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MOBIPLAN: an Internet-based personal mobility advisor

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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 effects. MOBIPLAN provides information on the personal, social and environmental effects of long-range-decisions in order to highlight them and, as well, to influence these decisions and, in turn, the daily space–time-behavior that derives from them.

Two main services, a *site mode* presenting quick as well as detailed information about the vicinity of a specific address and an *advisory mode* for the analyses of individual space–time-behavior, have been implemented. The latter offers three levels of functionality—an overview, the advisory mode for single or multiple day(s), and a projection of the daily results to 1 year. In the advisory modes, MOBIPLAN calculates the effects of a given or hypothetical activity chain and shows transport alternatives. 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 costs incurred. The evaluation covers the private and social, fixed and variable vehicle and transport usage costs.

Since its official release during the project's final conference in August 2001, MOBIPLAN is available at www.mobiplan.de free of charge.

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 may be taken without complete knowledge of the resulting effects in terms of the private and social costs (Beckmann, 2000). 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 generalized (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—which was initiated in 1998 by the German Ministry of Education and Research—aimed at analyzing the impacts on daily mobility resulting from improved information on long-term decisions. A further aim of the project was to deepen the knowledge about such long-term decisions in general and to see, whether such information can influence people's choices. Therefore,

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the Mobiplan project focused on the development of the Internet-based software system 'MOBIPLAN', a mobility planner and analyzer, which provides a comprehensive mobility information service. Among other functionalities, MOBIPLAN analyses, evaluates, and optimizes activity chains for alternative scenarios based on the user's input and provides estimates of their effects and so, gives an overview of the effects of the household's long range decisions.

It is the first time that these kinds of functionalities are provided on the Internet. We have grown accustomed to using Internet-based information services like trip planning systems for public (e.g. www.bahn.de) or private transport (e.g. www.falk.de) or both (www.reiseplanung.de). Advanced public transport information systems are accessible online at the transport provider websites (e.g. Rhein-Main-Verkehrsverbund: www.rmv.de) or offline at public transport stops. It is easy to get online access to current information on public transport schedules, connections, travel times, and fares. Most trip planning systems for private transport (online and in-vehicle route guidance systems) calculate the routes, estimated travel times and fuel consumption for the requested trip. Further information is sometimes provided, e.g. current locations of congestion and road works. These data can be transmitted to cell phones or personal digital assistants (PDAs), e.g. using wireless application protocol (WAP) technology.

But, these information usually apply to one single trip only. They do not offer information on a whole day's mobility pattern or longer timeframes. Additionally, these sources of online information were never linked in order to allow direct comparisons between transport alternatives, their characteristics (e.g. travel times, costs) and their social and environmental impacts. The possibility of comparing different long-term scenarios regarding the adaptation of routinized mobility behavior to changed conditions is also offered by MOBIPLAN only.

Among the individuals who want to inform themselves about their mobility, the specific target groups of the first version of the MOBIPLAN tool are individuals or households who are planning to move and are looking for advice, either alone on the Internet or with official assistance, e.g. at building societies, municipal offices or public transport providers.

2. Scope of the MOBIPLAN tool

Long-range decisions about locations, in particular residence or workplace, enable or restrict the peoples' participation in everyday activities. There are both long- and short-term restrictions to be considered which are implied by 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 to perform the household activities. 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 also to be taken into account.

Both long- and short-term restrictions influence the household's destination 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 behavior. Conversely, the experiences made and the restrictions in everyday behavior 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.

The Internet-based software system MOBIPLAN substantially fills this gap by providing personalized data and cost estimates of behavioral consequences and alternatives. MOBIPLAN informs the user on e.g.:

- the estimated travel time consumption,
- the transport costs, including fixed costs for vehicle purchases and season tickets,
- the environmental and social impacts resulting from the use of certain means of transportation.

This information is derived from the linking of MOBIPLAN with other data sources provided on the Internet, e.g. data servers providing 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).

MOBIPLAN provides information in two main modes of service (Fig. 1):

- a *site mode* presenting quick as well as detailed information about the vicinity of a specific address and
- an *advisory mode* analyzing the travel behavior of persons and households.

The site mode provides initial information, which requires only an address as input data. MOBIPLAN then displays locations and points of interest in the vicinity of this address, such as schools, public facilities, and institutions. It also informs about the nearest public transport stop and the accessibility of points of interest (train station, city center) by different modes of transport. An example for the presentation of results in the site mode is shown in Fig. 2. Because of its rather simple functionality, the site mode will not be dealt with in this paper.

The *advisory mode* aims at users interested in a

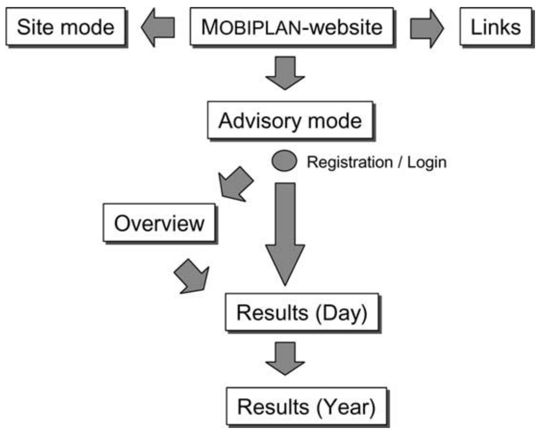


Fig. 1. Scope of MOBIPLAN.

comprehensive analysis of their mobility patterns at the current time or in upcoming situations. For users wanting to estimate the impacts resulting from a change of residence or workplace, MOBIPLAN supplies specific advisory sub-modes guiding them through these scenarios.

The advisory mode analyses mobility patterns on three different levels, of which the first one may be skipped (cf. Fig. 1):

- *Overview*
- *Results*: *Day*
- *Results*: *Year*.

These levels are explained in detail in Section 3.

3. The MOBIPLAN advisory mode

As this mode is based on the input of further user-related data, a user registration is required on entering the advisory mode. Data security is assured by a personal login which comprises an identifier (name), a password, and an address. This allows the data to be stored and re-used, maybe during a later login, in a user database on the MOBIPLAN—Server.

The structure of the advisory mode, its data needs and the algorithms used are shown in Fig. 3. The Overview is based on a few items given by the MOBIPLAN user (home, frequency of activities, person group). The users' mobility patterns are estimated for a period of 1 year using a demand-estimation model and evaluated in terms of travel time and costs as well as environmental and social impacts. In order to obtain more detailed results, the user may enter information on his frequently occurring activities (work, shopping, leisure, etc.) and the corresponding activity locations for each weekday. MOBIPLAN evaluates this data and suggests suitable transport modes which can be used to access the activity locations. Additionally, it provides detailed information on travel time and costs as well as the resulting environmental and social effects (Results: Day). This calculation may be used for a grossing-up to one year with respect to long-term scenario comparisons (Results: Year).

