BIM Context

Adriana Sanchez (18/02/2016)

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Building Information Modelling

Computer-aided Visualisation and Design

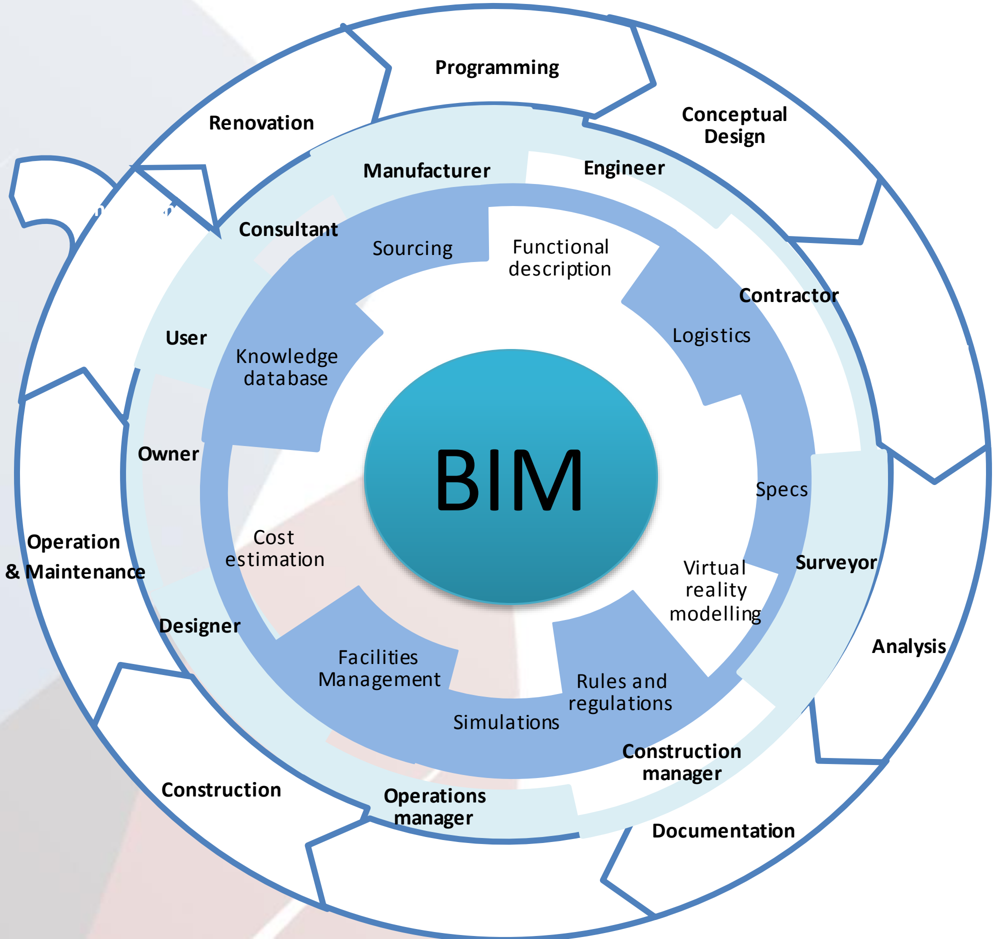
Building Information Modelling and Management - BIM(M)

Virtual Design and Construction

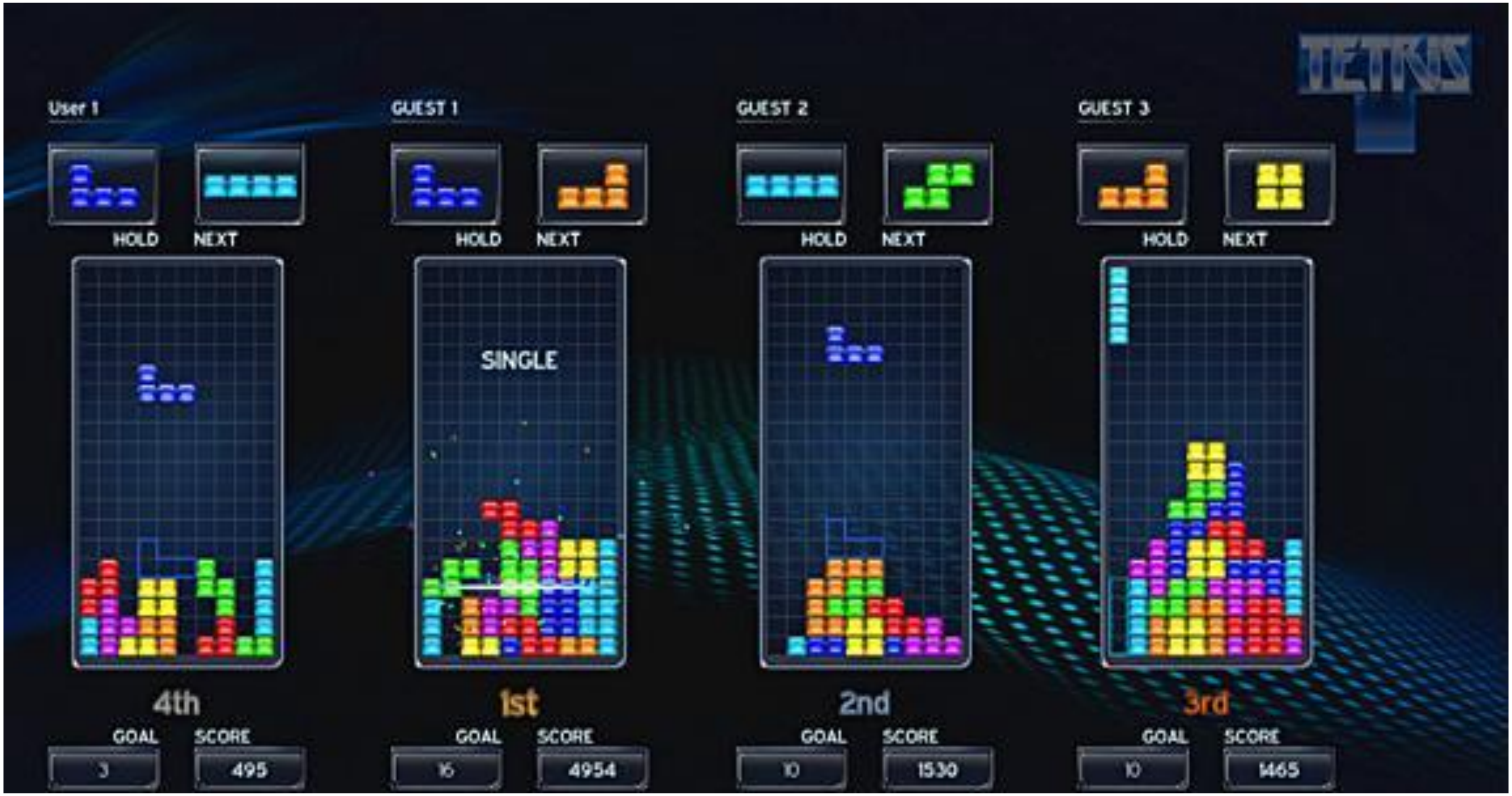
Digital Engineering

Building Information Modelling

BIM can be defined as a digital process that encompasses all aspects, disciplines, and systems of an asset within a single virtual model, allowing all to collaborate more accurately and efficiently than using traditional processes.



