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WHAT IS 'SOCIAL SUSTAINABILITY', AND HOW DO OUR EXISTING URBAN FORMS PERFORM IN NURTURING IT?

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Abstract

This paper focuses on the relationship between urban form and *social* sustainability. Although a social dimension to sustainability is widely accepted, exactly what this means has not been very clearly defined and agreed. We propose two main dimensions to the concept, relating to equity of access and the sustainability/quality of community. Claims for the allegedly greater social sustainability of certain urban forms, such as the 'compact city', have not been adequately tested. We therefore develop performance measures for these dimensions, and relate these to systematic measures which characterise differences in urban form. New evidence is presented on the relationships between these two sets of measures, controlling for relevant demographic and socio-economic factors, for five UK cities benchmarked against the wider UK context. The broad story suggests that there is a tradeoff between the greater accessibility of more compact forms and the apparently more socially stable and cohesive suburbs. However, it is clear that the socio-economic dimension of poverty-affluence cuts across this and may account for much of latter appearance. Thus urban form must be considered alongside the spatial location of social groups.

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WHAT IS 'SOCIAL SUSTAINABILITY', AND HOW DO OUR EXISTING URBAN FORMS PERFORM IN NURTURING IT?

Introduction

This paper focuses on the relationship between urban form and *social* sustainability. It discusses the meaning of the latter concept and considers how it may be promoted or undermined by different aspects of urban form. It then goes on to present some secondary and some new empirical evidence on this relationship in existing British urban settings.

'Sustainable development' is a widely-used term, which has exercised an increasing influence on planning, housing and urban policy in Britain, as for example in the *Sustainable Communities Plan* of 2003. Debates about sustainability have moved on from considering this solely as an environmental concern to include economic and social dimensions (Carley & Kirk 1998, p.3). Elkin et al (1991, p.203) argue that sustainable development also 'embraces the need for equity' because future urban development must 'provide for forms of social organisation which prevent inequality from damaging sustainability', and similar rehetoric is now widespread in the literature (e.g. Burton, 2000, cites Blowers 1993, CEC 1990, Sherlock 1990, Yiftchel & Hedgecock 1993). National and international policy pronouncements echo this theme, for example DETR (1997), ODPM (2003) and United Nations (2002). However, while there is widespread agreement that a social dimension is important, there is less agreement, and less systematic analysis, of what exactly is meant by social sustainability in different contexts.

Our motivation for pursuing this is to contribute to a wider project of assessing the evidence on the sustainability of different urban forms in the context of a mature post-industrial society, the UK. This project arises out of a particular focus in the UK and elsewhere on the alleged sustainable qualities of 'compact city' urban forms (Jenks et al 1996, Williams et al 2000). We are part of a research consortium known as 'CityForm' which aims to examine and test the claims made that more compact, high-density and mixed-use urban forms will be environmentally sound, efficient for transport, socially beneficial and economically viable. Through empirical neighbourhood research, based on three case study areas in each of the five cities, the CityForm project explores the nature and extent of the relationship between urban form and sustainability.

This paper proceeds by firstly seeking to clarify the meaning of 'social sustainability', so that more operational measures of its achievement may be developed. It then briefly considers the different dimensions of urban form and the ways in which these may be expected to impact on social sustainability outcomes. The empirical part of the paper presents some initial evidence on the relationship between urban form and relevant social outcomes. This evidence is drawn firstly from an existing large-scale secondary data source, the Survey of English Housing, and secondly from a new household survey conducted in case study neighbourhoods within five UK cities. The analysis seeks to separate the effects of urban form from other factors, including demographic and socio-economic variables which may intervene in the relationship.

Social Sustainability

Our approach to 'sustainability' and 'sustainable development

As already noted, a significant proportion of sustainable development rhetoric now stresses the importance of social equity One can see that there is a basic political rationale to this, insofar as there is a need to secure the cooperation of 'the poor' in measures to tackle global environmental degradation. Poor countries, and poor sections within more developed countries, will inevitably be concerned with meeting their basic needs and securing minimal opportunities for economic advancement before addressing long term environmental causes. In addition, there is growing recognition of the inequities in access to and use of environmental resources, with the ecological footprint of affluent nations' residents being seen as much greater than that of most of the poor in developing countries. Thus, the idea of environmental justice may be employed, and this is clearly closely modelled on and related to the concept of social justice.

Within mature industrial societies such as the UK one can perceive other political rationales for a focus on sustainability, including its economic and social dimensions. Economic and demographic growth require the continued development of new or expanded urban settlements, yet there is often strong resistance to such development manifested through the land use planning system (Barker 2004). While such resistance may represent a degree of selfish protectionism, it can also reflect past experience with new development which has frequently failed to deliver new settlements which are socially balanced, affordable, well-designed, and properly provided with services and amenities. One can intepret much of the thrust of the ODPM (2003) Sustainable Communities Plan as being about tackling this perspective head on.

Social Sustainability

Although the sustainable development agenda has begun to emphasise the importance of 'social' aspects of sustainability there has been little agreement as to what this constitutes. Various authors have attempted to define 'social sustainability'. Polese and Stren (2000: 15-16) defining social sustainability as:

> Development (and/or growth) that is compatible with harmonious evolution of civil society, fostering an environment conductive to the compatible cohabitation of culturally and socially diverse groups while at the same time encouraging social integration, with improvements in the quality of life for all segments of the population.

Whilst there is a relatively limited literature that focuses specifically on social sustainability, there is, however, a broader literature on the overlapping concepts of social capital, social cohesion and social exclusion. Box 1 below illustrates the parallels between these concepts. Other terms such as 'quality of life' are also used (as for example in DETR 2001).

Box 1

Social Capital

Social capital refers to features of social organisation such as networks, norms and trust that facilitate co-ordination, and co-operation for mutual benefit.
(Putnam, 1993: 35)

Suggested Elements

Empowerment	Participation	
Associational activity	Common purpose	
Supporting networks	Reciprocity	
Collective norms and values	Trust	
Safety	Belonging	(Forrest and Kearns, 2001)

Social Cohesion

Social cohesion can emphasis the need for a shared sense of morality and common purpose; aspects of social control and social order; the threat to social solidarity of income and wealth inequalities between people, groups and places; the level of social interaction within communities or families; and a sense of belonging to place
(Forrest and Kearns, 2001: 2128).

Suggested Elements

Common values and civic culture	
Social order and social control	
Social solidarity and reductions in wealth disparities	
Social networks and social capital	
Territorial belonging	(Kearns and Forrest, 2000)

Social Exclusion

Social exclusion is a process that deprives individuals and families, groups and neighbours of the resources required for participation in the social, economic and political activity of society as a whole. This process is primarily a consequence of poverty and low income, but other factors such as discrimination, low educational attainment and depleted living environments also underpin it. Through this process people are cut off for a significant period in their lives from institutions and services, social networks and development opportunities that the great majority of a society enjoys (Pierson, 2002: 7).

Suggested Elements

Poverty and low income	
Lack of access to jobs	
Lack of social support and networks	
Effect of the local area	
Exclusion from services	(Pierson, 2002)

Offering a working definition of social sustainability

There are two recognisable, overarching concepts at the core of the notion of social sustainability. Whilst social equity issues are powerful political and policy concerns, and centre upon a distributive notion of social justice – that is 'fairness in the apportionment of resources in society' (Burton, 2000a: 1970) – there is a more collective 'sustainability of community' dimension which, although seemingly more nebulous, is also fundamental to the concept. This second dimension is essentially concerned with the continued viability, health and functioning of 'society' itself as a collective entity, generally under the heading of 'community'. This is not to suggest that these two dimensions are completely independent of one another, merely, that this is a useful conceptual distinction. In exploring social sustainability at the neighbourhood level both of these dimensions need to be covered.

Clearly, to meet the requirements of equity in urban development it is essential that these provide appropriate opportunities in terms of accessible jobs and affordable housing. These aspects tend to receive most attention in strategic planning. However, there are other complementary aspects of equity which also deserve attention. From our review of the literature we identified some key elements of access to local services that emerged as important in for equity between and within local communities. These include services such as doctor, post office, chemist, supermarket, bank/building society (all of which were identified as essential in the Poverty and Social Exclusion Survey, Gordon et al 2000, 2006). We are also interested in finding out about the importance to peoples' lives of a wider range of services and facilities within neighbourhoods: corner shop/convenience store, restaurant/café/take away, pub, library, public sports facilities, community centre/venue for evening classes, facilities for young children, facilities for young people and public open/green space.

Literature on the wider concepts around ideas of social sustainability (such as social capital, social cohesion and social exclusion), summarised in Box 1, indicates that the following dimensions are also likely to be significant in helping to sustain local communities and neighbourhoods:

- Interaction in the community/Social networks.
- Community participation.
- Pride/sense of place
- Community stability.
- Security (crime)

Individually these dimensions tap into a number of interesting debates within urban policy. The variable 'interaction in the community' is part of the social mix agenda. The inclusion of an interaction criterion as part of our definition of social sustainability

emphasises that it is not just achieving a mix of characteristics of population within an area that matters, but also whether people *actually personally interact* with their neighbours. To this end we are exploring the nature and extent of people's social networks. We also explore community participation and are interested in whether people use facilities within their neighbourhood, and their attitudes towards these facilities. The premise is that if people participate in activities within their local community then they will have stronger ties to the community. A similar argument applies to the inclusion of the concept of pride /sense of place. This relates to the importance of feeling pride in one's area and of having a vested interest in the area, the idea being that if people feel attached to the neighbourhood, they will want to stay living in the area and contribute to its continued development. The fourth dimension that we consider from the sustainability of community perspective is community stability. Within the literature, areas of high turnover are perceived to be unsettled and undesirable areas, although this is not always be the case as some locations provide an appropriate setting for particular lifestages which are characterised by greater mobility (for example, studying in higher education or setting up a first home). Community stability is often associated with higher levels of social cohesion (for example, refer to Hirschfield and Bowers, 1997). With regard to the final dimension, Government policy is increasingly stressing the need and ability of communities to combat crime for themselves (Atkinson and Flint, 2003). There is also an established connection to urban form (as in the 'design and crime' literature). Shaftoe (2000: 230) argues that 'community safety is an essential prerequisite for a stable and sustainable neighbourhood' with crime and fear of victimization being 'two of the top deleterious ingredients of urban living' (2000:230).