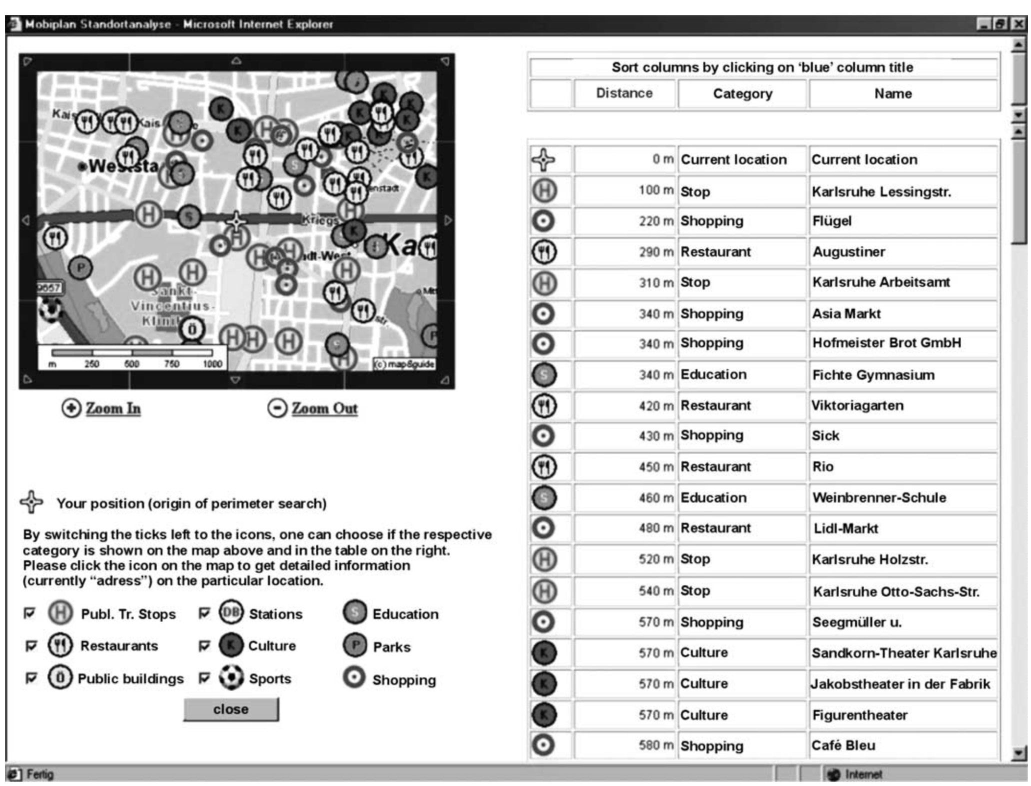


Fig. 2. Site mode results.

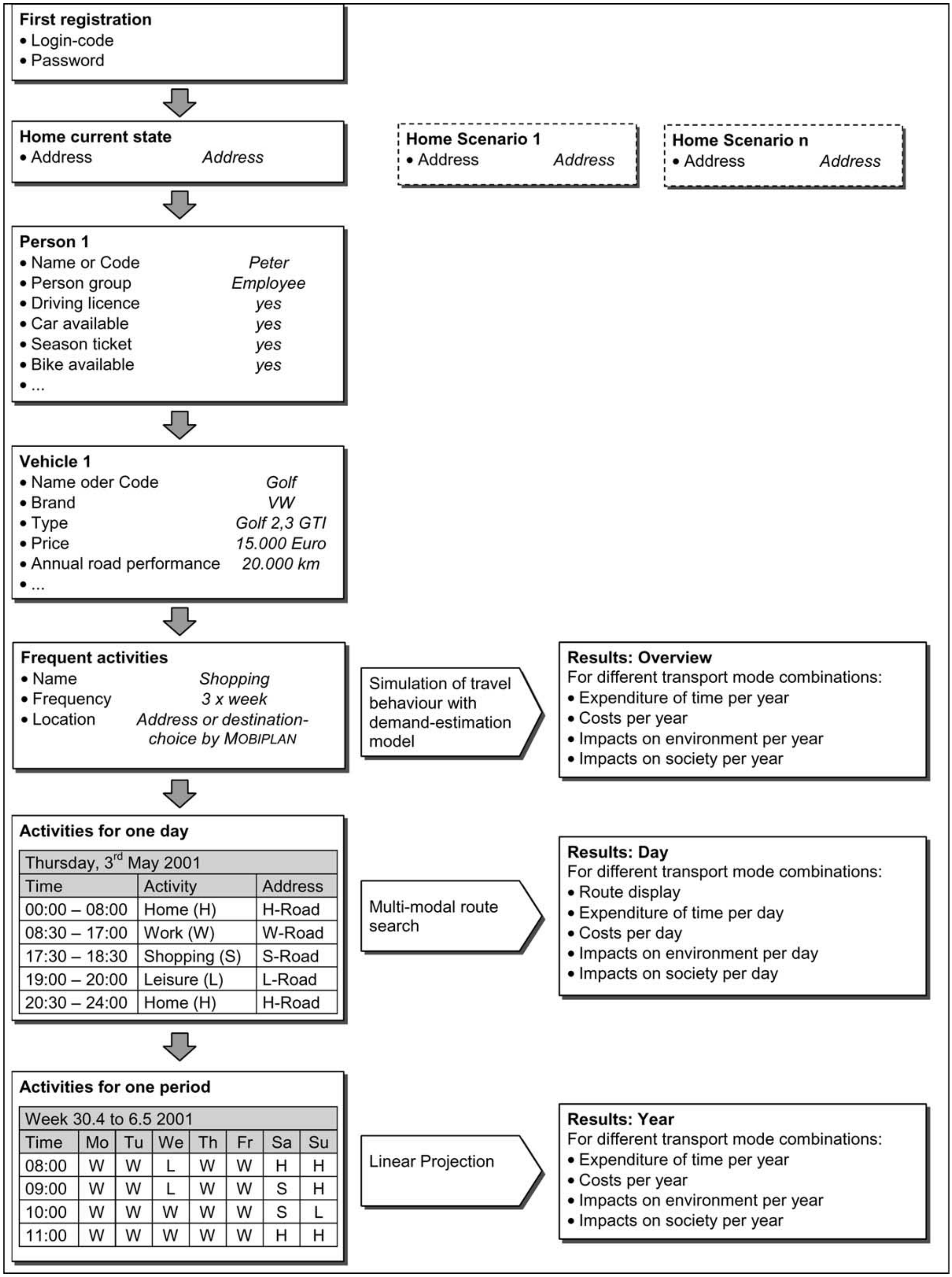


Fig. 3. Structure of MOBIPLAN advisory mode—data input and results.

