

Mike Jenks · Colin Jones
Editors

Dimensions of the Sustainable City

 Springer

Editors

Prof. Mike Jenks
Oxford Brookes University
Oxford Inst. Sustainable Development
Dept. Architecture
Gipsy Lane Oxford
Headington
United Kingdom OX3 0BP
mjensks@brookes.ac.uk

Prof. Colin Jones
Heriot-Watt University
School of the Built
Environment Edinburgh
United Kingdom EH14 4AS
c.a.jones@hw.ac.uk

ISBN 978-1-4020-8646-5(HB) e-ISBN 978-1-4020-8647-2
ISBN 978-1-4020-8645-8(PB)
DOI 10.1007/978-1-4020-8647-2
Springer Dordrecht Heidelberg London New York

Library of Congress Control Number: 2009938191

© Springer Science+Business Media B.V. 2010

No part of this work may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording or otherwise, without written permission from the Publisher, with the exception of any material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work.

Cover illustrations: (front) Urban infill on brownfield land can intensify activity in the city and help towards a more sustainable environment (Oxford City centre, UK). Photo: Mike Jenks; (back) An efficient tram system can encourage people to use public transport and reduce traffic in the city (Sheffield City centre, UK). Photo: Mike Jenks.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Chapter 1

Issues and Concepts

Mike Jenks and Colin Jones

What is Meant by the Sustainable City?

There has been a considerable amount of research that defines and characterises the form of the sustainable city, and which urban forms may most affect sustainability. It is a complex issue. The physical dimensions of urban form may include its size, shape, land uses, configuration and distribution of open space – a composite of a multitude of characteristics, including a city’s transportation system and urban design features (e.g. Handy, 1996; Llewelyn-Davies, 2000). However, its sustainability depends on more abstract issues – environmental (including transport), social and economic. Research suggests that, not one, but a number of urban forms may be sustainable (Williams et al., 2000). Yet much of the debate about the sustainability of cities and urban forms has focused on increasing the density of development, ensuring a mix of uses, containing urban ‘sprawl’ and achieving social and economic diversity and vitality – often characterised as the concept of a ‘compact city’ (see Jenks et al., 1996; Jenks and Dempsey, 2005).

In the UK, government policy embodies such principles through its Urban White Paper (DETR, 2000a; DCLG, 2006a), mostly based on the report of the Urban Task Force (1999). Thus in the UK, a dominant paradigm is being implemented in many towns and cities. It is for more compact, high-density and mixed use urban forms, and the belief is that they will be sustainable. This book will take this type of urban form as its starting point and will test the claims made for it.

Urban Form and Claims to Sustainability

With the implementation of policy, practice has, to an extent, overtaken the knowledge and evidence needed to assure the success of sustainable urban forms. Notwithstanding examples of good practice, advocacy rather than research has often

M. Jenks (✉)

Oxford Institute for Sustainable Development, Oxford Brookes University, Oxford, UK

characterised the debate, and has led to many positive claims for the influence and benefits of different urban forms.

The European Commission was an early and influential advocate of urban containment and more compact forms (CEC, 1990). The hypothesis was that compact urban forms would reduce urban sprawl, protect agricultural and amenity land, and lead to more efficient use of existing, previously developed urban land. With a mixture of uses in much closer proximity, alternative modes of travel would be encouraged, such as walking and cycling, and public transport use would also increase. This in turn would lead to environmental, social and economic benefits. Such ideas were taken up in UK government strategy (HM Government, 1994), strongly advocated as a basis for policy and implementation (Urban Task Force, 1999; DETR, 2000a) and in numerous government publications giving planning guidance (e.g. ODPM, 2004a, b, DCLG, 2006a, b), and policy guidance (e.g. CABE, 2005). Similar urban form concepts to achieve urban sustainability can also be found in, for example, the USA with New Urbanism and Smart Growth initiatives (Katz, 1994; Smart Growth, 2008). All tend to advocate urban forms that are higher than previous densities, with mixed use, which are contained in order to reduce travel distances and dependence on private transport, as well as being socially diverse and economically viable.

The effect of some of these proposed policies and 'solutions' has become evident. In the UK over the past five years there has been an increased take up of brownfield land, fuelled by government targets for building 60% of new homes on re-used urban land (DETR, 2000a, 2001). However, the intensive use of existing land means there is a potential loss of open space and amenity. Environmentally, less open space is likely to have adverse effects on biodiversity and the provision of environmental/ecosystem services (e.g. water and drainage), the consequences of which are largely unexplored. Socially, the impact of 'intensification' or compaction may affect the quality of life of users, and the effects may in some respects fall unevenly on the poor (Burton, 2000a).

Higher densities are strongly advocated, and on the ground there are examples of schemes built and being proposed at higher densities than recommended in guidance (CABE, 2005), of over 100 dwellings/ha (Owers and Oliver, 2001; Dawson, 2004). Theoretical studies have been undertaken on physical capacity, showing how reducing parking provision can increase density (Llewelyn-Davies, 1997; Stubbs and Walters, 2001), and examples of 'car free' housing have been built (Canmore Housing Association, 2008). An active Millennium Communities Programme (English Partnerships, 2007), emerging from the government's Millennium Villages initiatives, has identified seven potential developments, two of which (Greenwich Millennium Village, and Allerton Bywater) are being built. More recently the UK government has announced a competition to build a number of 'eco-towns' comprising zero carbon development as a move to support the UK's carbon reduction targets, and has short listed 15 potential sites for these developments (DCLG, 2007). The 'eco-towns' have been contested in sustainability terms, and are controversial, particularly where they are to be situated on green field sites (Revill and Davies, 2008).

Table 1.1 Aspects of a sustainable built environment (Sources draw upon, inter alia: CABE, 2008; English Partnerships, 2007)

Land use and built form	Environmental – energy conservation	Environmental – recycling and re-use	Communication and transport
<ul style="list-style-type: none"> ● Intensive use of urban land ● Networks of green corridors ● Community buildings, self-managed ● Mixture of land uses at relatively high density ● Affordable homes ● Local identity ● Sustainable building materials ● Flexible design and good space standards ● Improved noise insulation 	<ul style="list-style-type: none"> ● Combined heat and power (CHP) – local power generation ● Micro power generation ● Renewable energy ● Reduced energy consumption and embodied energy ● High levels of insulation ● Intelligent lighting and integrated security, heating, and IT systems ● ‘A’ rated white goods ● Eco-rating e.g. BREEAM ‘excellent’ 	<ul style="list-style-type: none"> ● ‘Grey’ water systems ● Recycle water for gardening and car washing ● Reuse water and filter, to be directed to ecology parks or green spaces ● Waste recycling, and use for production of biogas ● Reduced domestic and construction waste ● Carbon-neutral lifestyle 	<ul style="list-style-type: none"> ● Light transit routes, eco-friendly buses and bikeways ● Car clubs and cycle facilities ● Pedestrian-friendly infrastructure ● Restricted car parking ● Environmental advice – bus/transit times, energy and water monitoring ● IT enabled

