

**Programme: EESD-2001**  
**Key Action: City of Tomorrow**  
**Task: 3.1**



***PLUME***

**PLanning and Urban Mobility in Europe**

**Synthesis Report:  
Land Use Planning Measures**

***Project Contract No: EVK4-CT-2002-20011***

Authors: Stephen Marshall (UCL) and Yamina Lamrani (CERTU)

## CONTENTS

|          |  |           |
|----------|--|-----------|
| <b>1</b> | <b>OVERVIEW OF KEY FINDINGS FOR POLITICIANS .....</b>            | <b>1</b>  |
| <b>2</b> | <b>WHAT THE THEORY TELLS US .....</b>                            | <b>3</b>  |
| 2.1      | Settlement Planning .....  | 3         |
| 2.2      | Settlement Size and Containment .....                            | 3         |
| 2.3      | Urban Concentration / Densification .....                        | 4         |
| 2.4      | Urban Structure .....  | 4         |
| 2.5      | Location Policy Linked to Accessibility .....                    | 4         |
| 2.6      | Transit Oriented Development .....                               | 5         |
| 2.7      | Car Free Development.....  | 5         |
| 2.8      | Development Control.....   | 5         |
| 2.9      | Urban Design.....  | 6         |
| <b>3</b> | <b>WHAT MODEL RESULTS TELL US .....</b>                          | <b>7</b>  |
| 3.1      | Settlement Planning .....  | 7         |
| 3.2      | Settlement Size and Containment.....                             | 7         |
| 3.3      | Urban Concentration / Densification .....                        | 7         |
| 3.4      | Urban Structure .....  | 8         |
| 3.5      | Location Policy Linked to Accessibility .....                    | 8         |
| 3.6      | Transit Oriented Development .....                               | 8         |
| 3.7      | Car Free Development.....  | 8         |
| 3.8      | Development Control.....   | 8         |
| 3.9      | Urban design.....  | 8         |
| <b>4</b> | <b>WHAT EMPIRICAL EVIDENCE AND CASE STUDIES TELL US .....</b>    | <b>10</b> |
| 4.1      | Settlement Planning .....  | 10        |
| 4.2      | Settlement Size and Containment.....                             | 10        |
| 4.3      | Urban Concentration / Densification .....                        | 10        |
| 4.4      | Urban Structure .....  | 11        |
| 4.5      | Location Policy linked to Accessibility.....                     | 11        |
| 4.6      | Transit Oriented Development .....                               | 11        |
| 4.7      | Car Free Development.....  | 12        |
| 4.8      | Development Control.....   | 12        |
| 4.9      | Urban Design.....  | 12        |
| <b>5</b> | <b>TECHNICAL SUMMARY AND IMPLICATIONS .....</b>                  | <b>14</b> |
| 5.1      | Settlement Planning .....  | 14        |
| 5.2      | Settlement Size and Containment.....                             | 14        |
| 5.3      | Urban Concentration / Densification .....                        | 14        |
| 5.4      | Urban Structure .....  | 14        |
| 5.5      | Location Policy Linking Land-Use to Transport Accessibility..... | 14        |
| 5.6      | Transit Oriented Development .....                               | 15        |
| 5.7      | Car Free Development.....  | 15        |

|             |  |           |
|-------------|--|-----------|
| <b>5.8</b>  | <b>Development Control</b> .....         | <b>15</b> |
| <b>5.9</b>  | <b>Urban Design</b> .....                | <b>15</b> |
| <b>5.10</b> | <b>General</b> .....                     | <b>15</b> |
| <b>6</b>    | <b>References</b> .....                  | <b>17</b> |
| <b>6.1</b>  | <b>Bibliography</b> .....                | <b>17</b> |
| <b>6.2</b>  | <b>Websites</b> .....                    | <b>19</b> |
| <b>6.3</b>  | <b>Project Deliverables Quoted</b> ..... | <b>20</b> |

**APPENDIX A: Sketch of the LU/T Feedback Cycle**

## **1 OVERVIEW OF KEY FINDINGS FOR POLITICIANS**

Land use and transport are interlinked. To have an efficient and effective transport system implies getting the land use planning right, and planning urban development implies getting the transport access right. In other words, the different policy spheres and disciplines have to work together to deliver the best results for the functioning of a town or city.

A range of policy measures is available to influence travel demand. Of these, land use planning measures can contribute, but these may take a long time to take effect. The conversion of existing building stock and neighbourhoods takes place at a slow rate of change – a typical figure for the rate of turnover of the urban fabric is 1% per year. Therefore, the switch from, say, a policy of minimum housing density and maximum parking standards to a policy of maximum housing density and minimum parking standards will take some years to have an effect, since a large proportion of the existing urban development will already be laid out according to previous standards.

On the other hand, this long term nature means that land use planning measures can set the physical pattern upon which mobility patterns are based for generations. Put another way, once good practice has been invested in, it is less easily undone. The suburbs of the early 20th century – built to low density but before mass car ownership – have meant that car-orientation has been ‘built in’ to those localities for decades. This also implies that if we can ‘build in’ sustainability-oriented (e.g. travel-minimising) features to new development, we could expect these to be a worthwhile investment prevailing over decades to come.

There is a variety of land use planning measures available for influencing mobility. These range from the large scale planning of whole settlements down to the detailed design of urban design features such as buildings and ‘streetscape’ features. This report has considered these under the following nine themes:

1. Settlement Planning
2. Settlement Size and Containment
3. Urban Concentration / Densification
4. Urban Structure
5. Location Policy linked to Accessibility
6. Transit Oriented Development
7. Car Free Developments
8. Development Control
9. Urban Design

There have been a great variety of studies and results regarding the effect of land use planning measures on travel. The general themes are well known, but the robustness of results is not necessarily consistent, and the exact extent of cause and effect is not conclusive. Even where results appear to show clear correspondence between indicators, this clarity does not necessarily prove a straightforward underlying relationship. Often there is a complexity of factors involved, relating to particular people and localities involved. Nevertheless, the general impression of the planning policy contribution – that denser, more compact, mixed use settlements, and medium-large settlements tend to exhibit a greater propensity for travel by public transport and on foot, and to generate shorter journeys – is one often supported by evidence, and rarely if ever diametrically contradicted (Hall and Marshall, 2002).