In the case where the user wants to estimate the impacts resulting from different scenarios (e.g. change of residence or workplace), he may enter new activity locations or make MOBIPLAN choose them appropriately.

Then, a new space–time-behavior pattern 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

Table 1
Person data

Person data	Reason
First name	The name is necessary to distinguish between different household members
Person group	MOBIPLAN uses group specific behavioral data, such as activity chains and frequencies. Therefore, it is necessary to indicate to which group the person belongs to (e.g. employed/unemployed, housewife or househusband, pensioner, child, pupil, student, trainee or apprentice)
Driving licence	Only household members with a driving licence having access to a motorized private vehicle (as driver)
Season ticket availability and ticket costs	Necessary for calculating the costs of public transport
Car availability	This indicates whether a person has a vehicle as driver. It is also possible to choose a car-sharing vehicle as standard vehicle
Bike availability	This indicates whether a bike is available. The bike price helps to estimate the costs of the bike per kilometer based on an annual road performance of 1000 km and a linear depreciation over 10 years
Maximum acceptable walking distance (km)	This indicates the preferred maximum walking distance which is taken into account for the choice of transport mode
Maximum acceptable cycling distance (km)	This indicates the preferred maximum cycling distance which is taken into account for the choice of transport mode
Value of time (DM/h)	This indicates personal time costs for the monetary evaluation of travel time

Table 2
Vehicle data

Vehicle data	Reason
Brand and type of vehicle	The user can choose his type of vehicle from the database which includes the price, insurance rate, maintenance and repair costs as well as the average petrol consumption for each type of vehicle
Purchase price (DM)	The user can enter the actual purchase price. The price for a new car is suggested as standard value
Age of vehicle at date of purchase (yr)	This is used for calculating the depreciation. New vehicles have a higher depreciation than older ones
Mileage at purchase (km)	This is used for evaluating the repair costs. Vehicles with a high mileage have higher repair costs than vehicles with a low mileage
Anticipated period of use (yr)	The depreciation is distributed equally over the period of use, even if the depreciation is higher for the prior years
Annual mileage (km)	The higher the use is, the lower is the fixed costs' percentage of kilometer-related costs
Petrol consumption (l/100 km)	This is used for calculating the petrol costs. The standard value given by the vehicle database is the average consumption according to the DIN-standard
Petrol price (DM/l)	The price of petrol is needed for calculating the petrol costs

space–time-patterns relies on the statements about desired and fixed activities (type, preferred locations, preferred times) and preferred vehicles. 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.

All levels of the advisory mode require user statements about the household resp. place of residence, person, and vehicle data. The household data refers to the location which is analyzed. Both the current or planned places of residence can be entered.

The person data listed in Table 1 are requested for each household member.

The vehicle data includes all information required to calculate the costs of movement with a certain vehicle. This calculation is based on actual mileage. Fixed costs (depreciation, insurance, maintenance) and running costs (petrol) are distinguished. The basis is a vehicle database which stores information on the price, insurance rates and petrol consumption for each type of vehicle (Juchum et al., 1998). Table 2 shows the required vehicle data.

Similar to a travel survey, MOBIPLAN collects this information offering a special interview mode (see Fig. 4 as an example for the input of personal data). For user convenience, MOBIPLAN attempts to reduce the amount of input data by distinguishing between mandatory and optional input attributes. If stated by the user, MOBIPLAN completes the information automatically with suitable assumptions. The user may add additional data to the user database or modify all data input after the interview, leaving the interview mode and using a specific data input facility.

Information about the user's mobility behavior is collected in the next steps, according to the type of calculation—and detail of results—the user desires.

3.1. Overview

The Overview was designed to provide results quickly as accurately as possible, based on as little as possible user input. MOBIPLAN analyses the user's frequent activities and activity locations. Annual indicators are derived from these figures informing the user on the impacts of his mobility patterns. When different transport modes are combined (often car, often public transport, etc.) the factors travel time, costs, CO_2 emission and energy consumption are correlated with each other. PTV's model VISEM (Fellendorf et al., 1997) is used for trip generation and

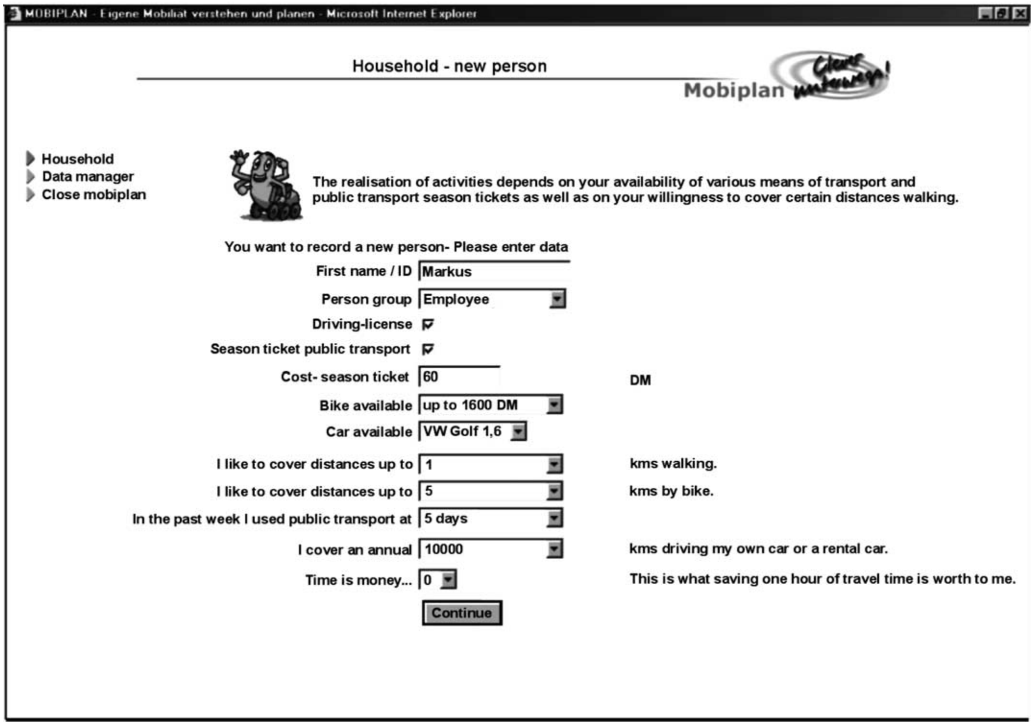


Fig. 4. Mobiplan—person data input.

destination choice in order to achieve meaningful results from the limited input data. This procedure is particularly useful for the analysis of moving to a different location or changing the workplace and then comparing the impacts of two different locations.

The results are aggregated, annual values resulting from model estimates. Therefore, they are presented as aggregated annual values in tables. Single routes or the destination choice results are not displayed.