The common features of these many initiatives that are claimed to contribute to sustainability are based on a general consensus of opinion, as well as some evidence, and are outlined in Table 1.1, above. These are largely the physical and environmental aspects of sustainability, and are those aspects that are probably easiest to incorporate into developments - not all of them relate to urban form – those that do are highlighted in the table. Generally, only these relevant aspects have been included in the core research reported in this book. However, these have not all been tested to see if they work in practice, and little has been done to show how they interact or integrate as a whole. So while this more intense development may have benefits of providing a more viable model or public transport, it is not clear from experience to date that there has been the modal shift in transport use necessary to yield the claimed environmental benefits. And there are social sustainability arguments underlying these physical aspects, for example high densities and good public transport are linked to social benefits of ease of access to facilities. But more difficult to achieve are safe, inclusive and equitable environments – the link to urban form has received little empirical attention and may well be tenuous. Nor is there evidence to show a clear link between such forms and economic viability. These are therefore not included in Table 1.1: the social and economic aspects are a key to the research that follows and will be placed in context at the end of the book.

An issue of Global Significance

Despite the lack of empirical research to support such claims, it seems evident, at least in the UK, Europe and much of the western world, these policies and 'solutions' provide a useful model and are being implemented in practice. However they are untested, raising questions about their validity. For every positive claim there are also potentially negative impacts to consider. Higher densities may lead to overcrowding, more traffic, and may not be the favoured choice for residents wishing to purchase homes – populations trends still tend to favour rural or suburban locations (e.g. Breheny, 1995). Also, as indicated above, the social and economic impacts are hard to trace to the influence of urban form – many other factors are more important.

It is surprising, therefore, that similar ideas have resonated beyond the western world, and have been taken up by countries where the urban context is very different (e.g. Jenks and Burgess, 2000). Across the world there are some 60 metropolitan regions with populations of more than 5 million inhabitants. Of these regions 46% have populations in excess of 10 million, the largest being the Tokyo Metropolitan Region with more than 36 million people. Most of these large regions, some 62%, are to be found in Asia where the growth rate is fast (World Gazetteer, 2005). These vast urban regions, with either very large urban agglomerations or huge cities at their core, are a far cry from the comforting compact city model inspired by the historic cores of relatively small European cities. These cities often have not just one, but many centres, and these are frequently decentralised, disconnected and fragmented forms (e.g. Graham and Marvin, 2001; Kozak, 2008). In this global context it suggests that the idea of a 'traditional' compact city could be seen as a contradiction in terms.

Nevertheless, some policies and forms that could be appropriate in the world context where cities are experiencing rapid growth are beginning to emerge. In these contexts urban form needs to be considered at a larger and more strategic scale. For example, linking public transportation and development, which may take a number of different forms, including the intensification (or densification) of development around transport interchanges – what has been termed 'transit oriented development' (e.g. Boarnet and Crane, 2001; Calthorpe, 1993; Cervero, 1998; Low and Gleeson 2003). Major transport routes may also provide the opportunity for denser development along the routes, and this has been successfully undertaken in Curitiba in Brazil (Acioly, 2000; Curitiba websites) and in Bogota, Colombia with their 'Transmilenio' bus rapid transit system. When many transportation nodes at higher densities, linked by transportation routes combine into a city-wide strategy, a polycentric form may emerge. Such planned and controlled polycentric development may have the potential to achieve more sustainable forms, provided all the 'nodes' are linked with efficient public transport, although again, these forms have not been rigorously tested (e.g. Jenks, et al., 2008; Lambregts and Zonneveld, 2003; Urban Task Force, 1999).

Within these large urban contexts, fast-growing cities and mega-cities, there are also smaller scale attempts at creating the sustainable city. Indeed the claims for such

developments, similar in concept but larger in scale, are often loud and assertive. In the Shanghai metropolitan region, the 'world's first sustainable city' has been proposed – Dongtan (Arup, 2008; Dongtan Development Co., 2008). This ticks most, if not all the boxes in the table above, yet in effect it is a relatively low density (for China) suburb of Shanghai. Even more surprising, in the United Arab Emirates, two eco-city initiatives are underway – Masdar in Abu Dhabi designed by Foster and Partners (Basantani, 2008; Foster and Partners, 2008) and an eco-city in Ras Al Khaima, designed by Rem Koolhaas and OMA (Trotter, 2008; OMA, 2008). These are 'stand-alone' models, again ticking all the boxes and edging towards zero carbon development. There is a danger that these 'models' will become eco-theme parks, functioning in a similar way to carbon offset schemes, salving the conscience, and freeing the neighbouring cities to continue business as usual development. Obviously these eco-cities (like the eco-towns in the UK) will be a help if all new development is zero carbon, but most places and most cities are already existing, and often very large. Sustainable development and sustainable urban forms need to pervade the whole environment, and not simply be exemplars that are separated from every day, messy reality.

Understanding the dimensions of the sustainable city is a complex issue. Care needs to be exercised over the context within which the cities exist, their cultural background and regional and national differences. There will be significant differences in different parts of the world of the interpretation of the sustainable city; however there are common underlying and enduring themes that appear to inform both the debate about and claims for urban forms that promote sustainability. Overall, research indicates that there are unlikely to be single spatial or physical solutions, rather that there may be many forms that can achieve sustainability, depending on the context in which they are applied (e.g. Guy and Marvin, 2000; Jenks and Dempsey, 2005).

The Aim of the Book

This book is about experience in the UK, but it picks up on many of the common themes and issues experienced in cities worldwide and presents research that assesses and measures them. Thus, in order to make progress, the research reported here measures and characterises urban form so it can be related to environmental, social and economic sustainability, and comparatively analyses different forms. The research concentrates on the physical design of urban form with respect to: physical configuration and layout, including links to the wider urban system; its land uses and functions; the typology and density of built form and presence of open space. The claims made that more compact, high-density and mixed use urban forms are environmentally sound, efficient for transport, socially beneficial and economically viable will then be tested. Each of these aspects is considered below, the current state of knowledge is briefly reviewed and gaps in knowledge identified.

Researching the Dimensions of the Sustainable City

The book explores the relationships between urban forms and environmental, social and economic sustainability. The major research question addressed is: *To what extent and in what ways does urban form contribute to sustainability?* This question is important to tackle and addresses several gaps in knowledge identified from analysis and review of research in the field. The sections below indicate some of the key problems that led to this research question.

