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Mobiplan
A mobility analyser for long-range decisions

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MOBIPLAN: A Mobility Analyser for long-range Decisions

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ABSTRACT

This paper describes the design and the implementation of the internet-based MOBIPLAN tool, an information and advisory tool for individual space-time-behavior. Everyday mobility is substantially influenced by previously made long-range decisions – such as choice of residential location or workplace - which are usually made without complete knowledge about their resulting effects. MOBIPLAN provides information on the effects of long-range-decisions in order to highlight them and, as well, to influence these decisions and in turn the daily space-time-behaviour that derives from them.

Three levels of functionality - an advisory mode for single days, for multiple days and an information mode – are implemented. In the advisory modes, MOBIPLAN calculates the costs of a given or hypothetical activity chain. Missing information is imputed or selected by the user based on system suggestions derived from linked internet data sources. The users are free to change any aspect of their situation and to adjust their activity chains to explore the effects of such changes on the cost incurred. The evaluation covers the private and social, fixed and variable residential, vehicle and transport usage costs.

KEYWORDS

Everyday mobility, space-time-behavior, location choice, long-range decisions, Internet advisory tool
1 INTRODUCTION

Individuals and households reach special points in their lives, such as the acquisition of a driver’s license, marriage or retirement, that might induce decisions about long term commitments, such as vehicle ownership, residential choice, change of workplace etc. These decisions lead to new circumstances which affect the daily mobility of the individual or the household. Decisions like these are usually taken without complete knowledge of the resulting effects in terms of the private and social costs. For example: a household moving due to a husband’s change of workplace may not be aware of the fact that the new residence offers worse public transport accessibility than the previous one. The household might therefore need a second car in order to be able to perform all the desired activities of the household members.

Frequently, people in such situations try to maintain the routines of their space-time-behavior. Alternative space-time-behaviors or the short-term (daily) space-time and travel opportunities are often not recognized or properly recognized by the individuals or households because of missing or inaccessible information. Furthermore, the persons or households usually do not know the generalised (individual as well as social) costs of their alternatives.

It can be assumed that individual respectively household choice processes could often produce other – perhaps more reasonable or conscious - results if these characteristics and resulting effects were known.

The Mobiplan project has the aim to observe, describe and model the effects on everyday mobility which may be caused by better information about the impacts of such long-range decisions. A further aim of the project is to deepen the knowledge about such long-range decisions in general and to see, whether the information can influence people’s choices.

The Mobiplan project will implement the internet-based software system "MOBIPLAN", a mobility planner and analyser. It is primarily aimed at individuals or households currently considering to change their residential location or other relevant places of activities.

Among other functionalities, MOBIPLAN analyses, evaluates and optimises activity chains for alternative scenarios based on the user’s input and provides estimates of their effects. It gives an overview of the effects of the household’s long range decisions.
This paper describes the underlying design, the functions and the implementation of the MOBIPLAN tool with special regard to the algorithms used and the cost assumptions developed for this task.

2 The Mobiplan Tool

2.1 Basic approach

Long-range decisions about locations, in particular residence or workplace, allow respectively restrict the peoples’ participation in everyday activities. There are both long- and short-term restrictions to be considered which are implied by the location choices.

Both long-term restrictions and opportunities derive from the spatial distribution of activity locations and their accessibilities. The accessibility depends on the local transport supply, its temporal constraints and the household’s availability of personal means of transport. A possible measurement index of the impacts is the total resource consumption needed for performing the household activities. The short-term restrictions and possibilities derive from the individuals or households desires and needs. Internal coordination between household members, the temporal constraints for their desired activities and their individual resource consumption have to be taken into account.

Both kinds of restrictions influence the household’s location choices, as the household usually – but not always and never completely – carries them in mind when making its decisions. They also influence the household members everyday behaviour. Conversely, the experiences made and the restrictions in everyday behaviour have an influence on long-term location choices.

It can be assumed that most people never really think about all these interactions, they only have an incomplete view or knowledge about them. Most decisions are based on intuitive knowledge or assumptions about the resulting effects. The possibility to get complete information is seldom available. MOBIPLAN shall substantially fill this gap by providing personalised data and cost estimates.

