THE ASSESSMENT OF INTEGRATED LAND USE AND TRANSPORT STRATEGIES IN EUROPEAN CITIES

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Abstract

The TRANSPLUS (TRANSport Planning Land Use and Sustainability) project was an EC supported project under the 'City of Tomorrow and Cultural Heritage' key action. Its aim was to identify best practice in the organisation of land use and transport measures in order to reduce car dependency in European cities and regions and promote economic, social and environmental improvement. A particular focus of the study has been on policies and measures that are designed to produce a shift towards public transport and/or non motorised modes and reduce the need for motorised transport. This paper is concerned with the assessment of the planning phase of land use and transport strategies, and examines what future scenarios/visions European cities have and how land use and transport planning strategies are used in these visions. The work is based on case studies of 23 European cities. The efforts made in these cities to adapt to their new strategies and predict outcomes through the use of monitoring systems and models are analysed, and the role of monitoring systems and models in the decision-making process is assessed.

Keywords: Land-use/transport interaction; Land-use and transport policy
Topic area: F1 Transport and Spatial Development

1 Introduction

There is increasing concern across the European Community, and elsewhere, about increasing congestion and the costs it imposes, particularly on accessibility, the environment, other social factors, such as accidents, and the economy in general. Strong and ongoing growth in mobility, especially in road traffic, means that transport trends are unsustainable if only current policies are pursued: with constraints on resources, space, safety and the environment there are only limited possibilities to extend transport supply to safeguard accessibility.

While transport policies are by far the most direct and efficient approach to achieving sustainable urban transport it needs to be acknowledged that in the long run the success of most transport policies is dependent on the existence of a supporting urban form (Wegener and Fürst, 2000). Without accompanying land use measures the effect of many transport policies can become counterproductive. For example, policies such as car pooling, teleworking and public transport improvement can result in less road congestion which will in its turn enable other households to reside further away from their working places and lengthen their car-based commute trip. These negative effects can diminish and even overrun the positive effects of the transport policy.

The potential benefits from integrated land-use transportation planning have been recognised for decades. However, successful implementations of integrated planning concepts are still rather scarce in most of the EU member states. One reason for this can be

the lack of knowledge about the interaction between land use and transport and the related planning consequences. Another reason can be found in the institutional demands for integrated policy making. Planning co-ordination is complex due to the different relevant spatial levels (local, regional, national, European), the different sector policy fields involved and the variety of public and private actors and stakeholders involved. Institutional barriers and insufficient planning regulation and procedures are likely to be partly responsible for the uncoordinated and fragmented current planning practice. Further deregulation and liberalisation can intensify this co-ordination problem. The momentum of market forces will become increasingly important, and will impel a fundamental consideration about the future role and legitimacy of pro-active and re-active public planning.

The TRANSPLUS (TRANSport Planning Land Use and Sustainability) project was an EC supported project under the "City of Tomorrow and Cultural Heritage" key action (TRANSPLUS, 2003). Its aim was to identify best practice in the organisation of land use and transport measures in order to reduce car dependency in European cities and regions and promote economic, social and environmental improvement. Integrated land use and transport planning is considered to be one of the instruments to reduce car dependency in European cities and regions and promote economic, social and environmental improvement. Many cities have therefore included integrated planning in their daily practice. The TRANSPLUS project aimed to learn from these practices.

2 Methodology

Based on case studies of 23 European cities (Table 1), the study has addressed new integrated transport and land use strategies and scenarios which are relevant for the city of tomorrow. For each of the cities, new concepts and scenarios have been described, assessed and evaluated; the perception of problems, the vision about their 'city of tomorrow' and the setting of goals is included in this assessment. A particular focus of the study has been on policies and measures that are designed to produce a shift towards public transport and/or non motorised modes and reduce the need for motorised transport.

Table 1 TRANSPLUS case study cities

Country	**Cities**
NL	Amsterdam; Groningen
D	Cologne; Munster; Dresden; Tübingen
BE	Brussels; Gent
UK	Merseyside; Croydon; Bristol
FR	Nantes; Orleans
I	Rome; Brescia
PT	Lisbon; Evora
SP	Barcelona; Bilbao
DK	Aalborg
RO	Bucharest
FIN	Helsinki
A	Vienna

This paper is limited to assessment of the planning phase of land use and transport strategies (TRANSPLUS, 2002a, b, c) and examines what future scenarios/visions European cities have and how land use and transport planning strategies are used in these visions. The efforts made in the case study cities to adapt to their new strategies and

predict outcomes through the use of monitoring systems and models are analysed and the role of monitoring systems and models in the decision-making process is assessed.

As noted, this paper is concerned specifically with the planning process. Other elements of the study have focussed on issues such as implementation, participation procedures or the analysis of barriers to implementation.

Land use and transport planning includes:

- The development of an integrated land use and transport strategy
- The development of simulation models to evaluate policy options
- The identification of relevant indicators

For each of these three planning tasks the state of the practice in land use and transport planning is outlined, using the experiences of the TRANSPLUS case study cities.

The 23 case studies were selected on basis of their proven relevance to land use and transport planning. Since land use and transport planning is generally a regional task, only cities which have an active regional planning strategy were selected. Hence, most of the cities selected are free-standing with only a few being part of a larger conurbation, such as Croydon or Amsterdam. Finally, the intention was to obtain a good distribution of cities over western Europe and the sample therefore includes cities from almost all countries in western Europe.

