Will BIM improve construction health and safety?

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Abstract

All sorts of claims are being made about BIM (Building Information Modelling), including that it will revolutionise construction site health and safety. This paper presents the findings from a survey of ~300 construction designers and design advisers in the UK regarding BIM. The paper finds that the current status of knowledge and experience of BIM amongst UK design-related professionals is very poor. It argues that BIM is currently near the peak of over-inflated expectations on the Gartner Hype Cycle. Whilst there is considerable potential for BIM to bring benefits to construction, there is a danger that it will stifle occupational health and safety by focussing only on standard risks and hazards rather than on the need for careful review of design, means and methods to eliminate or reduce hazards before they create risks on the site.

Keywords: BIM, Building Information Modelling, health & safety, hype.

1. Introduction

Building Information Modelling (BIM) is currently being lauded across the world as the solution to all of construction's ills (e.g. Hardin, 2011; Suermann & Issa, 2009; Young et al, 2008, Shih et al, 2012) and the proclaimed benefits include improved health and safety of construction workers (e.g. Zhou et al, 2012). Whilst 3D CAD models have been around for many years, and the use of solid models for management functions such as sequence planning and clash detection surfaced in the engineering construction sector as long ago as the mid-1990s (e.g. Gibb, 1999, p141), the all-encompassing promise of BIM has only become *de rigeur* in recent years. In many ways, BIM has taken on the mantle of 'saviour of the world' from previous initiatives such as Lean and Modern Methods. These too have been previously hailed as generic construction sector redeemers – and, in some cases still are.

A full discussion on the history, development and current use of BIM is outside the scope of this paper and much has already been written on this (e.g. Shih et al, 2012). However, for the purposes of this paper BIM is defined as: "a model-based technology linked with a database of project information" (Lee et al, 2006) and "a receptacle for project information that is structured in such a way that the data can be shared" (BuildingSMART, 2010). BuildingSMART continues to explain that the core of BIM is an object-based 3D CAD model

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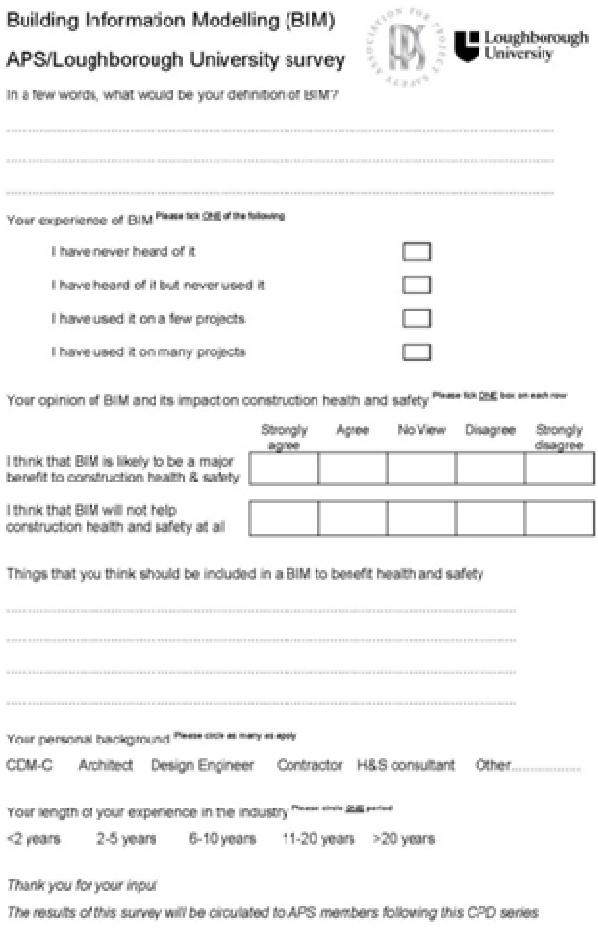
of the project, developed further to "4D (integrating time) or 5D (also integrating cost) and aspirationally, nD (covering a number of other factors)".

