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AIPM Conference 2008

13 October 2008



Cooperative Research Centre (CRC) for *Construction Innovation*

- Collaborative R & D
- Construction 2020
- Building Information Modelling



Working collaboratively

20 Industry, Government and Research partners

Industry



WOODS BAGOT

RLB | Rider Levett Bucknall



Government



Queensland Government

Department of **Main Roads**
Department of **Public Works**

Department of **Tourism, Regional
Development and Industry**



Department of
Housing and Works



Research



THE UNIVERSITY OF
NEWCASTLE
AUSTRALIA



CRC Construction Innovation
BUILDING OUR FUTURE

Construction 2020 Visions

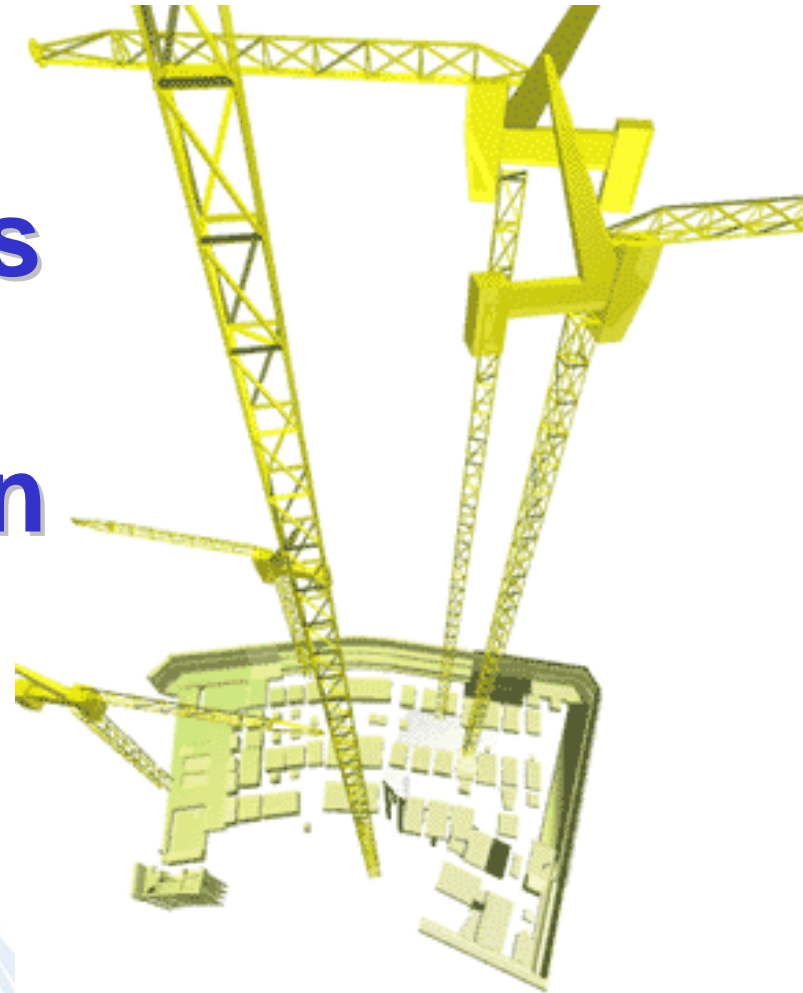
1. Environmentally sustainable construction
2. Meeting client needs
3. Improved business environment
4. Welfare and improvement of the labour force
- 5. Information and communication technologies for construction**
- 6. Virtual prototyping for design, manufacture and operation**
7. Off-site manufacture
8. Improved process of manufacture of constructed products





Design Explorations through Building Information Modelling

(Infrastructure and Buildings)



Definitions of BIM

Integrated Digital Modelling

- “A BIM is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onward.” - BuildingSMART
- “Building Information Modelling is the development and use of a computer software model to simulate the construction and operation of a facility. The resulting model, a Building Information Model, is a data-rich, object-oriented, intelligent and parametric digital representation of the facility, from which views and data appropriate to various users’ needs can be extracted and analysed to generate information that can be used to make decisions and improve the process of delivering the facility. The process of using BIM models to improve the planning, design and construction process is increasingly being referred to as Virtual Design and Construction (VDC).” - The Contractors’ Guide to BIM (AGC 2006)



