The Place for Information Models in Landscape Architecture, or a Place for Landscape Architects in Information Models

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1 Introduction

At Harvard University's Landscape Infrastructure symposium in March of 2012, Pierre Belanger's keynote began the proceedings with a dire warning. In a particularly chilling chart, Mr. Belanger illustrated how small the role of landscape architects in the design and construction industries truly is. In the US, the Department of Labor estimates that in 2010 there were 113,000 architects, 262,000 civil engineers, 523,000 construction managers, and only 21,000 landscape architects then employed. When you consider what Ahmad and Aliyu noted in 2012, that the UK Landscape Institute is noticing "major concern in the landscape industry regarding BIM use, that lack of expertise in the use of Landscape Information Modeling could effectively remove landscape architects from the supply chain", the outlook for landscape architecture looks grim indeed.

The Architecture, Engineering, and Construction (AEC) industries are rapidly adopting Building Information Modeling (BIM) tools that allow not just the modeling of structures, but the processes that drive those structures during and after construction. Architects can model the indoor environmental quality of their building designs based on solar aspect and insulation, local microclimates, and r-values of windows. Engineers model the performances of storm and sanitary sewer networks, dams, bridges, and highways, all under simulated conditions. With the UK's mandate of BIM adoption in AEC by 2016, landscape architects will have to finally grapple with Information Modeling. Is BIM a silver bullet? Is it a cure for all of landscape architecture's problems, or is it the one thing that will finally kill landscape architecture off? That comes down to the question "who's BIM?"

2 What is BIM?

Building Information Modeling (BIM) describes software tools in use in the Architecture, Engineering, and Construction industries. This is more than a simple computer aided drafting (CAD) system. These tools allow the creation of smart components within building models which allow professionals to model the processes involved in construction and operation of buildings. BIM tools are represented by Autodesk Revit, Graphisoft ArchiCAD, Bentley Architecture and others.

These tools are built on a set of standards governing the interoperability of information within the design and construction workflow. This interoperability is one of the key features of BIM packages. It allows professionals working across disciplines the ability to collaborate on large projects. An oft quoted statistic states that the US National Institute of Standards and Technology have identified that "poor interoperability and data management

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costs the construction industry $15.8 Billion a year, or approximately 3-4% of the total industry" (TAYLOR & BERNSTEIN, 2009; SUERMANN, 2009; originally GALLAHER et al., 2004)

Streamlining the collaborative process with interoperable standards is just one advantage BIM tools offer. the ability to model building processes has been extended to perform energy efficiency simulations. This capability is essential, not merely for the improved performance of the resulting structure, but because it has supported the proliferation of sustainability standards like LEED.

And as BIM is a relatively recent development, it is still evolving and finding new uses. Researchers at The University of Texas at Austin have been exploring the integration of laser scanning and BIM models of construction sites to create a real time construction control application (TEZIER et al., 2005).

3 How Can Landscape Architects Use BIM?

The advantages to architects and engineers using BIM are considerable: maintaining consistency of vision across very large projects, ease of making changes or versioning, cost control and quality assurance, spec'ing. But how can landscape architects capitalize on the advantages of information modeling? What would a Landscape Information Model (LIM) look like?

3.1 Large Parks

Large parks are gaining ground, and are seen as one solution to the myriad problems caused by urbanization and disurbanization. In North America, these projects are becoming the marquee projects of landscape architecture, from Orange County Great Park outside Los Angeles, to Downsview Park in Toronto, Ontario, to Fresh Kills and Jamaica Bay in New York. This trend can be seen in Europe as well, with Duisburg-Nord Landscape Park in Germany and Cultuurpark Westergasfabriek in the Netherlands. Termed Landscape Urbanism in North America, these projects are predicated on designing landscape process at a large spatial scale, centering on dynamic ecological successional plans without fixed outcomes. This premise flies in the face of the traditional construction process. And yet, conceptually at least, these are exactly the sorts of tasks that BIM is suited to.