Environmental Sustainability

Environmental benefits are claimed to accrue from more compact urban forms where concentration of uses means less need to travel and therefore lower emissions from vehicles (see Transport below). In addition, claims about higher densities suggest benefits in energy savings through combined heat and power (CHP) provision, but that benefits might be outweighed by the loss of open space. In assessing aspects of environmental sustainability the research focussed on the different patterns of provision of open, and especially green, space. The environmental benefits of open green spaces include: reduced surface and air temperatures, due to solar shading, free radiation to the night sky and evapotranspiration from trees leading to improved summertime thermal comfort (Vu et al., 1998); a haven from urban pollution and noise (Tyrväinen, 1997); and, buffering against wind reducing wind chills (Lacy, 1977). Benefits extend to the surrounding buildings, e.g.: heightened market value (Savard et al., 2000); improved access to natural light, reducing lighting loads in non-domestic buildings (Crisp et al., 1988); provision of passive solar heat to dwellings (Yannis, 1994); and, a low-noise and low-pollution source of fresh air allowing natural, rather than mechanical ventilation. Finally, green spaces can ameliorate the urban heat island effect and provide 'free' cooling to buildings (Watkins et al., 2002) – thus reducing the use of air conditioning systems thereby lowering energy consumption and CO₂ emissions, running costs and further anthropogenic heat release into the city.

The ecological benefits suggested for open green space include: the provision of ecosystem/environmental services with consequences for such diverse issues as flood control, waste management, and pest control (Bolund and Hunhammar, 1999; Attwell, 2000; Pauleit and Duhme, 2000); the provision of habitat for biodiversity (Gilbert, 1989; Savard et al., 2000; Kinzig and Grove, 2001); and, heightened awareness of environmental issues among users (Cannon, 1999; Savard et al., 2000).

Claimed social benefits of access to green space encompass a range of quality of life dimensions, including: improved human health and well-being (Ulrich, 1981; Ulrich et al., 1991; Parsons et al., 1998); opportunities for social interaction and group activities and a possible reduction in crime (Whyte, 1980; Skjæveland and Garling, 1997; Tinsley et al., 2002); strengthened feelings of neighbourhood attachment and local community (Bonaiuto et al., 1999; Langdon, 1994) and the

promotion of civic pride and sense of place (Duany and Plater-Zyberk, 1992) and providing opportunities for contact with nature (Burgess et al., 1988).

Despite this plethora of perceived benefits, there has been relatively little work done in UK cities to assess whether they materialise in practice. Little empirical research quantifies the magnitude of the benefit or determines who are the beneficiaries. There is little work on the effect which urban form has on the thermal comfort in open spaces and the energy and environmental implications for UK cities (except Regents Park, London (Watkins et al., 2002)). Neither have all the energy and emissions implications been studied simultaneously (i.e. heating of dwellings, cooling and lighting of non-domestic buildings) for particular combinations of building types, urban forms and open spaces.

While there is an extensive literature focusing on the social benefits, and usage, of managed urban green spaces (e.g. Tinsley et al., 2002; Faber et al., 1998; Payne et al., 2002; Burgess et al., 1988), there has been relatively little empirical investigation of the social benefits of non-managed public spaces and private gardens. Furthermore, very little is known about whether or how the perceived social benefits and usage of urban green spaces varies with the density of the built environment (investigated by only one empirical study by Syme et al., 2001), nor how frequently local green spaces are used and what benefits are perceived to be associated with them.

Transport

Key policy (DETR, 2000a) and planning guidelines in the UK (DTLR, 2001) suggest that planning can reduce both the need to travel and length of journeys, and give safer and easier access to facilities through more compact, higher density and mixed use forms. The benefit of these forms is *inter alia* claimed to reduce car use, and encourage a shift towards more sustainable modes of travel, such as walking, cycling, and through increased use of public transport. However, such transport benefits crucially depend on people changing their travel behaviour.

Links between urban form and travel behaviour were identified, for example, by Handy (1996) and Badoe and Miller (2000). Handy (1996) found that residents in traditional neighbourhoods, characterised by higher densities, better accessibility and pedestrian-friendly design exhibited more sustainable travel behaviour than residents of neighbourhoods with lower densities, poor accessibility and pedestrian unfriendly design. Urban form, as measured by density, diversity (i.e. mix) and design, exerted a *modest to moderate* influence on travel demand, and that compact, mixed-use, pedestrian friendly designs were associated with more sustainable travel patterns (e.g. Cervero, 1998). In the UK, Stead et al. (2000) found that socioeconomic characteristics typically explained around half of the variation in travel distance per person across different study areas, whilst land use characteristics explained around one third of the variation.

However, finding a significant association of this kind between urban form and travel demand does not in itself mean that urban form per se will bring about more sustainable travel behaviour. The potential for the 'compact city' to bring about this result was questioned by Simmonds and Coombe (2000). In a study using a transport model of the Bristol area, a number of urban form scenarios were tested and found to make little impact on both total travel and car travel when viewed against the trend of increasing car ownership and the low cost of travel by car. These factors have greatly weakened the influence of spatial segregation on travel behaviour, and have presented many individuals with a far wider choice of residential location, job opportunities, services and other activities than ever before. Thus, the policies of densification and mixed-use development are likely to have little effect on travel behaviour without appropriate supporting transport policies.

The gaps in research suggest the need to seek a better understanding of the impact of urban form on travel behaviour to enable more accurate predictions of the travel patterns resulting from changes in urban form to be made. Many previous studies that sought to do this can be criticised on either methodological or theoretical grounds (see Badoe and Miller (2000) for recent critiques).

A common failing is to give inadequate consideration (or none at all) to the effects of factors representing the availability and quality of transport options, such as travel times and journey costs. Many previous studies have used data aggregated at the local level which serves to mask the effect of within-area variability. Disaggregated analyses, which use individual and household personal and travel/activity data and urban form measured at the local or the household level, are better suited to reveal the underlying complexities of the relationship between urban form and travel behaviour. Ultimately, the development of the most appropriate balance of urban form policies for the delivery of more sustainable travel patterns in a given context requires the application of sound theory derived from causal inferences. The research reported here addresses how (and why) individual, or sets of interrelated, elements of urban form influence travel behaviour and in what way socioeconomic characteristics interact with urban form to influence travel behaviour.

Social Benefits

The claims about the influence of urban form on social sustainability are complex and embrace issues of both quality of life and social equity. Higher densities and mixed use urban forms will, it has been argued, lead a better quality of life due to more social interaction, community spirit and cultural vitality (e.g. Rudlin and Falk, 1999), in part due to 'proximity to work, shops and basic social, educational and leisure facilities' (Urban Task Force, 1999: 64). Having a variety of uses and the means to access them nearby is also seen as a key to achieving social equity (ibid: 45), especially for the more disadvantaged in society who may not have the resources (and for those who do not wish) to own a car. Burton (2000b) identifies

a number of claims that positively link compact urban form to social equity. These claimed benefits include better access to facilities and jobs, better public transport and opportunities for walking and cycling, lower levels of social segregation and less crime. But alongside the benefits, there are claims that compaction leads to negative impacts such as poorer access to green spaces, poorer health, reduced living space and less affordable housing (ibid).

