two Stage Managing Contract with John Holland Group (JHG) as the Managing Contractor (MC).
- **Services Provided:** Tertiary level pediatric health services and key secondary health services.
- **Floor Area**
  - 120.000 sq. meters;
  - 298 beds;
  - 11 operating theatres;
  - Over 35 clinical departments.

Case Study – Lean BIM at PCH – Utility Columns

BIM and Lean principles were applied to the high-density layouts in each of four utility columns, delivering improved access for installation and maintenance and reduced rework.

1: Utility Duct Assembly	• Ensure that major utility assets can be efficiency assembled into high density utility duct.	• Define required access approach and required clearances. • Use BIM & Lean process design to simulate and ensure required clearances are in place.	• Shorter assembly times. • Improved access for future maintenance and change out. • Efficient space utilisation allowing for future development.





Case Study – Lean BIM at PCH – Firedoors

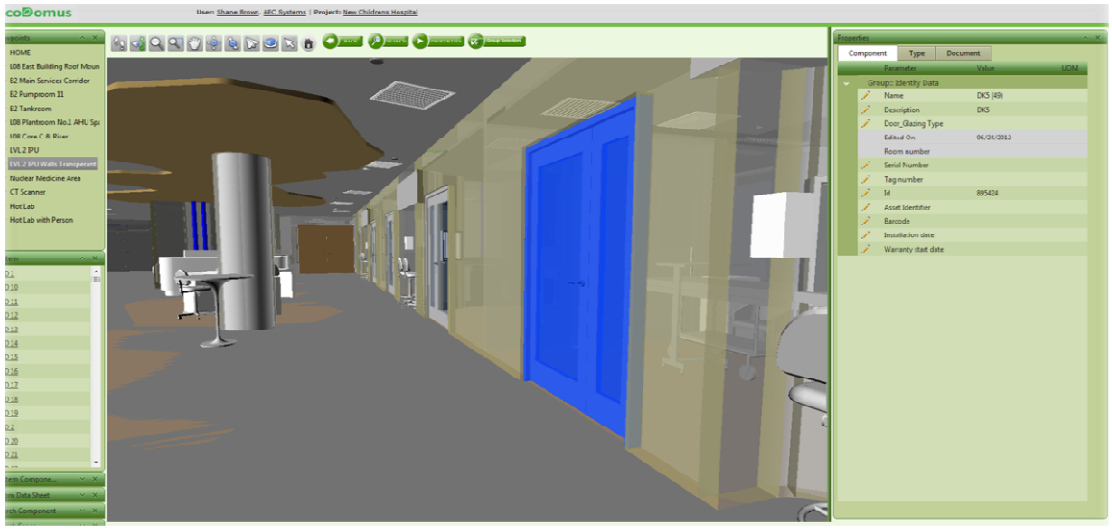
The use of BIM to drive a Lean-based design review to confirm the design integrity and procurement parameters of the fire walls and fire door design, avoiding significant rework.

2:Firedoor / Firewall Design Review

- Ensure that firedoor/firewall design and installation is to requirements.
- Avoid re-order and rework delay and costs post inspection.

- BIM object tagging used to visually check design integrity.
- Drive procurement directly from BIM database.

- A number of barrier gaps identified – improved firewall integrity.
- A number of wrongly specified fire doors identified prior to ordering – avoiding re-order delay & rework.



Case Study – Lean BIM at PCH – Site Logistics

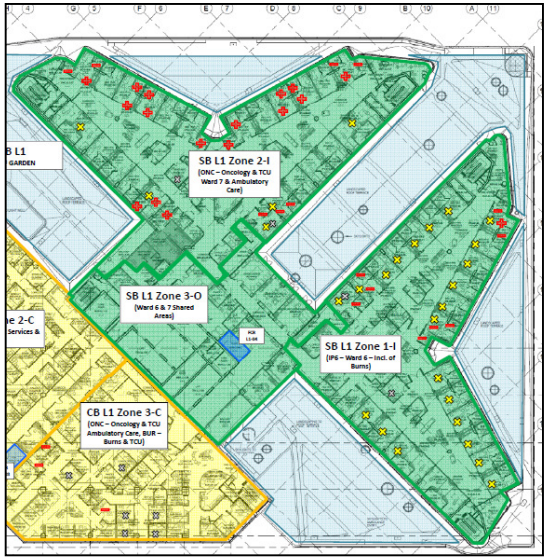
Supply and site logistics are a major challenge in such a functionally complex building. BIM and lean construction principles were used to drive the supply logistics strategy.