The research included two surveys. The first survey contained open questions intended to inventory current practices and the relationship with context variables. The second survey contained closed questions to validate earlier findings. The project consortium included partners in each country; these local partners were responsible for completing the survey for the cities in their country. For each case study, policy papers were reviewed and multiple interviews were executed with local urban planners.

3 Problem assessment and sustainability

There is no doubt about the fact that the middle-sized and larger European cities acknowledge that the transport pattern in their city does harm the local environment and that this might affect the economic and social viability of the city on the longer term. This was already concluded in two earlier EMCT/OECD surveys (EMCT, 1995, 2001) and was confirmed by the 23 in-depth case studies examined in this research. Since the case study cities were selected on the basis of their proven interest in land use and transport planning it is not surprising that keen debates on sustainable development and transport were found in all cities. The case study cities acknowledge that integrated land use and transport planning is needed to ensure a sustainable city in the longer term. Transport problems are becoming more and more urgent, and most cities have a clear understanding about the negative effects that uncontrolled mobility growth can have on the attractiveness and liveability of their city

It should be stressed however that none of the cities examined identified excessive energy use or CO2-emissions as the primary driving forces behind urban policy-making in the field of land use and transport. In most cases economic growth, with preconditions like liveability, attractiveness and accessibility, is the driving force. Of course there are some cities, in northern Europe especially - such as Munster and Aalborg, that pay special attention to environmental sustainability, but they are hardly typical of most European cities. Instead most cities struggle with the complex trade-offs between economic, social and environmental sustainability and they – probably much more than at a national or supranational level – interpret sustainability in terms of negotiations aimed at finding a reasonable balance between these elements. This balance is especially dependent on the economic strength of the particular city. Cities in decline and transition, such as Dresden and Merseyside, usually put particular emphasis on economic revitalisation. However, the

more comprehensive definition of sustainability applied by most cities does not imply a different attitude towards sustainable transport. Almost all cities acknowledge that decreasing car dependency has to be part of the solution.

4 Land use and transport integration

There is a considerable difference between the cities concerning their perspective on 'land use and transport integration'. There are two major integrated approaches:

- Land use policies to achieve transport goals (increase density to increase public transport use)
- Transport policies that generate land use patterns that can achieve transport goals (building a new metro will trigger land use developments around the metro line and this will result in more public transport use).

Examples of the first kind amongst the cases studies are the Amsterdam, Groningen, Lisbon, Bilbao, Helsinki, Tübingen, and Cologne while examples of the latter kind are Nantes, Bristol, and Croydon. Land-use policies are also implemented in the latter cases but transport policies are clearly dominant.

However, cities often use a more holistic definition of land-use and transport integration. Cities use the term 'integrated land use and transport planning' not only in relation to achieving transport goals but also in relation to land use goals like the production of a safe and attractive inner city (eg Aalborg, Nantes) or the development of a second centre (eg Lisbon, Bilbao). Land use and transport integration is of interest not only to transport engineers whose aim is a sustainable transport system but also to land use planners whose aim is at a high-quality liveable city. Their perspective is however different - the latter do not aim at sustainable transport but at a sustainable city in all its dimensions (for example Aalborg, Bilbao).

Which approach is chosen depends on the existence of regional land use planning legislation. Land use and transport planning is a regional task. Usually, transport planning, especially its financing, is organised at a higher level and is often constrained by national regulations. In some countries there is no equivalent land use legislation on the regional level and therefore regional planning often uses transport instruments. Countries or cities where there is some form of binding land-use planning on the regional level, as in the Netherlands or in Germany, show more applications of the first approach.

However, there are a number of alternatives to formal land-use planning. One of these alternatives is to use transport instruments to influence the land use pattern, but cities also use different means to influence land use patterns. While legislation and regulations are the most direct means, most cities have initiated more informal initiatives, such as:

- non-binding inter-municipal co-ordination and participation (Münster)
- public investment to trigger further private investment (Bilbao)
- the promise of public co-operation to trigger further private investment (Amsterdam)

5 'Ideal' land use and transport systems

The case studies showed that land use and transport strategies on a regional scale can be clustered into two categories: strategies that aim for a *monocentric* compact city and strategies that aim for a *polycentric* network city.

The monocentric development strategy puts the focus on revitalisation or further strengthening of the city centre. This strategy is one of the most popular strategies in Europe. Urban planning departments have initiated a variety of policies to strengthen the city centre. Firstly, they have directed large sums of public and private investment towards

the redevelopment of all kinds of inefficient inner city land uses, like the brownfields from the 19th century and older, run-down, residential neighbourhoods. At least as important however are the enormous efforts that cities make to improve the living quality of the inner city and the central city neighbourhoods. A long list of, partly transport, instruments are used. They facilitate leisure activities, differentiate living quality between neighbourhoods, integrate tramline development with city centre revitalisation, give space to pedestrians and public transport, restrict car access to the city centre and redesign neighbourhoods to favour sustainable transport. Thirdly, cities try to focus suburban residential development around public transport facilities. For these aims, too, a wide range of options is applied, ranging from intensification of public transport corridors inside the city and new urban expansion around new rail lines to development around existing but reactivated rail lines and stations. It is noticeable that it seems that cities are reluctant to implement discouragement policies such as limits on urban growth.