The evidence about these many claims raises a number of key questions for the research reported here. One clear message is that there is no single answer, as benefits (or costs) depend on the type of urban form and its social context. For example, while inner city mixed use areas might achieve benefits of more social interaction and vitality, and better access to facilities, they also could suffer from social tensions, crime or fear of crime and bad neighbour effects (Williams, 2000). In more suburban residential areas, quality of life may be enhanced by access to greenery, stronger social contacts and better safety and security, but poorer access to facilities (Masnavi, 2000). Questions are also raised about the acceptability of living in such urban forms (Jenks, 2000) and whether there is a social capacity beyond which environments begin to be unsustainable (Williams et al., 1999). Given the continuing counter-urbanisation trends (Breheny, 1995) and a powerful anti-urban ethos in the UK (Crookston et al., 1996), further questions are raised about peoples' attitudes to, and the extent to which they may wish to live in more 'compact' environments (notwithstanding the claimed benefits). When people do choose to live in more 'sustainable' urban forms (e.g. flagship or demonstration projects such as BedZed in the UK or Bo01 in Malmo, Sweden), the question remains whether or not they change to follow more sustainable lifestyles. Although the sustainability of certain physical aspects of the built environment such as density, compactness and design have been the subject of research (van Diepen, 2000; Williams, 2000; Williams et al., 2000; Carmona et al., 2001), in places these studies cast doubts on the link between built form and end user behaviour. However, so far no comprehensive studies have concentrated on behaviour or lifestyles associated with sustainable urban developments.

Economic Viability

It has been suggested that higher density forms support more diverse local service provision, by making local businesses and units more viable, while strengthening local supply chains. Higher density mixed used central areas are claimed to encourage more interaction and networking which promote innovation and creativity and hence greater endogenous growth including the formation of economic 'clusters'. Urban consolidation reduces infrastructure costs through scale and network economies and the re-use of existing capacity, whilst raising land values and so making (re-)development more viable, so reinforcing the spatial strategy.

Research has shown that range and quality of local services tends to be greater in high density areas, especially central/nodal places, but trends in the economics and

technology of some sectors is still leading to rationalisation into larger units, which may seek non-central locations. Service viability depends on income as well as density, and deprived urban neighbourhoods may lack services even when densities are high. Local supply chains are weak in many sectors, and may be weakening over time (Simmie et al., 2000; Simmie, 2001; Bramley et al., 2001). While some knowledge-based and cultural sectors are attracted to central cities, the evidence for clustering is weak in many cases and relevant networks may be more regional, national or international (Begg, 2001; Simmie, 2001). Many businesses are still attracted to low-density developments with ample car-parking in edge city locations accessible to motorways. Urban containment raises housing costs and reduces space consumption (Cheshire and Sheppard, 1989; Evans, 1991; Bramley, 1999, 2002; Bramley et al., 1995; Bramley and Watkins, 1996; Bramley, 2002), while high land values may militate against diversity of local services. Higher demand renders brownfield development viable but this is problematic for 'low demand' city regions (Monk and Whitehead, 2000; Bramley, 2002).

There were many gaps in economic research for this book to fill. There is a lack of systematic data on trends in the range and quality of local services and its relationship with urban form, and similarly with respect to supply chains and their key determinants. Systematic data on infrastructure costs of new or re-provision, and on their incidence, are conspicuously absent in the UK, unlike some other countries (US, Australia), although there is some literature on qualitative changes in provision (Guy et al., 1997). Data on property market performance is improving but has not been linked to urban form, and there are issues about the perceptions held by key property investors of different locations and forms of development including issues of risk (Heneberry and Guy, 1999). How susceptible such perceptions are to change based on experience and demonstration effects is important, and the same comment applies to business location preferences relating to congestion, access, parking and space constraints on expansion. Detailed urban form and design options, within a general high density framework, may significantly impact on the viability of residential developments, via values, costs, risks or timing.

Researching the Sustainable City

It is apparent that few of the claimed benefits of sustainable cities and features of these new 'sustainable' urban forms have been tested systematically, and the evidence to date is inconclusive. While it is possible to identify particular gaps in knowledge, there exists a deeper issue that needs to be addressed. Even where successes have been identified, and positive claims made, there is a considerable lack of evidence-based explanation, prediction and theory about the extent to which urban form as a whole contributes to sustainability. Many of the issues in this complex field interact and conflict. There may be many trade-offs and compromises to achieve advances in sustainability and to satisfy users and residents. In order to address these issues, and fill some of the gaps in knowledge, the research needed to deploy a range of robust and sophisticated methodologies.

Methodology

The methodology aimed to consider and integrate the range of aspects of urban form identified as influencing sustainability. It involves the measurement of urban forms, including building typologies, digital map footprints and configurations which are mapped on GIS, and analysed using methods including SPSS, measures of accessibility and spatial measures through Multiple Centrality Analysis (MCA). At the core of the research, three case study areas in each of five UK cities – Edinburgh, Glasgow, Leicester, Oxford and Sheffield - were selected. These areas represented a central, suburban, and ‘in between’ location in each city, representing a virtual ‘slice’ through a city. The research was carried out at a number of scales, including the city, the case study area (or neighbourhood), sub areas, the street and individual dwellings. Figure 1.1 below indicates the range of methods used at the city and neighbourhood scales of the investigation.

The methodologies employed to measure sustainability include:

- *Environmental*: environmental modelling, site surveys, biodiversity, mapped on GIS
- *Social*: questionnaires, focus groups, neighbourhood statistics
- *Economic*: interviews, land and property market data and models
- *Transport*: activity diaries, field surveys, accessibility assessments, transportation mode

These complex sets of data are analysed to find the urban forms which are beneficial, those which are problematic and those where conflicts between and within the sustainability impacts arise. The research was carried out by a number

