Chapter 93
Knitting Patterns:
Managing Design Complexity with Computation

Dermott John James McMeel
University of Auckland, Auckland, New Zealand

Robert Amor
University of Auckland, Auckland, New Zealand

ABSTRACT

Large software conglomerates like Trimble and Autodesk provide consumers with suites of software that perform many functions within the design and construction process. Communicating with software outside of the suite can be highly problematic as file types and communication protocols are proprietary and closed within that software family - the antithesis of interoperability). This is in stark contrast with emerging trends in consumer computing, where we find a rich ecosystem of devices and services facilitating a period of intense innovation. This paper documents original research that aims to implement communication beyond specific software suites and test, to what extent, wider software ecosystems revolving around open standards might be implemented within the design and construction domain. Our first test case—an agent-based dynamic simulation combining natural and built environmental components—is deployed to explore the city as a multitude of interrelated natural and built patterns. We analyze the role this simulation might play in managing the complexities of rebuilding a sustainable urban environment after the devastating earthquake in Christchurch, New Zealand. The second test case deploys an iPad application to communicate with a BIM model - exploring the development of a mobile application and methodology for openly communicating outside of the intended software family. Through these case studies we begin to identify ways to leverage emergent device and data ecosystems and representations for 'knitting' devices and services together in innovative ways to advance design and construction processes.

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INTRODUCTION

In contemporary society, our digital devices, services and applications are expanding beyond the desktop. An individual's digital ecosystem might typically include a smartphone or tablet—like the iPad—as well as a personal computer (PC) for accessing localized and remotely stored information. Services like Google maps, iCloud or Amazon web services are mostly invisible, yet they store, save and deliver vast quantities of information. As a consequence of this, the data we are using and generating does not exist on any one device as was historically the case with desktop computers, instead information is stored in a cloud, a generic term widely adopted to refer to storage somewhere on-line, which is then synchronized across a complex ecology of devices and applications. The benefits of this ecosystem are again most obvious in popular culture. Applications or 'apps' like Waze or Google Maps use crowd-sourced traffic data to provide real-time information back to users on congestion and traffic conditions. Foursquare is an example of an application claiming to 'make the world easier to use' by helping you find amenity, a place to eat or drink for example, and find friends to connect with around that amenity. It has sparked a micro-economy where cafés and restaurants reward frequent attendance using the foursquare application. This digital ecosystem enables innovators to appropriate and knit services together to improve the quality of experience for the individual, increase efficiency and generate new forms of commerce and interactions.

The design and construction process exhibits all the hallmarks of an ecosystem. It has a complexity of participant interactions, which includes designers, sub-contractors and project managers operating within smaller areas of the overall project (McMeel & Amor, 2011). We can also observe multiple unique communicative ontologies emerge, which are very efficient for—and specific to—particular sub-groups (Lee & McMeel, 2007). Design and construction operate at multiple scales and exists through the negotiation of interrelated tensions and resistances rather than as some idealized harmonious entity. However, the information and services generated are not as open as those we have just discussed in the consumer domain. Much of the data remains on desktop computers or secured on private servers. Software competition sees the main computer aided design (CAD) or building information model (BIM) providers like Graphisoft, Bentley and Autodesk build their own proprietary ecosystem of applications and processes. Deciding to buy particular software is deciding to buy into a closed ecology of tailored systems that support different specific needs. Consider for a moment the computing advances of the last thirty years, interchange between these systems has progressed little in the same period. Industry Foundation Class (IFC) has been established within the industry with the explicit purpose of describing and exchanging building data. Yet it is the drawing exchange format (DXF) and Autodesk's proprietary drawing format (DWG)—both established in the 1980's—that remain the industry standard to transfer building data between different software. Although this can be seen changing as we migrate from CAD to BIM (Building information modelling), there are still significant challenges to communicating outside specific software suites allowing for richer software ecosystems.

We hypothesize there are gains to be made by appropriating a digital 'ecosystem' metaphor emerging within popular culture. In this paper, we analyze two test cases to untangle the implications it may have for design and construction and begin to deepen our understanding of how it might affect the industry. In section two we will interrogate the notion of ecosystem as understood through the pattern work of Christopher Alexander (Alexander, Ishikawa, & Silverstein, 1977). Section three looks at a dynamic agent-based modeling tool to assist with the redesign of Christchurch, New Zealand after the 2011 earthquake. Finally section four looks at the 'snagging' process, which is a specific process that occurs