The Past, Present and Future of BIM in the UK

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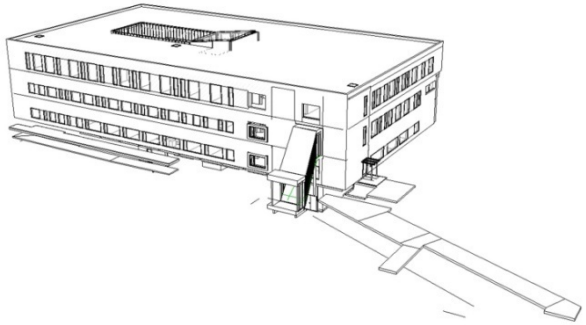
WHAT IS BIM?

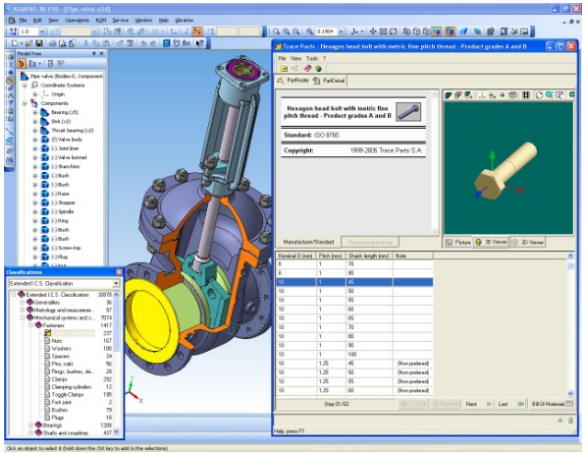
"Building Information Modelling (BIM) is a collaborative way of working, underpinned by the digital technologies which unlock more efficient methods of designing, creating and maintaining our assets. BIM embeds key product and asset data and a 3 dimensional computer model that can be used for effective management of information throughout a project lifecycle – from earliest concept through to operation"

UK Government, HM Industrial Strategy Report, 2012

HOW IS BIM DIFFERENT TO CAD?

CAD evolved and became more sophisticated:

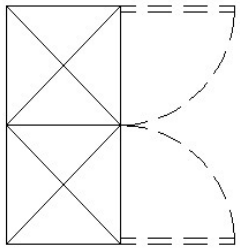


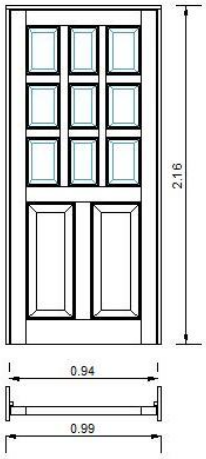


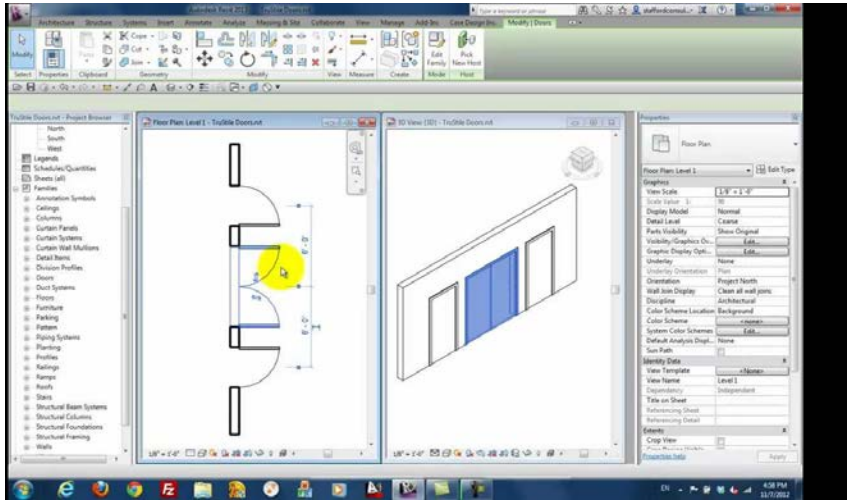
- Easier to use: productivity increased: elements only drawn once
- Possible to create 3-D visualisations
- **Aerospace and automotive industries began to draw and model in 3-D**
- Virtual “components” were associated with a database
- Instead of drawing lines “models” could be created using virtual components

HOW IS BIM DIFFERENT TO CAD?

"Intelligent" components:



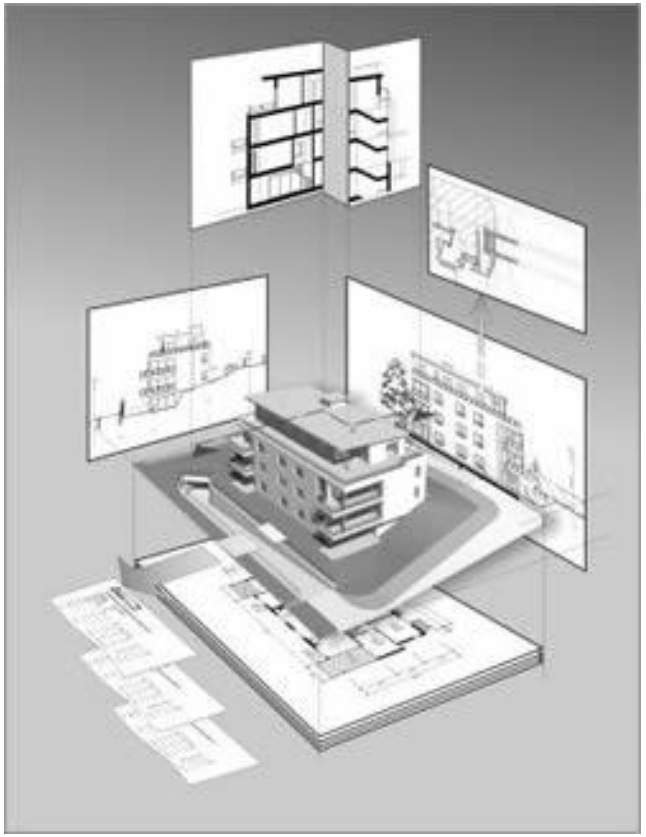




- A 2D door is just an assembly of lines
- Lines are "linked" together in the CAD software
- A door produced in BIM is a ready made 3D entity
- Manufacturers can provide standard 3D BIM components to designers
- Components can have specification information attached
- 3D modelling can help with co-ordination: CAD on steroids

HOW IS BIM DIFFERENT TO CAD?

Why BIM?



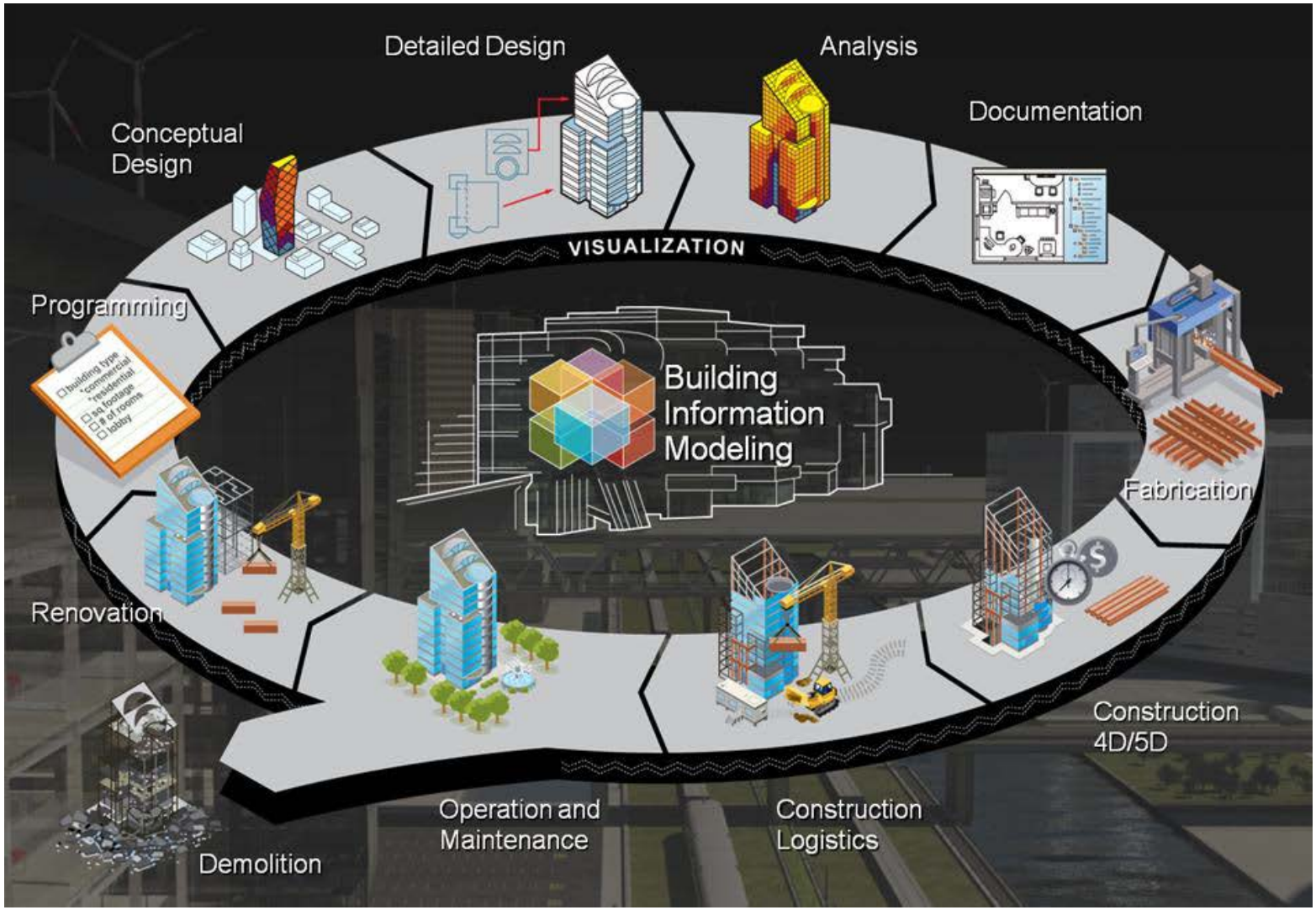
- Government Working Group set up in 2011
- Aims amongst other things:

"To identify how measureable benefits could be brought to the construction and post-occupancy management of assets (buildings and infrastructure) through the increased use of BIM methodologies"

BIM Strategy Report, Government Construction Client Group March 2011

- Drawings can now be used for construction, manufacturing building components and for facilities management
- **Drawn information is no longer a means to an end but an end in itself**

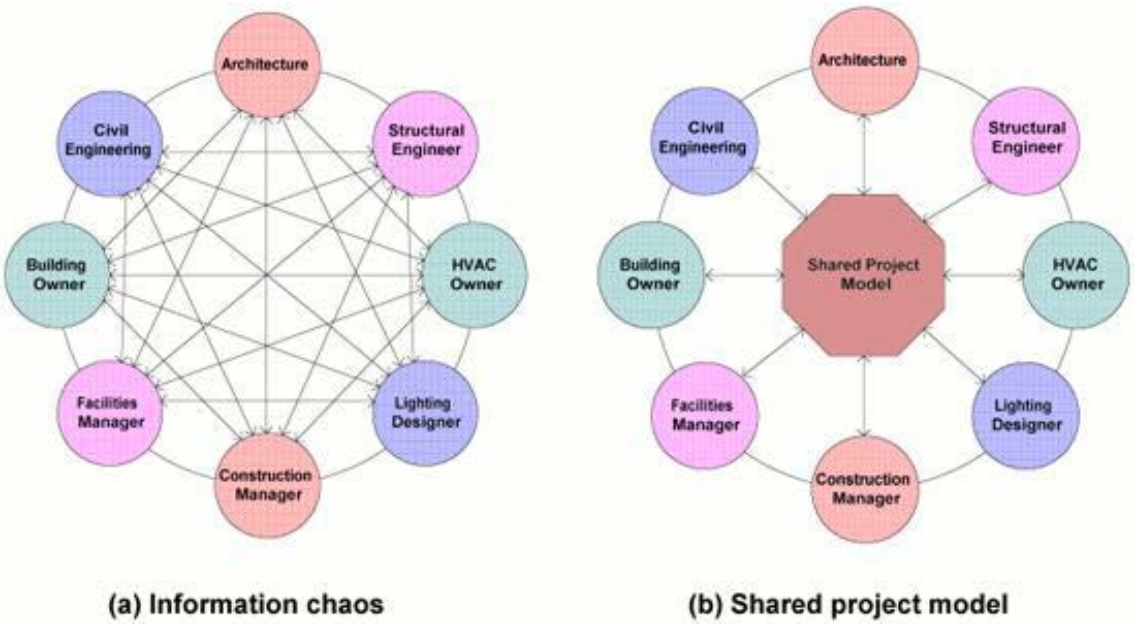
BIM IN CONTEXT



BIM AND NETWORKS

Why BIM?