At Downsview Park in Toronto, Ontario, Canada, the need for a Landscape Information Model (LIM) is apparent. Originating as a design competition in 1999, from its inception the park was meant to be ecologically dynamic. The competition brief stated that, "The physical conditions of the site and its natural processes provide opportunities to create new as well as old ecologies. [...] The design of the Park is to provide both an inauguration and a framework for change over time. It should anticipate an adaptive management approach in which the effects of interventions are monitored, adjustments are made, and new directions and configurations emerge" (MERTINS, 2001; in NORTH, 2012). The winning competition entry, from OMA/Bruce Mau Design, met this challenge head on. However, as construction has begun, several factors both within and outside the design process have shifted the design "from a diagram signifying a process framework toward a static plan and hence

eliminating the opportunity to test and reiterate the landscape-as-process theory" (NORTH, 2012)

While BIM cannot solve the political disputes involved in large scale civic work, it is suited to the challenges of large scale projects and of versioning. NORTH (2012) describes how the design of Downsview Park was broken up into discrete pieces handled by numerous subcontractors. A Landscape Information Model would have allowed these practitioners to work together on one model for the park, and allowed the project's principals more control over the multiple iterations that were produced. More importantly, the ability of BIM to model processes, when combined with versioning, offers a way forward for implementing dynamic landscapes within the traditional construction process. A LIM could offer landscape architects the ability to easily create sheet sets for each successional phase of a project, satisfying the needs of dynamic ecosystems and a linear construction process.

The failure at Downsview Park to realize the competition's call for change over time should be seen as a wakeup call. As NORTH (2012) states, "It is this critical aspect of time that leading landscape architects understand very clearly... but they are still lagging behind on solid design practices for orchestrating and developing such landscapes, especially once construction is complete." This is brinksmanship, plain and simple. If even "leading landscape architects" are unable to realize their designs, the hope for the rest of the profession does not look promising. The time for a Landscape Information Model has clearly arrived.

3.2 Smaller Scales

The advantages of BIM at Large Scales and for "leading landscape architects" is undeniable. But as Sipes notes, the cost not only of the software, but of the time lost to training may be quite high for smaller studios who work largely at residential scales (2008). What are the advantages of Landscape Information Modeling for smaller studios working at smaller scales?

LIM benefits smaller studios by helping to automate routine tasks and streamline administrative work. Vectorworks Landmark, which the publisher refers to as Site Information Modeling, offers tools for Grading and Plant Spec'ing. Autocad Civil 3D, part of Autodesk's Infrastructure Modeling Suite, offers very powerful grading tools. These programs also offer integrated libraries of materials and interoperable file formats to streamline the process of developing renderings.

These advantages could provide smaller studios with significant time savings, spending their billable hours on the work that matters. Small firms, however, do not have the luxury of being able to hire a BIM Manager, and so, "every team member must be committed to learning and implementing BIM" (SIPES, 2008).

3.3 Industry Advantages

Since 2005, the American Society of Landscape Architects (ASLA) has been developing a set of national standards for project sustainability called the Sustainable Sites Initiative. Modeled after the US Green Building Council's LEED system, Sustainable Sites awards credits for responsible site design decisions in categories including Water, Soil and Vege-

tation, Construction, Human Health and Well Being, among others. Still in the pilot stage, Sustainable Sites has the possibility to drive a new wave of sustainable landscape design and construction in much the same way as LEED has galvanized architecture. Landscape Information Modeling is organized to facilitate this process.

Architects use BIM like Autodesk Revit Architecture to count credits toward LEED certification of projects. Furthermore, BIM is able to easily recalculate the credits received by a project when the design is modified. This functionality is integral to the adoption of the Sustainable Sites Initiative credit system. Designers need the ability to know how each design element that is proposed affects the overall score if they are going to attempt certification of this type. Any implementation of the Sustainable Sites Initiative needs to consider Landscape Information Modeling if it is to succeed.