Target groups of the 1st version of the MOBIPLAN tool are individuals or households who are planning to move and are looking for advice at building societies, municipal offices or public transport providers. Institutions with multiplicatory functions might in turn be offices such as the ones mentioned above, but also other places to which people come to in order to get information or some kind of advice about their spatial behaviour.
In addition, a two-phase panel survey in the German cities of Karlsruhe and Halle (Saale) is conducted at the moment. The sample consists of households who recently changed their residential location. The main goal of the survey is to gain further knowledge about the re-arrangement respectively development of routinised space-time-behavior within households after a move.

Survey issues are:

- The reasons for the move and the choice of the new residential location,
- Frequent activities and frequently visited places (before, shortly after the move and a further three months later) as well as
- A one week travel-diary for each household member in each panel wave.

The results of this survey will be included in the MOBIPLAN in order to strengthen and improve the advisory functions.

2.2 Scope of the MOBIPLAN tool

As MOBIPLAN intends to offer quick as well as detailed information, MOBIPLAN provides two modes of service:

- A site mode presenting quick information about the environment of a specific address and
- An advisory mode analysing the travel behaviour of persons and households at the current time or in upcoming situations resulting from a new place of residence or a change of workplace.

The site mode requires only an address as input data. MOBIPLAN then displays locations in the vicinity of this site address, e.g. the nearest school, the location of grocery stores, banks and post offices. It also informs about the nearest transit stop and the accessibility of points of interest (train station, city centre) by different modes of transport.

The advisory mode aims at users interested in a comprehensive analysis of their mobility patterns. For users wanting to estimate the impacts resulting from a change of residence or workplace MOBIPLAN supplies specific advisory submodes guiding them through these scenarios. The advisory mode examines daily activity chains of persons and households. Based on these activity chains MOBIPLAN suggests routes between the activity locations for all useful modes of transport, i.e. car, public transport / transit, bike, walk, or a combination of modes. To evaluate the routes, MOBIPLAN calculates
indicators describing quality of the connection (travel time, number of transfers), travel costs and environmental impacts. This allows MOBIPLAN to evaluate the impacts of the user’s space-time-behavior as resulting from present or hypothetical situations, taking into account the consumption of time, fixed and variable transport costs and the costs of private means of transport. Both individual and social costs are considered. If several or all household members make entries concerning their situation, costs may be calculated on a household level. Additionally, residential costs may be included to allow comparisons between different scenarios in case of change of residence. The scenario results can be compared in order to clarify the impacts resulting from each option. The results are presented either in the original units or are converted to money values.

3 IMPLEMENTATION OF THE Mobiplan TOOL

3.1 Internet

MOBIPLAN is currently being implemented as an Internet application. This mode of operation was chosen as the Internet shows a rapidly increasing market penetration and offers the possibility of linking MOBIPLAN with other data sources provided on the Internet.

The core of MOBIPLAN is a framework of Active Server Pages (ASP). ASP are generated on the MOBIPLAN -Internet server and sent to the user. Some Java applets are incorporated for specific tasks. A conventional web-browser (Netscape, Internet Explorer) serves as user interface.

The structure of MOBIPLAN as shown in the Figure 1 consists of three components: data servers, a user database and the ASP framework. The data servers provide maps (Map Server: www.ptv.de), road and transit data for routing calculations (Map&Guide: www.ptv.de, HAFAS: www.bahn.de) and points of interest (Yellow Map: www.yellowmap.de). User-related data are stored in a user database. The user database contains socio-demographic data, vehicle data and mobility data (activity chains, activity locations). Data security is assured by a personal login with password which is required for accessing the advisory mode.
3.2 User input

Analysing mobility patterns of persons and households requires information on activities and activity locations, preferred modes of transport and household co-ordination. Similar to a travel survey, MOBIPLAN collects this information offering a special interview mode. The interview starts with questions concerning the household, the persons and the vehicles and is followed by recording the trips for one or more days (see Figure 2). For user convenience MOBIPLAN attempts to reduce the amount of input data by distinguishing between mandatory and optional input attributes. The user may add additional data to the user database after the interview using a specific tree view (see Figure 3) which allows to modify all data input.
Household data comprises an identifier (name), a password and the address of residence. Each household member is identified by a name and described by a set of attributes, e.g. "has driving licence", "has access to a car/bike", "owns season ticket for transit", "preferred modes of transport".