More than Just a Software



More than Just a Software

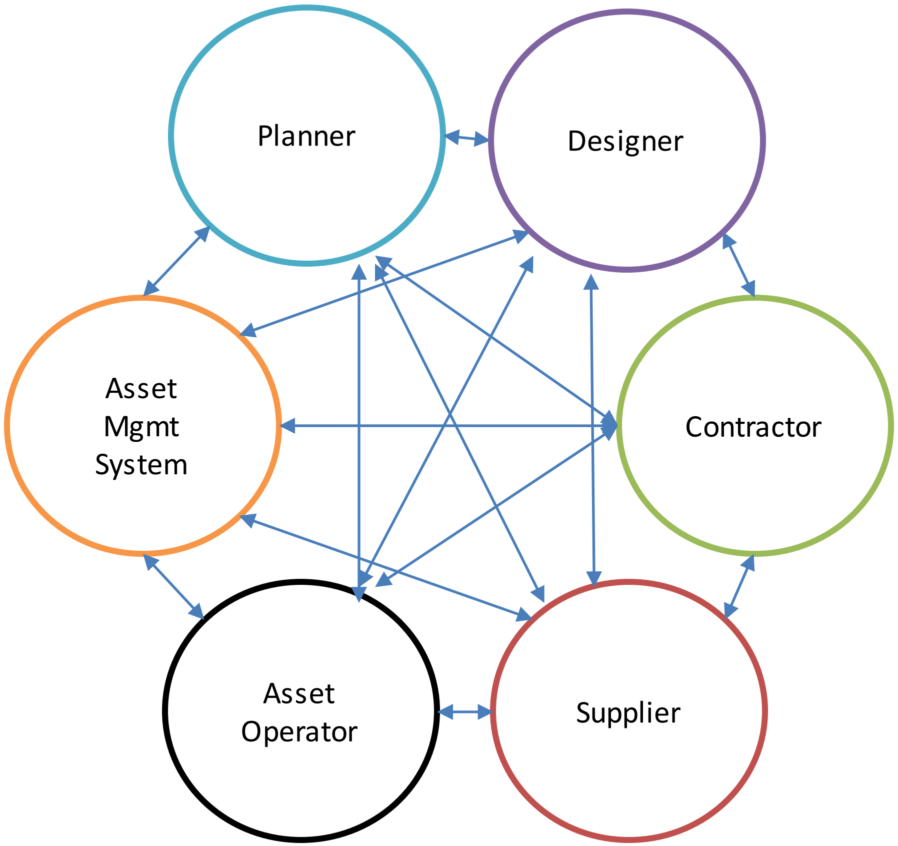
New Generation Rollingstock Depot in Queensland

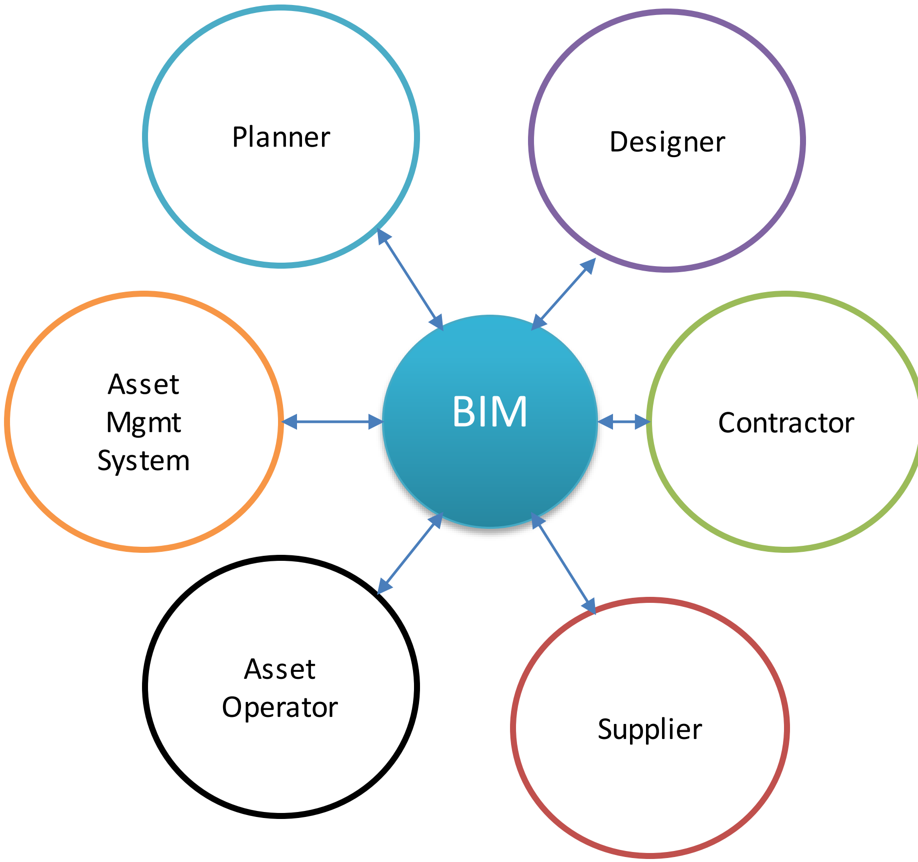
- 17 BIM-related processes and tools
- 25 benefits

Perth Children's Hospital in Western Australia

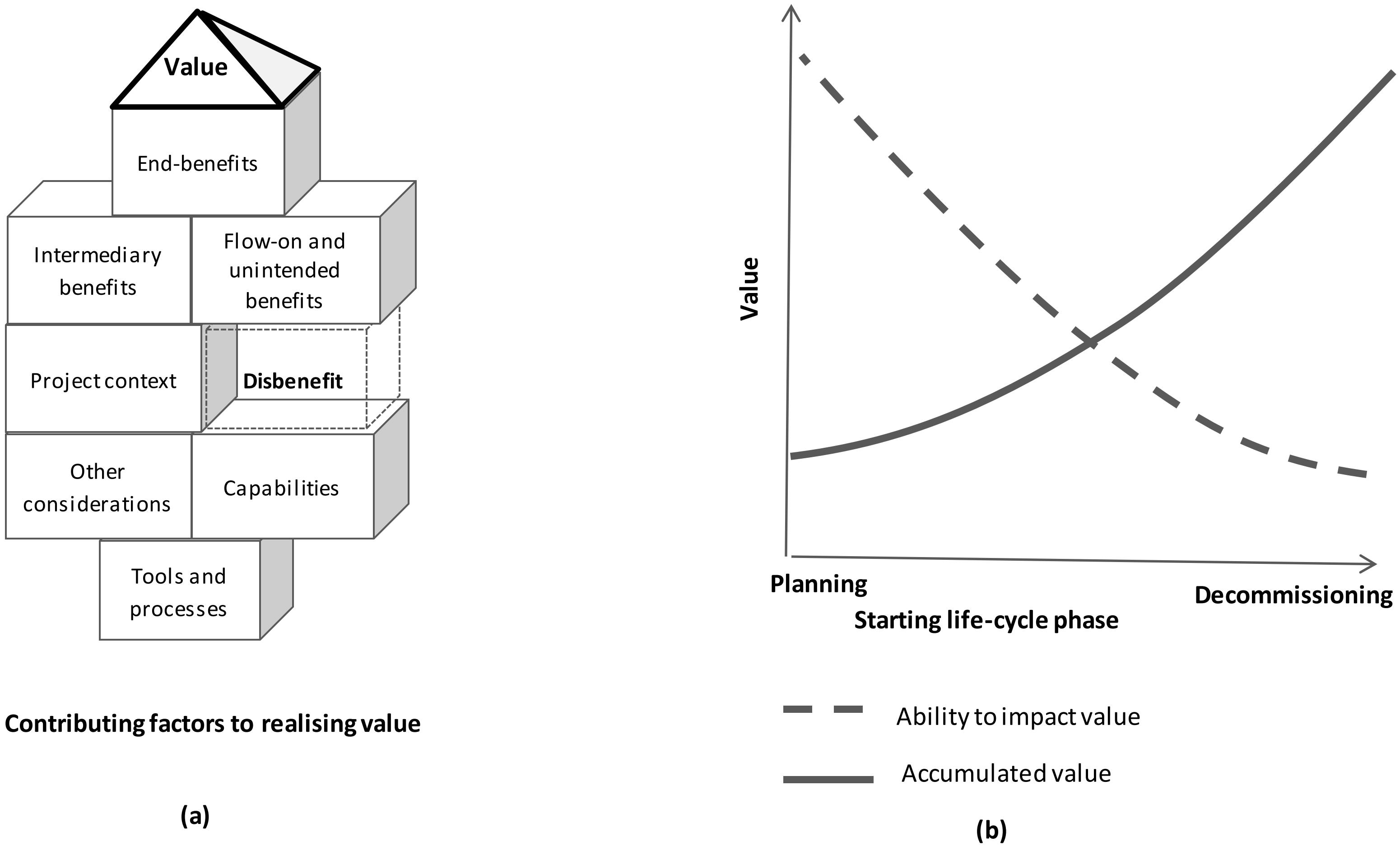
- 20 BIM-related processes and tools
- 26 benefits

