

## Chapter 33

# Real-Time Visual Simulation of Urban Sustainability

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### ABSTRACT

*Sustainable decision making for strategic planning is a challenging process: requiring an understanding of the complex interactions among environmental, economic and social factors. Commonly, such decisions are dominated by economic factors hence there is a need for a framework that supports inclusive decision making throughout all stages of urban and rural planning projects. Towards this the authors have developed the Sustainable City Visualization Tool (S-CITY VT) which comprises 1) indicators (these provide the basis for assessment and monitoring of sustainability) selected according to scale and development 2) modelling techniques that provide indicator values, as not all of the indicators can be measured, and allows spatio-temporal prediction of indicators 3) Interactive 3D visualisation techniques to facilitate effective communication with a wide range of stakeholders. The sustainability modelling and 3D visualisations are shown to have the potential to enhance community engagement within the planning process thus enhancing public acceptance and participation within the urban or rural development project.*

### INTRODUCTION

A number of decision support tools (DST's) have been created to aid decision makers in achieving more sustainable urban developments. There has been huge effort and resources invested in creating DSTs, yet, despite this, most are rarely used due to either the complexity of their operation or the

output complexity (Isaacs et al., 2007). Therefore, there is a need for new decision support tools that can deal with the complexity of sustainability assessment in urban design and which go beyond the technical orientation of previous tools (Sahota & Jeffery, 2005) to enable assessment of sustainability within the decision-making processes.

This article presents the development and testing of a prototype sustainability assessment and communication tool, S-CITY VT. The tool

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addresses the need to facilitate wider stakeholder input into the planning process by communicating the relative sustainability of urban design scenarios. This requires spatio-temporal modelling of the sustainability indicators, and the innovative presentation of sustainability assessment data using interactive and immersive 3D technologies.

The tool was developed and tested on a case study urban redevelopment project, the Dundee Central Waterfront Development. Previous work by the authors (Gilmour et al., 2011) has identified a set of sixteen sustainability indicators that are used by the Waterfront Development Partners to monitor and enhance the sustainability of the development. Therefore a verified set of sustainability indicators covering the social, environmental and economic aspects of the development, with robust supporting data, was available. A prototyping approach was adopted to explore the S-City VT concept. Six sustainability indicators were chosen from the full indicator set to ensure that overall the selected indicators set;

- Included two indicators from each aspect of sustainability (social, economic and environmental),
- Represented a variety of quantitative and qualitative data, and
- Included indicators with spatial and/or temporal variations.

The need for stakeholder engagement was addressed in two ways in the prototype tool. Firstly, a scenario design component enables stakeholders to explore the relative sustainability options for different designs of the development. They can add, remove or rearrange different components of the development such as building types, their location and their use. These changes are reflected immediately in the indicator models and in 3D representation of the physical appearance. Stakeholder engagement in the holistic aggregation of the indicator values is also addressed in the selection of the ANP multi-criteria analysis

approach, the main strength of which lies in providing the stakeholders with the ability to include their own personal knowledge and opinions about indicator interactions through the use of pair-wise comparisons (Saaty, 2006).

## Project Background

In 1987 the World Commission on Environment and Development (WCED, 1987) stated that “Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.” Out of the many definitions of sustainability this profound statement has become the most widely accepted. It is what these needs are, how we impact upon them and how our impact can be measured or assessed that raises the most debate (Parkin et al., 2003). Sustainability is often symbolized using three overlapping circles (Figure 1), representing the three aspects of sustainability (society, economy and environment). However this simple diagram over simplifies the complex interactions which occur between the aspects and the large number of indicators which are used to measure impact.

Figure 1. Aspects of sustainability



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