The necessary input about the user's activities is limited to frequent activities (work, school, education, shopping, leisure time) with the following specifications:

- Activity frequency: how often do you perform a certain activity during the week?
- Activity location: indication of address or choice of probable destination by Mobiplan, using a destination choice model which takes both distance to and attraction of the possible destinations into account.

Groups of persons with a so-called compulsory activity have to indicate the activity location as, in this case, an automatic destination choice is not helpful. Compulsory activities are:

- Employee → compulsory activity: work
- Pupil → compulsory activity: school
- Student → compulsory activity: university
- Trainee/Apprentice → compulsory activity: apprenticeship or training.

A travel demand model with integrated projection function, choice of destination and transport mode is required in order to provide the Mobiplan user with an overview of his current and future mobility patterns. Such a model was developed by PTV AG (Friedrich and Haupt, 2001) which includes all necessary data on infrastructure as well as on private and public transport:

- Network model for private and public transport with traffic zones (reference: PTV transport model Karlsruhe)
- Activity chain distributions specified according to homogeneous groups of persons (reference: KONTIV 1987—cp. DIW, 1993) and Mobidrive (cp. König et al., 2000)
- Land use data by traffic zones as attraction potentials (reference: PTV transport model Karlsruhe)
- Location of schools and colleges
- Location of universities
- Location of shopping facilities
- Location of recreation areas
- Indicator matrix describing impedance and service quality between traffic zones (reference: PTV transport model Karlsruhe)
- Direct distance
- Journey time: car, public transport, bike, walking
- Journey distance: car, public transport, bike, walking
- Number of transfers.

All addresses are allocated to the zone centroid. For the destination choice modeling, each traffic zone needs data on opportunities from which the attraction factors of the zone

Table 3
Attraction factors

Activity	Opportunities
Work	Work places
Education—school	School places
Education—apprenticeship	Training places
Education—university	Places available
Shopping	Shopping facilities
Leisure	Cinemas, theatres, restaurants, clubs, associations
Private matters	Inhabitants

are derived. Table 3 lists the land use data commonly used for this purpose. Large weights will be assigned to known addresses or possible locations near the residence for activities taking place at different locations of which only some addresses are stated, e.g. shopping.

The model employed by MOBIPLAN uses the annual distribution of activity chains to characterize a person. The distribution of the respective homogeneous group, to which a user belongs, is known from many other surveys (KONTIV, 1987—cp. DIW, 1993; Mobidrive—cp. König et al., 2000; Axhausen et al., 2002; Mobiplan—cp. Mobiplan Consortium, 1999, 2001). This prior distribution is adjusted to the self-reported activity frequencies using a modified Fratar-method (Fig. 5).

The next step creates a trip matrix which includes the specific user's movements between stated or likely activity locations. Therefore, the components 'trip generation' and 'trip distribution' of PTV's traffic demand model VISEM are used. This model searches a suitable location for each activity as part of an activity chain and thereby transfers the activity chains to so-called trip chains. Fig. 6 shows an example of how two trip chains and one trip matrix are derived from an activity chain 'home–work–shop–home'. The destination choice for likely locations is based on a gravity model. The corresponding trip matrix does not yet include any information on the transport mode (car, public transport, bike, walking). It calculates a total trip matrix for the relevant person.

A transport mode choice step (Fig. 7) derives separate trip matrices for public transport, car, bike or walking from the total trip matrix in order to present the impacts of different transport mode shares to the MOBIPLAN user. The modal split is based on a Logit model that includes journey time, transfers and costs for the different transport modes (Fellendorf et al., 1997). Furthermore, only these modes available to the MOBIPLAN user are taken into consideration. Four modal-split scenarios are calculated to display the impacts of combining different transport modes:

- Standard: assuming a transport mode choice which is typical to the homogeneous group of people
- Car preference: car is preferred for all trips longer than 1000 m
- Public transport preference: public transport is preferred for all trips longer than 1000 m, even if the journey time by car is shorter
- Environment: bike or walking is preferred for the user

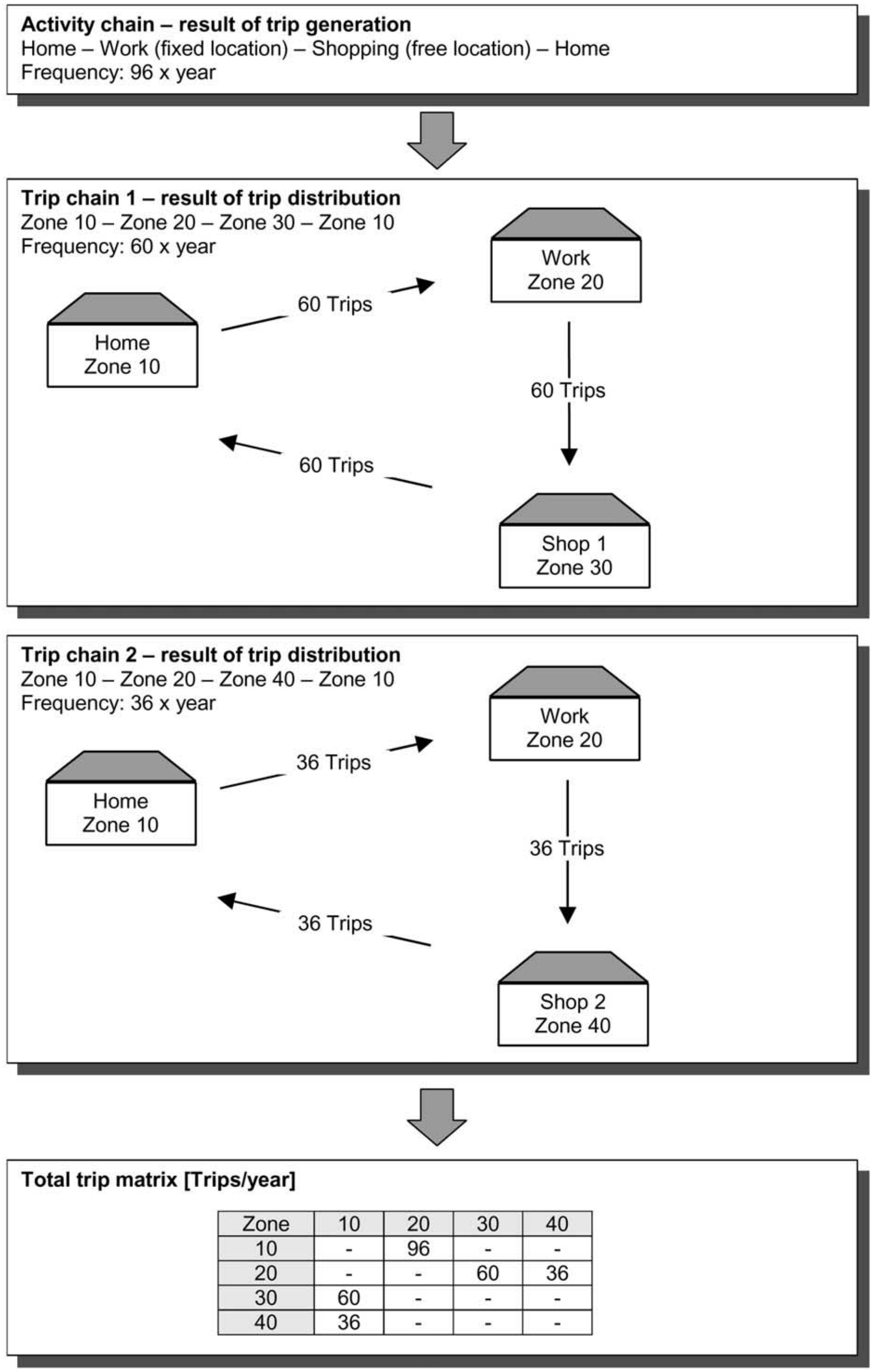
Activity chain	Frequency	Activity				Sum of trips*
	per year	Home (H)	Work (W)	Leisure (L)	Shopping (S)	per year
HWH	220	220	220	0	0	
HLH	72	72	0	72	0	
HSH	48	48	0	0	48	
HWSH	96	96	96	0	96	
HWLH	52	52	52	52	0	
HWSLH	32	32	32	32	32	
Trips/year KONTIV			400	156	176	732
Trips/year MOBIPLAN-user			440	180	80	700