Limitations in Current Design and Construction Practice

- **Little support for client requirements/performance or facility briefing**
- **Lack of integration of facility context for planning, sustainability, code checking compliance, etc**
- **What are most common design/construction errors?**
 - Design errors in construction - due to lack of/or poor coordination
- **Inadequate support for asset/facility management**
 - **Where is the facility information for operations and management?**

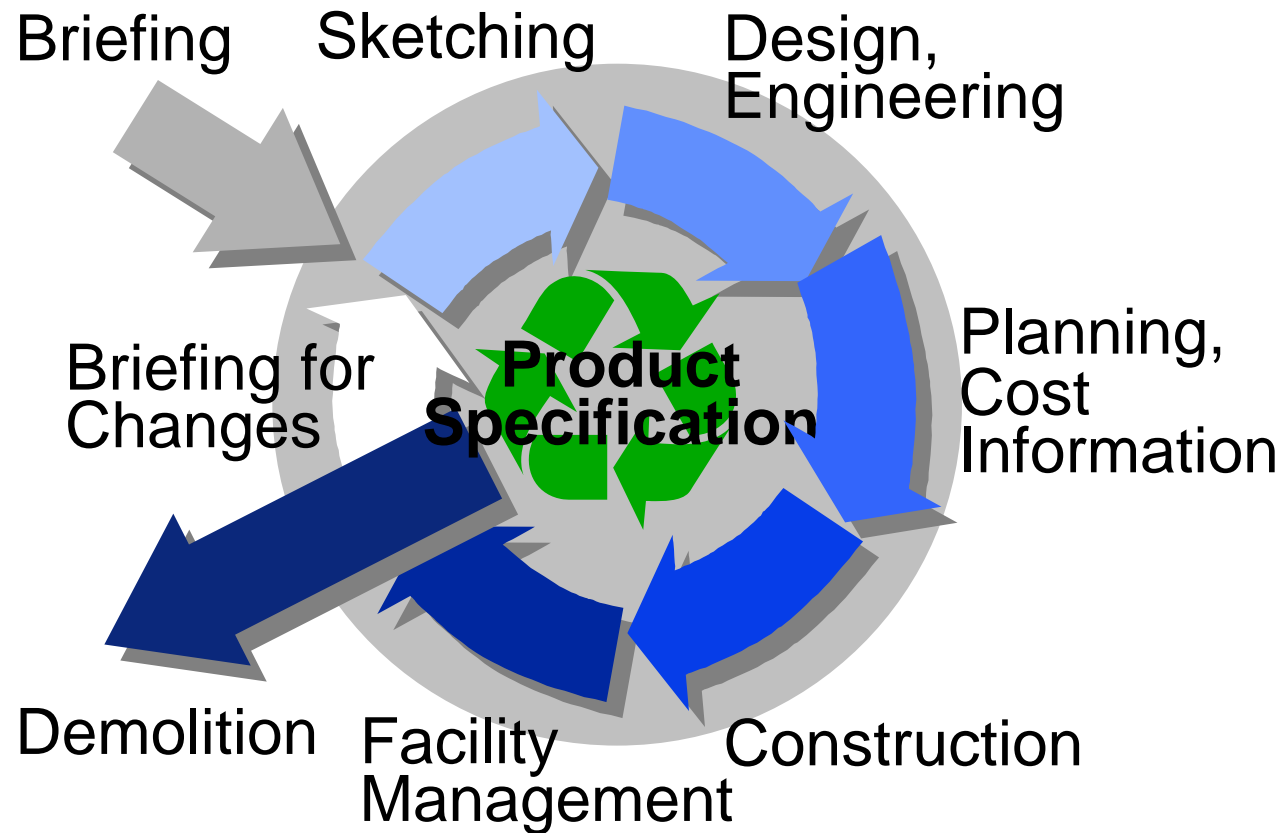


Some challenges with this model

- Within the same domain there is often significant communication errors and loss of project information
- 25-30% of the construction cost is caused by splitting up of processes and bad communication
- The same information is re-entered on average 7 times in different systems before the facility is handed over to owner organisation
- Same information is re-created several times by different software



