



UCL

WORKING PAPERS SERIES

Paper 70 - Nov 03

**Traffic, Urban Growth and
Suburban Sprawl**

ISSN 1467-1298



Traffic, Urban Growth and Suburban Sprawl[†]

Michael Batty, Elena Besussi, and Nancy Chin
m.batty@ucl.ac.uk e.besussi@ucl.ac.uk n.chin@ucl.ac.uk

Centre for Advanced Spatial Analysis, University College London,
1-19 Torrington Place, London WC1E 6BT, UK

10 November 2003

Abstract

Cities are still getting bigger in the western world. Even though urban populations are barely reproducing themselves and migration from the countryside to the town has slowed to a trickle, the demand for more living space shows no sign of abating as cities continue to expand their borders through suburban sprawl. The automobile, of course, makes this possible but we show no signs of moving to other forms of transport that might enable our cities to become a little more compact. The problems of sprawl are pervasive. Besides congestion, time wasted, and the long term costs of using non-renewable energy, the lack of good social infrastructure in rapidly growing suburban areas together with the erosion of agricultural land, often of high environmental quality, has focused the debate on whether or not such forms of development are sustainable. In this paper, we begin by noting that suburban sprawl is an age-old phenomenon which represents a fine balance between the forces that are pushing people together in cities and those that are forcing them out. These lead to different types of sprawl in different places and at different times but whatever the variety, there are costs to be borne. We briefly review these, noting how these affect suburban sprawl in Europe, and the efforts of the European Commission to understand the problem. We conclude not with a plea that cities should be compacted and all automobile traffic removed but that we should engage in policies for ‘smart growth’ such as those being adopted in North America.

Acknowledgements

We wish to thank the EU who funded part of this work through the **SCATTER** project under the “Energy, Environment and Sustainable Development Programme” of the *5th Framework Programme, Key Action 4: City of Tomorrow and Cultural Heritage*, Contract number: EVK4-CT-2001-00063.

[†]This paper was first presented at *Mobilidade Para Todos*, Automóvel Clube de Portugal, Lisboa, Portugal, 18 - 19 September 2003.

Urban Sprawl and Urban Growth: An Age-Old Phenomenon

As soon as cities began to grow, there was concern about their size. In the ancient world, Rome was the first city to reach a population of one million with the consequence that in the first and second centuries AD, the city was subject to series of Imperial edicts limiting its growth, but to little avail. The same kinds of pronouncement were made by the Courts of the Tudor Kings and Queens for 16th century London, where the notion of some sort of cordon, not only to protect the countryside but to stop the plague, was seriously proposed (Morris, 1994). But it was only when the industrial revolution began in the mid 18th century Britain that the explosive growth of cities around their edges really began.

Such growth is often taken to be sprawl but in modern times, sprawl has acquired a much more specific connotation, being defined as ‘uncoordinated growth’: the expansion of community without concern for its consequences, in short, unplanned, incremental urban growth which is often regarded unsustainable. This was recognised by commentators watching London grow in the early 19th century. William Cobbett (1762-1835), author of *Rural Rides* (published 1830), riding west from London, declared that “all Middlesex is ugly”, a sprawl of “showy, tea-garden-like houses”. 70 years later William Morris, founder of the arts and crafts movement, said: “Need I speak to you of the wretched suburbs that sprawl all round our fairest and most ancient cities?” (William Morris, *Art Under Plutocracy*, date unknown, between 1870 and 1896).

Sprawl is directly identified with urban growth. As cities get bigger, they clearly have to expand around their peripheries for it is much more difficult to increase central densities. What makes this possible is better transportation from the core to the edge. This is the typical chicken and egg conundrum of what comes first: better transportation or population growth; or population growth followed by better transportation? If the industrial revolution had not occurred, would we have got better transportation without the population growth that has occurred in western cities over the last 200 years? Probably not for population growth was and is intimately bound up with higher standards of living that are accelerated by technological innovation.

Uncoordinated urban growth – sprawl as we have defined it, is not only “...bad aesthetics”, it is “bad economics” as Whyte (1958) has so persuasively argued. But before we examine the costs of sprawl and the way the unfettered growth and use of the automobile has enabled western cities to sprawl ever further without adding much to their overall populations, we must inquire into the forces at work which create this phenomenon. We will begin by outlining the balance of these forces and how the basic forces of agglomeration which provide the glue that holds the city together, is compromised by the desire to tear it apart. We will then examine different types of sprawl which will lead us to charting the impact of such growth and the costs of sprawl. Our own analysis of sprawl in European cities is being developed under the auspices of the EU SCATTER project and we will briefly sketch its findings. We will conclude with some comments about policies to increase urban sustainability through instruments which do not aim to stop growth but to control it in intelligent ways.