Current research work on BIM and occupational health and safety is very encouraging and clearly significant steps forward are being made (Zhang et al, 2012; Behzad & Hallowell, 2012; Sulankivi et al, 2012). However, the very fact that this work is still at the research stage, emphasises that in most cases it is not yet a reality in construction practice. Bold claims in the popular or construction press should be read with care and a degree of scepticism. This paper presents findings from a UK survey of design-related professionals on their knowledge and experience of BIM and its potential to improve construction health and safety.

2. Methods and Sample

Survey sheets as in Figure 1 were distributed before the start of each training event in a continuing professional development series for the Association for Project Safety (APS). The events covered implications for CDMCs[2] and designers from innovative construction technologies and BIM. 329 survey sheets were completed across 16 events, held regionally across the UK (Table 1) between Feb-Jun 2012.

The surveys were completed by attendees prior to any input regarding BIM so they test the prior knowledge and opinions of attendees. Attendees were asked about their professional background, where they could tick as many categories that applied. Not surprisingly, given that almost all were APS members, almost all identified themselves as CDMCs. Figure 2 shows the additional professions identified.



Building Information Modelling (BIM)

APS/Loughborough University survey

Loughborough University

In a few words, what would be your definition of BIM?

Your experience of BIM Please tick ONE of the following

- I have never heard of it ☐
- I have heard of it but never used it ☐
- I have used it on a few projects ☐
- I have used it on many projects ☐

Your opinion of BIM and its impact on construction health and safety Please tick ONE box on each row

	Strongly agree	Agree	No View	Disagree	Strongly disagree
I think that BIM is likely to be a major benefit to construction health & safety					
I think that BIM will not help construction health and safety at all					

Things that you think should be included in a BIM to benefit health and safety

Your personal background Please circle as many as apply

CDM-C Architect Design Engineer Contractor H&S consultant Other.....

Your length of your experience in the industry Please circle ONE period

<2 years 2-5 years 6-10 years 11-20 years >20 years

Thank you for your input

The results of this survey will be circulated to APS members following this CPD series

Figure 1 – Survey Instrument

[2] CDMC – the design-phase health and safety coordinator required under UK legislation (CDM 2007) – similar roles are required across the European Union.

Table 1 UK Regional training events where surveys were completed

APS Region	*Location*	*Surveys*
East Midlands	Kegworth	18
Northern Scotland	Aberdeen	9
Yorkshire	Leeds	28
East Anglia	Stansted	39
London	London	28
South West England	Southampton	18
South East England	Gatwick	24
South Central England	Milton Keynes	12
Scotland West	Glasgow	7
Scotland East	Edinburgh	19
Midlands	Birmingham	21
South West England	Bristol	27
Wales	Cardiff	26
North West England	Knutsford	35
Northern England	Newcastle	18
Northern Ireland	Belfast	6

