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Case studies in quantitative urban sustainability

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Abstract

A sustainable city is one that relates its use of resources and its generation and disposal of wastes to the limits imposed on such activities by the planet and its organisms. Drawing upon a study that proposes quantifiable urban actions related to sustainability, we designed three cities with common characteristics but in different geographical and climatic regions (Vietnam, Namibia, Serbia & Montenegro). The intent of the designs is to maintain sustainability as the city evolves over a 20-year period. Several lessons emerge from these case studies: (1) The imposition of quantitative sustainability requirements poses no substantial barriers to the design of workable cities over a range of quite different geographic and climatic conditions; (2) Accommodating evolution is important to sustainable city design; a city can potentially be sustainable at some stages of its evolution but not others; (3) Cities can never be designed and built as totally isolated systems, so sustainable design is ultimately a hierarchical exercise with cities at a low level and the entire planet at the top of a multilevel system, each element of which must contribute to its sustainability.

Keywords: Energy; Water; Food; Non-renewable resources; Transportation; Housing; Waste management

1. Introduction

In 1791 Pierre L'Enfant began the design of Washington, DC. His aim was to create a city whose broad avenues and public spaces would express the greatness of the country in the city that was to be the center of government. A very different goal was pursued in England in the 1950s: the creation of cities such as Milton Keynes that were designed for 'livability'—neighborhood spaces, walking rather than driving, an emphasis on community. In today's world, with the increasing realization of environmental challenges and limits to the availability of

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resources, a new goal for urban design is emerging—that of the 'sustainable city'. This is an attractive sounding notion, but it is need of more definition. What is a sustainable city, and, if we can define such a thing, how can it be achieved?

In a companion paper in this issue [1; hereafter termed 'Paper I'], we suggested several quantifiable attributes of a sustainable city—sustainable levels of energy use, housing, use of non-renewable resources, and the like. In this companion paper, we attempt to design sustainable cities on the basis of these attributes. For this exercise, we define a set of common features of a model city, including population, size, and employment. In addition, we specify how those characteristics will change over the next two decades. This latter set of properties is imposed so that any designs that emerge will be evolutionary, capable of maintaining sustainability over time. We employ this approach in the design of three prospective cities, which have a number of common characteristics as shown in Table 1. Their locations are different, however, thus imposing distinctive requirements and limitations related to topography, local climate, and connectivity to the outside world. The urban designs described below reflect these attributes, and also the sustainability requirements of Table 8 of Paper I. After describing the design case studies that have resulted from this activity, we conclude the present paper by examining similarities and differences in the designs, and drawing conclusions based on the case studies and our analysis of them.

2. Case Study 1—Ba Phen, Vietnam

2.1. Introduction

Vietnam is a country on the cusp of rapid development. Real GDP more than doubled between 1993 and 2003, and with it rose the ability and need to improve the average standard of living. Among the major changes underway, for example, are some 15 dam construction projects, most of which will be finished in the next few years and will relocate at least 200,000 people. The task of providing the relocated people and others with services can be made easier by creating cities that use minimum resources and energy to provide people with basic needs. In the present work, we have used the sustainable requirements of Paper I to plan sustainable resource use systems for the new city of Ba Phen, located at 20.1°N 105.6°E (Fig. 1). To address

Table 1
The prospective cities: characteristics and location

Common characteristics of the cities

Year	Population	Area (ha)	City	Industrial area
0	3000	25	600	600
10	6000	40	1000	1000
20	12,000	65	1700	1700

Average family size: 3; Industrial area location: 4 km from the city boundary

Locations of the cities	Latitude	Longitude
Ba Phen	20.1°N	105.6°E
Turtle Bay	18.4°S	12.0°E
Zelengrad	45.0°N	21.3°E