Computerized Self-administered Survey and Modeling Framework for Students' Mobility and the underlying Scheduling Process

Wielant Ratz [1]
Claudia Jürgens [2]
Guido Rindsfüser [3]

[1] InTransiCon GmbH, Karlstr. 127, D - 76137 Karlsruhe, Germany
Phone +49-721-352515-0 (Fax -2) eMail: W.Ratz@intransicon.de (corresponding author)
[2, 3] RWTH Aachen, Institute für Stadtbauwesen und Stadtverkehr ISB
(Aachen University of Technology, Institute of Urban and Transportation Planning)
Mies-van-der-Rohe-Str. 1, D – 52074 Aachen, Germany, Fax +49-241-802-2247
[2] Phone +49-241-802-5235 eMail: Juergens@isb.rwth-aachen.de
[3] Phone +49-241-802-6204 eMail: Rindsfueser@isb.rwth-aachen.de

Project-Homepage: www.team-mobility.net (in German)

Abstract: This paper presents a new approach to analyze and model the "Activity-Travel Scheduling Process", tracing and observing triggers and reasons for activity planning at the very time of the scheduling-decision. A one-week self-administered survey on PocketPCs (PDA – personal digital assistant) handed out to students of ages 13-19 by complete class and in different types of school-environment with just 30 minutes for introduction was found to produce valuable results at little respondent burden and fatigue effects. The additional usage of the devices for games, music etc. was encouraged to keep the young and impatient respondents interested. The survey's detailed maps were widely preferred to typing in addresses decreasing also the efforts for geo-coding and facilitating future attachments to location-based services as well as team-calendars.

Though this was more exploring a technology and not fully representative statistics, students were found to behave significantly different by various attributes such as the day of the week, gender, age and especially the setting of their school. For example the mobility rate decreased much with higher age, the school setting could double non-motorized trips or weekends yielded doubled auto usage at the cost of transit only. Of the scheduled end-times of activities 40% were changed during the week; in about a third of the trips, persons being involved changed twice on average.

Observing the exact time and trigger of a decision concerning (re-)scheduling was found complex to categorize. Answering the prompted questions for reasons of specific choices of location, time or mode was often skipped due to the number of alternatives.

Word count: Abstract: 254
Entire Paper: 4904

Number of tables/diagrams: 8

Introduction

Activity-based travel demand models aiming at a complete coverage of activity choice, duration, location choice and sequencing are best named "activity-travel scheduling models" (Doherty and Axhausen in [1]). Scheduling also implies a continuing process of decisions - being not only interested in the final outcome of a schedule but in all the intermediate stages and (partial) decisions for one or more aspects of a planned activity or travel.

Doherty and Miller quote in [2] criticisms for complex data requirements and a lack of empirical insights into the scheduling process. They continue naming key issues to include how scheduling decisions are organized over time, why, when and how scheduling decision are revised, and how activities depend on the demands of other people, especially within households. Some of these demands are mostly technical in nature: Organization over time and when scheduling decision are revised can probably be observed by facilitating survey-input at all times and recording precise input time and a full changes-history. The other issues require new (forms of) questions partially proposed in this project.

A similar recent project surveying the planning process named CHASE [2] used a laptop-technology facing some new limitations compared to well known limitations of conventional diary techniques, for example through the instruction given to login at least once a day (which is a strong limitation for the goal to observe decisions near to the real decision point during the course of the day). The project described here is still adopting many of the experiences and approached of CHASE and extensions described in Rindsfüser, Mühlhans, Doherty and Beckmann in [6].

A more suitable device should be small, light, easy to handle and capable of storing data. The devices used for this project were Palmtop PocketPCs weighing 140g only (0.3 lb). Frequently transmitting data to some form of (partially) central database during the proposed one-week period was found not to be necessary. Rindsfüser et al. [6] showed in a similar approach the usage of such PDA for all ages and produced very good results compared with conventional surveys concerning the mean trip rates and other indicators.