"Government as a client can derive significant improvements in cost, value and carbon performance through the use of open sharable asset information"



- The now established use of networks allows information be shared
- Also allows information to be centralised
- In theory allows a diverse team to contribute to just a single model
- The software "knows" where every component is located
- The software can perform "clash detection" checks to aid co-ordination

WHY USE BIM?

The advantages of BIM

- Energy optimisation
- 4D/5D simulations: using the BIM model to assist with costings, project logistics, resourcing and programming
- Construction can be rehearsed
- Structural and wind tunnel analysis
- Facade engineering and simulation
- Fabrication direct from the model
- Is this the end of the notion that every construction project is a prototype?

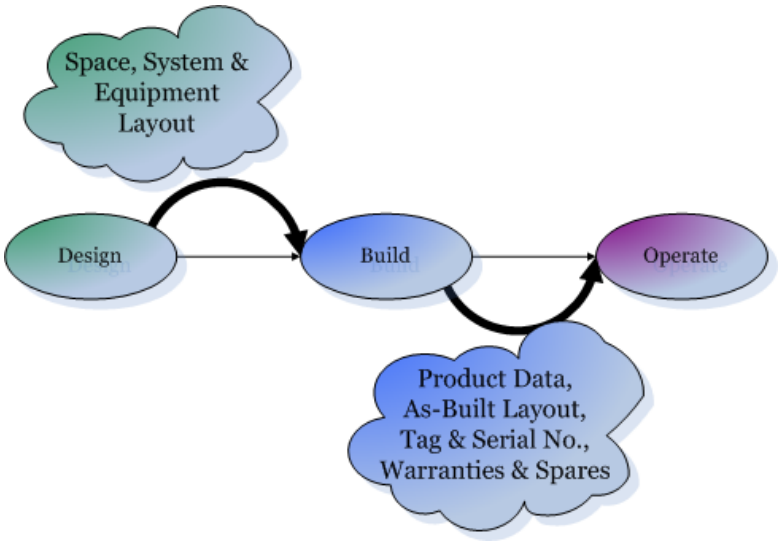
BIM: DEFINITIONS

It is…

- Also referred to as Virtual/Digital Prototyping
  - Optimisation over several model generations
- A design team knowledge transfer
  - Geometric and non-geometric data
- A system validation and optimisation
  - Virtual prototypes / simulation
- A way of capturing the interface of highly complex geometry and systems
- A way of reducing risk
  - Reduces waste
  - Optimises supply chain

BIM IN CONTEXT

What Are the Outputs?



DESIGN

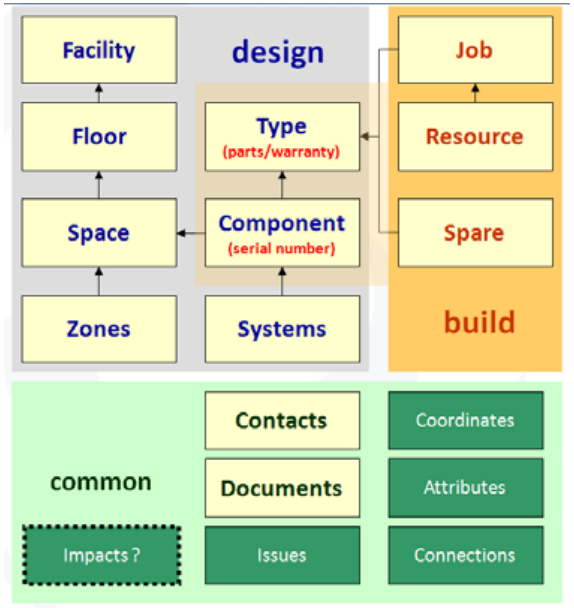
- 3-D Visualisations
- 3-D production models (but to what level of detail?)
- 3-D clash detection

BUILD

- 2-D detailed drawings extracted from the 3-D drawings (production information)
- Non-graphic data for managing the component/asset
- COBie (Construction Operations Building Information Exchange)

OPERATE

- All product/component/asset information in a series of linked spreadsheets

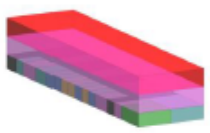
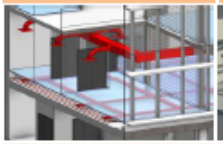


HOW DOES BIM WORK WITH RIBA WORK STAGES?

RIBA Plan of Work 2013

The Plan of Work organises the progress of designing, constructing, maintaining and operating building projects into a number of key Work Stages. The sequence or content of Work Stages may vary or they may overlap to suit the procurement method, the project programme and the clients risk profile.

RIBA Work Stages

	1	2	3	4	5	6	7
	Preparation	**Concept Design**	**Developed Design**	**Technical Design**	**Specialist Design**	**Construction**	**Use & Aftercare**
Description of Key Tasks	- Identify **Project Objectives**, the client's **Business Case**, **Sustainability Aspirations** and other parameters or constraints and develop the **Initial Project Brief**. - Examine **Site Information** and make recommendations for further information, including surveys, required. - Preparation of **Feasibility Studies** and assessment of options to enable the client to decide how to proceed. - Determine client's **Risk Profile** and agree the **Project Programme** and preliminary **Procurement Strategy**. - Assemble **Project Team**, agree **Scope of Service**, **Contract Relationship** and **Design Responsibilities** for each participant. Develop **BIM** and **Soft Landings Strategies**, **Information Exchanges** and conclude **Appointment Documents**.	- Preparation of **Concept Design** including outline proposals for structural design, services systems, site landscape, outline specifications and preliminary cost plan along with environmental, energy, ecology, access or other **Project Strategies**. - Agree development to **Initial Project Brief** and issue **Final Project Brief**. - Review **Procurement Strategy**, finalise **Design Responsibility** including extent of **Performance Specified Design** and take action where required. - Prepare **Project Manual** including agreement of **Software Strategy**, **BIM Execution Plan** and extent of **Performance Specified Work**. - Prepare **Construction Strategy** including review of off-site fabrication, site logistics and H&S aspects.	- Preparation of **Developed Design** including co-ordinated and updated proposals for structural design, services systems, site landscape, outline specifications, cost plan and **Project Strategies**. - Prepare and Submit **Planning Application** - Implement **Change Control Procedures**, undertake **Sustainability Assessment** and take actions determined by **Procurement Strategy**. - Review **Construction Strategy** including H&S aspects.	- Preparation of **Technical Design** information to include all architectural, structural and mechanical services information and specifications including the **Lead Designer's** review and sign-off of all information. - **Performance Specified Work** to be developed in sufficient detail to allow development and integration by **Specialist Subcontractors** during **Completed Design** stage. - Take actions determined by **Procurement Strategy** including issuing in packages where appropriate. - Prepare and submit **Building Regulations Submission** - Review **Construction Strategy** including sequencing, programme and H&S aspects.	- Progression of **Specialist Design** by **Specialist Subcontractors** including the integration, review and sign-off of **Performance Specified Work** by the **Lead Designer** and other designers as set out in **Design Responsibility** document - Review **Construction Strategy** including sequencing and critical path. - Undertake actions from **Procurement Strategy** or administration of **Building Contract** as required.	- Offsite manufacturing and onsite construction in accordance with the **Construction Programme** - Regular review of progress against programme and any **Quality Objectives** including site inspections. - Administration of **Building Contract**. - Resolution of **Design Queries** from site as they arise - Implementation of **Soft Landing Strategy** including agreement of information required for commissioning, training, handover, asset management, future monitoring and maintenance and ongoing compilation of "as-constructed" information.	- Implementation of **Soft Landings Strategy** including **Post Occupancy Evaluation**. - Conclude administration of **Building Contract** - Review of **Project Performance** in use and analysis of **Project Information** for use on future projects. - Updating of **Project Information**, as required, in response to **Asset Management** and **Facilities Management** feedback and modifications.
Procurement	The stage 1, 2, 3 and 4 outputs may be used for tendering and contract purposes depending on the **Procurement Strategy** as influenced by the clients **Risk Profile**, time, cost and quality aspirations and how **Early Contractor Involvement** and **Specialist Subcontractor** input is to be undertaken.						
Programme				Stage 4, 5 and 6 activities may occur concurrently depending on the **Procurement Strategy**. Work may also be undertaken in packages to facilitate its development by **Specialist Subcontractors**. Early package procurement may also occur during stage 5 depending on the procurement route. The **Project Programme** should set out the timescales for these overlapping design and, where appropriate, construction stages.			
Planning		**Planning Applications** typically be made using the stage 3 (**Developed Design**) output, however, certain clients may wish this task to be undertaken earlier. The project or practice specific **Plan of Work** identifies when the **Planning Application** is to be made. Certain aspects of the Technical Design may also be required as part of the application or in respond to planning conditions.					
Key Information Exchanges (at stage Completion)	The **Initial Project Brief**	The **Concept Design** including **Outline Structural and Mechanical Services Design**, associated **Design Strategies**, **Preliminary Cost Information** and **Final Project Brief**.	The **Developed Design** including the **Co-ordinated Architectural, Structural and Mechanical Services Design** and **Developed Cost Information**.	The **Technical Design** of consultant aspects in sufficient detail to enable construction of **Performance Specified Work** to commence.	The **Specialist Design** including the integration of **Performance Specified Work**.	**"As Constructed" Information**.	**"As constructed" Information** updated in response to on-going client feedback, **Asset Management** updates and **Facilities Management** information.
							