3.4 Current Opportunities

The benefits of maintaining consistency of vision across very large projects, ease of versioning, cost control, quality assurance, and spec'ing make a strong case for developing Landscape Information Models. Current tools and standards offer some of this functionality and could easily be extended for more functionality.

Geographic Information Systems (GIS) exist to represent discrete and continuous spatial data. These tools are often used by environmental scientists to represent relevant processes like migratory patterns, pollution dispersion, and to make statistical predictions of community interactions. There is vast potential to use these tools for representing site processes. Though interoperability between GIS software and BIM tools has improved greatly in recent years, this process remains very particular and requires training.

Existing file formats including LandXML and CityGML offer great opportunities for interoperability between software tools. LandXML has deep roots in the land development sector, and contains object classes of value to landscape architects. CityGML is much newer, but has been designed to store even more object classes including buildings, bridges, tunnels, and site furniture. While LandXML is writeable from many current software tools, CityGML is not yet available as a file format in many existing tools, and some work still exists before this file format is widely adopted by practitioners.

4 Obstacles to BIM Adoption

With all of these advantages Landscape Information Modeling seems poised to be the next big thing in landscape architecture, and yet it has not taken off. Why have landscape architects failed to adopt the tools necessary for flexibility in the design of large scale projects, increased productivity, and integration of sustainability standards? Many of the answers to this question do not withstand scrutiny.

4.1 Current BIM Tools Do Not Model Landscape Processes

Researchers exploring the topic of Information Modeling for Landscape Architecture often cite the fact that existing BIM packages do not model landscape processes. (PIETSCH et al., 2009; SIPES, 2008) This is not wholly true. Existing BIM tools like Autocad Civil 3D

model many landscape processes including drainage and grading volumes. This toolset exists within a larger BIM suite from publisher Autodesk that promises interoperability with another of their BIM tools Revit. Ahmad and Aliyu note that the UK Landscape Institute has a list of BIM tools ready for use in landscape architecture including Vectorworks Landmark, Siteworks, Graphisoft ArchiCAD, and more (2012). Clearly, there exist already BIM tools which model landscape processes.

4.2 BIM Tools Are Too Expensive

Many Landscape firms are small outfits and would not be able to take advantage of the scale benefits of Landscape Information Modeling. "It is probably overkill to use BIM for residential design, planting design, or other projects that are still best completed with CAD" (SIPES 2008). BIM tools are expensive and have large learning curves. Yet, Sipes quotes Vectorworks in referring to themselves as "'BIM software for the smart-sized firm'", and goes further saying "[Vectorworks] is one of the most affordable BIM products on the market" (SIPES 2008). It seems that cost is not truly an obstacle. What then?

4.3 Cultural Resistance

Perhaps the biggest obstacle to BIM adoption is the attitudes and mores within the profession. Here's SIPES, "soon [we will] be able to integrate GIS and BIM data seamlessly. Data will be interchangeable, and landscape architects will not have to worry about how this data exchange works." (2008) First of all, GIS and BIM integration still requires finesse from practitioners, 5 years after Sipes' paper. But what is more troubling about this statement is SIPES' – and as his paper was published by ASLA, the profession's – passive approach to information technology; the notion that if we wait around long enough, someone will come and solve our problems for us.

To underline this point, an example. BIM is as much a set of standards as a piece of software. In the US, the National Building Information Model Standard (NBIMS) has been in development since 2005 by an interdisciplinary group of professionals, vendors, government agencies, and professional associations. And yet, even though NBIMS is embarking on Version 3 of the standard, the steering committee remains free from the presence of landscape architects in any capacity. This is stunning as much for landscape architects passive attitude as it is for the AEC industries' antipathy to site processes.

