Automation in Construction 18 (2009) 357–375

Contents lists available at ScienceDirect

Automation in Construction

journal homepage: www.elsevier.com/locate/autcon

Building information modelling framework: A research and delivery foundation for industry stakeholders

Bilal Succar

University of Newcastle, Australia
RMIT University, Australia

ARTICLE INFO

Article history:
Accepted 10 October 2008

Keywords:
Building Information Modelling
Research and delivery framework
Maturity stages
Implementation steps
Lenses and filters
BIM ontology
Knowledge visualisation

ABSTRACT

Building Information Modelling (BIM) is an expansive knowledge domain within the Architecture, Engineering, Construction and Operations (AECO) industry. To allow a systematic investigation of BIM's divergent fields, its knowledge components must be defined and expanding boundaries delineated. This paper explores some of the publicly available international guidelines and introduces the BIM Framework, a research and delivery foundation for industry stakeholders. This is a 'scene-setting' paper identifying many conceptual parts (fields, stages, steps and lenses), providing examples of their application and listing some of the Framework's deliverables. This paper also identifies and deploys visual knowledge models and a specialised ontology to represent domain concepts and their relations.

1. Building Information Modelling

Building Information Modelling (BIM) is a set of interacting policies, processes and technologies generating a "methodology to manage the essential building design and project data in digital format throughout the building's life-cycle" [67]. The following sections expand on the BIM term, list related industry and academic efforts and identify the need for an investigative framework (Fig. 1).

1.1. BIM: the term

Building Information Modelling (BIM) is an emerging technological and procedural shift within the Architecture, Engineering, Construction and Operations (AECO) industry. Researchers have been investigating the components and repercussions of building product models [21] for many years before the emergence of BIM as a new term. While the mere presence of a label or an acronym is viewed by some researchers as a sign of poor lexical literacy [70], others refer to names as "vital for communication and useful for understanding a situation" [11]. Many industry writers and analysts have contested the many terms available while others have argued for the acceptance of BIM *as is* because of its adoption by industry's major CAD developers [54]. Whether the term itself is useful, agreed upon or contested, BIM is continuing its proliferation in both industrial and academic circles as the 'new CAD paradigm' [40].

1.2. Differences between terms

Some researchers have opted to differentiate between the many available terms [51] but the extensively overlapping boundaries render the uniqueness of each term questionable. From conceptual to descriptive in nature, these terms can be attributed to research or industry bodies as well as software developers. Table 1 sets out some of the more widely used terms in both research and industry literature while Fig. 2 presents some common connotations of the BIM term.

Some of the underlying knowledge and computational structures represented by these terms has shifted from research circles to the industrial realm [46] while many efforts could not attract the interest of the industry [33].

1.3. The need for a framework

In many writings, seminars and workshops, BIM is argued to be a catalyst for change [7] poised to reduce industry's fragmentation [17], improve its efficiency/effectiveness [34] and lower the high costs of inadequate interoperability [62]. These assertions — abridged as they may be — include several mental constructs derived from organisational studies, information systems and regulatory fields. Such divergence and coverage highlights the *lack of* and the *necessity for* a research framework to organise domain knowledge which, in turn, requires a systematic investigation of the BIM domain.

Additionally, the need for a systemically-defined BIM Framework extends beyond knowledge enquiry and organisation. Practitioners and educators alike will arguably find value in the delineation and

E-mail address: bsuccar@changeagents.com.au.

0926-5805/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.autcon.2008.10.003

subdivision of the BIM domain. Structured subdivisions promote understanding, dissemination and gradual implementation by presenting data and arguments in manageable sections. There is also *a need for* a framework that positions BIM as an 'integration of product and process modelling' [47] and not just as a disparate set of technologies and processes. Lastly, there is a *lack of* and a *necessity for* a framework that attempts to bridge the chasm separating 'academic' from 'industrial' understandings of BIM by providing a research and delivery structure adaptable to their complementary yet unique requirements.

1.4. Availability of other frameworks

BIM implementations and discussions continue to increase in intensity as more organisations and national bodies recognise its value-adding potential. This is evidenced by the accelerating emergence of guidelines and major reports dedicated to exploring and defining the requirements and deliverables of BIM (Table 2).