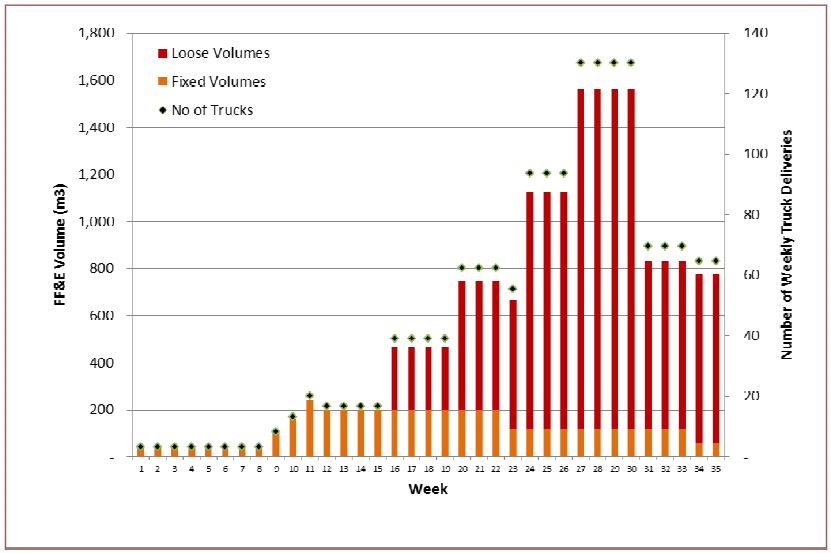
3: FF&E Site Logistics Planning

- Receive, check, locate and install 54,000 items of fixtures & fittings in 35 weeks at least cost and without schedule disruption.

- BIM and Lean used to design site logistics, identify volume & space requirements, link elements to targeted spaces.