The polycentric development strategy concentrates investment in the development of well-located subcentres. By the term (urban) subcentres we mean those places that contain urban functions of a regional level. They are an alternative for urban sprawl. Firstly, they can shorten trip distances due to their proximity to residential areas and, secondly, they can promote public transport due to their good access to the public transport network. The main challenge is to increase the density inside the subcentres, to embed them in the public transport network and to improve the attractiveness of these centres. There are numerous actions in the field of land use development that strengthen the sub-centres. A distinction can be made between the development of new urban centres to complement the city centre and the connection of new non-planned urban centres with the public transport network. In the former case strategies aim to develop places that are centrally located in the public transport network. The latter strategy, connecting new non-planned urban centres with the public transport network, is of course a transport policy. However, its aim is a better land use and transport system and therefore it is relevant in this context. Often the change from monocentric towards polycentric urban structures requires a shift from radial public transport structures towards network structures.

A lot of cities appear to favour the polycentric urban model, but it seems that they define the polycentric urban model in residential terms while employment and urban services are too concentrated in the city centre – what in literature is called the monocentric urban model. Few cities pursue a polycentric urban model; they aim to decentralise employment towards subcentres that are well embedded in the public transport network. Even when cities choose to develop subcentres, they still invest in their inner city and argue that the traditional city centre should remain the dominant centre of the region. This shows that the polycentric form does not conflict with inner city developments, but is additional.

For middle sized cities the choice between further enforcement of the inner city versus development of strong subcentres to prevent sprawl is important. Most cities seem to struggle with the balance between the inner city and the subcentres. The smaller cities promote the inner city (Croydon, Evora, Aalborg). Most middle-sized cities also promote the inner city, expecting market forces to develop the subcentres (Dresden, Nantes). Larger cities actively develop a polycentric structure (for example Rome). Some of these larger cities concentrate most efforts in one or two new city centres (Lisbon, Bilbao, Amsterdam).

There is however a dilemma for the middle sized cities. If they start too soon when they look for a polycentric urban model they are in fact encouraging urban sprawl. On the other hand, if they wait too long, focussing all attention on the city centre, then they might lose control over the developments at the periphery and uncontrolled urban sprawl will be the result. The question now is: when should cities shift from a monocentric urban form

strategy towards a polycentric urban form strategy? Due to the fact that urban Europe is characterised by middle sized cities, this question is particularly relevant for Europe. There is no final answer. The right urban model differs for each city and depends on a large number of local variables like the age of the city, the size, the number of inner city brownfields available for development, the existing rail network in the periphery, and so on.

6 Land use and transport strategies

There can be large differences between and within cities concerning land-use and transport policies. Transport goals are often only secondary for cities. More usually 'soft' goals like increasing liveability and creating 'a place to be' are more important in the minds of city planners. To achieve these goals, city strategies can vary from transport dominated through to land use dominated, with the range including fully integrated land use and transport strategies. The strategy adopted depends on city characteristics and specific locations within the city.

Some cities only use transport instruments to regulate the autonomous land use changes. In several cases land-use development is market driven and the city has no instruments to directly influence the land use changes. However, they are able to use indirect instruments, including transport instruments. Transport dominated strategies can include promoting public transport to reduce car use resulting in less road congestion and improved liveability and accessibility. Measures can vary from opening new lines, reopening old lines, opening new stations, improving services on stations, park and ride facilities, improving speed and/or frequency, introducing integrated fare-systems, reducing fares and public relation-activities. In most cases different measures are combined. These types of transport strategies also enable land uses to be influenced. Other transport strategies which influence land uses include parking restrictions in Vienna and cycle routes in Croydon.

In a few cases, for example in Groningen and Gent, the desired urban form is enforced through land use measures, by for example preventing land use development at car oriented locations (push measures). The growth of car dependent suburban living areas is most often seen as one of the major problems, but active policies to prevent these settlements or suburban retail centres are less often seen. While it is well known that this might be the most effective way to achieve a sustainable urban form, the cities have difficulties implementing it. The main two bottlenecks are the presence of zoning legislation and the absence of regional co-ordination.

Other cities have an active land use policy trying to pull private and public investment towards the designated sustainable locations. It will become much easier to achieve the desired urban form when land use instruments as well as transport instruments are used. Most common is public involvement with the development of new housing and offices around existing and new public transport stations/nodes. This public involvement can differ between co-ordination of private initiatives and active public investment and construction activities. There are several examples where the city has tried to stimulate development by investing in new public functions, such as Museums (Bilbao), an Expo area (Lisbon) or a City Hall (Merseyside). In other cases public involvement is more substantial and in Amsterdam and Münster public housing corporations are involved.

As mentioned earlier, the choice of using which instrument depends on the characteristics or location within the city. More space for pedestrians is mostly offered within high density mixed-use areas like inner cities or new centres, and is most often seen in redesigns of city centres (eg Aalborg, Nantes, Merseyside). Applying the same kind of measures in residential neighbourhoods requires a strong desire for recreational space

instead of car space. It is therefore mostly found in (often-older) very high density/low car ownership areas or in specific areas attracting non motorised target groups (Cologne, Vienna).

Bicycle use differs a lot between cities and countries. The most potential for enlarging the share of bicycle use is seen in smaller cities, because in those cities the opportunities for public transport are more limited. Creating cycle lanes and specific parking facilities are the most common measures. Lack of space and economic forces focused on good car accessibility makes it difficult to apply it at all desired locations - in some situations cycle lanes are not implemented on the most effective routes, but where spare space is available.

Redevelopment of inner areas can reduce car use. Old industrial or harbour areas are sometimes situated at attractive central locations and their replacement by housing, commerce, services and/or recreational facilities can improve urban quality and can also offer an attractive alternative for new locations outside the city, with a much higher expected level of (car) mobility. In some cases this is combined with investments in accessibility, by public transport, bicycle and car. In some cases, for example Amsterdam, there are clear signs that redesigning the inner city including the use of parking policies is effective.