Information Lifecycle

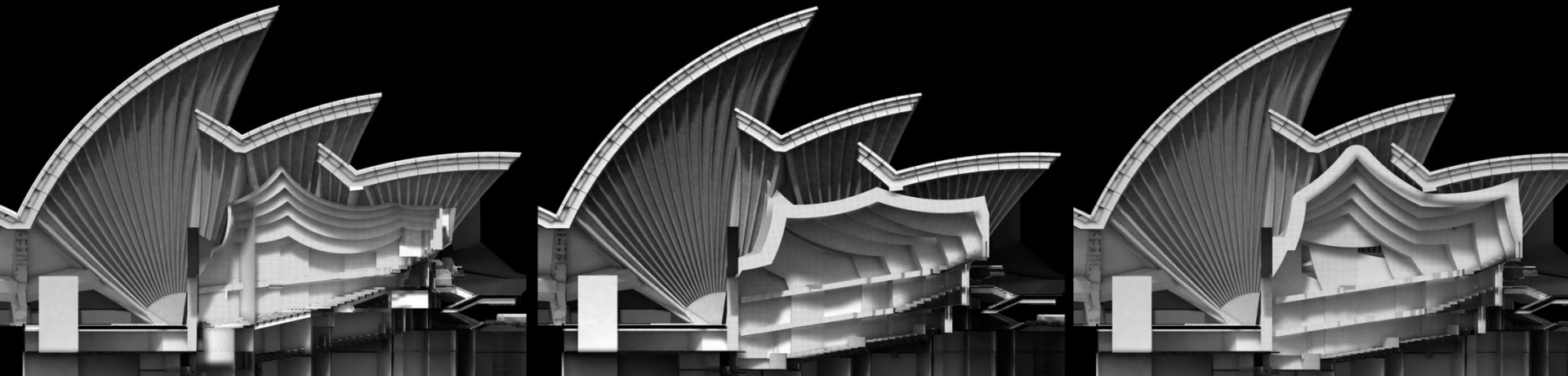
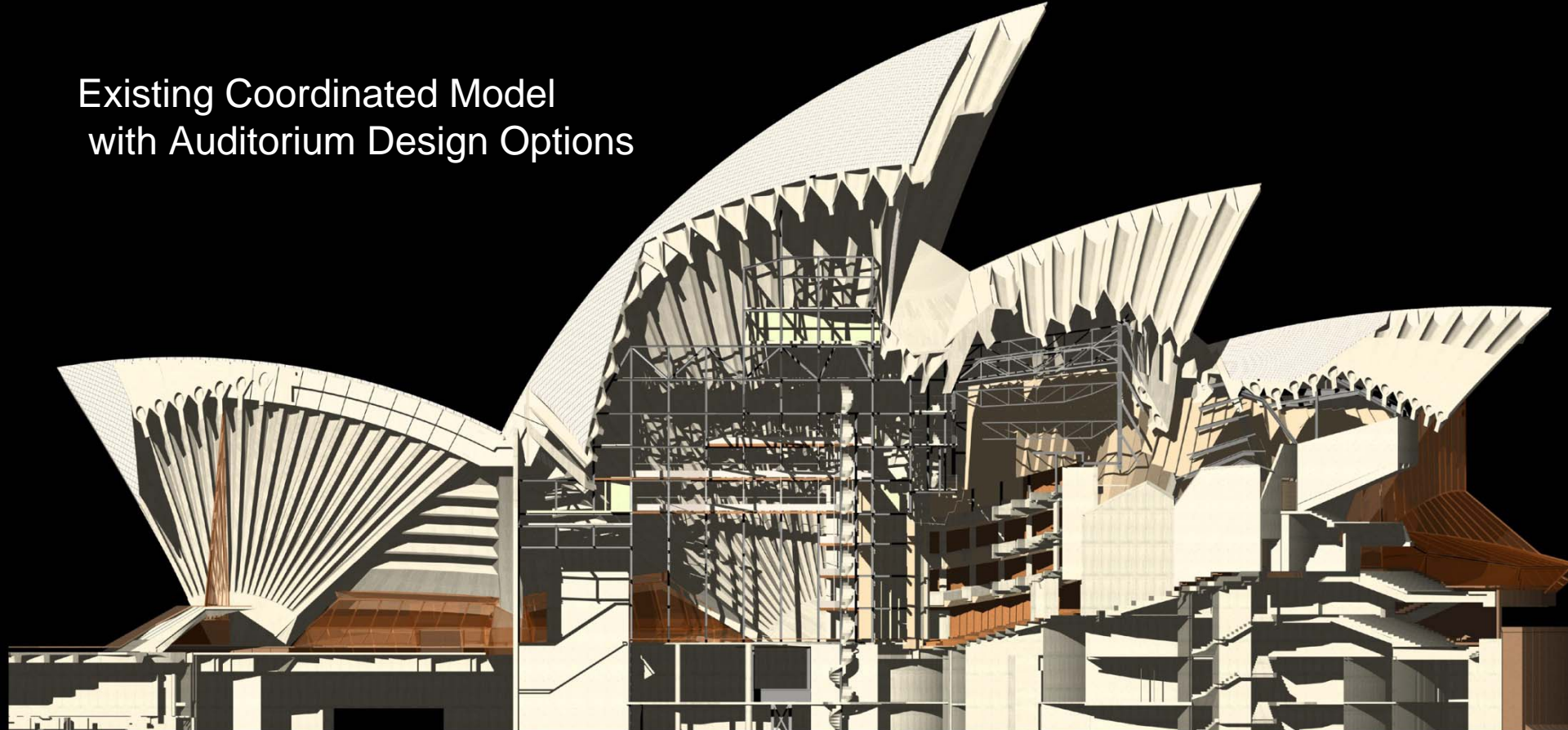


