Challenges and opportunities in the BIM education
How to include BIM in the future curricula of AEC professionals?

11th January 2013
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School of Built Environment
Content of my presentation

- Current messages about BIM
- Challenges
  - Understanding and management of expectations
  - Required education
  - Industry culture
  - Bad business models
  - Accreditation requirements are based on old view of the profession
  - Education is still often based on drafting
- Viewpoints of (architectural) design and technology
  - What should be different in BIM based education and why?
- Where are we in Salford?
- Conclusions
Current messages around BIM?

Fad, fashion or real change?
Many reported benefits...

Relative Importance of BIM Benefits to Improving ROI

- Better multiparty communication and understanding from 3D visualization: 77%
- Improved project process outcomes, such as fewer RFI's and field coordination problems: 74%
- Improved productivity of personnel: 73%
- Increased prefabrication: 71%
- Positive impact on marketing: 71%
- Reduced cycle time for project activities and delivery: 66%
- Lower project cost: 57%
- Improved jobsite safety: 50%
- Positive impact on sustainability: 44%
- Positive impact on recruiting/retaining staff: 43%
- Faster plan approval and permits: 36%

...some huge ROI figures...

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost ($M)</th>
<th>Project</th>
<th>BIM Cost ($)</th>
<th>Direct BIM Savings ($)</th>
<th>Net BIM Savings</th>
<th>BIM ROI (%)</th>
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...and Governmental requirements...

Government Construction Strategy to reduce costs

31 May 2011

The Minister for the Cabinet Office, Francis Maude publishes the Government’s new Construction Strategy today.

The strategy will reform the way in which government procures construction across all sectors, and in doing so will reduce costs by up to 20% by the end of this parliament, helping both the government and the construction sector.

The Government’s Plan for Growth, published alongside Budget 2011, and the Infrastructure Cost Review Implementation Plan [PDF, 627KB], published earlier this year, highlighted the critical importance of an efficient construction industry to the UK economy and the need for reform of public sector construction procurement to improve value for money to taxpayers and enable the construction industry to focus on bringing forward innovative solutions. This strategy sets out the detailed programme of measures Government will take to reform the way in which it procures construction.

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

- but unfortunately often related rather to
  - envy
    
    “We must also get those huge profits!”

- or fear
  
  “Are we losing our position on the market?”

- than a clear understanding of the
  real possibilities and potential of BIM.
Vision without action is a daydream.
Action without vision is a nightmare.

*Japanese proverb*
One size does not fit all…
Challenge 1: Understanding and management of expectations

Technology Hype Cycle after Gartner

Majority of the UK industry

Visibility

Time

- Technology Trigger
- Peak of Inflated Expectations
- Trough of Disillusionment
- Slope of Enlightenment
- Plateau of Productivity

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Contradictory attitudes in the industry

Denial of the value – Realism – Inflated expectations
Challenge 2: Required education

Who is educating the educators?

150,000 companies and 3,000,000 people with improved skills
Different maturity and competences in UK

- Providers
  - Institutions
  - Further Ed
  - Higher Ed
  - PTP
  - Vendors

- Decision Making
  - Strategic
  - Management
  - Technical

- Assets
  - Buildings
  - Infrastructure/Civils

- Lifecycle
  - Briefing
  - Design
  - Build
  - Operate

- Roles
  - Clients
  - Designers
  - Contractors
  - Operations/FM

Government BIM Strategy: Improving BIM Training & Education
by Adam Matthews & David Cracknell
Improving Training & Education: Conclusions

(1) Is the current training and education infrastructure fit to deliver the skills and resources required to support the Strategy

(1) **Infrastructure exists to support the training and education needs for Level 2 BIM**

(2) Are the current training and education offerings delivering the skills and resources needed to support the Strategy

(1) **Training and education providers do not know what is required of them**

(2) **Nor is there consistent demand for BIM skilled and knowledgeable professionals.**

(3) What needs to be done to address gaps in the current supply

(1) **The training and education providers need visible and consistent and sufficient quantity of demand for BIM skilled resources**

(2) **To improve consistency there is a need to standardise or certify BIM knowhow and skills across the construction sector**

(3) **The infrastructure of the training and education industry should be ‘engaged’ to respond to the BIM strategy in terms of provision of skills and knowhow**
Challenge 3: Industry culture

“It will not slice a pineapple”

“Propose to any Englishman* any principle, or any instrument, however admirable, and you will observe that the whole effort of the English mind is directed to find a difficulty, a defect, or an impossibility in it.