The Forces at Work: Concentration, Population Growth and Decentralisation

Cities are the essentially focal points in an economy where people come together primarily to exchange goods, to trade. The forces which create such clusters are usually defined to be those which lead to agglomeration economies whereby industries and services prosper if they are close to each other and close to their market. In the 19th century in western countries and today in a large part of the developing world, people left their agricultural pursuits in search of greater prosperity which was associated with the economy of cities. Until quite recently, the dominant force in city growth was the tendency to agglomeration defined as the concentration or polarization of resources, land, labour and capital, in the city itself. Only in the late 1970s did there appear to be a clean break in the United States as cities for the first time began to de-concentrate, de-agglomerate if you like, after almost 200 years of agglomeration. Cities which are growing under the influence of such centripetal forces do grow around their peripheries of course but in such circumstances, the desire to de-concentrate is not to the fore. Any de-concentration that does take place is simply a consequence of the fact that the most obvious locations for new development is in the suburban fringe.

In contrast, there are key forces of decentralization – centrifugal forces – which are forcing the city to break apart as existing and new activities locate as far from the existing city as possible but still remain connected to it through better transportation. These forces are based on the needs of the population and workforce to seek more space not less but within the confines of remaining connected to cognate activities, thus retaining their economies of agglomeration. Typically as transportation has improved, the possibilities for such dispersion or decentralization from the existing city and its core have got greater. For example, in North America where levels of individual car ownership have been greater than 50 percent by household since the 1920s, activities from the traditional city core have fled to the suburbs with most American cities becoming highly polycentric with many specialized centres existing in sea of urban development.

Urban growth in terms of physical development can occur with any balance of these forces. However, urban sprawl is usually associated with cities and societies where population growth is relatively modest, growth through redistribution into the suburbs being particularly significant. In fact, it quite possible to have suburban sprawl under either regime of extreme centralization and extreme decentralization and of course any mix in between. Sprawl is uncoordinated growth, unintelligent growth, and this can occur whatever the balance of forces. This is a crucial distinction which dominates the argument extended here. We can classify sprawl by the dominant force that drives it and by the extent to which growth is uncoordinated. Table 1 makes this classification clear.

Centralisation where growth around the periphery of the city is coordinated, is not likely to lead to sprawl but to compactness and in some very rare cases, this is an urban policy that has been followed and implemented. Compactness implies that movement is coordinated to the point where large numbers of people move easily and swiftly and this inevitably implies some kind of mass transit. The car has little place in such scenarios and consequently these types of urban form are quite unlikely to

emerge in reality. These are more idealisations and physical examples tend to be normative statements of what might be, rather than anything that exists in terms of contemporary cities. At the other extreme, unplanned, uncoordinated, decentralised development is characteristic of many newer cities, particularly those in the American south and west such as Los Angeles and Phoenix, Arizona. Even in these cases however there are some centralising forces which lead to concentrations of development in edge cities and central business district (CBD) clusters. Many European cities are more compact but still lack coordination which leads to sprawl-like growth. On the other hand, some cities are decentralised but coordinated: Portland, Oregon is such an example. What all this implies is that the development of cities is a complex mix of centralising and decentralising forces, the particular balance depending upon planning policy, cultural constraints on what and how people build, on economic prosperity which is usually reflected in transportation, and on the overall rate of population growth and the extent to which the city is growing through immigration.

	Concentration/ Centralization	De-Concentration/ Decentralisation
Coordinated Growth	<i>Compact Cities</i> e.g. Venice	<i>Broadacre City/ e.g. Milton Keynes</i>
Urban Sprawl	<i>The Industrial Cities</i> e.g. Manchester	<i>Post-Industrial Cities</i> e.g. Phoenix AZ, LA

Table 1: Sprawl and the Forces of Agglomeration

We can examine sprawl in many ways but a picture of the way cities are growing can be gleaned from their shapes. In Figure 1, we show urban development in South East England and in Western Europe where it is quite clear that the cities look like explosions, almost like cancers, to coin a phrase, in that they appear ‘out of control’ in the way they reach out into the rural landscape in their quest to consume space. It is quite easy to see these patterns as being the product of both forces of centralisation and decentralisation: centralisation as big cities must once have been small cities with their evolution clearly the product of attracting new development; decentralisation in that their structures reach out, dendritic-like, along main transportation corridors into their hinterland and surrounding space.

