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LECTIO MAGISTRALIS

SUSTAINABLE CITIES

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Key words: sustainability, urban form.

Abstract

It is commonly asserted that so-called compact development is the urban form most able to sustainably accommodate growth by reducing travel distances and conserving land, but credible supportive evidence remains limited.

This study rigorously and realistically tested the relative performance of spatial options over the next 30 years for three distinct kinds of English city regions. Statistical models first forecast the behavior of people within interacting markets for land and transport. These outputs were then fed to established simulation models to generate 26 indicators measuring the economic efficiency, resource use, social and environmental impact of the spatial options. This permitted an explicit comparison of the costs and benefits of compact against sprawling urban forms for these regions.

While the prototypes - i.e. Compaction, Market led development (sprawl), Planned expansion (edge expansion and/or new towns) - were indeed found to differ in their sustainability, no one form was clearly superior. Rather the change to 'white collar' lifestyles and associated population growth dominates the impacts on the natural environment and resources, far overwhelming those attributable to spatial urban form.

Introduction

A major research project – SOLUTIONS (Sustainability Of Land Use and Transport In Outer NeighbourhoodS) – has been completed which cast doubts on the government's planning policies to improve the sustainability of cities. The £1.75 million research funded by the Engineering and Physical Science Research Council (EPSRC) was supported by central government departments (Transport and Communities and Local Government) as well as local government (Tyne and Wear and Cambridge County Council).

The research which spanned five years and combined the expertise of five universities: Cambridge, Leeds, Newcastle, UCL and West of England, found that far from cutting transport carbon emissions, current government policies will lead almost inevitably to a significant increase.

The current land use policy is highly restrictive allocating most of the new development to brownfield sites at high density offering limited choices of life styles to households. Transport policy is focussing on public transport provision through increasing investment in capacity expansion with corresponding less highway investment (Banks, Bayliss and Glaister, 2007).

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The objective of the current land use and transport policy is to improve the sustainability of development by reducing the need to travel, encouraging public transport use, using existing urban sites efficiently and promoting urban vitality.

The current urban land use in England, which includes country roads, account for 10% of the total land. At present over 70% (CLG, 2008) of the new development is taking place in brownfield land at substantial densities, which in large measure, prevents the supply of new houses.

Case studies

In order to assess the sustainability of current land use and transport policies two contrasting case studies were investigated: the Wider South East (WSE) Region which includes London, East and South East regions of England and the Tyne & Wear City Region (T&W) as part of the North East region of England. In addition the research assessed possible alternative strategies for the areas. The WSE is an area which had a substantial pressure for development due to increase in population numbers and affluence. In contrast T&W area had a static population but still the population has increasing affluence which also creates pressure for development.

The resulting report (see www.suburbansolutions.ac.uk) is addressed to policy makers engaged in the preparation of integrated regional economic and spatial plans, and to national policy makers engaged in providing guidance for the spatial allocation of development. It assessed the current policies in the WSE and T&W and appraised three possible alternative policies (see figure 1):

(i) Compact City; development at high density within the existing urban footprint oriented towards public transport provision,

(ii) Market Led Dispersal; development at medium to low density orientated towards private transport provision, and

(iii) Planned Expansion; development of new settlements and urban extensions at medium density and with a mixture of public and private transport provision.

The study took a realistic perspective on what can be achieved within a period of thirty years starting from the premise that most of the urban development for the future is already here. The change in the stock of dwellings and commercial floor space is less than 1% per year and thus its contribution to sustainability will be modest.

Method

The method employed in the present study involved (see figure 2):

(i) Identifying policy levers to deliver the current policies within the market for land and for transport and use these levers to explore alternative urban forms. The levers are regulation of the use of land and transport (e.g. green belts. Bus only lanes, etc.), pricing the use of land and transport (e.g. rateable values, road pricing, etc.) and direct investment in land and transport (e.g. land reclamation, transport capacity expansion, etc.). By combining these levers it was possible to simulate the likely impact of alternative urban form through the use of computer models.

