The economic 'health' of market towns Ref 014
a configurational approach to accessibility

Julienne Hanson
University College London
j.hanson@ucl.ac.uk

Keywords
spatial configuration; urban morphology; urban growth; market towns; accessibility

Abstract
This paper describes a first excursion into using spatial configuration to explore the impact of relative accessibility or remoteness on the economic 'health' or prosperity of a sample of English provincial market towns. It presents a case study of twelve market towns that are located within two small, distinctive geographical regions of the southeast, Breckland and the Weald, that historically were both inaccessible. Today the Weald has become much more accessible than Breckland, thus bringing changes in relative accessibility over time and geographical distance to the fore. In what follows, relative accessibility will be quantified in terms of the mean integration and mean choice of the built up area of each town, considered both as a physically and spatially discrete entity and when set within the context of an analysed axial map of the whole of the southeast of England (the Greater South East Map) that stretches from East Anglia and the Fens in the north, to Berkshire and Oxfordshire in a westerly direction, including Greater London and the Home Counties and, further south, the coastal counties of Kent, Sussex and Hampshire.

The first stage has been to describe and represent, in the form of an axial map, the shape and configuration of the urban public realm of each of the twelve towns as it exists today. The next stage was to recover processes of growth and change through an understanding of the cartographic record of each town, after which the analysed axial structure that corresponded to each town was located within the map of the whole of the southeast of England and interrogated visually and numerically at a variety of spatial scales. Configurational measures of accessibility have been correlated with widely available measures of each town's economic prosperity, such as the extent of the commercial core, the numbers of workers employed in the retail and service sectors, the amount of retail and office floorspace and the rateable value income derived from retail and office premises, in order to shed light on the emergent patterns of accessibility and prosperity that may be indicative of a town's vitality, viability and health.

English market towns

Most English market towns are physically discrete settlements in the landscape which have a historic core based around a marketplace and lie at the centre of a transport web that brings people and goods into and out of the town, as well as affording accessible sites for industry and employment. Legally, a market town is a settlement in possession of a town charter granted by the ruler of the day. The charter can normally be precisely dated and is usually linked to rights to hold a market or fair (Hoskins, 1955; Beresford, 1967). Criteria can also be drawn up on the basis of a settlement's physical features, such as its metric area, population size or residential density, or by the presence of strategic non-residential building types such as fortifications, castles, cathedrals, town halls or a mint, or even from the occurrence of distinctive morphological features such as a planned street layout, market square, long, narrow burgage plots or being the hub of a network of long-distance transport routes (Heighway, 1972). A third approach has been to emphasise socioeconomic relationships, including the existence of an elaborate division of labour based on occupation, the presence of complex religious or judicial organisations or the formation of distinct

social classes (Sjoberg, 1967), whilst more recent definitions have tended to rely on a purely economic approach, where market towns are understood to provide a locus for the redistribution of goods and services produced both locally and regionally (Powe and Shaw, 2003, 2004).

Whichever definition is adopted, the traditional idea of an English market town is of a physically separate settlement, sometimes walled and gated, that supports a variety of urban functions and a range of services such as trade and commerce, politics and religion, education, leisure, health, social and civic activities (Schledermann, 1970). Many English provincial market towns have a surviving late Saxon or mediaeval core based around a marketplace, which has been augmented over many centuries by Georgian and Victorian residential and industrial development. Town topography usually evolved slowly. Few historic towns were subject to large scale replanning and most were able to absorb population growth by building on land that had previously been orchards and gardens, so that a visual comparison between Speed's 1611 town maps and the first editions of the Ordnance Survey (OS) that were produced between 1853 and 1893, reveals a striking continuity in the physical size and detailed urban morphology of many market towns and their suburbs, testifying to the remarkable stability of the framework of streets and open spaces that made up the urban public realm until as recently as the 1930s (Platt, 1976).

However, since the middle of the last century the physiognomy of many English market towns has been altered dramatically by the construction of large, mono-functional housing estates at the periphery of the town, the development of shopping malls and precincts in the town centre, the building of industrial estates, retail and business parks, and, since the turn of the millennium, by the building of office, information or cultural quarters, mixed use regeneration projects and urban village extensions. At the same time, some contemporary market towns have become physically more amorphous, perhaps because previously separate towns have coalesced into a polyfocal urban agglomeration, whilst others have become physically separated from their hinterland either by the superimposition of a canal or railway in the late eighteenth and nineteenth centuries or, in the twentieth century, by a high-speed ring road or bypass.

Today, life in many small English market towns still focuses on the marketplace, located in the historic core of the town close to the parish church, town hall, shopping, local businesses, health-care and entertainment. The marketplace affords a meeting point for local people as well as a venue for trade, though the original open-air general retail market may have been augmented or replaced by a permanent covered market hall or even by a modern shopping mall. However, in a minority of towns, the urban grid has evolved to such an extent that the old marketplace has been bypassed by more recent developments. Whether or not the original marketplace has survived, some market towns are still well placed to serve local regions because *"the town catchment may be sufficiently large to allow economies of scale and a degree of specialization"* (Powe and Shaw, 2004) with respect to a relatively accessible rural hinterland that can easily be serviced by public transport. Indeed, Moseley (1979) has identified accessibility as key to enabling this service role to develop.

Yet other market towns have stagnated and declined in recent years, due to a variety of factors that include the growth in out-of-town shopping centres, car boot sales and internet shopping, the closure of both livestock markets and street markets, a reduction in local jobs in manufacturing and retail and the increasing impact of private car ownership. Taken together, these factors adversely affect high street businesses, lower the range and quality of services offered by market towns and weaken place attachment and social cohesion. Another factor that exerts pressure on some market towns is major population growth, which may lead to redevelopment or expansion that significantly alters the character of the town.

Recent research (Courtney et al, 1998) has suggested that the traditional role of many market towns has been seriously undermined by socio-economic change in three distinct ways. First, the town's primary role is no longer to serve the needs of the surrounding agricultural community; second, the town centre now supports a diverse range of non-agricultural as well as agricultural businesses; and finally market towns serve a larger and different rural population than they did historically, so that they now play a purely economic role within rural society whereas formerly they also played a social one. Contemporary influences on local economic activity include increasing

globalization, restructuring of the UK economy away from manufacturing and towards service industries, the growth in car ownership and developments in telecommunications. As a result, the authors argue, at least some market towns have become dysfunctional. Furthermore, as an increasing proportion of economic transactions have become non-local, questions need to be addressed about the role played by market towns in the overall rural economy.

The UK Government's Rural White Paper (2000) and the subsequent Market Towns Initiative have sought to counteract this decline in market towns in recent years by identifying ways to support them in functioning as a focus for sustainable rural communities. As well as improving the shopping offer, diversifying the attractions in the town centre by promoting residential use and developing a range of new functions such as education, catering, arts and community activities, tourism and enterprise, has been seen as an important way to make small market towns more sustainable (URBED, 1999). To support local initiative and investment, the streets of the town need to be safe, well lit, well kept and cared-for. However, it has long been accepted that small market towns cannot be understood simply in terms of their internal urban morphology, but rather as intensifications or 'hubs' of economic and social activity within a broader rural hinterland, and the URBED report, referred to earlier, drew attention to the need for successful market towns to be *'highly accessible to all their potential customers'*.

Roads and regions

According to Beresford and St John (1979) the alignments of pre-mediaeval roads were dictated by long-distance networks. The first roads in England were ancient trackways that evolved over many hundreds of years for long distance trade and kept mainly to the high ground. Their direction was, *'alien both to the very localised life of the fields and to journeying to county or feudal headquarters'*, (ibid., p. 273). Although the existence of these prehistoric routes may seem remote from modern life and many have not been incorporated into the modern road system, their existence may help to account for the origin of many settlements at a point where either two trackways intersected or a single trackway crossed a river or other prominent natural feature (Hoskins, 1967).

Most Roman roads were originally dictated by military requirements and were surveyed and laid out to take the most direct route between centres. Because they were straight and paved to ensure that vehicles as well as troops could use them in inclement weather conditions, the Roman road network provided a reliable infrastructure for transporting goods over long distances up until the eighteenth century, when the first toll roads were constructed. By contrast, most mediaeval roads were *'entirely local in purpose…..they would not necessarily make through connections with similar roads in an adjacent parish'*, (Hoskins, ibid. p.273). Journeys to market, church and court were the main exceptions to this localised development of road systems and, as a result, marketplaces tended to occupy privileged positions within the regional road network.

Thus, until the industrial revolution, country towns in the south of England formed a closely spaced network of small market towns that catered for the needs of a mainly agricultural population and were separated from one another by physical distances of as little as five to ten miles. Highways exerted little and railways almost no influence at all on settlement location. The exception was in areas that were subject to parliamentary enclosures during the seventeenth and eighteenth centuries, where the enclosure commissioners rationalised a pre-enclosure road network that was often little more than meandering footpaths across the open countryside, and set out a grid of highways and footpaths that formed a regular structure within which the rest of the landscape was enclosed.

By the beginning of the nineteenth century, more than a thousand turnpike companies maintained and charged a toll to use some 20,000 miles (32,000 km) of highways between major urban centres that were linked by stagecoach. However, the advent of the railways in the nineteenth century led to the demise of the stagecoach and the last turnpike trust ceased trading in 1895. Whilst several of the market towns in the sample developed close to or on the banks of navigable rivers, only North Walsham (1812-26) and Wymondham (1803) in Breckland were affected by the

canal building boom of the early nineteenth century, and only then in a minor way. By contrast, every town in the sample had a railway line and station, and several became important railway junctions. The impact of the railway on the morphology of most market towns in the sample was considerable, not only because its arrival stimulated population growth but also because it both encouraged urban development around the station and at the same time obstructed growth at the outskirts, where the line cut off newly-emerging suburbs from the rest of the town.

By the turn of the twentieth century, responsibility for the road network had devolved to nearly two thousand separate town, district, rural and county councils. The arrival of the car in the late 1900s led to huge increases in the volume of traffic using the roads, which resulted in demands that central government should undertake responsibility for road building and maintenance. A system of A and B roads was launched in 1922, and in 1936 the first Trunk Roads Act was passed to give central government control over the most important through routes in the country, but responsibility for building and maintaining minor roads and footpaths has been retained to the present day by the local authorities.

As with market towns, significant transformations in urban form and road networks have taken place during the second half of the twentieth century. The first experimental motorway, the Preston bypass, was constructed in 1956, shortly to be followed by a section of the M1 in 1959, and from then until the turn of the new millennium, the UK's national transport policy prioritised road building, together with a programme of ring roads and bypasses to divert through traffic around the centres of towns in the hope of easing congestion. One way and gyratory traffic systems were designed to direct movement along certain streets within the town centre, whilst in others the centre was completely pedestrianised. Grade separated road intersections, together with bridges or underpasses whenever pedestrians needed to cross over busy roads, have produced a complex, multi-level and increasingly unintelligible movement infrastructure for both vehicles and pedestrians that is in sharp contrast to the relatively direct, accessible and shared routes that were characteristic of previous eras. Innumerable small and large changes to the urban realm within and the road network between towns have brought about a situation in which the relative accessibility of towns is difficult to comprehend other than 'as the crow flies', in terms of the physical distance between town centres.

Research Methodology

It has long been accepted by geographers and planners that market towns cannot be understood simply in terms of their internal morphology, but rather as intensifications of spatial, economic and social activity within a broader rural hinterland. Some towns are important service centres that offer a wide range of retail outlets and businesses and are affiliated to many dozens of neighbouring villages, whilst others have a more localised impact and serve just a few nearby settlements. Accessibility is thought to be key to enabling this service role to develop and may therefore be indicative of a town's socioeconomic viability or 'health' (Thurstain-Goodwin and Unwin, 2000; Thurstain-Goodwin , 2002; Scottish Government, 2007), but, hitherto, accessibility has been usually been conceived of in terms of simple, straight line networks of trips or transactions (Linneker, 2006).

However, new ways of harnessing cartographic data and assigning these to axial maps have enabled the scale of configurational modelling to expand from the city to the region without losing the fine detail of urban street networks and localised patterns of rural settlement, and recent software developments have permitted a sophisticated, multi-scaled analysis of axial maps that allows researchers to layer functional data such as land uses onto the analysed axial map (Hillier and Vaughan, 2007; Turner, 2007). These developments have permitted old questions about the relationship between the relative 'accessibility' of a town and its 'health' – defined as its social liveliness and economic prosperity - to be addressed and answered in new ways so that, unlike previous attempts to model accessibility, this account will both take into account the shape and length of roads and will attempt to quantify relative accessibility in terms of the overall configuration of the road network.

