THE USE OF INDICATORS FOR INTEGRATED SPATIAL AND MOBILITY PLANNING IN EUROPEAN CITIES

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1. INTRODUCTION

The research for this paper was executed within the framework of the TRANSPLUS (TRANSport Planning Land Use and Sustainability) project. TRANSPLUS is part of a cluster of the Land Use and Transport Research Cluster (LUTR), a group of five interrelated research projects funded by the European Commission under the programme: “The City of Tomorrow and Cultural Heritage.” This paper presents the results concerning the identification of innovative practices in land use and transport policy in order to reduce car dependency in European cities and regions and to promote economic, social and environmental improvement. Special attention is given to the development of integrated land use and transport monitoring systems. Findings and case study documents can be found on www.transplus.net.

The main goal of TRANSPLUS is to identify good practices regarding the integration of land use and transport in the various stages of the planning process. In order to select the most interesting and innovative practices in Europe a filtering approach was implemented. Starting point was an extensive database of nearly 70 cities or regions with quantitative (population figures, economic figures, social figures…) and qualitative (recent policy initiatives, interesting particularities…) information on the city or region and a short description of interesting policy elements. This database was composed by the project local partners. Figure 1 shows this first selection of cities.

In-depth case study cities were selected following a three step approach starting with a first scan, followed by a written questionnaire and completed by a series of in-depth interviews. The first scan comprised an extensive collection of existing urban indicators (population figures, economic figures, social figures…) and other city information (recent policy initiatives, interesting particularities…). Based on the results of this desk research 23 cities were selected, taking into account criteria such as geographical spread, spread in city typologies such as size and urban structure (monocentric – polycentric – spread out – urban networks) and the innovative character. For these cities interviews were executed with one or more city representatives based on a standard questionnaire, addressing questions about planning, project implementation, tools and monitoring, barriers and communication. These questionnaires allowed the most interesting cases to be selected for each research item and they were further examined through in depth interviews with several city representatives. Figure 2 presents the 22 case studies (Bucharest was also included in the original list but has...
been omitted here due to lack of information), which were retained for in-depth analysis in one or more of the study’s research areas.

Figure 1.1 location of case studies
2. ASPECTS OF LAND USE AND TRANSPORT INTEGRATION

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

1. Land use policies to achieve transport goals (e.g. enlarge the building density around public transport stops);
2. Transport policies that generate land use patterns which can achieve transport goals (e.g. building a new metro line will trigger land use developments around the line which will result in more public transport use). Here, transport policies are clearly dominant to land use policies.

However, cities often 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 (e.g. Aalborg, Nantes) or the development of a second centre (e.g. Parque Expo development in Lisbon). Land use and transport integration is not only of interest for transport engineers aiming at sustainable transport. Also land use planners aiming at a high quality lining conditions in the city try to integrate land use and transport. Their perspective is however different. They do not aim for sustainable transport but for a sustainable city in all its dimensions.

The integration of land use and transport planning includes a wide range of policies and practices, on different scale levels and in different stages in the planning process. The policy life cycle acts as a basic framework to structure integrated land use and transport initiatives. In this research, the policy cycle was examined from a 4 step perspective (figure 1.1).

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Problems and objective
1. urban dynamics
2. problem perception
3. objectives

Policy design
4. planning concepts/ scenarios
5. selection of policy instruments
6. assessment of expected impacts

Policy evaluation
10. checking actors reaction
11. monitoring
12. evaluation of policies’ impacts

Policy implementation
7. deployment of policy instruments
8. implementers
9. resources, time and space scales
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*Figure 1.2: policy cycle (Transplus, 2002)*

Within the different stages of the policy life cycle, integration can be studied at different scales. In the Transplus project, measures were classified according to their scale: micro, meso, or macro. Measures such as neighbourhood design to influence modal choice belong to the micro level, parking regulations at city level to reduce traffic belong to the meso level, and location policy based on accessibility of an entire region belongs to the macro level.

Using the policy life cycle as a frame of reference, the case study analysis revealed a number of interesting and innovative practices related to integrated spatial and transport planning.
These integration policies were classified in three main categories: public transport oriented development, promotion of non motorised modes and car restriction measures. Table 1 presents the resulting framework for classification of measures, with a few examples. Table 2 illustrates how impacts of these measures were examined.

