Architectural design is a complex activity. The development of a building involves multiple agents with contrasting goals and orientations that need to be addressed in context-specific conditions. The diverse variables involved can often conflict and result in rigid normative frameworks. Whilst this normativity ensures fulfilment of minimal standards, it can often reduce possibilities for designers. This is the case of some low-cost housing developments and estate projects. Social, economic, and political concerns can often collide and pressure architects, limiting their ability to respond to the diverse variables involved in the design of a building.

The aim of this research is to increase design possibilities under such conditions with an evolutionary system that relies on mass customization and complexity principles to enhance the capabilities of architects when working under heavily prescribed design-spaces.

The design-space is referred to here as an abstract set containing all the variables that can be potentially addressed during the design process (Heape 2007: 364-375; Westerlund 2009: 117-130). The widest boundaries of a design-space are generally rigid or mandatory constraints such as building codes and a budget, while more flexible or self-imposed constraints...
constraints enable further exploration of design options (Lawson 2006: 83-111; Gedennyr 1996: 69-100). Therefore, when these interacting constraints result in rigid normative frameworks, a design-space can become almost deterministic due to significant design variables and their relations being defined a-priori. Digital technologies enable higher and more manageable amounts of information during the design and manufacturing process, opening new possibilities for architects working in such conditions.

Design can be understood as a process of information transmission that connects a designer with a materialized building (Gero 1990: 27-29). This conceptual standpoint entails that digital technologies may enable generation of complex design-spaces that are not conceivable without computers (Mitchell 2009). CAD/CAM technologies increase the potential information content of a design-space and therefore the potential capacity of the resulting buildings to accurately address contrasting environmental variables (Mitchell 2004: 2005).

The proposed evolutionary system relies on multi-agent simulation to explore the bottom-up emergence of complex design-spaces using simple rules and local interactions, while modular building components ensure their compliance with normative standards (Figure 1). The different objectives involved in a design task are implemented as populations of low-level agents that interact with their virtual environment by exploring the combinatorial possibilities of prefabricated modules. The complexity of the generated design prototypes is assessed according to an entropy factor (Shannon 1948: 10-15; Gero & Sosa 2008). Random variations are then introduced to these agent populations affecting their strategies and peer-influence. After a number of iterations, only the traits that result in prototypes of higher complexity are maintained, resulting in a system able to respond with enhanced accuracy to their environment (Figure 2).

The main contribution of this research is to potentially expand design possibilities for architects working under prescriptive conditions, increasing their capacity to respond to complex environmental phenomena.

WORKS CITED


VICTOR BUNSTER is a registered architect currently working on his PhD research at the Faculty of Architecture, Building and Planning of the University of Melbourne. His main research interests are design computing, agent simulation, energy-efficiency, and low-cost housing. He has been a research assistant for CRIDA (Critical Research in Digital Architecture) and a scientific committee member for the Iberoamerican Society of Digital Graphics (SIGraDi). Before receiving governmental sponsorship to pursue postgraduate studies in Australia, he worked in the design and development of social housing complexes in Chile.