Generic Attributes of BIM - Integrated Digital Modelling

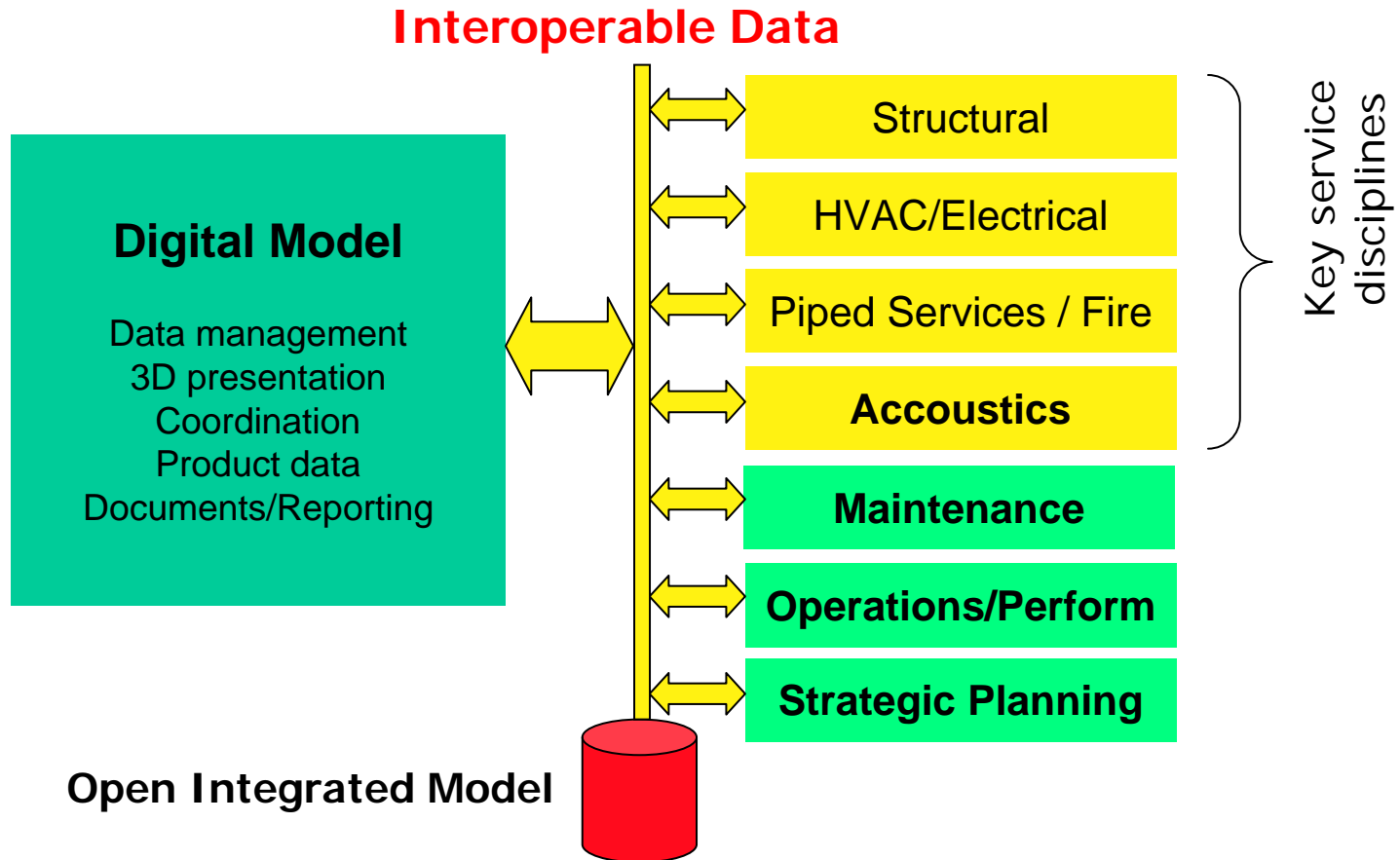
- *robust geometry* - objects are described by faithful and accurate geometry, that is measurable
- *comprehensive and extensible object properties* that expand the meaning of the object - Objects thus can be richly described e.g. a manufacturers' product code, or cost, or date of last service etc.
- *semantic richness* - the model provides for many types of relationships that can be accessed for analysis and simulation e.g. is-contained-in, is-related-to, is-part-of etc.
- *integrated information* - the model holds all information in a single repository ensuring consistency, accuracy and accessibility of data
- *life cycle support* - the model definition supports data over the complete facility life cycle from conception to demolition, extending our current over-emphasis on design and construction phase.