Vehicle data includes brand and type of vehicle, age of vehicle, mileage and purchase price. From this data MOBIPLAN can derive vehicle specific petrol consumption, maintenance cost and deprecation.

Activity data is collected in form of a trip diary for one or more day-types, i.e. the user inputs a chain of activities. For each activity the following data is required (see Figure 2):

- Type of activity (work, shopping, education, leisure, etc.),
- Address of activity location,
- Start time and duration of activity,
- Preferred modes of transport,
- Participating household members.
3.3 Results for one day

For each day-type MOBIPLAN conducts a route search resulting in a set of possible modal chains, which can involve different modes of transport across the day. The table of results gives an overview on the indicators of each modal combination:

- Modes of transport: car, transit, bike, walk or a combination of modes.
- Quality of connection: travel time, number of transfers,
- Travel costs: transit fare, fixed and kilometre-dependent car costs,
- Environmental impacts.
Clicking on one combination in the table provides a map view with a graphical display of the selected sequence (Figure 4).

![Figure 4: MOBIPLAN map view showing a suggested tour](image)

3.4 Grossing up for one week

As MOBIPLAN wants to support long-term decisions, it is not sufficient to end the evaluation with the results for one day only.

Entering activity chains for several day-types, if possible, for each household member, is time consuming and cannot be expected of an Internet user. Estimating long-term impacts based on only just one or few day-types, however, requires some kind of reweighting.

The simplest and most obvious method is a grossing-up of individual days to one week. For this, the user assigns one day-type to each weekday. The calculation then takes the indicators calculated for each assigned day-type from the single-day calculations and simply multiplies every indicator with the
indicated frequency. From Table 1 it is apparent that this method comes up with more realistic results, if the user is willing to report a trip diary not just for one day but for all relevant day-types.

<table>
<thead>
<tr>
<th>Weekday</th>
<th>Assigned Day-Type</th>
<th>Case 1: One day-type</th>
<th>Case 2: Several day-types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>normal working day</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Tuesday</td>
<td>normal working day</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Wednesday</td>
<td>normal working day</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Thursday</td>
<td>normal working day</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Friday</td>
<td>normal working day</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Saturday</td>
<td>normal working day</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Sunday</td>
<td>normal working day</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Grossing up: Assigning day-types to weekdays

Differences between the observed and calculated values can be expected because of the variability of activity chains for the different days of a week. Furthermore, there is no typical day or typical week. Differences also result from the fact that the activity chain of a day-type defined in one week may have different characteristics (activity locations, activity times, means of transport used, ...) in the next one (see Axhausen et al., 2000).

To estimate the error of a simple grossing-up, samples from a recent travel survey containing trip diaries over a period of six-weeks (Mobidrive project: www.ptv.de/mobidrive) were examined. For information on the Mobidrive project see also Axhausen et al. (2000).

The observed travel times for an entire week were compared to calculated values, which were based on either

- 1 day,
- 2 days,
- 3 days.

In the calculations based on one day, the travel times of one randomly selected week-day (Tuesday) were multiplied with the factor 7. In the forecast based on two days, the sum of the travel times of two randomly selected week-days (Tuesday and Thursday) was multiplied with the factor 3.5. In the
forecast based on three days, the sum of the travel times of two randomly selected week-days (Tuesday and Thursday) was multiplied with the factor 2.5 and added to the travel times of one weekend day (Sunday) multiplied with the factor 2.

Figure 5 shows the results of the comparison for the weekly travel time. The x-axis describes the ratio between the observed and the calculated travel times of an entire week. The results indicate that the simple grossing up based on just one day-type produces for 41% of the calculated values an error of less than 25% for the calculated travel time compared to the observed travel time. Based on two day-types, 57% of the calculated values stay within that range. Having three day-types as basis, 68% of the calculated values show an error of less than 25%.