(ii) Using existing computer models to forecast the likely locational and travel behaviour of households and firms in response to the introduction of these policy levers. The model used for the WSE was the LASER (London and South East Region) model owned by the Department for Transport and Transport for London (see ME&P, 2004). For Tyne and Wear the model used was TAMMS (Tyneside Area Multi Modal Study) owned by the Highway Agency (see ARUP, 2001). Both models were updated for the study and used to forecast the likely outcome of policies to be assessed in term of sustainability criteria.

(iii) Assessing their outcomes using sustainability indicators that measure economic efficiency, social equity, environmental protection and resource use. The main economic indicators measures the changes in cost to export industries (basic sector) as well as the changes in costs that retired and unemployed people will need to absorb as a result of the introduction of the policy. The main social indicator measures the degree of crowding, but several other indicators were also estimated. Amongst the environmental indicators the emissions from buildings and transport were estimated as well as water pollution, bio-diversity, etc. The resources use indicators estimated the use of land, energy and materials.

Assessment of current policies

The economic consequences of current policy are significant with higher costs of living and of production. It was estimated that by 2031 the increase in costs in WSE will be of the order of £30 billion per annum in 1997 prices to basic industry and non-working households. Around £20 billion of this increase is due to insufficient supply of new dwellings and transport congestion, reducing the competitiveness of the WSE. In T&W area the increase in cost will be of the order of £1.3 billion per annum in 2000 prices for an area of 1/20th of the population of the WSE.

The social consequences are equally significant with a substantial increase in crowding in London because the policy of higher density development results in smaller housing units and more people living in flats. Living costs in the WSE increase by around 14% due to inadequate supply of dwellings and transport. In T&W the increase in living costs is 25%. Housing cost rises by 26% in WSE and 20% in T&W making housing less affordable and increasing crowding.

There are substantial adverse environmental consequences from a continuation of current policies with a 43% increase in car kilometres travelled in WSE despite a substantial increase in rail patronage. Car kilometres increase in T&W by just 16% over the same period due to having lower population growth than the WSE. Energy consumption increases by around 30% in the WSE and 10% in T&W mainly due to the increases in travel distance and the increase in congestion. Total carbon dioxide (CO_2) emissions increase by 34% in WSE and 11% in T&W which will make it difficult to achieve government targets for CO_2 reduction.

Main causes of the evolution of the urban pattern

The study confirms that the socio-economic trends resulting from the changing composition of employment – less industrial and more services – leads to increases in professional and clerical groups (white collar) with higher space demands and mobility. It is anticipated that the current financial crisis will not alter this long term trend. It is noticeable that the areas which currently have suffered the least (as measured by people claiming unemployment benefits) are those which has substantial service economies particularly in the WSE and those which have suffered most are the manufacturing regions The impact of the crisis in T&W is being cushioned, at least temporarily, by the high proportion of governmental jobs in the area.

The current policy trend does not satisfy the demand for housing types in the right location as it restricts the supply of dwellings to mainly flats on brownfield sites in locations that do not necessarily correspond to where the employment is growing. It leads also to increasing car travel despite the substantial shift of investment to public transport resulting in further congestion of both public transport (because of the separation of jobs from dwellings) and private transport (because of lack of capacity in routes that are not supplied with good public transport).

The Barker and Eddington recommendations

Increasing the supply of dwellings by 4% following market signals as proposed by Barker (2004) does make a significant social impact by reducing property prices by 8% which improves affordability. This significantly reduces of cost of living, improving the competitiveness of the WSE by over £3bn per annum.

Introducing Road User Charges as advocated by Eddington (2006) has a small impact on total kilometres travelled by car (-5%), because improvement in speed somewhat compensate the increase in money cost. The effect in corridors well served by public transport is more pronounced but a substantial number of trips continue to be by car because there are no convenient alternatives. It is inflationary as it adds a cost of £3bn per annum to the economy of the WSE and £30 million per annum to the economy of T&W, but does reduce transport energy consumption and CO_2 emissions by 5% in WSE and by 3% in T&W.