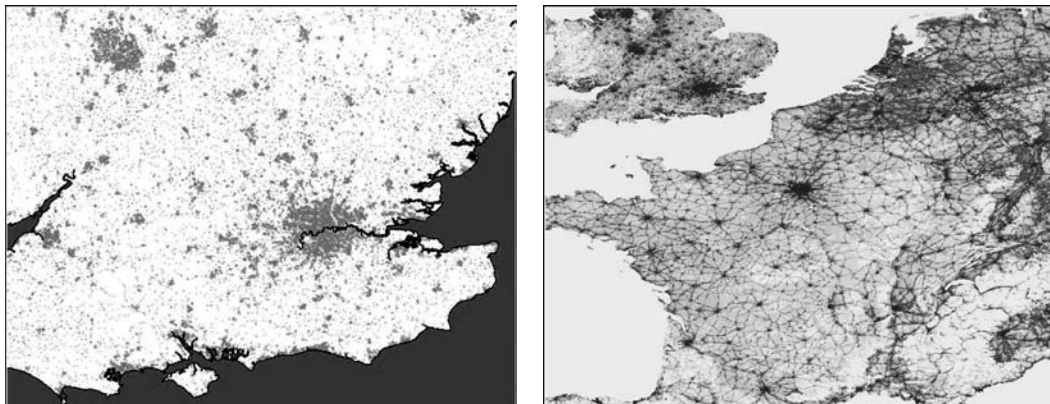


Figure 1: Exploding Cities in South East England (left) and Western Europe (right)

There is somewhat of a contradiction concerning suburban sprawl: large tracts of land which appear to be organised and homogeneous, characterise such development, particularly in the residential sector. This does not look much like uncoordinated development in and of itself. Pictures of such development in Los Angeles 50 years ago (Davies, 1998) and in contemporary times are shown in Figure 2 but it is only when the wider context is examined that the degree to which such development is uncoordinated is clear. Agricultural land is lost, such development is uniform and monotonous, such suburbs depend entirely on the car for transportation, and usually social services and related facilities are long distances away. In short, only young families can live in such places and even these groups face the disadvantages of social isolation. But before we go further, we must say something about the various types of sprawl for not all development is uncoordinated in the same way.

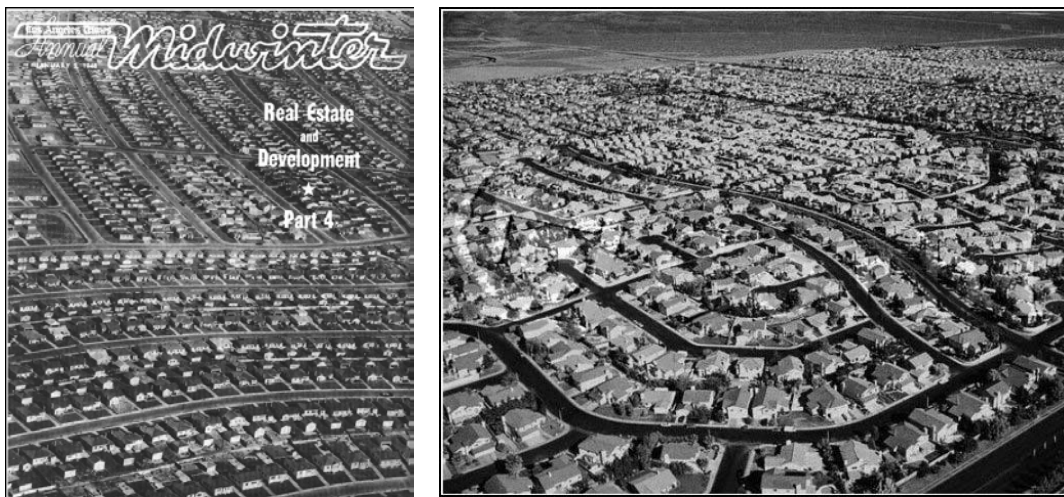


Figure 2: Homogeneous Residential Sprawl in Los Angeles, 1948 (left) and 1998 (right) (left, from an advertising supplement in the LA Times, 1948)

Types of Sprawl: The Impact of the Car

To classify different types of sprawl, urban development can be defined in terms of its density and type of physical configuration although there are many other features that can be used in its categorization. The typical North American form of sprawl is low density and dispersed, that is, in a pattern where development is not contiguous but spread out across an urban region. In contrast, in parts of Europe, the density is higher but the form is equally scattered with development discontinuous, the city and its suburbs being full of empty spaces. It is this empty space that suggests a lack of efficiency in development which is a consequence of uncoordinated growth. We can classify different types of sprawl in a similar way to our treatment of urban forces above. Table 2 below seeks to impose some sense on the kinds of development that occur in terms of density and configuration.