matrix correction with Fratar

Activity chain	Frequency	Activity				Sum of trips*
	per year	Home (H)	Work (W)	Leisure (L)	Shopping (S)	per year
HWH	299	299	299	0	0	
HLH	89	89	0	89	0	
HSH	7	7	0	0	7	
HWSH	50	50	50	0	50	
HWLH	68	68	68	68	0	
HWSLH	23	23	23	23	23	
Trips/year KONTIV modifed			440	180	80	700
Trips/year MOBIPLAN-user			440	180	80	700

* outbound and non-home-based trips

Fig. 5. Matching of MOBIPLAN user's activity frequencies to KONTIV data.



Zone	10	20	30	40
10	-	96	-	-
20	-	-	60	36
30	60	-	-	-
40	36	-	-	-

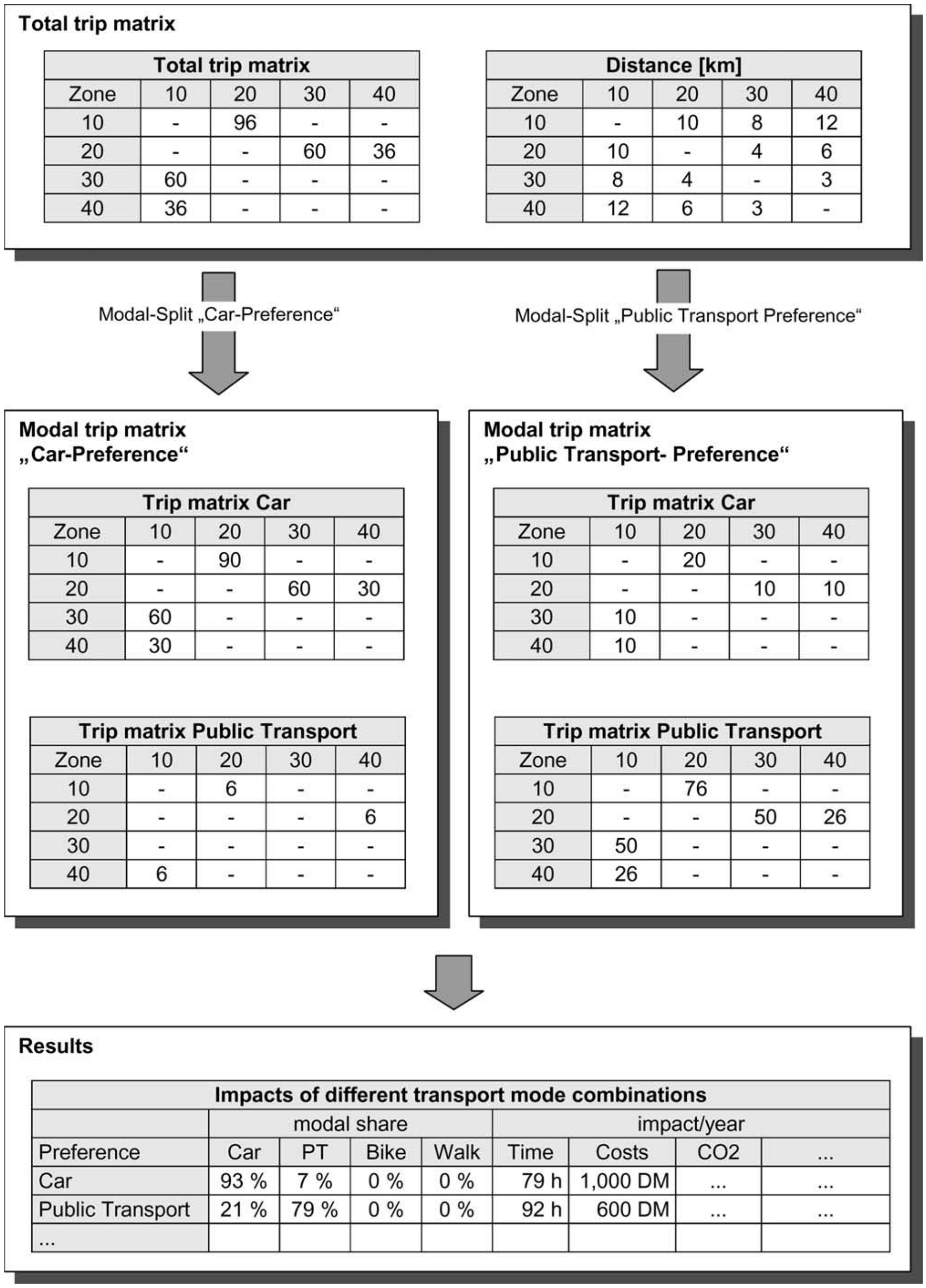
Fig. 6. Trip matrix generation derived from activity chains.

specified maximum trip distances, otherwise public transport is used.

Each scenario produces four demand matrices (car, public transport, bike, walking). These data are used for impact analysis and evaluation. The following indicators are calculated for each, covering a period of 1 year:

- Travel distance (km/yr)
- Travel time (h/yr)
- Fixed costs (DM/yr) (for purchase)
- Travel costs (DM/yr)
- Time costs (DM/yr)
- Environmental impacts (kg-CO_2/yr)
- Energy consumption (MJ/yr).