Judging from the weeks producing ratios higher than 4, it seems that the underestimated travel times in these cases mostly result from a below average number of trips made on the days used for the calculations. The results are presented either in the original unit or converted to money values.

Figure 5: Grossing up: Sum of the travel time ratios (observed and calculated travel time within one week)

As an alternative, a more complex reweighting approach is currently examined. This approach uses two sources of input:
- *Travel surveys* provide information on the journeys and their probability differentiated by person groups. *Table 2* shows selected chains and their probabilities taken from a nation-wide German travel diary survey (KONTIV 1989, see Axhausen, 1995). The probability states the frequency with which the chain is carried out by a group member (in %). Note that the probability sum will well exceed 100 % since many persons leave home more than once a day.

- *MOBIPLAN user input* provides frequencies for all type of activities (work, shop, education, etc.).

These two data sources can be used to estimate a likely distribution of journeys consistent with the known marginal distributions of the activity frequency stated by the MOBIPLAN user. Compared to the simple grossing up, this method reduces the amount of input data from the MOBIPLAN user as it does not require activity chains but only activity frequencies. This method can also handle optional activity locations by applying a destination choice model (see Fellendorf et al., 1997) which transfers activity chains into trip chains by allocating activities to specific destination zones. Thus, the MOBIPLAN user only needs to state the place of residence and other fixed locations (workplace, school) whilst the model would complement other locations. This capability is especially useful for analysing scenarios, for example a change of residence to a location, where the user knows little about the nearest activity locations (e.g. shops).
### Table 2: Some journey types and their probabilities [%] for an average working day (source: KONTIV, 1989, persons ≥ 10 years, Monday – Friday)

<table>
<thead>
<tr>
<th>Person groups</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>E+c Employee with car availability</td>
<td>H Home</td>
</tr>
<tr>
<td>E-c Employee without car availability</td>
<td>W Work</td>
</tr>
<tr>
<td>NE+c Non-employed with car availability</td>
<td>S Shop</td>
</tr>
<tr>
<td>NE-c Non-employed without car availability</td>
<td>E Education School</td>
</tr>
<tr>
<td>St&lt;18 Students younger than 18 years</td>
<td>U University</td>
</tr>
<tr>
<td>Appr Apprentices</td>
<td>P Private</td>
</tr>
<tr>
<td>St 18 Students 18 years old or older</td>
<td></td>
</tr>
</tbody>
</table>

3.5 **Cost Calculation**

MOBIPLAN calculates the effects of the user’s space-time-behavior. It is especially intended to give information on the costs that may arise from a hypothetical situation (e.g. former and new activity locations and the resulting space-time behavior).
3.5.1 Cost categories

Three cost categories are considered:

- Costs of residence,
- Fixed costs of transportation,
- Costs of travel.

They are broken down by

- Personal costs,
- Household costs,
- External costs (see Table 3).

<table>
<thead>
<tr>
<th></th>
<th>Person</th>
<th>Household</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residence</td>
<td>Shared costs</td>
<td>Complete costs</td>
<td>-</td>
</tr>
<tr>
<td>Fixed</td>
<td>Costs for vehicles primarily used by this person</td>
<td>Costs for shared vehicles</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Costs for public transport season tickets</td>
<td>Costs for shared for public transport season tickets</td>
<td>-</td>
</tr>
<tr>
<td>Travel</td>
<td>Out-of-pocket time</td>
<td>-</td>
<td>Environmental</td>
</tr>
</tbody>
</table>

Table 3: Cost categories and types

The user specifies his space-time-behavior including activity locations, means of transport used, activity times and the number of travel participants. From these data, further variables and values (route length, travel time) can be calculated, on which the evaluation is based. Additionally, the user might indicate the route he used to access the respective activity location. Social costs could then be determined by the degree with which traffic impacts on the adjacent inhabitants and users.