While land use distribution and the design of development does not necessarily directly cause shifts towards more sustainable travel behaviour, it can provide choice and *support* more sustainable behaviour – and at least improve on previous practice in which the most sustainable options were often ‘designed out’ from the outset.

A combination of complementary land use planning measures can provide an integrated package where each element reinforces each other towards the ‘more sustainable’ outcome.

Within this synthesis report information from the following EU-funded research projects were used: ASTRAL, DANTE, ELTIS, PROPOLIS, PROSPECTS, SCATTER, STELLA, TRANSLAND, TRANSPLUS, and UMS.

## 2 WHAT THE THEORY TELLS US

Theory tells us that there is a cycle of feedback between land use and transport, where the distribution of land uses (origins and destinations) gives rise to a demand for travel between those origins and destinations. To meet this demand, transport infrastructure and services are provided, which create an ‘accessibility field’ which attracts land uses and urban development to locate at accessible locations. A classic example of the land use-transport feedback cycle is given by Wegener (1995) and Wegener and Furst (1999). Another way of expressing the relationships is given in the Appendix to this paper. In each case, it is not implied that there is a simple mechanistic iteration. The strength and directness of the relationships will vary in different circumstances, and will depend partly on the economic context and other factors.

### 2.1 Settlement Planning

In the broadest sense, the notion of ‘town planning’ is based on the idea that planning a town as a whole entity can optimise the design of settlements. This is in contrast to a *laissez-faire* situation where there is ‘no planning’ (or no development control), or where development is planned on a piecemeal basis. In conventional settlement planning, then, the unit of planning is the whole settlement (town or city). The idea is that by starting with the needs of the town or a city as a whole, it is possible to plan, for example, a more efficient road network or public transport system. This effectively implies a top-down approach, which makes sense for the transport sphere to the extent that transport networks are integrated entities that perform as networks rather than simply as the sum of the performance of individual links (such as isolated sections of tramway or motorway). An integrated land use–transport system implies that the transport system is not only well connected internally but also relates closely to patterns of demand and servicing of significant land uses.<sup>1</sup> The idea of planning a settlement as a unit is linked to the next issue, that of settlement size and containment.

### 2.2 Settlement Size and Containment

Theory suggests that if settlements are of a sufficient size to maintain a certain range of facilities, then a settlement can be ‘self-contained’ and inter-urban travel minimised. The same could be applied to any scale: a neighbourhood with a full range of facilities appropriate for that scale could be expected in principle to generate fewer inter-neighbourhood trips than neighbourhoods bereft of facilities. This links to the case for mixed use development (see Development Control). It could also apply at the scale of single buildings, where housing blocks with their own facilities (gardens, nurseries, launderette, and shops) could in principle generate less travel. Settlement size is also related to the idea of a settlement’s ability to support certain kinds of transport system. For example, a town of a certain size could support its own bus service; a city of a certain size could support a metro. Settlement containment is an attempt to stop sprawl by limiting the physical area of a settlement by imposing some kind of growth boundary or green belt. Green belt policy has been a long established convention in the UK, for example, with policies implemented since 1935 (UK Department of the Environment, 1995; Perndall and Fulton, 2002; SCATTER D4.1). By providing a limited

---

<sup>1</sup> The benefits of a formal top-down approach to settlement planning itself (starting with considerations for the whole settlement and successively sub-dividing into districts and neighbourhoods down to individual developments) are less clear and have been subject to debate within the planning and urban design professions.

supply of land, this should increase demand for more intensive development that minimises travel distances. This links to the idea of urban concentration or densification.

### **2.3 Urban Concentration / Densification**

The theory suggests that by increasing urban concentration, or densification – or maximizing the amount of land uses and activities in a limited area – then travel distances can be reduced. For example, a ‘compact city’ in which all the functions of the town take place in a limited area should generate shorter trips between any pair of locations in the city. This reduction in trip distance could also trigger a switch in modes, as people previously using motorised modes could switch to non-motorised modes (walking and cycling).

### **2.4 Urban Structure**

The integrated land use and transport strategy needs to link the urban development to the transportation networks on a two-way interaction approach. That means:

- Concentrating urban development along transport corridors and around stations with a dense and mixed distribution of activities, to reduce continuing urban sprawl and to provide more accessible public transport.
- Adapting the public transport network to the urban structure by improving public transport accessibility within cities and extending tram or rail networks in existing settlements.

This interactive approach can be achieved through the strategy of compact cities and polycentric urban structures: concentrating urban development and renewal in the urban centres, limiting sprawl at the urban fringe by reinforcing and revitalising urban sub-centres around transport stations and connecting the city centre with orbital sub-centres with an integrated rail, tram and bus system.

### **2.5 Location Policy Linked to Accessibility**

For an integrated approach, urban planning aims at locating the activities according to the level of accessibility of the site and the need for transportation of these activities: this is the principle of the ABC policy

- Activities with a lot of visitors and employees should be located in the city centres, which provide very good public transport accessibility and offer very few parking spaces (A-location).
- Activities which need good accessibility by car as well as by public transport should be located in the sub-centres, near a public transport station (B-location).
- Activities which depend on the highway network (especially for the transport of goods) should be located farther from the centre nearby a motorway connection (C-locations).

In some cases a systematic policy is employed at a city, regional or national scale (e.g. ABC policy). In other cases, a more informal use of accessibility indicators is used to guide policy for the location of development. For example in the UK, some municipalities use ‘Public Transport Accessibility Levels’ (PTALS) to inform land use planning decisions.