The setting of this project was to conduct a survey with students in several complete classes one at the same time in order to capture common events and other conditions. The group "students" were picked due to special attributes of habit, duty and innovation. The model concept (part of the project) was also designed to be able to give practical advice to city planners about students' perspective and immediate problems in the surroundings of the schools leading to certain mode choice or activity choice nearby.

Therefore the project described in this publication combines:
- A new form of institutional cooperation involving students in design and implementation with
- The usage of new technology (light, electronic survey-media involving PocketPCs) and
- A survey and modeling approach to the Activity-Travel Scheduling Process.

During the project a university institute, a planning consultancy and a special school-course cooperated. The three parties were being involved in developing, conducting and analyzing this computerized survey conducted among other students of different schools. To complete the cycle towards travel behavior models and planning needs a comprehensive behavior model following the "triggering-approach" described below was outlined and will basically be implemented by the time of the TRB conference.

CONCEPTS

Definitions - Activity-Travel Chains, Impulse-Trigger, Decisions-Reasons

This paper will roughly adopt the definitions for activity, stage and trip proposed by Axhausen [4] (tour and journey will not be needed) changing some details: The inclusion of waiting time before an activity or (first) stage in a trip is not easily shown in a visual schedule and therefore apparently omitted for practical reasons. The spatial setting of the activity should not extend to the far away parking lot and not include walking to the final destination. Minor setting-modifications like switching to neighbor-rooms or eating/drinking during work will not be considered a change of spatial setting. On one hand during an activity the exact number and type of persons interacting is omitted since there is no apparent need in the model. On the other hand the stage was supplemented with the number and type of persons directly involved (accompanying). The trip was also supple-

mented optionally with intermediate locations where another stage starts or persons are picked up or dropped off (changing the number of persons accompanying).

The modified definitions and some scheduling terms will be used as follows:

- An **activity** is the main business carried out in one spatial setting. It includes any waiting time before the start of the activity itself thus starting when arriving at the final spatial destination.
- A **stage** is a continuous movement with one mode including any waiting times before the start of or during the movement. It includes a constant or no group of persons accompanying.
- A **trip** is a sequence of one or more stages and intermediate locations between two activities.
- A **trigger** is an internal or external (effective) event resulting eventually in a (re)scheduling impulse
- A scheduling **impulse** is the actual act of changing a schedule at a certain time (sometimes observable)
- A **context** for an impulse describes the time, location and conditions (e.g. weather) affecting the decision
- A **choice** (of activity, timing, sequencing, location or mode) is a selection among alternatives reflecting personal preferences and restrictions.
- **Reasons** for a choice are a reflected set of preferences, dependencies and decisions picked to cope with conflicting goals.

Differences between activity-types listed in Table 1 compared for example to the ones used in CHASE [2] are:

- a closer focus on the relating location type of the activity (at home, at work, at school, at all other locations)
- stops while traveling may also include certain (very short) activities such as pickup/bring persons or meals
- reducing travel activities (unless related to staying in one location for a certain time or round-trip)

0 Still Unknown	3 Work 30 Stationary work 31 Business travel 32 Regular secondary job 33 Irregular part-time job 34 Business training 35 Seeking a job 39 Others work	5 Leisure 50 Meeting friends 51 Sports (at one location) 52 Sports (moving around) 53 Walking/Pleasure drive 54 Event/Concert/Movies 55 Course 56 Eating out of home 57 Leaving home (leisure) 58 Excursion 59 Others leisure
1 Being at Home 10 Generally at home 11 In secondary home 12 Studying/homework 13 Visit from friends 14 Visit from relatives 15 Housework/garden 19 Others at home		
2 Education/Formation (at ...) 20 Child care 21 Elementary School 22 Secondary School 23 College/University 24 Formation School 25 Learning assistance 29 Others education	4 Shopping 40 Daily needs 41 Major shopping(weekend) 42 Non-food, spontaneous 43 Non-food, planned 44 Mostly browsing 49 Others shopping	6 Services 60 Doctor/Dentist 61 Public Administration 62 Post office, Bank, ... 63 Volunteering 64 Bring/Pick up 69 Others services

Table 1: Generic activity types used in this survey/model (organized in a numerical hierarchy)

Modes are categorized in similar detail. Each trip may contain as many stages as necessary with intermediate locations and certain activities during this changing time (e.g. shopping at a station while waiting for a train).