Existing Coordinated Model with Auditorium Design Options



Strategy for Design and Construction Information Integration



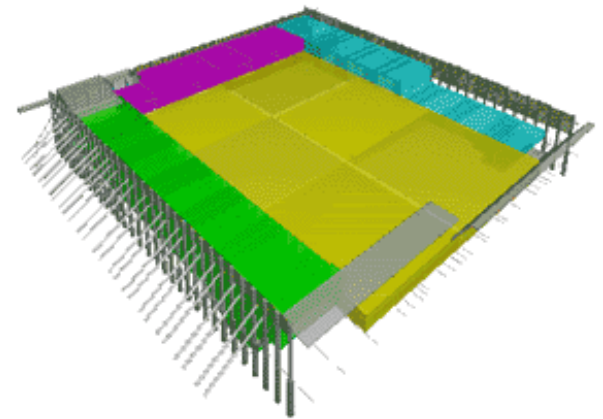
Benefits of BIM - Open Integrated Digital Modelling

- *Faster and more effective processes* – information is more easily shared, can be value-added and reused
- *Better design* – Design proposals can be rigorously analysed, simulations can be performed quickly and performance benchmarked enabling improved and innovative solutions
- *Controlled whole life costs and environmental data* - environmental performance is predictable, life-cycle costs are understood
- *Better production quality* – documentation output is flexible and maximiser automation
- *Life-cycle data* – requirements, design, construction and operational information can be utilised in facility management
- *Integration of planning and implementation processes* – government, industry and manufacturers have a common data protocol