Exploring the relationship between social sustainability and dimensions of urban form

Jenks *et al* have described the relationship between urban form and sustainability as 'one of the most hotly debated issues on the international environmental agenda' (1996:11). Since the publication of the Bruntland Report (WCED, 1987) much of the debate on sustainable urban form has focused on the environmental impact of urbanisation; in particular considering issues such as the impact of car emissions, air pollution and the energy efficiency of human settlements. As discussed above there has been a move away from focusing solely on environmental dimensions of sustainability to consider other dimensions of sustainability such as 'urban sustainability' and 'social sustainability' (CEC, 1990). This part of the paper focuses on the relationship between the individual dimensions of urban form and social sustainability. What emerges from this review of the literature is that there are competing claims regarding the extent to which urban form influences social sustainability; claims and debates that have, to date, rarely been supported by empirical evidence.

Urban form may be defined in terms of a number of distinct elements, including:

- Size of city, city-region or settlement, conventionally measured by population

- Structural form within this region, whether monocentric, polycentric or linear for example
- The distribution of residential and job densities within this structure, in terms of the degree of concentration versus uniformity
- The density of residential development, which may be measured in various currencies including dwellings, rooms, floorspace or population per unit of area, with the a distinction between 'gross' and 'net' densities depending whether non-housing land uses are included within the denominator
- The configuration of local road networks
- The layout of housing units and blocks
- The predominant type of residential or other buildings, and in particular whether single or multi-family units and the typical height of buildings
- The mix of land uses, including the extent to which economic activities are separate from or intermixed with residential and the size and distribution of public open spaces, both green and paved

These different elements of urban form vary to some extent in the scale at which they are conceived, with the first two being more macro (city-wide) in scale whilst the others relate to a more micro-scale of neighbourhoods. Density is perhaps the most general, as it can be easily measured at different scales and it tends to reflect and be reflected in other elements.

Of the elements of urban form considered by the CityForm project, density is also the one element that has received the most attention in the literature with regard to its impact upon the social sustainability of areas. Much of this focus has been upon whether policy should seek to contain the spatial extent of urban development by developing at higher densities or whether it should not curtail impose such a constraint and thereby enable building at lower densities – as reflected in the 'compact city' versus 'sprawl' debate.

The density of urban development has the potential to impact upon all of the dimensions of social sustainability that concern us. For example, higher densities may make access to services and facilities both easier and more economically viable (Bunker, 1985; Collie, 1990; Haughton and Hunter, 1994; Burton, 2000b). Williams (2000) found that access may vary for different services. The ODPM (2003) argues that particular densities are needed to support basic amenities in the neighbourhood and to minimise the use of resources such as land. Burton (2000a; 2000b) has produced (arguably) the most comprehensive work exploring the impact of urban form on social equity. In particular looking at whether higher density urban form promotes social equity (Burton, 2000a). Burton (2000b) found that nearly all of the 14 social equity effects that she identified are related in some way to urban compactness; job accessibility and wealth being the exceptions. For medium sized English cities she found that higher urban densities may be positive for some aspects of social equity and negative for others.

Higher densities may also mean that people are more likely to meet each other on the street than in lower density areas (Talen, 1999; Duany and Plater-Zyberk, 2001). In contrast lower densities reduce the potential for spontaneous interaction and leads to an

orientation towards car travel (TCRP, 1998). Glynn (1981) and Nasar and Julian (1995) both found 'sense of community' to be higher in neighbourhoods that facilitated face-to-face interaction. There are, however, alternative arguments that in higher density societies, people may withdraw from social contact. Wirth (1938) argued that high density living, along with the anonymity of city life leads to an increase in stress and the severing of traditional ties that results in a decline in community or social ties. Bridge (2002:4) refers to Simmel's (1995) discussion of the 'psychic over-stimulation' of the city'. In this way higher densities may lead to weaker social ties. There is an argument that whilst very low densities may undermine social ties, at some point further up the scale higher densities may start to have the same effect (Freeman, 2001). It is argued that in a compact city, that is a city with high-density and mixed-use urban form, communities are likely to be more mixed, and that as such there is likely to be a lower level of social segregation. Suburban sprawl in particular has come to be associated with high levels of segregation and inner city decay (CEC, 1990; Burton, 2000a; Bramley and Morgan, 2003).

The density of development may also affect the appearance and aesthetics of places. The TCRP (1998) review found that there is little evidence within the literature to suggest that Americans find sprawl less attractive than more compact forms of development. However, they do cite work by Nelessen (1994), Shore (1995) and Diamond and Noonan (1996) which argues that lower density development is less aesthetically pleasing. There is also an argument that low density developments can be more attractive (Audirac and Zifou, 1989). Gordon and Richardson (1997) argue that given the choice people prefer low-density suburban living to high-density urban living. They note that many consumer preference surveys have shown a strong preference for suburban living.

We can see from this brief review of the literature that the discussions on the relationship between urban form and social sustainability are quite complex, with at times contradictory findings. Further, there is a dearth of analysis at a small scale local level. In order to address this gap the next part of the paper draws upon secondary data sources to examine preliminary evidence on some aspects of social sustainability and their relationship to urban form.

Analysis of Survey of English Housing

It is possible to obtain some indicators relevant to aspects of social sustainability from large-scale household surveys, and recent years have seen an expansion of the availability of such surveys from Government in Britain. Hitherto, it has mainly only been possible to report the results of such surveys for very broad geographical entities, such as regions. This meant that only limited conclusions could be drawn about any associations between sustainability indicators and urban form, which obviously varies at a much finer spatial scale than that of the region. However, a number of scholars have attempted to persuade Government to attach attributes of smaller neighbourhoods to these survey datasets, in order to explore such relationships. For example, there has been particular interest in the situation in 'deprived' neighbourhoods and in rural versus urban settlement, and a

growing interest in measures of the quality of life ('liveability') of urban environments and in the viability of local housing markets.

The Survey of English Housing (SEH) is an interview survey carried out with 20,000 households across England each year, starting in 1993/4. As the name would imply, SEH is particularly relevant to housing and the environment around it. There is a broad common core of questions which are carried forward from year to year, and the datasets can be easily pooled across years. In this instance we report data from just the most recent year of the survey (2003/04).

For the purposes of this research the Office of the Deputy Prime Minister (ODPM) made the data available with the usual attached area codes and attributes (region, local authority, urban-rural indicator, deprivation indicator) but also (possibly for the first time) with unit postcode still attached. This enabled the researchers to link data from the recent (2001) Census at the smallest geographical level possible, the Census Output Area (COA for short). Output Areas in England have an average population of 300 and an average number of households/dwellings of around 125. An output area typically comprises a street or block, or part thereof. This is clearly quite an appropriate scale at which to measure urban form. Because of the way that (most) residential areas were developed, streets or blocks very often have a common building form, so that these units are relatively homogeneous internally while differing markedly one from another. By incorporating this data linkage, it becomes possible for the first time to analyse the impact of relatively micro-elements of urban form within these large-scale household surveys.

Urban Form Measures

The elements of urban form which can be measured at COA level from Census data are

- Density (gross residential), measured variously in terms of population, households, dwellings ('spaces'), or habitable rooms
- House type mix, expressed as the proportion of flats, detached, semi-detached or terraced houses
- Presence of high(-er) residential buildings, proxied by households whose lowest floor of accommodation is above various floor levels
- Density of cars, relative to space, dwellings or people, can also be measured – although an 'outcome' (or 'intervening variable') rather than strictly an element of urban form, this may still have considerable physical impact on neighbourhoods and how people experience them

It must be noted that there are some limitations to these measures. Net residential density cannot be measured from Census data, because COAs cover all land uses, not just housing. The available measure of land area is also rounded, so imparting some imprecision to density. Aspects of urban form which the Census cannot measure include

quality of design, type of building and street layout, open space and mixed use. Having said this, by combining with a household survey like SEH it is possible to include measures for individuals which imply certain urban form at the micro scale, for example whether the household has a garden or a yard/patio, and the type of parking facilities available. Subjective views of 'access' to certain facilities (buses, shops, etc) are also asked about. In addition, certain independent datasets measuring land use or access at a broader scale may also be attached to the data.

As discussed above, the most important single aspect of urban form is probably density, because it is a general summary measure which many other features will be partly correlated with. The 'compact city' concept implies relatively high density. We have a choice of measures although these are correlated. The main measure used is room density (habitable rooms per hectare), because this arguably best captures the intensity of the built structures. All the density measures are subject to controlling for extreme high outliers.There is evidence that for some outcomes the effects are nonlinear and become more pronounced at the highest (or in other cases the lowest) level of density.