The selection of the towns that have participated in the current study was not arbitrary. Between 2001 and 2005, the Department for the Environment, Farming and Rural Affairs (DEFRA)

commissioned research to develop clear definitions and an unambiguous methodology that would enable the level of rurality or urbanity to be determined for Local Authority Districts (LAD) and Unitary Authorities (UA) in England. This work resulted in the identification of a new settlement type, the 'larger market town' or LMT, which was defined (DEFRA, 2004; DEFRA, 2005a, 2005b) as an urban settlement with a population of between 10,000 and 30,000, which served a wider rural hinterland within a predominantly rural area. LMTs were further identified by the functions they provided for their hinterland in the form of a prescribed set of services and commercial facilities. For example, a LMT should have either at least three shops or at least 1.3 shops per 1,000 population, at least one bank or solicitor, at least one GP and at last 3.5% of addresses should be commercial in nature.

By applying these criteria, the DEFRA study identified 207 larger market towns in England with a total population of 3.72 million, which served as a sample frame for this study, (DEFRA, 2005b), of which 69 are contained within the Greater South East map. Investigating the spatial and functional characteristics of all 69 LMTs that feature in this map was not a viable proposition, so two smaller, geographically distinctive regions were selected for study, which are known to differ in their relative accessibility in that, according to Tarling's (1993) distinction between 'accessible' and 'remote' rural areas, today the Weald is 'accessible' whereas Breckland is 'remote'. Twelve LMTs, six from each of the two regions were adopted as case studies, in order to pilot a configurational approach to accessibility (Figure 1).

Figure 1

Map of the southeast of England showing the location of the twelve LMTs selected for study.

The Breckland / Broads area of Norfolk and Suffolk lies about 100 miles to the north-east of London in rural East Anglia, to the south and east of the Wash. Breckland and the Broads have a long history of settlement but, writing in 1769, William Gilpin described the region as '*a piece of absolute desert almost in the heart of England'*. Even today, the landscape feels remote and sparsely populated. Nucleated villages follow the river valleys and there are a few, small and widely dispersed towns. Most of these have expanded significantly in the second half of the 20th century. Only six of the East Anglian towns that are located within and around the Breckland / Broads area are also listed in DEFRA's classification of MLTs. These are East Dereham, North Walsham, Thetford and Wymondham in Norfolk and Beccles and Mildenhall in Suffolk (Figure 2a). The maps have been drawn to scale and the boundary of the built up area of each town has been outlined in red. The axial lines of the retail core are also highlighted in red.

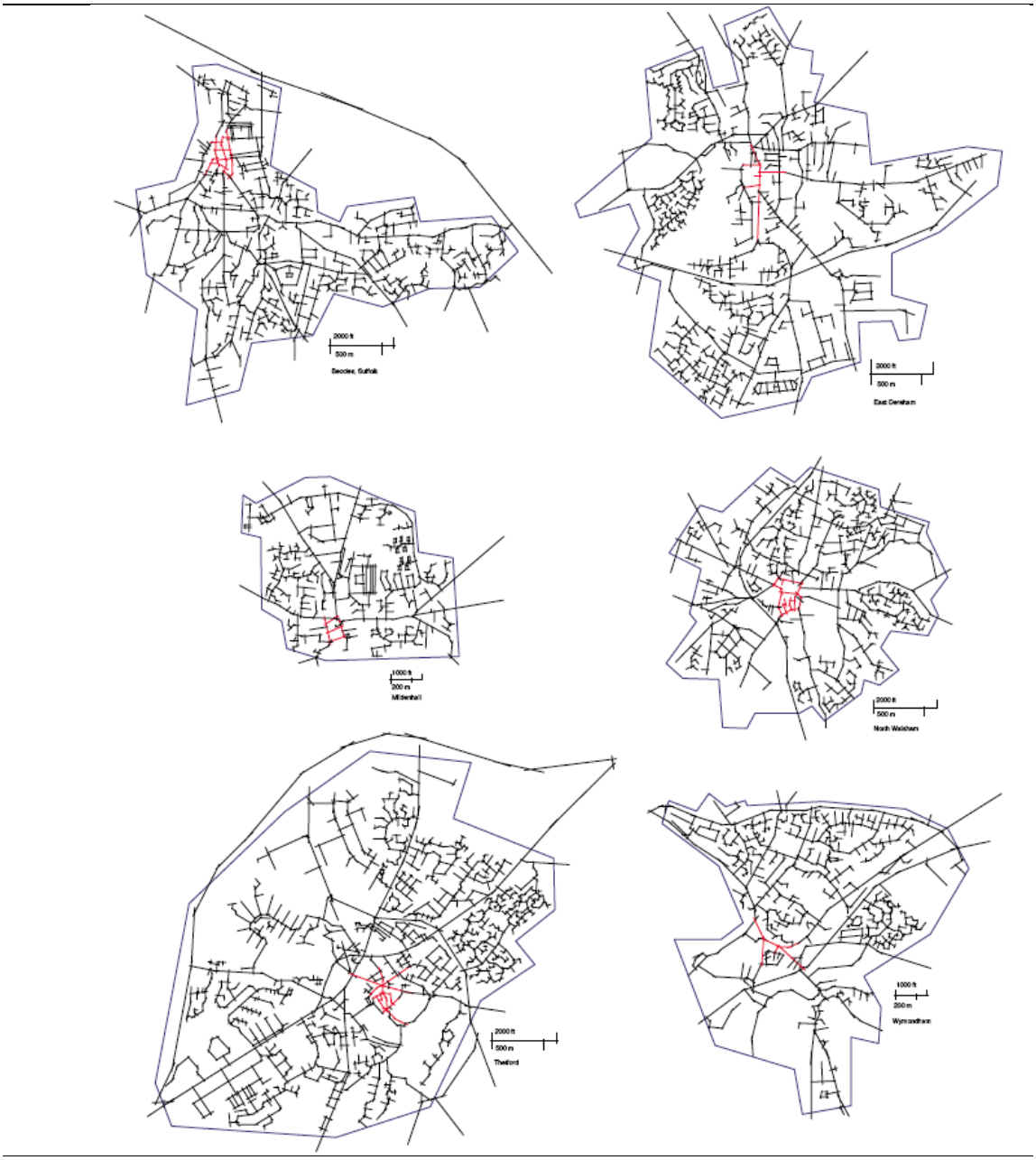


Figure 2a
Axial maps of six Breckland towns

The area of Kent, Surrey and Sussex between the North and South Downs, known as the Weald, selected for comparison, lies some 30 miles south of London and extends over an area about 135 km (85 miles) in an east-west direction and about 50 km (30 miles) in a north-south direction. Hasted (1797) described the region as, *'nothing more than a waste desert and wilderness, not*

furnished with habitations and peopled as the rest of the county was, but like a forest, stored with herds of deer and droves of hogs'. Settlements were widely scattered and villages did not occur until the 13th-14th centuries. Though it was notoriously inaccessible in the past, today the Weald is easily accessible from London by means of the M20, M25 and M26 motorways to the north and the M23 to the west. Only six Wealden towns - Crowbrough, East Grinstead, Lewes, Oxted, Sevenoaks and Uckfield – also feature on DEFRA's list of LMTs, so these six have been selected for comparison (Figure 2b). The distinctive features of each town have been colour coded in the same way as before.

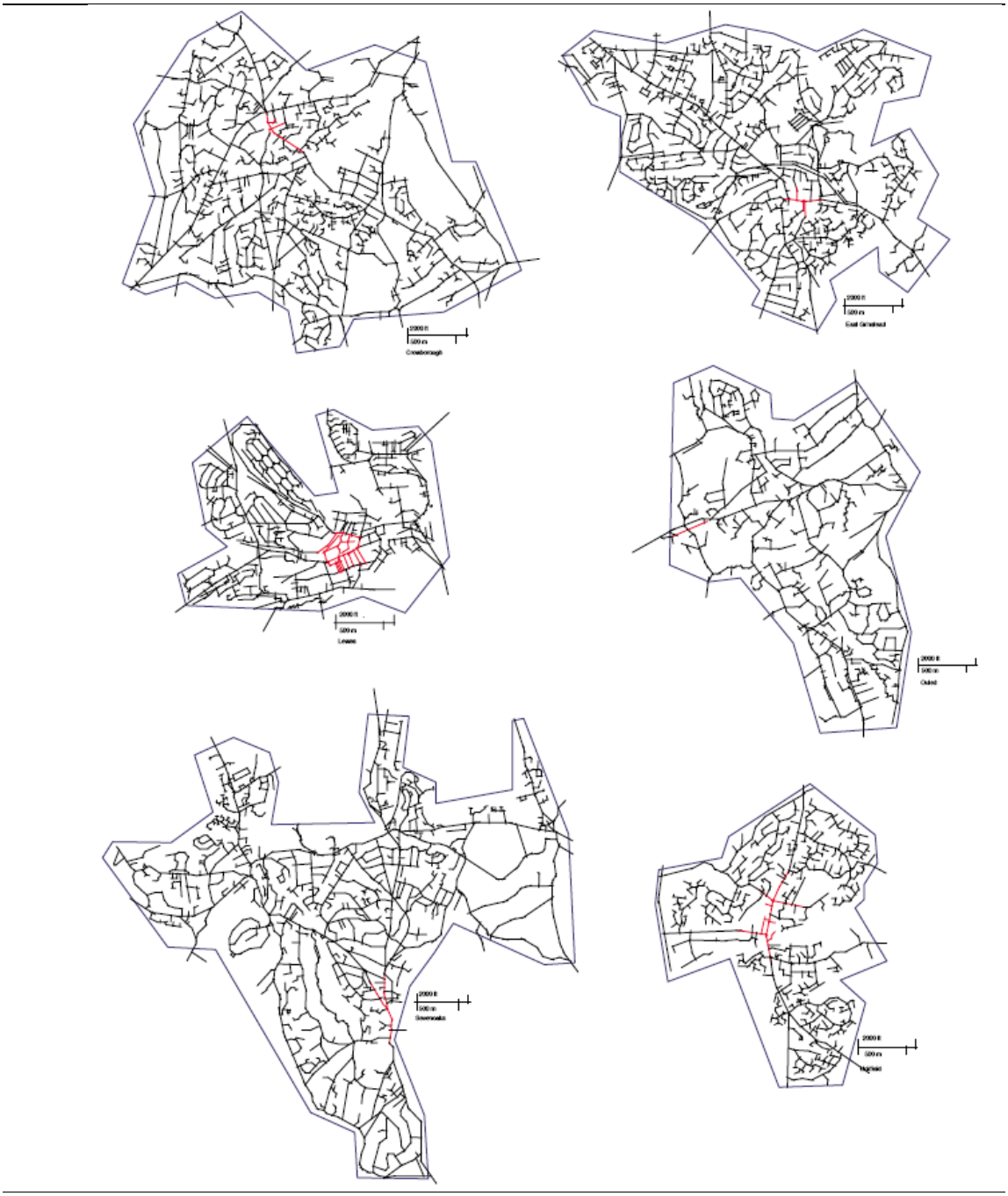


Figure 2b
Axial maps of six Wealden towns

Data from the UK government's recent town centre statistics project for England and Wales (ODPM, 2002) have been used as a proxy for the 'health' (or otherwise) of each town. This project gathered information for 1079 areas of town centre activity (ATCA), defined as places where there are concentrations of the types of activity and patterns of property ownership usually associated with town centres, under three main headings:

- the number of people employed in commercial offices, public services, convenience, comparison and service retail trading, the arts, culture and entertainment industries and in restaurant and licensed premises,
- the amount of retail and office floorspace in square metres, and
- the rateable value derived from retail and office premises in pounds sterling.

Employment data were provided by the Office of National Statistics, floorspace data by the Valuation Office Agency of the Inland Revenue and detailed information on rateable values was provided by the Local Authorities.

Morphological research on samples of towns is only feasible if it can draw on resources that are readily available. Up-to-date maps of the twelve LMTs selected for study were sourced from Google Maps UK, an open access Internet resource. Google Maps can be interrogated interactively at a variety of resolutions. For the purposes of this study, larger and physically more extensive towns were mapped at a resolution of 500 m (2000 ft) and smaller, more compact towns were mapped at a resolution of 200m (1000 ft.), in both cases switching at will between map, satellite and terrain representations and zooming in as necessary to determine the precise alignment of roads and to differentiate between streets of different widths. The axial map was terminated at the extent of the built up area of each town. The process of translating the images found on Google Map into an axial map proved simple, required minimal computer and graphic skills and each map took only two to three hours to create.