Government Gateway	Information Exchange 1 ●	Information Exchange 2 ●	Information Exchange 3 ●			Information Exchange 6 ●	As Required ● ● ●

Royal Institute of British Architects

© RIBA 2012

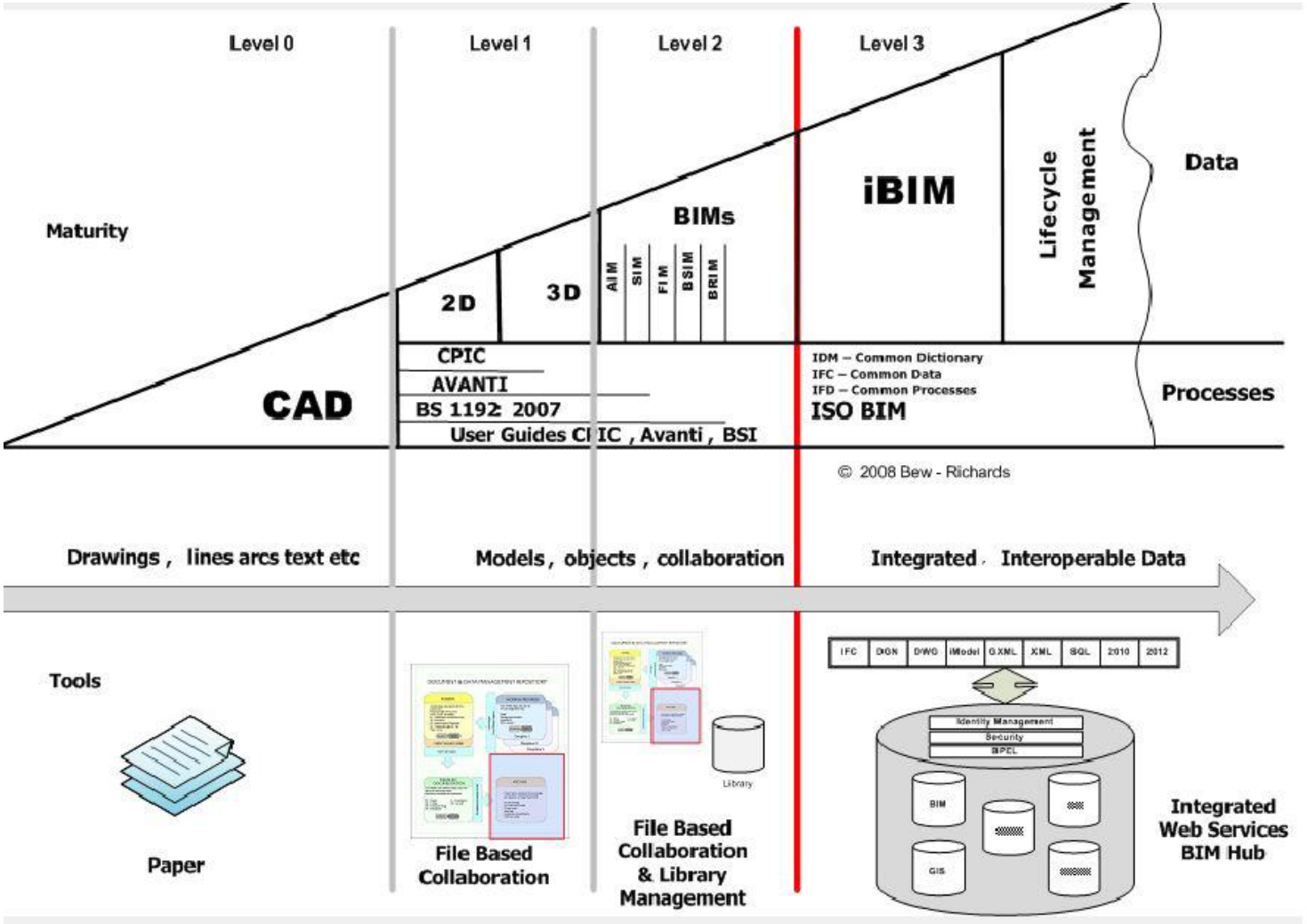
BUILDING INFORMATION AND BIM LEVELS

BIM Industry Working Group's Strategy Paper for the Government Construction Client Group (March 2011)

- Level 0
  - Unmanaged CAD possibly 2D, with paper or electronic data exchange mechanism
- Level 1
  - Managed CAD in 2D or 3D format using BS1192:2007 with a collaboration tool providing a common data environment without integration of cost management packages.
- Level 2
  - Managed 3D environment held in separate discipline "BIM" tools with attached data. Commercial data managed by an ERP and may utilize 4D (programme) and 5D (cost) elements.
- Level 3
  - Fully open process and data integration enabled by "web services" compliant with the emerging IFC (Industry Foundation Classes) standards, managed by a collaborative model server

THE BIM TIMETABLE

So Where Are We Now?



UK GOVERNMENT SUPPORT FOR BIM

The BIM Task Group – A UK Government Initiative

"This Government's four year strategy for BIM implementation will change the dynamics and behaviours of the construction supply chain, unlocking new, more efficient and collaborative ways of working. This whole sector adoption of BIM will put us at the vanguard of a new digital construction era and position the UK to become the world leaders in BIM."

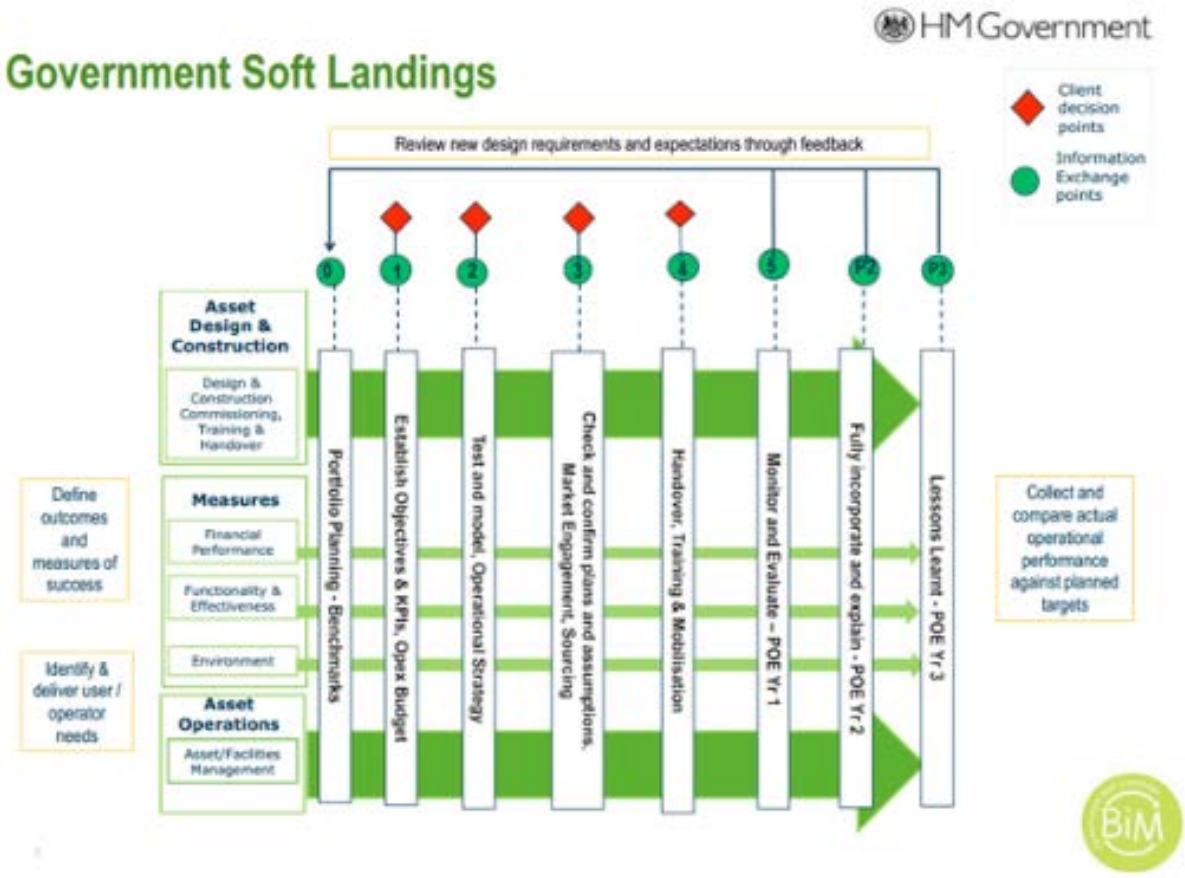
Francis Maude
Minister for the Cabinet Office

THE BIM TASK GROUP

- The Government Construction Strategy was published by the Cabinet office on 31 May 2011
- A four year programme
- The report announced the Governments intention to require: collaborative 3D BIM (with all project and asset information, documentation and data being electronic) on its projects by 2016
  - *"The UK programme based on the BIS BIM Strategy is currently the most ambitious and advanced centrally driven programme in the world"*
- A focus on public sector procurement, focus on standardisation to reduce costs, aim to introduce on all government projects by 2016
- Aim is to encourage world class innovation in construction and support software, procurement to be part of the asset lifecycle
- Encourage participation by manufacturers of construction products
- On 6 September 2012, Government announced the formation of a working group to investigate benefits of offsite manufacturing for housing

THE BIM TASK GROUP – SOFT LANDINGS (BS 8536)

- The 2011 Strategy identified the need to improve value in public sector construction projects
- Promotes a smooth transition from design and construction to operation phase.
- Linked to British Standards, European Standards and recognised best practice



THE BIM TASK GROUP – SOFT LANDINGS

Example

Early feedback from the Ministry of Justice (MoJ), an early adopter of GSL, has identified significant capital and operational savings through the use of GSL on its new build and refurbishment projects. Improvements have been identified in future design and operation of their facilities as a result of applying GSL. MoJ will now be implementing GSL into all its future projects.

Service level required by the client

- Targets – running cost, capital cost, environment and functionality
- Comparison of predicted performance against targets
- Simple operating instructions
- Early warnings of problems
- Metered data on the performance
- Ready access to all digital data about our asset
- Cost effective transfer of data from construction to operation
- Service provider having all required operational data
- Actual measured performance of our asset
- Fine tuning the actual performance
- Recorded performance
- Feedback to the design and construction team.

Required Outcomes

(Measured by Post Occupancy Evaluation)

- **Functionality and Effectiveness** (section 3):

Buildings designed to meet the needs of the Government Department Occupiers; comfortable, usable, manageable and maintainable environments conducive to occupant productivity.

- **Cost** (section 4):

Meet Government Department performance targets for capital cost and operational cost.

- **Environmental** (section 5):

Meet Government Department performance targets for energy use, carbon dioxide emissions, water usage and waste reduction.

Processes

(Measured by Key Performance Indicators)

- **Facilities Management** (section 6):

A clear, cost efficient strategy for managing the operations of the building.