One focus of the project was to analyze differences in behavior of students living in a bigger city/town relatively close to their city-school and other shopping/leisure opportunities compared to students from surrounding villages coming to the smaller town over longer distances. Other focuses were the changing habits while growing up including motorization and different coordination habits.

Impulse-Reaction Scheme

The trigger for planning actions can sometimes remain deeply unconscious inside a human being, such as impatience or a vague need to meet people. This was decided not to be of importance unless it leads to a behavioral effect/change called the impulse. Sometimes this might actually be very similar to a trigger. Table 2 shows the types defined:

1 Personal trigger	**3 Information – different media**	**5 Unforeseen events**
10 Habit/routine	30 Letter/invitation	50 Activity lasts longer
11 Feel like doing something	31 Newspaper/magazine	51 Weather
12 Not interested anymore	32 Radio/TV	52 Communication blocked
13 Stress, pressure	33 Poster/public announcement	53 Sickness of acc. person
14 Sickness/feeling unwell	34 Traffic information	54 Sickness of family member
15 Hunger/thirst	35 Weather forecast	55 Accident
16 Tired	36 Erroneous information	59 Other unforeseen events
19 Other personal reason	39 Other information	
2 Appointment/planning	**4 Mode-related**	**8 Other trigger**
20 School hour/working hour	40 Planned vehicle broken	80 Input error
21 Other timetable/Habit	41 Planned vehicle taken	81 Change due to other chg
22 Coordination with others	42 Coordination with others	89 Other unspecified trigger
23 New appointment	43 Transit late	
24 Forgotten appointment	44 Transit cancelled	
25 Remembered appointment	45 Overcrowded line	
26 Personally being late	46 Congestion/detour	
27 Appointment cancelled	49 Other mode-related	
28 Location changed/same time		
29 Other planning		

Table 2: Generic Impulse types used in this survey/model (organized in a numerical hierarchy)

Information-filtering

The difference of trigger and impulse can be justified by the person filtering the kind of influences in one's life by ignoring some ("I don't have time for lunch today"), delaying or diverting to other forms of satisfaction. Besides there are modifiers which are not the original reason underlying a change, but which influence the outcome: Especially communication with other persons via phone or directly or the current weather conditions can actually influence the change of plans. With regard to communication triggers, the question was added of whether the other person(s) actually did decide the change of plans, or whether they left the respondent to execute their decision.

Rule-based Simulation using Agents

The kind of software system supporting this kind of individual decision process using a simulation of deterministic rules or probabilities, filtering individual or environmental influences according to some internal state are "Multi-Agent"-Simulators. They were originally built for very simple behavioral settings such as insects-cooperation but they can be applied to human behavior as well. Most of the demand models used today for planning purposes do not assume complex dependencies of personal decisions. So the proposed model will start from some already optimized skeleton-activity-structure as described by Doherty and Axhausen in [1], similar to the static activity-chains used in some of today's planning models.

Some rules to apply might be viewed like a distribution of answers; some might be an explanation in terms of parameters and some logical or functional outcome. Time constraints or conflicts could be solved according to some priority in activities or modes by context (of weather, daytime or next opportunity) or some heuristics to be added later. All these possibilities used to describe behavior will be basically implemented even though data to estimate parameters is still rare or needs to come from other surveys of perhaps different backgrounds as well.