<table>
<thead>
<tr>
<th></th>
<th>MACRO</th>
<th>MESO</th>
<th>MICRO</th>
</tr>
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<tbody>
<tr>
<td>Public transport</td>
<td>Location policy (residential, manufacturing, services etc.)</td>
<td>Transit oriented development</td>
<td>Redevelopment of public transport stops</td>
</tr>
<tr>
<td>oriented development</td>
<td></td>
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<tr>
<td>Non motorised</td>
<td>Short distance structure development</td>
<td>Promotion of high density facilities networks</td>
<td>Mixed use development Pedestrian and cycling friendly site development</td>
</tr>
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<td>modes promotion</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Car restriction</td>
<td>Development control at main roads</td>
<td>Private parking regulation in building codes and public parking regulation in local land use plans</td>
<td>- Parking restrictions in new developments - car free neighbourhood development</td>
</tr>
<tr>
<td>measures</td>
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</tbody>
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Table 1: Framework for the classification of policy measures
<table>
<thead>
<tr>
<th>Direction</th>
<th>Factor</th>
<th>Impact on</th>
<th>Observed Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Use</td>
<td>Residential Density</td>
<td>Trip Length</td>
<td>Numerous studies support the hypothesis that higher density combined with mixed land use leads to shorter trips. However, the impact is much weaker if travel cost differences are accounted for.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mode Choice</td>
<td>The hypothesis that residential density is correlated with public transport use and negatively with car use is widely confirmed.</td>
</tr>
<tr>
<td>Transport</td>
<td>Employment Density</td>
<td>Trip Length</td>
<td>In several studies the hypothesis was confirmed that a balance between workers and jobs results in shorter work trips, however this could not be confirmed in other studies. Mono-functional employment centres and dormitory suburbs, however, have clearly longer trips.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mode Choice</td>
<td>Higher employment density is likely to induce more public transport use.</td>
</tr>
<tr>
<td></td>
<td>Neighbourhood Design</td>
<td>Trip Length</td>
<td>American studies confirmed that ‘traditional’ neighbourhoods have shorter trips than car-oriented suburbs. Similar results are found in Europe.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mode Choice</td>
<td>‘Traditional’ neighbourhoods have significant higher shares of public transport, walking and cycling. However, design factors lose in importance once socio-economic characteristics of the population are accounted for.</td>
</tr>
<tr>
<td></td>
<td>Location</td>
<td>Trip Length</td>
<td>Distance to main employment centres is an important determinant of distance travelled.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mode Choice</td>
<td>Distance to public transport stops strongly influences public transport use.</td>
</tr>
<tr>
<td></td>
<td>City Size</td>
<td>Trip Length</td>
<td>Mean travel distances are lowest in large urban areas and highest in rural settlements.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mode Choice</td>
<td>Public transport use is highest in large cities and smallest in rural settlements.</td>
</tr>
<tr>
<td>Transport</td>
<td>Accessibility</td>
<td>Residential Location</td>
<td>More accessible locations are developed faster. If accessibility in the whole region grows, residential development will be more dispersed.</td>
</tr>
<tr>
<td>Land Use</td>
<td></td>
<td>Industrial Location</td>
<td>There is little evidence of impacts of accessibility on location of manufacturing, but ample evidence of the importance of accessibility for high-tech and service firms.</td>
</tr>
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<td></td>
<td></td>
<td>Office Location</td>
<td>Office development occurs predominantly at highly accessible inner-city locations or in office parks or ‘edge cities’ at the urban periphery with good motorway access.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Retail Location</td>
<td>Retail development occurs either at highly accessible inner-city locations or on peripheral sites with ample parking and good road accessibility.</td>
</tr>
<tr>
<td>Transport</td>
<td>Accessibility</td>
<td>Trip Length</td>
<td>Suburban dispersal accelerated by good accessibility to the central city generates longer work and shopping trips.</td>
</tr>
<tr>
<td>Transport</td>
<td>Travel time</td>
<td>Trip Length</td>
<td>Travel time savings through transport system improvements are partly spent on longer trips.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mode Choice</td>
<td>Travel time improvements on one mode strongly influence modal choice</td>
</tr>
<tr>
<td></td>
<td>Travel cost</td>
<td>Trip Length</td>
<td>Price elasticity of trip length was found to be in the range of -0.3.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mode Choice</td>
<td>Travel cost differences influence modal choice; making public transport free will not induce many car drivers to switch to public transport, mainly former walkers and cyclists.</td>
</tr>
<tr>
<td></td>
<td>Trip frequency</td>
<td>Trip Length</td>
<td>Travel time savings through transport system improvements are partly spent on more trips.</td>
</tr>
</tbody>
</table>

