Emerging BIM –
an update of UK’s current situation

Prof. Arto Kiviniemi
School of Architecture
Governmental demand for BIM

Government will require **fully collaborative 3D BIM** (with all project and asset information, documentation and data being electronic) as a minimum by 2016.

“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

http://www.bimtaskgroup.org/
BIM Task Group partners

- BIM4 Steering Group
- Technology Strategy Board
- CIC BIM Regional Hubs
- BIM4LG
- BIM2050 Group
- BSI
- BIM4FM Group
- BIM4 Private Sector Clients
- BIM For Retail
- BIM4SMEs
- BAF
- BIM4SupplySideDelivery

- BIM 4 Infrastructure (UK)
- BIM4RailUK
- BIM4Water
- BIM 4 Data Centres
- Building SMART UK
- The National Improvement and Efficiency Partnership (NIEP)
- Construction Industry Council (CIC)
- Survey4BIM
- National Institute of Building Sciences US
- BIM4FitOut
- BIM4M2
BIM policy stage by adoption rating in Europe

Source: Autodesk 2012
Current situation & expectations in the UK

In three years’ time we will use BIM
- 2010: 82%
- 2011: 90%
- 2012: 91%
- 2013: 93%

In one year’s time we will use BIM
- 2010: 62%
- 2011: 75%
- 2012: 77%
- 2013: 81%

We currently use BIM
- 2010: 31%
- 2011: 41%
- 2012: 43%
- 2013: 54%

Should we be worried about 2016?

Source: NBS National BIM Report (UK) 2014
BIM in FM: Case Manchester Town Hall Complex
BIM CASE STUDY

VENTILATION MOTOR REPLACEMENT
(Manchester Central Library Theatre)

Summary:
This case study compares how historically one of the ventilation Motors was replaced and a comparison has been made on how this would be managed if the Facilities Management Team had access to accurate and robust BIM data, the saving in disruption, time and money is considerable.

The anticipated saving having access to BIM is £286
Using BIM Technologies would have potentially reduced the delay from 4 weeks to 1 day

Delay: 4 weeks ⇒ 1 day = - 96%
Man hours: 14 ⇒ 3 = - 79%

Quote: P. Harvey,
THC Building Services Manager, Manchester Working LTD
"To have the ability to interrogate an isolated service such as a chilled water system or a combined network such as the ventilation layout all from the relative ‘comfort’ of a handheld device provides measurable cost savings and immeasurable safety / efficiency savings.
BIM really is the essential maintenance tool."

Manchester City Council
Heron House, 47 Lloyd Street
Manchester, M2 3LE
**BIM CASE STUDY**

**EXTRACT DUCT - UNKNOWN WATER BUILD UP**
(Manchester Central Library)

**Summary:**
This case study compares how historically one of the Sub-basement Extract Ducts kept filling up with water from an unknown source, preventing Air filter changes & a comparison has been made on how having access to accurate BIM mechanical & electrical installation routes and data would have reduced costs, time and frustration to MCC.

The anticipated saving having access to BIM is £838.
Using BIM Technologies would have potentially reduced the delay from 12 weeks to 1 day.

**TIME LINE**

**TRADITIONAL METHOD**

- Initial Investigation
  - 2 inches of water found in the sub Basement Extract Air Duct from unknown source.
  - Asbestos team called out for safety measures to run air Tests. (3 day waiting time, 3 hours testing work)
  - Results clear: FM carry out localised investigation & Water pumped out via small pump (4hrs / 2x staff)
  - Unknown source and no obvious failing pipe work
  - 1 week monitoring put in place
  - Man Hours for Labour - 13 hours

- Further Investigation
  - No reported issues but 5 weeks later 0 weekly Filter change. Water reported to be building up again.
  - Specialist Contractors called in to pump water out and investigate. (£500 equipment hire)
  - Again, no obvious sign of pipe leaking. No water ingress
  - Contractors monitor for 1 month
  - During monitoring, contractors investigate surrounding ducts / links but fail to find any source.
  - Man Hours for Labour - 8 hours

- Outcome
  - Water ingress still occurring but is a slow build up.
  - Contractors still not clear of source until they come across a 2 inch plastic pipe on the other side of a duct. Not original and looked like a relatively recent addition (10yrs or so)
  - No known reason for pipe or current usage / source.
  - Joint on plastic piping is poor and is repaired.
  - Man Hours for Labour - 2 hours
  - Total Delay in solving problem - 12 weeks

**TIME LINE**

**USING BIM**

- Initial Investigation
  - Use BIM to see what pipe work is near to current source of issue and the systems they belong to.
  - Check to see if there is any asbestos presence.
  - Water pumped out via small pump (4hrs / 2x staff)
  - Man Hours for Labour - 9 hours

- Further Investigation
  - No reported issues but 5 weeks later 0 weekly Filter change. Water reported to be building up again.
  - Specialist Contractors called in to pump water out and investigate. (£500 equipment hire)
  - Again, no obvious sign of pipe leaking. No water ingress
  - Contractors monitor for 1 month
  - During monitoring, contractors investigate surrounding ducts / links but fail to find any source.
  - Man Hours for Labour - 8 hours

- Outcome
  - Contractors called in to repair pipe.
  - Man Hours for Labour - 1 hours

**Benefits & Value of using BIM**
- Anticipated cost saving £838
- Time Saved man hours - 13 Hours
- Reduced disruption & inconvenience by 92 days
- Avoid time & money wasted on lengthy monitoring periods

**Quote:** P. Thompson, Manchester City Council Facilities Manager

"BIM provides an Operational FM Team the ability to provide right first time, every time solutions to everyday issues. BIM manages multiple information sources and presents them in a logical manner that Operational Teams understand. This brings real savings in cost, time and effort and ultimately an enhanced service for my customers."