PDA-ASSISTED SURVEY

This survey developed to observe the activity-travel scheduling process should by definition open the possibility of data entry or modifications of any originally planned activity or travel stage at any time of the day. Any activity/travel may be planned to various degrees of completeness. This kind of atomic information requires fast and simple navigation, which is difficult (e.g. on most cell phones have a user-interface exposing mostly just cursor-movements through lists of text). Since every bit of information should be time-stamped for future tracking of decisions made, the amount of memory used to store is not negligible.

Some data entries are difficult to handle in terms of visualization (giving the information back to the user), e.g. one planning-impulse which decides on

- Just the day, not the time or order of activities. This is pretty difficult to visualize in a diary-type of list expressing at least an order.
- The location only ("let's meet at that Pub sometime this week!")
- The mode only ("I need the car tomorrow and you must take the bus")

It was decided not to add new lists for this partially-fixed information, but to stick to lists of ordered activities.

The overall goal was to allow data entry at any decision-time with little effort, the device being light and easy to carry along and able to run an entire day at least.

Device Technology, Geo-Coding/Maps

Existing diary techniques are limited to various degrees depending on the type of media used:

1. Using a paper diary recording the time of writing down a certain decision or the sequence of changes is not advisable. Rescheduling is difficult to visualize and the paper is prone to dirt, humidity and illegible hand-writing which decreases usable data records.
2. An internet diary requires easy internet-access depending on various techniques to run reliably and fast.
3. A Laptop diary requires a rather large and expensive device which cannot be carried around easily and which has got either very limited battery capacity or long startup duration and procedures.
4. A cell phone (not Smart Phone) diary is still either difficult to program due to little memory or expensive to transmit frequent changes (WAP/SMS) and has generally very basic keyboard and display capabilities.

Most high school students own cell phones sending lots of SMS[1]-messages. Other types of survey (e.g. Wermuth et al. in [5]) do actually use simple SIM[1]-card programs navigating through few/small lists of alternative answers. This is definitely not enough complex for activity scheduling. Cell phones can be traced by their cell-base stations offering the possibility to substitute all time and address input or map usage by automated locating of the cell phone. The precision of this technology (not yet UMTS[1]) actually measured in a densely populated city was not less than 400m (0.25 mi) of radius. Transmitting SMS-messages or WAP[1]-calls containing the impulse-information and technically triggering the location-trace also involves significant extra costs and administration.

Finally PDAs (Personal Digital Assistant, also named Handheld or Palmtop) were selected as a compromise. Most of these devices come with some kind of keyboard (mostly on the screen) offering easy programming and high resolution screen using pen-pointing navigation that is very easy to use. Light types weigh 100g (3.5 oz) almost like cell phones, heavier ones up to 210g (7.4 oz). PocketPC are the Microsoft-based PDAs with bright screens and a windows-user-interface similar to PC-systems. Each device costs about half compared to a cheap laptop computer.

GPS-receivers attached to the PDA were also considered to add location information. These devices keep getting cheaper but still add a lot of weight and reduce battery-lifetime significantly. They are unreliable inside buildings and under certain atmospheric conditions. So finally a detailed map of the city and a rougher map of the surrounding villages were included in the survey instrument on the PDA giving respondents the opportunity to insert graphically instead of typing the address. Some locations might not have a proper address or might be unknown to the respondent.

Introduction, Assistance

The device and survey was handed out to the responding students during one regular school-lesson at the most (limited for organizational reasons and by their attentiveness), offering an introduction to the device and input technology, inserting the initial inputs of personal data and routine activities. An entire class was always asked to fill in the survey for the same time-period of one week. So students could also help each other during the week. A telephone hotline was offered as well, the interview was optional and no incentives used.

[1] Standard cell phone technology

User-Interface, Sequence

To decrease the respondents' burden the planned and actually achieved handling time should be limited to about 10 minutes per day (after the introductory course where the routine activities are already inserted). Every impulse should be inserted doing 2-3 steps selecting the exact activity/trip involved, the kind of impulse leading to a certain change. The reason for this change was an optional input.