New Approach to Information Mgmt





Value of BIM


Value
End-benefits
Intermediary benefits
Flow-on and unintended benefits
Project context
Disbenefit
Other considerations
Capabilities
Tools and processes
Contributing factors to realising value
(a)
Value
Planning
Decommissioning
Starting life-cycle phase
Ability to impact value
Accumulated value
(b)

Global Context

1982

Finland *– discussions begin about integrating IT into construction*

2006

Hong Kong *Housing Authority begins piloting BIM*

2007

US *GSA started publishing their BIM Guide Series*

2009

Sweden *launches OpenBIM (now BIM Alliance) to establish BIM standards - Trafikverket*

2010

Singapore *Building and Construction Authority issues a nationwide BIM roadmap*

2011

UK *begins 5 year BIM implementation plan*

2012

Finland *requires the use of BIM for government procurement*
US *industry-wide uptake of BIM increased to 71 Percent*
UK *decides to become a world leader in BIM*

2014

UK *government establishes BIM Task Group*
NZ *BIM Acceleration Committee created*
Hong Kong *Industry Council issued a BIM Roadmap*

2015

Singapore *mandates the use of BIM in all new projects larger than 5,000 square metres*
Swedish *Transport Administration mandates the use of BIM*

2016

UK *mandates use of collaborative 3D BIM on all projects*
EUPPD *requires EU members to encourage or mandate the use of BIM for publicly funded construction projects beginning 2016*

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Activity in Australian Infrastructure

Department of Planning, Transport and Infrastructure (DPTI) ***of South Australia and Queensland*** *Transport and Main Roads conducting research and pilot projects into BIM requirements and procedures.*

Transport for New South Wales *has put together a ten-person team to develop a strategy for BIM adoption.*

The ***Victoria*** *government has also announced their BIM pilot programme with the 'potential staged implementation of BIM across infrastructure projects in future'.*

Australian Productivity Commission *Inquiry Report into Public Infrastructure recommended public clients to develop common set of BIM standards and protocols, and use BIM to improve procurement and reduce cost.*

Talks among the ***ACIF/APCC*** *BIM Summit Group, formed by the leadership of these organisations and others such as* ***buildingSMART Australasia****, decided having a greater focus on infrastructure for future actions.*

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TfNSW BIM Vision

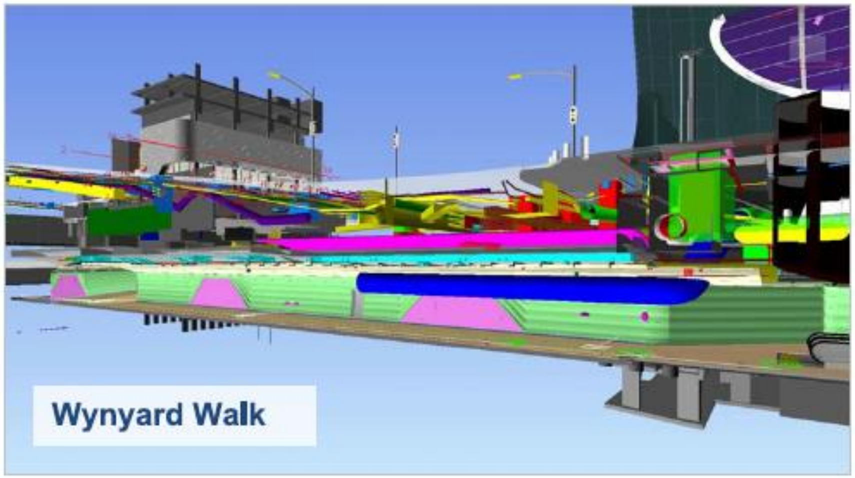
“To drive **value for money**,
by having the **right asset information**,
at the **right time**,
to make an **informed decision**”

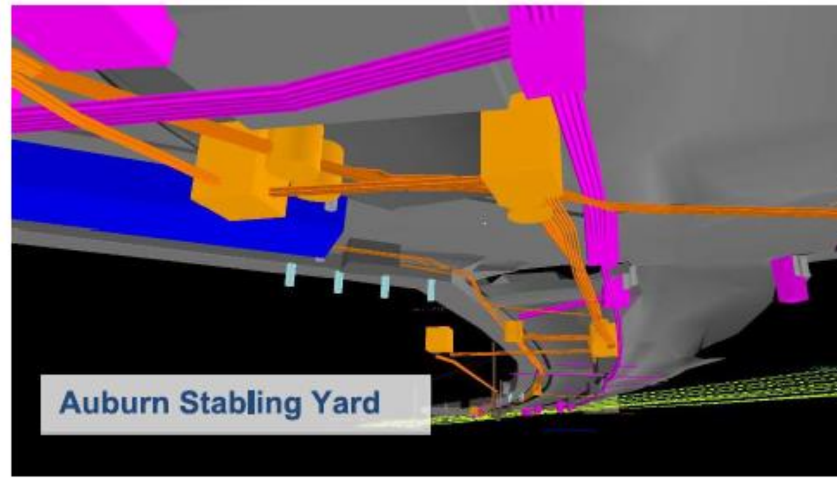
Courtesy of Simon Vaux, TfNSW, January 2015