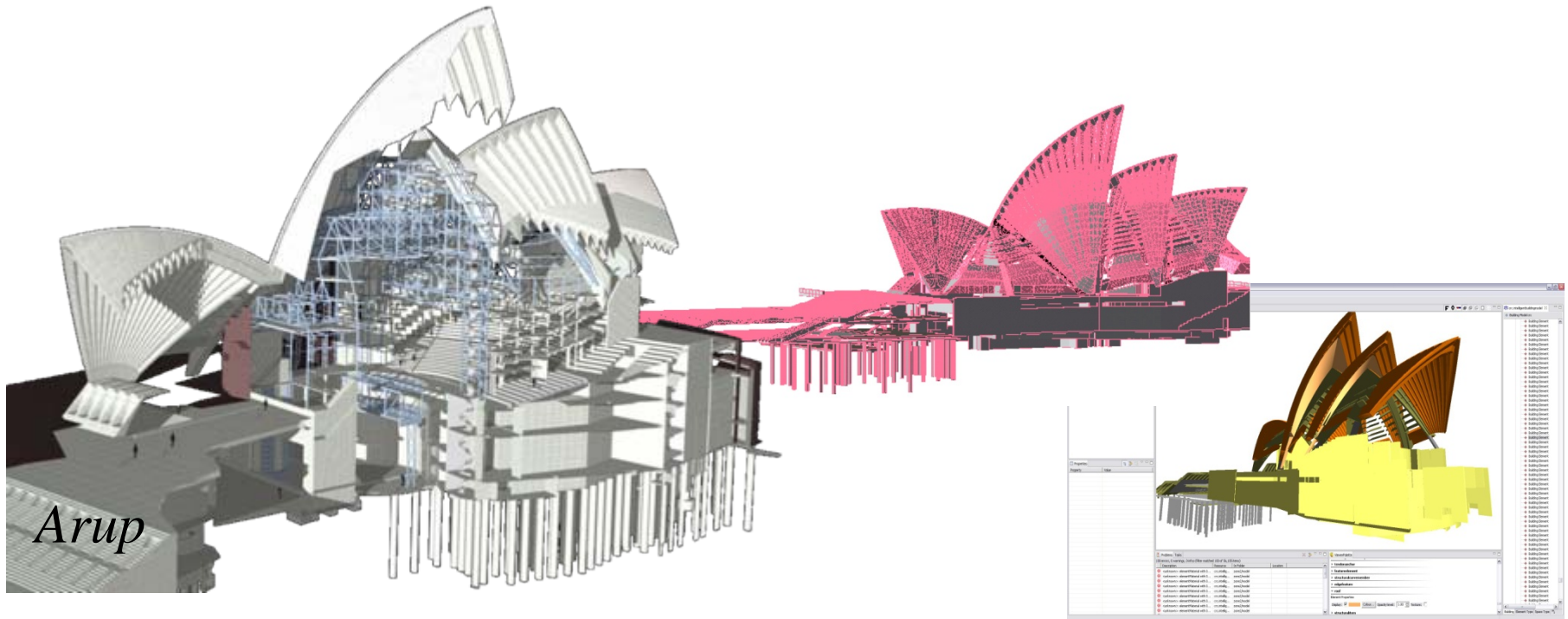


Construction Over time

- Progression of construction over time;
- Improves quality of:
 - Simulations
 - Construction Plans
 - Safety
 - Logistics
 - Costs
- Allows professionals to test the design for performance, construction sequences and identify design conflicts.



Reusing Standard Data



Bentley Structural

Structural Model

IFC

ArchiCAD

Design Model

IFC

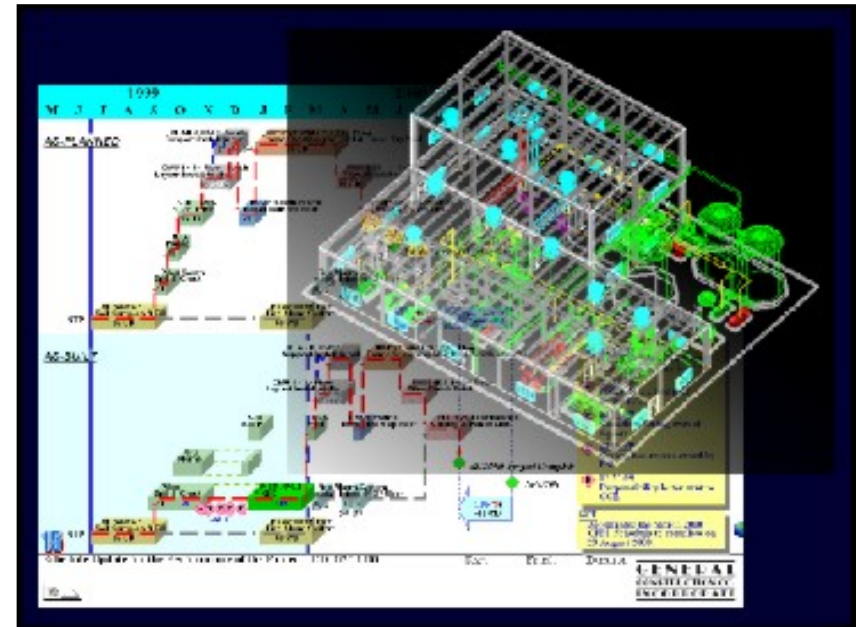
Viewer

FM Model



Business Case for Implementation

- Project teams are able to produce simulations of different design ideas and schedules quickly and easily
- Delays and changes can be minimised as design work is integrated with construction work
- Eliminates potential problems with constructability, design conflicts, assembly of building components and materials delivered to site.