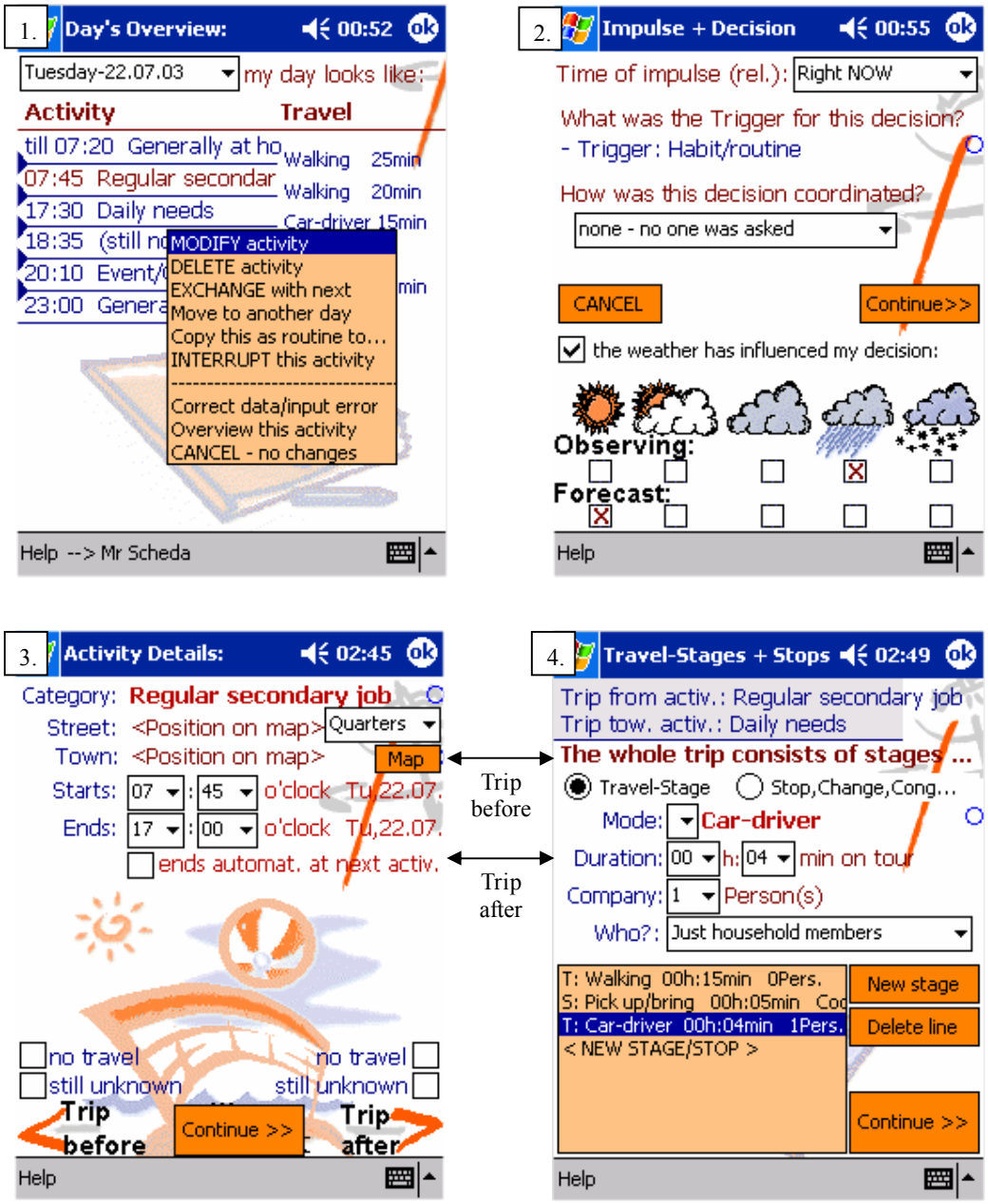

Diagram 1: Screenshots from the survey program in the order of appearance (some are optional)

The introduction of the instrument was done in one school-lesson splitting the usage into 2 phases:
Phase 1: Inserting the routines and regular activities and trips does NOT require information about any impulse since known for long and not decided for a specific reason comparable to time, location or mode choice of other activities.