Costs of vehicle operation are calculated using the cost tables of the German Automobile Association (ADAC)



Total trip matrix

Zone	10	20	30	40
10	-	96	-	-
20	-	-	60	36
30	60	-	-	-
40	36	-	-	-

Distance [km]

Zone	10	20	30	40
10	-	10	8	12
20	10	-	4	6
30	8	4	-	3
40	12	6	3	-

Modal trip matrix „Car-Preference“ – Trip matrix Car

Zone	10	20	30	40
10	-	90	-	-
20	-	-	60	30
30	60	-	-	-
40	30	-	-	-

Modal trip matrix „Car-Preference“ – Trip matrix Public Transport

Zone	10	20	30	40
10	-	6	-	-
20	-	-	-	6
30	-	-	-	-
40	6	-	-	-

Modal trip matrix „Public Transport- Preference“ – Trip matrix Car

Zone	10	20	30	40
10	-	20	-	-
20	-	-	10	10
30	10	-	-	-
40	10	-	-	-

Modal trip matrix „Public Transport- Preference“ – Trip matrix Public Transport

Zone	10	20	30	40
10	-	76	-	-
20	-	-	50	26
30	50	-	-	-
40	26	-	-	-

Impacts of different transport mode combinations

	modal share				impact/year			
Preference	Car	PT	Bike	Walk	Time	Costs	CO2	...
Car	93 %	7 %	0 %	0 %	79 h	1,000 DM	...	...
Public Transport	21 %	79 %	0 %	0 %	92 h	600 DM	...	...
...								

Fig. 7. Mode choice for different preferences.

(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 fees. 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. 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.

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. (1997) and FGSV (1997). The time costs of each private and public transport trip are based on the travel times and trip purposes of each traveler. Appropriate values were taken from Paulußen (1992).

External costs are equated with the environmental costs (emissions, 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). If 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.

The social 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. So, marginal cost calculations (cf. TRB, 1996) were inexecutable. Following INFRAS and IWW (1994) and Ellwanger (1995), external benefits are considered to be negligible.

An example for the presentation of the results is given in Fig. 8.

3.2. Results for 1 or multiple day(s)

In the second stage, the MOBIPLAN user may add more details on his activities on a day of his choice for a detailed analysis of his own mobility behavior on that day. The results for 1 day will inform the user on the possible routes for a predefined activity programme, i.e. activity sequences, as well as on the impacts on time use, costs, environment, and society. Therefore, information is required on the user's regular activities on the chosen day and the activity locations. In general, activity locations visited during the day are used as input data. The calculation is based on the daily programme of one user. MOBIPLAN provides a calendar display where the MOBIPLAN user can enter his daily activities, similar to a diary (Fig. 9). Each activity is described by the following features (Fig. 10):

- Type of activity (work, shopping, education, leisure, etc.)
- Address of activity location
- Start time and expected duration of activity
- Transport modes available
- Participating household members.

From this input, MOBIPLAN derives suggestions, how the activity locations of the given activity chains may be reached with different means of transport, i.e. it suggests the best routes between the activity locations for all modes of transport choosing from car, public transport/transit, bike, walk, or a combination of modes. The individual routes are then linked to each other forming a trip chain which takes transport mode transfers into account. At any time, a change between the modes 'public transport' and 'walking' is possible. However, to change from car or bike to a different transport mode is only possible at a few locations, e.g. at the home address. If complex trip chains are created, only the best combinations are chosen so that the user has a clear overview of the transport mode combinations. The selection aims at concentrating on a few combinations which should always include one public transport alternative.

The selection of suitable transport modes for individual trips depends on the vehicle availability and the direct distance between start and destination: the modes 'bike' or walking are considered up to a maximum route distance which the MOBIPLAN user enters with his personal data. Vehicles are only taken into account when a vehicle is available. This also applies to the bike availability.

The transport network data or timetables for the individual transport modes are required for these calculations. PTV's component map and guide (PTV, undated) is used for private routing (car, bike). Public routing uses a Hafas Server (Hacon, undated).

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, including the particular travel times, individual costs as well as social and environmental effects of each alternative.

If several or all household members make entries concerning their situation, costs may be calculated on a household level. 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.

The table of results gives an overview of the indicators for each modal combination:

- Modes of transport: car, transit, bike, walk or a combination of modes
- Travel time (h/day): travel/access/egress/transfer time, duration, average travel speed
- Travel costs (DM/day): transit fare, fixed and kilometer-dependent car costs, time costs
- Environmental impacts: energy consumption (MJ/day), CO_2-emissions (kg-CO_2/day), taking the higher CO_2 emission for shorter trips by car into account (Hassel und Jost, 1994)
- Social impacts (DM/day): global costs of emissions, noise, accidents, congestion (VCÖ, 1998).

Each indicator is shown on a separate tab, see for example the environmental impacts shown in Fig. 11. Clicking on one alternative in the table provides a map view with a graphical and tabular display of the selected sequence (Fig. 12).

3.3. Grossing-up to 1 year

The third level of MOBIPLAN provides an estimate for the effects during 1 year based on the given mobility behavior

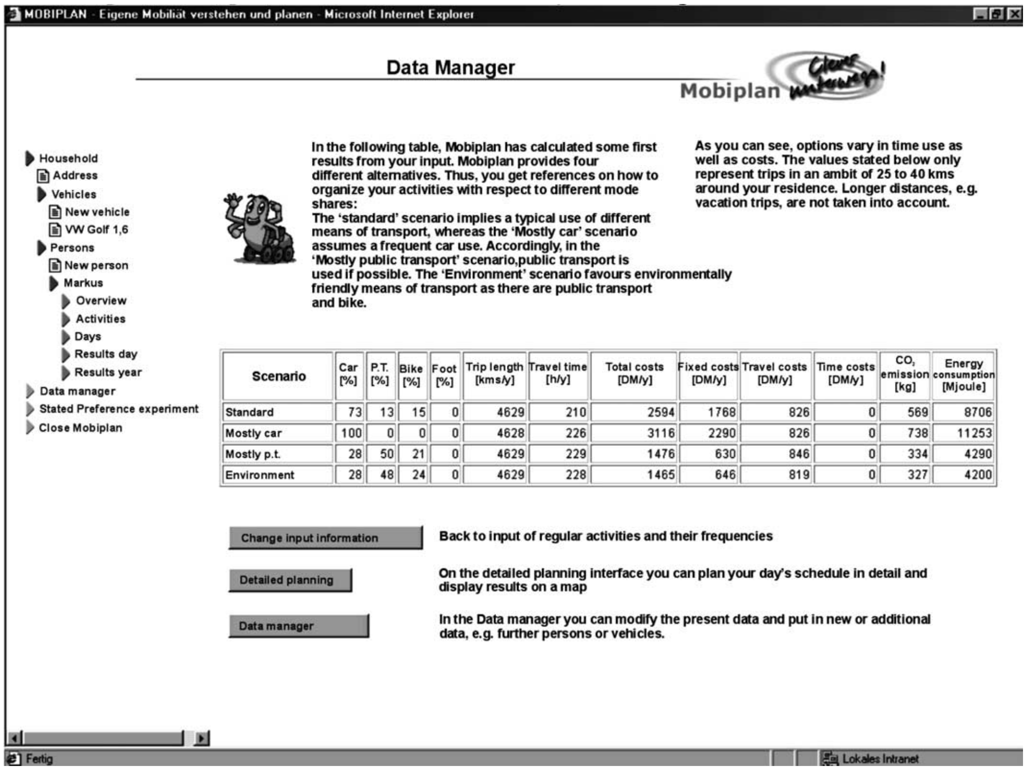


Fig. 8. Overview: results for 1 year.