Configurational analysis was initially undertaken using Axman software (Dalton, 1997). Measures generated by the software included global (r=n) and local (r=3) integration, together with depth, connectivity and control values. Subsequently, angular segment analysis was carried out (Turner, 2007), using Depthmap software (Turner, 2001), and segment length weighted integration was calculated to facilitate a comparison with configurational analysis of the towns at a regional scale, embedded in the southeast regional map. Measures generated by this technique included angular integration and choice values for each line segment. Integration measures the geometric relative closeness of a network, whereas the choice measure captures geometric path overlap and the amount of flow through a network.

The existence of the Greater South East axial map, alluded to earlier, was an important stimulus for the study, as it enabled the relative accessibility of individual towns to be determined spatially and syntactically within a regional context. The influence of any individual market town could be explored and quantified in respect of its rural hinterland of villages and hamlets, as could the relative 'pull' of any competitor towns in the vicinity that were of a roughly equivalent size and provided a similar range of services, and the relative spatial 'attraction' of any large urban centres within the region could also be determined, without having to make *a priori* assumptions about the physical extent of and boundaries to each town's catchment area.

The South East regional map, which comprised some 2.4 million axial lines, was created in a rather different manner by Space Syntax Ltd., on the basis of the 'integrated transport network' recorded in the digitized (GIS) Ordnance Survey. This data enabled the road centre lines of all 'adopted' streets; that is, streets which are the responsibility of the local highways authority and are maintained by the public purse, to be accurately plotted and configured as a line map that represented the region's vehicular road network. The practical benefit of the approach was that it permitted large regions to be mapped in a reasonable period of time. However, an important limitation was that some pedestrianised areas in towns were not included. The map was therefore checked for accuracy, using Google maps, and amended accordingly before it was processed. The sheer size of the map necessitated parallel computing, using angular segment analysis software. Measures generated included road segment length, which enabled the physical size and extent of regions to be identified as driven or walked, rather than 'as the crow flies', and integration and choice for each segment with respect to a hinterland of 5, 10 and 50 km.

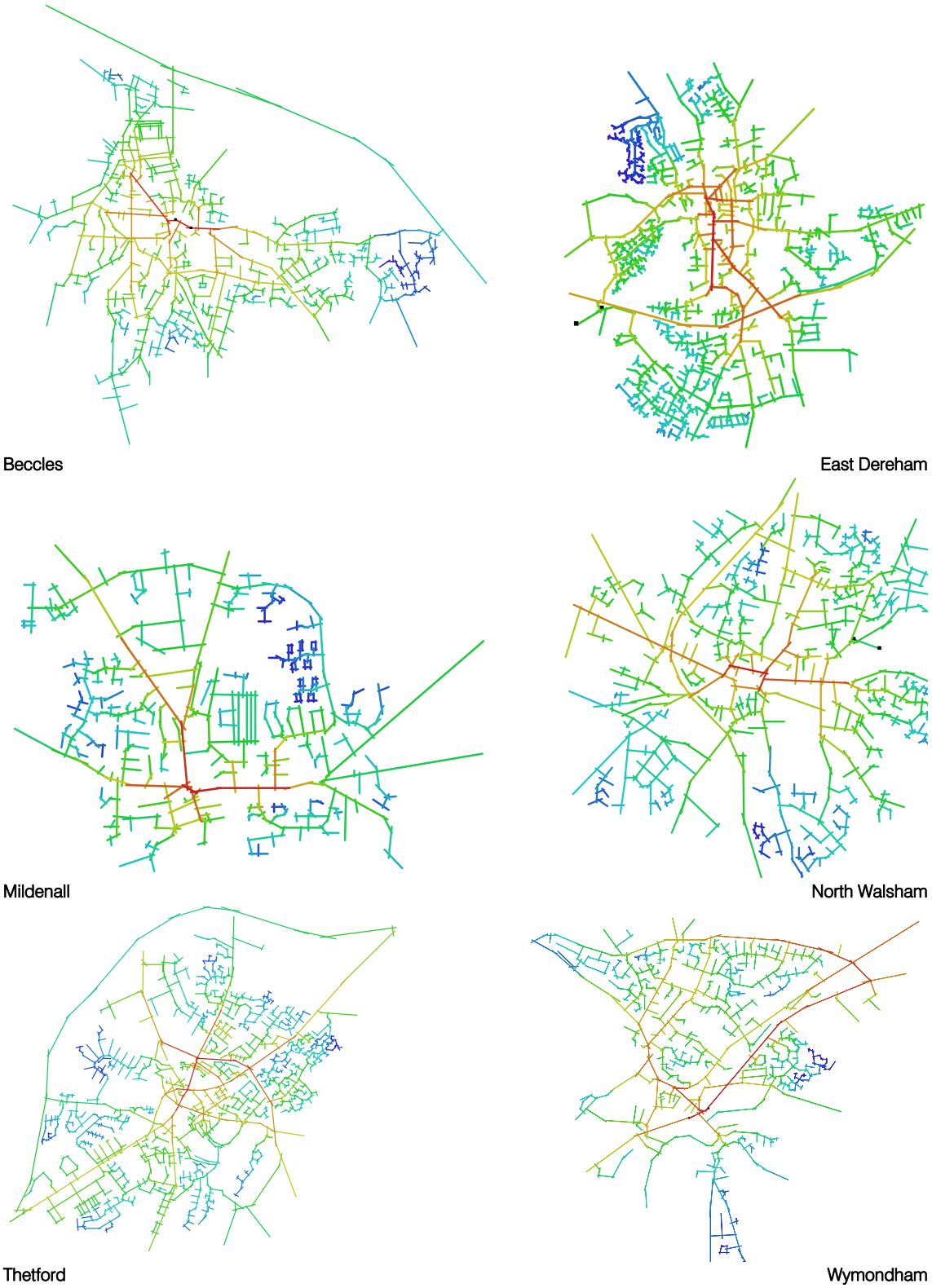


Figure 3a
Global axial line integration maps of six Breckland towns.

A visual inspection of the axial maps of the built up area of each town depicted in Figures 2a and 2b, and of their distributions of global integration shown in Figures 3a and 3b, reveals that the towns' built up areas tend to be very irregular (non-convex). This is largely due to the uneven development of housing estates around the outskirts of the towns. These can be inferred from their small scale, deep, irregular and broken-up layouts and from their relative segregation within the towns' global integration maps. The towns' commercial cores tend not to be located at the

geometric centre, the exceptions being East Dereham and North Walsham in the Brecklands and Lewes and Uckfield in the Weald, but with one or two notable exceptions, most retail cores are fairly well integrated. The location and relative accessibility of each town centre as revealed by its degree of global integration can be understood by reference to the unique history of each town.

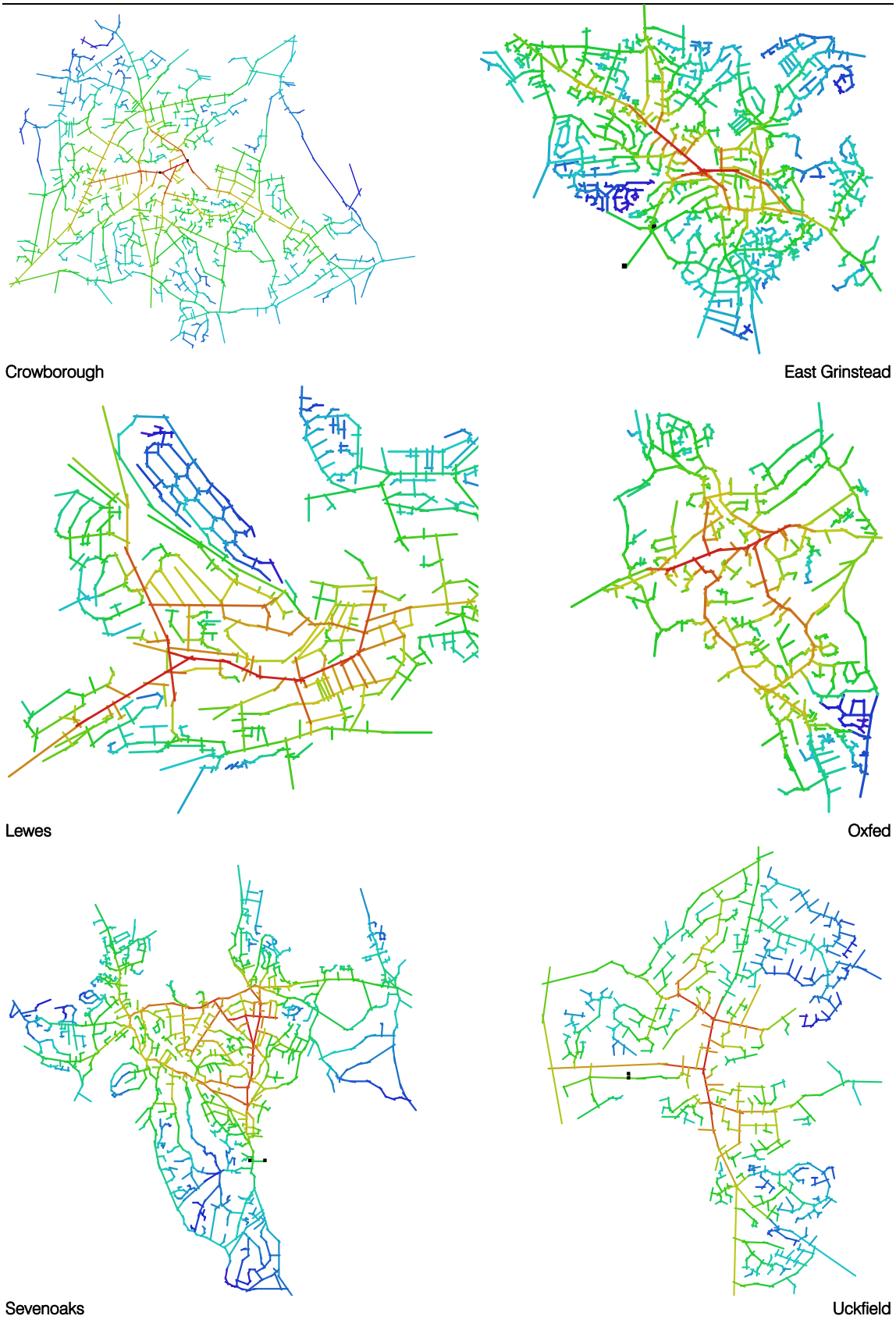


Figure 3b
Global axial line integration maps of six Wealden towns

Beccles for example, was originally a Saxon river port on the River Waveney, sited on elevated ground at the intersection of several long distance routes. Its commercial core is located around the old marketplace in the north of the town, close to the quayside. Development towards the northeast was, however, blocked by railway lines that were built during the 1850s and early 1860s. This promoted some housing and commercial development but the town greatly expanded after WWII when several large, low density residential suburbs were constructed to the south and east of the town centre. Today, integration centres on Blyburgate, which is the approach road to the historic core, rather than on the market place itself. East Dereham, on the other hand, was originally a long street village. The commercial core has remained on the site of the original marketplace, whilst the town has spread out uniformly around it in all directions. The old High Street is still the most integrated street in the town.

Mildenhall's historic core lies at what used to be the centre of the original town, where the A1101 Bury Road crosses the River Lark to connect Mildenhall with Bury St Edmonds, but when a large RAF base was established to the north of the town in 1931 followed by a light industrial estate in 1974, this encouraged residential development to take place in a northerly direction. Integration follows the A1101 and several well-integrated streets intersect at the northern end of Mildenhall's High Street. North Walsham's growth was constrained when the railway was sited immediately to the west of its historic core. The alignment can be traced in the town's road network. Shops in the Market Place still occupy long, narrow plots and are accessed down narrow alleyways known locally as 'lokes'. These, together with the east-west approach roads to the town centre, still form the integration core in North Walsham.

To establish control over the town of Thetford and its hinterland. the Normans sited a castle there shortly after 1066. The retail centre is still located immediately to the west of the castle, but a modern pedestrianised shopping precinct has been added along King Street to the north west of the old marketplace. This is better integrated than the old marketplace, but the most integrated roads are sections of Thetford's inner ring road, which passes to the north of the town centre. The rest of the town expanded dramatically after WWII when modern housing estates and two industrial areas were located between the old centre and the A11 bypass, creating large segregated areas, and there is also a particularly labyrinthine, segregated housing estate on the eastern edge of the town. Wymondham's growth was constrained by the arrival of the railway in 1845 at a station located due south of the old market area, so that the modern town has grown mainly in a northerly direction. Here also, the most integrated roads run along sections of the town's dual carriageway, particularly where this meets the southern edge of the modern retail core. The old marketplace is moderately well integrated.