Alternative urban forms

In contrast with the Trend scenario the Compaction option reduces the vehicle distance travelled by around 3% in the WSE and 1.4% in T&W, which is in line with other reported case studies in the US (see Erwing and Cervero, 2001) and UK (see Gordon, 2008). It increases costs because there is an increase in property prices which translate into increases in cost of living and wages cost. It reduces energy use by 1% in both areas with a 40% decline in land take from the Trend in the WSE (representing a saving of 1% of the total WSE land) and 34% decline in T&W (representing a saving of 0.6% of the total T&W land). In both areas the CO_2 emissions are 1% less than the Trend but the increased runoff from impermeable surfaces reduces biodiversity. The social impacts are significant with a 32% and 87% increase in crowding and traffic noise in WSE and T&W, respectively, somewhat compensated by increased urban vitality and less severance by roads. The question is: do these small environmental gains compensate for the negative social and economic impacts? (see figure 3).

The Market Led Dispersal increases vehicular distance travelled by 4% but not travel time. There is an improvement of the economic competitiveness of the WSE as a result of lower cost of living because of price reductions and lower wage inflation with relatively less congestion. The use of energy and CO_2 emissions increases by 2% above the Trend. Land take increases by 34% and 25% with respect to the Trend in the WSE and T&W, respectively. The developed land represents 13.4% of the land in the WSE compared to 12.9% in the Trend In T&W the developed land is 15.7% of the total compared with 15.2% in the Trend. There would be less impact on biodiversity due to less run off into water courses from impermeable areas. The social benefits are significant with a 33% and 42% reduction in crowding in WSE and T&W, respectively and a 2.5% reduction the cost of housing. There is, however, a 2% increase in traffic accidents (see figure 4).

The results for the Planned Expansion option are partway between those of the Market Led Dispersal and the Trend. It would provide similar improvements in living space to the Dispersal option but with less land take. Energy use would be similar to the Trend because the new settlements would be designed around public transport with the aim of reducing travel distances by having a high degree of self-containment of employment and services (see figure 5)

Overall conclusion

The overall conclusion of the study is that the relatively small differences between the options are overwhelmed by the impacts of socio-economic trends. The current planning policy strategies for land use and transport have virtually no impact on these major long term increases in resource use and energy consumption and actually tend to increase costs and reduce economic competitiveness. The impacts of land use and transport policies are much greater for a smaller area with pressures for growth like the Cambridge sub region but the impacts of a policy tend to even out if it is applied over a larger area. The alternative options have only a small effect on environmental sustainability: 5% either way. The Compaction option has a small positive benefit on resource use and the environment but with negative social and economic impacts. The Market Led Dispersal has a negative impact on resource use and on some of the environmental indicators but has social and economic benefits. The Planned Extension lies partway between the options and gains as much as the Dispersal option on living space and economic efficiency but with less environmental impact. For more details see Echenique et al. (2012).

Substantial improvements to the environmental sustainability of the areas must rely on **technological** improvements or on substantial **behavioural** changes. The latter will demand strong incentives or penalties to make a significant difference which will have detrimental effect in some of the social and economic indicators. Relying on technological improvements is more plausible because it has been estimated that they can contribute an order of magnitude to the abatement of transport CO_2 emissions (King, 2007) and energy reduction for buildings and transport (MacKay, 2009).

While the land use dispositions and transport configurations, in themselves, do not contribute to significant changes in sustainability they do, however, determine the kind of technologies that can be implemented for improving sustainability (e.g. ground source heat pumps or solar power requires relatively low density development while combined heat and power may require more compact forms of development). The research into the effects of spatial planning on 'green-technologies' is the next step in the EPSRC Sustainable Urban Environment research programme ReVISIONS (see figure 6 and 7 and www.regional visions.ac.uk.)

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ReVISIONS at www.regional visions.ac.uk.