Galster et al. (2001) have classified sprawl into distinct types that match those in Table 2. They define strip or linear development, development that leapfrogs over green space, and development that is continuous but scattered, interspersed with much

vacant or non-urban land. We show some of these types in Figure 3. All these can be seen in terms of the degree of compactness or dispersion, ‘scatteration’ as some have called it. Polynucleated nodal development lies somewhere in between, characteristic of growth where many smaller towns have fused. Sprawl however is strictly discontinuous development which is much lower density than the traditional originating settlement, being physically separated from the core city or region and depending very largely on a single mode of transport, usually the automobile.

	High Density	Low Density
Compact Contiguous	<i>Circular or radial using mass transit</i>	<i>Possible but rare ?</i>
Linear Strip Corridor	<i>Corridor development around mass transit</i>	<i>Ribbon development along radial routes</i>
Polynucleated Nodal	<i>Urban nodes divided by green belts</i>	<i>Metro regions with new towns</i>
Scattered Discontiguous	<i>Possible but rare ?</i>	<i>Metro regions with edge cities</i>

Table 1: Types of Sprawl

It might appear that sprawl in its extreme form is something that can only exist in urban societies that have a short history of city development such as those in the New World where there are many cities which have developed during the age of the automobile. But in older cultures such as in Europe and in countries which are much less prosperous where car ownership is low, there are many different varieties of sprawl. We will identify four types which are very different from the low density sprawling suburbs pictured in Figure 2. In old industrial areas in western Europe such as those in the UK where settlements were built around coalfields, population is falling but still there is sprawl: new development occurs on the edge. Populations wish to live in new single family homes, not in the crowded terraces which characterise the older settlements and hence whole streets of older houses remain vacant while small estates appear on the edges of such towns and villages.

In more prosperous medium-sized European cities, people demand more space, and development on the edge, again in single family homes, is only made possible by the automobile. In Eastern China in the coastal cities, there is dramatic urbanisation with development in the most uncoordinated fashion imaginable in places like the Pearl River between Hong Kong and Guangzhou and in the Yangtze Delta between Shanghai and Nanjing. Entire regions are being urbanised with scattered development around the old village pattern being the norm, served by relatively uncoordinated public transport but still with very low rates of car ownership. In South American cities, the phenomena of sprawl is reversed: the poor still flock to the cities with informal development around their edges, again served by uncoordinated public transport. These are all varieties of sprawl which imply a lack of coordination with respect to past development, housing needs, and transportation.