Cities focus on stimulating policies instead of restrictive policies. It seems that 'carrot' policies, policies that aim to encourage good behaviour, are especially popular. For example most cities use some type of public investment to stimulate desired development projects. The most popular 'stick' policy instruments are planning and design regulations like restrictive zoning and road space reduction. Less commonly applied 'stick' policy instruments are development regulations like binding area- or company-based transport management regulations, building orders, parking restrictions, and minimum values for densities or mixing

7 Supporting tools

The objective of TRANSPLUS was to review the whole development cycle, from the planning phase through to implementation and monitoring. Therefore, the review of supporting tools was one element of the study. As such, TRANSPLUS was only able to provide a snapshot of the supporting tools used in the 23 case studies. This section of the paper shows the use and lack of use of decision making tools, it does not include a review of all models currently used by cities assessing land use and transport strategies. However, one of the interesting aspects is the limited use of advanced decision support tools in the case studies. There was some evidence amongst the case studies that monitoring and modelling were viewed as alternatives rather than complementary techniques.

To measure the severity of urban problems and to assess the impacts of intended actions on these problems a wide range of methods can be applied. Two groups can be distinguished: indicator-based monitoring systems and advanced urban models. The former in general address what has happened and assess elements of the urban system in isolation, the latter look at predicted impacts and are able to address all kinds of interdependencies between elements of the urban system. Both require the collection of data.

8 Classification and overview of the use of indicators in case study cities

Indicators can be used to measure the severity of urban problems, inform strategies and monitor the effects of implemented schemes. Figure 1 illustrates the extent to which cities use transport and land use indicators. Case studies presenting a good mixture of transport and land use indicators or using indicators that are really measuring the integration of the two fields are placed on the diagonal of Figure 1. The graph shows that many cities actually use transport indicators to assess the impact of land use on transport

and vice versa. Rome, for example, has an automated extensive traffic management system. However, a link with land use monitoring is still missing due to lack of data. Only a few cities have developed integration indicators, mostly related to accessibility measures of origin and destination points.

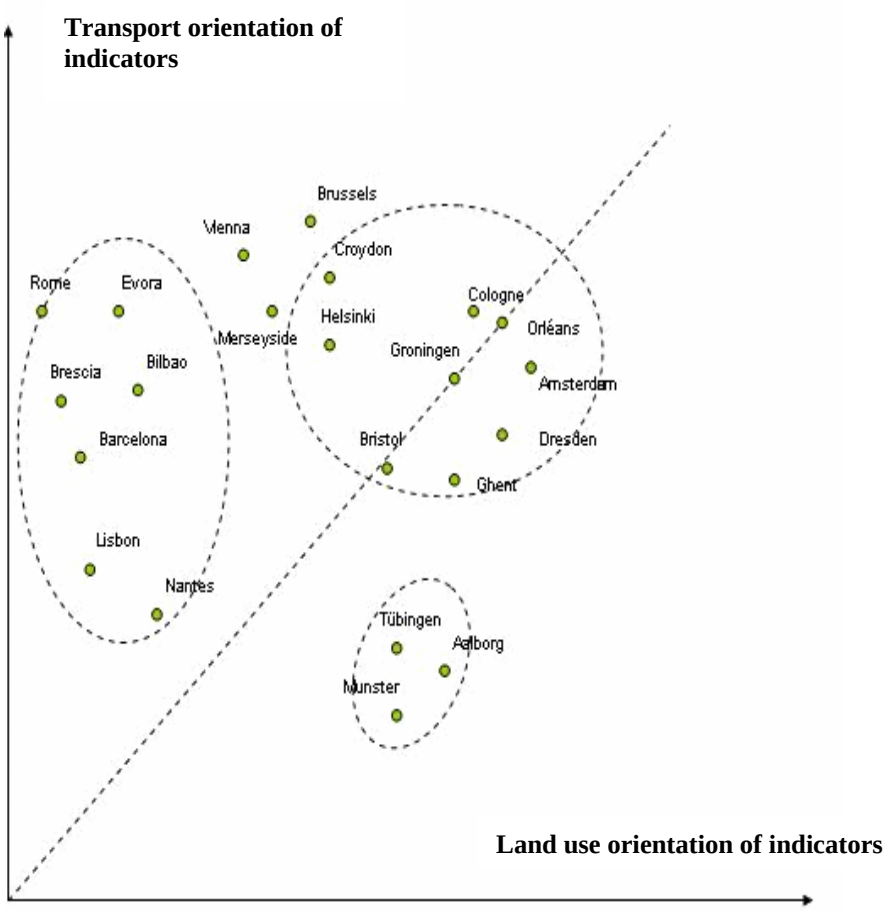

Figure 1 Positioning of case studies according to a dominance of land use or transport indicators

Secondly, the monitoring efforts of the cities have been assessed according to the distinction between system indicators and policy performance indicators. The results are shown in Figure 2. Some indicators serve to monitor the planning process and the implementation of well-defined projects, such as a car free neighbourhood project or a revitalisation scheme. In some cities the monitoring is organised on the overall city level for the development of strategic planning documents, without direct relation to specific projects. In the majority of case studies indicators used at the strategic level are different from those used at the project level, as seen in Figure 3.

The most important findings of the classification are:

- The majority of cities claim to have an integrated transport and land use planning process, including monitoring tools. We can learn that there is a considerable difference among the cities concerning their perspective on land use and transport integration. The general tendency in the investigated cities is a dominance of transport oriented monitoring and tools, especially in southern European cities. Reasons for this bias may be that, in a number of cities, the transport department is better equipped than the land use department. Also, the transport effects are

generally more directly measurable on a short term than land use effects that are often only measurable in the long term but which are subject to many concurrent factors.