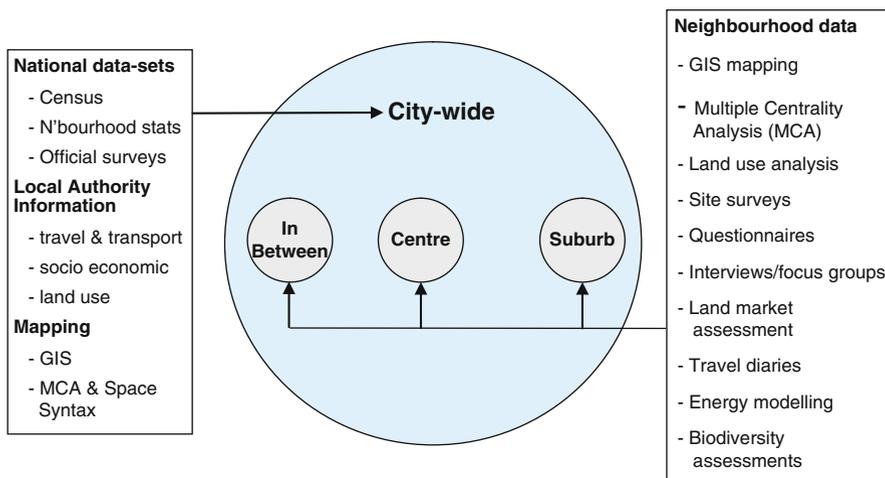
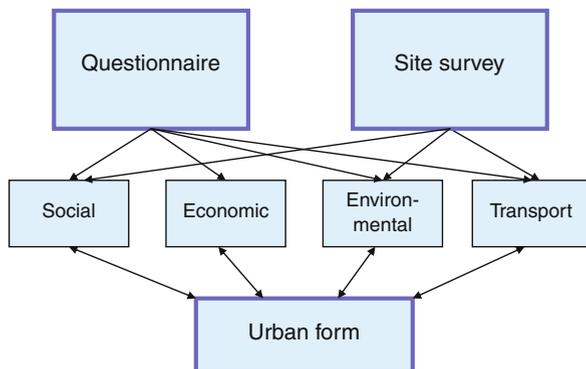


Fig. 1.1 Research methods used at city and neighbourhood scales

Fig. 1.2 Common research methodologies used



of specialist groups within the consortium. Two common methods were used by all in order to provide a basis for the specialist research carried out in each aspect of sustainability (Fig. 1.2). These overall measurements and the specialist ones, were related to the measurements of the urban form of the 15 case studies.

The Structure of the Book

The book attempts to determine the relationships between different urban forms in a range of urban contexts, and: environmental sustainability; transport; social sustainability; and, economic sustainability. It provides guidance on sustainable urban forms, which are acceptable to users, and appropriate for the future. The book follows the structure of the research which was organised into a large, integrated, core project, with three related but separate projects feeding into it (Fig. 1.3).

Thus the book is organised in chapters that relate to the key claims about urban sustainability, and report on the research undertaken.¹ It addresses each major set of claims in separate chapters, and concludes at the end with an initial integration of the research findings that provides some answer to the key question as noted earlier – *to what extent and in what ways does urban form contribute to sustainability*, thus illuminating the dimensions to the sustainable city.

The first chapter presents an introduction to and justification for the book. In doing so it offers an overview of different urban forms and their claims to sustainability, assesses the state of the debate and introduces the key pillars of sustainability – environmental, transport, social benefits, and economic viability.

¹This forms part of the output from the *CityForm: Sustainable Urban Form Consortium* funded by the Engineering and Physical Sciences Research Council (EPSRC) under its Sustainable Urban Environments Programme (Grant number GR/520529/01). Further details of the research and publications can be found at <http://www.city-form.org/>

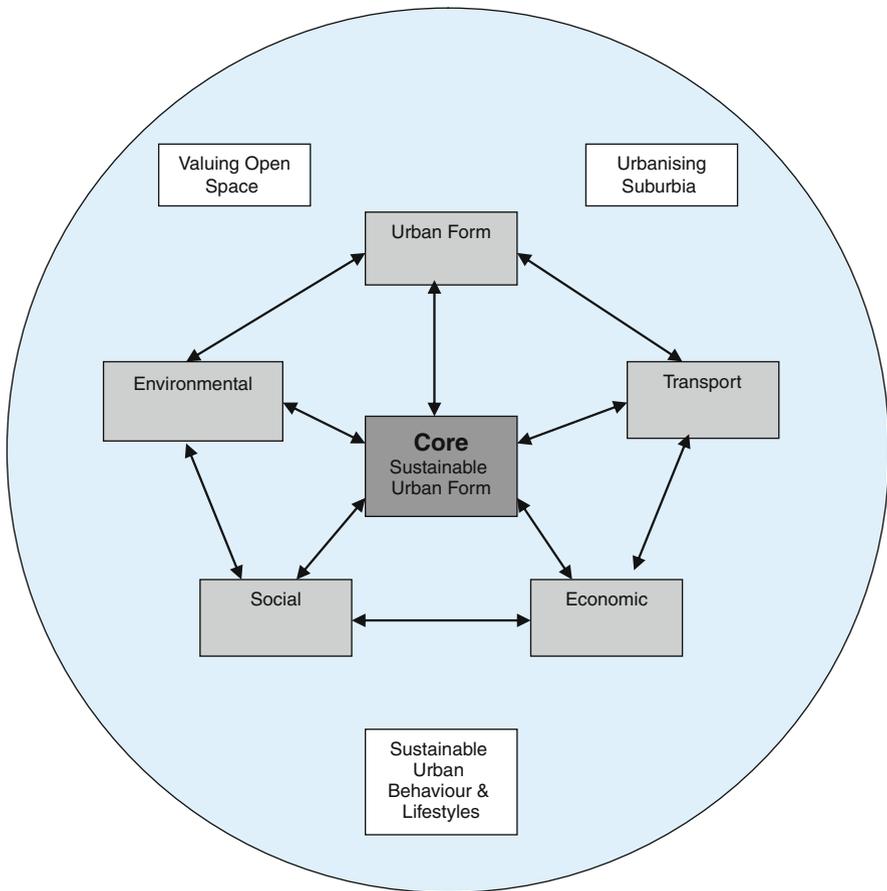


Fig. 1.3 Structure of the CityForm research

A platform for the research is presented in the second chapter. It begins with a review of measures of urban form recognising the role of different scales and outlines the methods of measurement used in the project. It profiles the five cities and fifteen case study areas within these cities that are examined in detail in later chapters. Case study areas represent a ‘slice’ through each city – a suburban area, a central area and an area ‘in between’. These profiles encompass the urban physical form and the socio-economic characteristics by reference to Census statistics. The chapter concludes with a clear exposition of the elements that make up urban form and how they might integrate together.

The effect of urban form on mobility and activity, focusing particularly on the role of neighbourhood is assessed in the third chapter which reviews the underlying issues and current planning policy in the UK that aims to promote more sustainable mobility within cities. Multivariate analysis is used to explore the

relationships between residential neighbourhood characteristics, travel behaviour and the type, duration and frequency of activity participation, whilst taking into account the effects of employment location, the wider urban structure and personal characteristics. This empirical research is based on a combination of national data sets and in-depth travel surveys. The chapter concludes with an appraisal of these relationships.

Increasing densities is a key aspect of contemporary urban development, but the ecological consequences of denser urban forms, which Chapter Four examines, are poorly understood. It is suggested that the major determinant of ecosystem performance in urban areas is the amount of available green space. While both green space availability and ecosystem performance are negatively related to urban density, there is considerable complexity within these relationships. This suggests that at any given density, there is substantial scope for maximising ecological performance. For example, in residential areas, the amount, quality and subdivision of green space are strongly influenced by housing morphology. Nevertheless, different aspects of ecosystem performance have different optima with respect to the configuration of urban green space. The implications for ecological optimisation of urban form are discussed alongside the empirical evidence derived from the study.