TfNSW BIM Vision

Courtesy of Simon Vaux, TfNSW, January 2015

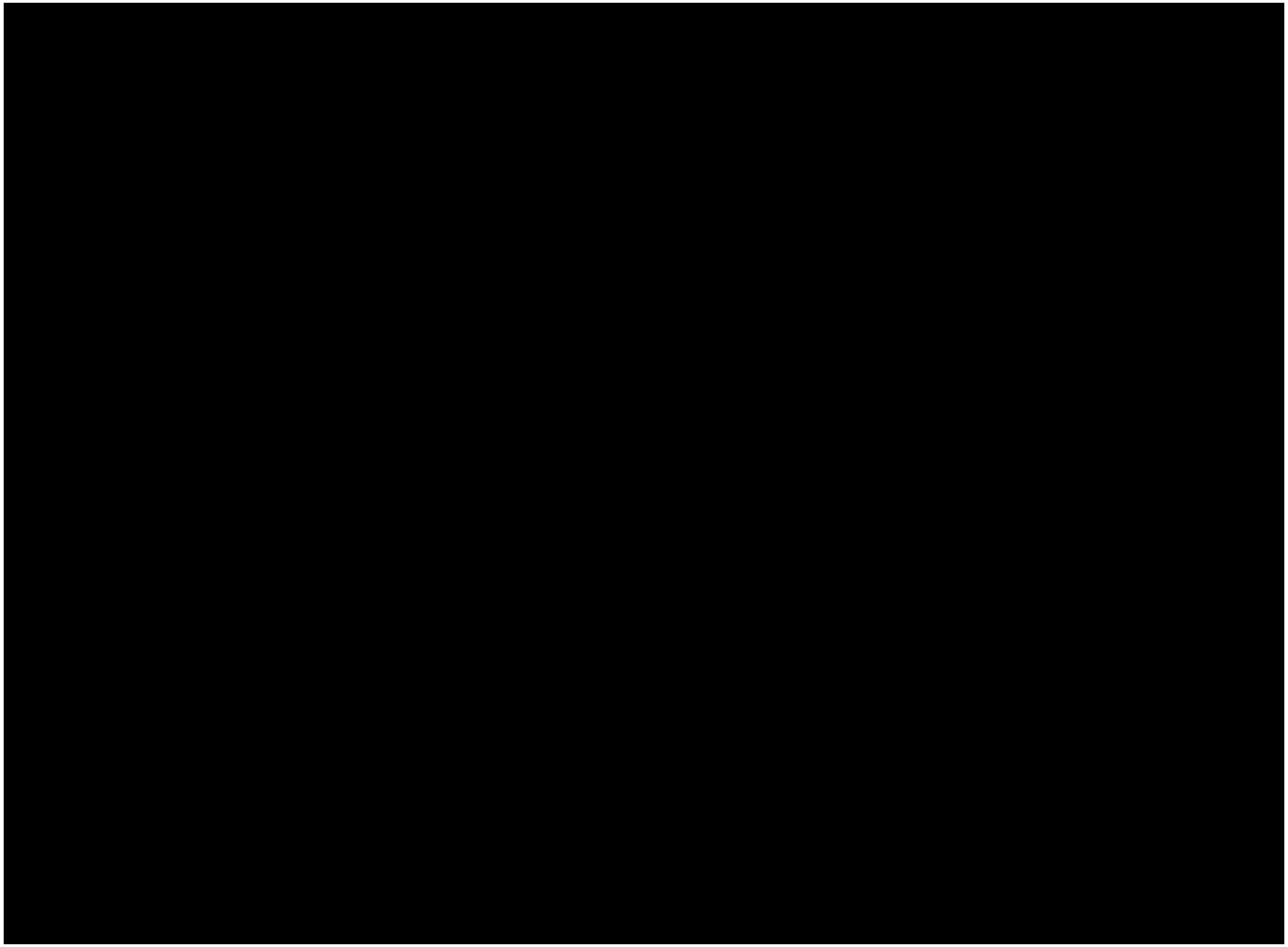
TfNSW BIM Vision





Courtesy of Simon Vaux, TfNSW, January 2015

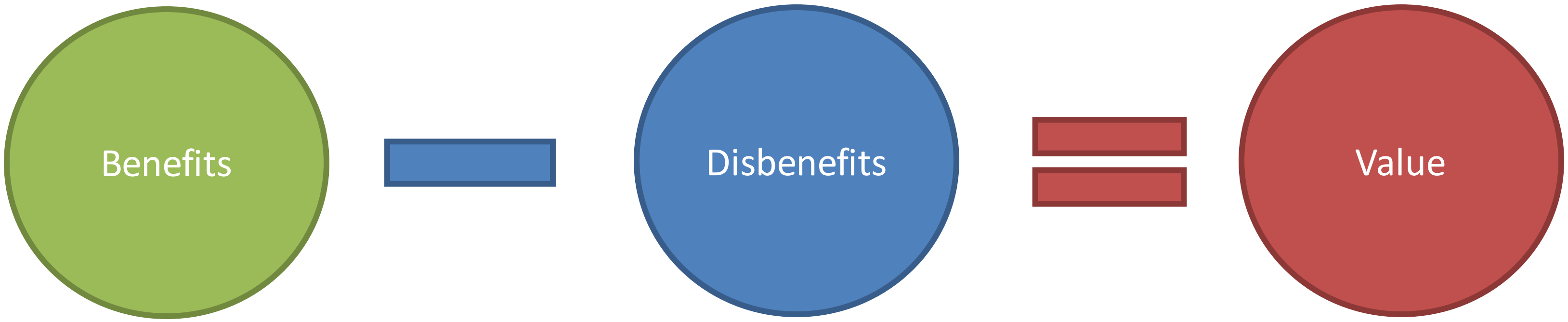
Dutch Ministry of Infrastructure and Environment Visions



Discussion and Break

The Value of BIM
To Infrastructure

Value of BIM

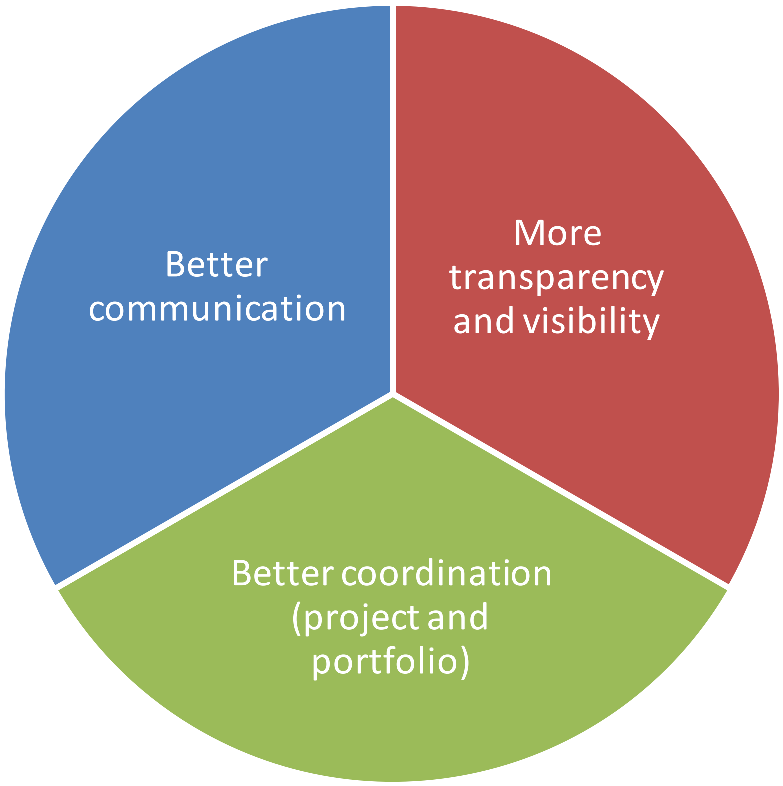


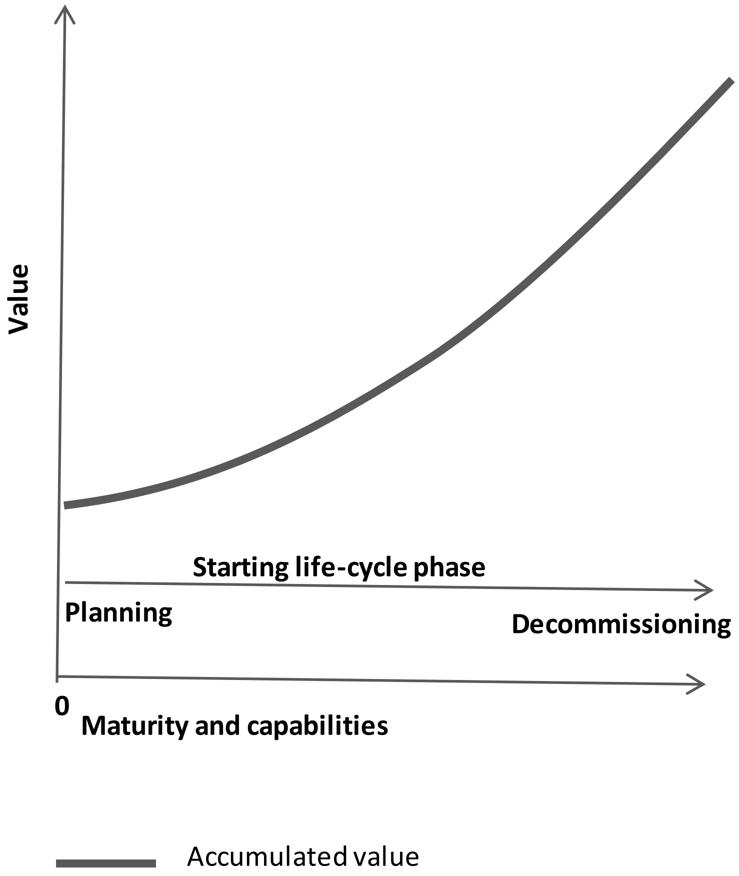
Improvement on current standards of practice and project outcomes