If you speak to him of a machine for peeling a potato, he will pronounce it impossible: if you peel a potato with it before his eyes, he will declare it useless, because it will not slice a pineapple.

Impart the same principle or show the same machine to an American, and you will observe that the whole effort of his mind is to find some new application of the principle, some new use for the instrument.”

Charles Babbage, 1852

Many people try to invent excuses why not accept changes – such as BIM – but the real reason is that they do not want to change!
Strong silos

- Standardised roles, but also poor understanding of the information flows and needs in the process
Poor development of productivity

Construction & Non-Farm Labor Productivity Index (1964-2003)

Productivity Growth in the UK Construction Industry 1993-2003

Productivity Development in Finland

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Why?

- Lack of genuine global competition
  - Construction is basically local activity
- Old phrase says that there are three factors defining the value of a building – **location, location, location**
  - Why invest in the product development? It has very little to do with the selling price as long as the minimum requirements of the target group are met
- This had created an industry culture which is very change adverse:
  "The early bird may catch the worm, but the second mouse gets the cheese"

...let’s just wait until some else proves that the new solution certainly works...
Challenge 4: Bad business models

- Low bid ad-hoc teams
  - Clients select the services based on the lowest price – in design this basically means selecting the least effort.

- Sub-optimisation and lack of real process owners
  - Because of the low-bid business model, everyone must minimise their own workload, despite of the fact that the consequent mistakes increase total costs, but nobody owns the process so who cares…

- Missing business benefits for upstream partners
  - Why would they produce more or better information?

- Legal responsibilities
  - Fear that new methods increase uncertainty and risks
What’s there for me?

**Systemic Innovations**, i.e. product and process innovations that require multiple firms to change their processes, are difficult to implement in project based industries.
Perceived ROI by domain

Less perceived benefits in the “upstream” – i.e. design and engineering

More perceived benefits in the “downstream” – i.e. construction and maintenance

Challenge 5: Accreditation requirements are based on old view of the profession

- Many of the construction related programmes are accredited either on national or sometimes even multinational level
  - For example, architectural education is standardised on European level
  - Very different levels of BIM in different countries ⇒ difficult to agree about any changes
- Required content is often quite generic, but the interpretation of requirements can be very strict
  - Accreditation bodies can be conservative and protective about their own status
  - Do they have sufficient understanding and knowledge of BIM?
  - Risk that we will have contradictory requirements for different professions
Challenge 6: Education is still often based on drafting

- Most teachers are experts in 2D drafting, some in 3D modelling, only few in BIM
  - Lot of friction, in worst case active resistance

- Curricula are full of topics, there is no space for additional issues
  - What can be left out?

- Developing new or changing existing curricula can be a very difficult and time consuming process
Some viewpoints of (architectural) design and technology
Media affects our thinking

Design by experience - physical models
Manual drafting and tracing, highly illustrative drawings

Requirement for building permit drawings (in Finland)
Manual drafting, copying machines, simplified/abstract representation

Early CAD = automated drafting

Back to the illustrative representation

Integrated BIM

Modelling
Interoperability
Simulation
Collaboration platforms
Virtual prototyping

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Future key competences?

Architecture

Ability to lead the team, coordinate design efforts and collaborate

VENUSTAS

FIRMITAS

UTILITAS

Horizontal specialisation

Vertical specialisation

Sustainability + BIM + Lean
Understanding of Digital Design and Media

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Learning the visual language

- Intelligence without Representation (Dreyfuss 1988)
  - Creation of “intentional arcs” through experience; “skills which are ‘stored’, not as representations in the mind, but as dispositions to respond to the solicitations of situations.
  - Experienced designer is like a master level chess player, recognising thousands of combinational situations instantly and identifying potentially usable solutions by intuition

- Designers do not just learn to make drawings; they learn to think through drawings (Daniel Fällman 2003)
  - Un-learning is a painful effort; when learning a new media a design expert becomes a novice ⇒ Focus shifts from content to the tool ⇒ significant loss of efficiency and creativity until the new media is an integral part of the designer’s mindset