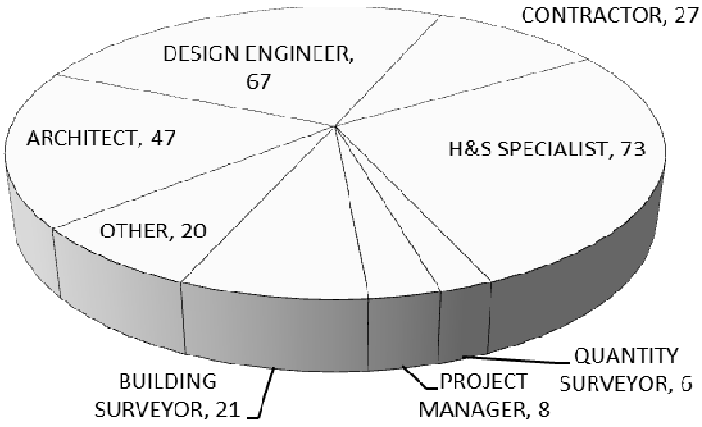


Figure 2 Professions in addition to CDMC

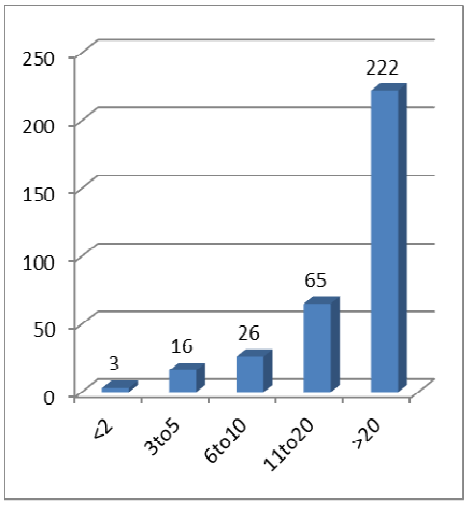


Figure 3 Years' experience

Attendees' length of experience in the industry revealed that 67% had over 20 years' experience and a further 20% had between 11 and 20 years (Figure 3). This was not necessarily in the CDMC role as this was not specified and the CDM Regulations only created the Planning Supervisor role in 1994 which was changed to CDMC in 2007. Therefore the experience was deemed to be in the other profession specified.

3. Results

3.1 Experience of BIM

Attendees were asked about their past experience of BIM (Figure 4). Almost a quarter of this experienced sample had never even heard of the term and almost three-quarters had heard of it but never used it.

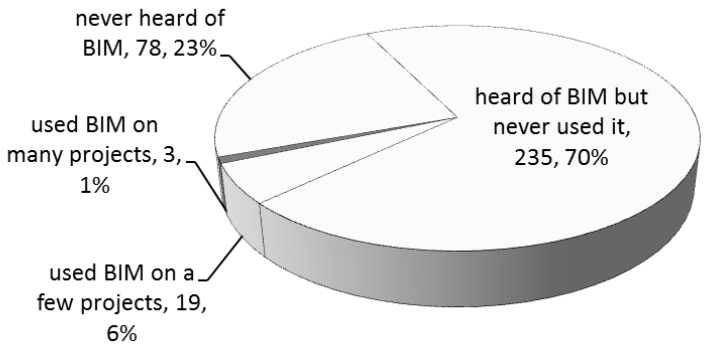


Figure 4 – Experience of BIM

Given the current publicity surrounding BIM and the amount of coverage in the technical press in the UK over the last year or so, the 23% who claimed to have never heard of the term was somewhat surprising, as was the very low number (n=22, 7%) of those who had used BIM on many projects. This illustrates that the hype attached to the subject may well be clouding the true extent and range of understanding.

3.2 BIM definitions

Before the start of the session, attendees were asked to provide a short definition of BIM to test their understanding of the subject alongside their statements regarding their own experience. 33% (n=111) did not complete this section or stated that they did not know, which was to be expected, particularly as a number admitted not having heard of BIM. 11% (n=36) merely restated the words Building Information Modelling. Only 16% (n=52) gave definitions that could be considered as fulsome or reasonably accurate when reviewed against the 'standard' definitions provided in the session. A simple thematic analysis (Table 2) identified the main themes as influencing more than just design (79), integration and coordination, including clash detection (59), 3D (53), sharing of information across project stakeholders (33) and a single or common model / store (15). Figure 5 is a Wordle representation of all 'correct' definitions (www.wordle.net) and Figure 6 a representation of the words used omitting the words Building, Information/Info and Model / Modelling.

Figure 5 Wordle of definitions

Figure 6 Wordle of definition omitting BIM

Table 2 BIM Definitions - Content Analysis (Rank Order)

(excluding zero entries, don't knows and incorrect entries i.e. scoring 1-5, n=183)

Term	*Number*	*Term*	*Number*
Design(er/ed)	93	Team	9
Info(rmation)….	88	Software	8
Model(ling)	80	Component	8
Building	77	Change(s)	7
3D	54	IT	6
Project	36	Standard(s)	6
Construct(ion/ed/or)	33	Collat(e/ed/ion/ing)	5
Coord(ination/inate/d	27	Communicat(ion/ed/e)	5
Computer	22	Cycle/Life cycle	5
Integrat(e/ed/ion)	21	Technique	4
Management	21	Better	4
System	19	More	4
Data	18	Architect(ural)	3
Process	13	Engineer(ing)	3
CAD	11	Collection	2
Element	11	Collab(oration)	1
Building information model	10	Object	1
Electronic	9	Improv(ed/ment)	1

In addition a few definitions offered (n=34) were significantly incorrect such as: *a theoretical approach to risk assessment & hazards; coordination of all services in risers and voids; an innovative construction planning technique; methods of managing project safety & risk information;* and *a database of key performance indicators*. Finally a small number used the opportunity to make particular points such as: *Gimmick! Fad! High cost disaster in the making; a new 'buzz word'; innovative but expensive; means of putting all liability for quantities onto the architect;* and *more of a student activity at college*. One respondent made the point that BIM was 'the future!' and exhorted: 'Get the training sorted now!'