## **2.6 Transit Oriented Development**

Urban development can be specifically designed to link to nodes in the public transport system, and to improve transport intermodality. That means:

- Promoting public transport for long distance trips by combining regional transport with local transport, offering high quality infrastructure at interchange nodes.
- Reactivating and redesigning stations to enhance the functionality of the station as a transport node, to improve its attractiveness and to revitalise the urban area around it.
- Providing density, mixed land-use (including social housing) and high urban quality in the close-by neighbourhoods of the stations.
- Promoting non motorised modes as a complement for public transport in a door-to-door travel chain.
- Adapting parking to the function and the location of the stations (by limiting the number of parking spaces in the inner centre stations or by providing park-and-ride in the orbital stations).

Transit oriented development has been promoted in the United States by authors such as Calthorpe (1993) and Bernick and Cervero (1997); see also SCATTER D4.1.

## **2.7 Car Free Development**

The theory is that the provision of car-free development will lead to less car use. Car-free developments could contain a mixture of limited car access, limited car parking or an ownership or tenancy condition which prohibits car ownership. In some cases a car free development could be complemented by a local car-sharing or car hire scheme, to enable those who do not own their own car to use a car for selected trips (e.g., holidays, deliveries).

## **2.8 Development Control**

In general, development control can be used to guide the location and form of development to encourage more sustainable travel patterns and less car use. Mode-specific forms of development control would include zoning regulations relating to permitted uses next to public transport stops (section 2.6) or relating to car-free status of development (section 2.7). Conventional town planning has made extensive use of the idea of a separation of land uses into discrete, mono-use zones. Nowadays, mixed use development may be encouraged with the intention that allowing homes, shops and workplaces to be mixed in together can promote choice and minimise travel distances.

Planning regulations can influence the number of loading and unloading bays available in buildings; require the provision of off-street delivery bays in new buildings of commercial and industrial activities; or require a plan for service and distribution traffic when a building permit for a new site is being sought. Relocating logistics or industrial activities away from residential areas can resolve conflicts between environmental amenity and transport operations. Urban logistics and distribution centres (or zones) which are open to any logistics company are already operative or being planned in several partner countries. The location of supermarkets and hypermarkets within a city has notable impacts especially on the demand for goods transported by the customers in their personal cars. Since markets located on the

outskirts of the city generate more traffic in total, some countries and cities have taken steps to limit the establishment of new such markets (Henry, 2003).

## **2.9 Urban Design**

In principle the design of development can make a locality more ‘people-friendly’ in general and more ‘pedestrian-friendly’ in particular, and can promote walking. A variety of urban design features can be employed, from the placement and design of buildings in different spatial relationships – such as in streets and squares – to ‘streetscape’ and street furniture features including provision of trees, shelter, textures and surfaces, public art, seating, and so on, that can all contribute to a pedestrian-friendly environment. Advocacy for various forms of neo-traditional urbanism, that blend together features such as compact cities, urban villages and public transport oriented development in an overall urban design package, aims explicitly to use urban design related measures to assist in promoting more sustainable patterns of travel (see for example Aldous, 1992; Calthorpe, 1993; Ryan and McNally, 1995; Urban Task Force, 1999). The most prominent Neo-traditional urbanism movement is New Urbanism which also combines with other land use and regional planning philosophies in the work of the Congress for the New Urbanism (see for example Marshall, ed. 2003). An associated group is the Council for European Urbanism (Thompson-Fawcett, 2003).

### **3 WHAT MODEL RESULTS TELL US**

Basic transportation models generally speaking imply a relationship between land use and travel. For example, gravity models imply that demand for travel is proportional to the size of population centres and inversely proportional to the distance between them. This can be interpreted in terms of land use distributions, where the ‘land uses’ equate with trip generators and the ‘distribution’ equates with the geographical spread of distances between origins and destinations.

A review of land use and transport modelling carried out for the TRANSLAND and subsequently the TRANSPLUS project found all existing models and assessment tools to be ‘severely limited’. Perhaps only about 25% of policy interventions available could be properly addressed by current techniques. This is partly due to data availability, skill and knowledge availability, and software availability. But the overriding reason why modelling lags behind the requirements of decision makers is that there is generally an insufficient understanding of the underlying behavioural and structural mechanisms involved, and that required data is becoming even more complex and detailed and is often not available (TRANSPLUS, 2002, D2.2). Of 16 models studied, only four (MEPLAN, TRANUS, STIT and Exterieurplanung) integrate land use elements with transport planning (TRANSPLUS, 2002, D2.2).

#### **3.1 Settlement Planning**

Modelling of settlements tends to test alternative distributions of facilities within settlements, or alternative settlements structures (section 3.2) (rather than testing the effects of planning at the settlement level versus other kinds of planning or non-planning). Some results suggest relationships between monocentric patterns (many to one), polycentric patterns (many to many) or isolated patterns (one to one), which may be equated with suitability for different transport modes (public transport, private motorised transport and walking, respectively). Simmonds and Coombe (2000) test a variety of scenarios and land use changes, and model their effects on transport. They conclude that even if the most radical scenarios were implemented – ‘if feasible’ – their results in terms of reducing overall travel would be small. The impression is that land use policies would be ineffectual.

#### **3.2 Settlement Size and Containment**

Specific modelling results not known.

#### **3.3 Urban Concentration / Densification**

As far as models should predict shorter trip distances resulting from concentration of activities in a smaller spatial area, we would expect compact cities to perform better than sprawling cities. However this would depend on the assumed distribution of land uses. In principle, even in a sprawling city where all movements were local, distances could be relatively constrained. Simmonds and Coombe (2000) compared the transport consequences of one or more compact city scenarios with a ‘trend’ scenario reflecting the continuation of recent changes in land use distribution (1990–2015). They found a limited impact of the compact city, with no significant encouragement to non-car modes; the most pronounced

effect left the total volume of traffic over the entire urban area virtually unchanged, but more concentrated in the centre.