Outcome Measures

Turning to the measures of social sustainability 'outcomes', the most important are those reflecting people's overall satisfaction with their home and their local area. These capture the dimensions of attachment to/pride of place and (indirectly) residential stability. As with the other measures used here, we use the negative measure of being very or slightly dissatisfied with the area or home as our key indicator, to focus on that significant minority who register some level of dissatisfaction.

Other measures used include:

- whether area has 'got better or worse' over the past two years;

- where respondents think particular negative features or behaviours are 'a (serious) problem in this area', including crime; vandalism or graffiti; traffic or noise; dogs or litter; neighbours or harrassment

- residential turnover, based on recent (one year) moves, or having taken steps towards moving -owner occupiers who have placed their home on the market to sell, and households who have registered on a housing waiting list .

- four subjective measures of access to local services, based on respondents reporting it as being fairly or very difficult to get to (a) a corner shop or a large food supermarket; (b) a post office; (c) a doctor (GP); (d) a hospital.

These do not all map simply on to the dimensions of sustainability identified earlier but they can be seen to cover the dimensions of pride in area, environmental quality, safety, turnover and access to services. The dimensions of social interaction and collective activity are not really represented.

Other relevant variables

In seeking to understand the relationships between urban form and social sustainability outcomes, it is necessary to take account of the influence of other variables which may be important in determining these outcomes. For example, dissatisfaction with area or a propensity to move may be systematically related to a wide range of factors, including age, household composition, socio-economic status, or the type and size of housing occupied. Many of these variables may be regarded as exogenous, while some might be regarded as 'intervening' factors which mediate the effects of urban form. Most of the variables of this kind available for this analysis are attributes of the individual households in the Survey or the individual dwellings which they occupy. There are also some variables available in the analysis which describe characteristics of the areas where people live, other than urban form per se, such as the socio-economic and tenure profile of the area, including the general level of deprivation versus affluence. Broadly, for the purposes of this analysis these other variables are essentially playing the role of controls. We need to take account of their influence before we can isolate the particular influence of urban form.

Descriptive patterns

As a first approach to the analysis we present some straightforward descriptive charts showing the pattern of scores on the outcome variables across banded values of our key urban form indicator, density (rooms per hectare). To take some account of some of the other variables which may be important influences or mediating factors, we can break these analyses down into various sub-categories according to household composition, tenure, house type, region; or urban-rural category. However, to save space we only report on some of the differences between these categories. These charts show at a glance (a) whether there is a general pattern (slope) in the scores across the density bands, and (b) whether the levels of these scores, or the slopes with density, vary between the other categories.

Figure 1 looks at the basic indicators of dissatisfaction and intention to move. In general, dissatisfaction is greater at higher densities, and this pattern applies across each of the measures and most of the sub-categories. The relationship (slope) is slightly stronger for area dissatisfaction than for dissatisfaction with the home, but in both cases there is some evidence of a nonlinear increasing effect at the higher density levels. This pattern is similar for the waiting list indicator, but rather less for the 'area got worse' indicator, the selling indicator (for owners), and the mobility (moved in last year) indicator.

Figure 2 looks at the key indicator of area dissatisfaction for different household types and housing tenures. The same general picture of greater dissatisfaction at higher densities applies in all cases.. Social renters are generally much more dissatisfied at all levels of density, while private renters seem more tolerant of higher densities. Two general reasons for social renters' adverse scores is that they are a group who generally have less choice within the housing market and hence over where they get to live, and that social renting areas tend to be more deprived and (as we show below) deprivation is a strong predictor of dissatisfaction and neighbourhood problems. Although not shown here, families with children tend to display higher dissatisfaction with home, and more

sensitivity to density (a steeper slope), particularly on the dissatisfaction with home, 'got worse' and waiting list indicators..

Figure 3 looks at the incidence of five specific neighbourhood problems. The most common of these problems is dogs-litter, followed by crime and vandalism. All of these indicators show a fairly strong pattern of greater problems at higher density, with scores two to three times higher in the densest band than in the least dense band. In general the relationship with density appears to be nonlinear increasing. The more adverse picture for higher densities may reflect a greater incidence of problems, but also a greater tendency for any problems to impinge on residents when they live much closer together. Many (if not all) of these problems reflect negative interactions between some residents and other residents.

Families with children record higher scores on four of the five indicators, and a steeper slope with density in the cases of crime, vandalism and dogs-litter. Social renters have much worse scores on all of these indicators, but tend to be less sensitive to density than owner occupiers. Figure 4 illustrates this in the particular case of crime. It also shows that people living in flats record worse scores but with less sensitivity to density than applies to people living in houses. London has significantly higher scores on all indicators but shows less variation with density within the region; again Figure 4 illustrates the case of crime. There is quite strong variation with density in the north. These indicator scores tend to be very low in sparse settlements, particularly for crime, vandalism and dogs-litter.

Figure 5 looks at access to service difficulties. The most widely-reported difficulties are with access to hospitals, and the least with post offices, although hospitals are likely to be less routinely visited by most respondents. The pattern here is generally quite different, with greater difficulties associated with lower densities, as would be expected. However, the sensitivity to density is generally less than with the indicators described above, with the lowest density band scoring one to one-and-half time higher than the highest density band.

It may be the case that density measured at the block level, as in these analyses, is less critical for service access than density measured at a wider settlement level. This is illustrated in Figure 6 in the case of time to bus stop, where sparser areas show much less accessibility, as would be expected.

Logistic regression modelling

The next step in the analysis is to carry out regression modelling to see how far these patterns can be explained by systematic relationships with all of the variables available to us. In particular, we are interested in what effect urban form characteristics have once we have controlled for a raft of other exogenous and intervening variables. The technique used is logistic regression analysis, which is an appropriate standard technique to use when the variables we are seeking to explain/predict are individual, binary (yes/no) factors. Within these analyses we can not only look at the effects of density, and variant measures such as child density, but also housing type mix, height measures, and measures relating to cars and car-parking. The neighbourhood-level variables also include tenure

mix (at OA level) and deprivation (at SOA level), and house prices (at local authority level). A very large number of individual household attributes are available for the analysis, but those which turn out to be insignificant are largely weeded out of the models reported here.

We do not report all of the logistic model results in full, to save space. Perhaps the most important single overarching outcome measure is 'dissatisfaction with neighbourhood', so we do report the full model for this in Table 1. Most of the variables retained in this model are statistically significant. Among the individual/household attributes (chiefly included as controls), the most significant are: number of adults and children in household and lone parent status, which are positive (more dissatisfaction), and income and Asian ethnicity which are negative (less dissatisfaction). Among the area variables other than urban form, relative deprivation ranking (RELIMDR) is strongly negative, implying that less deprived areas have less dissatisfaction, while more dissatisfaction is associated with more social renting, nonwhite population and vacant housing.

Several variables measuring urban form are significant in this model: density and the share of terraced houses are associated with higher dissatisfaction, allowing for all the other factors in the model. The ratio of cars to dwellings has some positive effect on dissatisfaction as well. More noteworthy is the strong significance of the negative effect (less dissatisfaction) from 'regarding street parking as adequate' (this variable crops up in many of the models).

So there is general support for the hypothesis that urban form affects satisfaction with area of residence, and specifically that higher density, as well as some housing types associated with higher density (e.g. terraces), make for somewhat less popular neighbourhoods. However, it should be emphasized that the crude profile of dissatisfaction by density revealed in Figures 1-5 may give an exaggerated picture of the effect of density per se. Much of that difference is due to the correlation of density with deprivation, social renting, lone parents, and other factors which the logistic model controls for. The estimated effect of an increase in density on dissatisfaction, holding everything else constant, can be estimated from the coefficient (or the exp(B) 'log-odds') factor in the model. In this instance, we estimate that doubling density at the mean value would raise the proportion dissatisfied by about 10% (which is about 0.9% points). For comparison, the simple descriptive analysis shows that an increase of this order in density is associated with a crude rise of 3.7% to 5.6% points in area dissatisfaction, when other factors are not held constant. This implies that the true direct effect of density per se is only of the order of a sixth to a quarter of the apparent effect.

The other key urban form variable which is significant in this model is terraced housing share. Doubling the share of terraced houses would increase dissatisfaction by 15%, or 1.4% points. Again, this is not a very large effect. For example, the crude overall difference in area dissatisfaction between flat dwellers and house dwellers is 4.5% points. In general, these findings do tend to put the urban form issue in perspective.

Rather than report the full detail of all the models, we concentrate in Tables 2-4 on the impact and significance of the urban form variables across the range of outcomes. For

this purpose grouped composites indicators (i.e. mean scores) are used to combine four 'neighbourhood problems' (other than crime) and three access indicators (excluding hospitals). We show the marginal effects of a doubling of the variable's value at the mean (described as 'elasticity %'), as well as the conventional logistic regression parameters.

Density (log of rooms per hectare) has a significant impact on six of the eleven outcome variables, in most cases in the expected direction (Table 2). These variables are 'area got worse', crime, and neighbourhood problems, with the 'difficulty of access' composite being negatively related to density as expected. Higher density is associated with more people saying that parking is adequate. In none of these cases does the marginal impact exceed the level described above for density on area dissatisfaction.