3.3 Will BIM improve construction health and safety?

Respondents were asked to respond to two statements:

- I think that BIM is likely to be a major benefit to construction health & safety
- I think that BIM will not help construction health and safety at all

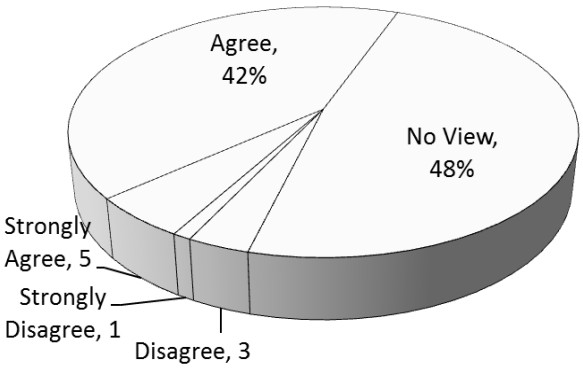


Figure 7 Responses to 'I think that BIM is likely to be a major benefit to Construction H&S

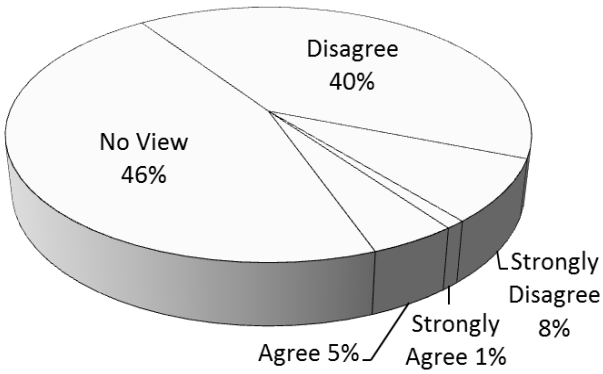


Figure 8 Responses to 'I think that BIM will not help construction H&S at all

Around half (48% and 46% respectively) of respondents either responded 'no view' or did not make an entry. This again is consistent with those who admitted that they had little or no appreciation of BIM. Other than this, there was generally strong agreement that BIM will bring benefits to construction health and safety. However, in further discussions during the training sessions, it was clear that this benefit was a future potential rather than a present reality since health and safety issues have not been incorporated within the BIMs.

4. Discussion

The precise nature and extent of a BIM is still not completely clear and the variety of definitions by the workshop attendees is mirrored across the construction sector. Some argue for a fairly narrow, technically-driven definition whilst others would agree with Tim Broyd, Halcrow Group director of technology and innovation who argues that BIM is "a set of software-enabled processes that allow project information to 'flow' through the lifetime of a project (building or infrastructure facility) such that individuals have access to the information they need, when they need it and in a manner that allows efficient and effective design, construction and operation."

One of the key challenges of BIM that was discussed at the workshops was the assumption that the stakeholders are all working collaboratively. Figure 9 is taken from the BuildingSMART guide to BIM and illustrates this point. If each stakeholder is to freely contribute to the BIM then they need a degree of confidence that their contribution is recognised and that their intellectual or commercial property is not abused.