- We must start teaching our students to think through models, not through drawings!
Three design accounts (Daniel Fällman 2003)

- **Conservative**
  - "Design is thought of as a scientific or engineering endeavour aiming to convert an undesired situation into a desirable one"
  - Examples on project level: Process plants, bridges…

- **Pragmatic**
  - "Design as an hermeneutic process of interpretation and creation of meaning, where designers iteratively interpret the effects of their designs on the situation at hand"
  - Examples on project level: Offices, apartments, warehouses…

- **Romantic**
  - "Designers are seen as imaginative masterminds equipped with almost magical abilities of creation"
  - Examples on project level: Cultural monuments, churches…
Three “levels” of business cases?

- **“Everyday environment”**
  - Most of the projects; need for spaces, tight budget and schedule, limited resources, liability issues...
  - Client is mostly interested in **cost, scope and schedule**
  - Efficient tools can have a significant role in the success or failure

- **“Landmark buildings”**
  - Client has high expectations and accepts higher design and construction costs; the **architecture is important**, but not (necessarily) the architect
  - Tools are often crucial because of the complexity of the project

- **“Celebrities”**
  - Frank Lloyd Wright, Alvar Aalto, Frank Gehry, Zaha Hadid...
  - Client wants to have the **famous architect**, because their building can change the image of a company, city or area
  - Tools can be important for the “star designer’s” own process
Problems and implications

- Any fundamentally new technology must provide significant advantages to be acceptable, small benefits are not enough
  - “The purpose of contextual research methods is to uncover the user’s experience of usability: that is, to identify dimensions of usability important to the user.” (Shneiderman 1987)
- However, it can be difficult to measure users’ experience

- Several reasons are hindering the change
  - Most people are cautious by nature; change is not wanted
  - Unlearning is difficult and requires a lot of effort; thinking through drawings is a very strong obstacle
  - Personal pride and fear can play an important role; moving from the expert level into a novice is not easy for most people

- Should we rethink the basis of architectural education, and abandon the technical drafting totally?
  - Teaching drafting based design may not be only useless but damaging for the new generations of architects
Where are we in Salford?

MSc in BIM and Integrated Design &
Open BIM Learning Xchange
BIM is not about technology

**PROCESS**
- Lean design management
- Integrated project delivery
- Design intent
- Validation/verification

**PEOPLE**
- Leadership
- Collaboration
- Stakeholders engagement

**Better value:**
- Benefits realised through process change, technology adoption and development of people

**TECHNOLOGY**
- BIM
- Modelling and simulation
- Interoperability
- Integration

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Programme aims

- Multidisciplinary approach; designers, construction and project managers, quantity surveyors...
- Advanced knowledge on lean, integrated processes utilising BIM technology
- Educate those involved with designing and managing (complex) re/development of built environment
- Develop managerial, technical and interpersonal skills to deliver better value through design and information management
Flexible structure

Programme is available in full time, part time and distance learning modes. International participation increasing rapidly.

BIM is now emerging as an element into all our existing programmes.

A new BSc Architecture programme in preparation, strong focus in integrated BIM and collaboration. Planned to start in September 2015.
Open BIM Learning Xchange

- The Xchange aims to a strong collaboration between industrial and academic institutions.
  - Research, collaboration in teaching, professional education

- BIM is evolving rapidly and many of the innovations happen in the leading-edge companies
  - Learning from and with the industry is extremely important

- Working together and exchanging the experiences and best practices speeds up the adoption of BIM and improves the quality and productivity in our industry.
Conclusions

- Many definitions and unclear messages what BIM is.
- BIM is relatively new and there are limited number of people having clear understanding of the topic and what it means to different professions. This means also competition of competent people with the industry.
- There are many traditional and mandatory topics in the curricula; what can we leave out without endangering the necessary skills or accreditation of our programmes?
- BIM is evolving rapidly. Who will/can define what is the appropriate BIM content for accreditation?
- Although BIM is not just technology, learning to use tools takes time to practise. Do we have the sufficient software, hardware and support resources?
Traveller, there is no road, you make your own path as you walk.

Antonio Machado (1875 - 1939)