
The Need for Landscape Information Modelling (LIM) in Landscape Architecture

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Abstract

Building Information Modelling (BIM) is growing in the Architecture, Engineering and Construction (AEC) Industry, with the new UK Government strategy to mandate BIM by 2016, there is a need to identify the importance of BIM in architectural landscape design to encourage BIM adoption. The use of BIM best practices can lead to efficient and effective BIM collaborative technology and partnering. BIM has the potential to challenge some of the limitations of designing, constructing and managing the built environment. The drive for this paper is a literature review on BIM and landscape architecture, describing current BIM use in landscape architecture using academic search engines and findings from UK Landscape Institute. Landscape architects should be BIM oriented. It is difficult to specifically identify a BIM software for landscape architects, this creates a need for landscape architects to come together and demand software, creating market for software vendors, to realise the manufacturing of landscape BIM software, with more specific landscape software, landscape architects could be able to provide a more innovative design with effective competence and collaborate with other BIM users efficiently. BIM process requires collaboration.

This research might be of importance to practitioners and academics, as it outlines different definitions of BIM, the relevance, need, benefits and challenges of BIM in landscape architecture.

Keywords: BIM; collaboration; construction; design; efficiency; landscape architecture.

1 Introduction

BIM means different things to different people (ARANDA et al 2007, 2008; Succar 2009). This research defines BIM by different BIM champions in the (AEC) Industry. The methodology used in the definition of BIM is based on a robust literature review. It is important to better understand BIM definitions, as there is a UK Government push to mandate the use of BIM in major building projects by 2016 (BIS 2012, JAMIESON 2011). This paper addresses two key questions on BIM; what are the benefits of BIM in a broader case? What is the need for landscape architects to use BIM in their projects? JAMIESON (2011) stated that there is: (1) Global increase in population growth; (2) Increase in infrastructure construction growth rate, with an estimate of “infrastructure construction growth” of 128% and 18% “developed markets” by 2010-2020; (3) By 2020 the global

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construction market will be 55% “emerging markets” and 45% “developed markets”. (4) An estimate of 70% of populations will be living in urban areas by 2050. These statistics shows that there would be an increase in population, city centre developments, creation of green spaces, infrastructure construction and so on. SHEPLEY (2010) stated that in 2000, there was no website related with green healthcare architecture, while awareness increased to make healthcare facilities greener, with these developments, green areas needs to be designed, created and organised to improve sustainable environmental development, perhaps this creates a need for landscape and urban designers to engage with modern tools to participate in improving the AEC Industry. By 2016 AEC Industries in the UK most use BIM to a certain level in their projects, currently there is no specific BIM platform for landscape architects, and this can hinder collaboration with other BIM compliant professionals. FLOHR (2011) stated that Landscape architects should not be left out of the BIM process.

2 Need for BIM in Landscape Design

Using BIM tools and applications, landscape analysis can be explored, developed and documented for design planning and organisation, as BIM stores object information such as: irrigation pipe lines; areas allocated to specific plants; and list of different plants involved in each landscape project. Annotations used in landscape drawings can be 2D or 3D with information attached to it. BIM can help in planning for both hard and soft landscape elements, with many details involved it can also be used to store data for landscape architects to easily develop and organise detailed information. With the ability for simulation and visualisation, landscape architects should be able to produce detailed plans, walk-through animations and renderings for presentation and exploring the scope and nature of work to make informed decision at early design stages. Plant data description and specifications can be used to make sure the right plants are used in the right places, for example a drought tolerant plant can be used were there are major issues with water availability, sun loving plants used in open areas, and natural growing plants to be used in chemical controlled areas. With lots of landscape element’s information (soft elements) such as different plant types, water usage and (hard elements) such as lighting, surface covering, pools, benches, and walk pathways to combine and analyse in a single landscape model, these details will allow the designer to design, report plans and proposals.