Negative outcomes

Organisational Goals

Core Benefits





Capabilities and Functionalities

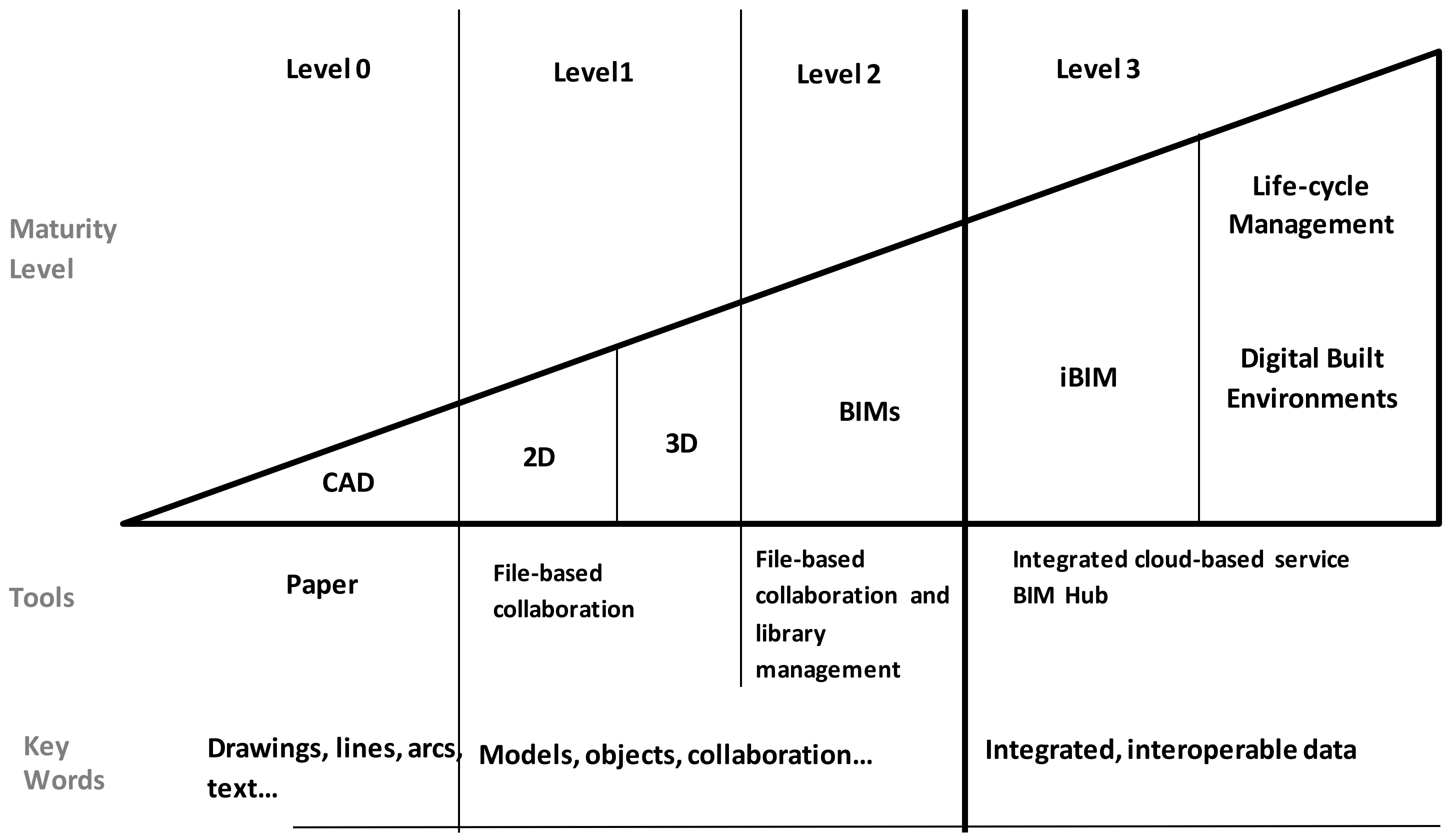
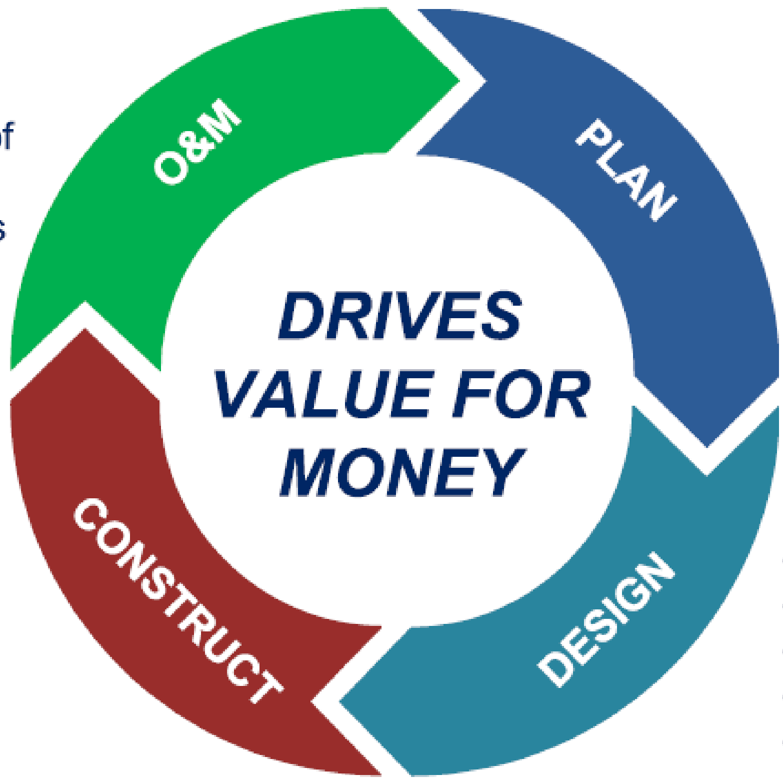


Illustration of the UK iBIM model (taken from Sanchez, Hampson and Vaux (2016) Delivering Value with BIM: A Whole-of-life Approach, London: Routledge).