Crowborough is one of two examples in the sample not to have begun life as a historic market town. Until 1905, it was a tiny hamlet within the neighbouring parish of Rotherfield, but the settlement expanded rapidly after the arrival of the railway in 1868 at Jarvis Brook to the south east of the town, as a consequence of Crowborough's growing reputation as a health resort. After World War II, large housing developments consolidated the surrounding Victorian hamlets into the enlarged, modern town of Crowborough. Its modern High Street is located where the road that leads from the station to the old settlement of Rotherfield, intersects with the A26. This road is also the most integrated in the town. East Grinstead is located on high ground on the London to Lewes road, now the A22, which still passes through the centre of the town. Its High Street is reputed to contain the longest continuous run of 14th-century timber-framed buildings in England. The London Road and parts of the inner ring road are most integrated, while the High Street is moderately well integrated.

Lewes is sited at an ancient river crossing point at a gap in the South Downs. The town began as a Saxon burgh on the western bank of the then navigable River Ouse. After the Norman Conquest Lewes Castle was built to the north of the High Street, to strengthen the town's perimeter. Traces of the mediaeval street grid remain to this day in the town's retail core to the south and east of the castle, and these are moderately well integrated, but the urban grid is dominated by several large, modern and highly segregated housing estates that have been built on the Downs overlooking the town centre. The main Western Road / Brighton Road that extends from the retail centre towards

the southwest is the most integrated. Oxted is located at the foot of the North Downs, on the A25 about 20 miles south of London. The oldest houses in what used to be a village but has now become a town date from the 16th century. Like Crowborough, Oxted expanded after the arrival of the railway in 1884, and amalgamated with the nearby settlement of Hurst Green to the south. Its old High Street used to be on the A25, but it has been bypassed and is now on the edge of the built up area. The A25 itself remains the most integrated road of all, but the two roads linking Oxted village with Hurst Green are also well integrated.

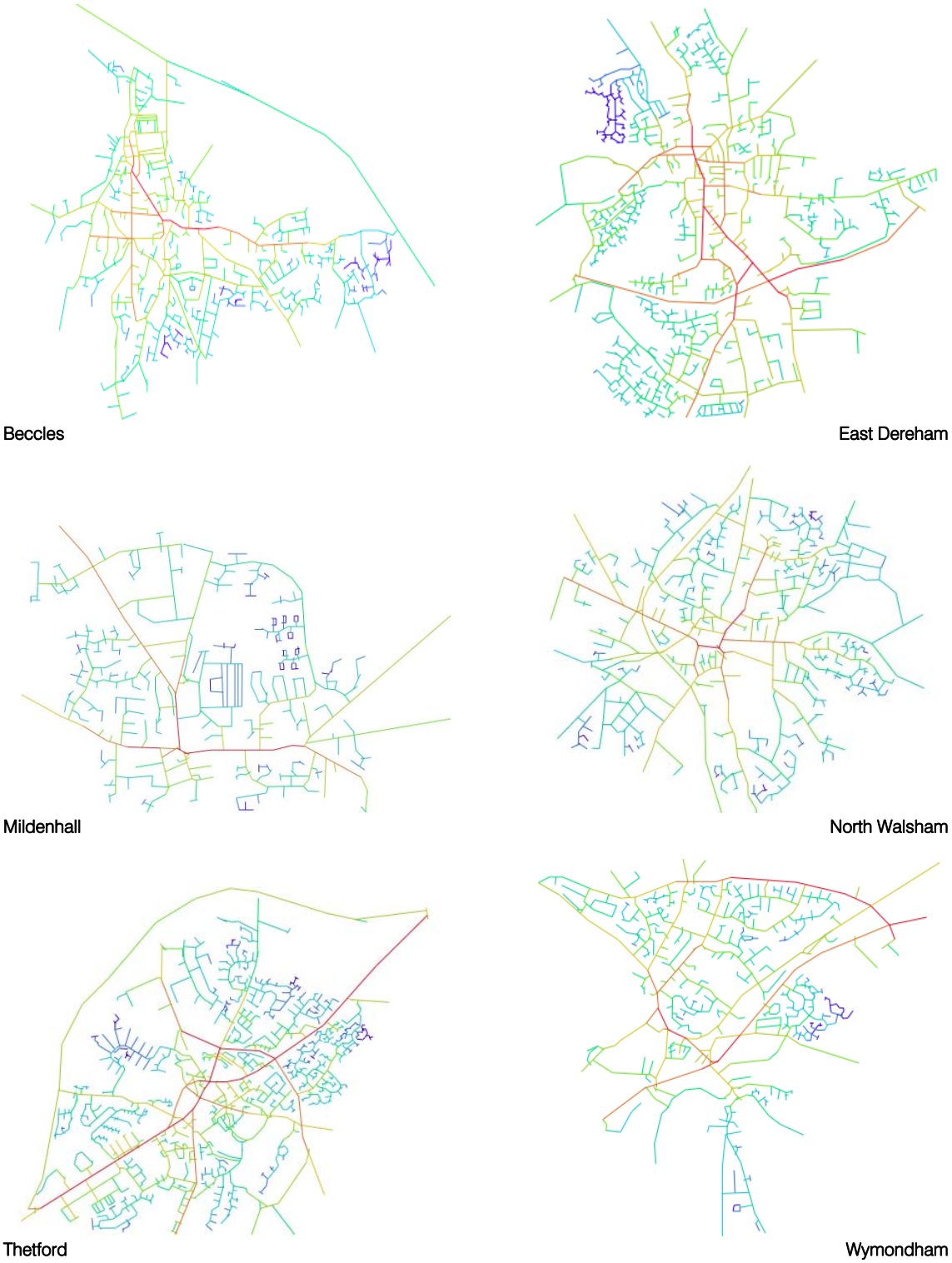


Figure 4a

Global line segment integration for the six Breckland towns

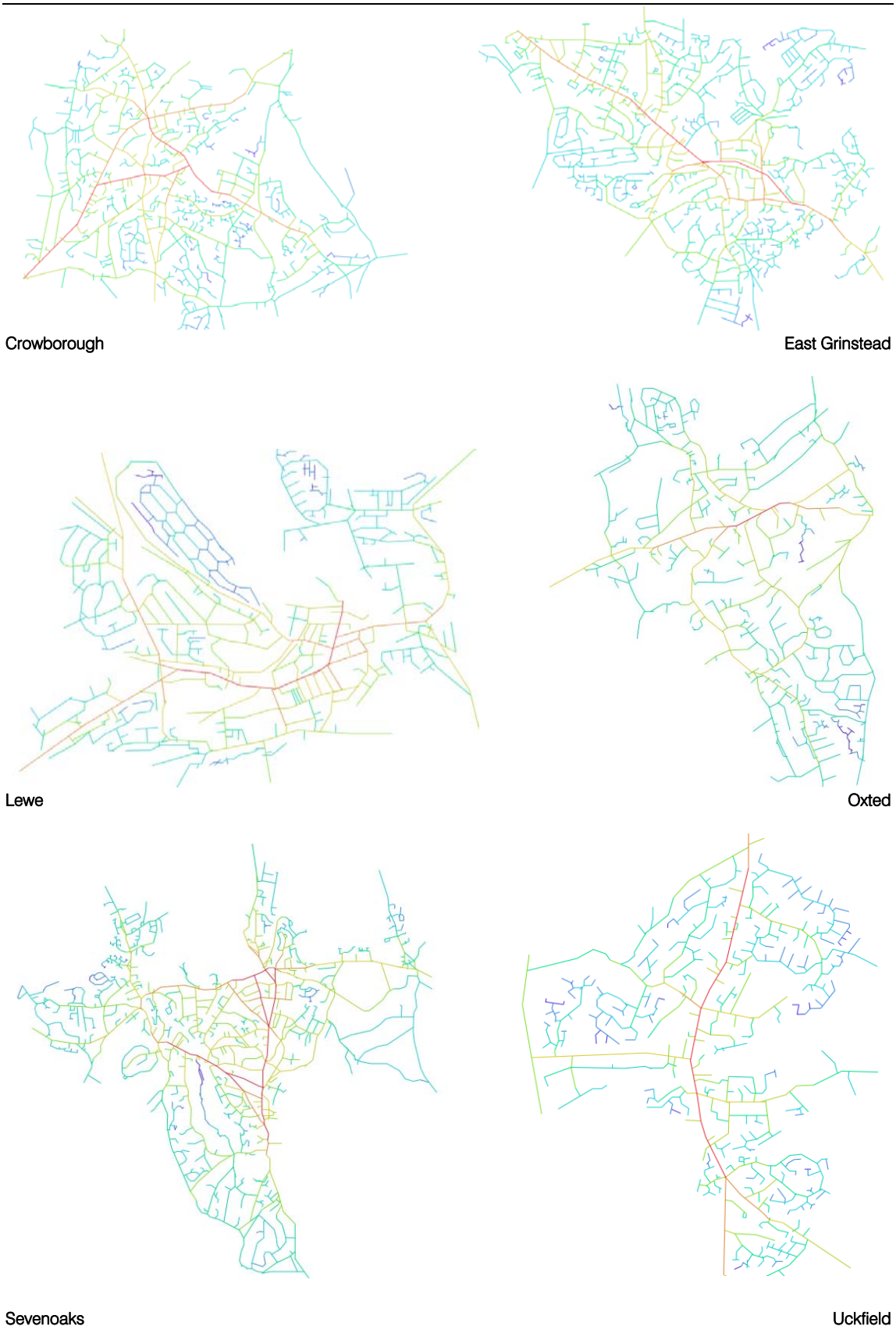


Figure 4b
Global line segment integration for the six Wealden towns

There is no mention of Sevenoaks in the historical records before the 13th century, so it is thought that the town was probably founded at about that time, where two main roads leading from

London to the south coast intersected with the east-west Guildford to Maidstone road, now the A25, to the north of the High Street. This provided a suitable location for a market and the alignments of the old roads are still visible in the modern retail core. The coming of the railway in 1862 opened up the town to London commuters, but whilst the railway increased the town's accessibility it cut off the western suburb from the town centre. To the east of the High Street, the extensive grounds of Knole House prevented growth. Though the old High Street is still well integrated, the most integrated sections of this road are further north, towards the A25. Records suggest that Uckfield has been in existence since at least the 12th century. Its population was recorded in 1811 as only 916, but after the railway arrived in 1868, increasing the town's accessibility, the population gradually increased. However, the railway line cut off the old town from its southern suburbs of New Town and Ridgewood, and the two parts are joined only by the High Street, which is also the most integrated street in the settlement.

Global angular segment analysis of the six Breckland towns as discrete physical entities, shown in Figure 4a, and of the six Wealden towns, shown in Figure 4b, shows a broadly similar distribution of the high value angular integration line segments to the global axial line integration values shown earlier in Figures 2b and 3b, except that, with respect to several of the towns, this representation highlights a more extensive, well-integrated network of main roads. However, the mean values for both global and local axial integration and angular integration are unrelated to one another (r^2 = .069 and .012 respectively), implying that the rank order is completely different in each case. Sevenoaks, for example, has the highest mean segment integration but is the second least integrated in terms of mean axial integration. Conversely, Mildenhall has the highest mean axial integration and the lowest mean segment integration. Oxted is 12th in terms of mean axial and 11th in terms of mean segment integration; Crowborough is second in the rank order of mean integration values, whether considered by axial line or by segment. The rest vary by a few places.