Child density is significantly related four of the outcomes (Table 3): dissatisfaction with house, crime, neighbourhood problems, and parking adequacy. The marginal effects are between 5% and 10% for a doubling of child density. This time the impact on parking adequacy is negative, perhaps picking up the problems of damage to parked cars caused by petty vandalism, joy-riding, etc. These impacts make some sense, insofar as concentrations of children might be expected to impact through crime, vandalism, litter, etc.

The proportion of flats relates significantly to three outcomes (Table 4): area got worse, access difficulties, and parking adequacy. In the first case the sign is negative, indicating (surprisingly?) that areas with more flats were slightly less likely to report a deterioration. In the second case the sign is also negative, indicating that more flats goes with easier accessibility, as expected; while in the third case the negative sign indicates that parking is less likely to be seen as adequate in more flatted areas.

The main conclusion from this more detailed modelling is that urban form variables do have some impact on social sustainability outcomes, but these effects are typically much smaller than would be suggested by the simple charts or two-way tables. This is generally true for area dissatisfaction and related variables, but less so for access to services. Figure 7 sums up this story, with the key finding reflected in the rather small elasticities in the final column of the table after controlling for other factors.

CityForm Household Survey

The second set of empirical evidence considered derives from a household survey conducted in summer 2005 by this research team in 15 neighbourhoods set within 5 UK cities: Edinburgh, Glasgow, Oxford, Sheffield and Leicester. The neighbourhoods each contain c.2000 households and for each city three areas were chosen to represent a location adjacent to the city centre, an outer suburban area, and an area situated at an intermediate position. Taken as a whole these areas represent a wide variety of urban forms and a mixture in terms of tenure, demographic and socio-economic profiles. A random sample of addresses in each area was selected and a self-completion questionnaire was administered by post with two follow-up reminders, achieving an overall response rate of just over 30%. The responses are re-weighted to reflect the Census based household population of each area in terms of household type and tenure.

The questionnaire collects information and some opinions, particularly relating to our social sustainability criteria but also some other issues, as well as basic household demographic and socio-economic information. The questionnaire response data are linked to data from the Census for the relevant COAs and to certain other measures based on location (some of which are currently only available for the three English cities).

It should be noted that the nature of the sample chosen, while well-representative of medium sized cities, does not attempt to cover the whole of the UK urban system, and clearly does not represent the extremes of London on the one hand or smaller towns, villages and rural areas on the other. In other words, the range of variation of urban form is less than that contained in the SEH analysis. We intend to carry out further work to benchmark key indicator scores against wider national sources, including SEH.

A profile of the areas

Table 5 presents a socio-demographic profile of the case study areas, comparing cities, locations and (COA-level) density bands. The case study areas taken as a whole deviate somewhat from the national picture by having less older households and families and more rented housing, particularly private renting. The residential densities in these areas are relatively high, averaging 95 persons per hectare, equivalent to about 41 dwellings per hectare. However, in this respect they are more similar to the densities favoured by current English planning policy and by policy commentators such as Lord Rogers.

In general, inner areas have less older households and very few families with children (see also Bramley & Morgan 2003). Inner areas have lower incomes, partly because of smaller households but partly because social rented housing is more important there. However, 'peripheral' public sector housing estates are common in British cities and two of our case studies feature such estates significantly in their outer case study.

Table 6 presents some additional urban form measures for the English case studies, based on a recently-released data source known as the Generalised Land Use Database (GLUD). The geographical level is rather coarse, being based on wards, but it does give some additional insights into the reality of differing urban forms. The five indicators quoted all show the ratio of the total land area in a particular category to the land area of domestic buildings. So, for example, gardens represent on average 2.28 times the area of the domestic building footprint. However, this varies from 3.54 in the outer areas to 1.43 in the inner areas; and from 2.67 in areas where densities are below 50 PPH to 1.05 in areas with densities above 200 PPH. As as shown below, gardens seem to be very significant for several aspects of social sustainability.

The ratio for non-domestic buildings provides a measure of proximity to commercial, service and employment zones but also, to a degree, of the presence of 'mixed use'. This may be a negative environmental 'externality' or a positive 'access to opportunities' indicator, or possibly both for different groups or in different circumstances. This measure varies significantly between the cities, owing to the particular choice of area boundaries. However, the general pattern is for this to be much higher in inner/central areas, unsurprisingly. A surprisingly large proportion of land area is utilised by roads,

1.86 times the area of domestic buildings. This again is higher in inner areas, but there is a relatively little overall relationship with density. Water is presumably a positive amenity, and in these case studies it is more prevalent in the outer areas.

Social Sustainability Measures

The questionnaire was designed to generate a range of measures of the main underlying dimensions of social sustainability as defined earlier. For the purposes of this paper, where we are trying to paint the bigger picture, we work with a number of composite measures designed to capture these dimensions. These composites were defined judgementally. However, as a subsequent check a factor analysis was carried out of the underlying data, and this came up with a remarkable similar set of main factors, which provides some reassurance for the underlying construct validity.

Each composite indicator takes particular responses which represent either the positive or the negative end of the spectrum, counting one for each instance, and then adds these up across a number of relevant questions. This gives a simple 'score'. The main composite indicators cover the following dimensions of social sustainability:

- Friendliness and social interaction, measured by seeing friends and relatives in the neighbourhood frequently, seeing/chatting with/borrowing from/knowing by name 'some/most/all' of the neighbours, and agreeing that this is a place where neighbours look out for each other or are friendly.

- Pride in/satisfaction with neighbourhood, measured by general satisfaction, good appearance ratings, and feelings of pride, identification and belonging

- Safety, measured by more negative responses to standard question about safety walking alone after dark, serious problems of crime, disturbance by children/youth or traffic, and not feeling comfortable/safe waiting for public transport

- Environment, measured by negative rating of street lighting or parks/open spaces, serious problems with noisy neighbours, litter/graffiti, lack of parking or amount of traffic.

- Mobility, measured by having lived here less than 3years, or expecting to move in the next few years for reasons relating to accommodation or area.

- Collective group activity, measured by participating at least once a month in each of six activities within the neighbourhood or the city, including sport/exercise, adult education, community/residents groups, support groups, religious or other groups.

- Use of local facilities: those of 11 local services used at least once a month; these can also be measured by estimated annual frequency, for two main groupings (see note to table 8).

We also provide an overall 'social sustainability score' by simply adding all of these indices together. This is admittedly a crude method of combination; different scaling and weighting schemes could certainly be explored. The problem is that we do not really have any powerful independent measure to use as a basis for weighting. Nor have we sat our respondents down in a room and got them to agree which of these is more or less important, and what their overall 'social welfare function' would be. Some would say that this is adding apples and oranges. On the other hand, in the face of general uncertainty, much assertion and little evidence, there is probably some value in a simple summary index. This can then be compared with other metrics for other aspects of sustainability, for example energy use, CO2 emissions, biodiversity, GDP or whatever.

Descriptive findings

Table 7 shows the scores on the various composite indicators across the cities, location types and density bands. It should be noted that some dimensions are given both positive and negative scores, while others are either positive or negative (as shown in the header). Shading is used to indicate the 'best' and 'worst' scoring area in each case.

Friendliness and interaction is best in Sheffield and least good in Leicester. However, as with a number of other indicators, the differences within cities are greater than those between them. Inner areas are much poorer for friendliness and interaction than outer areas, and the same is true to a slightly lesser extent when we compare high and low density.

Neighbourhood pride and satisfaction is again best in Sheffield, but this time Glasgow scores poorest. Again, there is a marked difference between the poor scores for inner areas and the favourable ones for outer areas, and there is a similarly strong contrast between high and low density bands.

For safety, Sheffield again scores well but this time Oxford comes out worst. This may seem surprising but reflects the dominance of a problematic peripheral public housing estate in Oxford's out case study. This in turn means that the overall relationship with location is muted, and the same seems to apply to density.

Neighbourhood environmental problems show a similar pattern to neighbourhood dissatisfaction, with substantially worse incidence in inner areas and higher density areas.

Satisfaction with the home is greater in outer areas and low density areas. This may be reflected in the next indicator, that for mobility, which is very much greater in inner areas, as expected, and somewhat greater in denser areas , although this relationship is less strong.

Group participation is one of the most widely used indicators of 'social capital'. Our data suggest that this is only slightly greater in outer areas than in inner areas, and that it may even be slightly higher in the densest areas than in areas of medium and lower density. However, this is a simple bivariate relationship, uncontrolled for demography. The activities people from the inner city do may differ somewhat from those most prevalent in

the suburbs, and a predominantly single/childless population may have more need for group association outside the home and family.

The use of local facilities is the dimension of social sustainability which we expect to have the most positive relationship with density and centrality, because of simple considerations of physical accessibility and nearness of facilities (possibly reinforced by factors associated with car ownership, parking and use). Our hypothesis is borne out to the extent that inner areas have a higher score and higher density areas also have a somewhat higher score than the medium and lower density areas. However, the latter relationship is not very strong.

The frequency of use of local services may be a better measure, and certainly one where the degree of difference between areas may be quantified more confidently. Table 8 provides these figures for two sub-groups of services, a group referred to as 'utility' services and a second group referred to as 'leisure' services. For both groups, inner areas see higher utilisation frequency than outer areas, but he difference is much greater for leisure services (more than double) than for utility services (26% more). On the density comparison, the highest density areas have frequencies about a third above the lowest density areas.

Before leaving Table 7, it is worth bringing out the point that the 'outer' areas are not always the best – sometimes the middle areas score better. Similarly, the lowest density band is not always the best; for four indicators shown the second lowest density band (50—100 PPH) shows a better score.