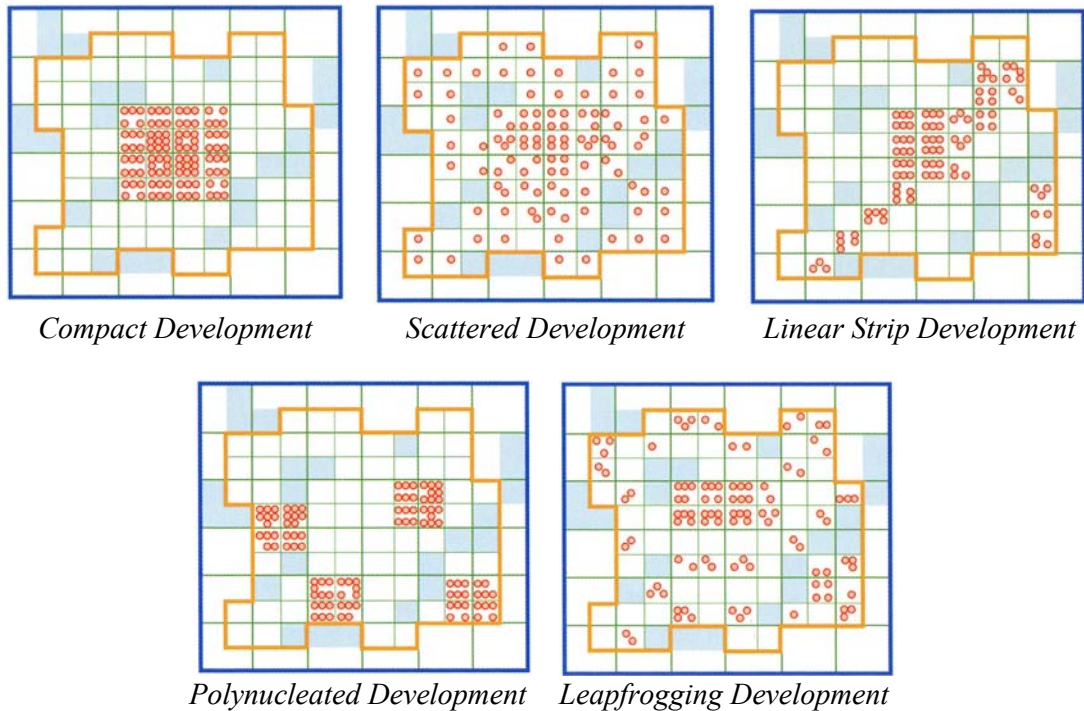


Figure 3: Physical Patterns Defining Sprawl (From Galster et al., 2001)

The Costs and Impacts of Sprawl

Urban sprawl is generally perceived to be undesirable relative to more compact and higher density development, largely due to the lack of diversity that it encourages and the economic resources that it consumes. Yet the debate is by no means clear. There is a distinct although relatively narrow view that suggests that sprawl is no more or less than the efficient operation of the land market, and in this sense, is the outcome of a competitive process. The problem with this is that no process of development exists within a purely competitive market, indeed sprawl might be seen as the failure of the market to take account of the longer term economic externalities in favour of 'short termism'. And of course social and qualitative environmental issues are rarely considered in this kind of debate, notwithstanding the view that what takes place is what people value.

We can define four major perspectives on the impacts of sprawl. First there is the general issue that sprawl is unpleasant aesthetically. This is the argument put forward by Cobbett and Morris in 19th century Britain which we quoted at the beginning of this paper. Sprawl is seen as despoiling the countryside, ruining the rural economy and idyll, and as such it is part of a long-standing anti-suburban view that will always persist. Second and much more significant, there is the issue of efficiency. Sprawl is regarded as a more costly form of urban development due to the spreading out of infrastructure (utilities and related services). Wasteful commuting through loss of time due to length of journeys and congestion, increased household spending on transport, lack of an alternative choice in transport due to the absence of public transport, loss of agricultural land, and the loss of environmentally fragile lands which

include disturbance to local ecologies, all incur greater costs if development is low density and spread out. The reactions to this view range from those who assume that sprawl can be controlled through regulation, charging for externalities, increasing the price of gasoline, taxing low density housing at more than proportionate rates and so on, in contrast to more direct control, exercised by physical planning and development permits. In fact such policies have been in existence for many years in many western cities, ranging from defining urban growth boundaries to green belts and the positive channelling of growth into polynucleated regional cities and urban corridors.

The third issue relates to social structure which includes issues of equity. Sprawl benefits those who can pay in that it tends to segregate residential development according to income. This tends to exacerbate social and ethnic divisions, particularly in American cities, with the inner cities being dominated and ghettoised by non-white communities and the suburbs being almost exclusively for the whites. However, the lack of social interaction in suburban areas means that those who cannot travel long distances, the very young and the very old for example, are unable to live effectively in such areas. The dominant types of sprawl are for middle and upper income families with children who have the requisite mobility and life style to enable them to function. Large segments of urban society are thus excluded from living in such areas.

As sprawl is simply one manifestation of urban development, all the factors that affect city growth and form are influenced by this phenomenon. Transportation is a major influence on the degree to which development 'sprawls' but rather than examining simply transport and the growth of the private car, we will examine more generic issues and concentrate on three kinds of impact: ecological, economic and social. In terms of ecological impacts, then the consumption of land and energy is affected by sprawl, with a useful indicator being the amount of space consumed per capita. In overall terms, in western countries, the amount per capita has more than doubled during the last 50 years as cities have begun to sprawl. The increase in energy per capita, particularly in terms of transportation, is directly affected by car ownership and although vehicles are becoming ever more fuel efficient, the number of persons using car transport is still increasing as in western societies access to such transport moves towards 100 percent. In contrast, pollution is increasing because of the growth in car use, despite better controls.

The one factor that has to be filtered out in this discussion relates to the fact that as incomes rise, populations use their wealth to consume goods that require energy use and this masks the massive improvements that are taking place in the energy-efficiency of the goods being purchased. We are just beginning to see some evidence of a reduction in pollution in cities in California, for example, where car ownership has peaked – anyone who wants a car has one – and where pollution controls are at last making an impact. In fact it is in cities with the highest densities that pollution is worst although the overall rate of pollution may not be any higher than in sprawling cities. Density and pollution are intimately connected and the whole notion of increasing densities and the space cramming that they force, has negative costs and impacts which temper the debate and argument against low density, car-based urban development. There is no consensus about such issues as it is not possible to assemble all the factors that give rise to the costs and the benefits of high or low density forms of urban development to produce a definite answer as to how costs outweigh benefits or vice versa.