Town	Area Ha	Axial lines	Dead ends	Mean depth	Mean Rn	Mean R3	Intell	Syn	Mean seg int	Mean segchoi
Beccles	500	579	147	11.079	0.567	1.459	0.1534	0.2393	171.696	28982.7
Dereham	843	803	214	15.113	0.501	1.398	0.0886	0.1412	192.763	50573.8
Mildenhall	284	398	90	10.412	0.606	1.403	0.1919	0.2698	132.236	14495.0
Thetford	989	1058	228	14.161	0.522	1.436	0.1231	0.1594	265.078	60277.6
Walsham	467	538	134	13.823	0.564	1.390	0.1393	0.2172	166.850	25133.5
Wymondham	532	545	125	13.732	0.561	1.454	0.1723	0.2189	174.053	22394.7
Mean Breck	*603*	*654*	*156*	*13.053*	*0.554*	*1.423*	*0.1448*	*0.2076*	*183.780*	*33642.9*
Crowborough	946	912	239	25.905	0.572	1.396	0.1096	0.1884	285.124	51110.5
Grinstead	776	951	202	14.165	0.538	1.458	0.1000	0.1406	276.820	53284.3
Lewes	442	573	97	17.087	0.507	1.590	0.0955	0.1494	181.855	33018.0
Oxted	657	577	122	16.454	0.409	1.380	0.0399	0.0578	153.885	28202.6
Sevenoaks	1402	1278	228	20.430	0.413	1.450	0.0923	0.1415	341.666	83803.8
Uckfield	466	581	154	15.227	0.450	1.358	0.0822	0.1045	184.827	30433.4
Mean Weald	*782*	*812*	*174*	*18.211*	*0.482*	*1.439*	*0.0866*	*0.1304*	*237.363*	*46642.1*
Mean Sample	692	733	165	15.632	0.518	1.431	0.1157	0.1690	210.571	40142.5

Table 1
Syntactic data for the 12 market towns

A first impression of the scaled axial maps shown in Figures 2a and 2 bsuggests that Mildenhall in the Brecklands is a comparatively small example, physically, whereas Sevenoaks in the Weald is comparatively large, and this is borne out by the figures (Table 1). Both town clusters contain examples of large, medium and small towns, but the mean area of the built up area of the Wealden towns in this study is 179 ha larger than that of Breckland's towns. The average number of axial lines in the maps is correspondingly larger for the Wealden subset, by 158. The r^2 between area and axial lines is .926 for the whole sample. The difference between the two subsets in terms of dead ends or *culs de sac* is less obvious, though on average Wealden

towns tend to have more, but here too there is a clear relationship between settlement size and the number of dead ends, $r^2 = .744$.

Wealden towns tend to be deeper than Breckland towns on average, but the relationship between size in ha and mean depth is not a strong one, $r^2 = .374$. Conversely, Breckland towns are slightly more integrated, on average, and the smaller in area a town is, the higher its mean global integration is likely to be, but this relationship is not strong either, $r^2 = .209$. There is no significant difference between the two subsets in terms of local integration; it follows that there is no relationship at all between size and local integration. Intelligibility, the correlation between connectivity and integration, is very low for all the towns considered in isolation, and so is synergy, the correlation between local and global integration values.

Town	Cluster	Popu-lation	Retail Ha	Area Ha	% retail	Employ-ment	Emp %pop	Retail floorsp	Office floorsp	Retail/ Office	RV retail £	RV office £
Beccles	Breckland	12,917	8.50	500	1.700	860	6.658	15560	2090	7.4:1	852250	107750
Dereham	Breckland	17,799	13.75	843	1.631	1140	6.405	24940	7220	3.5:1	1687920	305190
Mildenhall	Breckland	12,151	5.50	284	1.937	340	2.798	12520	2670	4.7:1	739130	117930
Thetford	Breckland	21,760	11.25	989	1.138	910	4.182	18740	4210	4.5:1	1592030	209120
Walsham	Breckland	11,845	7.50	467	1.606	610	5.150	14100	2280	6.2:1	864750	99190
Wymondham	Breckland	11,420	4.75	532	0.893	390	3.415	7840	640	12.3:1	542470	33710
Mean	*Breckland*	*14,649*	*8.542*	*603*	*1.484*	*708*	*4.768*	*15,617*	*3,185*	*4.9:1*	*1,046,425*	*145,482*
Crowborough	Weald	20,281	9.75	946	1.031	820	4.043	15000	5340	2.8:1	1452400	358580
Grinstead	Weald	26,222	32.25	776	4.156	3850	14.682	38370	39430	0.97:1	3764430	3207630
Lewes	Weald	15,988	28.50	442	6.448	3000	18.764	32410	34640	0.94:1	2793870	1906250
Oxted	Weald	12,576	12.25	657	1.865	910	7.236	15290	7650	2.0:1	1189630	918400
Sevenoaks	Weald	26,699	23.00	1402	1.641	3640	13.633	36940	30060	1.2:1	4486730	3538610
Uckfield	Weald	15,374	14.75	466	3.165	1050	6.830	23910	8330	2.9:1	2337630	558900
Mean	*Weald*	*19,523*	*20.083*	*782*	*3.051*	*2,212*	*10.865*	*26,987*	*20,908*	*1.3:1*	*2,670,782*	*10488370*
Mean	Sample	17086	14.33	692	2.071	1460	7.816	21302	12047	1.8:1	1858603	946771

Table 2

Socioeconomic data for the 12 market towns

Breckland towns are, on average, also smaller in terms of their population (by about 5,000) than are Wealden towns. This also relates directly to their size, in that the smaller a town's area the smaller its population is likely to be, and vice versa, $r^2 = .675$. The difference between the extent of the retail cores of Breckland and Wealden towns tends to be much greater, though; the retail cores of Wealden towns are larger by a factor of about 2.5, on average. The size of the retail core as a percentage of the built up area varies from less than 1% in Wymondham to as much as 6% in Lewes.

Employment totals are correspondingly 3 times greater, on average, in Wealden towns. The relation between the size of a town's resident population and the size of its employed population is positive and direct, $r^2 = .756$, though it cannot be assumed that the latter is a subset of the former because of patterns of commuting. Nevertheless, the percentage of people employed in the town centre relative to its resident population varies from under 3% in Mildenhall to as much as 18% in Lewes.

The average amount of retail floorspace in the two subsets follows the same, by now established, pattern in that the Wealden towns have, on average, approaching twice as much retail floorspace as Breckland ones. The smallest amount is in Wymondham, that has just under 8,000 sq.m. of retail and the largest is in East Grinstead, that has just over 38,000 sq.m. This is only weakly associated with the physical size of the town and its resident population ($r^2 = .215$ and .594 respectively) but unsurprisingly it is strongly associated with the size of the retail core and the numbers employed there ($r^2 = .899$ and .900 respectively).

The amount of office space is dramatically different between the two regions, with the Wealden towns offering nearly seven times as much. As with retail, this is even more weakly associated with the physical size of the town and its resident population (r^2 = .102 and .445 respectively) and it is even more strongly associated with the size of the town centre and the numbers employed there (r^2 = .954 and .955 respectively). At the extremes, Wymondham has only 640 sq.m. of office accommodation, whereas East Grinstead has over 39,000 sq.m. The ratio of retail space to office space varies from as much as 12.3:1 in Wymondham to as little as 0.94:1 in Lewes, which, along with East Grinstead, actually offers more office space than retail. These Wealden towns can perhaps be considered as 'business towns' as well as 'shopping towns' (Bracey, 1956).

Business rates are the way in which local businesses contribute towards the cost of local authority services. Clearly, the amount of retail and office floorspace available relates directly to the income the towns are able to generate from the rateable value of commercial properties. Wealden towns on average, generate over twice as much rateable value from retail space and twelve times as much from office space as their Breckland counterparts. Clearly, the greater the floorspace a town has, the greater its income will be from these sources is (r^2 = .915 and .870 respectively). In the Brecklands, only Thetford and East Dereham derive more than £1m *per annum* from retail rates, and Wymondham derives just over half a million. The least prosperous Wealden town, Oxted, derives over £1m and the most prosperous town in this sense, Sevenoaks, derives nearly £4.5m from the total rateable value of its retail outlets. East Dereham gains just over £300,000 from the rateable value of its offices, nearly ten times more than Wymondham, but this is about the same as the lowest total office rateable value reported from the Wealden towns, at Crowborough, and this is dwarfed by Sevenoaks' income from office rateable value of over £3.5m. These findings establish that whatever their size the towns in the more 'accessible' Wealden cluster are 'healthier'; that is, more commercially active and more prosperous than their more 'remote' Breckland counterparts.

An exploration of syntactic data for the towns considered in isolation, that is, in respect of the axial map that extended to the edge of the built up area of each town show that, for this sample, a town's relative prosperity, as measured by either its size, or the size of its retail core, its residential population, the numbers of people employed in the town centre, the amount of retail and office floorspace or the income derived from retail or office rates, is not at all related to its relative accessibility as measured by any of the syntactic attributes of axial lines such as mean depth, mean local and global integration, intelligibility or synergy, and this statement applies equally to the whole sample and to each cluster of towns considered separately.

However, the relationship between a town's relative prosperity and its mean segment integration and mean segment choice, considered on the basis of the same axial map, is a little more promising. For the sample of all twelve settlements, a town's physical size and its population both relate positively to its mean segment integration, with an r^2 = .814 and .872 respectively, and to its mean segment choice, with an r^2 = .922 and .921 respectively. The relationship between a town's total retail rateable value and mean segment integration is r^2 = .523 and r^2 = .550 for mean choice. The relationship with employment, retail and office floorspace and rateable value derived from offices are weaker but positive, when the towns are considered as discrete settlements.

Considered at the street segment level, Breckland towns are on average about three-quarters as integrated (78%) and have about three-quarters as much choice (72%) as Wealden towns, reversing the situation previously reported in respect of global axial integration. Moreover, the relationships between all eight prosperity indices considered and mean segment choice are stronger in respect of the Breckland subset[1] than for the whole sample, but weaker in the case of the Wealden subset. This could be interpreted as implying that with respect to configurational accessibility Breckland towns behave more like independent settlements than the Wealden towns.

Market towns embedded in their regions

One striking feature of the analysed Greater South East Map (GSE map, Figure 5) is that, irrespective of whether integration is considered at 5, 10 or 15 km, the pull of London is so extraordinary that visually, in terms of the red to blue colour spectrum that reflects the distribution

of integration, London is revealed as a 'hot spot' whilst rest of the map, including large cities like Norwich in remote East Anglia, is depicted in various shades of blue. Choice shows a less extreme contrast between London and the rest of the region, so that larger towns and cities and main routes can be identified as concentrations of activity, but the coverage of the map is so large that the detail is impossible to read. Nevertheless, even at this scale integration, especially at 50 km, reveals shades of turquoise blue in the Weald and of indigo in rural East Anglia, supporting the earlier suggestion that the former is generally more 'accessible' while the latter is more 'remote'.

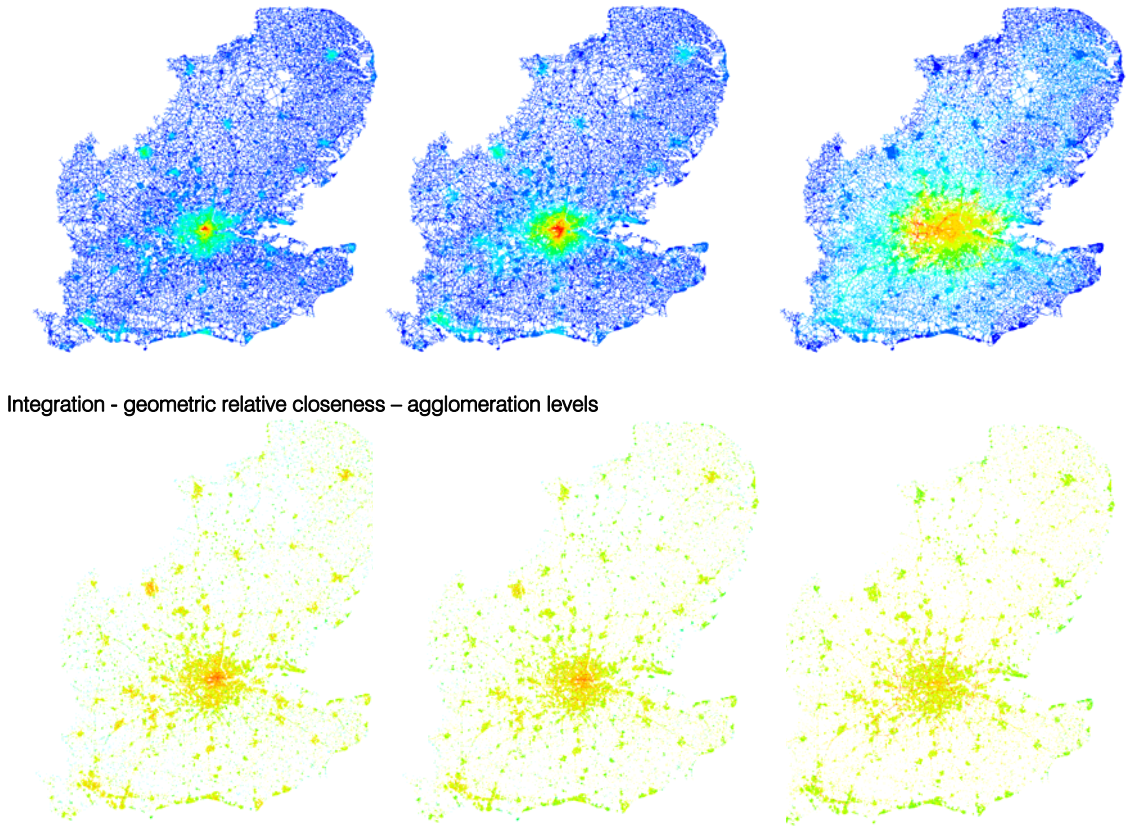
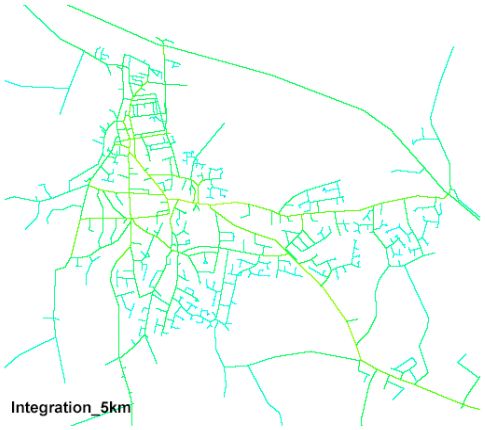


Figure 5
Analysed axial map of the greater southeast region of England, courtesy of Space Syntax Limited, showing integration and choice at 5, 10 and 50 km radii.