According to GOLDMAN (2011), “There exists a belief that BIM software is immature or simply not applicable to the field of landscape architecture. This is the leading barrier to adoption of BIM for landscape“. This was also mentioned further in an interview with a member of the UK Landscape institute, he stated that “there is major concern in the landscape industry regarding BIM use, that lack of expertise in the use of Landscape information modelling could effectively remove landscape architects from the supply chain”, therefore they would have to take important initiatives to equip their registered member with the necessary skills and information required to fully participate in the BIM workflow chain, he also stated that “Working groups will gain an appreciation of the level of BIM knowledge amongst our registered practices” and that the best software for landscape information modelling were Autodesk Revit and a times Bentley. There are software that can be used for landscaping, but for detailed landscaping that will facilitated

functionality, workflow and site planning; there is a need for software vendors to focus on landscape architects to enable collaboration with other BIM users in the AEC Industry. HAYEK et al. (2011) quoted (APPLETON et al. 2002; PAAR 2006) that there is no “universal landscape visualisation solution” perhaps software like ArchiCAD and Autodesk’s Revit can be used to partly carry out landscape design tasks.

References	Relevance of BIM to landscape architecture
PIETSCH (2009)	State that “Landscape models can be used to make simulation, explanation, experimentation and communication”. A BIM model can also be used to store digital information with landscape planning details for “landscape analysis, landscape assessment, impact assessment, landscape planning”
BOHMS (2008)	BIM allows for partnering/collaboration, sustainability, efficiency and consumer orientation
KALKHAN (2011)	Describes that landscape parameters can be understood through the use of complex model with thematic mapping approaches.
JOSEPH (2011)	Describe that with exception of the building, plants could also contain integral intelligent properties that will foster better construction and maintenance.
WEYGANT, (2011)	State that BIM has created an opportunity for visualisation of exterior components by “creation of accurate site-based components] objects, landscaping, planting and topography”.
JACKSON (2010)	BIM is taught in institutions. It is encouraging that BIM technology is designed to integrate information, by facilitating collaboration among different student’s disciplines in the construction industry such as planning, facility management, architecture, landscape architecture and engineering.
HAYEK et al. (2011)	State that there is no “universal landscape visualisation solution”.
BIS (2012)	“Building Information Modelling and Management BIM(M) is a managed approach to the collection and exploitation of information across a project. At its heart is a computer-generated model containing all graphical and tabular information about the design, construction and operation of the asset”
AUTHORS	To enable landscape architects to use BIM.
AUTHORS	To collaborate with fellow BIM users in the AEC Industry when BIM is mandated by the UK Government in 2016.
AUTHORS	BIM can help in organising landscape data.
AUTHORS	BIM automation can reduce time frame to conduct landscape design tasks.

Table 1: Why BIM use in landscape architecture

BIM and landscape architectural articles are available in a few numbers; Figure 1 shows primary findings from academic search engine that articles relating to BIM and landscape architecture are growing slowly. Figure 2 shows a slow rise in publications from 2002-2011. This research has sampled academic search engines relating to engineering and construction on the Athens page in January, 2012, which are not in any particular order or hierarchy. The aim of sampling data was to find the current development of articles in the field of BIM and landscape architecture. Keywords such as “BIM and landscape architecture” were used and results showed a low rate of growing publications. Findings below raise research questions such as: Why are there few BIM and landscape architectural related articles?; Is there a need for the application of BIM in landscape architecture?; How can landscape architects plan for the UK Government strategy to mandate BIM by 2016?; Can landscape architects work efficiently and effectively within the BIM work flow without specific BIM (landscape) software?