**Delay:** 12 weeks ⇒ 1 day = - 99%

**Man hours:** 23 ⇒ 10 = - 57%
Conclusions from the case study

• Significant reductions in the man hours (-57...-80%)
• Because of relatively small tasks individual savings per task quite small (8...13 hours), but because of repetitive nature of maintenance operations significant annual savings
• Main benefit is huge reduction in waiting time to fix the problems (-96...-99%) \( \Rightarrow \) Reduced disruption and inconvenience for the users helping to avoid reputational damage

• **BIM has significant, measurable value in operational FM**
BIM is not about buildings only!

Case Crossrail, London
Cost Savings

- Finding information – from our “single source of truth”
- The creation of non-CAD deliverables e.g. reports, lists, mailings, databases
- The creation of models and drawings

At Farringdon Station
- 3D model linked to the delivery programme
- cost £120k but saved over £8million from risk contingency (interfacing complexity)

Source: Malcolm Taylor, Head of Technical Information, Crossrail, June 2013
Crossrail Vision

A responsive, efficient, flexible railway that adapts to variations in demand and perturbations.

Engaged motivated, valued people with tools to diagnose, predict and advise.

Central Data Hub

Asset Information
Intelligent Assets that manage themselves and require minimal human intervention.

User Applications

SERVICE
- Predictable 24/7
- Seamless - Sit to train
- Comfort
- Safety to your destination

PEOPLE
- Customer Service
- Operations & Control
- Asset Technicians

ASSETS
- Stations
- Rolling Stock
- Infrastructure

Source: Malcolm Taylor, Head of Technical Information, Crossrail, June 2013
Conclusion

Seen what BIM currently looks like

- Creating a virtual world as well as a physical one
- Embracing new technology
- Demonstrating efficiencies

Source: Malcolm Taylor, Head of Technical Information, Crossrail, June 2013
Conclusion

Capturing Asset Information

Source: Malcolm Taylor, Head of Technical Information, Crossrail, June 2013
## Conclusion

<table>
<thead>
<tr>
<th>£14,800,000,000</th>
<th>Cost</th>
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<tbody>
<tr>
<td>1,250,000</td>
<td>CAD Model files – so far!</td>
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<tr>
<td>815,000</td>
<td>e-Documents stored – so far!</td>
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<tr>
<td>650,000</td>
<td>Assets to be tagged</td>
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<tr>
<td>8,250</td>
<td>Individual Document users – so far!</td>
</tr>
<tr>
<td>650</td>
<td>Individual CAD users – so far!</td>
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<tr>
<td>61</td>
<td>Main Construction Contracts</td>
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<td>25</td>
<td>Main Design Contracts</td>
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<td>8</td>
<td>Main Central Interchanges</td>
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<td>Future Infrastructure Maintainers</td>
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<td>Crossrail</td>
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</tbody>
</table>

*It would all be much harder without BIM!*  

Source: Malcolm Taylor, Head of Technical Information, Crossrail, June 2013
BIM in education
Are we educating for the past or for the future?

How can we get talented people interested in working in the AEC industry?
BIM Academic Forum (BAF)

Over 60 members from 30+ teaching centres

VISION
• To foster integrated collaborative working on projects over the lifecycle of the asset through academic involvement and enhancement of BIM

MISSION
• To create a dynamic group to develop and promote the Training, Learning and research aspects of BIM through strong collaboration and cooperation

OBJECTIVES
• Focus on and elevate the T&L and Research aspects of BIM
• Collective promotion of BIM
• Establish open medium for communication thus sharing knowledge; experience; case studies; views, etc.
• Collaboration for joint activities and research projects
• Collective voice in both T&L and Research matters, so to contribute to policy issues, funding priorities and agenda setting
• Attempt to minimise duplication, create standard practices while celebrating diversity

• Roadmap towards a longer-term vision of embedding BIM learning within ‘discipline-specific’ undergraduate and postgraduate education
• Started to breakdown and establish the potential learning outcomes requirements at Levels 4-7 of HEI education
Some available BAF material

- **Report** Embedding Building Information Modelling (BIM) within the taught curriculum @ https://www.heacademy.ac.uk/node/3242
- **Presentation** BIM - Collaboration within undergraduate AEC education @ https://www.heacademy.ac.uk/resources/detail/resources/detail/stem-conference-2014/Post_event_resources/Built_environment/BIM
- **Presentation** Opening the eyes of the Civil Engineer through BIM @ https://www.heacademy.ac.uk/resources/detail/stem-conference-2014/Post_event_resources/Built_environment/Opening_the_eyes
TSB (Technology Strategy Board) funded competition to deliver an integrated BIM management tool for the industry. Work starts in October 2014 and is scheduled to be finished in 6 months.
Data Cube Concept