Figure 1 - Alternative Urban Forms assessed in SOLUTIONS

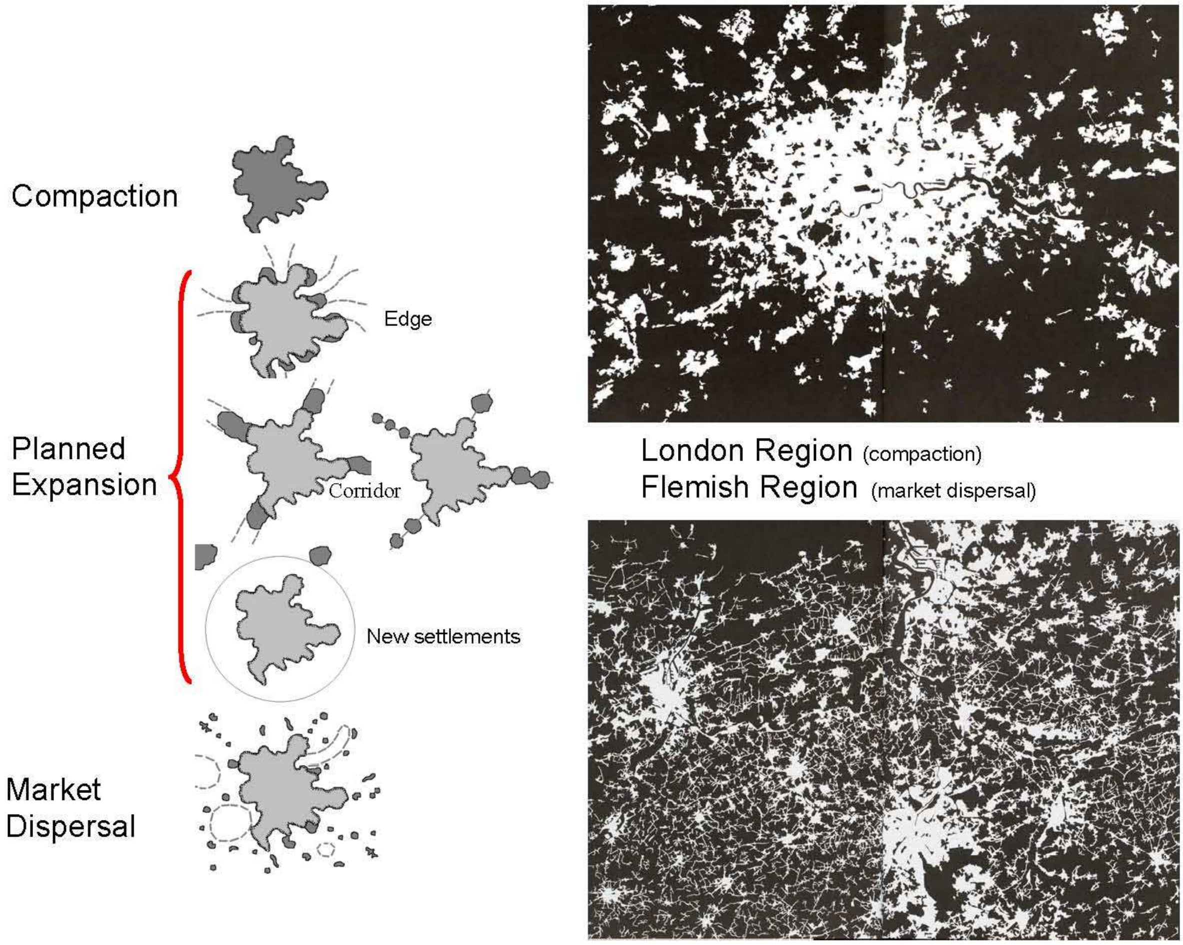

Figure 2 - **Method used in SOLUTION: for each study area the alternative designs were feed into the computer simulation models and the results were assessed in term of sustainability indicators.**