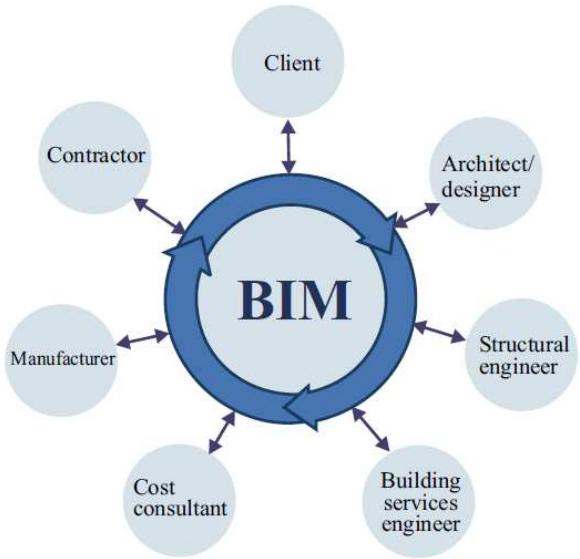


Figure 9 – BIM stakeholders (BuildingSMART, 2010)

The fact that the CDMC is not included in this representation was also not missed by this constituency. There was no clear view as to whether the CDMC constituency was in a position to act as the BIM coordinator, nor whether they would want to fulfil the role. The fear was expressed that the CDMC role could be bypassed completely by the onset of BIM.

In Europe, the Temporary and Mobile Construction Sites Directive has required designers and pre-construction planners to consider the health and safety of workers in the construction, maintenance and demolition phases of the building and facility. This has led to the Construction Design & Management Regulations in the UK and other national legislation across the European Union. This approach has also been extolled by a number of researchers and practitioners across the world, particularly through the Prevention through Design initiatives. The assumption of this approach is that design professionals are able to carefully consider their designs and make informed decisions having assessed the risks that would be involved during construction.

Figure 10, again from BuildingSMART, allocates (or relegates) health and safety to the rules and regulations category along with Building Regulations and Planning.