### **3.4 Urban Structure**

Between the monocentric development strategy and the polycentric urban structure, models have not shown in which case and from which size of cities one model is more relevant than the other. The most sustainable urban form differs for each city and depends on a large number of local variables (size and age of the city, number of developable inner cities brownfields available, and existing rail network available in the periphery). The only clear conclusion is that a sprawling low density urban development does not promote car use reduction.

### **3.5 Location Policy Linked to Accessibility**

Models show that trip length and mode choice are dependent on the specific location and spatial configuration of population and facilities. Therefore, an ABC policy can have positive effects on reducing car use. Other indicators point out that the portion of income spent on travel by households or employees can be reduced if the locations of activities are connected to the public transport network. But, we can also notice that higher downtown parking fees (implemented in A-locations) generate negative effects in the centre and make out-of-town shopping centres more attractive.

### **3.6 Transit Oriented Development**

Available indicators and models are currently insufficient to assess the enhanced attractiveness of interchange stations. But, indicators show that this strategy can reduce budgetary pressure and subsidizing of public transport in those areas that benefit from an increasing concentration of land uses around interchange stations.

### **3.7 Car Free Development**

Specific modelling results not known.

### **3.8 Development Control**

In principle models can test between mono-use zoning versus mixed use zoning. Specific modelling results not known.

### **3.9 Urban design**

Conventional land-use transport models do not generally deal with the level of detail for addressing urban design scale features. At the scale of streetscape and urban design, a section of street space is an area of land use and a destination activity, whereas in a conventional transport model a street is simply a 'link in the network' which typically has 'link' attributes such as distance, capacity and cost associated, but not necessarily 'place' attributes which relate to the quality of experience and use of that street as a space. This particularly affects pedestrians, where the choice of walking will be sensitive to environmental conditions, including the presence of other people (relating to vitality and personal security) which is part

of a feedback loop. In contrast to conventional transport approaches, space syntax methods relate a detailed specification of the configuration of space to pedestrian presence and movement using measures such as 'spatial integration'. However, this is limited to the effects of layout geometry and not a full range of urban design features (Hillier et al., 1993; Penn et al., 1998).

## 4 WHAT EMPIRICAL EVIDENCE AND CASE STUDIES TELL US

Empirical evidence and case studies can tell us ‘what actually happened’ in practice. However, in these cases it is not always possible to attribute causality. There may be a number of factors involved that give rise to different patterns of mobility arising from a given set of land use planning policies. In particular, the influence of socio-economic and behavioural characteristics that might lead to patterns of movement which do not equate with what we might expect from theory.

### 4.1 Settlement Planning

Settlement planning as a whole can help to create integrated transport networks. However, in the case of public transport, if the services using the networks are deregulated and not well integrated, it may not perform as efficiently as it might. With regard to settlement planning as opposed to a *laissez-faire* situation, effects are perhaps best seen in terms of individual measures, such as the presence or absence of settlement containment or mixed use zoning. It is not easy to attribute a certain mobility pattern to the ‘plannedness’ of a settlement as a whole, as opposed to what would have happened had the town or city not been planned, since it is difficult to ‘test both options’ as it were. In contrast, empirical assessment of different neighbourhood designs or expansion strategies is perhaps more feasible.

### 4.2 Settlement Size and Containment

There is suggestive evidence that trip lengths form a ‘U-shaped’ distribution with respect to settlement size, where longer trip distances are found in small rural communities and in the greatest conurbations, while shorter distances are observed in medium-sized cities (Orfeuil and Salomon, 1993:45; Wegener and Furst, 1999; Banister, 1999). The implication is that small settlements that are unable to support a large range of services and facilities may force local residents to travel longer distances in order to access the services and facilities that they require. On the other hand, the very largest, centralised settlements may lead to longer travel distances as the separation between homes and the urban centre becomes large. Large settlements with a very large range of jobs and services may also attract people living long distances away to travel to them (London is the outstanding case in the UK context) (Hall & Marshall, 2002). Banister (1999) suggests that a minimum threshold for sustainable settlement size put at 25 000 population (10 000 dwellings). Towns that are apparently more self-contained (e.g., due to relative isolation) may minimise some travel needs, but may generate greater travel distances for out of town services (Headicar, 2000).

Settlement containment is a policy that has been implemented in the city of Portland, Oregon. This has used the concept of a growth boundary to promote densification and avoid sprawl, and increase concentration of demand for the use of public transport (see for example Marshall, 2001; Pendall and Fulton, 2002; for side-effects on house prices, see Downs, 2002; Nelson *et al.*, 2002).

### 4.3 Urban Concentration / Densification

As the density of development increases, the average trip length, the use of the car, and the distance travelled all reduce (Banister, 1999). This is also apparent for different levels of car

ownership, though causality has not been proved. The greatest growth (in distance/car distance) has taken place in low-density locations. Higher density is also generally associated with increased proportion of shopping trips by public transport, increased proportion of commuting trips on foot (Stead and Marshall, 2001). Wegener and Furst (1999) report a variety of German evidence that travel distances only partly or not much related to density; they cite Kagermeier's findings that spatial scale and distances between the city centre and secondary centres were much more important. The PROSPECTS study found very little evidence of the scale of the effects of density, except for cross-sectional comparisons which demonstrate that residents in lower density areas are more likely to use the car and to travel longer distances (May and Matthews, 2001). Maat also alludes to the weak effect of density (1999, 2000).

#### **4.4 Urban Structure**

Case studies show that a lot of cities consider the polycentric urban model in residential terms while the employment and the urban services still ought to be concentrated in the city centre, which is closer in theory to the monocentric urban form. Finally, few cities indeed pursue a polycentric model because, even if they develop mixed land-use sub-centres:

- The public transport network is still inadequate in the periphery, especially from one sub-centre to another
- They want the traditional city to remain the dominant centre of the region.