Table 2: Empirically observed impacts of transport and land use measures (Transplus, 2002)
3. EUROPEAN PRACTICES REGARDING INTEGRATED LAND USE AND TRANSPORT MONITORING

In the second part of the paper we focus on the degree of integration of land use and transport in the monitoring stage of the planning process. To what extent are the monitoring and evaluation of land use and transport policies integrated and have new indicators or models been developed to facilitate integrated monitoring?

Integration indicators are defined in this study as indicators that are measuring significant overlaps between policy domains (EU, 2001b, EU, 2002). They link transport and land use objectives. They assess whether land use and transport policies are exploiting potential win-win opportunities. An example of an integration indicator is the percentage of inhabitants living within a certain range of public transport nodes. Component indicators measure various mobility, land use, economic, social or other components that give information about the degree of integration of land use and mobility and their effects. Examples of component indicators are the modal split, the average daily travel distance or the number of building permits.

Despite the growing interest for integrating transport and land use strategies, little attention has been paid so far to the development of adequate tools and instruments to monitor these strategies. Most monitoring is mono-disciplinary oriented, emphasising one and ignoring the other component. However, the development of an operational integrated land use and transport monitoring system requires more than a simple combination of land use and transport indicators. Simple reporting of various transport and land use indicators would provide no more than fragmented pictures of reality and would be of little value to the planning process, unless strong assumptions about cause-effect relationships are made (BRIASSOULIS, 2001). The search for integrated land use and transport indicators fits in the broader, current search for indicators that cover the multi-dimensional character of sustainable development (BRIASSOULIS, 2001, EEA, 2000, OECD, 1999).

In the case studies selected for in-depth analysis in the TRANSPLUS project, two important and interrelated tools for measuring transport and land use integration were found: monitoring systems and models. The use of these tools is very specific for each case, and the innovative character can best be presented through the discussion of an example.

4. SELECTION OF INTERESTING EXAMPLES FROM TRANSPLUS

Application of an integrated land use and transport model: TRANUS in Brussels Capital Region

The TRANUS model is used to analyse the effects of land use and transportation policies or combinations of policies on the location of various activities. It is intended to assist transportation and land use planners in simulating and evaluating transportation, economics and/ or environmental policies at a urban, regional or national scale.

The structure of the TRANUS model comprises two main components: a land use sub model and a transport sub model, which interact dynamically. In TRANUS, economic activities interact with each other, generating flows: these flows determine the transport demand and are assigned to the transport supply in the transport sub model. Thus, changes in land use will result in changes in the travel demand within the same time period. On the other hand, changes in the transport subsystem will also have an immediate effect on travel demand. In
Turn, the supply-demand equilibrium in the transport sub model determines accessibility, which is fed back into the land use system, influencing the location and, hence, flows between activities. This feedback however does not occur instantly in the same time period, but is lagged: transport accessibilities in time period t1 affect the spatial distribution of activities and the distribution of flows in time period t2. Since there are also elements of inertia in land use from one period to the next one, the effects of changes might well take several periods to consolidate. Iterations are executed until a state of equilibrium is achieved or until a given time period.

In Brussels, the TRANUS model has been adapted to the local situation within the framework of the European project ESTEEM (European Scenarios on Transport-Energy-Environment for Metropolitan areas, 4th Framework Programme). The model has been used in the Brussels Capital Region in the following applications:

- In the ESTEEM project: to estimate the possible impact of the RER on the location choice of households and activities of persons and companies. The study area comprised 130 communes and the situation of 1991 was taken as a reference.

- In the EUROSIL project (4th FP): to determine the various pricing mechanisms that could be applied to reverse the negative effects of the RER: the investigated measures were: toll mechanisms on the ring belt or on the entrance gates of the BCR, level of toll charges and level and structure of prices for RER transport.