Economic costs and benefits are equally difficult to disentangle. Many of these are indirect or derivative. Transport costs and loss of travel time must be weighed against congestion incurred if higher densities were to replace decentralised, low density development. The accessibility provided by the car with the ability to make multi-trips and to combine diverse activities, generate less obvious benefits such as the psychological convenience of such access. This is not simply a matter of public versus private costs or long term versus short term but of differential impacts on those affected. Other economic costs associated with the loss of land in other uses are problematic as uses such as agriculture decline as a proportion of all economic activity in employment terms at least. It is also difficult to track the economic performance of sprawling auto-centric landscapes as these depend so much on the wider urban economy that sustains them and which they, in turn, sustain.

This issue of performance relates to the problem of optimal town size, a recurrent theme in terms of defining ideal urban forms. Cities imply externalities although as they become larger, these externalities change qualitatively. Beyond a certain point which no one has ever really found, it is assumed that diseconomies of scale set in as congestion and density lead to the inefficient functioning of urban markets. Cities which grow through sprawling suburbs are often taken to be associated with such diseconomies. However the appearance of edge cities, specialised nodes in the suburbs and wider metro region, are often taken as evidence that the costs of centralisation, size and density are dissipated by decentralisation. Nevertheless, there are still important issues related to investment in infrastructure which is abandoned when massive decentralisation takes place. The loss of such infrastructure is sometimes regarded as cost in itself, notwithstanding the fact that the land uses and activities that populate these structures have often outlived their economic usefulness. The abandonment of town centres and downtowns is often simply a response to market forces.

Our third area involves the spatial segregation that takes place due to sprawl and the lack of social cohesion that clearly characterises remote single family suburbs. We have noted the fact that sprawl tends to segregate communities ethnically as well as dividing families according to age and life cycle. In general, social facilities are less well developed in lower density suburbs but at the same time, the life styles of those who reside in such communities tend to be more uniform and routine than those who are single or older. The kinds of suburbs pictured in Figure 2 are often portrayed as soulless with no community or identity. In metropolitan cities affected by dynamics of sub-urbanisation and sprawl, space develops according to clear patterns of social ecology but once again it is hard to unravel changes in life style occasioned by these patterns from the broader trends at work in society-at-large.

To summarise, there is still confusion over the impacts of sprawl on the wider urban economy. The loss of environmentally desirable locations is incontestable and suburbanisation is counter to diverse social interaction but overall there is no agreement on characteristics, causes and effects. The benefits of sprawl are rarely taken into account and the debate is usually emotive and often political. Effects due to different levels of density, types of land use, and physical discontinuities need to be isolated as do the effects of development standards, lack of infrastructure, and levels of service. There also needs to be recognition that sprawl may be a short term affair, a

consequence of rapid growth which changes in its physical and economic character as development begins to compact as it matures. These costs and impacts have been monitored for over 30 years in the US by the Transportation Research Board (1998).

The SCATTER Project: Sprawl in Europe

Most work on urban sprawl has been conducted in North America where the dominance of the automobile with its comparatively lower cost of operation has led to extensive urban decentralisation in the last 50 years. In Europe, only quite recently have cities begun to sprawl in the same way. Up until around 1970, the spread of cities in Europe was largely influenced by public transportation systems, rail and bus. Since then however, cities have begun to spread in the same way as in North America, albeit with higher densities and smaller lot sizes with respect to residential housing. Our work on European cities has been to figure out the extent to which cities have begun to sprawl over the last 30 years and to contrast different kinds of cities. The SCATTER project which is financed by the European Commission under the 5th Framework is designed to enable comparative research into different European cities and to explore policies to control and influence residential sprawl (Besussi and Chin, 2003).

We have already illustrated how cities in Western Europe are exploding in Figure 1 and in Figure 4, we show remotely sensed land uses in the six cities from the SCATTER project at different scales. The city regions are very different in aerial size and in Figure 5 we show this. In terms of population, the smallest city region is Rennes with about half a million population to the largest Milan with a population of nearly 4 million. There is no sprawl in Europe which is like that in North American cities. The difference is the historical landscape on which contemporary urban clusters are developing. Europe is strongly polycentric and everywhere there is a dense underlying network of villages and small towns consistent with the past agricultural basis of medieval society. Holmes (1992) in his Preface to *The Oxford History of Medieval Europe* says: “Most Europeans live in towns and villages which existed in the lifetime of St. Thomas Aquinas, many of them in the shadow of churches built in the 13th century. That simple physical identity is the mark of a deeper continuity”. This ‘deeper continuity is important in terms of the way cities have expanded from the beginnings of the Industrial Revolution.