The Dutch new town of Houten, next to Utrecht, has a central railway station with direct cycle and bus connections radiating from it, while the road network is deliberately more indirect, requiring the more circuitous negotiation of a ring road for motor traffic (Kraay, 1996; Maat, 2000). Here, peak period car trip generation was found to be 10 per cent less than the national average, despite car ownership being amongst the highest in the Netherlands. Use of the car for shopping trips was also found to be between 8 and 13 per cent less than in comparable urban areas (with similar characteristics but different network structure). However, trip distances for those (shopping) trips that are made by car are longer than in the comparator cases (Marshall and Banister, 2000).

#### **4.5 Location Policy linked to Accessibility**

The ABC policy has been implemented in several cities, with a strong regulation on urban development locations and on legal norms for parking spaces (especially in the Netherlands or in Belgium) (Maat, 2000). However, to encourage the "right activity in the right location", many cities don't apply the ABC policy in a 'coercive way': they aim to attract stakeholders by creating a high quality 'place to be' but make less effort to push them away from 'wrong' locations, by regulations, legal norms or financial tools for example. We can also notice that growing efforts are being put, with success, into housing programmes (especially social housing) integrating spatial components.

#### **4.6 Transit Oriented Development**

Case studies point out how high population density and concentration of employment in the direct vicinity of stations form the basis for an efficiently used rail transport connection. It is also important to co-ordinate the different modes interchange (train, tram, buses, P&R and

non-motorised modes. But, the multiplicity of operators and institutions acting on stations makes this integrated approach difficult. Examples of public transport oriented development are found in the TRANSPLUS project (D3, D3.1). These include the cases of Münster, Germany, where there is a comprehensive policy of relating development to public transport; Vienna, where development is laid out along public transport axes; and Orleans where light rail was used to structure development. The case of Curitiba in Brazil is a well-known example of public transport routes forming 'structural axes' of the city (see for example TRL, 1997). The value of transit oriented development has been scrutinised by Crane and Schweitzer (2003) who point out that for sustainability benefits to accrue investment must be targeted to attract car users to public transport, rather than simply to improve service level or convenience for existing public transport users; this has equity implications.

#### **4.7 Car Free Development**

Car free development has been shown to be associated with less car travel. This could be partly to do with location (where located close to facilities and public transport) as well as due to the car-free nature of the development. Examples of car-free development are found in the TRANSPLUS project (Deneef and Schröder, 2002), including the case of a successful development in Vienna combining high density housing with on-site facilities; and in the case study of Edinburgh, reported in work related to the DANTE project (Mittler, 1999; Maat, 2000). The topic of car free development is also considered in some detail in the book *Carfree Cities* (Crawford, 2000).

#### **4.8 Development Control**

Development control can encourage mixing of uses and hence reduced travel distances. It has been found that mono uses developments generate more travel, where housing located on its own creates car-based (long-distance) travel patterns (Banister, 1999). According to Stead *et al.* (2000), characteristics such as the mixing of land uses appear to explain variations in both travel distance and mode. Other land-use characteristics, such as the provision of local facilities, explain variation in travel distance but do not explain variations in travel mode. Stead and Marshall (2001) suggest that the level of mixed use may contribute to travel demand, particularly through the decentralisation of less specialised employment. Van and Senior conclude that mixed land uses encourage walking and cycling, and deter car use, for light food shopping trips. However, they cast doubt on the strength, and even the existence, of the impacts of land use diversity on travel behaviour in general (2000, 141). Generally, their data suggest that mixed land uses may have partial effects on car ownership, mode choice and trip frequency. However, they find not even the remotest evidence that mixed uses influence commuting behaviour (Van and Senior 2000, 145). The PROSPECTS project found little evidence that users do in practice travel to the jobs and leisure facilities which are nearer to their homes (May and Matthews, 2001), reporting on findings from a Dutch study (Snellen, 2000).

#### **4.9 Urban Design**

A particular built form does not necessarily mean behaviour will alter in a simple, deterministic way. Replicating the form of traditional neighbourhoods associated with low car use does not necessarily mean that low car use will follow. (As with car free development, this relates also to the location of the development and the availability of

alternative modes as well as to the nature of the development itself). The influence of design on travel has been debated in particular with respect to New Urbanist development in the United States (see for example, Berman, 1996; Boarnet and Crane, 2001). United States evidence suggests that the influence of neighbourhood design on travel is particularly problematic to evaluate (TRB 1996:22). That said, people-friendly urban design is seen as a prerequisite to encouraging walking and supporting public transport (where environmental quality can encourage or deter walking and waiting) (Ewing, 1996). Crane and Schweitzer (2003) suggest that the benefits of good urban design in promoting walking and cycling may be more certain of being realised than those of regional public transport-based planning policies.

## **5 TECHNICAL SUMMARY AND IMPLICATIONS**

### **5.1 Settlement Planning**

In principle there is a case for integrated planning of settlements with their transport systems. However, at the level of whole settlements, it is difficult to evaluate the implications of one kind of planning over another (or none) by empirical means for a particular locality at a particular time. It is possible to model relationships, but to an extent these are dependent upon the inputs and assumptions in the model; if these do not include wider urban contextual factors (outside the binary land use-transport relationship), then their added value (compared with modelling of individual sub-components) would be limited.

### **5.2 Settlement Size and Containment**

There is some evidence to suggest that cities of a certain size with a certain degree of self-containment can minimise car travel. However, caution is required in drawing policy conclusions, since if a settlement threatens to grow above its 'optimum' size, this could imply creating new satellites that are further away from the central city, which could increase total travel. Combining the issue of settlement size and containment with intensification / densification could, however, assist in keeping travel distances capped.

### **5.3 Urban Concentration / Densification**

Empirical evidence suggests some relationships between high density and less travel, but causality is not clear. Modelling results do not find much significant impact of density on travel as such. This suggests that a variety of factors – which may to some extent be associated with density – could be in play. The implication is that density could assist or be compatible with a package of land use measures, even if insufficient on its own.