- In the TRACE project (4th FP): to calculate the elasticity of the transport demand by private car on the price and duration of the route: a distinction was made between the “short term” elasticity, where changes in the location choice of households and companies nor changes in the destination choice were taken into account, and the “long term” elasticity, where these effects were taken into account.

- At the moment the ESTEEM model is being ameliorated within the framework of the PROPOLIS project in order to optimise accompanying measures to the RER project. The model is used to generate long term forecasts (20 years) of the land use and distribution of origins and destinations of trips. It is also applied in the SCATTER project in the study of measures to stop urban sprawl in Europe and North America.

Development of integration indicators to guide the planning process for a car free neighbourhood in Cologne

The City of Cologne develops the concept of car free neighbourhood to implement the principles of density and mixing laid down in its planning documents. The project steps are extensively documented and analysed to minimise investment risks. Indicators have been developed to estimate the potential for car free living in a certain area (based on questionnaires) and to assess the success of the project (based on questionnaires, simulation and calculation). In other words the innovative character of the measures forces the city to organise an extensive monitoring system and to look for indicators measuring the success of the project.

Since the concept of car free neighbourhoods is not yet established in the housing market, extensive market analysis and monitoring is needed to assess potential demands and to determine the design that is most likely to be successful. Also, 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 and should have good access to shops, schools and kindergartens. The area should have a certain minimum size. Potential areas were weighted through a points system. The criteria “integration in existing settlement structures”, and “contemporary realisation” are weighted less, where settlement extend” becomes twice as much important. “Social and service infrastructure” are weighted six times and the “quality of the public transport integration” is weighted eight times. In this way a classification of areas was made, withholding areas below a threshold score. The selection and weight of the criteria is being monitored continuously. An extension with the criterion of land ownership is being considered, since it is easier to develop land owned by the city to a car free neighbourhood. Finally, 4 potential areas were selected for further analysis and consultation with the citizens.

- A second step is a micro census analysis identifying the number of car free households in Cologne, their characteristics, their location and their living preferences. This information is the basis for discussions with decision makers. Based on questionnaire information a typology of potential inhabitants was constructed: this profile is used to generate a set of indicators measuring the potential for a car free neighbourhood in a certain area:

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

A final system of indicators to measure the success of car free neighbourhood related measures is not yet available. Currently the following indicators are used:

- number of households within the neighbourhood that deviate from the car free concept (through parking lot analysis and car registration statistics);
- number of project related abolished cars (surveys);
- reduction of car operations, energy saving and reduction of pollution through abandonment of cars (calculation);
- prevention of additional traffic strain in the project environment (simulation);
- noise reduction in the project area and its environment (simulation);
- number of saved parking space and land savings (calculation);
- satisfaction within the residential area (questioning).
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 mobility behaviour resulting from the implementation of the model project. The quota to be fulfilled can be set through questioning of new inhabitants and the information from the indicators in the micro census analysis. The monitoring system accompanying the car free neighbourhood project also allows following up potential negative effects of the project such as an increase of parking and traffic in the surroundings of the car free neighbourhood.

**The realisation of a mobility observatory to institutionalise regional land use and transport integration**

La Loi sur l’Air (Law for Air) imposes the elaboration of an 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 monitoring and evaluation. It is the role of these observatories to observe and analyse urban changes, which are relevant for the PDU and to monitor the implementation of policy actions. The Orléans observatory was one of the first to be operational in France and is an example for many others.

The primary function of the observatory is to ensure the implementation of decisions taken, to measure their progress and their efficiency for the whole planning period. A second function of the observatory is to detect land use, transport and socio-economic evolutions and trends and, if necessary, to propose actions to reverse them. In most cases the observatory will present an annual report with up-to-date figures and analyses. Thirdly it has the function to communicate with the population. 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.).

The elaboration of the observatory starts with a selection of the principal objectives and actions of the PDU, followed by a definition of indicators for all of them and finally the determination of a reference situation. A strong selection of indicators is to be made, making sure that:

- Only the most synthetic and relevant indicators are selected. Equilibrium needs to be found between synthetic indicators on the one side, and indicators that are able to indicate a local evolution over the concerned period on the other hand;

- The selected indicators are clearly defined (geographical spread, calculation mode, source, periodicity);

- The selected indicators must permit the monitoring of the six basic orientations of the Law of the Air (Loi sur l’Air): reduction of car traffic, enhancement of public transport and non motorised modes, structuring of the road network, a parking policy, a policy with regards to the transport and delivery of goods and the encouragement of companies and public institutions to organise collective transport and carpooling;