Referring back to SEH evidence, it is also worth remembering that we have no rural areas in this sample, and that it is generally in rural areas that the problems of physical inaccessibility to services becomes most acute.

Turning last to the overall social sustainability score, what becomes apparent here is that this is a tool for teasing out the extent of differences in outcome between nominally similar areas. The relationships with location and density are much more clear-cut. The outer areas have scores more than three times those of the inner areas. The same is true for low density versus high density areas. Looking at individual case study neighbourhoods, he differences in scores are striking. Three outer areas in Edinburgh, Leicester and Sheffield, which happen to be relatively affluent/comfortable, predominantly owner occupied suburbs, score between 13 and 14. Yet another outer area, that in Oxford dominated by a problematic public housing scheme, scores only 3.4. Two middle areas, in Glasgow and Oxford, score pretty highly (between 10 and 11). However, none of the inner areas score above 4.7.

It is hoped to explore further, through more detailed qualitative investigations, why it is that some of these areas seem to score much more strongly on a range of criteria of social sustainability.

Modelling findings

What have been presented so far are simple descriptive patterns of bivariate relationships. As with SEH, we wish to move beyond this to recognise the role of exogenous and intervening variables, for example factors associated with demographic lifestage or socio-economic status, which may confound the apparent effects of urban form. We can, as with SEH, run cross-tabulations which control in turn for various obvious factors, such as age group, household type or tenure. However, to save space we do not do that. Instead we report on a first attempt at using statistical models to measure the influence of, or association with, the key variables of interest, while simultaneously taking account of the effect of exogenous or intervening variables. The latter may be described as 'controls'; we are trying to measure the effects of urban form while controlling for demography, socio-economic status, and so forth.

The composite indicators just described are the dependent variables to be explained. Unlike the variables used in the SEH analysis, these are not discrete dichotomous (one-zero) responses, but rather cardinal numbers which can take a range of values. The overall social sustainability score is certainly a continuous variable with a reasonably normal distribution. The individual components are strictly integer counts and we should investigate their distributions further. Pending further possible sophistication, we undertake his initial investigation using ordinary least squares (OLS) regression analysis. As with the SEH work, the explanatory variables consist of a large number of individual households attributes, mainly expressed as dummy (one-zero) variables, and a further number of local area attributes, particularly census ratios (percentages) for COAs, which are mainly continuous.

Rather than report all of the individual component regressions, we simply reproduce one set of regression results in full, that for the combined sustainability score. This is shown in Table 9. Most insignificant variables tested have been excluded, but variables of particular interest are retained in the model even though they may not be significant.

Urban form has some effects, even allowing for all the other control variables. The main effects are associated with gardens, certain house types, and density. Density has a negative effect but it is not very strong (as shown by the standardised regression coefficient). People in flats show lower scores, as do people without gardens, and particularly those without any form of private outdoor space. Terraced housing is marginally insignificant and negative. Areas with more large dwellings (8+rooms) show more positive scores.

The main significant controls in this model are: age (older people show greater sustainability – no pun intended!); nonwhite (positive); families (positive); working (negative – perhaps those working full time have insufficient time to engage with or appreciate their neighbourhood – see also Gordon et al 2006); social renting areas (negative); and neighbourhood deprivation (IMD score – negative). The finding of negative influences from poverty, including neighbourhood concentrations of it, is a significant finding, alongside the important demographic influences. As was starkly

illustrated by the peripheral estate in Oxford, socio-economic factors may sometimes override locational and physical factors.

Table 10 tries to summarise the direction and significance of the effects of different variables relating to urban form and other factors, grouped in a more coherent fashion, across five of the main component measures and the combined index. The key findings on urban form are

- *density* (COA gross population density) is significantly negatively related to two or three of the components (pride, environment, and possibly use of services), as well as the overall index. It does not appear in the models for interaction and safety.

- *Location* (inner outer) only appears to have an independent effect on one dimension, use of local facilities

- *Gardens*, particularly the lack of them, are significant for three components (interaction, pride, environment) and overall; furthermore GLUD data for England reinforces this finding for pride and overall

- *Non-domestic buildings*, when more present in the ward, appear to exert a positive influence on pride as well as use of facilities and the overall score

- *More greenspace* is positively reflected in the pride and environmental components

- *Flats-dwelling* is associated with more friendship/interaction (perhaps this is the influence of the sitcom 'Friends'!), but also associated with more negative environmental features. Terraced housing has the same characteristics, but more weakly

- *High floor* living (above 5th) seems rather surprisingly to be associated with better scores on safety and (marginally) pride

- *Large dwellings* (8+ rooms) in the neighbourhood have a positive effect on pride, environment and overall social sustainability. *Small dwellings* are associated with a poor local environment

- *Less accessible places* have more pride and a better environment, but use local services less and may be slightly worse for safety. Moving away from your nearest shopping centre increases the use of local facilities, apparently, and the overall sustainability score; whilst moving further away from the nearest major centre has the opposite effect

- *Nearness to/frequency of bus services* is positively associated with use of services

The last part of this table reports on the main effects of control variables. Various general points are worthy of note, including the mixed effects of tenure and work status, the mainly positive effects of age and families, the weak effects of income (and the fact that car ownership only comes up once). However, the most important point we would emphasise is that neighbourhood deprivation is significantly negative on three components (pride, safety, environment) and in relation to the overall sustainability score.

Conclusion

In this paper we have discussed how social aspects of sustainability have come to be an increasingly important part of the sustainable development agenda. We have mapped out the development of our understanding of the concept of 'social sustainability'. One of the main reasons that social aspects of sustainability have received such limited attention is that they are difficult to define, let alone to quantify (Burton, 2003). This paper therefore has been an attempt to move these debates on, with the discussion highlighting the complexities involved. Our definition of social sustainability incorporates both social equity issues (with a particular focus on access to services and facilities), and sustainability of community issues (the key issues being identified from the social capital literature). The second part of the paper explored some of the possible relationships to the different urban form elements discussed in the literature. It is necessary to explore the individual relationships between dimensions of urban form and social impacts. Otherwise, the social outcomes taken together can cancel each other out (Burton, 2003). In the empirical parts of the paper, using data from the Survey of English Housing and from our own survey we drew out some of these relationships

The messages from this analysis are quite complex. Broadly, the patterns of outcomes relative to urban form revealed from simple tabulations do recur when subjected to stastistical modelling, controlling for many other factors. However, the size of the urban form effects is often quite small once these factors have been controlled for. More dense (compact) urban forms, and their associated housing types, tend to be associated with somewhat worse outcomes in relation to dissatisfaction with home and neighbourhood, social interaction, safety, environmental quality, and indications of potential mobility. Some outcome patterns point different ways, however. In particular, access to services is generally better in denser urban forms, while collective engagement is more neutral.

This leads one to question whether there is any way in which the disparate dimensions of social sustainability can be brought together into a single measure, which enables one to arrive at an overall balance of advantage/disadvantage. Such an index might be regarded as a form of 'social welfare function' or cost-benefit analysis, although whether such economistic language is appropriate is questionable. If one could do this, a plausible outcome might be that the balance would be different for different groups.

The study also has the potential to draw out more particular features of urban form which are significant. The important role of gardens emerges strongly from our own survey, and

there is more work to be done on the role of publicly accessible greenspaces. This could be linked to emerging evidence on the role of nature in health and wellbeing (Brown, 2005). There is evidence from SEH that how different urban forms cope with cars is an important issue which affects social sustainability outcomes. This requires closer investigation. The study also confirms other work in showing that neighbourhood concentrations of poverty, and social rented housing, are often more strongly associated with adverse social outcomes than urban form per se. In other words, who lives where within the urban form, and with what resources, may be more key to making urban communities work.

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Table 1: Logistic Regression Model for Dissatisfaction with Area

	B	S.E.	Wald	Sig.	Exp(B)
LONPAR	0.474	0.109	18.962	0.000	1.606
DISAB	0.256	0.111	5.341	0.021	1.292
ELD2	-0.139	0.125	1.227	0.268	0.870
NUMADULT	0.237	0.062	14.570	0.000	1.267
NAGE16	0.176	0.056	9.715	0.002	1.192
AGEHRP	0.041	0.016	6.421	0.011	1.042
AGESQ	-0.015	0.006	6.316	0.012	0.985
AGEU30	0.326	0.140	5.395	0.020	1.385
UNDER5	-0.168	0.107	2.456	0.117	0.846
LONGRES	0.128	0.077	2.746	0.097	1.137
LOGINC	-0.134	0.042	9.985	0.002	0.875
BLACK	-0.293	0.161	3.318	0.069	0.746
ASIAN	-0.771	0.184	17.493	0.000	0.462
PRENT	-0.187	0.102	3.345	0.067	0.829
NBEDS	-0.221	0.086	6.621	0.010	0.802
BEDSTND	0.232	0.080	8.335	0.004	1.261
DET	0.189	0.108	3.033	0.082	1.208
SHARE	-0.787	0.472	2.773	0.096	0.455
PARKADEQ	-0.363	0.056	41.464	0.000	0.696
NEARBUS	0.017	0.006	8.847	0.003	1.017
RELIMDR	-0.758	0.090	70.970	0.000	0.469
LONDON	0.201	0.102	3.916	0.048	1.223
NORTHK	-0.438	0.263	2.781	0.095	0.645
LOGDENS	0.150	0.036	17.102	0.000	1.162
CHDENS	0.001	0.003	0.166	0.684	1.001
PDETOA	-0.003	0.002	1.958	0.162	0.997
PTEROA	0.006	0.001	19.509	0.000	1.006
PFLATOA	-0.001	0.002	0.609	0.435	0.999
PVACOA	0.026	0.007	12.027	0.001	1.026
PSRENTOA	0.012	0.002	34.002	0.000	1.012
PNWHITOA	0.010	0.002	18.367	0.000	1.010
CARDWGOA	0.388	0.201	3.707	0.054	1.473
Constant	-3.504	0.598	34.275	0.000	0.030
Model Summary					
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square		
1.000	9274.068	0.061	0.130		
Classification	Table		Predicted		
			DISAREA2		% Correct
	Observed		0	1	
Step 1	DISAREA2	0	14546	10	99.9
		1	1562	8	0.5
	Overall Percentage				90.3