The reference case is the present situation of the user without a change of behaviour. If the user gives data about different residential locations and hence, the resulting space-time-behavior, MOBIPLAN can
present the evaluation of these scenarios with respect to the costs of residence and costs of travel. So, the trade-offs between the choice of the residential location and resource consumption are made clear.

The fixed costs of the private means of transport (e.g. cars, bicycles) have to be taken into account, even if these means of transport are not used in the current situation.

3.5.2 Social costs

Individual or household-based costs are already covered in the MOBIPLAN evaluation. The resulting social costs are also part of the evaluation to highlight these for the user.

The external cost calculations are based on the average external costs (see Mobiplan Consortium, 1999, for details) as marginal cost rates and more importantly the size of populations affected were not available to the project.

Following INFRAS and IWW (1994) and Ellwanger (1995), external benefits are considered to be negligible.

3.5.3 Costs of residence

While housing costs are irrelevant at the daily level, they are crucial for the long term decision. These costs are household-specific. For the calculation of individual costs, they are divided by the number of household members.

The user is asked to indicate the following item for the reference case, and, if possible, also for his alternative scenarios:

- For renters: rental, without and with associated costs,
- For owner occupation: mortgage and related costs.
3.5.4  Fixed costs of transport

The fixed costs are assigned to the household member who uses the vehicle or public transport season ticket exclusively or predominantly. Costs are assigned to the household, if the means of transport is shared by the household members. This applies to both fixed costs of private vehicles and public transport season tickets.

For private vehicles the following elements are considered:

- Loss of value, the leasing rate or dues of car-sharing organisations,
- Repairs / care,
- Insurance(s),
- Taxes,
- Rental costs of a parking garage / site.

The user indicates the type of the vehicle, its age and mileage. Based on these variables, the actual costs of vehicle operation are determined using the cost tables of the German Automobile Association (ADAC) (Juchum et al., 1998). These values are presented to the user for examination and, if necessary, adjustment. If these values are not available, the user is presented average values, which he can edit. The same applies for parking costs.

For non-motorized private transport, the costs are calculated from the vehicle’s average useful life and its replacement value. The costs of public transport are equated with the costs of the relevant season ticket, given their geographical coverage and transferability.

3.5.5  Travel costs

The variable costs of the space-time-behavior are an important part of the evaluation. Three types of travel costs are produced while travelling:

- Out-of-pocket-costs,
- Time costs,
- Environmental costs.
Based on the statements about activity locations and means of transport, the distances covered and the travel time can be determined. The estimates are based on HAFAS (www.bahn.de) and Map&Guide (www.ptv.de).

Out-of-pocket-costs are assigned to the travelling person. In the case of private transport, they are shared equally among the persons travelling together with the same vehicle. Out-of-pocket-costs of each private transport trip result from the operating costs of the vehicle and parking fees. The operating costs are calculated from the distances covered. Appropriate values were taken from Juchum et al. (1998). Parking costs which are not already covered by the fixed costs have to be specified by the user. In public transport, the costs of the appropriate ticket are known by the chosen form of public transport. Thereby, the possession respectively availability of season tickets is taken into account.

Time costs are also assigned to the travelling person at the individual level. Time costs depend on the trip purpose. There are different values in the literature, e.g. in Hague Consulting Group (1990), Paulußen (1992), Gunn (1996), Baum et al. (1997b), FGSV (1997). The time costs of each private and public transport trip are based on the travel times and trip purposes of each traveller. Appropriate values were taken from Paulußen (1992) (see Table 4).

<table>
<thead>
<tr>
<th>Trip purpose</th>
<th>Value of time [DM/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work and related</td>
<td>11.50</td>
</tr>
<tr>
<td>Education</td>
<td>8.70</td>
</tr>
<tr>
<td>Shopping</td>
<td>7.40</td>
</tr>
<tr>
<td>Other, especially leisure</td>
<td>7.00</td>
</tr>
</tbody>
</table>

Table 4: Values of time (Paulußen, 1992)

External costs are equated with the environmental costs. The following components are taken into account:

- Emission costs,
- Noise,
- Accidents,
- Congestion,
for public and private transport. For bicycles, only accident costs are considered. No external costs resulting from pedestrians are taken into account in this context. The environmental costs are calculated with average values depending on the trip distance. Values were taken from VCÖ (1998), see Table 5. Do several persons share a vehicle for a trip, the costs are divided by the number of them. For public transport, an average vehicle occupancy is assumed.