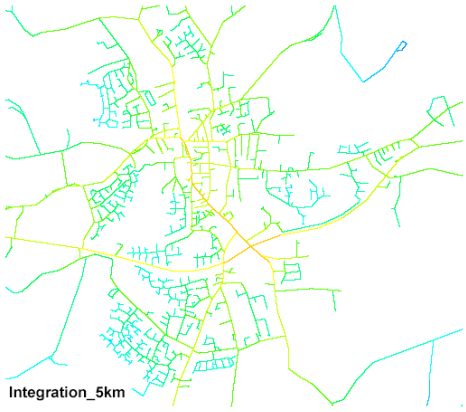
Figure 6a therefore shows extracts from the GSE map that correspond to the six Breckland towns and Figure 6b shows the comparable set of Wealden towns, where the integration of each segment has been calculated with respect to surroundings of 5 km. All the maps in each subset have been set to the same bounds, allowing the colours to be directly compared. The built up area of each town is outlined in red so that, although the extracts cut from the GSE map are a little larger than and extend beyond the built up areas shown previously, the distributions of integration can be compared visually with Figures 3 and 4 inclusive. Arguably, in this representation the integration of a segment provides a reasonable proxy for its relative accessibility with respect to a surrounding region of 5 km.

What is striking about these maps, especially in respect of the Breckland set and to a lesser extent of the Wealden set, is that a great deal of the spatial differentiation shown in the earlier maps has disappeared. So far as Breckland towns are concerned, some sections of major roads are picked out in yellow - that is, they are moderately well integrated - in East Dereham and Thetford, but for the most part the maps are fairly homogeneous. Mildenhall is relatively segregated and has a

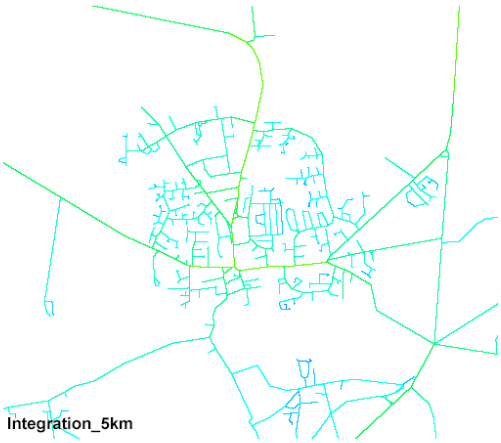
greater proportion of blue than the rest of the towns from this region. The comparable maps for the Wealden towns reveal that several towns - Crowborough, Lewes, Oxted and Uckfield - are predominantly green and blue; that is fairly uniformly segregated. East Grinstead and Sevenoaks, however, exhibit a greater degree of internal differentiation that more closely mirrors the axial and segment integration cores shown in Figures 3b and 4b respectively.



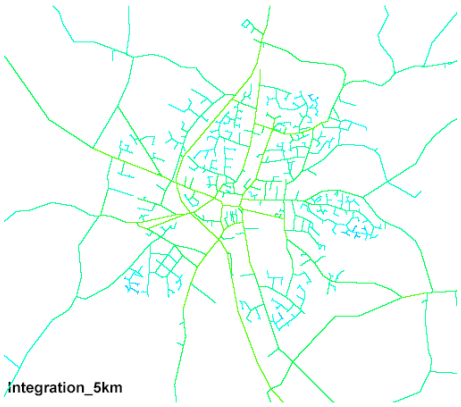
Beccles



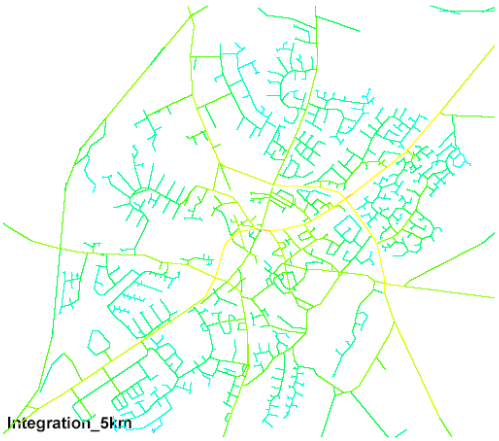
East Dereham



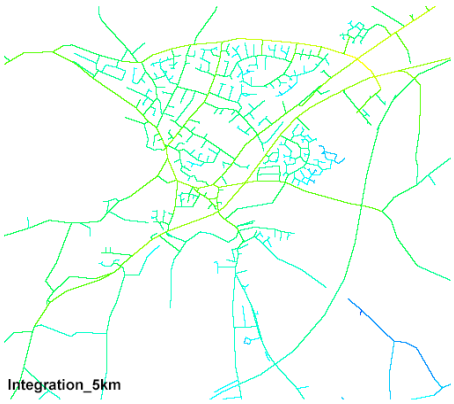
Mildenhal



North Walsham



Thetford



Wyndonham

Figure 6a

Regional integration for the Breckland towns at 5 km.

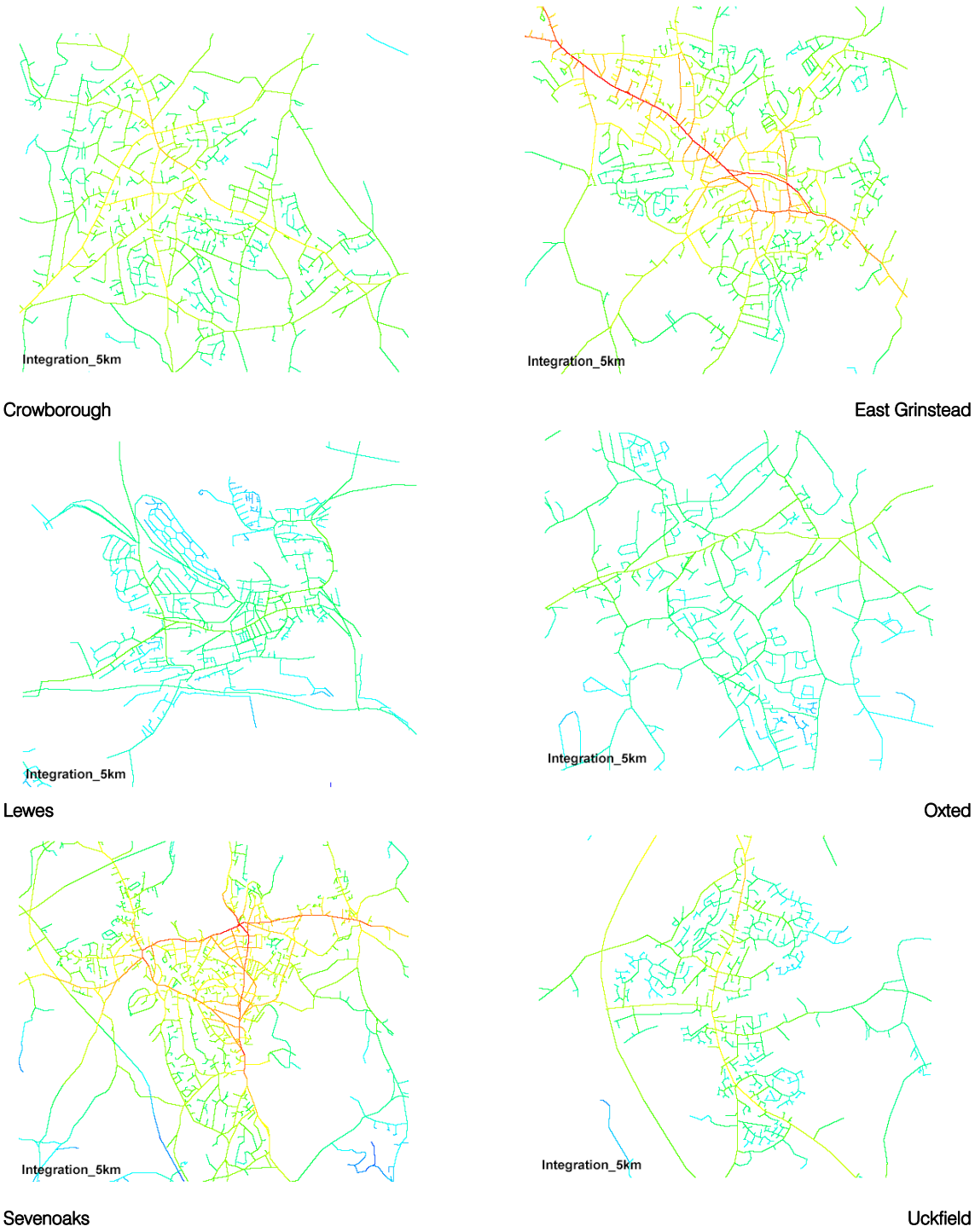
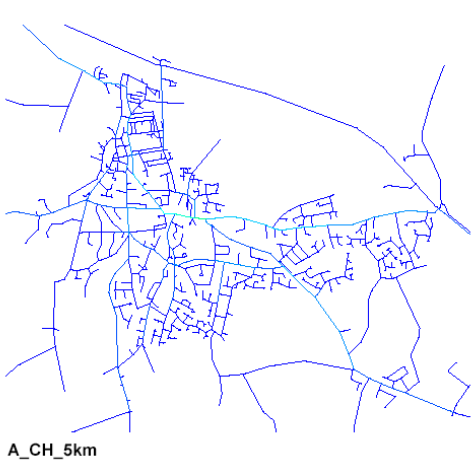


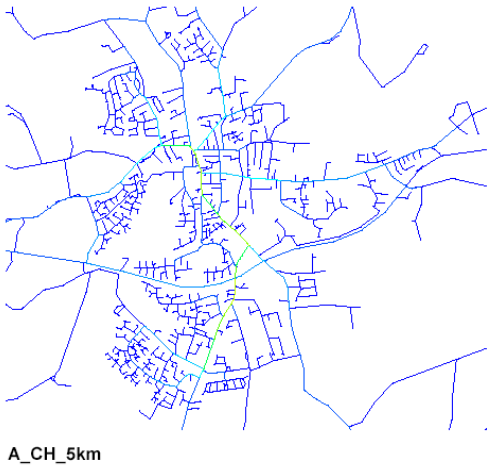
Figure 6b

Regional integration for the Wealden towns at 5 km.