The social dimension of sustainability is widely accepted but exactly what this means has not been clearly defined and agreed. Similarly, claims about the social sustainability of certain urban forms, such as the 'compact city', have not been adequately tested. Chapter Five addresses both of these challenges. It begins with a discussion of social sustainability, identifying two main dimensions to the concept, related to equity of access and the sustainability/quality of community. The second part of the chapter concentrates on the relationships between social sustainability and urban form, presenting new evidence about the relationships between these two sets of measures based on quantitative measures and taking account of other socio-demographic influences. Finally qualitative evidence is drawn together to gain further insight into the relationships found.

In strictly physical terms the influence of urban form, and particularly built form on building energy use is well understood. At certain levels of description however there remain gaps to be filled if our understanding of these factors is to be well related to other aspects of energy use, particularly those determined by behaviour to improve building energy efficiency. Chapter Six describes work based on recently available UK energy consumption data that aims to improve knowledge in these areas, with the goal of improving energy models that underlie UK home energy rating schemes. Results are presented from the statistical analysis of consumption and questionnaire survey data from respondents living in different built form types in the study areas.

Chapter Seven initially focuses on the nature of the economic debate surrounding sustainable urban forms. From this base it considers the underlying forces that shape the elements of urban form and their impact in turn on a sustainable urban economy. The roles of transport infrastructure and spatial real estate markets in particular are highlighted in the examination of urban form. The chapter suggests an alternative formulation of the approach to urban sustainability that requires, as a necessary

condition, viable real estate sectors with sustainable markets. The implications of this viability condition are considered alongside the empirical evidence of individual intra-urban land use patterns in the five cities including ‘viability’ maps of the housing market and retailing.

Chapter Eight describes the development and application of a tool that allows the systematic comparison of the physical, social and economic characteristics of urban areas with commonly agreed indicators and target or threshold values of sustainable development. Establishing the difference between existing and target values allows the objective assessment of adaptation in urban areas in order to make them work in a more socially and economically balanced way. The applicability of the tool for the planning and the programming of urban areas is illustrated in a number of case studies in Glasgow.

Chapter Nine presents the results of research investigating the question: Do sustainable urban environments engender sustainable behaviour and lifestyles, and if not why not? The research findings review the behavioural impacts on households living in sustainable housing developments. The research tests the lifestyle impacts of 13 housing schemes built according to sustainability principles. These schemes include a number of design features associated with sustainability, such as energy-efficient homes and infrastructure which promotes walking and cycling. The chapter presents findings on the extent to which elements of neighbourhood design (drawn from a checklist of over 100 features) support eight key sustainable behaviours. The chapter concludes with comments on the relevance of the findings for designers and policy makers.

Urban green spaces are valuable resources in cities. There is a growing realisation that urban areas form significant components of regional and national biodiversity conservation networks, and the importance of urban nature for the well-being of human urban residents has been the focus of distinct bodies of research. With half of the world’s human population living in urban areas and a continued decline of biodiversity in the wider landscape, urban green space plays an increasingly important role in creating sustainable cities. Chapter Ten considers the links between the distribution of people and biodiversity in the city, the relationship between biodiversity and human well-being, and the potential trade-offs between management of urban green space for people and nature based on empirical research undertaken.

The final chapter addresses the key question: to what extent and in what ways does urban form affect sustainability? It challenges theories about the sustainability of urban form and the oft repeated mantras so prevalent in policy. It summarises the relationships between urban form elements and the dimensions – social acceptability, energy use, travel and mobility, ecology and biodiversity and economic viability – set out in earlier chapters. Some key results that integrate the various components on the research are presented, thus going some way towards answering the key research question raised. The chapter aims to provide policy guidance based on the evidence presented and the key urban form trade offs are identified. The chapter also examines the potential impact of building individual sustainable developments, the use of open space and adapting the city.

References

- Acioly, C. (2000) 'Can Urban Management Deliver the Sustainable City?' In *Compact Cities: Sustainable Urban Forms for Developing Countries*, (eds. M.Jenks and R.Burgess), Spon Press, London.
- ARUP (2008) <http://www.arup.com/eastasia/project.cfm?pageid=7047>
- Attwell, K. (2000) *Urban land resources and urban planting – case studies from Denmark*. *Landscape & Urban Planning*, **52**, pp.145–163.
- Badoo, D.A. and Miller, E.J. (2000) *Transportation – Land-use Interaction: Empirical Findings in North America, and Their Implications for Modeling*, *Transportation Research Part D*, **5**, pp.235–263.
- Basantani, M. (2008) Plans for Foster's Masdar Carbon Neutral City Debut, <http://www.inhabitat.com/2008/02/06/plans-unveiled-for-worlds-first-zero-carbon-zero-waste-city-masdar-city/>
- Begg, I. (2001) *Urban Competitiveness: Policies for dynamic cities*, Policy Press, Bristol.
- Boarnet, M, and Crane, R. (2001) *Travel by Design: The influence of urban form on travel*, Oxford University Press, New York.
- Bolund, P. & Hunhammar, S. (1999) Ecosystem services in urban areas. *Ecological Economics*, **29**, pp.293–301.
- Bonaiuto, M., Aiello, A., Perugini, M., Bonnes, M., and Ercolani, A.P. (1999) Multidimensional Perception of Residential Environment Quality and Neighbourhood Attachment in the Urban Environment. *Journal of Environmental Psychology*, **19**, pp.331–352.
- Bramley, G., Bartlett, W., and C. Lambert (1995) *Planning, the Market and Private Housebuilding*, UCL Press, London.
- Bramley, G. & Watkins, C. (1996) *Steering the Housing Market: new building and the changing planning system*, The Policy Press, Bristol.
- Bramley, G. (1999) Housing market adjustment and land supply constraints. *Environment & Planning A*, **31**(7), pp.1169–1188.
- Bramley, G, Kirk, K. & Russell, J. (2001) *Planning Central Scotland: The Role Of Infrastructure, Urban Form And New Development In Promoting Competitiveness And Cohesion*. ESRC Cities Central Scotland Integrative Cities Study, Policy Discussion Paper (Revised), University of Glasgow, Dept of Urban Studies (website).
- Bramley, G. & Morgan, J. (2002) Building Future Living Environments: The Role Of New Housing In Competitiveness And Cohesion. *ESRC Cities Central Scotland Research Policy Paper for Communities Scotland and the Scottish Executive*.
- Bramley, G. (2002) Housing supply and land use regulation. In *Housing Economics and Public Policy*, (eds. K.Gibb and A. O'Sullivan), Routledge, London.
- Breheny, M. (1995) Compact cities and transport energy consumption. *Transactions of the Institute of British Geographers NS*, **20**(1), pp. 81–101.
- Burgess, J., Harrison, C. and Limb, M. (1988) People, Parks and the Urban Green: A Study of Popular Meanings and Values for Open Spaces in the City. *Urban Studies*, **25**, pp.455–473.
- Burton, E (2000a) The compact city: just or just compact? A preliminary analysis, *Urban Studies* **37**(11), pp.1969–2006.
- Burton, E. (2000b) The potential of the compact city in promoting social equity, in *Achieving Sustainable Urban Form* (eds. K. Williams, E. Burton and M. Jenks) E & FN Spon, London, pp 19–29.
- Commission for Architecture & the Built Environment (CABE) (2005) *Better Neighbourhoods: Making higher densities work*, CABE & the Corporation of London, London.
- Commission for Architecture & the Built Environment (CABE) (2008) www.buildingforlife.org
- Calthorpe, P. (1993) *The Next American Metropolis: Ecology, community and the American dream*, Princeton Architectural Press, New York.
- Canmore Housing Association (2008) *Slateford Green Housing*, Edinburgh, www.edinburgharchitecture.co.uk/slateford_green_housing.htm