ROI from VDC efforts can be quite good

	Type of Project, Organization, Project Cost	VDC Model Cost	Savings from using VDC model	ROI
1	Music Center, GC, \$250M	\$100,000 (actual)	\$500,000 (real, but estimated)	5:1
2	Office Complex, GC, \$200M	\$50,000 (actual)	\$3,000,000 (real, but estimated)	60:1
3	Retail Complex, GC, \$100M	\$40,000 (actual)	\$575,000 (real, but estimated)	14:1
4	Large campus with complex facilities, Owner, \$250M	\$400,000 (estimated)	\$16,800,000 (incurred → potential savings)	42:1

Cases 1-3: VDC was used, cost and savings were realized on the project.
 Case 4: VDC was not used, cost was not incurred, savings were not realized.

Professor Martin Fischer et al, Stanford University – CIFE



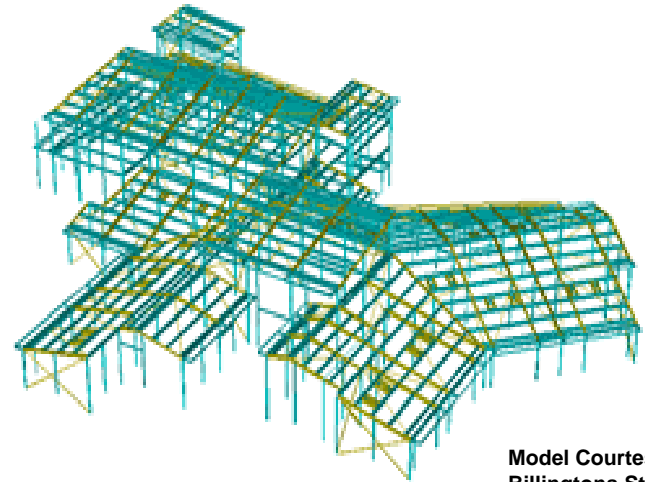
Technologies you can use confidently

- Capturing existing (as-built) conditions – Fewer unforeseen Conditions
- Visualisation – Better scope definition, stakeholder engagement, and decisions
- Design iterations – energy analysis, faster, more accurate takeoff for cost estimating, people and vehicle movements etc.
- Coordination in 3D – Fewer (no) RFIs, change orders, less rework, as-constructed digital model
- Fabrication from digital models – no shop drawings, safer, faster field assembly
- Coordinating construction with 4D models – more reliable schedules

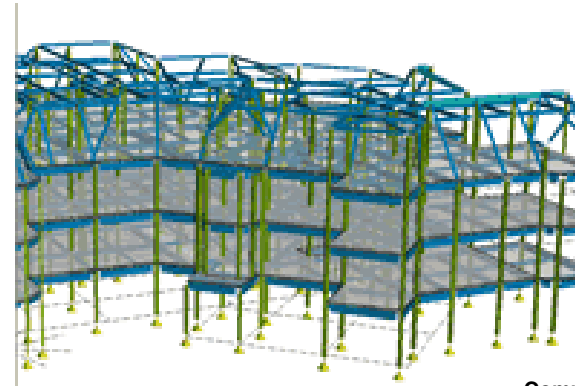


HOW TO IMPLEMENT

- A new work method/process is required in which more detailed information is supplied early on.
- Allow digital models to be developed initially instead of having to try to convert 2D data.
- 3D models must allow changes to be made without having to completely reconstruct the model.



Model Courtesy of
Billingtons Structures



Complete Building Design

Think Big, Start Small, Act Now!

Current Research and Implementation Projects

- Development of the international standard for roads, landscaping, site works and underground services.
- National Guidelines and Case Studies.
- Collaboration Platforms
- Future Implementation Program for Open Integrated Digital Modelling

Update Seminars

Melbourne, Brisbane, Sydney and Perth

www.construction-innovation.info