- The selected indicators should be readily available. Budgets are not available to collect additional indicators, for example by the organisation of regular mobility surveys. In many cases, indirect indicators will be used, for example to monitor changes in modal share;
• The selected indicators must be easily understandable by policy makers and the public. The simplicity of selected indicators also facilitates the normalisation of indicators among different observatories;

• The selected indicators must be reliable in the sense of definition, place (geographical extent) and time (the selected indicator should be measured over a long time period);

• The selected indicators should allow distinction between (inter)national regional or local trends, resulting from the realisation of the PDU. In many cases a general and a “local” indicator will be defined.

An important element for the operation and success of the mobility observatories is the motivation of the local authorities involved. The mobility observatory doesn’t 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. A lack of technical expertise in the local authorities can also be a problem for the observatory.

It is too early to estimate the impact of urban policies from the monitoring at the observatories. However, the monitoring instruments are particularly interesting for various reasons:

- They enable a constant observation of the mobility and land use situation as well as a monitoring of the measures related to the PDU;

- They make sure that the actions put down in the PDU do not stay unimplemented, moreover because the same organisations that are involved in the planning process are involved in the organisation of the mobility observatory;

- They enable an integrated and consistent monitoring of integrated land use and transport integrated projects by concentrating all the monitoring and evaluation in one body, that operates rather independently from the local authorities;

- They serve as an information collecting instrument, using all kinds of data that are available at various institutional and sectoral levels; they can identify data gaps and formulate proposals for further research;

- They can compare local evolution to national and regional trends. Co-ordination among observatories (selection, definition of indicators) will enable easy comparison and analysis among cities.

5. CONCLUSIONS

It is obvious that the use of integrated land use and transport monitoring tools is not yet a standard practice in European policy making. However, this doesn’t imply that planners refrain from these tools, but it strongly depends on the project, the regional and national planning standards and local practices. In the examined European cities so-called integration tools are mostly transport indicators to assess the impact of land use policies on transport (such as the effect of an increase of housing density on public transport use) or transport indicators to assess the impact of transport policies with a spatial impact (such as the effect of a new metro line).

Currently, the institutions developing indicators use very different methodologies. The different styles lead to inconsistent and partly incomplete views of problems and possible solutions. The diversity of land use and transport monitoring systems reflects that the
selection of indicators is a largely subjective process. Indicators always reflect political aims and priorities. The national or regional policy level can be the driving force for developing an integrated land use and transport monitoring system. In most of the cases the higher policy levels will to some extend support the development of integrated tools and monitoring. Good examples are Cologne and Orleans.

The case study analysis shows a dominance of non-model based monitoring. Only five of the cities employ an interactive land use/transport model (MEPLAN, TRANUS), mostly capital cities and within the framework of European projects. A number of reasons can be found for this dominance of non-model based monitoring. First it should be noted that the capability of all existing models and assessment tools is severely limited, especially with regards to the modelling of underlying behavioural and structural mechanisms influencing mobility behaviour. This is due to several factors; data availability; skill and knowledge availability; and software availability. Existing land use and transport models are often insufficiently suited for local conditions and data requirements put a heavy burden on city administrations. Secondly, models are often perceived by city administrations as being unreliable, expensive and limited in their capabilities to predict policy effects. For small and medium size cities especially the threshold for implementing land use and transport indicators is lower than adopting a land use and transport model. A third reason lies in a diminishing appraisal of rational analysis in the urban policy process in many European countries since the 1980’s (VOOGD, 1997). In the 1980’s it seemed no longer strictly necessary for political executives to present their decisions as the obvious result of a rational analysis. Decision-making is more and more seen as a socio-political and organisational process, where the search for generally accepted, or more precisely, politically accepted decisions defines the main evaluation criteria. The search for a so-called ‘win-win alternative’ is tending to be not so much based on an analysis of all the available material, but on a selective, strategic use of information to support prepossessed viewpoints and private interests.

6. REFERENCES


EUROPEAN COMMISSION, DIRECTORATE GENERAL FOR AGRICULTURE (2001b) A Framework for Indicators for the Economic and Social Dimensions of Sustainable Agriculture and Rural Development, Brussels, pp10-20