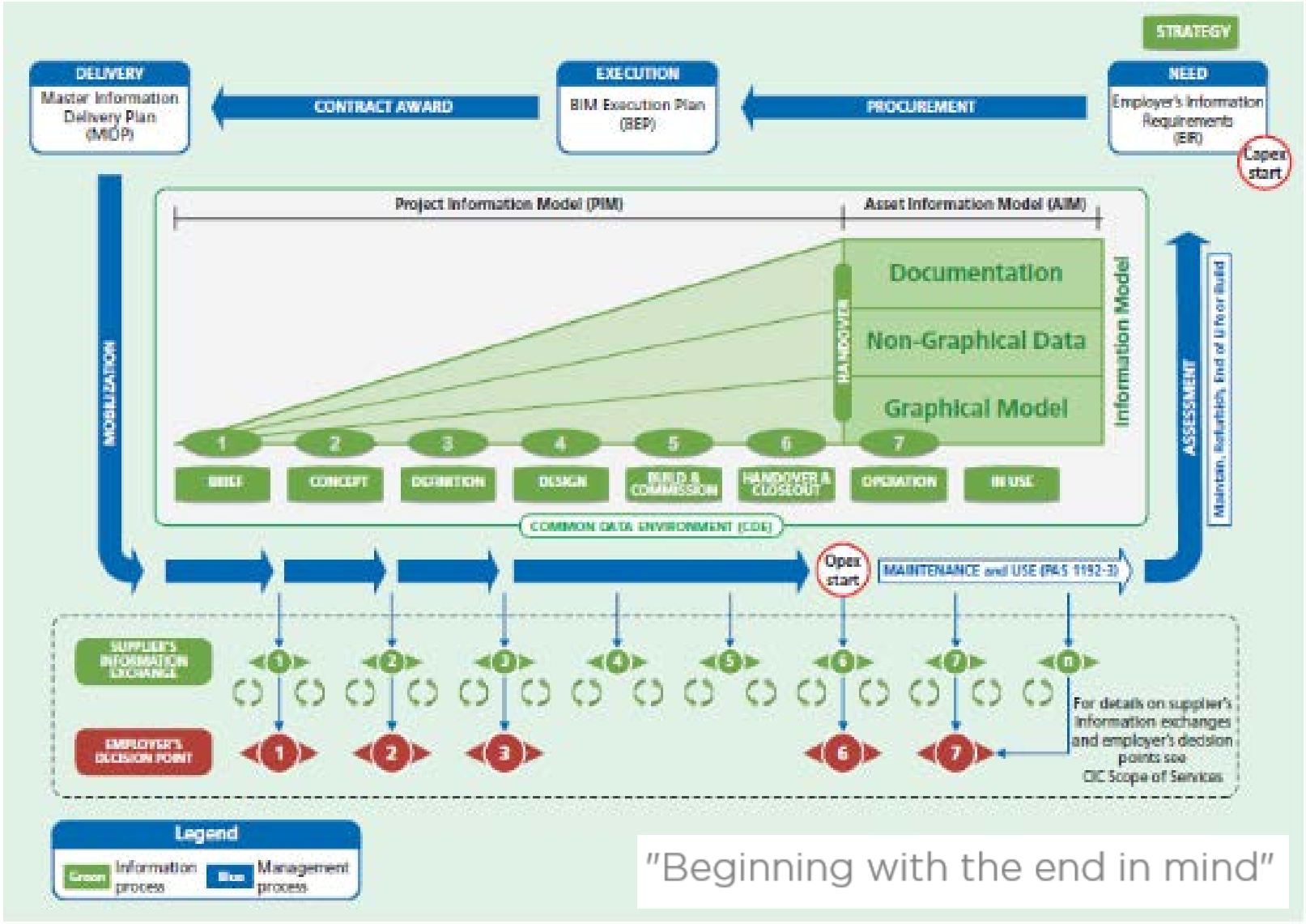
- **Commissioning, Training and Handover** (Section 7):

Projects delivered, handed over and supported to meet the needs of the End Users.

BRITISH STANDARD PAS 1192

- BS PAS 1192: 2007
  - provides details of the standards and processes that should be adopted to enable consistent, structured, efficient and accurate information exchange
  - Includes collaborative procedure, a method for managing the production and distribution of documents, naming policy, use of metadata, etc
- BS PAS 1192-2: 2013
  - For Level 2 BIM
  - Specifies requirements
  - Sets out framework for collaborative working
  - Offer guidance on information management requirements
  - focuses specifically on the 'delivery' phase of projects (from strategic identification of need through to handover of asset), where the majority of graphical data, non-graphical data and documents are accumulated from design and construction activities
  - Includes details on project execution plan, ERs Asset information model, common data environment, etc

BRITISH STANDARD PAS 1192- 2:2013



"Beginning with the end in mind"

BRITISH STANDARD PAS 1192-3

- BS PAS 1192-3: 2014
  - Provides a framework for managing digital information on built assets over their life
  - Pt 3 is more flexible than Pt 2 with a mixture of planned and unplanned events
  - Assets lifecycle includes maintenance, breakdowns, repairs, extensions, refurbishment…
  - …and demolition
- 3D drawings are linked to data on performance, maintenance regimes, costs, anticipated lifespan, health and safety, etc

> "It's about getting a better, digital grasp of your building"

- Is this the perfect O&M manual?

OTHER BRITISH STANDARDS

- BS PAS 1192-4: 2014
  - defines a methodology for the transfer between parties of structured information relating to Facilities, including buildings and infrastructure (COBie)

- BA PAS 1192-5: 2015
  - specifies the processes that will assist organisations in identifying and implementing appropriate and proportionate measures to reduce the risk of loss or disclosure of information which could impact on the safety and security of personnel, occupants, the asset itself, asset information, etc

- BA PAS 1192-6: 2017
  - Currently in draft form
  - Addresses the requirements for sharing structured H&S information throughput the project lifecycle

SO, WHAT IS THE MAIN THING WE HAVE LEARNED?

- Sophisticated software is required to work with BIM
- BUT…

- **Importantly Building Information Modelling (BIM) or digital prototyping is an approach (a school of thought) rather than specifically about software**

- It enables early design information to be developed collaboratively, early visualisation of the project, coordination during design development, the incorporation of physical and performance characteristics of building components, the use of the model post construction as an asset management tool

LEGAL ISSUES ARISING FROM BIM

Main areas:

Ownership and Management of Data

- BIM Co-ordinator Role
- Access to Data
- *Trant v Mott McDonald* (2017)

Contractual Provisions

- JCT 2016
- NEC 4 2017
- PPC 2000 2013 cd

Reliance and Responsibility.

BIM COMES TO THE TECHNOLOGY AND CONSTRUCTION COURT

Trant Engineering wins £55 million contract to upgrade power plant in Falkland Islands.

7th May 2016

Trant Engineering Ltd v Mott McDonald Ltd

[2017] EWHC 2061 (TCC)

5th July 2017

BIM COMES TO THE TECHNOLOGY AND CONSTRUCTION COURT

- **Project**: provision of new power generation facility, modification and automation of existing facility and upgrading of Medium-temperature hot water distribution system.
- **Location**: Mount Pleasant Complex, Falkland Islands.
- **Contract**: Work Contractors Conditions of Contract, FCOM, Ministry of Defence.

BIM COMES TO THE TECHNOLOGY AND CONSTRUCTION COURT

During the tender period, Trant engaged Mott McDonald to provide design consultancy services:

- Preliminary design
- Detailed design
- Design co-ordination
- Preparation and implementation of BIM and procurement support
- Principal designs responsibilities

Fee £780,000 (1.23 million CHF / EU 876,000).

BIM COMES TO THE TECHNOLOGY AND CONSTRUCTION COURT

- Dispute arose over Mott McDonald's claim for additional payment. Trant refused to pay and Mott revoked passwords to servers hosting design data.
- Trant sought injunction, ordering that Mott provide access to the design data.
- Mott denied that Trant had any entitlement to the design data.

BIM COMES TO THE TECHNOLOGY AND CONSTRUCTION COURT

Mrs Justice O'Farrell held:

- the documents presented were inconclusive on contractual responsibility, which could only be decided at a full trial. Trant would pay £475,000 to the court to hold pending resolution.
- that Mott's argument that money compensation would sufficient because they had already sent the design data to Trant in pdf form should not be accepted.
- that Trant's argument that work could not progress without access to the design database on the project platform should succeed and Mott would be ordered to allow it.

BIM COMES TO THE TECHNOLOGY AND CONSTRUCTION COURT

Analysis I

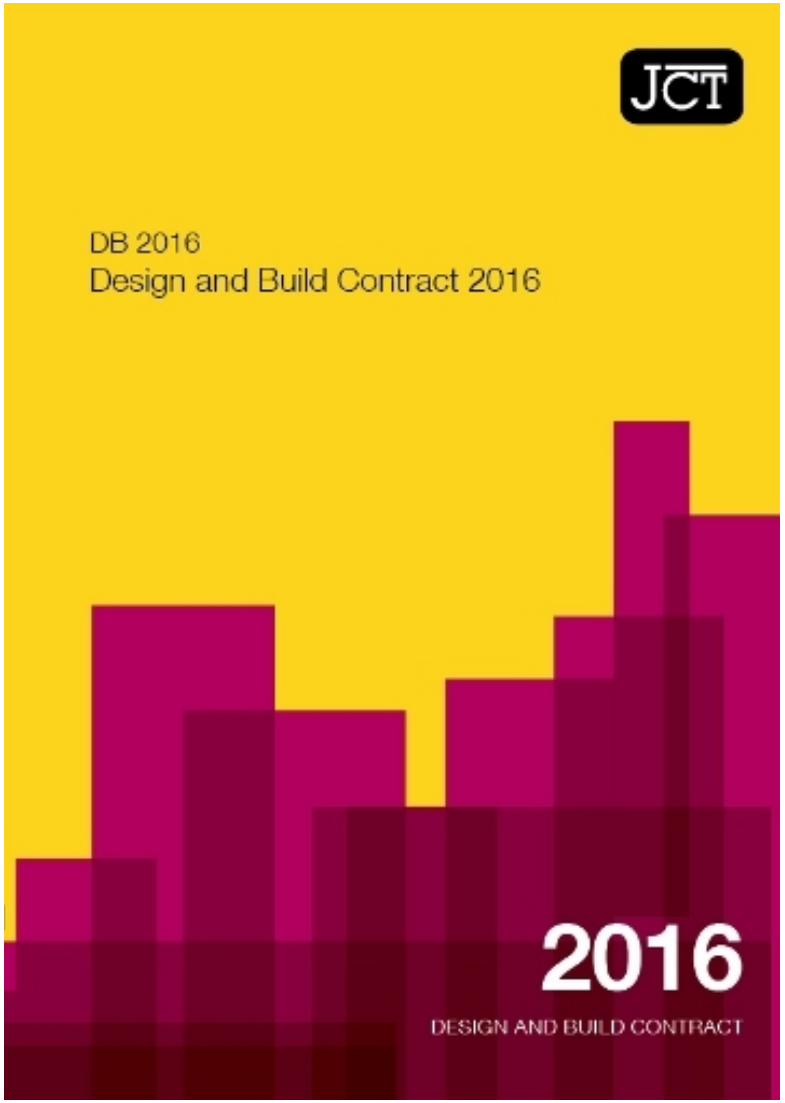
- The co-ordinator of the common data environment within a BIM enabled project can be the gatekeeper to the data room for the entire project.
- If a BIM co-ordinator denies access to a common data environment, which could be permissible under a contract (for example, for non-payment of fees), it could prevent the employer having access to all design data.

BIM COMES TO THE TECHNOLOGY AND CONSTRUCTION COURT

Analysis II

- If a BIM co-ordinator is not the employer, but a third party, denial of access to the design data could bring whole project to a halt. It is therefore better if the BIM co-ordinator is part of the client organisation, the problem is lack of expertise.
- If the employer lacks the necessary expertise, it is possible to have co-ordination done by a consultant, but with regular down-loading of data to reduce the effect of loss of access. Alternatively, the co-ordination role can be split.
- The arrangements need to be set out in the construction contract and in the Consultancy agreement.