Phase 2 (starting after the introductory lesson): Every actual change of the schedule starts describing the impulse and ends with the information about the reason for a decision (optional), as can be seen in Diagram 1.

There is an extra dialog containing a zoomable map and one to copy an activity to other days making it a routine. The "Day's overview" can hold many activities but might be less informative than the 2-line version of the built-in PocketPC-Task-Manager. The layout of the activity and trip-description is also similar to the built-in task-scheduling programs to facilitate the usage for people accustomed to the PocketPC.

RESULTS OF ANALYSIS

One goal of this research project is to assess daily mobility patterns of students since they have certain duties and specific leisure habits while maturing and exposing innovative behaviour in other fields. Comparisons to other groups and differentiations among members of this group will be of interest. The major scientific emphasis was the activity-travel scheduling process being a relatively young discipline. This paper will present here some almost final results (analysis still in progress).

Socio-demographic Description

The net sample size was 98 students between 13 and 19 years. Students only from 8th, 10th and 12th grade in two different schools were asked by class to participate for one week (gross sample size: 122). One school in the middle of a city with students mostly coming from the neighborhood (Goethe-Gymnasium in the middle of the city of Karlsruhe, being a partner in this project) and the Eichendorff-Gymnasium in the smaller town Ettlingen, similarly typed with a lot of students coming with buses from surrounding villages in but with less ideal transit conditions for the students coming from villages further away from the school.

Age is not distributed evenly due to the picking of every second grade. Younger students were participating more frequently due to bigger classes, more technical enthusiasm and less objections to surveys in general. Boys are slightly more in number than girls independent of the grade (53% to 47%). More than 55% own a transit season ticket, some students (47%) have regular access to a car (a fifth being drivers, rest just passengers) and just 1% has access to some form of motorcycle. Beside these individual descriptors the frequency and type of internet-access and a cell phone ownership were questioned, following the assumption that new media was used especially by young people to coordinate their daily activities and travel. Two thirds actually use the cell phones every day, one fifth slightly less frequently and the rest uses it irregularly or never. The internet usage is similar to that of the cell phones.

Realized mobility

The actually realized mobility (or travel pattern) will be sketched by indicators as there are mobility rate (per day), distance traveled, travel duration, mode and number of accompanying persons. Obviously these indicators are differentiated by school (setting). In order to reduce potential errors only the complete days with no gaps (unspecified time) of more than 15 min were taken into account, leading to 282 complete days with 1045 trips.

The **mobility rate** is 3.89 trips per weekday and mobile person. This is comparable with to 3.71 trips per weekday among the 15-17 years old in a recent survey on young people's behavior conducted in the project U.MOVE (Hunecke et al. in [7]). Differences by several criteria are shown in Table 3. (s=standard deviation)

Criteria		Mobility rate (trips per day)
Day of the week	Weekday	3.89 (s=1.648, n=236 days)
	Weekend	2.74 (s=1.482, n=46 days)
Gender	Female	3.77 (s=1.766, n=124 days)
	Male	3.65 (s=1.604, n=158 days)
School setting	Goethe-Gymnasium (city)	3.68 (s=1.752, n=182 days)
	Eichendorff-Gymnasium	3.75 (s=1.533, n=100 days)
Age	Ages 13-15	3.83 (s=1.693, n=125 days)
	Ages 16-17	3.65 (s=1.682, n=124 days)
	Ages 18-19 (driver's license)	3.42 (s=1.582, n=33 days)

Table 3 Mobility rate according to several attributes

Mode choice: More than 55% of all trips were not motorized, the others shared 3:2 between transit and auto trips. The overall mode choice for all trips is very similar to the mode choice on home-to-school-trips only. Also interesting is the differences by school setting: 70% of the city's school use non motorized modes, whereas for the smaller town's school students, just one thirds are non motorized, one third transit and one third car (including being a passenger). Table 4 gives an overview showing especially clear influences of the school setting.