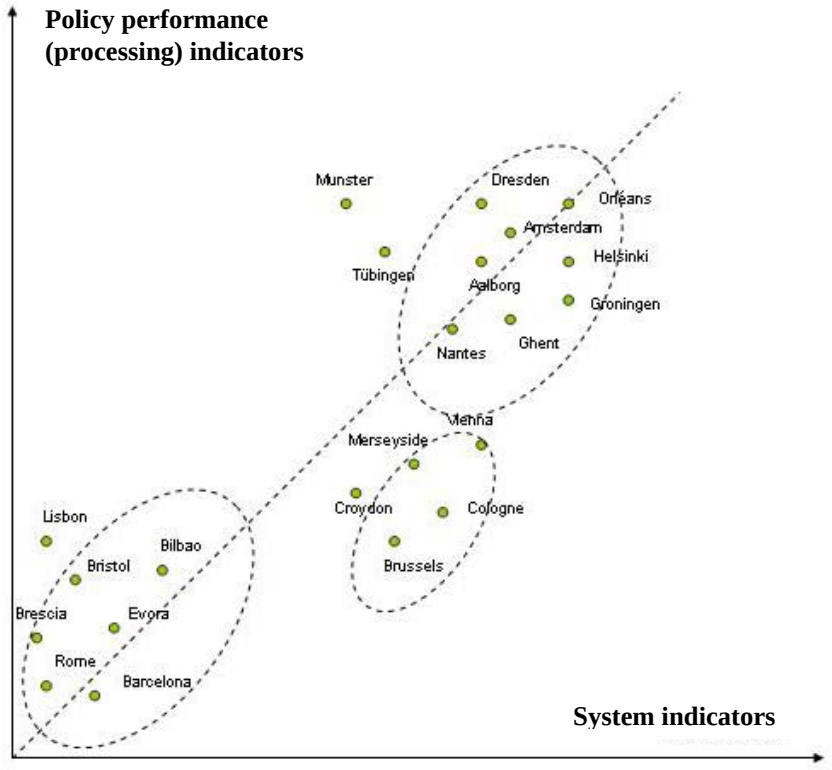

Figure 2 Positioning of case studies according to a dominance of system or policy performance (process) indicators

- Most efforts to monitor land use and transport policies in an integrated way are aimed at finding indicators for an integrated analysis of the spatial system in question. More critical, however, are the qualitative, institutional aspects of integration such as the integration of planning departments, changes in values, beliefs and norms, related processes, their time duration and actors involved (social groups, city departments). In a few cities such a measurement of the integration of management is present (Orléans, Helsinki, Groningen). The case studies indicate that the presence of institutions besides the traditional land use and transport departments helps to monitor the integration of the land use and transport situation in the city, but also the degree of integration of the institutional structure itself. In cities where institutions have been set up to organise integration of land use and transport, these institutions develop their own monitoring system, evaluating their functioning and success in terms of the institutional integration of land use and transport.
- In some of the cases integrated monitoring of land use and transport is not yet structurally present, but a project around this theme has been set up. Within this project, indicators have been developed to assess the various stages in the policy process, such as the feasibility study, the evaluation of alternatives, the monitoring of the implementation and the evaluation of impacts. The applied methodology and the indicators that have been developed can evolve to structural city practise. In other cities, the monitoring is organized on the overall city level for the

development of strategic planning documents, without direct relation to specific projects. Here the driving forces are the higher policy levels, using land use and transport models and indicators, and they stimulate lower policy levels to follow, or they might couple extended discretionary powers or subsidies to the development of an adequate monitoring system.

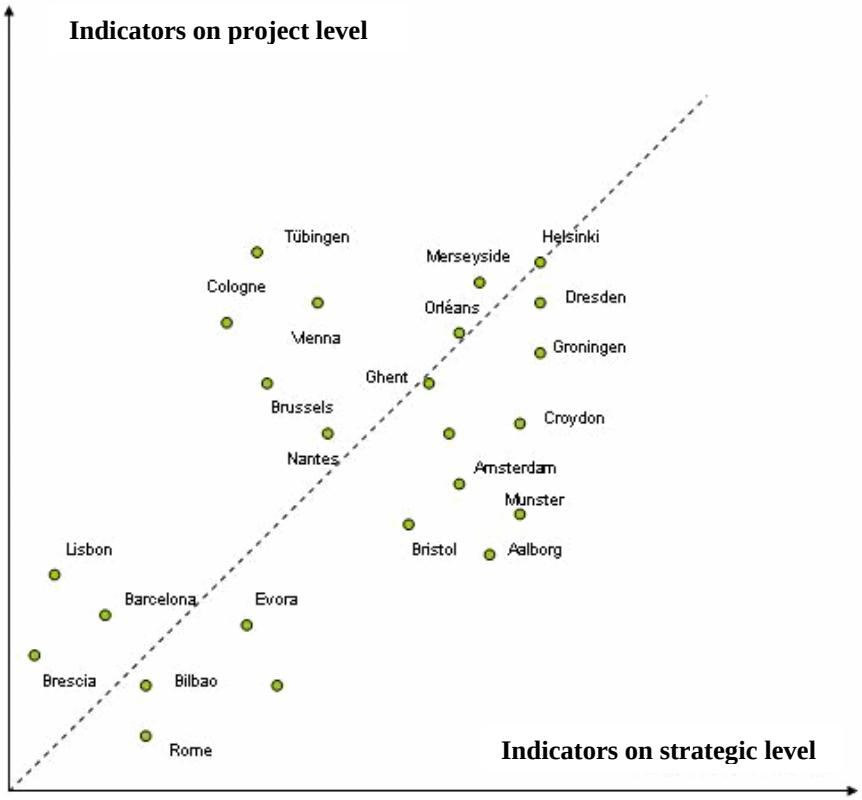

Figure 3 Positioning of case studies according to the function of the land use and transport indicators used (their use in the policy process)