### **5.4 Urban Structure**

To limit urban sprawl, the polycentric urban structure is an interesting strategy to limit urban sprawl for quite important cities. For less important cities a monocentric urban form can be sufficient to reach this objective. The fact that urban Europe is characterised by middle sized cities makes this question particularly relevant for Europe.

### **5.5 Location Policy Linking Land-Use to Transport Accessibility**

The ABC location policy ('the right activity on the right location') is an efficient way to both control urban sprawl and provide the attractiveness of public transport. Not only does it need to attract stakeholders on the right place (by providing a high quality transport system and an attractive 'place to be', but it is also necessary to use more coercive tools (urban planning schemes, regulations of locations and of parking spaces, financial or fiscal advantages...).

## **5.6 Transit Oriented Development**

The key factor in a transit oriented development of public transport stations is redesigning both the station itself but also the area around it. The station must be considered as a transport node (functionality) but also as an urban node (attractiveness). But, in this integrated approach, the challenge is to co-ordinate the transport operators, the local authorities and the private partners; one of the solutions could be that the transport operators could have the opportunity to enter directly into the real estate business, owning and developing the land around the transport infrastructure.

## **5.7 Car Free Development**

Car free development may be associated with less car travel. That said, a number of factors may be involved, including accessibility of the location and availability of alternative modes, and propensity for individuals to self-select. Car-free development could yet contribute to a package of complementary land use measures, which reinforce each other towards sustainable mobility.

## **5.8 Development Control**

Mixed use development can in principle have the potential of reducing travel distances. However, this depends on people behaving in a particular way – for example, using their local shop rather than driving to a larger supermarket further away in the pursuit of greater choice. People will not necessarily choose to live close to their work, or work close to where they live. Research from United States and Australia suggests an optimal commute time not of zero but of about 15 minutes (Mokhtarian and Salomon, 1999). If this commute is done by car, then a substantial distance is implied. For multi-worker households, it will be particularly difficult to have everyone working close to home. Therefore, a mixed use policy will not necessarily result in everyone taking advantage of the potential to work and shop close to home. But without the chance of short distances or trip-chaining (e.g. shopping near workplaces) trip distances are likely to be greater.

## **5.9 Urban Design**

As far as can be ascertained from empirical evidence, there are associations between ‘people-friendly’ and ‘people-sensitive’ urban design and the propensity to walk. As with other cases, it is difficult to isolate the effects of specific factors, but a combination is likely to influence the overall outcome.

## **5.10 General**

Finally, some cross-cutting issues regarding a range of policies aimed at limiting sprawl and the impacts of sprawl are drawn together by the SCATTER project. This project draws on international literature and interviews in the United States as well as European case studies.

Results from the SCATTER project summarise the debate for intervention versus non intervention between Gordon and Richardson (1997) and Ewing (1997). Gordon and Richardson argue that the decentralized suburban development offers advantages to the

individual in the form of reduced travel times and lower housing costs, as well as higher consumer satisfaction. Ewing points out that there are increased infrastructure costs, travel distances and loss of land due to sprawl. This includes debate over empirical evidence for increased resource consumption and increase in travel and congestion due to sprawl, but for the most part the debate over the problem of sprawl depends on whether the focus is on the individual or the community as a whole.

The SCATTER project also reports that to some extent urban sprawl can be dealt with at different spatial levels, for example (1) neighbourhood level (2) city wide level (3) regional level. It is considered important to approach the issue of sprawl at a broad enough scale so that the problem is addressed directly rather than being shifted to another locality or political jurisdiction.

This finding echoes some findings from the TRANSPLUS project which looked at cross-boundary issues (Marshall, 2002), and the DANTE project, which found that outer city areas showed the highest growth in travel and the least restraint (Marshall, 1999). Ongoing research is addressing the issue of outer city areas in the UK project SOLUTIONS (Marshall, 2003).

Overall, the application of land-use planning measures suggests the need for a set of policy measures that are packaged so that they are reinforcing each other and complementary with dedicated transport policies (Banister and Marshall, 2000; Maracrio *et al.*, 2003).

## 6 REFERENCES

### 6.1 Bibliography

#### *References from CITY FREIGHT*

- Henry, A (2003) CITY FREIGHT contribution to PLUME synthesis reports.

#### *References associated with DANTE project*

- DANTE Consortium (1999) Good Practice Guide. DANTE Final Deliverable. Brussels: EC.
- Maat, K. (1999) The compact city and mobility: a Dutch perspective, in Feitelson and Verhoef (eds.) *Transport and Environment: In Search of Sustainable Solutions*. Cheltenham: Edward Elgar.
- Maat, K. (2000) Travel reduction ‘built in’: the role of land use planning, in Banister, D. and Marshall, S. *Encouraging Transport Alternatives: Good Practice in Reducing Travel*. London: The Stationery Office.
- Marshall, S. (1999) Restraining Mobility while Maintaining Accessibility: An Impression of the ‘City of Sustainable Growth’, in *Built Environment*, **25** (2), 168–179.
- Marshall, S. and Banister, D. (2000) Travel Reduction Strategies: Intentions and Outcomes, in *Transportation Research – Part A*, **34A** (3), 321–338.
- Mittler, D. (1999) Reducing travel?! A case study of Edinburgh, Scotland, in *Built Environment*, **25** (2), 106–117.

#### *References from PROSPECTS*

- May, A. D. and Matthews, B. (2001) *Initial Policy Assessment*, PROSPECTS Deliverable No. 4.