<table>
<thead>
<tr>
<th>Means of transport</th>
<th>Emissions</th>
<th>Noise</th>
<th>Accidents</th>
<th>Congestion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DM/ (person km)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0*</td>
</tr>
<tr>
<td>Bicycle</td>
<td>0</td>
<td>0</td>
<td>0.020</td>
<td>0*</td>
</tr>
<tr>
<td>Car, inner-city</td>
<td>0.081</td>
<td>0.037</td>
<td>0.063</td>
<td>0.169</td>
</tr>
<tr>
<td>Car, out-of-city</td>
<td>0.046</td>
<td>0.024</td>
<td>0.023</td>
<td>0</td>
</tr>
<tr>
<td>Rail, Tram, Underground</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 70 km</td>
<td>0.009</td>
<td>0.006</td>
<td>0.004</td>
<td>0</td>
</tr>
<tr>
<td>&gt; 70 km</td>
<td>0.009</td>
<td>0.009</td>
<td>0.004</td>
<td>0</td>
</tr>
<tr>
<td>Bus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>short-distance transport</td>
<td>0.070</td>
<td>0.023</td>
<td>0.019</td>
<td>0.011</td>
</tr>
<tr>
<td>long-distance transport</td>
<td>0.051</td>
<td>0.02</td>
<td>0.004</td>
<td>0</td>
</tr>
<tr>
<td>Trolley-line/-bus</td>
<td>0.009</td>
<td>0.017</td>
<td>0.009</td>
<td>0.011</td>
</tr>
</tbody>
</table>

Table 5: Values of external costs (VCÖ, 1998) (*own values)
3.5.6 Example

To clarify the cost calculation, the following example (based on the trip of one person on one day from the Mobidrive sample, see Table 6) was calculated. Costs of residence are not included.

<table>
<thead>
<tr>
<th>Trip No.</th>
<th>Trip Purpose</th>
<th>Mode: Walking</th>
<th>Mode. Car as driver</th>
<th>Trip distance [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shopping</td>
<td>15</td>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td>2</td>
<td>Return home</td>
<td>15</td>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td>3</td>
<td>Work</td>
<td>0</td>
<td>9</td>
<td>8000</td>
</tr>
<tr>
<td>4</td>
<td>Return home</td>
<td>0</td>
<td>12</td>
<td>8000</td>
</tr>
</tbody>
</table>

Table 6: Cost calculation: Example (trips)

Assuming that

- This person only possesses one car which he bought new with a purchase price of 30,000 DM (e.g. VW Polo),
- This car has an average mileage of 20,000 km/year,
- This car is primarily used by this person,
- That all these trips were made unaccompanied by a household member,