9 Good practice examples of the use of transport and land use integration indicators

9.1 Orléans mobility observatory

The *Loi sur l'Air* in France imposes the elaboration of a Urban Mobility Master Plan (Plan de Déplacements Urbains or PDU) for the area that is served by urban transport in conurbations of more than 100,000 inhabitants. The installation of an observatory is one of the essential elements that allows for guiding the process of evaluation. The Orléans observatory was one of the first to be operational in France and an example for many other observatories. The monitoring structure usually consists of a steering committee, a technical committee and a mobility observatory. The steering committee consists of the actors that were involved in the PDU planning process (representatives of local authorities, regional authorities etc.), while the technical committee usually consists of other partners, economic organisations, associations, experts etc. The primary function of the observatory is to ensure the implementation of decisions, to measure their progress and their efficiency for the whole planning period. A second function is to detect land use, transport and socio-economic evolutions and trends and, if necessary, to propose actions to reverse them. Thirdly the observatory is in charge of communication to the population. The working of the observatory is usually co-financed by the State, the Region, the Department and the

involved municipalities. In the case of Orléans the observatory is co-financed by the constituting local authorities (80%) and the State (20%).

The observatory consists of a research team of a project leader and specialists with different thematic backgrounds (collective transport urbanism, traffic, parking, pollution etc.). In Orléans budgets are expected to have one full time study leader during the year. Three study leaders, one drawer and one technician actually worked on the observatory, but on part time basis. The observatory is linked to the local authorities by the data they need to supply.

The activity of the observatory starts with a selection of the principal objectives and actions of the PDU; subsequently there is a selection of indicators and targets, ensuring that the indicators:

- are synthetic and relevant;
- are clearly defined (geographical spread, calculation mode, source, periodicity) and reliable;
- allow the monitoring of the six basic orientations of the *Loi sur l'Air*: reduction of car traffic, enhancement of public transport and non motorized modes, structuring of the road network, a parking policy, urban freight policies and mobility management policies;
- are readily available;
- are easily understandable by policy makers and the public;
- allow the distinction between global and regional or local evolutions, resulting from the realisation of the PDU.

An important element for the working and success of the mobility observatories is the motivation of the local authorities involved. The mobility observatory does not have the budgets to execute its own research projects or to organise large scale mobility surveys. Intensive communication and feedback towards the local authorities needs to keep them motivated and a lack of technical expertise in the local authorities can also be a problem for the observatory. However, the instrument of the observatories has not yet been long enough established to assess its impact on urban policies.

9.2 Groningen monitoring system

Groningen is a middle-sized town located in the northeast of the Netherlands. It is the most important city of the three northern provinces of the Netherlands and has about 170.000 inhabitants. Another 230.000 people, most of them economically dependent on Groningen, live within a radius of about 30 kilometres. The provinces of Groningen and Drenthe and several smaller municipalities have agreed in the 'Regional Vision Groningen-Assen 2030' upon a collective urban development planning process until the year 2030. The Regional Vision promotes the accessibility of the city and region by car and public transport. To realise the policy objectives at the regional level the Groningen-Assen region developed a monitoring framework to monitor regional developments and problems. Monitoring will take place at three different stages: an extensive evaluation (once every four years), a policy monitor (once every two years) and an operational monitor (once every year, or as often as problems are encountered). In the monitoring system of the region both municipalities and provinces deliver basic data. The project organisation of the Regional Vision analyses the information and delivers monitoring reports including recommendations and advice for the steering committee. Decisions are then taken by the steering committee. The councils and states are informed or consulted by the steering committee. The monitoring process is organised on the different administrative levels (national, provincial, regional, urban) whereby the various levels

exchange data and evaluate each others policies. This process is schematically represented in Figure 4.