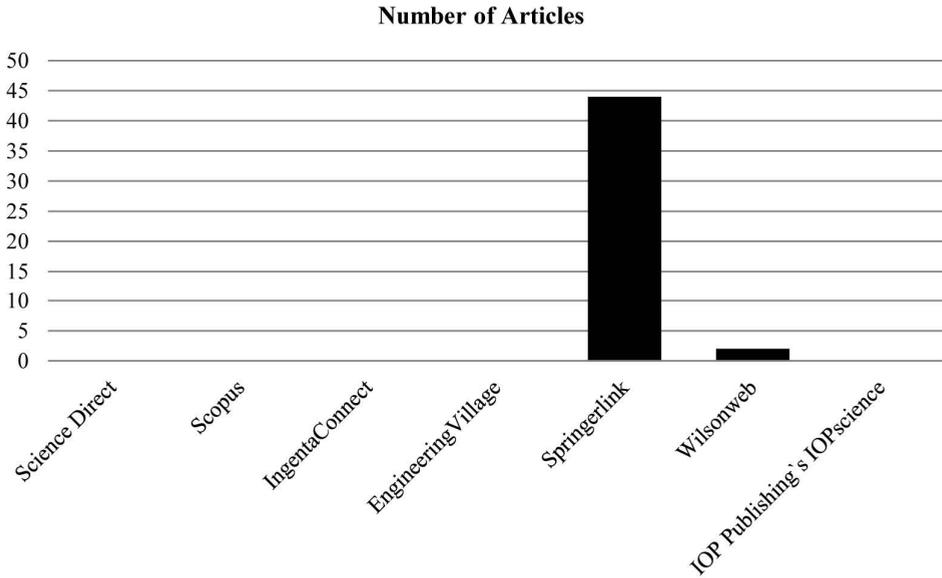


Fig. 1: Number of BIM and landscape articles available

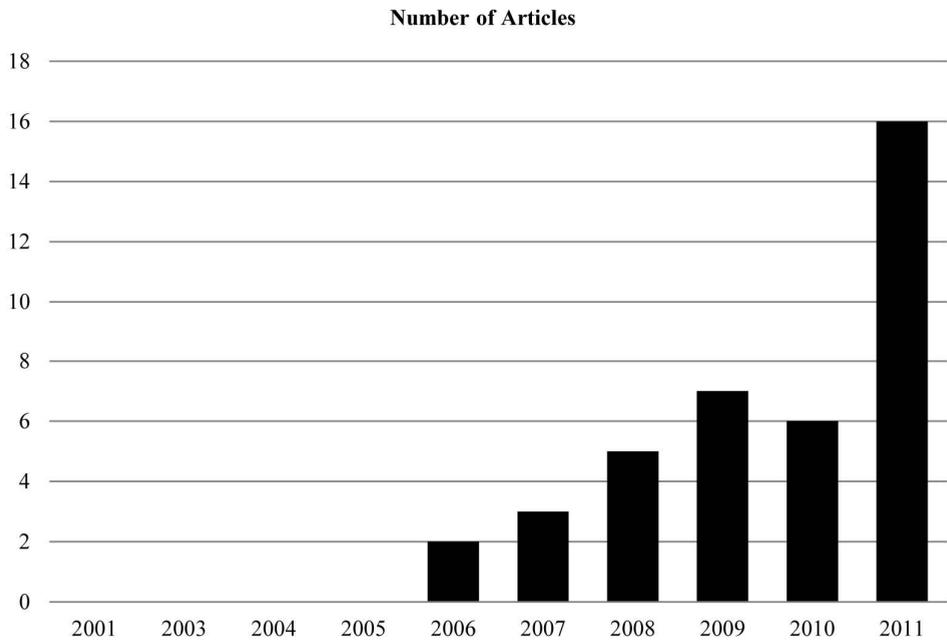


Fig. 2: Number of BIM and landscape architecture related articles from 2002 – 2012

3 Literature review

3.1 Defining “BIM”

HARDIN (2009) agrees with EASTMAN et al (2011) that BIM is defined by various experts and organisations differently. BIM requires technology to be implemented. AUTODESK (2003) stated these technologies as: CAD (traditional drafting); object CAD (3D geometry of buildings) and parametric Building Modelling (real time self-coordination of information). Key words used in these definitions below are: technology, information, building, management, process and geometry.

References	Definitions
1. WEYGANT (2011)	BIM is a technology that has improved the way structures are designed and built”...“A technology that allows relevant graphical and topical information related to the built environment to be stored in a relational database for access and management”.
2. HARDIN (2009)	Describe BIM as a process, and also a means of adopting and establishing a new notion of thinking.
3. BENTLEY (2011)	define BIM as a new way of approaching design and document of building projects, the entire life cycle information is considered (design, build and operations) defining and simulating building delivery and operations using integrated tools.
4. STATE OF OHIO (2010)	State that “The term BIM may be used as a noun to describe a single model or multiple models used in the aggregate, the term BIM may also be used as a verb in the context of Building Information Modelling or Management, the process of creating, maintaining, and querying the model”.
5. AUTODESK (2002)	Define BIM as an information technology in the building industry that facilitate the creation and operation, management and collaboration for digital database to be captured, preserved and used for building construction.