CONTRACTUAL PROVISIONS : JCT 2016



CONTRACTUAL PROVISIONS : JCT 2016

JCT Public Sector Supplement 2011

The 2016 contracts incorporate BIM aspects of the Public Sector Supplement.

SBC and D+B Defined term

1.1 BIM Protocol ‘the document identified as such in the Contract Particulars’

1.4.6 ‘reference to documents shall, where there is a BIM Protocol or other protocol relating to the supply of documents or information, be deemed to include information in a form or medium conforming to that protocol.

CONTRACTUAL PROVISIONS : NEC 4

X.10.1

Option X.10 Information Modelling

- "The Information Model is the electronic integration of Project Information and similar information provided by the Client and other information Providers and is in the form stated in the Information Model"

X.10.2

Collaboration

- Contractor collaborates with other Information Providers

X.10.3

Early Warning

- Contractor and Project Manager have duty of notification of any matter adversely affecting Information Model.

X.10.4

Information Execution Plan

- Contractor submits Plan to Project Manager, if none is provided in the Contract Data.

CONTRACTUAL PROVISIONS : NEC 4

X.10.5

Compensation Events

- Changes to the Information Execution Plan can entitle the Contractor to compensation.

X.10.6

Use of the Information Model

- The Client owns the Information Model.
- The Contractor's rights to project information are owned by the Client. The Contractor must obtain such rights from sub-contractors.

X.10.7

Liability

- A fault or error in the Information Model or in information provided by Information Providers, excluding the Contractor, is the responsibility of the Client.

CONTRACTUAL PROVISIONS : PPC 2000 (2013 EDITION)

Appendix 10 Building Information Modelling

BIM Protocol identified and defined

1. **BIM Co-ordinator**: Party named to ensure implementation of BIM Protocol and co-ordinate use of BIM and input of data into BIM.
2. **BIM Protocol**: Protocol for use and development of BIM and input of data into BIM.
3. **BIM**: Three-dimensional electronic building information model.
4. Implementation of the Project is to be in accordance with the BIM Protocol.
5. Design Development Process to be in accordance with the BIM Protocol and fully involving the BIM Co-ordinator.
6. Designs approved by the Client become Partnering Documents, including contents of BIM.

CONTRACTUAL PROVISIONS : PPC 2000 (2013 EDITION)

7. All Partnering Team members to comply with BIM Protocol and to input information in accordance with the Protocol as required by the BIM Co-ordinator.
8. Ownership of contents of BIM is with client, subject to any contrary Intellectual Property rights.
9. The word '**design**' for Intellectual Property purposes, includes the contents of the BIM.
10. Commencement of implementation of design is dependent on BIM having been sufficiently developed in accordance with the BIM Protocol.

BIM AND CONTRACTS

- One of the big advantages of BIM is that it enables the team to:

‘To build the building before you build it’

- If D&B is probably the most popular method of procurement…
  …where the project is only partially developed pre-contract…
  are (at least some of) the benefits of BIM lost?
- REMEMBER…
- Despite the hype not all production information can be output using BIM
- At Level 2, much production information is still produced using 2D
- Even at Level 3, high power computers not yet available will be required to fully model an asset and in reality time may not permit EVERYTHING to be modelled
- For JCT Contracts, the CIC BIM Protocol should be incorporated

CONSTRUCTION INDUSTRY COUNCIL (CIC) BIM PROTOCOL

- For JCT contracts, the CIC BIM Protocol should be incorporated.
- The primary objective of the Protocol is to enable the production of Building Information Models at defined stages of a project
- A further objective of the Protocol is that its use will support the adoption of effective collaborative working practices in Project Teams
- The encouragement of the adoption of common standards or working methods under PAS 1192-2
- The Protocol is intended to be expressly incorporated into all direct contracts between the Employer and the Project Team Members
- On :a Design and Build project:
  - will initially be appended to the contracts of the design team entered into prior to appointment of the Contractor
  - when the Contractor is appointed, the Building Contract should make him responsible for providing the models and should include the Protocol

CIC BIM PROTOCOL

- The Protocol deals with:
  - concept of 'Permitted Purpose' to define the licenced uses of Models (IP)
  - remove the need for separate Electronic Data Exchange Agreements between the Project Team Members by addressing the principal risks associated with the provision of electronic data, in particular the risk of corruption following transmission
  - definition of the Models covered by the Protocol
  - Change Management
  - liability for the use of models
  - The Protocol requires the Employer to appoint a party to undertake the Information Management Role
  - the implementation of Information Requirements (project specific)
  - allocation of responsibility for preparation of models and identification of the level of detail set out in the Model Production and Delivery Table

CIC BIM PROTOCOL

Specimen Model Production and Delivery Table

Showing models required at different project stages

LOD definitions (from PAS 1192)

1 Brief
2 Concept
3 Developed Design
4 Production
5 Installation
6 As constructed
7 In use

Stage definitions (from APM)

0 Strategy
1 Brief
2 Concept
3 Definition
4 Design (production information)
5 Build & Commission
6 Handover & Closeout
7 Operation and end of life

Model Originators identified by name

	Drop 1 Stage 1		Drop 2a Stage 2		Drop 2b Stage 2		Drop 3 Stage 3		Drop 4 Stage 6	
	Model Originator	Level of Detail	Model Originator	Level of Detail	Model Originator	Level of Detail	Model Originator	Level of Detail	Model Originator	Level of Detail
Overall form and content										
Space planning	Architect	1	Architect	2	Contractor	2	Contractor	3	Contractor	6
Site and context	Architect	1	Architect	2	Contractor	2	Contractor	3	Contractor	6
Surveys							Contractor	3		
External form and appearance			Architect	2	Contractor	2	Contractor	3	Contractor	6
Building and site sections					Contractor	2	Contractor	3	Contractor	6
Internal layouts					Contractor	2	Contractor	3	Contractor	6
Design strategies										
Fire			Architect	2	Contractor	2	Contractor	3	Contractor	6
Physical security			Architect	2	Contractor	2	Contractor	3	Contractor	6
Disabled access			Architect	2	Contractor	2	Contractor	3	Contractor	6
Maintenance access			Architect	2	Contractor	2	Contractor	3	Contractor	6
BREEAM					Contractor	2	Contractor	3	Contractor	6
Performance										
Building	Architect	1	Architect	2	Contractor	2	Contractor	3		
Structural	Architect	1	Str Eng	2	Contractor	2	Contractor	3		
MEP systems	Architect	1	MEP Eng	2	Contractor	2	Contractor	3		
Regulation compliance analysis							Contractor	3	Contractor	6
Thermal Simulation							Contractor	3	Contractor	6
Sustainability Analysis							Contractor	3	Contractor	6
Acoustic analysis							Contractor	3	Contractor	6
4D Programming Analysis										
5D Cost Analysis										
Services Commissioning							Contractor	3	Contractor	6
Elements, materials components										
Building			Architect	2	Contractor	2	Contractor	3	Contractor	6
Specifications			MEP Eng	2	Contractor	2	Contractor	3	Contractor	6
MEP systems					Contractor	2	Contractor	3	Contractor	6
Construction proposals										
Phasing							Contractor	3		
Site access							Contractor	3		
Site set-up							Contractor	3		
Health and safety										
Design							Contractor	3		
Construction							Contractor	3		
Operation							Contractor	3	Contractor	6

WHO BENEFITS FROM BIM?

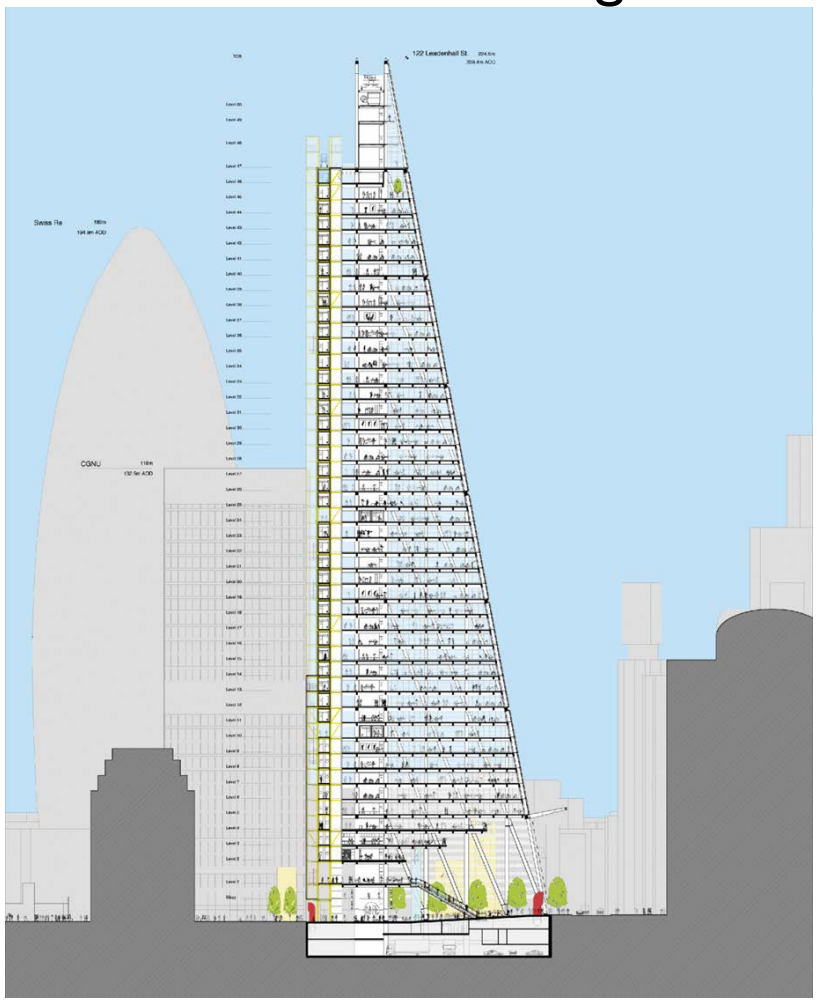
- Contractors should benefit from better design co-ordination
- Fewer construction errors and claims (?)
- (….but BIM does not guarantee quality of workmanship)
- Owners benefit from greater efficiency
- Owners benefit from having a model as a basis for facilities management
- Designers have to buy new software and hardware and train staff (expensive)
- **The designers who will have to adapt most (and bear most of the costs) are likely to benefit the least**
- Legal uncertainties may increase the risks for designers
- Little incentive to adopt BIM but for government projects there will be no option

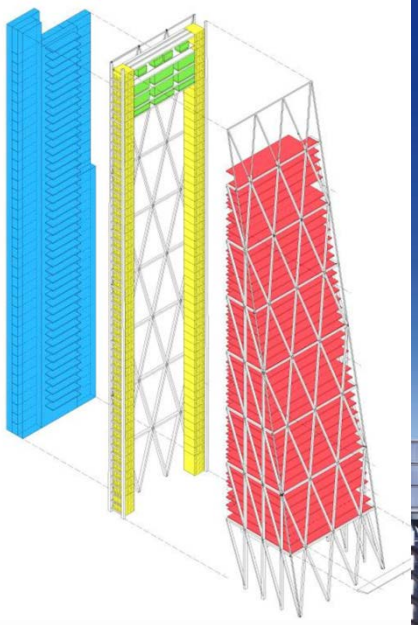
USING THE BIM MODEL

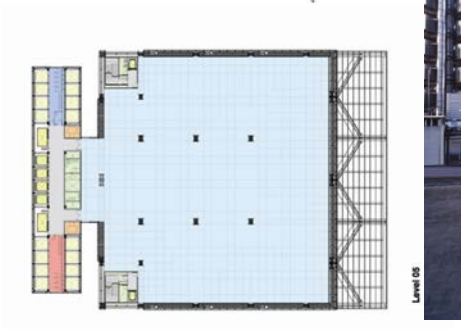
- How is information to be presented to the contractor?
- Is the contractor who receives a BIM model just left to extract the information?
- Should information be selectively extracted by the design team?
- How should this be presented: 3D PDF?, 2D drawings?
- Is this any different to how information is presented now?
- BIM can still assist with pre-construction clash detection and co-ordination
- A BIM model can form the basis of factory manufactured components
- How will BIM actually affect work on building sites?