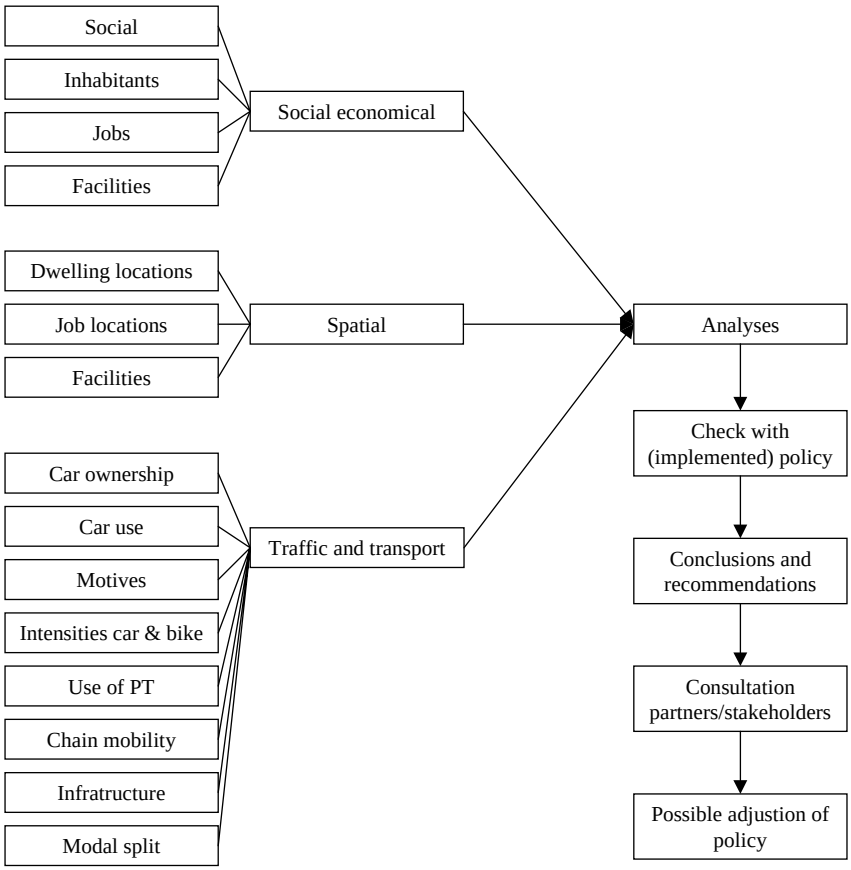

Figure 4 Organisation of the Groningen monitoring system

9.3 Croydon accessibility monitoring

Croydon is situated at the southern edge of Greater London in Outer London. It is the most populated borough on London with 330,000 residents. It is an important economic and commercial centre within the Greater London Area, as well as an important transport hub for urban and regional transport. The National Road Traffic Forecasts (NRTF) and the National Trip End model (TEMPRO) determine national and local traffic growth objectives. Local models must use these for their forecasts unless they can be shown to inappropriate due to local conditions. Each Borough within the Greater London Authority has the responsibility to monitor changes in land use and development and other trends in the Borough. Croydon has set up a whole range of indicators to measure the impacts of policies. A land use and transport model, ACCMAP, has been developed to measure accessibility patterns and shifts due to policy measures. The model has been commercialised and is now being used by a large number of local authorities, in and out of the Greater London Area. ACCMAP is a journey access and travel time mapping package, providing tools to import and manipulate multi modal transport networks. For any origins and destinations it provides travel times by car, bus, train, tram, underground or walking through the appropriate networks. ACCMAP uses the GIS environment of MAPINFO. It primarily serves as an easy-to-use accessibility indicators builder, allowing estimating the

accessibility of places for all kinds of modes, to all kinds of destinations, and drawing accessibility maps. Secondly, the effect on accessibility of policy measures can be estimated, not only of transport measures (changes in public transport provision, new pedestrian or cycling routes, speed reduction measures), but also of measures or trends in related policy domains such as land use (new residential locations, new shopping areas, reduction of parking places etc.), economy (number of working places, local activity rate) and demographic trends (increase of number of households, increasing share of younger people in the Borough).

9.4 Cologne system of indicators for car free neighbourhood projects

The absence of data about people who wish to live car free forced the city of Cologne to organise an extensive monitoring system. The first step is a land use analysis, where potential housing areas of the Housing Program of the City of Cologne were identified to examine their compatibility towards car free neighbourhoods. The chosen areas should be easily reachable by public transport, should have good access to shops, schools and kindergartens. A second step was a micro census analysis identifying the number of car free households in Cologne, their characteristics, their location and their living preferences. This information was the basis for discussions with decision makers. The indicators used to measure the potential for a car free neighbourhood in a certain area were:

- age group 25-45 years
- households with children younger than 6 years
- people with a high education level
- households living in the inner city of Cologne or areas very near to the central area of the city
- households regularly using public transport and non motorized transport modes
- people that are relatively independent from the car for their regular trips (less than 1% of the people always go to work by car)
- households which prefers buying a house rather than renting (about 10-20 % living in a social flat).

Although a number of indicators was in use, a full system of indicators to measure the success of car free neighbourhoods related measures is not yet available. However, the number of households that abolished the car, because of better living conditions and better infrastructure supply, can be regarded as an indicator for changes in the mobility behaviour consequent to the realisation of a car free project.

10 Modelling state of the art

There is a range of methods and modelling tools available to assist urban policy makers in their decision making. Model selection depends on what information was available/used in the policy setting process for the project, what key elements are to be assessed and which main impacts are to be measured, and the times scales to which they apply. TRANSPLUS was of course most particularly interested in methods that look at the impact of land use on transport and vice-versa, but there are many investment issues addressed by urban planners that do not require the whole gamut of land-use and transport modelling, and it would be quite unreasonable and unnecessary to attempt to do so. However, large scale changes in infrastructure significantly affecting accessibility and mobility for large numbers of people may well engender some changes in land use, as people change jobs, or in the longer term their homes, to take advantage of the new accessibilities.

It should however also be noted that the capability of *all* existing models and assessment tools is severely limited. It has been pointed out that current methodologies are

only suitable to examine a relatively small proportion of policy interventions that could be applied by policy makers at various levels of the policy-making spectrum. Perhaps only about a quarter of policy interventions available to policy makers can be properly addressed by current methodologies (DSC, 2000; Simmonds, May and Bates, 2001). This is due to several factors like 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 are becoming ever more complex and detailed and are often not available.

11 Classification of models applied

The efforts made in the TRANSPLUS case study cities to adapt to their new strategies and predict outcomes through the use of models has been analysed and the role of models in the decision-making process assessed. Table 2 summarises the results of the questionnaire addressed to planners and officials in the city authorities concerning model selection, and classifies the models available according to a broad typology based on the representation of transport and land use.