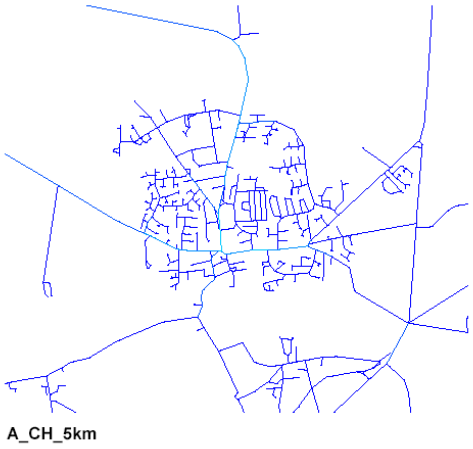
According to Turner (2007), choice computes the shortest path routes for all possible pairs of origins and destinations in the urban system under consideration, so that the most frequently used segments on all routes take up high values whilst those segments that fall on fewer paths take up low values. In this sense, Turner suggests, choice *'seems to be a more intuitive model for movement* (or more accurately, perhaps, movement potential – author's note) *than the traditional space syntax measure of integration'*. The comparable choice maps for two clusters of towns at 5 km (Figures 7a and b) tell a similar story to integration, but in most towns the core of higher choicer lines is either more concentrated or takes a slightly different alignment from the set of most integrated roads



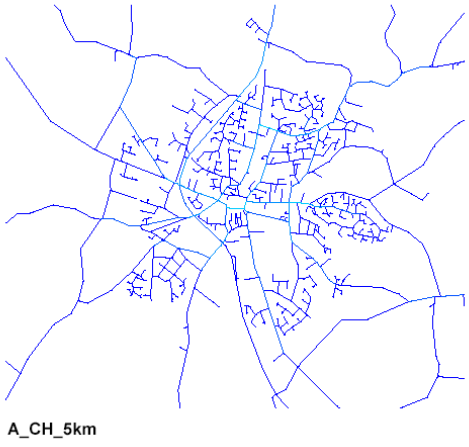
Beccles



East Derham

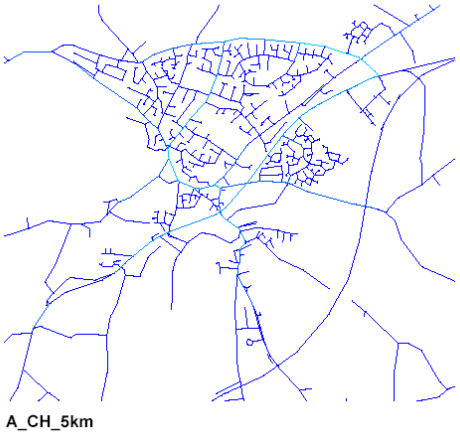


Mildenhal



North Walsham

Thetford



Wyndonham

Figure 7a

Regional unlogged choice for the Breckland towns at 5 km.

Crowburough East Grinstead

Lewes Oxted

Sevenoaks Uckfield

Figure 7b

Regional unlogged choice for the Wealden towns at 5 km.

Appearances may be deceptive, so an investigation was undertaken of numerical data generated from the GSE map, please refer to Table 3. Average segment length, mean choice, mean log choice and mean integration values at 5 and 10 km were produced for the built up area of each town and for each town centre and compared to both the syntactic data for the towns considered in isolation and with the eight previously arrived at indices for prosperity, including the size of the resident population,

the built up area of the town, the size of its retail core, the total numbers in employment, the amount of retail and office space and the total rateable value income from retail and office premises. All twelve towns were considered as a singe dataset, but each sub group was also examined separately as the accessibility of each cluster is markedly different (as the means for each variable reveal). The task was a complex one, involving many hundreds of variables, and the measures were unsophisticated, based on simple mean values for the main syntactic variables under consideration.

	Average segment length	mean choice 10	mean choice 5	log choice 10	log choice 5	int 10	int 5
Beccles	61.0651	110288.86	36336.61	7.43649	6.81316	353.167	214.653
Dereham	63.9652	185905.94	60915.32	7.27912	6.73462	433.174	246.910
Mildenhall	57.2125	91619.73	24617.68	6.96322	6.34205	326.395	175.710
Thetford	60.8240	78709.98	42794.63	6.96970	6.65256	343.937	230.110
Walsham	59.5359	102023.26	32829.79	7.11933	6.52935	360.248	199.660
Wymondham	67.9062	148435.24	36108.08	7.76963	6.98264	430.113	216.094
Mean	*61.751*	*119497.168*	*38933.685*	*7.256*	*6.676*	*374.506*	*213.856*
Crowborough	75.4044	154651.65	44372.62	7.56912	6.92774	420.304	269.368
Grinstead	62.8763	324253.27	75775.01	7.78648	7.13132	533.851	313.739
Lewes	67.1969	141997.44	41976.55	7.81460	7.16947	349.146	199.733
Oxted	80.0668	167605.49	35275.54	8.02389	7.12044	442.756	205.879
Sevenoaks	75.1016	322306.88	76851.33	8.40713	7.66148	591.929	337.160
Uckfield	57.0072	124693.82	46057.86	6.86915	6.33019	389.719	229.940
Mean	*69.609*	*205918.092*	*53384.818*	*7.745*	*7.057*	*454.618*	*259.303*
Mean	65.680	162707.63	46159.252	7.501	6.866	414.562	236.580

Table 3.
Syntactic data for the 12 towns extracted from the GSE map

Most of the comparisons between variables are meaningless, but a small number of intriguing results can be identified from a simple regression analysis of the data. Considering first the relationship among syntactic measures, for the sample of 12 towns, there is no meaningful relationship between mean global (radius = n) axial integration of the built up area of each town analysed separately and mean segment integration of each town in the GSE map at either 5 or 10 km. There is no meaningful relationship between mean segment integration of the built up area of each town analysed separately and mean segment integration of each town in the GSE map at 10 km. However, at 5 km, there is a relationship (r^2 =.824).

The relationship between mean segment choice for the built up area of each town analysed separately and mean segment choice for each town in the GSE map is weak at 10 km but stronger at 5 km (r^2 =.686). There is no relationship between mean segment choice for the built up area of each town analysed separately and mean log choice for each town in the GSE map at either 5 or 10 km. Mean choice and mean log choice for the 12 towns in the GSE map at 5 and 10 km are only weakly associated, but mean choice and mean integration at 10 km are strongly associated (r^2 = .912) and only a little less so at 5 km (r^2 = .868).

With respect to the relationship between 'syntactic' measures and 'prosperity' indices for all 12 towns embedded in the GSE map, there is a weak, positive relationship between the total income from retail rateable value and mean choice at 5 km (r^2 = .762), 10 km (r^2 = .670) and integration at 5 km (r^2 =.644) and also between the total income derived from office rateable value and mean choice at 10 km (r^2 = .790), 5 km (r^2 =.649) and integration at 10 km (r^2 =.616). There is also a relationship between mean choice at 5 km and the total amount of retail floorspace (but not office floorspace) a town has (r^2 = .723). The size of a town's resident population is positively associated with mean integration and mean choice at 5 km (r^2 =.818 and .770 respectively), but this is to be expected as

these spatial variables are also associated with one another. The higher a town's mean choice at 10 km and 5 km, the larger a town's employed population is likely to be (r^2 = .685 and .661). Finally, the larger a town is in hectares, the higher its mean integration is likely to be at 5 km (r^2 =.691).

Considered separately, Breckland towns show a consistent and strong relationship between mean choice at 5 km and all of the 'prosperity' indices. The best association is with the amount of retail floorspace (r^2 = .772); the worst is with total retail rateable value (r^2 = .656), but then Breckland towns are relatively poor in this particular respect. High mean integration at 5 km is also associated with more people in employment, a larger town centre area and a higher amount of retail floorspace and *vice versa* (r^2 = .700, .762 and .641, respectively).

The picture is more mixed for Wealden towns considered separately. Larger towns are associated with higher mean integration values at 5 and 10 km (r^2 =.699 and .698 respectively). Higher populations are associated with higher mean choice at both 5 and 10 km (r^2 = .897 and .790 respectively) and also with higher mean integration at 5 and 10 km (r^2 = .932 and .671 respectively) and vice versa. Total income from retail rateable values (r^2 =..822 and .654), total income from office rateable values (r^2 =.771 and .819) and total numbers in employment (r^2 = .659 and .631) and the total amount of retail floorspace (r^2 = .656 and .519) are all positively associated with mean choice at 5 km and 10 km respectively.

	Average segment length	mean choice 10	mean choice 5	log choice 10	log choice 5	int 10	int 5
Beccles	54.646	266167.190	103330.930	11.322	10.321	456.731	274.667
Dereham	56.318	1141110.870	389846.220	12.977	12.099	576.133	358.876
Mildenhall	51.555	185228.140	57221.790	11.047	10.011	404.325	223.748
Thetford	75.143	551517.300	203494.900	13.146	12.200	483.795	285.808
Walsham	49.480	75869.370	51906.540	10.269	9.899	419.467	285.666
Wymondham	77.720	318676.670	102756.400	11.904	10.798	523.880	288.999
Mean	*60.890*	*423094.923*	*151426.130*	*11.778*	*10.888*	*477.389*	*286.294*
Crowborough	87.526	864179.360	317852.550	12.982	12.037	537.962	388.800
Grinstead	75.541	861192.250	245301.000	12.668	11.578	673.733	446.560
Lewes	56.580	284329.220	99982.690	10.339	9.483	400.547	246.689
Oxted	70.582	28434.170	9287.330	8.702	7.809	558.982	259.351
Sevenoaks	80.591	1582251.690	370585.060	14.192	12.740	703.165	454.402
Uckfield	62.972	734676.940	304088.820	11.560	10.820	516.673	345.543
Mean	*72.299*	*725843.938*	*224516.242*	*11.741*	*10.744*	*565.177*	*356.891*
Mean	66.554	574469.431	134057.635	11.759	10.816	521.283	321.592

Table 4
Syntactic data for the 12 town centres extracted from the GSE map

If data are extracted from the GSE map just for the lines that make up the town centres, (please refer to Table 4) very little survives apart from the disparity in just about all of the mean figures between the two subgroups. For the set of 12 towns, it can be said that the larger the population and the greater its area, the higher the mean choice at 10 km (r^2 =.675 and .651 respectively) and the more integrated the town centre is likely to be at 5 km (r^2 =.692). Average choice for the whole town and the town centre at 10 km and 5 km are only weakly associated (r^2 =.483 and .579 respectively), and log choice not at all. However mean integration for the whole town and the town centre at 10 km and 5 km respectively are strongly associated (r^2 =.919 and .934 respectively).

However, in respect of the Breckland sub set, the 'prosperity' indices that were previously noted are even better associated than before with mean choice for the town centre lines at 5km, including the total amount of office floorspace available (r^2 =.817), the total office rate income (r^2 = .810), the size

of the retail core (r^2 =.782), the amount of retail floorspace and its total rateable value (r^2 = .734 for both) and the total numbers in employment (r^2 =.669). All these indices are also strongly related to mean choice at 10 km, but in most cases the actual figures are a little lower. The mean log choice for the town centre at 5 km relates well with the overall size of the town, the size of its population and the size of its retail core (r^2 =.903, .811 and .622 respectively).

By contrast, in the Weald all the relationships previously noted in respect of the whole town completely disappear when just the town centre lines are considered. The only relationship that survives is to population, in that the higher the population the higher the mean choice of the town centre at 10 km (r^2 =.720), the log choice of the town centre at 10 km and 5 km, (r^2 =.774 and .712) and its mean integration at 5 km (r^2 =.834).

Discussion

Current software does not permit a statistical comparison of the syntactic values for each street line in the town, derived from the four different modes of analysis undertaken during the course of this study (global axial integration of the discrete settlement, global angular segment analysis of the discrete settlement, angular segment analysis of the whole towns embedded in the GSE map at 5 and 10 km and angular segment analysis of the town centres embedded in the GSE map at 5 and 10 km) but nevertheless it can be stated that, although the red-to-blue colour distributions of the axial maps of the analysed towns derived from different modes of syntactic analysis appear similar to one another, this is not reflected even in the rather crude and simplistic quantitative measure of the mean integration of each town on the basis of the various representations. A combination of visual and numerical analysis is therefore recommended.

Spatial configuration in the towns that were used as a test bed for this particular study tends to be relatively stable and robust, in the sense that when the axial maps were checked and several were subsequently amended to take account of additional pedestrian or vehicular links, the numerical measures tended not to be greatly affected, even in the case of quite a substantial amendment such as reconnecting the two ends of a town centre street that had been pedestrianised in the middle. This suggest that today's public realm in English market towns can absorb a good deal of change without significant alteration to their traditional morphology and functionality. A similar phenomenon was found in an earlier study of the mixed use and residential areas of three large English cities, (Zako and Hanson, 2009).

What is perhaps more surprising is that considered as discrete settlements, the towns are totally unintelligible and lacking in the syntactic property of synergy. Whether or not this was the case historically, and if not what led to change, is an important question for future research. Possible drivers of change include the cumulative impact wrought by innumerable small, incremental adjustments to the urban grid, as well as comprehensive neighbourhood development projects and major improvements to the road network, but the relative impact of these on urban functionality is poorly understood. Fine scale historical reconstruction, coupled to a detailed and theoretically driven reconstruction of the urbanization process in traditional market towns, should lead to a greater understanding about which alterations to the urban grid do not greatly affect their morphology and which have a major impact on overall configuration. Such modeling and simulation should provide the evidence base that will allow policymakers to link past planning decisions to current dilemmas and future proposals.