- The dPoW will define the deliverables required at each stage of the design, construction, maintenance and operation of built assets.
- The dPoW will be made available digitally to enable simple access to all stakeholders to make use of the system to give clear definition as to what geometry, data and other information should be delivered at each of the eight stages of a project.
Some of the points of departure

- “The construction industry contributes almost £90bn to the UK economy (6.7% of the total) and its value comprises of 280,000 firms employing 2.93 million people, most of that employment is skilled labour. **What will happen when we only need half of that labour?**”
  *Professor David Philp, BIM2050 Group Chair*

- “**Our behavioural biases in construction inhibit collaboration.** We need to change the stereotypical relationships between disciplines. Future generations will not accept these conventions and construction will remain a second choice career route for talented people. How can we address our image and make construction attractive to talented people?”
  *Neil Thompson, Group Vice Chair*

- “Technology has outpaced our ability to educate generally across the economy and will continue to do so moving forward. **Construction tends to lag behind more advanced industries and investment in innovation is low, both academically and professionally.** How will the needs of an advanced industry adapt to these ever increasing changes?”
  *Rebecca De Cicco, Steering Group Lead*
Key technologies & BIM levels

- Level 4: Paradigm Threshold
  - Advanced Robotics
  - Autonomous Vehicles
  - Self healing materials
- Level 3: Industrial 3D Printing
  - Self Procuring
- Level 2: RFID Telemetry
  - Spines Integrated
- BIM 2016
- Construction Strategy 2025

- Wave 1 (2010)
- Wave 2 (2020)
- Wave 3 (2030)
- Wave 4 (2040)
- Wave 5 (2050)

- Moore's Law Ends
- Graphene, Spintronics, Quantum Computing
- Slow down of gross fixed capital formation & start of Non-Additive Construction Cycle
- Everything in Beta
- 10bn Population Plateau

50% Reduction in Skilled Labour by 2050
Feedback Cycle Wave

Waves: the first wave shows how the current lag of information exchange gives us only one chance to exchange between formal transactions. As we move in to wave 2 the lag is less and we can fit more iterations of simulation into our transactions. Moving through to wave 4, transactions are almost instantaneous and computing power enables vast simulation options.

Wave 1
- Analogue Decisions
  - At key stages
  - Capex/Opex

Wave 2
- Digital Decisions
  - Converging Information
  - Performance / Operation

Wave 3
- Predictive Digital
  - Emerging Information
  - Social Outcomes

Wave 4
- Artificial Intelligence
  - Adaptive & Agile

Analogue Decisions 2010-2020
Digital Decisions 2020-2030
Predictive Digital 2030-2040
Artificial Intelligence 2040+
<table>
<thead>
<tr>
<th></th>
<th>Recommendations</th>
<th>Organisations</th>
<th>Academia</th>
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<tbody>
<tr>
<td>1</td>
<td>Cyber Security</td>
<td>Data Residency</td>
<td>Encryption &amp; Penetration</td>
</tr>
<tr>
<td>2</td>
<td>Interoperability for Smart Cities</td>
<td>Dynamic Infrastructure</td>
<td>Machine learning &amp; Adaptive Efficiency</td>
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<tr>
<td>3</td>
<td>Behavioural Intelligence Management</td>
<td>Pre-occupancy Evaluation</td>
<td>Knowledge-based Engineering</td>
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<tr>
<td>4</td>
<td>Nano-second Procurement &amp; Performance</td>
<td>Optimisation, Improved Asset Utilisation &amp; Big Data Techniques</td>
<td>Predictive Analysis &amp; Configurators</td>
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<tr>
<td>5</td>
<td>Biological Complexity</td>
<td></td>
<td>Smart Materials, Self-Assembly, Regenerative Construction</td>
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<tr>
<td>6</td>
<td>Life-Long Learning</td>
<td>Free, Open + Immersive &amp; Integrated</td>
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</tr>
<tr>
<td>7</td>
<td>Consumer Access Economy &amp; Space Travel</td>
<td>Service Business Models</td>
<td>Building Out of Gravity</td>
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<tr>
<td>8</td>
<td>Sector Skill Migration</td>
<td>Skill Warfare &amp; Jobless Growth</td>
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<tr>
<td>9</td>
<td>Robotics and Autonomous Systems</td>
<td>Skilled Labour &amp; System Maintenance</td>
<td>Automation in the Supply Chain</td>
</tr>
<tr>
<td>10</td>
<td>Business in the Future</td>
<td>Talent as Commodities, Mobile Capital &amp; Demountable organisations</td>
<td></td>
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Next steps
...UK Government is serious about BIM!

...adoption of BIM will put us at the vanguard of the new digital construction era and position the UK to become the world leaders in BIM.

Francis Maude
Minister for the Cabinet Office

http://www.bimtaskgroup.org/