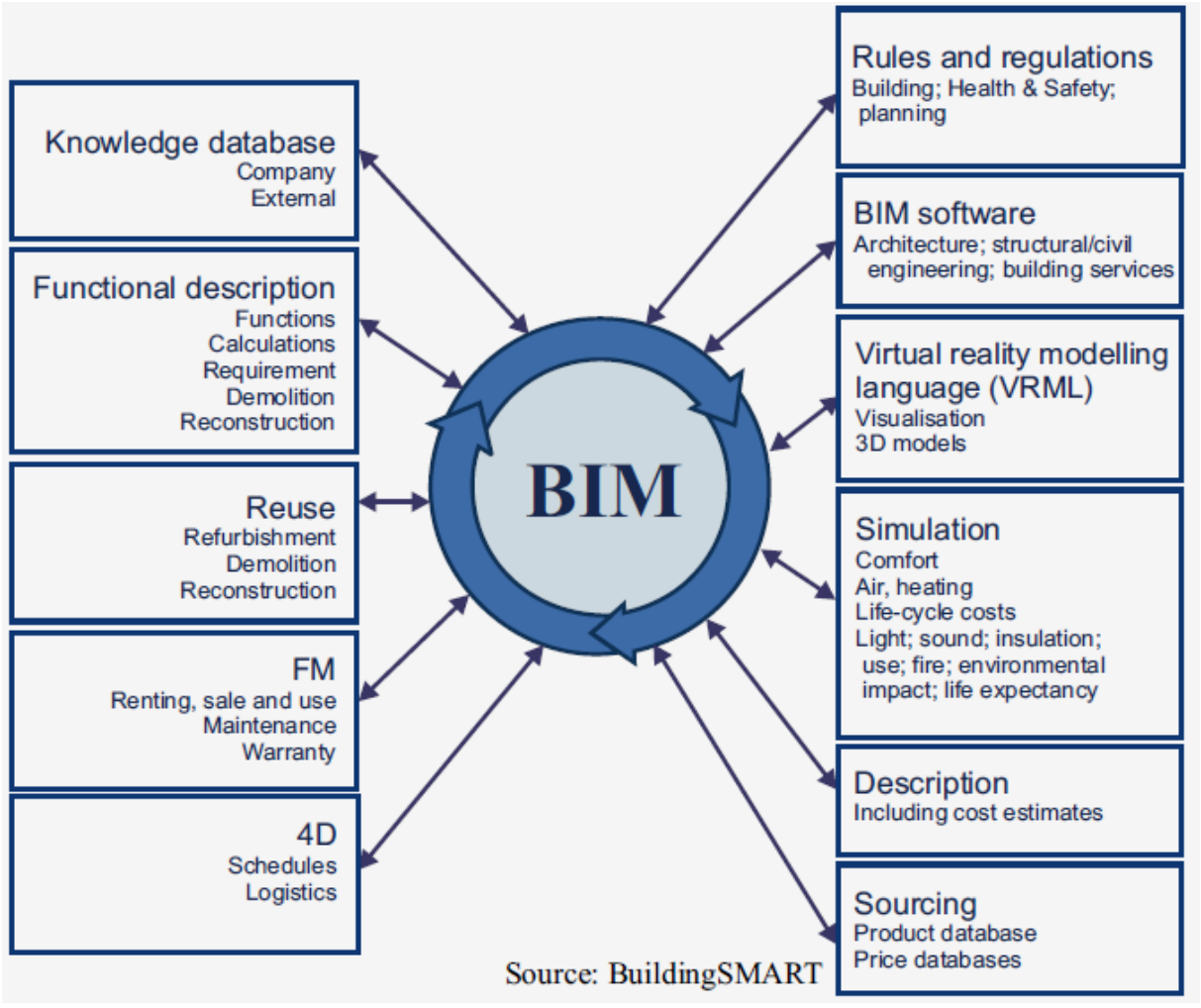


Figure 10 Categories in an ideal BIM (BuildingSMART, 2010)

The danger of this allocation is that occupational health and safety may just be treated as a matter of complying with legislative requirements rather than being seen as an integral part of project management. The workshop attendees agreed that this may result in effective health and safety being lost amongst a plethora of standardised data. Areas such as the control of substances hazardous to health (COSHH) tend to produce large volumes of information. Attendees warned that, as there was already a tendency to try to standardise risk assessments, this could be exacerbated by downloading copious amounts of health and safety data that could be included in a BIM. The danger is not that health and safety would be forgotten in a BIM but rather that it may be lost in a mass of information.

One of the dangers of all good ideas is assuming that they will solve all your problems. Figure 11 shows the Gartner Hype Cycle (Adapted from Fenn & Raskino, 2008). Workshop attendees agreed that BIM was currently near the top of the peak of inflated expectations. They argued for a more realistic set of expectations and an increased engagement with the further development of BIM, particularly with respect to health and safety.

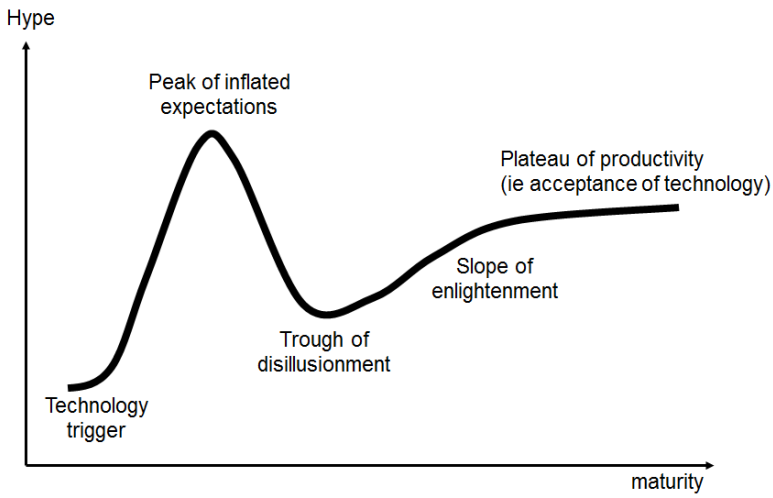


Figure 11 Gartner Hype Cycle (Adapted from Fenn & Raskino, 2008

5. Concluding thought

Notwithstanding the current limited deployment, and the distinct lack of knowledge about BIM, the UK Government is ploughing ahead with its requirements to implement BIM (level 2) on all Government-funded projects from 2015. So, as a community, we need to make sure that we engage with the development to ensure that construction health and safety maintains a vibrant and effective part of the BIM.

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