#### *References from SCATTER*

- Downs, A. (2002) Have housing prices risen faster in Portland than elsewhere? in *Housing Policy Debate*, **13** (1) 7-31.
- Ewing, R. (1997) Is Los Angeles style sprawl desirable? *Journal of the American Planning Association*, **63** (1) 107-127.
- Gordon, P. and Richardson, H. W. (1997) Where's the sprawl? *Journal of the American Planning Association*, **63** (2) 275-278.
- Nelson, A. C., *et al.* (2002) *The link between growth management and housing affordability*. Washington, D.C.: The Brookings Institution Center on Urban and Metropolitan Policy.
- Pendall, R. and Fulton, W. (2002) *Holding the line urban containment in the United States*. Washington, D.C.: Brookings Institution Center on Urban and Metropolitan Policy.
- UK Department of the Environment (1995) *Planning Policy Guidance 2: Green Belts*. London: HMSO.

#### *References from TRANSLAND*

- Wegener and Furst (1999), TRANSLAND Deliverable 2b Report.

### **References from TRANSPLUS**

- Deneef, H. and Schröder, S. (2002) *Car Restricted Oriented Development: Significant Practice in Europe*. TRANSPLUS Deliverable D3.3.
- Marshall, S. (2002) *Methodological Framework for Compatibility Analysis*, TRANSPLUS Deliverable D4.2.
- Macario, R., Carvalho, D. Fermisson, J. and Lopez, I. (2003) *Achieving Sustainable Transport and Land Use with Integrated Policies*. TRANSPLUS Deliverable D6.

### **Other references**

- Aldous, T. (1992) *Urban Villages*. London: Urban Villages Group.
- Banister, D. (1999) Planning more to travel less, in *Town Planning Review* **70** (3) pp313-338.
- Banister, D (2003) Sustainable transport and public policy, in Transportation Planning and Engineering in *Encyclopedia of Life Support Systems (EOLSS)* - EOLSS Publishing Oxford UK <http://www.eolss.net>
- Berman, M. A. (1996) The transportation effects of neo-traditional development, in *Journal of Planning Literature*, **10** (4), 347–363.
- Bernick, M. and Cervero, R. (1997) *Transit Villages in the 21st Century*. New York: McGraw-Hill.
- Boarnet, M. and Crane, R. (2001) *Travel by Design*. New York: Oxford University Press.
- Calthorpe, P. (1993) *The Next American Metropolis: Ecology, Community and the American Dream*. New York: Princeton Architectural Press.
- Crane, R. and Schweitzer, L. A. (2003) Transport and Sustainability: The Role of the Built Environment, in *Built Environment*, **29** (3), in press.
- Crawford, J. H. (2000) *Carfree Cities*. Utrecht: International Books.
- Ewing, R. (1996) *Pedestrian- and Transit-Friendly Design*, report prepared for the Public Transit Office, Miami. Tallahassee: Florida Department of Transportation.
- Hall, P. and Marshall, S. (2002) *The Land Use Effects of 'The 10 Year Plan'*. Report for Independent Transport Commission, London.
- Headicar, P. (2000) The Exploding City Region: Should It, Can It, Be Reversed, in Williams, K., Burton, E. and Jenks, M., (eds) *Achieving Sustainable Urban Form*. London: E & F N Spon.
- Hillier, B., Penn, A., Hanson, J., Grajewski, T. and Xu, J. (1993) Natural movement: or, configuration and attraction in urban pedestrian movement, in *Environment and Planning B: Planning and Design*, **20**, 29–66.
- Kraay, J. H. (1996) Dutch approaches to surviving with traffic and transport, *Transport Reviews*, **16** (4), 323–343.
- McNally, M. G. and Ryan, S. (1993) A comparative assessment of travel characteristics for neotraditional developments, in *Transportation Research Record* **1400**, 67–77.
- Marshall, A. (2001) *How Cities Work: Suburbs, Sprawl and The Roads Not Taken*. Austin: University of Texas Press.
- Marshall, S. (2003) Transport and the Urban Pattern, in *Town and Country Planning*, **73** (2) 106–108.
- Marshall, S. (ed.) (2003) New Urbanism issue of *Built Environment*, **29** (3), in press.
- Mokhtarian, P. L and Salomon, I (1999) Travel for the Fun of It, in *Access*, No. 15, pp26-31.
- Orfeuil, J. and Salomon, I., (1993) Travel Patterns of the Europeans in Everyday Life. in Salomon, I., Bovy, P. and Orfeuil, J. (eds) *A Billion Trips a Day. Tradition and Transition in European Travel Patterns*. Dordrecht: Kluwer Academic Press.

- Penn, A., Hillier, B., Banister, D. and Xu, J. (1998) Configurational modelling of urban movement networks, in *Environment and Planning B: Planning and Design*, **25**, 59–84.
- Simmonds and Coombe (2000) The Transport Implications of Alternative Urban Forms, in Williams, K., Burton, E. and Jenks, M, (eds) *Achieving Sustainable Urban Form*. London: E & F N Spon.
- Stead, D and Banister, D (2001) Influencing mobility outside transport policy, *Innovation* **14**(4), 315-330
- Stead, D. and Marshall, S. (2001). The Relationships between Urban Form and Travel Patterns: An International Review and Evaluation, in *European Journal of Transport and Infrastructure Research*, **1** (2), 113–141.
- Stead, D., Williams, J. and Titheridge, H. (2000) Land Use, Transport and People: Identifying the Connections, in Williams, K., Burton, E. and Jenks, M, (eds) *Achieving Sustainable Urban Form*. London: E & F N Spon.
- Thompson-Fawcett, M. (2003) A New Urbanist Diffusion Network: The Americo-European Connection in *Built Environment*, **29** (3), in press.
- TRB [Transportation Research Board] (1996) *TCRP Report 16: Transit and Urban Form*. Washington, DC: National Academy Press.
- TRL (1997) *Urban Design Considerations in Transport Planning: A Guide for Planners and Engineers*. Crowthorne: Transport Research Laboratory.
- Urban Task Force (1999) *Towards an Urban Renaissance*. London: DETR / E. & F. N. Spon.
- Van, U-P and Senior, M (2000) The Contribution of Mixed Land Uses to Sustainable Travel in Cities, in Williams, K., Burton, E. and Jenks, M, (eds) *Achieving Sustainable Urban Form*. London: E & F N Spon.
- Wegener, M. (1995) Accessibility and Development Impacts, in Banister, D. (1995) *Transport and Urban Development*. London: E & FN Spon.