- Cannon, A. (1999) The significance of private gardens for bird conservation. *Bird Conservation International*, **9**, pp.287–297.
- Carmona, M., de Magalhaes, C., Edwards, M., Awour, B. and Aminossehe, S. (2001) *The Value of Urban Design*, Report by the Bartlett School of Planning for CABE and DETR, Thomas Telford, London.
- Cervero, R. (1998) *The Transit Metropolis: A global inquiry*, Island Press, Washington D.C.
- Cheshire, P. and Sheppard, S. (1989) British planning policy and access to housing: some empirical estimates. *Urban Studies*, **26**, 469–85.
- Commission of the European Communities (CEC) (1990) *Green Paper on the Urban Environment*, European Commission, Brussels.
- Crisp, V., Littlefair, P., Cooper, I. and McKennan, G. (1988). *BR129: Daylighting as a Passive Solar Energy Option; an Assessment of its Potential in Non-Domestic Buildings*, BRE, Garston.
- Crookston, M., Clarke, P. and Averley, J. (1996) The compact city and the quality of life. In *The Compact City: A Sustainable Urban Form?* (eds. M. Jenks, E. Burton and K. Williams,) E & FN Spon, London, p.135.
- Curitiba websites:
<http://solstice.crest.org/sustainable/curitiba/>
http://www.solutions-site.org/artman/publish/article_62.shtml
- Dawson, R. (2004) *Towards Good Practice in Sustainable urban Land Use*, Bristol City Council, Bristol.
- Department for Communities and Local Government (DCLG) (2006a) *Planning Policy Statement 3: Housing*, The Stationary Office, London.
- Department for Communities and Local Government (DCLG) (2006b) *Sustainable Communities: Building for the Future*, www.communities.gov.uk/publications/communities/sustainablecommunitiesbuilding
- Department for Communities and Local Government (DCLG) (2007) *New eco-towns could help tackle climate change* www.communities.gov.uk
- Department of the Environment, Transport and the Regions (DETR) (2000a) *Our Towns and Cities: The Future – Delivering and Urban Renaissance*, Cm 4911 Urban White Paper, HMSO, London.
- Department of the Environment, Transport and the Regions (DETR) (2001) *Planning Policy Statement 13: Transport*, HMSO, London.
- Dongtan Development Co (2008) <http://www.dongtan.biz/english/zhdt/plan.php>
- Duany, A. and Plater-Zyberk, E. (1992) The second coming of the American small town. *Wilson Quarterly*, **16**, pp.3-51.
- English Partnerships (2007) *Millennium Communities Programme*, ENG0049, English Partnerships, Warrington, UK.
- Evans, A. W. (1991) Rabbit hutches on postage stamps: planning, development and political economy. *Urban Studies*, **28**(6), pp.853-70.
- Faber Taylor, A., Wiley, A., Kuo, F. and Sullivan, W. (1998) Growing up in the inner city: Green Spaces as Places to Grow. *Environment and Behavior*, **30**, pp.3-27.
- Foster and Partners (2008) <http://www.fosterandpartners.com/Projects/1515/Default.aspx>
- Gilbert, O.L. (1989) *The Ecology of Urban Habitats*. Chapman & Hall, London.
- Graham, S. and Marvin, S. (2001) *Splintering Urbanism: Networked infrastructures, technological mobilities and the urban condition*, Routledge, London.
- Guy, S., Graham, S. & Marvin, S. (1997) Splintering networks: cities and technical networks in 1990s Britain. *Urban Studies*, **34**(2), pp.191-216.
- Guy, S. and Marvin, S. (2000) Models and Pathways: The Diversity of Sustainable Futures. In *Achieving Sustainable Urban Form*, (eds. K. Williams, E. Burton and M. Jenks) E & FN Spon, London.
- Handy, S. (1996) Methodologies for exploring the link between urban form and travel behaviour, *Transportation Research – D*, **1**(2), pp.151-165.
- Henneberry, J. and Guy, S. (1999) Paper presented at ‘Property’ Colloquium of ESRC Cities Research Programme, Reading, May 1999.