USING BIM – A PRACTICAL EXAMPLE

The Leadenhall Building, London







LEADENHALL BUILDING – THE PROCESS

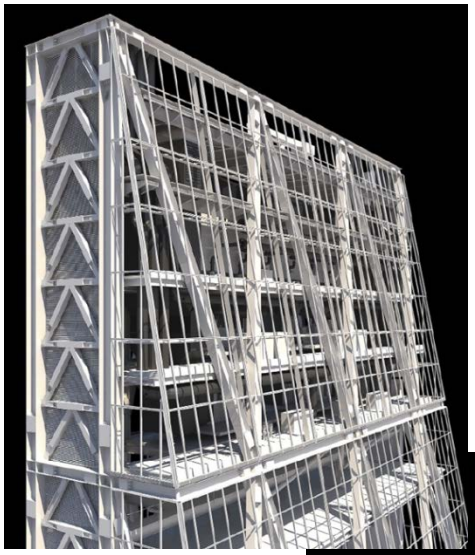
- Early collaboration and coordination
  - Design team collaboration and interaction the in preparation of BIM data
  - Evolution of the architectural model
  - Evolution of the engineering model
  - Structural analysis: integration of specialist software strands:
    - structural loads
    - plate thickness
    - parametric properties
  - Design team sign-off
  - Informing the fabricator's model

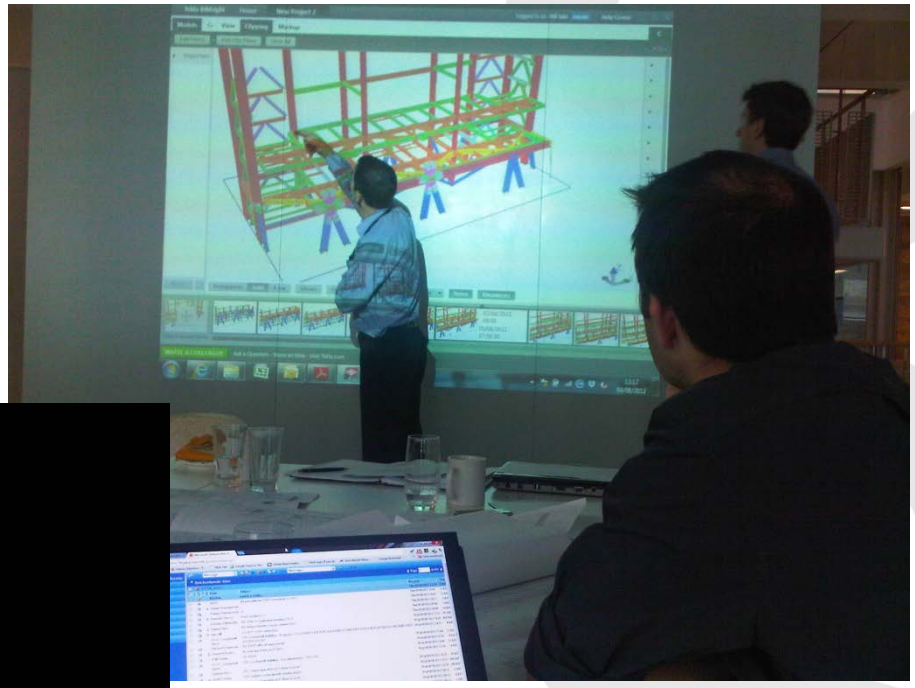
LEADENHALL BUILDING – THE PROCESS

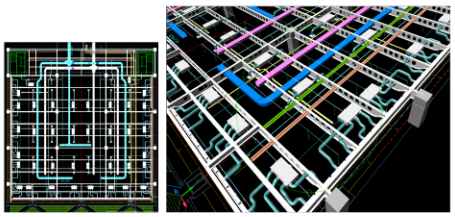
- Phasing, simulation and 4D modelling
  - Visualisation of demolition/construction method informing the programme
  - 4D Demolition
  - 4D Construction
- Conflict and collision detection
  - Detailed structure and services coordination for prefabrication
  - Learning from the aeronautical industry
  - Detailed MEP and structure coordination
  - Design of large sections of the structure to be prefabricated populated with services off site
  - Regular team evaluation workshops
    - Team analysis with the use of a large projections
    - Common 'inspection' of the model
  - Complex element prefabrication
    - Virtual prototypes / simulation
- Fabrication

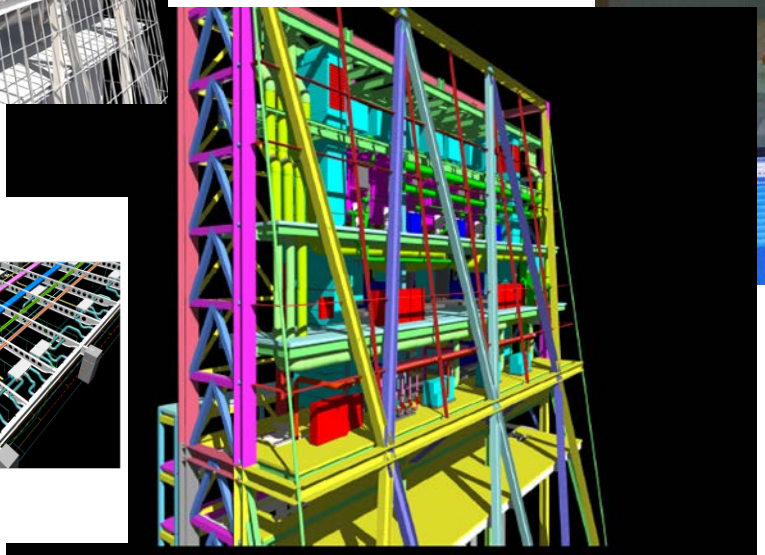
THE LEADENHALL BUILDING

Conflict and collision detection





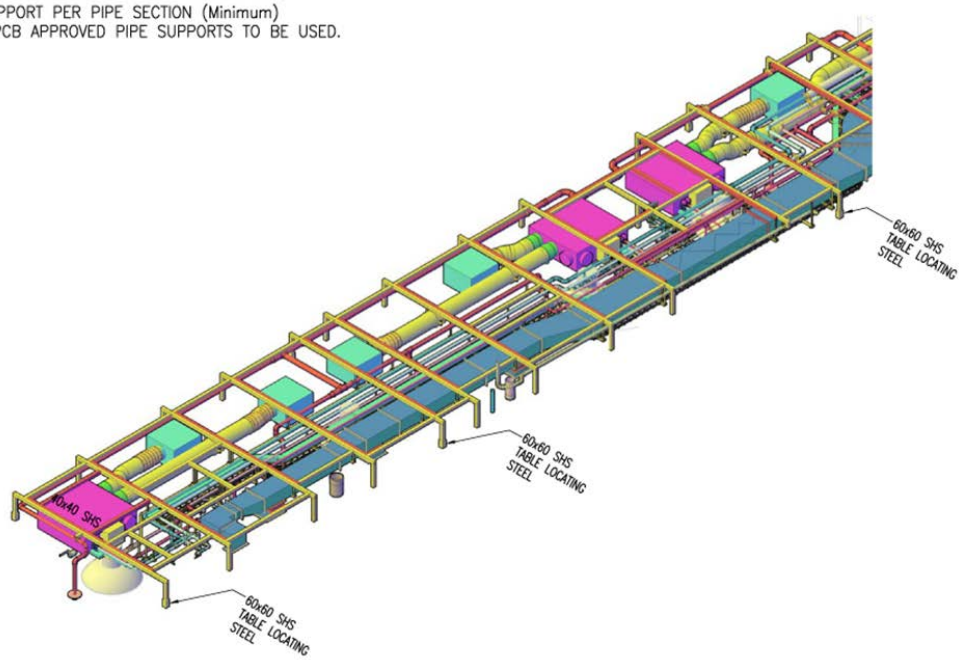




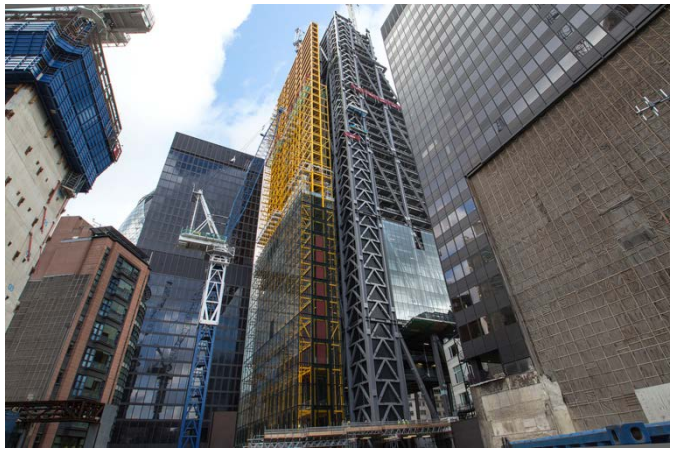
THE LEADENHALL BUILIDNG

Coordination of prefabricated elements

1. ALL OUTLETS TO BE 32ømm.
2. PIPE TO BE SUPPORTED AT + 3.0m SPACING.
3. ONE SUPPORT PER PIPE SECTION (Minimum)
4. ONLY LPCB APPROVED PIPE SUPPORTS TO BE USED.