Value of BIM (DE) - TfNSW

- Seamless data transition (handover)
- Accelerated understanding of failures or incidents
- More cost effective decisions
- More targeted, preventative maintenance
- Information mobility

- Reduced risk
- Improved cost certainty
- Improved baseline data
- Improved optioneering for faster decisions
- Reduced site investigation
- Improved prior knowledge

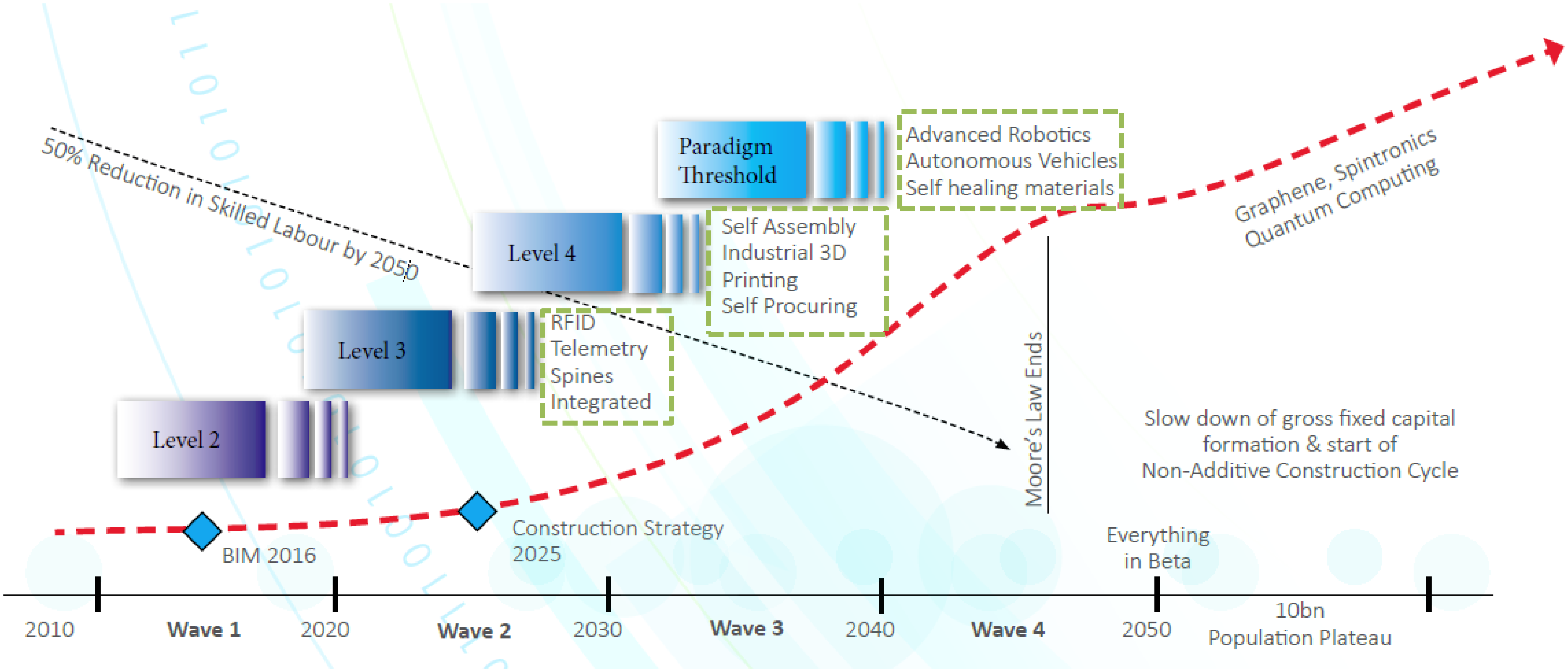


- Improved safety
- Reduced risk
- Improved cost estimating
- Reduced rework
- Off-site fabrication
- Schedule optimisation
- Improved procurement

- Improved design coordination
- Clash detection
- Improved accuracy & drawings
- Early visualisation
- More effective consultation
- Improved configuration control & requirements management

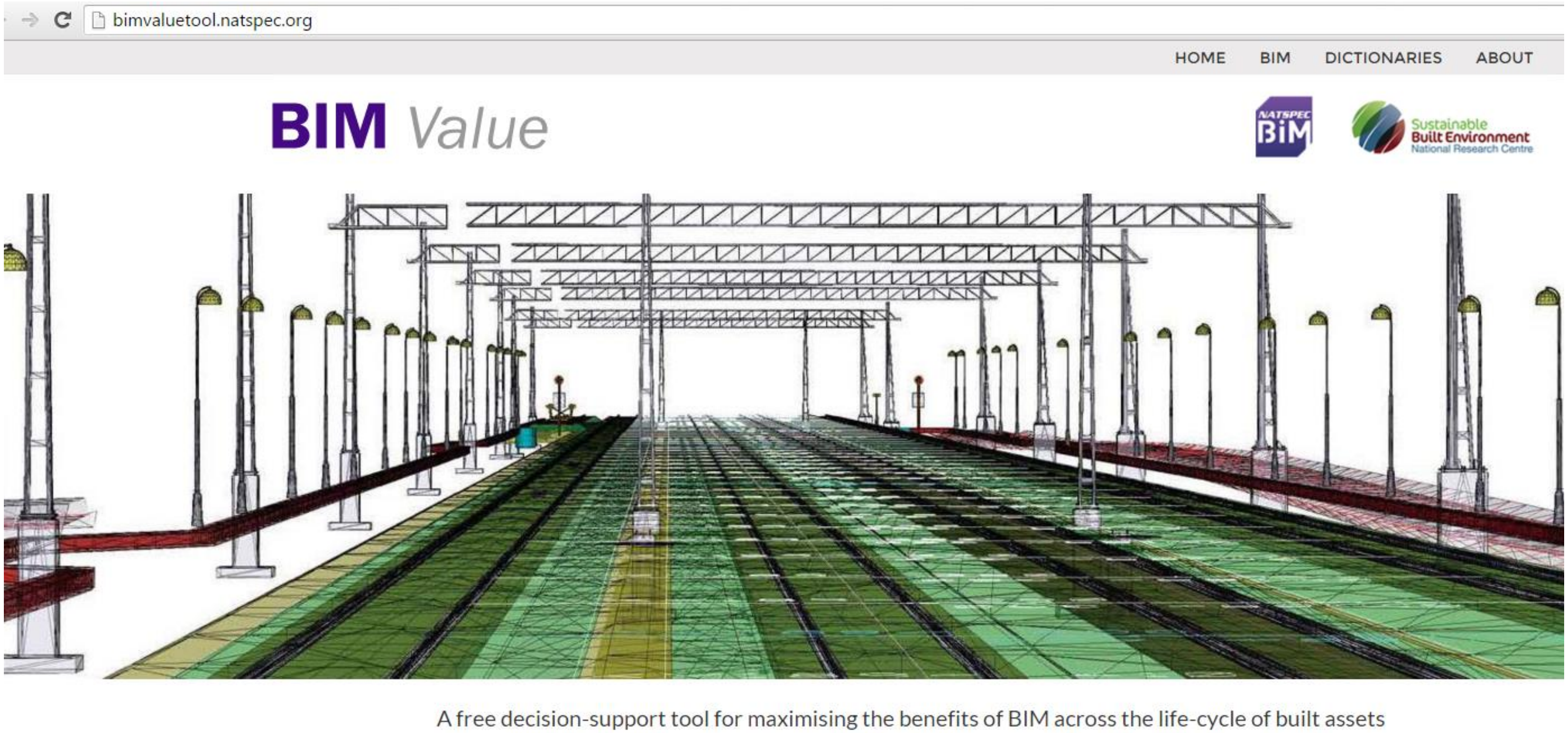
Courtesy of Simon Vaux, TfNSW, January 2015

Beyond the Socio-technical Frontier



Taken from Philp and Thompson (2014) Built Environment 2050: A Report on Our Digital Future, London: Construction Industry Council.