Table 2: What is BIM?

3.2 Benefits of BIM

(BIM Benefits in Pre-design and design phase): OLOFSSON et al. (2008) highlighted that BIM at the conceptual design stage provide the following benefits; quick visualisation; good decision shore up in project development process; precise automatic updating; diminution of man hours for space programs; increased project team communication; increased confidence of scope of work. BIM is used to produce schematics design details and improve the presentation to clients for easier and better decision making.

(BIM Benefits in Pre-Construction phase): The use of BIM in the construction phase enables scheduling and work flow coordination whilst at the preliminary pre-construction level, cost estimates and constructing virtual logistic of cranes and materials on site (AUTODESK 2003). The 4 fourth dimension is of particular importance as BIM is used in the construction phase to establish and evaluate various construction options. A 4D model can be obtained by adding schedule data to a 3D building design, introducing time as the 4 fourth dimension (AUTODESK 2003). 4D planning is a technique that integrates 3D CAD

models with construction activities (schedule) which allows clear visualisation of a construction programme sequence. 4D is noted by AUTODESK (2003) to be developed by comprehending schedule dates from project plan to model, the evaluation of construction sequence, detection of clashes, identifying construction milestones before construction begins to take place.

BIM Benefits in Construction Phase: The main benefits of BIM at this phase as stated by AUTODESK (2003) includes: Scheduling of construction schemes, scheduling what is constructible; Clash detection and reporting; And quality of projects is being analysed and improved by rescheduling.

Benefits of BIM in a broader view: ARANDA-MENA et al. (2008) suggested that execution of BIM at industry level has three outcomes, which are: Technical capabilities: this involves the ability to share information with other consultants and the production of drawings and documents from BIM model; Operational capabilities: this supports design collaboration, reduces errors and allows the ability to design in 3D environment; Business capabilities: completing projects with efficiency, and also reduces information errors. VTT (2006) described the benefits of BIM use, to have various opportunities to professionals in the AEC Industry, these are listed as: Strategic thinking + BIMs = Transformational opportunities; Tactical thinking + BIMs = Informational opportunities; Operational thinking + BIMs = Automational opportunities.

3.3 Limitation of BIM use

Technical and managerial issues are stated as the two main problems of BIM execution. BERNSTEIN & PITTMAN (2005) described Technical issues as: Production of a well-defined construction process model; Adopting formats that enable design data to be computable; Enable accurate data exchange and integration within a BIM model. They also described the Managerial issues as a major factor hindering the progress of BIM implementation; it is related to the issues of BIM implementation cost and use. Due to lack of standardised established BIM implementation manuals, the management of BIM at industry level becomes very difficult to implement. WEYGANT (2011) noted that the main challenges of BIM are: poor data exchange approaches; interoperability; cost of training, hardware and software.

4 Research Methodology

Literature review was used in constructing the basis of this research, defining BIM and also describing its benefits and challenges at various stages. The literature searches involved the use of both online and offline data to gather information on BIM and landscape architecture in the AEC Industry. Data sources used includes:

1. Springerlink;
2. Automation in construction;
3. ProQuest;
4. Google books; and
5. Scholar.

Other academic sources used for the purpose of secondary data collection includes: Books; journals; and conference papers. Keywords such as BIM, BIM and landscape architecture, Landscape information modelling, landscape architecture and landscape modelling were used to find relevant data for the purpose of this research paper. A short interview with a member of the UK Landscape Institute was conducted. This paper addresses questions such as: Is there a need for BIM in the AEC Industry? Is there a need for BIM in landscape architecture? What are the benefits of BIM in a broader case? And what are the uses of BIM in landscape architecture?