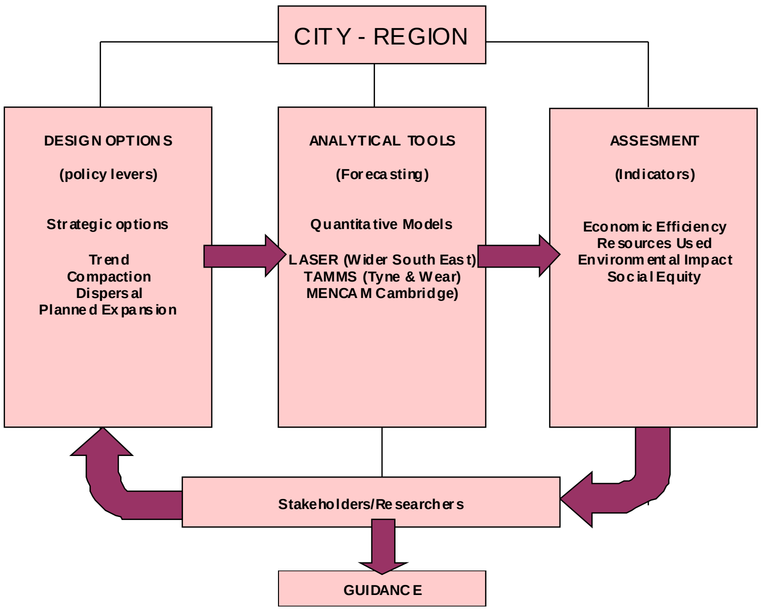

Figure 3 - **Compact city as seen by Richard Rogers (see CLG, 2008).**

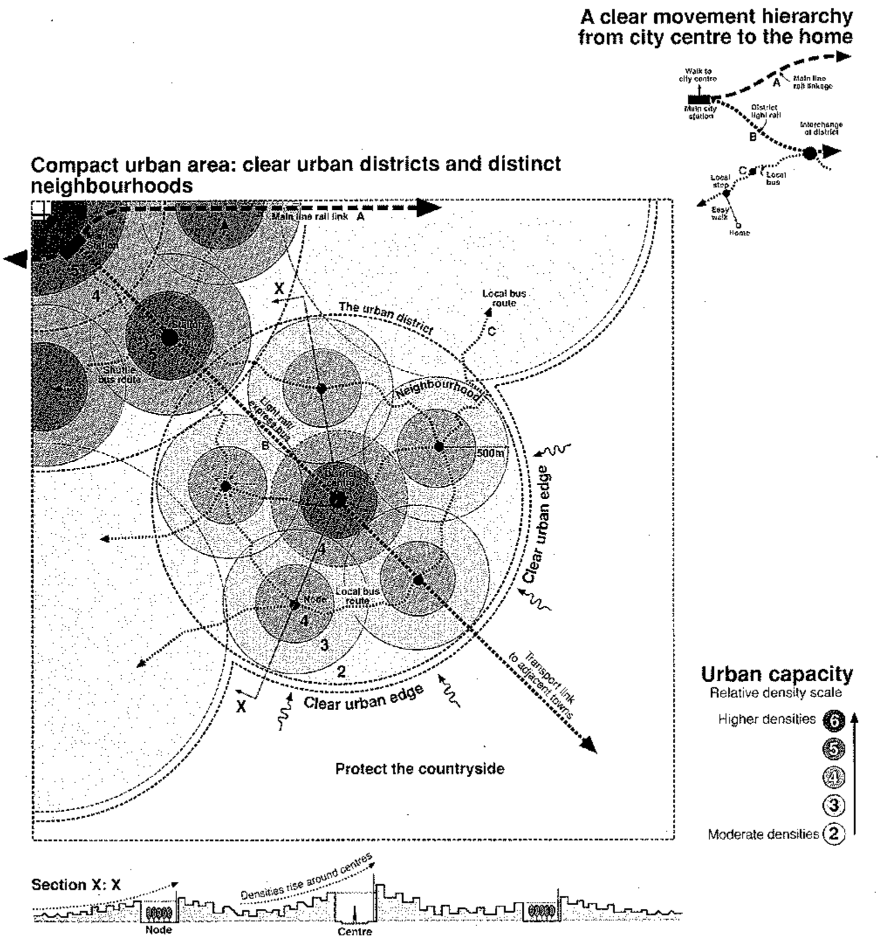

Figure 4 - **Market led city in Cambridge: low density employment and medium density residential development based onindividual dwellings.**

Figure 5 - **Planned expansion as seen by Howard (1898) in his garden city and a contemporary version By Hall and Ward (1998) based on railways.**