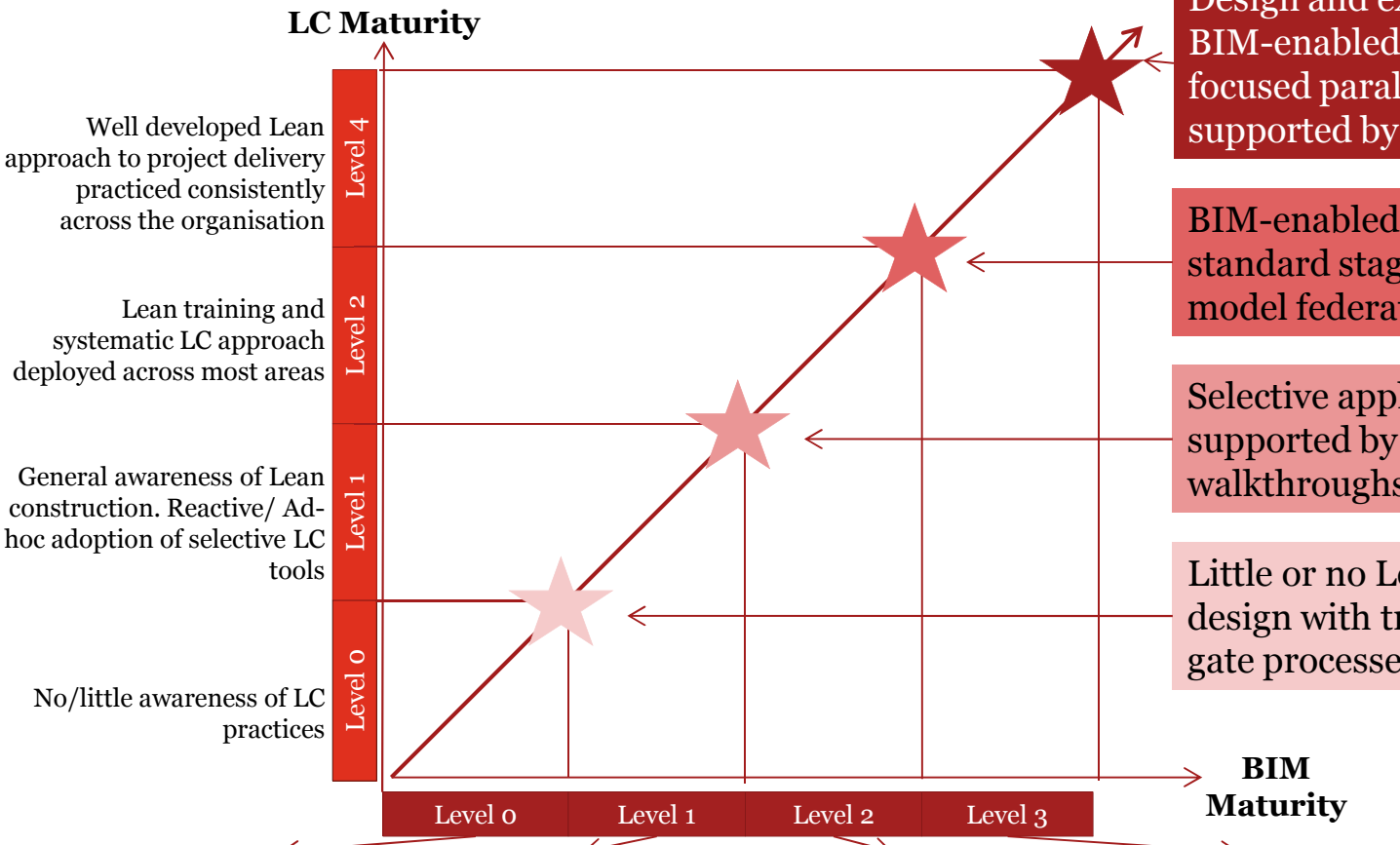
- In progress - success of front end planning, including JIT versus off-site logistics model yet to be proven.
- Future opportunity to use scheduling capability within BIM to better align logistics.





Integrated Maturity Model – Where are we?

Highly mature Lean enabled BIM operators have redesigned their stage-gate processes to optimise value capture from these approaches.