Table 2 Modelling approaches used in the case studies

	No evidence of model use	Transport	Land Use	Land use and transport
Aalborg		EMME/2		
Amsterdam		GENMOD AKTOE		
Barcelona	X			
Bilbao				MEPLAN
Brescia		TRIPS		
Bristol		BRITES, TRAM, TRIPS, SATURN		
Brussels		TRIPS, SATURN		TRANUS
Bucharest		STRADA		
Cologne	X			
Croydon		SATURN, ACCMAP, URECA2	TRAVL	
Dresden		Trip Interchange models		Exterieurplanung
Evora	X			
Gent		Multi-modal model		
Groningen	X	EMME/2		
Helsinki		Traffic models		MEPLAN
Lisbon		NETVIU, VISUM		
Merseyside		MERITS, START		
Munster	X			
Nantes		DAVISUM OPERA		
Orleans	X			
Rome				STIT
Tubingen	X			
Vienna		VISEM, VISUM		

Examination of the city case studies investigated in **TRANSPLUS** identified that the cities' use of formal modelling procedures fall into three groups:

- those that use an integrated land-use/transport model;

- those that use models, but do not take the feedback from transport to land use into account (what might be called the 'traditional' approach); and
- those that, on the evidence obtained, do not appear to use any formal modelling tool.

Few of the cities employed an interactive land-use/transport model. The remainder of the cities employed a variety of different transport planning tools which mainly are concerned, at best, with the impacts of land-use on transport. There is no evidence to suggest this picture is not representative of the majority of cities in Europe.

The reasons for this situation are varied. Many local transport officers and planners throughout Europe acknowledged the usefulness of models to predict effects on transport, but:

- Interactive models are by their nature very complex, and the skills and understanding necessary to use them, not forgetting the increased resources required, may not always be present;
- the lack of resources within local government means that models are seldom re-run regularly or updated;
- accuracy of interactive models over time is not yet proven, and this leads practitioners to a degree of suspicion and uncertainty as to their full usefulness;
- models are often considered as a confirmation and an additional check of the estimations made by a city's administration;
- many local officers remain unconvinced by the outcome of models and therefore political judgement, influenced by business, can override professional judgement;
- whether or not models are reliable, decisions also need to be based on public acceptance. Therefore, final decisions can often be based on the judgement of politicians who are answerable to the public and to business.

In this situation, however, there is still the danger that potentially important impacts are overlooked or undervalued. Interactive land-use/transport models must be improved, and there remain some challenges to be met:

- the transport submodels used in most current land-use transport models do not apply state-of-the-art activity-based modelling techniques but the traditional four-step travel demand model sequence which is inadequate for modelling behavioural responses to many currently applied travel demand management policies. A promising technique for activity-based transport modelling is microsimulation which aims at reproducing the complex spatial behaviour of individuals on a one-to-one basis (see below);
- the spatial resolution of present models is still too coarse to model neighbourhood scale policies and effects. In spite of the fact that few of the cities acknowledge environmental issues as a primary planning objective, future requirements are increasingly likely to require that models are able to assess the impacts of policy interventions on air quality, traffic noise, land take and our environmental surroundings, and to address quality of life issues;
- issues of spatial equity, economic and socio-economic distributions are expected to gain similar importance in model building, as they become more important in the city decision-making process;
- there are advances in transport modelling that make it possible to relate the demand for transport to household activity, as well and household and job location, and, through microsimulation, to predict the movement of vehicles through a network. This latter feature is a necessity if local pollutant emissions and imissions are to be properly measured. The linkage between these two – very detailed spatial representation, and transport microsimulation – has not yet been attained to the

degree that robust and practical tools can be made readily available to the planner and policy maker.

Models will always be a generalisation of reality. While detail is important to the user, so is flexibility and the ability to construct interactive models relatively easily while still retaining accuracy, robustness and, crucially, acceptability. This is particularly relevant to smaller cities, where resource and skill availability may be a problem.

12 Conclusions

Cities have to link the development of integrated land use and transport policy with supporting planning tools and a supporting organisational framework. While researchers often separate these fields of research, practitioners have to deal with the many interdependencies between them, and there are many lessons to be found on the overlap between policy development, supporting tools and organisation; in particular:

1. Integration is only realised when it is applied to policies and methodological approaches as well as organisational structure.

2. Well-balanced policy packages with “stick and “carrot” measures are important. While cities acknowledge that a balanced package of ‘stick’ and ‘carrot’ measures is theoretically the most beneficiary approach to achieve reductions in car use, they acknowledge that this is not always carried through to practice. A correct phasing of measures is therefore needed.

3. Creating attractive ‘places to be’ is a key objective of many cities. However, available indicators and models are currently not adequate to assess enhanced attractiveness.

4. Cities are interested in integrating land use and transport on a regional level. However, institutional and organisational complexity often hampers the development of spatially coherent policies and a sustainable urban form.

5. Based on the case studies it can be seen that the use of integrated land use and transport indicators at the state or regional level can provide a framework for cities, and can facilitate reports on national land use and transport integration processes.

6. Many cities highlighted the issue of cost and complexity as a barrier to using models. TRANSPLUS has identified key areas where models need to be developed to ensure that city planners are able to utilise them more effectively.

Finally, the case study research has given a lot information on the problems and research needs of city planners and about opportunities to enable integration of land use and transport planning. The study has therefore highlighted also several routes by which research and practice can be brought closer together.

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