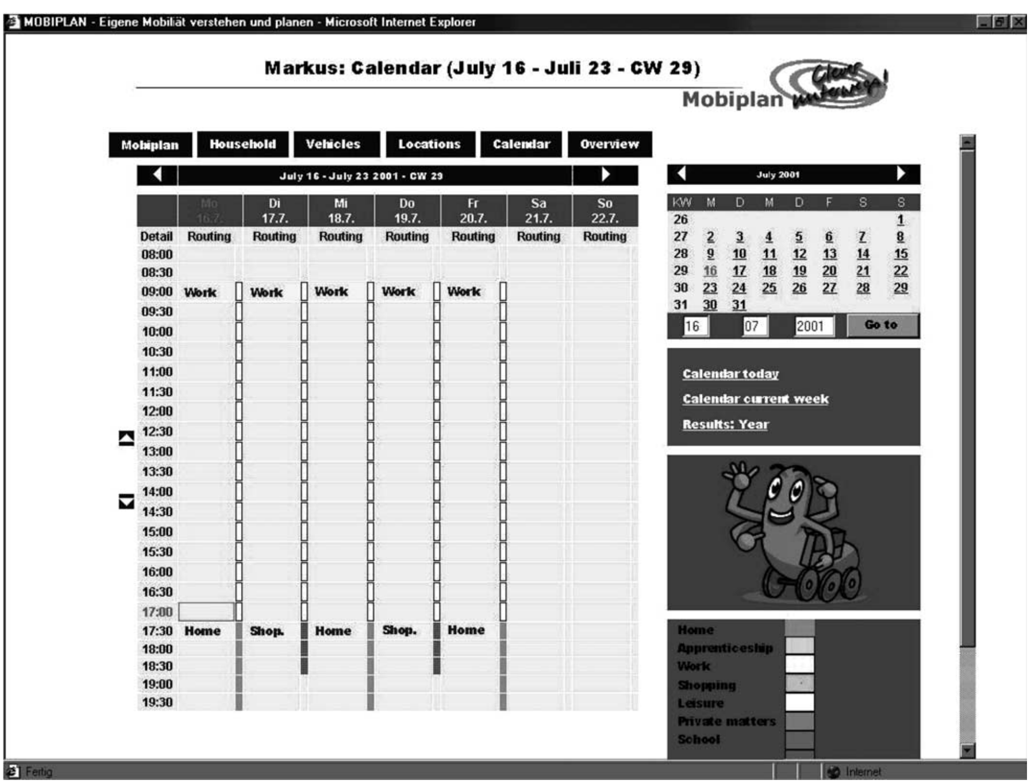


Fig. 9. MOBIPLAN—calendar display for activity data input for 1 day.

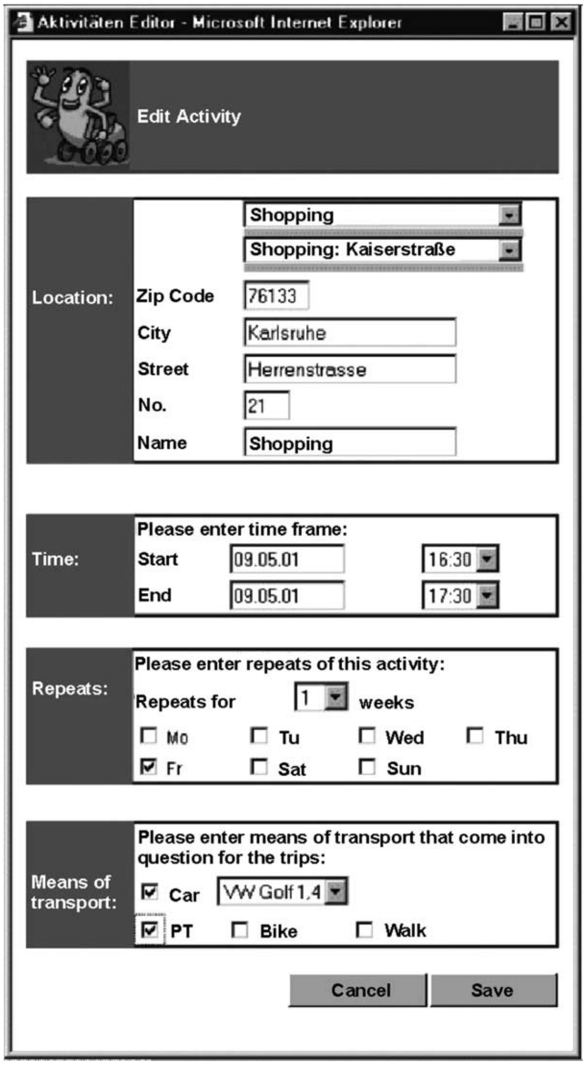


Fig. 10. MOBIPLAN—input of activity details.

of 1 day (or—depending on the user input—several days). This projection relies on the more detailed user input from the second level and allows, therefore, for more accurate results than the Overview.

The grossing-up simply projects the behavior on individual days to 1 year. For this, the user assigns one of the days he already entered into MOBIPLAN to each day of the week. The calculation then takes the results calculated for each assigned day from the single-day calculations and simply multiplies every indicator with the necessary frequency. 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 1 day but for all relevant day-types.

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 single day may have different characteristics (activity locations, activity times, means of transport used,…) in the following week (Axhausen et al., 2002).

The error of a simple grossing-up was estimated by Kreitz et al. (2000). It turned out that a calculation based on just 1 day produces for 41% of the cases an error of less than 25% for the calculated travel time compared to the observed travel time. Having 3 days as basis, 68% of the cases show an error of less than 25%, which was considered as an acceptable result for this kind of projection.

The results are given in the same tables as the results for 1 day, but without the map view functionality, which is of no interest for this stage of the application.