Benefits to MRWA



Benefits to MRWA

Life-cycle phase	Benefits	Enablers	Metrics
Planning	• Better scenario and alternatives analysis • Higher process automation • Improved efficiency • Lower cost	• Automated clash detection • Common data protocol and environments • Integrated model and program management systems • Online collaboration and project management	• Clashes • Cost predictability • Cost savings/avoidance • Labour intensity • Speed of production • Time per unit
Construction	• Better use of supply chain knowledge • Fewer errors • Improved data and information management • Improved documentation quality and processes • Improved output quality • More accurate quantity take-off • Reduced risk	• Cost estimation (quantity take-off) • Data-rich, geometrically accurate model components • Design reviews • Early engagement of stakeholders • Field and management tracking • Online collaboration and project management • Virtual walk-through and animations • Well-structured data	• Contingency cost • Cost per defects-warranty • Knowledge management metrics • Quality • Risk • Schedule conformance • Stakeholder involvement • Variations and change orders • Volume of Rework

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Benefits to MRWA

Life-cycle phase	Benefits	Enablers	Metrics
Whole-of-life	• Better scenario and alternatives • analysis • Improved output quality	• Design reviews • Integrated model and program • management systems • Phase planning (4D modelling)	• Accuracy and number of errors/ • omissions • Cost predictability • Model (or drawing) coordination • consistency • Quality • Resource use and management • Satisfaction • Volume of Rework

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Reported Averaged Benefits

- **10-40% fewer unbudgeted changes**
- **60% fewer requests for information**
- In buildings – up to **30% cost reduction in electrical materials**
- **Handover packages created and uploaded** to commercial asset management systems **in minutes**
- **Cost estimates within 3%** of final value and **produced 44—80% faster**
- **44% of infrastructure owners** in a global survey found the **value of BIM** to be in being able to **visually convey complex engineering projects**; specially for **review and approval processes with non-technical groups**.
- Up to **75-80% savings in operational energy cost** of transport infrastructure pilots

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Interesting Facts

- Omission errors account for up to 38% of total rework experience in the average construction project with traditional methods; design changes account for 41%
- GPS machine control reduce lost time injury frequency by up to 40 per cent and change orders by approximately 70 per cent.

Quick Alternatives – No Rework

Regional Road 22 (Norway), 2013

Context

- Road expansion to 4 lanes
- Objective: relieve congestion and improve emergency operations
- BIM for alternative analysis to investigate new routes and alternative locations for river crossing

Outcome

- 17 road alternatives and 8 bridge designs, including terrain, buildings and existing transport network
- All conceptual design alternatives evaluated within single model
- Drag and drop road types and alignments, tunnels, etc.
- Models linked to original data sources

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Fewer Errors

Road and Bridge Case, Finland, 2013

Context

- Road and bridge project with pipelines
- Automated clash detection
- Significant challenges – lack of skills and low quality of data

Outcome

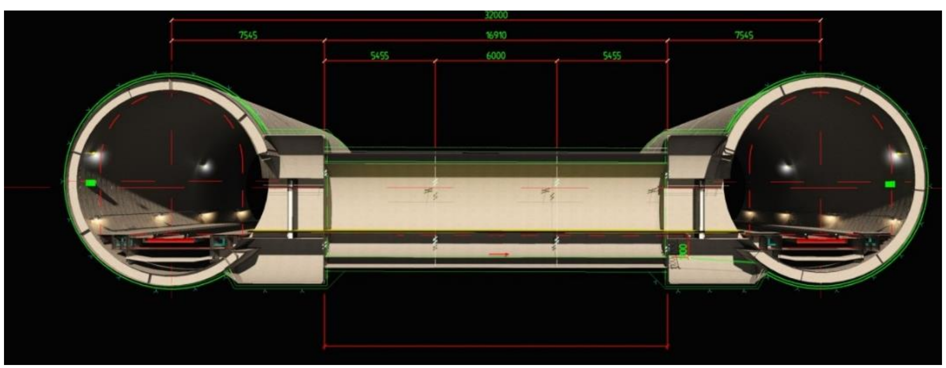
- 2 major clashes were found that would have not been found until construction
- The pipeline company was contacted before construction started
- Avoided cost was estimated to have completely covered the implementation of BIM
- Time delays and rework were avoided

Improved Outcomes

Hallandsås Tunnel, Sweden, 2013

Context

- AUD1.8 billion
- 8.7 km parallel railway tunnel
- Significant challenges: excavation works through hard rock and soft rock and clay; high water pressure; significant restrictions regarding leakage to ground water



Outcome

- 40,000 segments manufactured
- BIM-based machine control (3D control)
- Improved coordination across trades due to single source of truth
- Better design and quality of documentation required for operations
- Optimise production

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Higher Process Automation

South West Rail Link (NSW), 2012

A visualization of the Glenfield Transport Interchange Station elevation.

Context

- Upgrade of bus/rail interchange + 11.4 km of rail
- AUD2.1 billion
- Integrated 3D modelling

Outcome

- 1,500 man-hours saved by creating drawings automatically from model rather than doing them in CAD
- Phase 1 of construction completed 4 weeks ahead of schedule – less time of closed roads

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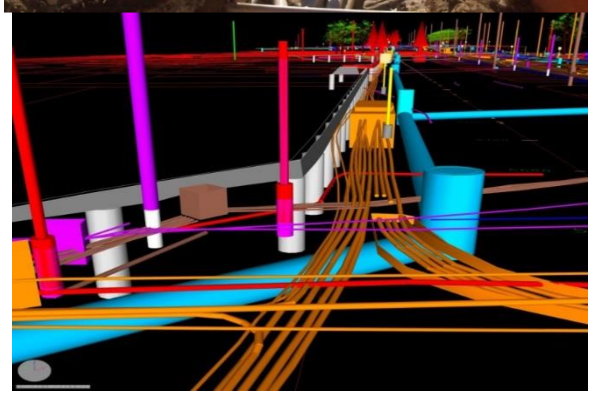
Lower Cost

Upgrade of Great Eastern Highway (WA) 2013



Context

- Widening from 4 lanes to 6

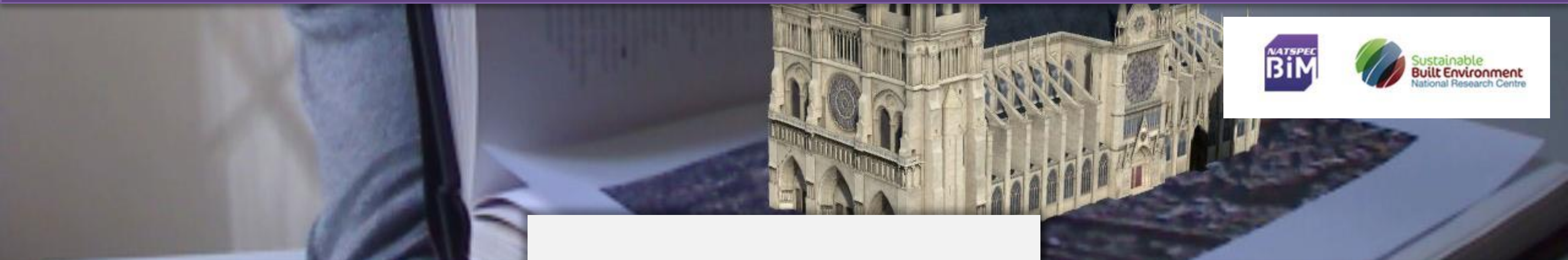
- BIM was used for: constructability analysis, traffic impact simulations, 3D Coordination, engineering analysis, clash detention, product master data, and field survey

Outcome

- Use of BIM tools contributed to AUD24 million savings (14% of the total project cost) – AUD2 million/km avoided cost of relocating pipeline
- Project cost AUD7 million less than the target budget
- Completed 3 months ahead of schedule

Benchmarking the Value of BIM

3Bs BIM Value Projects Metrics Sign Out



Project name

Project reference number

Project Description

Add Information

Project Name

Project description...

Edit details **Add met** **Access BIM Value**

Metrics Summary

Current Metrics	Measurement o
Labour Intensity	Add measureme
Carbon footprint	Add measurement

Project Summary

tion, decommissioning

e.g. low, medium, high

Project type

e.g. building or transport

Project Value

e.g. low, medium or high cost

Number of stakeholders

Tools and Processes Summary

Enabler	Date introduced
	click date to edit
Add enablers	

Measurement Options

Per man-hours units method

Lost time accounting

Multi-factor productivity

Earned Man-Hours baseline method

Popular approach to measure Labour Intensity. To calculate it, the estimated unit rates are multiplied by the amount of work completed (units) to date. The actual number of man-hours charged to a task can then be subtracted from the number of earned man-hours to provide an indicator of job productivity (Cox, et al., 2003).