## 6.2 Websites

**LUTR**: Land Use and Transport Research – [www.lutr.net](http://www.lutr.net)

**TRANSPLUS**: Transport Planning Land Use and Sustainability – [www.transplus.net](http://www.transplus.net)

**SCATTER**: Sprawling Cities and Transport: from Evaluation to Recommendations – [www.stratec.be](http://www.stratec.be)

**PROPOLIS** : Planning research for Land Use and transport for Increasing Urban Sustainability – [www.ltcon.fi/propolis](http://www.ltcon.fi/propolis)

**UMS**: Database of Good Practice in Urban Management and Sustainability – [www.europa.eu.int/comm/urban](http://www.europa.eu.int/comm/urban)

**ELTIS**: guide to current transport measures, policies and practices implemented in cities and regions across Europe – [www.eltis.org](http://www.eltis.org)

**CERTU** : Centre for studies on urban planning, transport, utilities and public construction – Land Use and Transport Interactions (*Interface Urbanisme et Déplacements: IUD*) – [www.certu.fr](http://www.certu.fr)

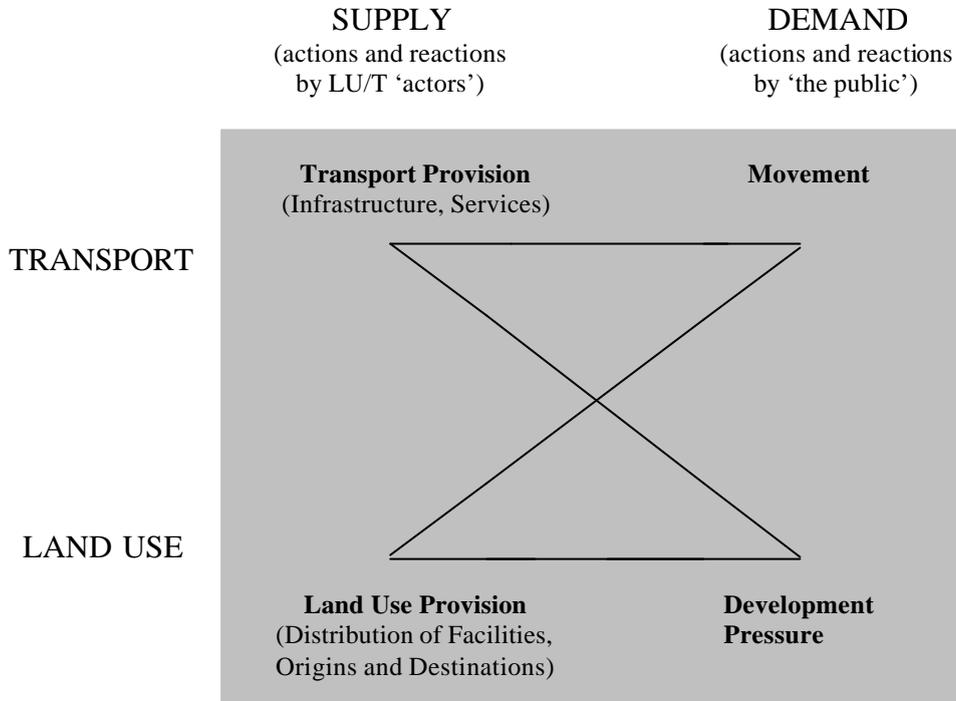
**STELLA**: Sustainable Transport in Europe And Links And Liaisons With America – <http://www.stellaproject.org/>

### 6.3 Project Deliverables Quoted

- DANTE – Deliverable 3 – Good Practice Guide (1999)
- PROSPECTS – Deliverable 4 – *Initial Policy Assessment* (2001).
- SCATTER – Deliverable 4.1 – Review of policy measures aiming to tackle urban sprawl (2003)
- TRANSLAND – Deliverable 2b Report (1999).
- TRANSPLUS – Deliverable 2.2 – *Supporting Models and Indicators* (2002)
- TRANSPLUS – Deliverable 3 – *Assessment of Implementation Strategies* (2002)
- TRANSPLUS – Deliverable 3.1 – *Public Transport Oriented Development* (2002)
- TRANSPLUS – Deliverable 3.3 – *Car Restricted Oriented Development* (2002)
- TRANSPLUS – Deliverable 4.2 – *Methodological Framework for Compatibility Analysis* (2002).
- TRANSPLUS – Deliverable 6 – *Achieving Sustainable Transport and Land Use with Integrated Policies* (2003).

## APPENDIX A

**Figure A.1: Sketch of the LU/T Feedback Cycle**



|   |   |
|---|---|
| Authorities provide transport infrastructure and services to cater for movement demand.   | Supply of transport services and infrastructure generates demand for movement.  |
| New development leads to authorities laying out transport infrastructure to cater for the demand for access.  | The distribution of land uses (origins and destinations scattered in space) gives rise to demand for movement.                                  |
| The presence of traffic or people circulating in streets and within transport interchanges can result in land uses such as shops and businesses being located along those arteries. | Supply of transport services and infrastructure generates demand for development at accessible locations.                                       |
| Developers and public authorities provide houses, shops and services to cater for development demand.   | Demand for development stimulated by the supply of 'land uses' (for example, provision of houses generates demand for retail development, etc.) |

Each link will not operate in isolation but presupposes other conditions – for example, movement does not normally occur independently of land uses (purposes associated with trip ends) and land use supply and development demand relationships presuppose transport links. The strength and directness of the relationships will vary in different circumstances, and will depend partly on the economic context and other contextual factors.