Table 2: Impact of Log Density on Different Outcomes in Logistic Regression Models

	B	S.E.	Wald	Sig.	Exp(B)	Elasticity %
DISHOUS2	-0.018	0.042	0.182	0.670	0.982	-1.1
DISAREA2	0.150	0.036	17.102	0.000	1.162	9.8
GOTWORSE	0.050	0.024	4.479	0.034	1.051	2.7
MOVE1	0.034	0.242	1.000	0.983	0.000	2.2
SELLD	0.016	0.064	0.064	0.800	1.016	1.1
WLISTD	-0.067	0.061	1.211	0.271	0.935	-4.4
SRNMND	0.015	0.203	0.005	0.942	1.015	
CRIME	0.102	0.031	10.840	0.001	1.107	6.3
NPROB4	0.058	0.022	7.051	0.008	1.060	3.6
ACCESS3	-0.089	0.022	16.407	0.000	0.915	-5.4
PARKADEQ	0.097	0.018	27.907	0.000	1.102	

Table 3: Impact of Child Density on Different Outcomes in Logistic Regression Models

	B	SE	Wald	Sig.	Exp(B)	Elasticity %
DISHOUS2	0.008	0.003	5.671	0.017	1.008	9.7
DISAREA2	0.001	0.003	0.166	0.684	1.001	1.3
GOTWORSE	0.003	0.003	1.718	0.190	1.003	3.2
MOVE1	0.004	2.800	1.000	0.993	0.000	4.9
SELLD	0.003	0.007	0.203	0.652	1.003	3.8
WLISTD	0.001	0.005	0.053	0.819	1.001	1.3
SRNMND	0.015	0.011	2.153	0.142	1.016	
CRIME	0.005	0.003	3.833	0.050	1.005	5.6
NPROB4	0.005	0.002	4.788	0.029	1.005	5.7
ACCESS3	-0.003	0.003	1.203	0.273	0.997	-3.3
PARKADEQ	-0.013	0.002	31.048	0.000	0.987	

Table 4: Impact of Percentage of Flats in Output Area on Different Outcome Measures in Logistic Regression Models

% FLATS OA	B	S.E.	Wald	Sig.	Exp(B)	Elasticity %
DISHOUS2						
DISAREA2	-0.001	0.002	0.609	0.435	0.999	-2.4
GOTWORSE	-0.003	0.001	5.257	0.022	0.997	-4.7
MOVE1	0.001	0.002	0.093	0.760	1.001	1.1
SELLD						0.0
WLISTD	0.003	0.003	1.026	0.311	1.003	6.0
SRNMND	0.007	0.007	0.961	0.327	1.007	
CRIME						0.0
NPROB4						0.0
ACCESS3	-0.005	0.001	13.642	0.000	0.995	-7.9
PARKADEQ	-0.004	0.001	9.516	0.002	0.996	

Table 5: Socio-demographic profile of CityForm study areas

City	% age 60+	% family	Income £k	% social rent	% private rent	Density pph
Edinburgh	22.6	17.7	26.6	17.3	9.2	120.5
Glasgow	14.4	24.9	27.9	22.9	11.0	116.9
Leicester	16.3	15.2	25.0	21.7	23.8	77.4
Oxford	15.2	23.1	29.1	31.2	25.6	79.0
Sheffield	19.8	19.7	25.2	32.1	14.6	73.5
Total	17.7	20.3	26.8	24.9	16.4	94.9
Location	% age 60+	% family	Income £k	% social rent	% private rent	Density pph
Inner	14.2	8.8	22.7	38.6	23.4	122.8
Middle	17.8	21.4	29.8	13.9	22.2	100.3
Outer	21.3	31.2	28.1	21.4	3.3	60.3
Total	17.7	20.3	26.8	24.9	16.4	94.9
Density	% age 60+	% family	Income £k	% social rent	% private rent	Density pph
<50 pph	20.4	19.8	30.3	21.8	14.8	29.3
50-100 pph	18.6	22.4	25.7	24.9	14.4	72.2
100-200 pph	14.2	18.5	25.8	26.2	22.4	139.6
>200 pph	12.1	16.3	21.3	32.2	17.7	322.4
Total	17.7	20.3	26.8	24.9	16.4	94.9

Table 6: Additional Urban Form measures for English case studies
(ward level ratios of land areas to domestic building footprint)

City	Gardens	Nondomestic Bldg	Roads	Greenspace	Water
Leicester	2.04	1.49	1.96	4.21	0.24
Oxford	2.16	1.05	1.52	7.51	0.66
Sheffield	2.62	0.83	2.13	19.33	0.57
Total	2.28	1.11	1.87	10.63	0.50
Location					
Inner	1.43	1.90	2.22	3.89	0.31
Middle	1.94	1.16	1.79	7.20	0.48
Outer	3.54	0.23	1.59	21.38	0.71
Total	2.28	1.11	1.87	10.63	0.50
Density					
<50 pph	2.67	1.18	1.94	14.26	0.56
50-100 pph	2.26	1.09	1.87	9.87	0.39
100-200 pph	1.88	1.00	1.71	8.27	0.71
>200 pph	1.05	2.01	2.19	2.58	0.00
Total	2.28	1.11	1.86	10.68	0.50

Source: ODPM Generalised Land Use Database, calculated from OS Mastermap.

Table 7: Composite Social Sustainability Indicators by City, Location and Density

(a) Interaction, pride/dissatisfaction, safety and environment

City	Friends/ interact +	Friends/ interact -	N'hood Pride +	N'hood dissatis -	Unsafe N'hood -	N'hood Environ -
Edinburgh	3.59	3.08	1.61	0.90	0.38	1.22
Glasgow	3.55	3.01	1.38	1.11	0.51	1.23
Leicester	3.32	3.23	1.49	0.95	0.38	1.22
Oxford	3.46	3.20	1.53	1.08	0.60	1.04
Sheffield	3.75	2.75	1.70	0.70	0.38	0.89
Total	3.54	3.05	1.54	0.95	0.45	1.12

Location	Friends/ interact +	Friends/ interact -	N'hood Pride +	N'hood dissatis -	Unsafe N'hood -	N'hood Environ -
Inner	2.59	4.09	0.89	1.41	0.54	1.58
Middle	3.81	2.58	1.82	0.73	0.35	0.97
Outer	4.28	2.40	1.96	0.68	0.45	0.78
Total	3.54	3.05	1.54	0.95	0.45	1.12
Ratio Loc	1.65	0.59	2.21	0.48	0.84	0.49

Density	Friends/ interact +	Friends/ interact -	N'hood Pride +	N'hood dissatis -	Unsafe N'hood -	N'hood Environ -
<50 pph	3.70	2.97	1.88	0.83	0.38	1.10
50-100 pph	3.73	2.88	1.57	0.84	0.47	0.93
100-200 pph	3.35	3.06	1.32	1.07	0.49	1.20
>200 pph	2.69	3.89	0.79	1.57	0.51	1.82
Total	3.55	3.04	1.55	0.95	0.45	1.12
Ratio Dens	1.38	0.76	2.37	0.53	0.75	0.61

Table 7, contd
(b) Home satisfaction, mobility, group participation, use of local facilities and overall social sustainability scores

City	Home satis +	Mobility rate -	Group Partic +	Use Local Facils +	Overall SocSust +
Edinburgh	2.69	0.72	1.31	4.83	7.73
Glasgow	2.33	0.88	1.32	4.73	6.58
Leicester	2.56	0.98	1.23	5.35	7.20
Oxford	2.25	0.95	1.22	4.49	6.09
Sheffield	2.56	0.82	1.25	4.49	8.22
Total	2.48	0.86	1.27	4.77	7.17

Location	Home satis +	Mobility rate -	Group Partic +	Use Local Facils +	Overall SocSust +
Inner	1.89	1.16	1.20	5.17	2.94
Middle	2.54	0.86	1.29	4.91	8.87
Outer	3.06	0.55	1.33	4.19	9.97
Total	2.48	0.86	1.27	4.77	7.17
	1.62	0.47	1.11	0.81	3.39

Density	Home satis +	Mobility rate -	Group Partic +	Use Local Facils +	Overall SocSust +
<50 pph	3.01	0.81	1.31	4.74	8.55
50-100 pph	2.51	0.77	1.23	4.68	7.82
100-200 pph	1.99	1.02	1.21	4.86	5.90
>200 pph	1.68	1.07	1.38	4.96	2.64
Total	2.48	0.86	1.27	4.76	7.20
Ratio Dens	1.79	0.76	0.95	0.96	3.23

Table 8: Frequency of use of local services, distinguishing 'utility' and 'leisure' services, by city, location and density
(number of times used per annum)

City	Utility' Services	Leisure' Services
Edinburgh	229	67
Glasgow	226	88
Leicester	237	96
Oxford	199	72
Sheffield	191	74
Total	216	79

Location	utilfreq	leisfreq
Inner	236	104
Middle	223	81
Outer	188	51
Total	216	79

Density	utilfreq	leisfreq
<50 pph	204	77
50-100 pph	211	72
100-200 pph	221	84
>200 pph	269	100
Total	216	79

Note: 'utility' services are chemist, corner/convenience shop, supermarket, post office, bank/building society; 'leisure' services are restaurant/cafe/takeaway, pub, library, public sports facility, community centre, facilities for children/young people.