These guidelines and reports — although valuable in their own right — do not provide a foundational framework suitable for the systematic investigation of the BIM domain. The availability of a

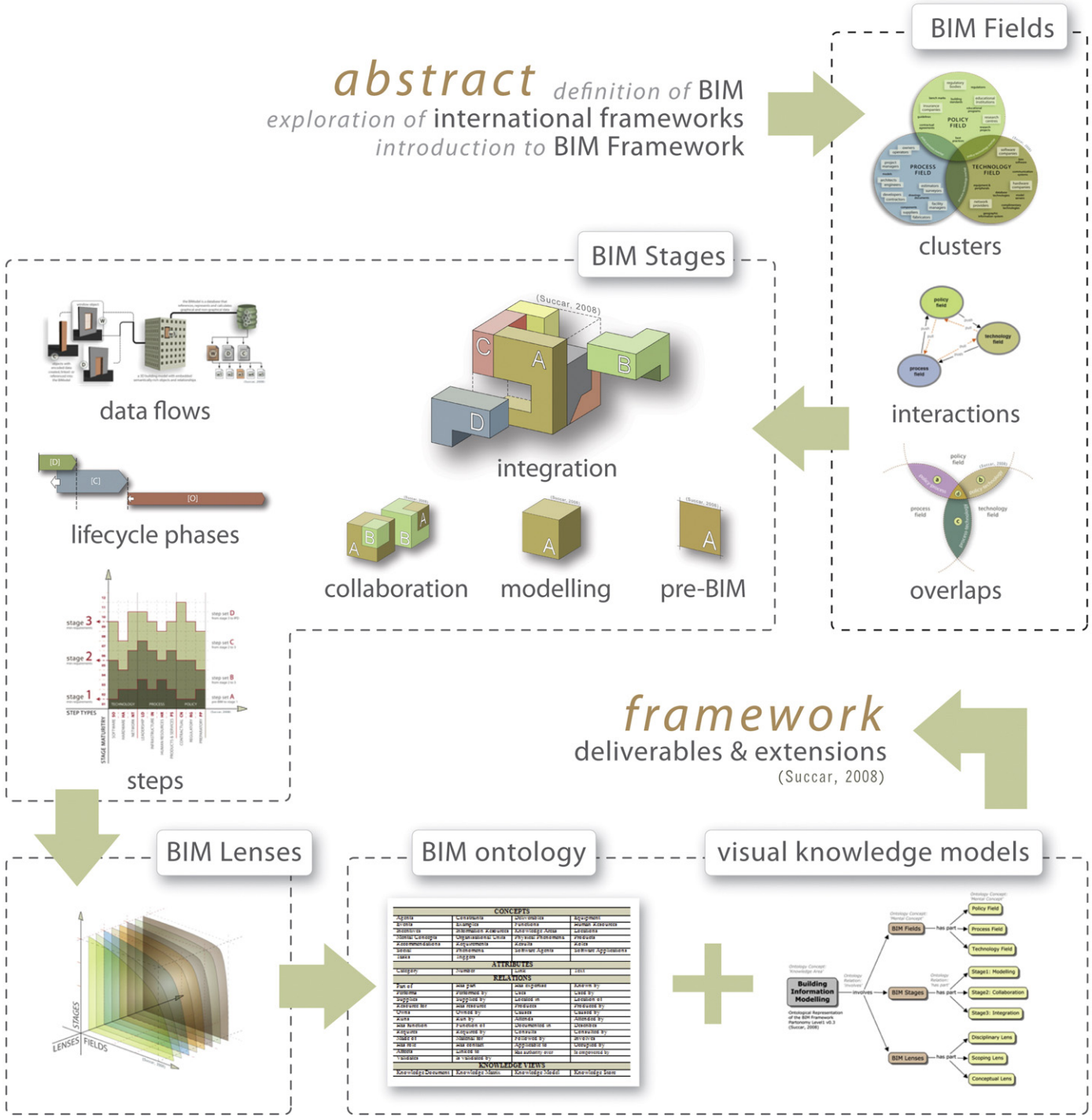

Fig. 1. Visual abstract of this paper.