the following costs are produced (see Tables 7 and 8):
<table>
<thead>
<tr>
<th>Costs per unit</th>
<th>Trip duration or distance</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential costs</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fixed costs (car)</td>
<td>7,511 [DM/a]</td>
<td>-</td>
</tr>
<tr>
<td>Out-of-pocket costs</td>
<td>0.155 [DM/km]</td>
<td>16 km</td>
</tr>
<tr>
<td>Time costs:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Work</td>
<td>11.5 [DM/h]</td>
<td>9 min</td>
</tr>
<tr>
<td>- Shopping</td>
<td>7.4 [DM/h]</td>
<td>15 min</td>
</tr>
<tr>
<td>- Other</td>
<td>7.0 [DM/h]</td>
<td>27 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental costs:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Emissions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode: walking</td>
<td>0 [DM/p-km]</td>
<td>1 km</td>
</tr>
<tr>
<td>Mode: car as driver</td>
<td>0.081 [DM/p-km]</td>
<td>16 km</td>
</tr>
<tr>
<td>- Noise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode: walking</td>
<td>0 [DM/p-km]</td>
<td>1 km</td>
</tr>
<tr>
<td>Mode: car as driver</td>
<td>0.0377 [DM/p-km]</td>
<td>16 km</td>
</tr>
<tr>
<td>- Accidents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode: walking</td>
<td>0 [DM/p-km]</td>
<td>1 km</td>
</tr>
<tr>
<td>Mode: car as driver</td>
<td>0.063 [DM/p-km]</td>
<td>16 km</td>
</tr>
<tr>
<td>- Congestion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode: walking</td>
<td>0 [DM/p-km]</td>
<td>1 km</td>
</tr>
<tr>
<td>Mode: car as driver</td>
<td>0.169 [DM/p-km]</td>
<td>16 km</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Cost calculation: Example (calculation)
<table>
<thead>
<tr>
<th>Residence</th>
<th>Person</th>
<th>Household</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed</td>
<td>20.58 [DM/d]</td>
<td>Not applicable</td>
<td>-</td>
</tr>
<tr>
<td>Travel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Out-of-pocket</td>
<td>2.48 [DM/d]</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>- Time</td>
<td>6.73 [DM/d]</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>- Environmental</td>
<td>-</td>
<td>-</td>
<td>5.61 [DM/d]</td>
</tr>
<tr>
<td></td>
<td><strong>29.79 [DM/d]</strong></td>
<td>-</td>
<td><strong>5.61 [DM/d]</strong></td>
</tr>
</tbody>
</table>

Table 8: Cost calculation: Example (results)

### 3.6 Building Scenarios

In the case that a person enters new activity locations, for example when the household plans to move or a member will change his workplace, a new space-time-behavior has to be derived from his former activity patterns. This new space-time-behavior based on the changed conditions is created interactively with the user, regarding primarily the change in activity locations, times and the activity chains.

The creation of the new space-time-patterns relies on the statements about desired and fixed activities (type, preferred locations, preferred times) and preferred vehicles. If not already given, probable activity locations can be taken from the YellowPages – in combination with an Address Locator - or YellowMaps. The location choice can be made by the user (the user chooses from all locations displayed for this activity type) or by MOBIPLAN (probable locations chosen by distance, name, size). Unfortunately, at the moment, the YellowMaps system contains only incomplete and roughly categorized data without statements about size, quality or a proper description of the location.

Activity times have to conform to external constraints such as opening hours, minimum and maximum duration of activities and the user’s variable time gaps. Possible activity chains can be suggested, but in this version of MOBIPLAN, they are not optimized for minimum travel costs or travel time.
4 CONCLUSION

The goal of this paper was the description of the design and implementation of the internet-based MOBIPLAN tool, an information and advisory tool for individual space-time-behavior in the short and long term.

At present, the Mobiplan website is not publicly accessible. A first version of MOBIPLAN will be tested in Summer 2000. Its first (monitored) application will take place in Autumn 2000 in Karlsruhe (Germany). Then, some selected Stated Response (SR) experiments on location choice, travel behaviour and vehicle ownership will be added based on the finished tool. Further improvements of the tool will follow integrating the results of the application. Afterwards it will be accessible via the Internet free of charge. Implementation for further cities is planned.

Existing transport models may benefit from the experiences of the Mobiplan project in terms of activity scheduling, activity chain generation and coordination among household members as well as of costs of activity performance.

The use of MOBIPLAN is not only restricted to an information or advisory tool. Its design also allows the conduction of internet-based SR applications, as well as single- or multi-day travel-activity surveys via internet. The structure of the user database does not need to be changed for these applications. MOBIPLAN may, for these purposes, benefit from further current links - additional to route planning or transit systems - Yellow Maps or similar indexes to support and broaden its functionalities.

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- IVT, Swiss Federal Institute of Technology, Zuerich (ETH), Switzerland
- PTV AG, Karlsruhe, Germany
- Institute for Sociology (IfS), University of Karlsruhe, Germany.
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6 REFERENCES


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