Table 9: Regression model for combined social sustainability score
(Cityform household survey respondents in five cities; OLS estimation)

Variable	*Coeffic B*	*Std Error*	*Std Coeff Beta*	*t-stat*	*Signif p*
(Constant)	2.977	1.608		1.852	0.064
Private Rent	-1.265	0.403	-0.048	-3.142	0.002
Bungalow	-0.630	0.693	-0.014	-0.910	0.363
Terrace	-0.659	0.476	-0.027	-1.385	0.166
Flat	-1.090	0.516	-0.054	-2.112	0.035
Basement	0.778	0.611	0.017	1.272	0.204
5th floor or higher	1.844	0.979	0.026	1.884	0.060
Garden	0.944	0.447	0.047	2.113	0.035
No garden/yard/patio	-3.276	0.443	-0.115	-7.392	0.000
Older (60+)	1.472	0.500	0.061	2.944	0.003
Nonwhite	1.563	0.477	0.046	3.273	0.001
Working	-1.238	0.361	-0.062	-3.434	0.001
Couple family	2.180	0.484	0.077	4.500	0.000
No. of rooms	0.222	0.082	0.041	2.710	0.007
Years of residence	0.024	0.013	0.030	1.806	0.071
Age of respondent	0.543	0.108	0.099	5.049	0.000
Household Size	0.379	0.158	0.047	2.397	0.017
Income £k	0.014	0.009	0.030	1.566	0.117
Managerial/profess occ	0.277	0.329	0.013	0.840	0.401
Density PPH	-0.004	0.002	-0.040	-2.469	0.014
COA_ %detached	0.006	0.013	0.010	0.435	0.664
COA_% flats	0.010	0.009	0.037	1.088	0.277
COA - % terrace	-0.008	0.010	-0.022	-0.860	0.390
COA- % 2 rooms	-0.031	0.019	-0.033	-1.651	0.099
COA - % 8+ rooms	0.084	0.017	0.091	4.926	0.000
COA - % social rent	-0.027	0.009	-0.077	-3.025	0.003
COA - % private rent	0.014	0.014	0.024	1.061	0.289
COA - % 1 person hhld	-0.013	0.016	-0.026	-0.840	0.401
COA - % family w chn	-0.007	0.020	-0.010	-0.361	0.718
COA - % age 60+	0.117	0.017	0.142	6.982	0.000
COA - % F T employment	0.032	0.017	0.039	1.886	0.059
Deprivation - IMD score	-0.055	0.013	-0.096	-4.358	0.000
Access score (IMD)	-0.071	0.211	-0.005	-0.336	0.737

Model Summary	R	R Square	Adj R Square	Std Err Est
1	0.519	0.269	0.263	8.557

ANOVA

l		Sum of Squares	d f	Mean Square	F
1	Regression	113269	32	3539.668	48.347
	Residual	307718	4203	73.214	
	Total	420987	4235		

Table 10: Summary of Urban Form and other Influences on Selected Social Sustainability in Outcomes in CityForm case study areas
(direction and significance of effects in OLS regression models)

Explanatory Variables	*Friends/ interaction*	*Pride in N'hood*	*Safety*	*N'hood Environ*	*Use Local Facilities*	*Combined Soc Sust*
Urban Form						
Density - COA		---		--	(-)/---	--
Location (outer)					++	
Garden - indiv	(+)					++
No garden/yard/patio	---	--		---		---
Garden ratio - ward		+++		+	+	+++
Non-Dom ratio -ward		+++		+	+++	+++
Roads ratio - ward		(-)				-
Greenspace ratio -ward		+++		++	---	
Housing Type - indiv						
Flat	++			---		
Terrace	+			---		
Detached /bungalow				--		
Floor12	--					
Floor5		+	+++			
Housing Type - COA						
Flat			-	--		--
Terrace		-	--	--		(-)
Large (8+ rooms) - COA		+++		+		+++
Small (2 room) - Coa				---		
Access						
IMD poor access (rural)		++	-	+++	---	
Distance nearest cent					+++	+++
Distance major cent					---	---
Bus near/frequency					+++	

[continued over]

Table 10 continued

Soc-Demog Controls						
Social rent		++	---	--/+++		--
Private rent	---			++		
Male			+++			
Older/age	+++	+++	---	+++		+++
Nonwhite		+++				+++
Working	-		+++	+++	---	---
Single person hhd					---	
Couple family	+++		---		+++	+
Household size	+					+++
Years residence	+++		---			+
Income	-	+				(+)
No of Cars	+++					
Deprivation - IMD		---	---	---		---

Note: based on OLS regression models for relevant composite indicators; +++/--- indicate positive/negative coefficient significant at the 99%; ++/-- significant at 95% level; +/- significant at 90% level; (+)/(-) nearly significant, i.e. 75% level.
All effects expressed such that + means substantively positive, i.e. more friends, more pride, more safe/less unsafe; better/less bad environment.