Findings that indicate a relationship between spatial configuration and 'town health' for the sample of twelve towns and for the Breckland and Weald subsets are summarized below in Table 5.

Mean global integration and mean segment choice are both related to important indicators of prosperity for the market towns in this study, considered as discrete settlements, with choice – the relative movement potential measure - performing a little better than integration – the relative accessibility measure. The relative prosperity of towns in the more 'remote' Breckland cluster is better predicted than those in the more 'accessible' Weald. The Breckland towns appear to function as discrete, independent entities with their own internal spatial logic but, despite their relative economic

disadvantage compared to Wealden towns, this spatial independence may be no bad thing, for recent research (Courtney et al, 1998) has found that residents living in and around a more 'remote' settlement carried out a higher proportion of daily transactions in their immediate locality than those living in and around a more 'accessible' market town. Two thirds of the residents in employment in the remote area worked in their local market town; in the more accessible region half the residents commuted to work in local regional centres. Likewise, firms in more 'remote' rural areas were found to be more strongly tied to locality in terms of sales and supplies than those in accessible rural locations, regardless of the type of firm involved. The authors concluded that towns with more facilities were likely to be more self-contained than those with fewer. From a sustainability standpoint, towns that were self-contained and self-supporting were deemed to be preferable to those that functioned more like a dormitory town, where residents did little more than eat and sleep whilst making most of their economic transactions outside the local area.

Characteristic	Breckland	Weald
subjective accessibility	historically remote, remote today	historically remote, accessible today
built up area	smaller in area, fewer axial lines, both thoroughfares and dead ends, shallower overall	larger in area, more axial lines, both thoroughfares and dead ends, deeper overall
syntactic properties as discrete systems	axially more integrated globally but overall less well integrated at street segment level, lower mean choice values	axially less well integrated globally but overall more integrated at street segment level, higher mean choice values
socioeconomic factors	smaller populations, smaller retail cores, lower employment totals, less retail space, far less office space, far less income from business rates	larger populations, larger retail cores, higher employment totals, more retail space, far more office space, far greater income from business rates
syntactic / prosperity relationships for the built up areas of towns considered as discrete settlements	size of built up area in ha and mean segment choice = .922 size of resident population and mean segment choice = .921 size of resident population and mean segment integration = .872 size of built up area in ha and mean segment integration = .814 total retail RV income and mean segment choice = .550 total retail RV income and mean segment integration = .523	
	relationships to 'prosperity indices' stronger for the subset	relationships to 'prosperity indices' weaker for the subset
visual appearance in the GSE map	less integrated as a region of the map, towns are more homogeneous in appearance	more integrated as a region of the map, towns are more internally differentiated syntactically
relationships between syntactic measures	mean integration for whole town and town centre in the GSE map at 5 km =.934 mean integration for whole town and town centre in the GSE map at 10 km =.919 mean choice and mean integration in the GSE map at 10 km = 912 mean choice and mean integration in the GSE map at 5 km = .868 mean segment integration of each town as a discrete entity and when embedded in the GSE map at 5km = .824 mean segment choice of each town as a discrete entity and when embedded in the GSE map at 5km = .686	
syntactic / prosperity relationships for the whole towns embedded in the GSE map	size of resident population and mean integration at 5 k = .818 size of resident population and mean choice at 5 km = .770 size of town in ha and mean integration at 5 km = .691 numbers of people in employment and mean choice at 10 km = .685 numbers of people in employment and mean choice at 5 km = .661	
syntactic / financial prosperity relationships for the whole towns embedded in the GSE map	total income from office RV and choice at 10 km = .790 total income from retail RV and mean choice at 5 km = .762 total retail floorspace and mean choice at 5 km = .723 total income from retail RV and mean choice at 10 km = .670 total income from office RV and choice at 5 km = .649 total income from retail RV and integration at 5 km = .644 total income from office RV and integration at 10 km = .616	
	Breckland whole towns perform well with mean choice and mean integration at 5 km	Wealden whole towns perform well on several indices at both 5 km and 10 km
syntactic / prosperity relationships for the town centres in the GSE map	size of resident population and mean choice at 10 k = .675 size of town in ha and mean choice at 10 km = .651 size of resident population and mean integration at 5k = .692 size of town in ha and mean integration at 5 km = .692	
	Breckland town centres perform well on most prosperity indices with mean choice at 5 km, and some are related to mean log choice at 5 km.	Wealden town centres are related to syntactic measures mainly in respect of size of population

Table 5.
Summary of findings for the sample of 12 towns.

Average choice is also a better predictor of a town's prosperity than integration when it is embedded in its region, with a 5 km travel distance performing slightly better than a 10 km reach, though it should be borne in mind that these two measures are strongly related to one another. Again, the relationship holds more strongly in Breckland than the Weald, and is more apparent at the more local range of 5 km. In Breckland the association holds for both the whole town and the town centre, whereas in the Weald the configuration of the town centre would appear to have less of an impact on prosperity than that of the whole town. These findings are suggestive, but need to be explored in greater depth over a larger sample of towns.

One explanation of these results may relate to Bracey's (1956) observation that, before the industrial revolution, country towns in the south of England formed a closely spaced network of small market towns that were separated from one another by physical distances of as little as five miles (8 km). Humans walk at a pace of about 20 minutes per mile on reasonably flat terrain, so that the 5 km / 3 mile reach that emerges as an important predictor of a town's economic prosperity or 'health' approximates about a hour's walking distance. It could be that the particular forms of grid intensification that are associated with 'healthy' market towns still reflect the pedestrian scale of an earlier era. As climate change and diminishing oil reserves begin to challenge the supremacy of the car, this could turn out to be a significant factor in predicting which towns will be better placed in respect of long term economic prosperity, vitality and ultimately sustainability.

An important issue for consideration is whether the GSE map has added value in respect of understanding the way these small market towns function as intensifications of the urban grid within a more open, loosely woven surrounding road network, particularly in view of the large effort required to model the road and footpath network at a regional scale. The limited evidence of this enquiry suggests that the answer depends on how independent the towns in a particular region are of one another, physically and functionally. Where overlap occurs, a regional perspective over a larger radius of influence may be appropriate, but much work needs to be done before the contribution of spatial accessibility and movement potential to a town's overall prosperity relative to its neighbours (or competitors) is fully understood.

The size and population of the towns in this study clearly have a bearing on their overall accessibility (mean integration) and overall movement potential (mean choice) though this is by no means inevitable and might even be thought of as counter-intuitive, in that most of the towns in this sample were produced by piecemeal and partially-constrained growth over several hundreds of years. Yet the larger the town is in area or population, the higher its mean segment choice and mean integration are likely to be, measured in several different ways. It may not be surprising either that larger towns with larger populations are more prosperous than smaller ones, but it is not inevitable that they should be better integrated, nor is it obvious that a more integrated and higher choice town should be more prosperous than a more segregated or lower choice town of the same size.

The crude and simplistic mean choice and mean integration measures used in this study have yielded findings which suggest that both movement and access may be deeply implicated in equally crude and simplistic measures of the relative prosperity or 'health' of a town. Yet this merely restates the question: what is it about the accessibility and movement potential of the urban grid that advantages some towns and disadvantages others in the struggle for economic survival? Further work needs to be done to unpack the way in which these overall morphological measures, which are so convenient to use for comparative purposes, relate to the growth, generic features and particular place histories of English market towns in ways that can reliably inform future planning processes.

Acknowledgement

The author wishes to acknowledge the support provided by Space Syntax Limited in granting permission to reproduce an image of the Greater South East Axial Map and for generating and releasing numerical data from the analysed map that have made the writing of this paper possible.

Special thanks are due to Alessandro Columbano at Space Syntax Limited, who processed the data.

Notes

1 The r^2 for mean segment choice with the size of the built up area =.966, with area of retail core = .780, with population = .924, with employment = .699, with amount of retail floorspace = .601, with amount of office floorspace = .522, with retail rateable value = .869, with office rateable value = .621.

References

Beresford, M. (1967) New Towns of the Middle Ages: town plantation in England, Wales and Gascony. London: Prentice-Hall.

Beresford, M. and St Joseph, J. (1979) Mediaeval England; and aerial survey, Second Edition, Cambridge: Cambridge University Press.

Bracey, H. E. (1956) A Rural Component of Centrality Applied to Six Southern Counties in the United Kingdom. Economic Geography, Vol. 32, No. 1, pp. 38-50.

Courtney, P., Dawson, J., Errington, A.J. and Cullinane, S. (1998) The present-day functions of the English Market Town: A Comparison between 'Remote' and 'Accessible' Rural Areas, paper presented to RICS Research Conference, Roots98, Cambridge 14-15 April 1998.

Dalton, N. (1997) An advanced tutorial in Axman, software manual produced by the Space Syntax Laboratory, UCL London, http://www.spacesyntax.com

DEFRA (2004) Rural and Urban Area Classification 2004: an introductory guide. London: DEFRA.

DEFRA (2005a) DEFRA Classification of Local Authority Districts and Unitary Authorities in England: an introductory guide. London: DEFRA.

DEFRA (2005b) DEFRA Classification of Local Authority Districts and Unitary Authorities in England: a technical guide. London: RERC.

Gilpin, W. (1809) Observations on Several Parts of the Counties of Cambridge, Norfolk, Suffolk, and Essex: Also on Several Parts of North Wales; Relative Chiefly to Picturesque Beauty, in Two Tours, the Former Made in the Year 1769, the Latter in the Year 1773. London: T. Cadell and W. Davies.

Hasted, E. (1797) The History and Topographical Survey of the County of Kent: Volume 1. Canterbury: W. Bristow.

Heighway, C. ed., (1972) The Erosion of History: archaeology and planning in towns. Council for British Archaeology. London: HMSO.

Hillier, B and Vaughan, L (2007) The City as One Thing. Progress in Planning: special issue on The Syntax of Segregation, 67 (3) pp. 205-230.

Hoskins W.R.G. (1967) Fieldwork in Local History, London: Faber.

Hoskins, W.R.G. (1955) The Making of the English Landscape. London: Hodder and Stoughton.

Linnekar, B., (2006) Exploring Aggregate measures of remoteness and accessibility for rural England, London: Rural Evidence Research Centre.

Moseley, M.J. (1979) Accessibility: the rural challenge. London: Methuen.

ODPM (2002) Rural White Paper (2000) Our Countryside: The Future - A Fair Deal for Rural England. London: ODPM.

Platt, C. (1976) The Evolution of Towns: natural growth. in Barley, M.W. ed., The Plans and Topography of mediaeval towns in England and Wales. Leamington: CBA Report No.14, pp. 48-56.

Powe, N. and Shaw, T. (2003) Market Towns: investigating the service role through visitor surveys. Planning Practice and Research. Vol. 18, No 1. February. pp. 37-50

Powe, N. and Shaw, T. (2004) Exploring the current and future role of market towns in servicing their hinterlands; a case study of Alnwick in the North East of England, Journal of Rural Studies, 20, pp. 405-418.

Schledermann, H., The idea of the town: typology, definitions and approaches to the study of mediaeval towns in Northern Europe. World Archaeology 2, 2, October 1970, pp. 115-127

Scottish Government (2007) Town Centre and Retailing Methodologies Working Paper 1: Literature Review, http://www.scotland.gov.uk/ Publications/2007/ 12/20105342/1

Sjoberg, G. (1967) The Origin and Evolution of Cities, in Cties, Knopf, A. ed. (first published 1965).
Speed, J. (1611) The Theatre of the Empire of Great Britaine, London: John Sudbury and George Humble.
Tarling R, Rhodes J, North J, Broom G. (1993) The Economy and Rural England. London: Rural Development Commission.
Thurstain-Goodwin M. (2002) Producing Boundaries and Statistics for Town Centres, London Pilot Study Summary Report. London: ODPM
Thurstain-Goodwin, M. and Unwin, D. (2000) Defining and delineating the central areas of towns for statistical monitoring using continuous surface representations. CASA Working Papers (18). London: UCL Centre for Advanced Spatial Analysis.
Turner, A., (2001) Depthmap: a program to perform visibility graph analysis. In Proceedings 3rd International Symposium on Space Syntax pp. 31.1–31.9
Turner, A. (2007) From axial to road-centre lines: a new representation for space syntax and a new model of route choice for transport network analysis. Environment and Planning B: Planning and Design (34) pp. 539–555
URBED (1999) New Life for Smaller Towns: A handbook for action. London: Action for Market Towns.
Zako, R. and Hanson, J. (2009) Housing in the Twentieth-Century City, Chapter 7 of Cooper, R., Evans, G. and Boyko, C. Designing Sustainable Cities London: Wiley Blackwell.