Sprawl in all our cities with the exception of Helsinki which exists in a very low density hinterland, show patterns of urban development which are polynucleated at the most basic level in that small towns and villages become incorporated in the sprawl as these cities have grown. In fact, each of our city regions has quite good public transportation although in all cases, congestion and long commute distances are fast becoming a feature of such development. However a substantial part of this commuting is not for movement to central cities *per se* but to other adjacent urban regions where there are job opportunities. This is an oft-forgotten benefit of sprawl – the fact that commuters are able to access a much wider set of job opportunities than ever before, almost at the same level as those living in the central city, perhaps more so. Sprawl of course betrays such a lack of coordination; there is little doubt that these problems pervade the European cities such as those we are studying

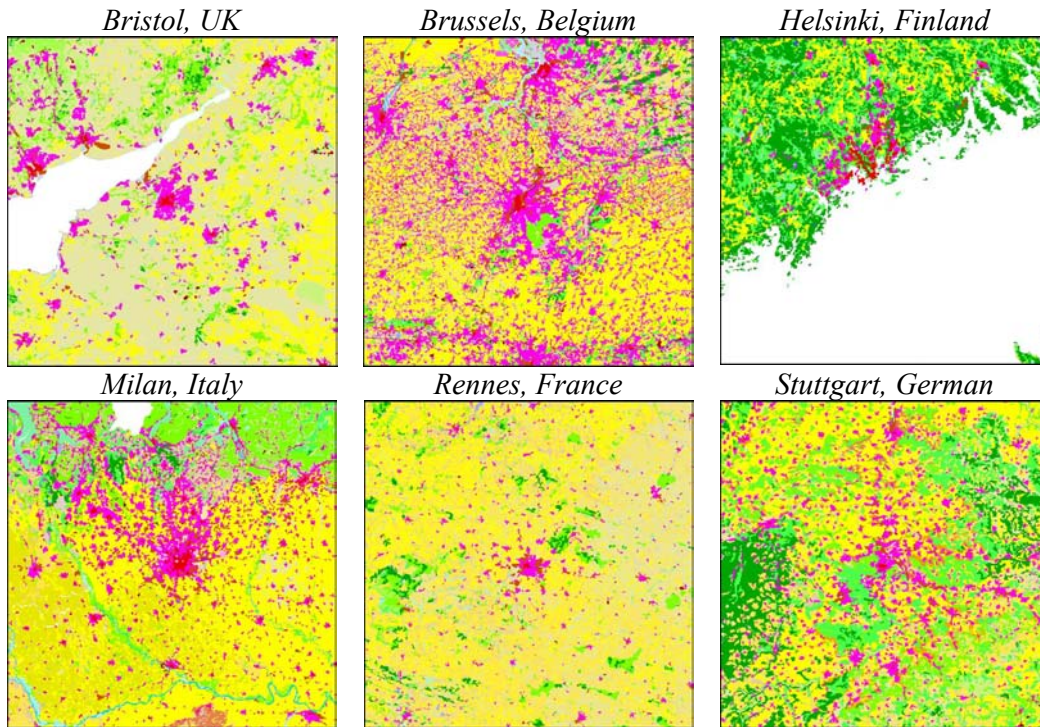


Figure 4: Urban Land Use (Purple) from Remotely Sensed Data (Corine 1990) in the Six European City Regions