- HM Government (1994) *Sustainable Development: The UK Strategy*, HMSO, London.
- Jenks, M., Burton, E. and Williams, K.(eds) (1996) *The Compact City: A Sustainable Urban Form?*, E & FN Spon, London.
- Jenks, M. (2000) The acceptability of urban intensification, in *Achieving Sustainable Urban Form* (eds. K. Williams, E. Burton and M. Jenks) E & FN Spon, London, pp 242-250.
- Jenks, M. and Burgess, R. eds (2000) *Compact Cities: Sustainable Urban Forms for Developing Countries*, Spon Press, London.
- Jenks, M. and Dempsey, N. eds (2005) *Future Forms and Design for Sustainable Cities*, Architectural Press, Oxford.
- Jenks, M., Kozak, D. and Takkanon, P. eds (2008) *World Cities and Urban Form: Fragmented, Polycentric, Sustainable?*, Routledge, Oxford.
- Katz, P. (1994) *The New Urbanism: Toward an Architecture of Community*, McGraw-Hill, New York
- Kinzig, A.P. & Grove, J.M. (2001) Urban-suburban ecology. *Encyclopedia of Biodiversity, Vol. 5* (ed. S.A. Levin), Academic Press, San Diego pp. 733-745.
- Kozak, D. (2008) Assessing Urban Fragmentation: The emergence of new typologies in central Buenos Aires. In *World Cities and Urban Form: Fragmented, Polycentric, Sustainable?* (eds. M. Jenks, D. Kozak. and P. Takkanon), Routledge, Oxford.
- Lacy, R. (1977) *Climate and building in Britain. A review of meteorological information suitable for use in the planning, design, construction and operation of buildings*, Building Research Establishment Report, BRE, Garston.
- Lambregts, B and Zonneveld, W. (2003) *Polynuclear Urban Regions and the Transnational Dimension of Spatial Planning*, Delft University Press, Delft.
- Langdon, P. (1994) *A Better Place to Live: Reshaping the American Suburb*, University of Massachusetts Press, Amherst: MA.
- Llewelyn-Davies (1997) *Sustainable Residential Quality: New Approaches to Urban Living*, report for the GOL, DETR and LPAC, LPAC, London.
- Llewelyn-Davies (2000) *Urban Design Compendium*, English Partnerships and The Housing Corporation, London.
- Low, N. and Gleeson, B. eds (2003) *Making Urban Transport Sustainable*, Palgrave Macmillan, Basingstoke.
- Masnavi, M.-R. (2000) The new millennium and the new urban paradigm: the compact city in practice, in *Achieving Sustainable Urban Form* (eds. K. Williams, E. Burton and M. Jenks) E & FN Spon, London, pp 64-73.
- Monk, S. and Whitehead, C. (2000) *Restructuring Housing Systems: from social to affordable housing*. York Publishing Services.
- Office of the Deputy Prime Minister (ODPM) (2004a) *Planning Policy Guidance 3: Housing*, ODPM, London.
- Office of the Deputy Prime Minister (ODPM) (2004b) *Planning Policy Guidance 13: Transport*, ODPM, London.
- OMA (2008) www.oma.eu
- Owers, R. and Oliver, G. (2001) 'Urban healing', *EcoTech Sustainable Architecture Today*, **4**, pp.28-32.
- Parsons, R., Tassinary, L.G., Ulrich, R.S., Hebi, M.R. and Grossman-Alexander, M. (1998) The view from the road: implications for stress recovery and immunization. *Journal of Environmental Psychology*, **18**, pp.113-140.
- Pauleit, S. and Duhme, F. (2000) Assessing the environmental performance of land cover types for urban planning. *Landscape & Urban Planning*, **52**, pp.1-20.
- Payne, L., Mowen, A. and Orsega-Smith, E. (2002) An Examination of Park Preferences and Behaviours Among Urban Residents: The Role of Residential Location, Race and Age. *Leisure Sciences*, **24**, pp.181-198.
- Revill, J. and Davies, C. (2008) 'Secret' eco-town plans spark protest. *The Observer*, February 10, 2008 online: www.guardian.co.uk/society/2008/feb/10/communities.planning1?gusrc=rss&feed=networkfront

- Rudlin, D. and Falk, N. (1999) *Building the 21st Century Home: The Sustainable Neighborhood*, Architectural Press, London.
- Savard, J-P.L., Clergeau, P. & Mennechez, G. (2000) Biodiversity concepts and urban ecosystems. *Landscape and Urban Planning* **48**, pp.131-142.
- Simmie, J. (ed) (2001) *Innovative Cities*, Spon Press, London.
- Simmie, J., Wood, P. and Sennett, J. (2000) *Innovation and clustering in the London Metropolitan Region*. Paper presented to ESRC Symposium on 'Urban Competitiveness', South Bank University, April 2000, and reproduced in I. Begg (ed) (2001).
- Simmonds, D. and Coombe, D. (2000) The transport implications of alternative urban forms, in *Achieving Sustainable Urban Form* (eds. K. Williams, E. Burton and M. Jenks) E & FN Spon, London, pp 121-130.
- Skjæveland, O. and Garling, T. (1997) Effects of Interactional Space on Neighbouring. *Journal of Environmental Psychology*, **17**, pp.181-198.
- Smart Growth (2008) www.smartgrowth.org
- Stead, D., Williams, J. and Titheridge, H. (2000) Land use, transport and people: identifying the connections. In *Achieving Sustainable Urban Form* (eds. K. Williams, E. Burton and M. Jenks) E & FN Spon, London, pp 174-186.
- Stubbs, M. and Walters, S. (2001) Car Parking in Residential Development: Assessing the viability of design and sustainability in parking policy and layout. In RICS Foundation, *The Cutting Edge 2001*, RICS, London.
- Syme, G., Fenton, D. and Coakes, S. (2001) Lot size, garden satisfaction and local park and wetland visitation. *Landscape and Urban Planning*, **56**, pp.161-170.
- Tinsley, H.E.A., Tinsley, D.J. & Croskeys, C.E. (2002) Park Usage, Social Milieu, and Psychosocial benefits of Park Use Reported by Older Urban Park Users from Four Ethnic Groups. *Leisure Sciences*, **24**, pp.199-218.
- Trotter, C. (2008) Rem Koolhaas' Ras Al Khaimah's Eco City to rival Masdar <http://arquitectura.pt/forum/fl1/rem-koolhaas-ras-al-khaimah-s-eco-city-to-rival-masdar-9816.html>
- Tyrväinen, (1997). The amenity value of the urban forest: an application of the hedonic pricing method. *Landscape and Urban Planning*, **37**(3-4), pp.211-222.
- Ulrich, R.S. (1981) Natural versus Urban Scenes: Some Psychophysiological Effects. *Environment and Behavior*, **13**, pp.523-556.
- Ulrich, R.S, Simons, R.F., Losito, B.D., Fiorito, E., Miles, M.A. & Zelson, M. (1991) Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology*, **11**, pp.201-230.
- Urban Task Force (1999) *Towards an Urban Renaissance*, E & FN Spon, London.
- van Diepen, A. (2000) *Households and their Spatial-Energetic Practices: Searching for Sustainable Urban Forms*, Netherlands Geographical Studies, Groningen, Netherlands.
- Vu, T., Asaeda, T. and Abu, E. (1998) Reductions in air conditioning energy caused by a nearby park. *Energy and Buildings*, **29**(1), pp.83-92.
- Watkins, R., Palmer, J., Kolokotroni, M. and Littlefair, P. (2002) The balance of the annual heating and cooling demand within the London urban heat island. *Proceedings of Climate Change and the Built Environment, International Conf, CIB Task Group 21, Climate Data for Building Services*, Manchester.
- Whyte, W.H. (1980) *The Social Life of Small Urban Spaces*, Projects for Public Spaces, New York.
- Williams, K., Burton, E. and Jenks, M. (Eds.) (2000) *Achieving Sustainable Urban Form*, E & FN Spon, London.
- Williams, K., Jenks, M and Burton, E. (1999) How much is too much? Urban intensification, social capacity and sustainable development. *Open House International*, **24**(1), pp. 17-26.
- World Gazetteer (2005) <http://www.world-gazetteer.com>
- Yannis, S. (1994) *Solar Energy and Housing Design, Vol. 1: principles, objectives, guidelines*, Architectural Association, London.