Landscape encourage public realm improvements through pedestrians networks, creating sense of place that is embrace by the public, these landscape areas are integrated into the existing urban fabric. Landscape enhances the quality of our build environment, in healthcare facilities, green environments are encouraged as they can improve patient care. Despite the advantages of landscape in the urban fabric, there are many problems affecting the practice in the UK such as economic recession, and the need of BIM application in practising landscape firms. Membership with the UK Landscape Institute is still growing regardless of the economic recession that affected the building industries; this shows a growing interest in landscape architecture. There is a growing rate of UK landscape institute membership by landscape practitioners, with 5214 members in 2007, 5427 in 2008 and 5693 in 2009 (Landscape Institute, 2008-2010).

4.1 Landscape with BIM

Landscape architecture is not totally compatible with all architectural BIM software, software should be developed with landscape application in mind, to enable landscape designers to design effectively, lack of specific software for landscape design can create drawbacks, software at the moment can only be recommended for landscaping, choosing a software can therefore be difficult, it is claimed that there is no one software package that is landscape information modelling ready. Regardless of these difficulties, BIM is still encouraged as technology that will allow the ability for GIS and design landscape in multi-dimensions, to achieve creativity and innovative state of the art designs. Software such as Land FX can be used for planting and irrigation modelling purposes, ArchiCad for presentation, rendering and quantification, it can be possible to calculate the amount of water needed for the entire landscape design when figures are collected, the amount of water for each plant can vary, but an estimate of water required for each plant can be obtained, with these increased modelling information, BIM can facilitate information storing, sharing and modelling capability providing distinctive design opportunities for landscape architects, it also creates an opportunity for the visualisation of exterior building components such as benches, pools, planters and so on, these objects in 3D will contain information that will foster the design process. To achieve a collaborative BIM studio, all professionals including landscape architects have to come together. Collaboration between architects, landscape architects and engineers has being an on-going process for over a decade (FRUCHTER 2003). BIM is widely gaining recognition in the AEC Industry, and its potential is not yet fully exploited and explored. Therefore landscape can be enhanced with continuous BIM explorations. Landscape architects are currently using BIM tools for their various designs, but this software is not 100% compatible with all landscape tasks, as current software is modified to enable landscape architects to use for their designs.

4.2 Common BIM use in Landscaping

Some uses of BIM in landscape include: quantity counts (number of both soft and hard elements); error reduction with organisation of data; smart symbol use (2D and 3D); landscape presentation (plants) before they eventually grow; storing data; Site information modelling; cutting and filling sites (site analysis details); assigning plants types at areas that suit their nature (site analysis details); and exploring and presenting ideas to clients. In a short interview with a member of the UK Landscape Institute, states that BIM software that can be used for landscape architecture includes: Vectorsworks Landmark, Land F/X, LandCADD, SiteWorks, ArchiTerra, AutoCAD Civil 3D, Autodesk's Revit, Grahisoft ArchiCAD.

5 Conclusion

LANDSCAPE INSTITUTE (2010) stated that "When landscape is placed at the heart of the development process, developers profit while businesses and communities reap the economic benefits" perhaps landscape can be a cutting edge service that enhances buildings and the entire built environment. BIM use is important in landscape architecture for the purpose of: automation; collaboration; adding quality to design; saving time and cost; reducing errors; and designing landscape with objects which have additional information attached, allowing object data to be easily collected and managed, this fosters the design by enabling designers to make informed decisions at early design stages due to the availability of instant and comprehensive amount of information. There are various benefits to the application of BIM in landscape, but BIM faces a staggering challenge of economical; social; legal; educational; and technical constraints. Interoperability seems the ultimate challenge of BIM, PIETSCH (2011) noted that the problem of information exchange in landscaping modeling planning can be improved by extending existing standards and producing new standards. "BIM and landscape architecture" articles are limited; this shows a need for awareness, to inform landscape architects the importance of the use of BIM in their profession and within the BIM collaboration process. The analytic aim of this paper is to identify BIM: awareness; partnering; need and application. A prescriptive solution is for stakeholders to come together and produce landscape information modeling articles and make available to practitioners. This can increase awareness of "BIM and landscape architecture" in industry.

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