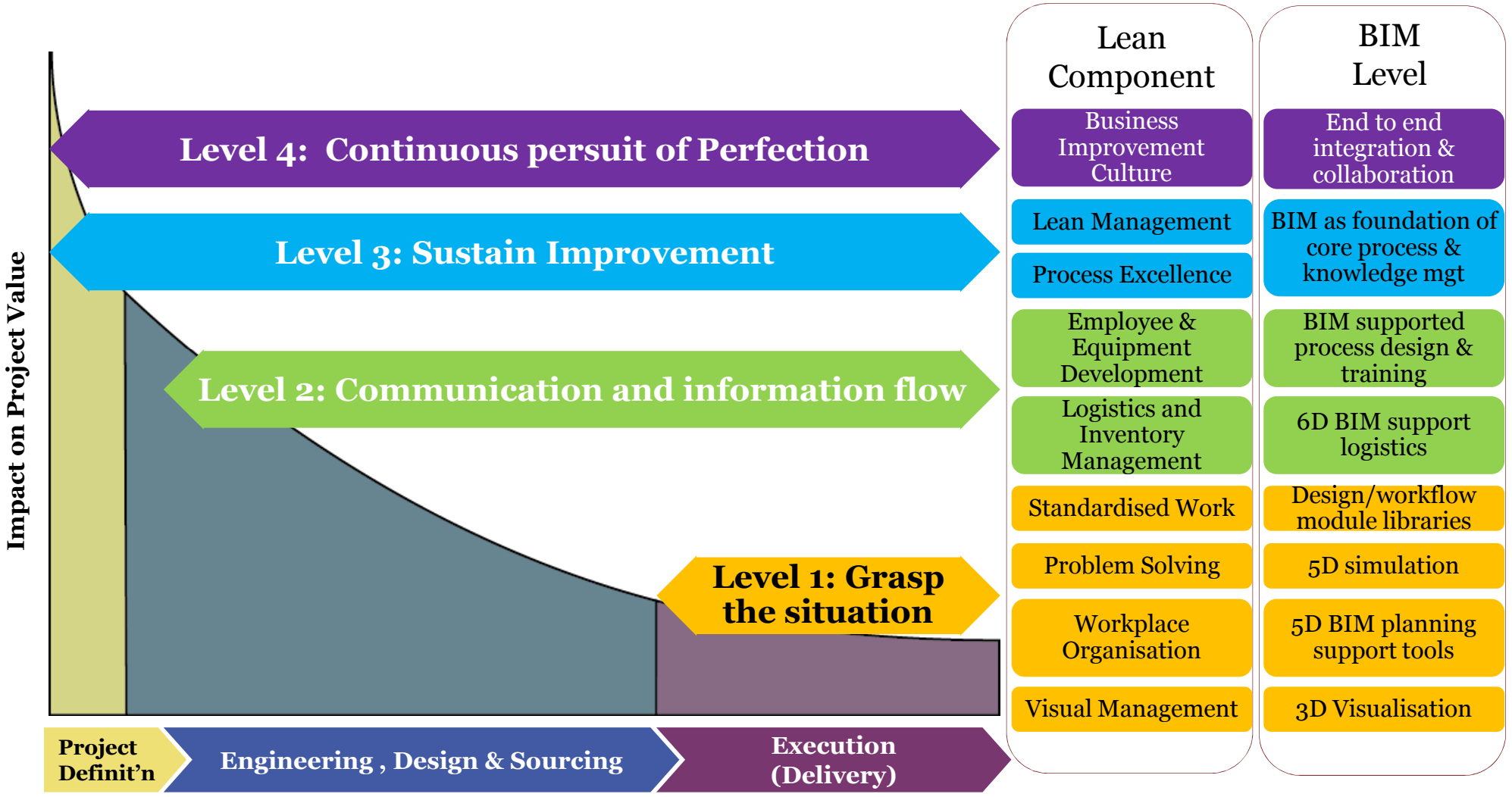
Design and execution process optimised for BIM-enabled collaboration, integrating Lean-focused parallel design and execution, supported by innovative, lean-centred culture

BIM-enabled Lean approach overlaid on standard stage gate processes with periodic model federation and collaboration events.

Selective application o f Lean practices supported by 3D cad visualisation and walkthroughs.

Little or no Lean awareness. Limited 3D design with traditional stop-start serial stage gate processes.

Lean Construction – Implementation Timing



Challenges – Supply Side and Project Owners

- Perception that all the value is in the asset management phase:
  - There is often a low level of understanding of what a fully integrated BIM enabled Lean approach looks like and what value it can deliver;
  - The value is sometimes difficult to measure.
    (what would the "do nothing" outcome have been? How relevant are benchmarks from project to project?)
- Managing Contractors and Architects appear slow to adopt the technology and approach:
  - Slow to adopt technology at the drafting level;
  - Slow to see the overall process and collaboration benefits – is the resulting openness and transparency challenging for some?
- But many sub-contractors see the benefits and just need some encouragement:
  - Many sub-contractors seem willing to embrace the technologies,
    (e.g. in MEP mark out and installation sequencing and process redesign.)
  - Potentially important change-agents in the industry.

Way Forward – How to begin on the journey

- Assess where you are.
- Understand what is realistic stretch.
- Think broadly about BIM/Lean – not just a visualisation tool and set of frameworks – requires change of mindset and culture – construction as the factory floor.
- Educate and develop supply side.
- Stronger success stories/ case studies.

Thank you