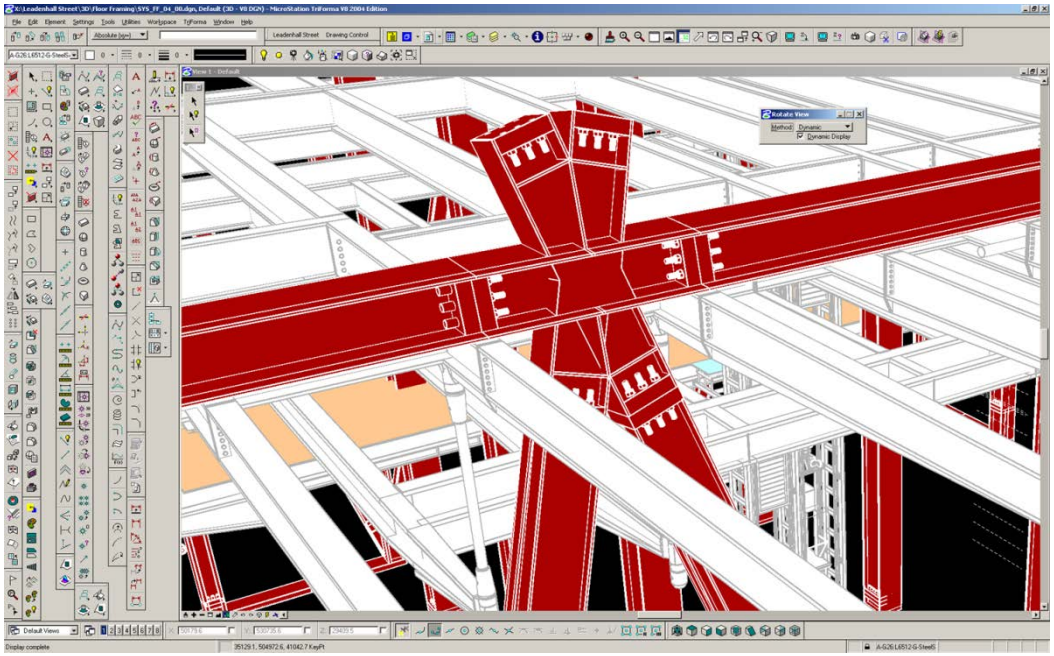
PERSPECTIVE VIEW 1

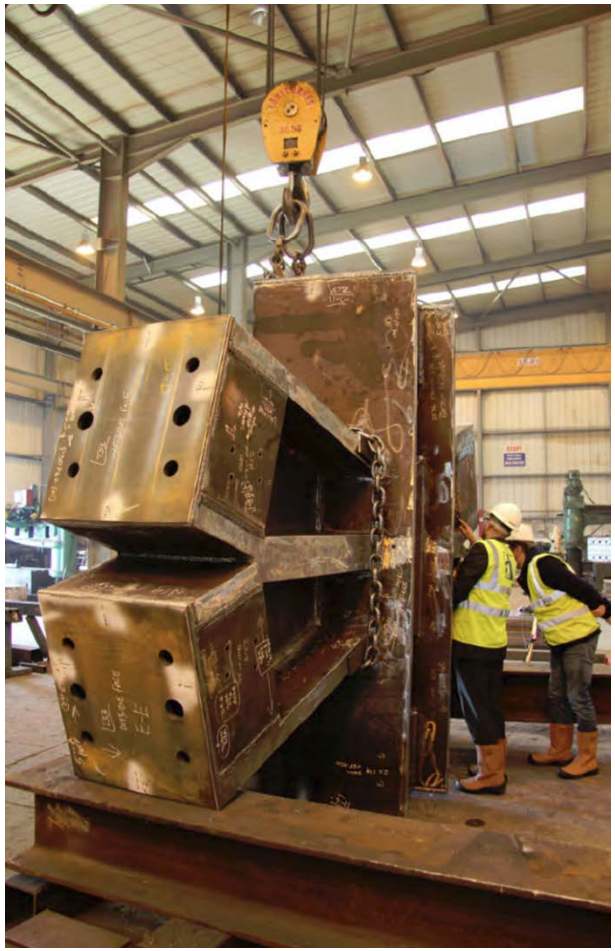


THE LEADENHALL BUILDING

Fabrication

- The Fabricator's model
  - Informed by the Architect's model
  - ...and the engineering analysis
  - Optimised over several model generations
  - Used for sign off by design team

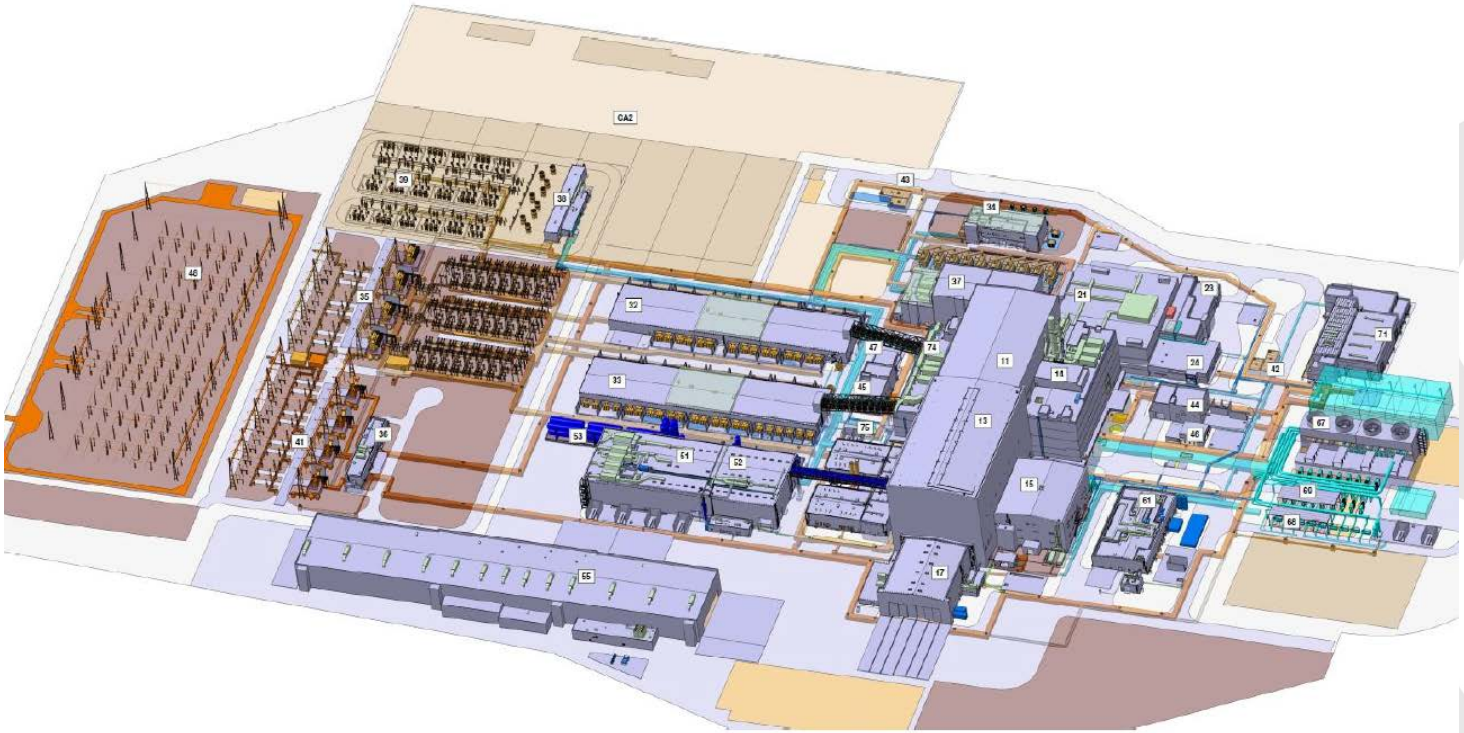




ANOTHER PRACTICAL EXAMPLE

The ITER project

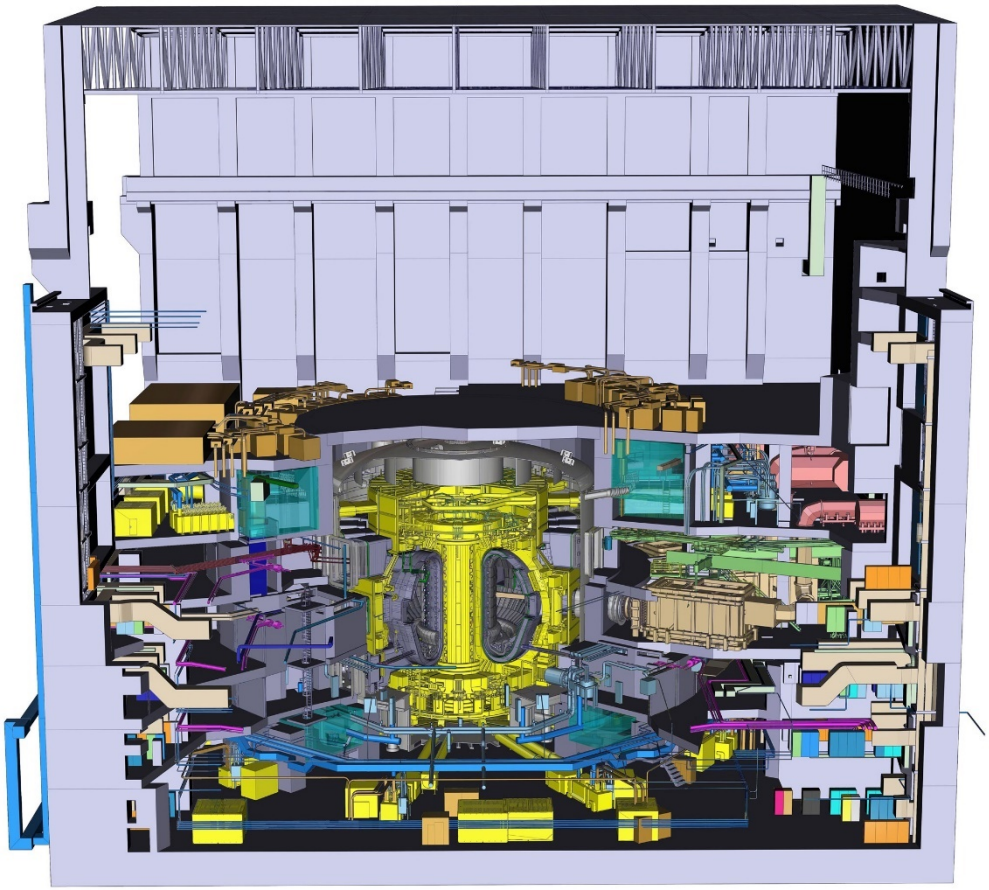
- A prototype nuclear fusion project in Cadarache, France
- A 35 year project with contributions from 34 countries
- Is this one of the largest public projects in the world?