4. Test of the MOBIPLAN tool

In the Spring of 2001, the MOBIPLAN tool was tested regarding its functionalities and handling. The test took place with 60 persons in Karlsruhe, Germany. Contents of

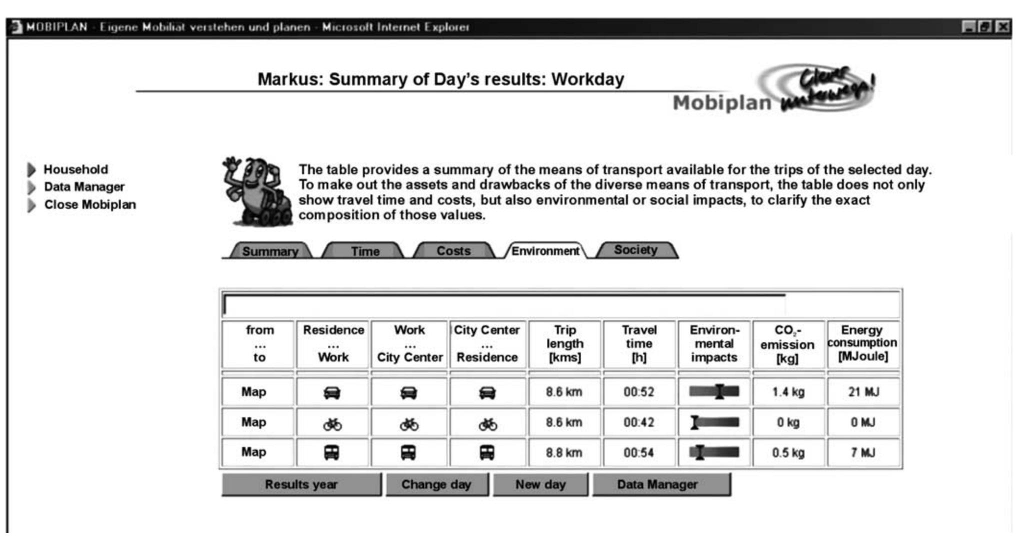


Fig. 11. Results for 1 day: environmental impacts.

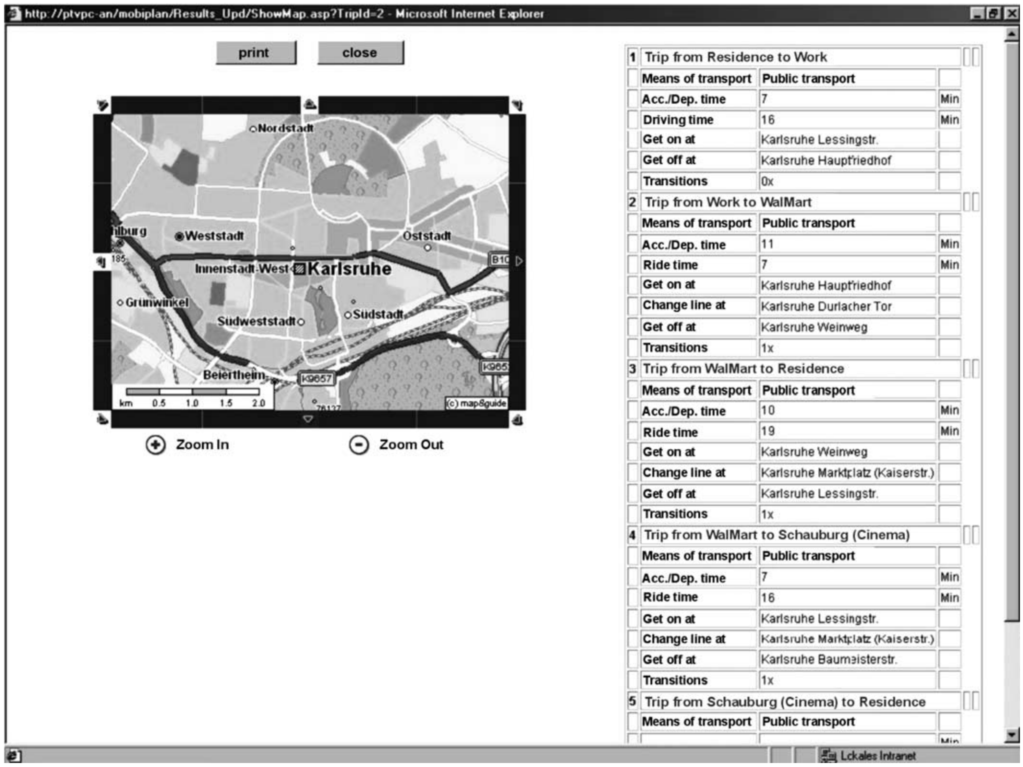


Fig. 12. Map view showing a suggested tour, using public transport.

the test were the overview mode, the results for 1 day and the grossing-up.

The sample was drawn in order to represent the Mobiplan target groups. Therefore, 85% of the persons had a computer available at home and 90% at their business, while 70% of all also had an Internet-account. The sample consisted of 43% male and 57% female persons. No car was available for 18% of the sample and 50% of the sample were younger than 30 years.

Generally, 65% of the sample stated that it was fun to work with the tool, of whom 69% declared they would also use the tool at home. The others found faults in the results and their presentation, which were continuously revised during the test. Of the samples 72% assessed the tool and said the results as 'interesting', but only 32% were embarrassed by the results presented. Suggestions for the further development of the tool included an improved input module for the activities on 1 day, further increased emphasis on alternative means of transport (walking, biking, public transport) and a concise presentation of results.

As a result of the test, the calendar described earlier was implemented as input mode, in order to facilitate the entry of activity data. Out-of-date data bases, e.g. for routing, were exchanged.

5. Conclusion

This paper describes the design and the implementation of the Internet-based Mobiplan tool, an information and advisory tool for individual space–time-behavior in the short- and long-term. It is the first time that various information sources available on the Internet are linked in order to provide information about individual mobility behavior and its alternatives, along with a calculation of the resulting individual, social and environmental effects at different levels of detail. Mobiplan also allows the comparison of current behavior and upcoming situations—e.g. resulting from a new place of residence or a change of workplace.

Since its official release during of the Mobiplan project's final conference, Mobiplan is available at www.mobiplan.de free of charge. In this first version, only the German region 'Upper Rhine' is included. Further cooperations with regional transport providers in order to extend the area covered by Mobiplan are on their way.

Future commercial applications are primarily expected with public authorities. Mobiplan may be used by public transport organizations in order to broaden their customers service with the calculation and presentation of the effects of transport alternatives. Improved information may lead to an increased mode share for public transport. Mobility information services provided by cities and regions may benefit from Mobiplan as they can offer long-term advice for households facing long-term decisions. This may help these persons to improve their choice processes as well as the results.

Furthermore, the use of Mobiplan is not only restricted to an information or advisory tool. Its design also allows the conduct of Internet-based survey applications, as well as single- or multi-day travel-activity surveys via Internet. So, it is an ideal enquiry tool for market observation, for the pre-test of transport planning measures or the launch of a new product on the traffic and transport market.

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