Cox, R. F., Issa, R. R. & Ahrens, D., 2003. Management's Perception of Key Performance Indicators for Construction. Journal of Construction Engineering and Management, 129(2), pp. 42-151.

Date measured: 19/02/2016

Calculate value:

Estimated unit rates:	Total	Units
Amount of work completed:	Total	Units
Amount of work completed:	Total	Units

Final value:

Job productivity:	Total	Units

Hours

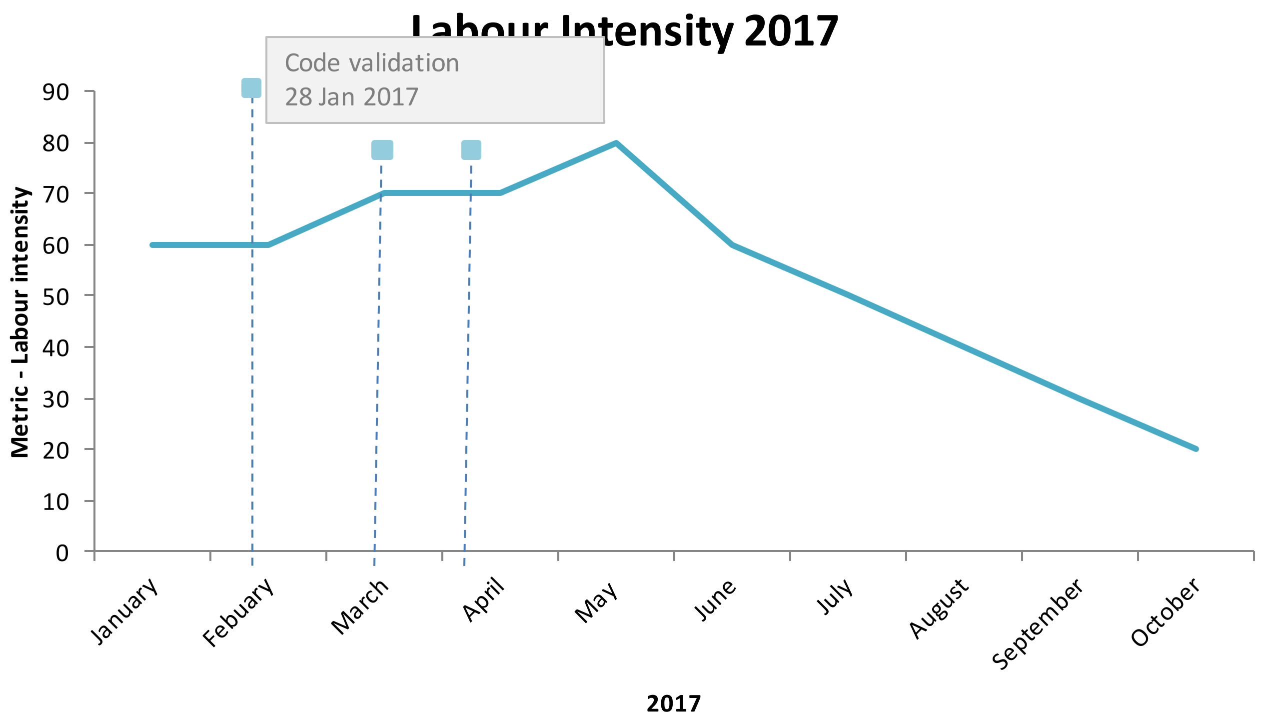
Days

Weeks

Insert measurement to project summary

Metrics Summary

Current Metrics	Measurement option
Labour Intensity	Earned Man-hours baseline method
Carbon footprint	



Enablers Summary

Enabler	Date introduced
Code validation	28 January 2017
Photogrammetry	28 January 2017
3D Laser Scanning	28 January 2017
Energy Simulation and analysis tools	15 February 2017
Sustainability evaluation	8 March 2017
Add more.....	

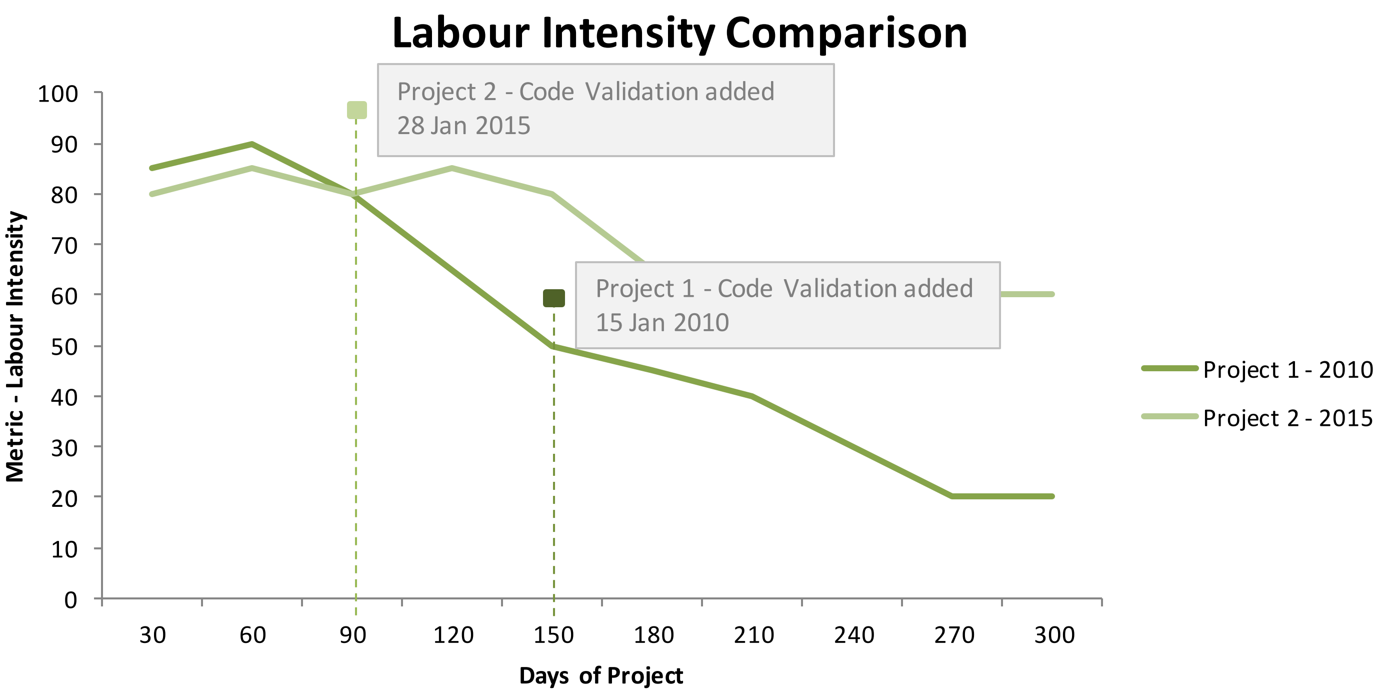
Metrics Summary

Project 1

Current Metrics	Measurement option
Labour Intensity	Earned Man-hours baseline method
Carbon footprint	

Project 2

Current Metrics	Measurement option
Labour Intensity	Earned Man-hours baseline method
Learning Curve	



Enablers Summary

Project 1

Enabler	Date introduced
Code validation	15 January 2010 (150 days from project start date)
Add more.....	

Project 2

Enabler	Date introduced
Code validation	28 January 2015 (90 days from project start date)
Photogrammetry	28 January 2015