The Sustainable Sites Initiative is the closest that the American landscape profession has come to developing a shared set of standards for design. Yet unlike NBIMS, the Sustainable Sites Initiative is largely unilateral, being developed almost entirely by ASLA. this indicates that the programs reach will be limited by the sphere of influence of ASLA, which is already dwindling. The irony is that inclusion of site processes and Sustainable Sites credits in NBIMS would do much to counteract this decline.

5 Is BIM the Answer?

BIM has many advantages, and much of the resistance to BIM adoption is no longer valid. So the question then becomes, is a Landscape Information Model what landscape architects need?

Robert Aish is a senior software engineer at Autodesk and developed Generative Components for Bentley. He believes that designers need flexible tools which they can program themselves. AISH notes that, "Tools give possibilities, from these possibilities we discover advantages, advantages become a convenience, and convenience can too easily become a convention. Some tools, or the way some tools are used, make certain forms or processes 'convenient' and this can have a deeply conservative influence on design" (2011). OZIMEK & OZIMEK echo this sentiment when they note that "Autocad Civil 3D ... provides users with a great spectrum of solutions ...[yet] sometimes discourages students from experimenting and does not help develop their spatial imagination" (2011). Powerful software tools, in the hands of passive designers, lead to complacency and convention. We have already identified the US landscape architecture profession's generally passive attitude toward Information Modeling. What results should we expect, then, when landscape architects finally, inevitably adopt LIM?

Grasshopper, the generative modeling environment for Rhinoceros 3D is really quite startling in its flexibility and accessibility to beginners. The key to its power seems to be in the community that has grown around it. Grasshopper's designers have allowed the software to be extended by the community and have created a forum where those explorations can be shared and improved. The freedom to use and extend the tool for an individual designer's needs and the involvement of the software developers in the user community have created a robust technology that welcomes newcomers yet is powerful enough to be of value to experts. This is equally true of the creative coding environments openFrameworks and Processing. Is a BIM for landscape architects, developed by a for-profit company with a finite customer service budget the tool we need? Is there a way to couple LIM to an open community of experts and beginners engaged in the work of extending the tools?

WATSON (2010) discusses how there is a bottleneck in the digital education of Landscape Architecture students. He notes that increasingly students require more and not less instruction on digital tools, and that faculty are less and not more able to meet this challenge. FRICKER et al. (2010) note that until they had radically rethought what a landscape architecture curriculum could be, their students were not being adequately prepared for the complexities of the current design climate. If landscape architecture students are currently joining the profession underprepared, how will the development of new software substantially change anything?

BIM tools offer many advantages to the landscape architecture profession, yet the profession at large has been slow to adopt these tools. Many existing BIM packages could be used to model landscape processes, but overly complex software tools can lead to decreased creativity. Open source tools exist with robust user and developer communities that offer open ended design strategies and are more forgiving to beginners. Meanwhile, many students are joining the workforce without adequate exposure to existing tools. is the development of another BIM, specific to landscape architecture, the solution?

6 Conclusions and Further Research

6.1 Conclusions

BIM tools are powerful pieces of software with the potential to not only bring the landscape architecture profession into the present but to propel it into the future. These tools have the opportunity to address serious contemporary problems within the profession such as how to generate construction documents for dynamic designs and how to manage large scale projects which are increasingly the focus of "leading" firms. But the simple development of a new software tool will not in and of itself solve these contemporary problems.

Large firms should focus on adopting and extending existing BIM tools. Professional associations need to work with other entities within the AEC industries on developing shared standards. Software tools have the greatest success when they are supported by active user communities and when developers are involved in those communities. Educators need to expose students to these tools and to some basic programming to enable students with the agency to create their own tools.

6.2 Further Research

While the conclusions above are compelling, they are based on incomplete information. It would be illuminating to conduct surveys of landscape architecture firms working on large scale projects and see how they are or are not using BIM. Furthermore, it would be illuminating to survey landscape architecture and planning departments of large AEC firms to understand where they fit into the BIM workflow. The answers to these questions may provide a guide for how to develop a BIM for landscape architects.

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