Figure 1

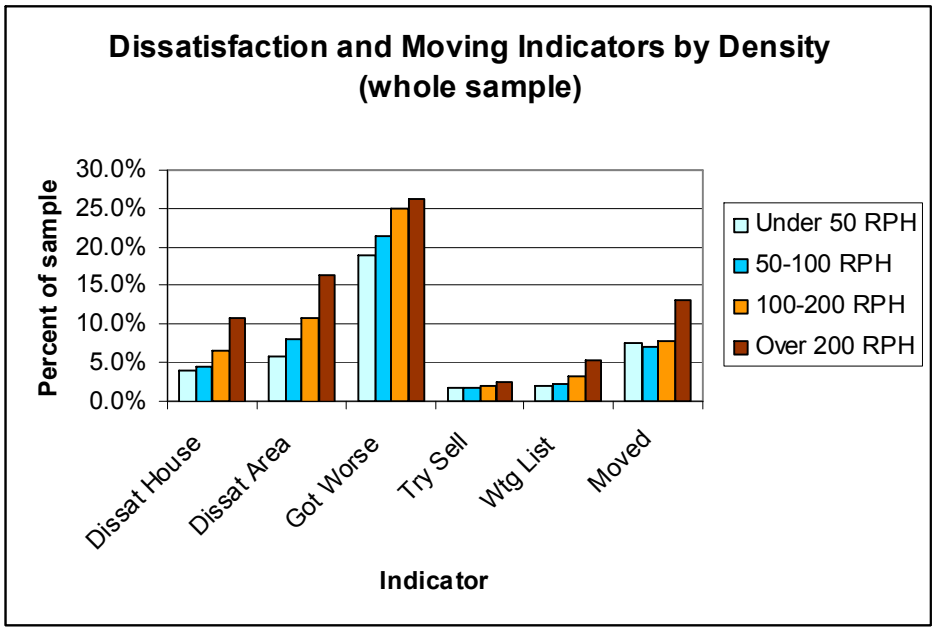


Figure 2

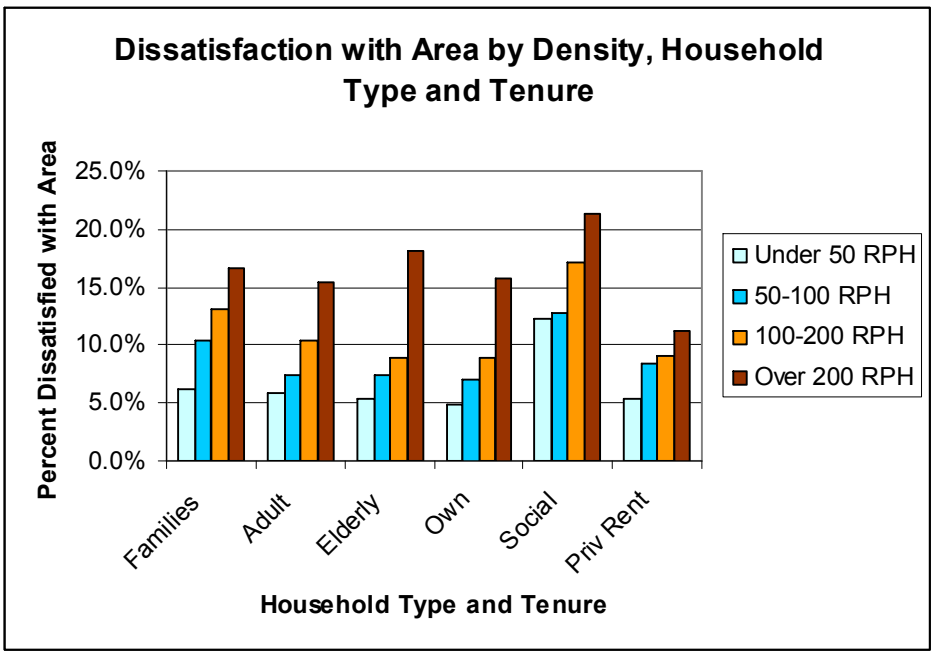


Figure 3

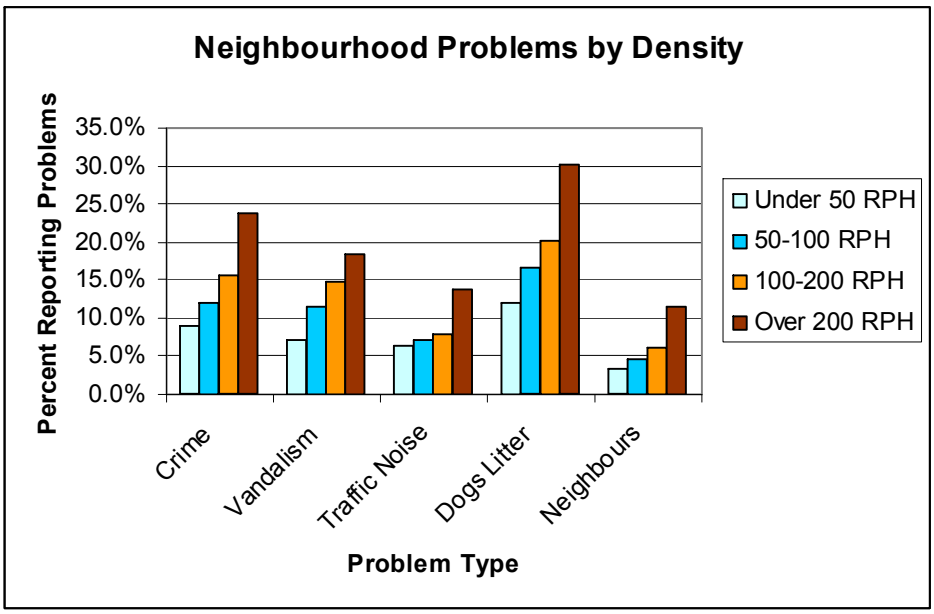


Figure 4

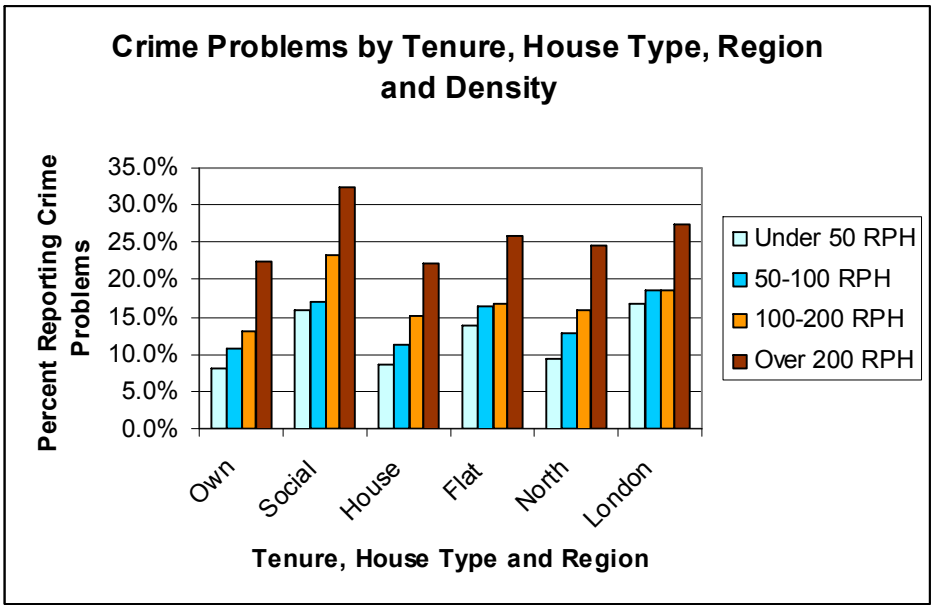


Figure 5

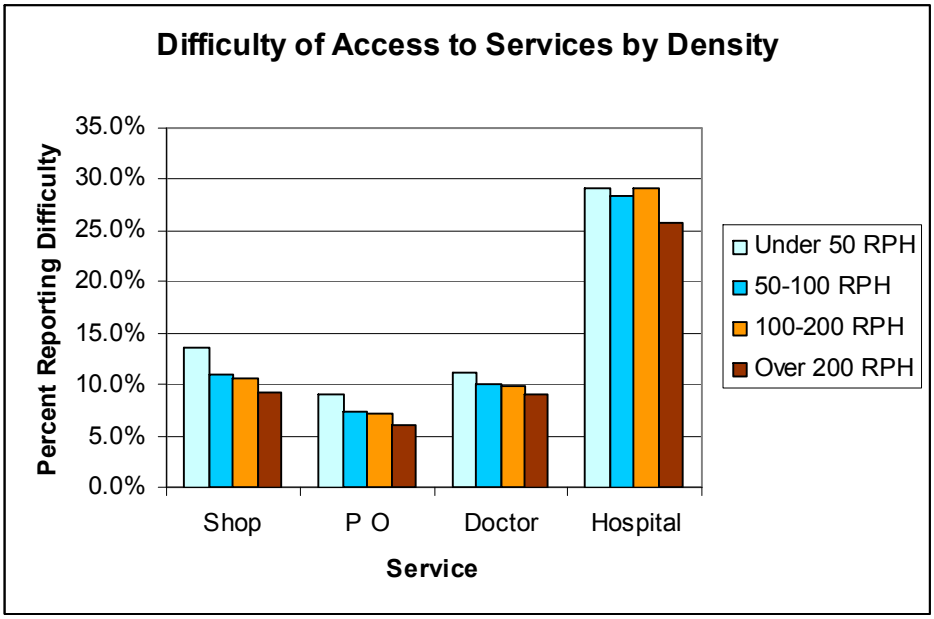


Figure 6

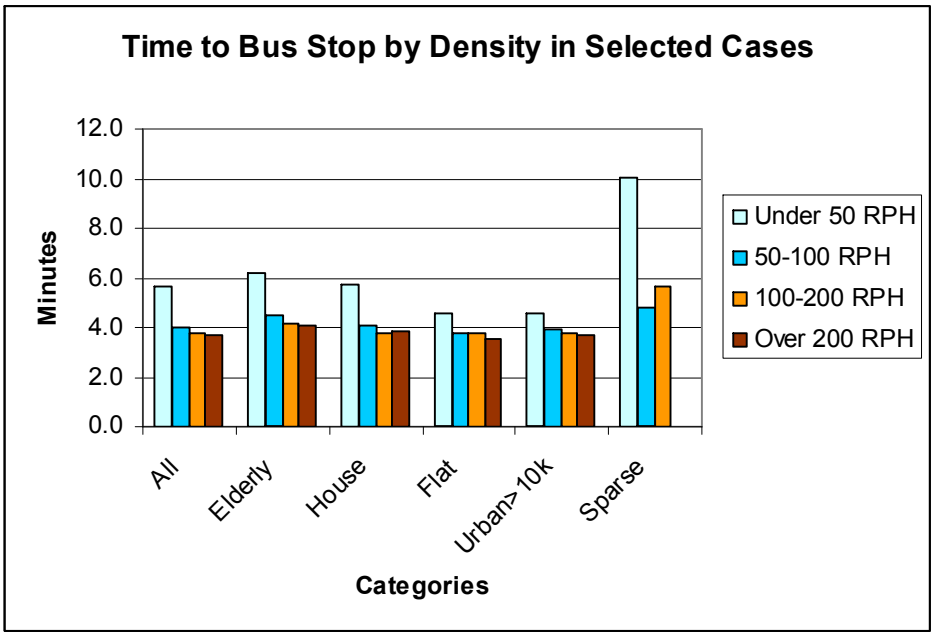
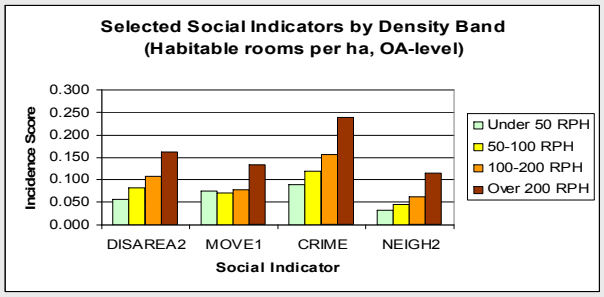
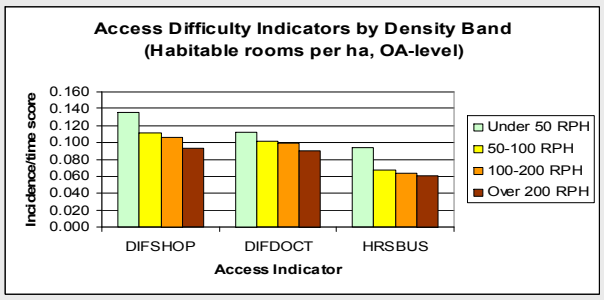


Figure 7

Density and Social Sustainability





Density Elasticities

Social	Middle	Upper	Controlli
Dissatis Area	0.31	0.78	0.10
Mobility	0.11	1.02	0.02
Crime	0.30	0.81	0.06
Access			
Difficult Shop	-0.04	-0.18	-0.05
Difficult Doct	-0.02	-0.11	-0.05
Time to Bus	-0.05	-0.04	-0.05

Note: summary of analysis based on SEH.