ANOTHER PRACTICAL EXAMPLE

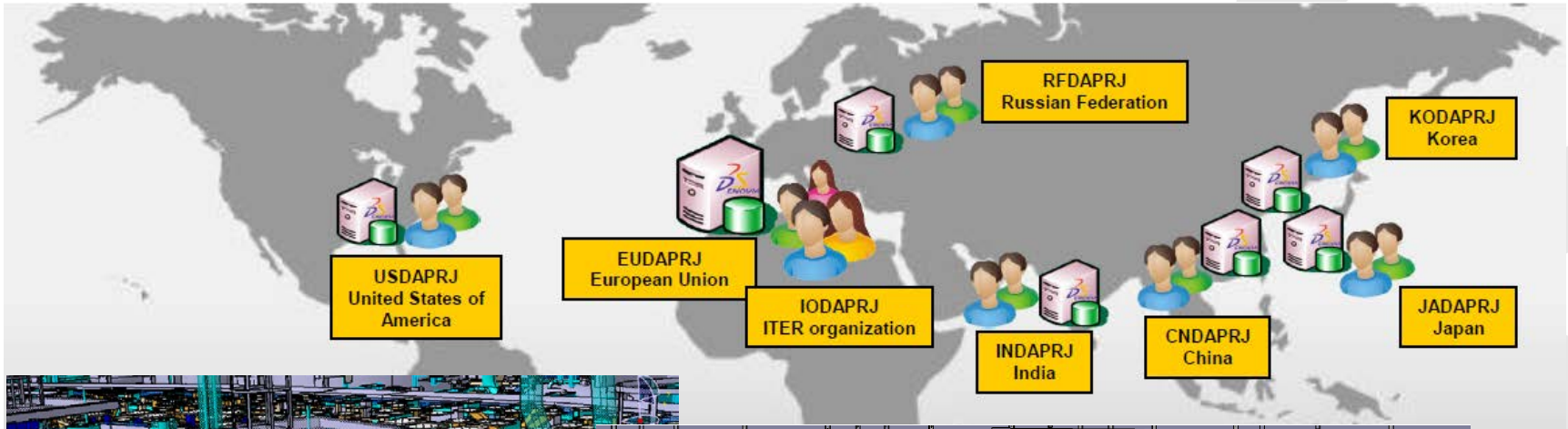
The ITER project

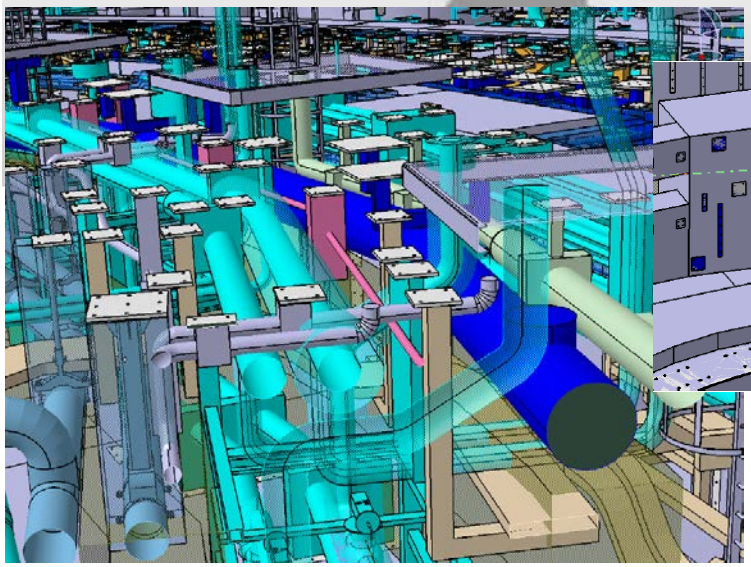
- CAD = 3D data
- 3D master model
- Evolution of design and systems are managed and communicated in 3D
- Simultaneous engineering all over the world
- 3D tool: CATIA
- 3D database: ENOVA

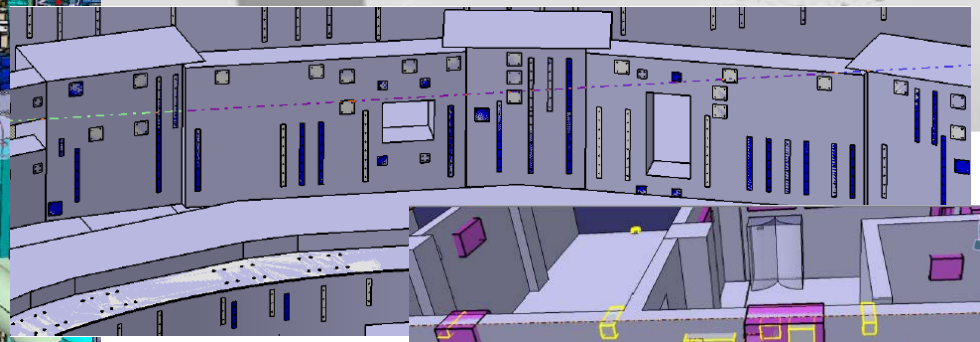


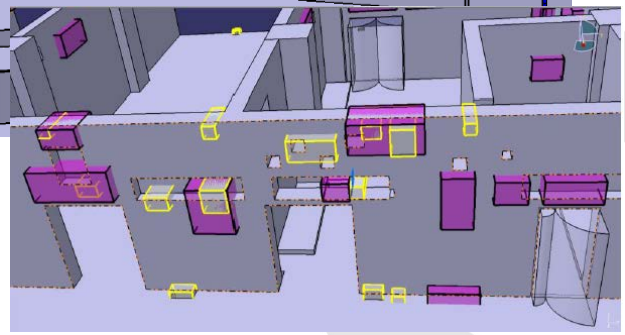
ANOTHER PRACTICAL EXAMPLE

The ITER project: BIM used for coordination







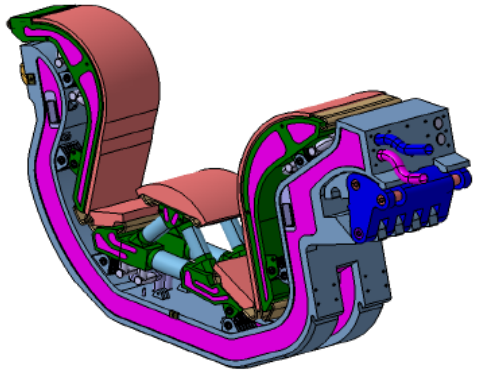


ANOTHER PRACTICAL EXAMPLE

The ITER project: BIM used for analysis

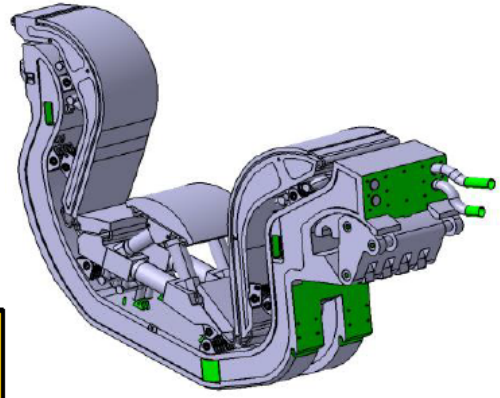
Representation 1

Detail Model (DM)

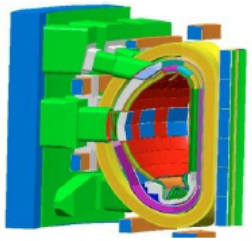


Representation 2

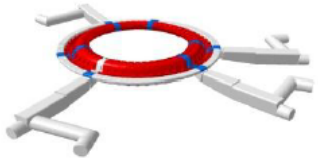
Configuration Model (CM)



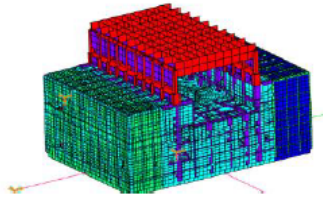
Other Examples of simplified representation not managed with ENOVIA:



Simplified model (Neutronics analysis)



Simplified model (pumping analysis)

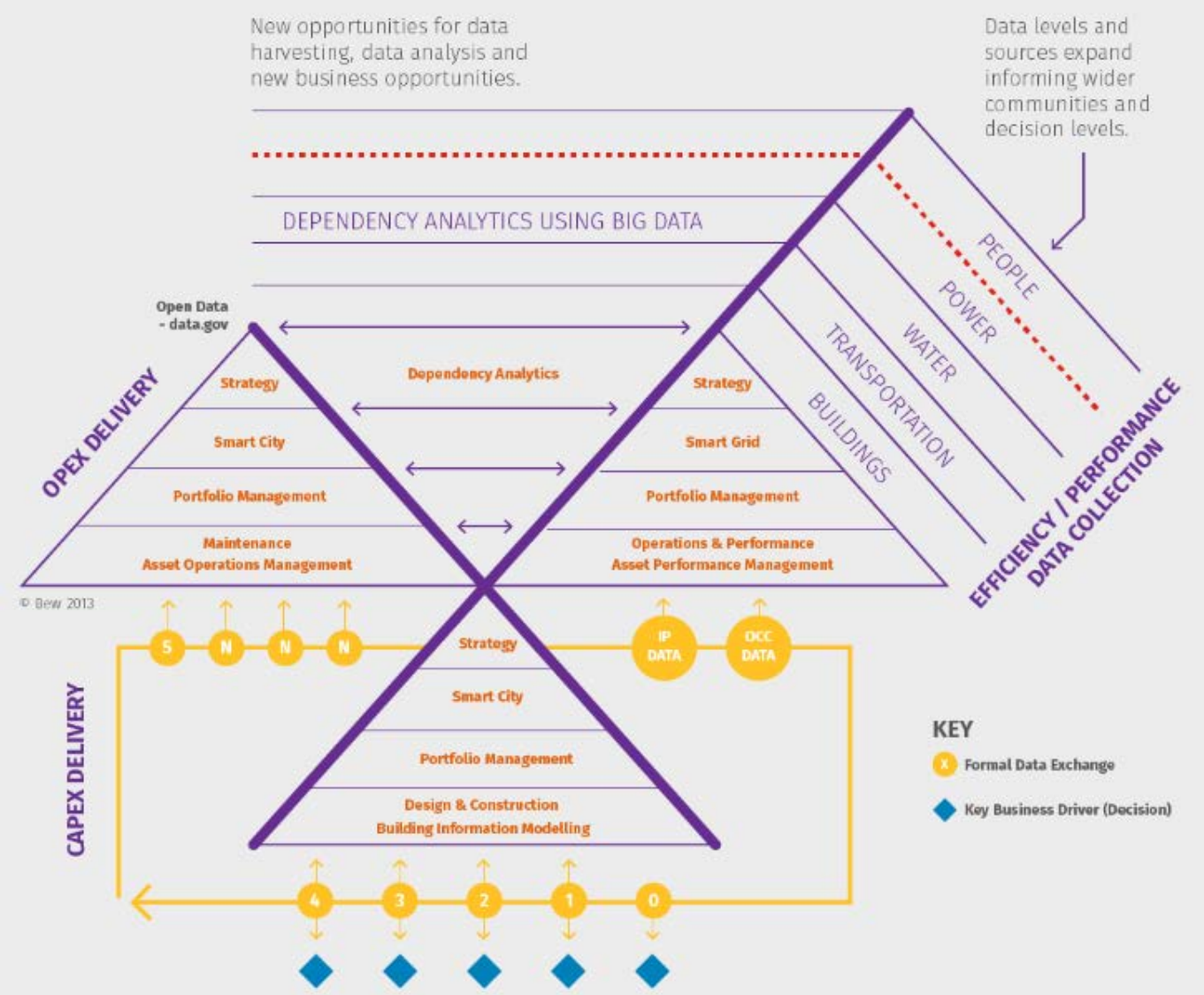


Simplified model (FEM analysis)

BIM LEVEL 3

- Uses the same techniques as advanced aerospace design
- Social performance becomes the primary objective
- Every contributor works real time on a single, shared, centralised model
- Enables real time cost and carbon data management and lifecycle management
- In Formula 1, teams use real time data to make cars go faster
- At level 3 we can (in theory) do the same for buildings
- Human factors: having the right data may not mean we take the right decisions. Will human intervention in design be reduced?
- What is the timescale?
- Optimist says 2018, but 2025 more likely…or possibly beyond
- Is likely to be phased in: Levels 3A to 3D:
  - Level 3A: Enabling improvements in the Level 2 model.
  - Level 3B: Enabling new technologies and systems.
  - Level 3C: Enabling the development of new business models.
  - Level 3D: Capitalising on world leadership.

BIM LEVEL 3



CONCLUSIONS:

- BIM is now an integral part of the design and construction processes in the UK industry.
- The progress to BIM level 3 is being driven by Government and will happen.
- Contract forms are being adopted to meet BIM requirements.
- The first BIM litigation in the English Courts has provided warning of unresolved issues in control and management of the BIM process.

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