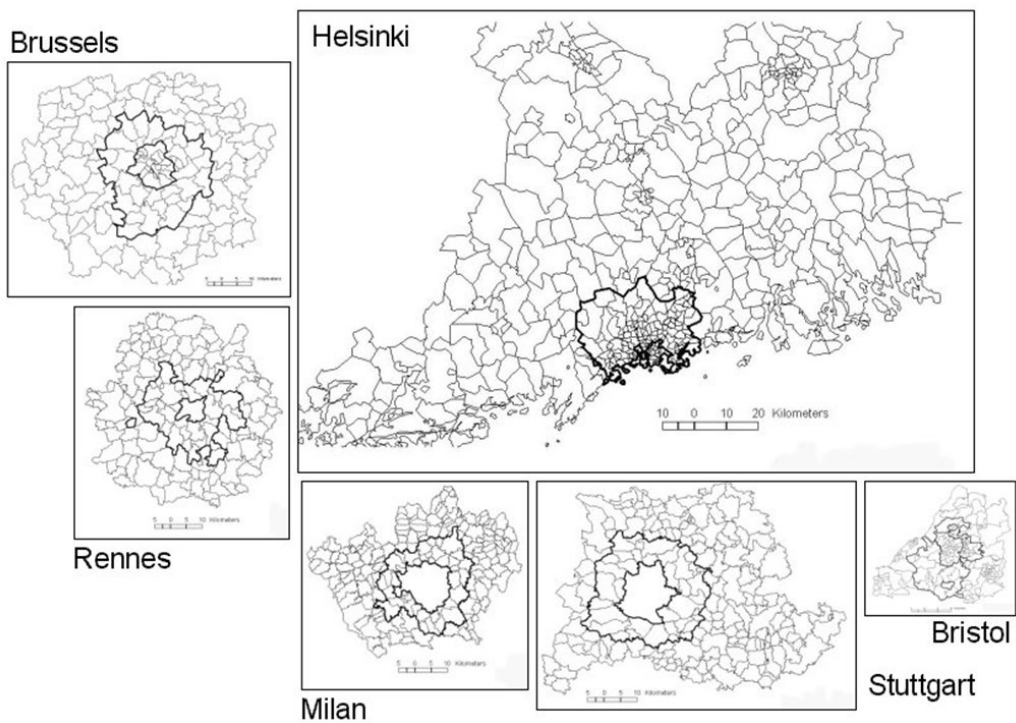


Figure 5: The Six Cities (presented at the same scale)

but these are problems also caused by the fragmentation of government units and by the inability of different governments to coordinate across different sectors. Our project is revealing interesting insights into sprawl which show that such development has more complicated roots than we originally thought. Readers are encouraged to visit our web site to review the most recent results (<http://www.casa.ucl.ac.uk/scatter/>).

Next Steps: Towards Sustainability and Smart Growth

Sprawl is perhaps the major problem facing urban planning at the beginning of the 21st century. It encapsulates the key problem of urban transportation which revolves around the emphasis on the car as the dominant means of movement. It focuses attention on the problem of preserving and conserving infrastructure established in earlier times when people were less mobile. It identifies the problem of losing environmental quality as the countryside is paved over. And it reveals the way different social and income groups polarise and segregate themselves from one another. Ways of addressing these problems in a collective and coordinated way are currently being explored in terms of the development of sustainable communities. In this way, sustainability is built around the notion that decisions need to be made for the long term, for future generations and that this involves not stopping growth but intelligent ways of handling existing growth – in short, smart growth.

In the 19th and 20th centuries, responses to urban growth were short sighted, indeed ill-considered for it was simply assumed that growth could halted; or rather, growth could be controlled and where it then went, disregarded. Green belts and urban cordons served simply to preserve open land, not halt growth which simply leapfrogged over. A more intelligent approach is required where investments need to be coordinated. We need much more ‘redundancy’ in cities in terms of the way we build, travel, and interact. This does not mean getting rid of the car for there is little doubt that the energy crisis will be ‘solved’ with the production of clean and more efficient engine technologies. What we need to consider are alternative means of transport and locational controls which might be implemented in parallel to solve problems of congestion while at the same time increasing spatial accessibility for all.

References

Besussi, E., and Chin, N. (2003) Identifying and Measuring Urban Sprawl, in *Advanced Spatial Analysis* (Edited by Paul A. Longley and Michael Batty, ESRI Press, Redlands, CA), pp. 109-128.

Davies, M. (1998) *Ecology of Fear: Los Angeles and the Imagination of Disaster*, Henry Holt and Company, New York.

Galster, G., Hanson, R., Ratcliffe, M. R., Wolman, H., Coleman, S., and Freihage, J. (2001) Wrestling Sprawl to the Ground: Defining and Measuring an Elusive Concept, *Housing Policy Debate*, 12, 681-717.

Holmes, G. (1992) Preface, In: G. Holmes (Editor) *The Oxford History Of Medieval Europe*, Oxford University Press, Oxford, UK, iii.

Morris, A. E. J. (1994) *History of Urban Form: Before the Industrial Revolutions*, Longmans, Harlow, Essex, UK (Third Edition)

TRB (1998) *The Costs of Sprawl – Revisited*, Transportation Research Board and the National Research Council, National Academy Press, Washington, DC.

Whyte, W. H. (1958) Urban sprawl, in *The Exploding Metropolis* (The Editors of Fortune, Doubleday-Anchor Books, New York), pp. 115-139.