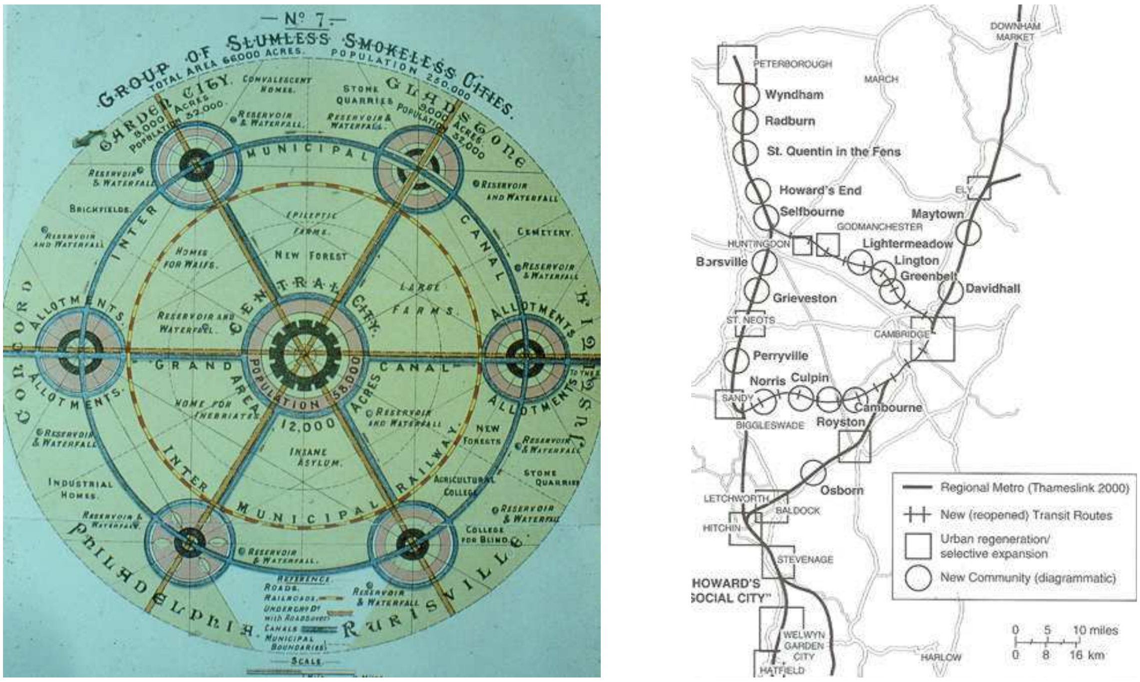

Figure 6 - **Eco-town as a possible sustainable city with low density and use of renewable resources (see ReVISIONS)**

Eco – town

Energy micro-generation

- Solar
- Wind
- Geo-thermal
- Waste processing

Water

- Harvesting
- Reuse
- Grey water recycling

Waste

- Processed on site
- Use for energy
- Recycling

Transport

- Local cycling/pedestrian
- Long distance (regional centre by Public transport, elsewhere by car)

Materials

- Renewable (e.g. timber)
- Self built or kit assemblage possibilities

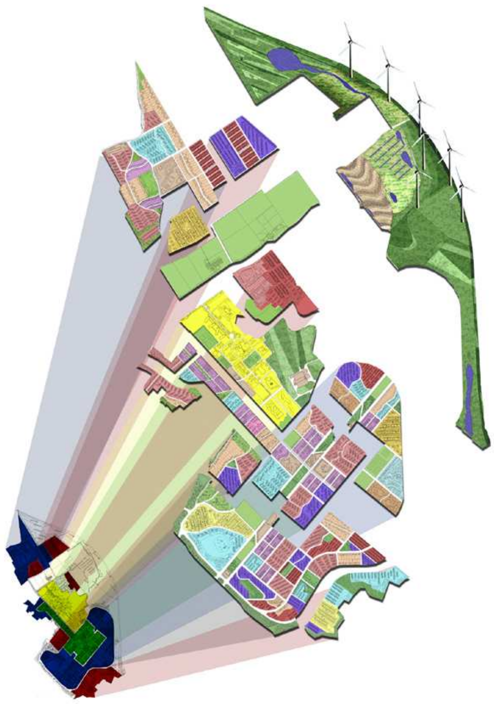

Figure 7 - **Low energy development with renewable materials, grey water, ground source heat pumps, wind and solar power (see ReVISIONS)**