Criteria		N trips	Non-motorized	Transit	Auto	Not rep.
Day of the week	Weekday	919	56.8%	27.3%	14.9%	1.0%
	Weekend	126	59.5%	11.9%	28.6%	0%
Gender	Female	468	54.2%	28.1%	15.8%	1.9%
	Male	577	59.4%	23.3%	17.2%	0.5%
School setting	Goethe-Gymnasium (city)	670	69.1%	20.7%	10.0%	0.3%
	Eichendorff-Gymnasium	375	35.8%	34.0%	28.3%	1.9%
Age	Ages 13-15	479	62.9%	19.6%	15.8%	1.7%
	Ages 16-17	453	61.0%	24.5%	13.6%	0.9%
	Ages 18-19 (driver's license)	113	25.2%	33.3%	41.4%	1.0%

Table 4: Mode choice according to several attributes

The average trip duration is 15 minutes and average distance is 3.3 km (2.05 mi). The averages of home-school trips look very similar. The mean trip of a student at the city's school is much shorter than the corresponding trip length in the smaller town. Trip duration does not differ as much. Table 5 gives an overview.

Criteria		N time/dist*	Mean travel time	Mean dist.(km)	Mean dist.(mi)
Day of the week	Weekday	919/684	15 min (s=15)	3.1 km (s=3.5)	1.9 mi (s=2.2)
	Weekend	126/72	16 min (s=23)	4.6 km (s=6.4)	2.9 mi (s=4.0)
Gender	Female	468/306	13 min (s=9)	2.9 km (s=3.6)	1.8 mi (s=2.2)
	Male	577/450	16 min (s=16)	3.5 km (s=4.1)	2.2 mi (s=2.6)
School setting	Goethe-Gymnasium (city)	670/495	13 min (s=10)	2.1 km (s=2.6)	1.3 mi (s=1.6)
	Eichendorff-Gymnasium	375/261	18 min (s=18)	5.4 km (s=4.9)	3.4 mi (s=3.0)
Age	Ages 13-15	479/322	14 min (s=10)	2.7 km (s=3.2)	1.7 mi (s=2.0)
	Ages 16-17	453/342	15 min (s=12)	3.1 km (s=3.5)	1.9 mi (s=2.2)
	Ages 18-19 (driver's lic.)	113/92	18 min (s=24)	5.8 km (s=6.0)	3.6 mi (s=3.7)
Mode category	non motorized	592/424	11 min (s=7)	1.4 km (s=1.8)	0.9 mi (s=1.1)
	Individual/by car	172/119	19 min (s=20)	6.4 km (s=5.5)	4.0 mi (s=3.4)
	Transit	264/201	22 min (s=15)	5.3 km (s=3.9)	3.3 mi (s=2.4)

Table 5: Travel time and distance according to several attributes (*N(distances) is lower due to missing addresses, coordinates)

Involved persons: Since coordinating a trip with other people is taking some time and effort and certainly adds planning impulses, this project always asked for the number and type of company. Two thirds of all trips in company (60%) are with friends only.

Altogether, one could state pretty plausible results compared to similar studies/surveys despite a small sample size and relatively few really completely filled-out days. This new type of surveying shows the influence of a person's home and school location for the effort required for mobility in general, especially for students in more rural surroundings.

Planning impulses

Some initial results presented here were obtained by assuming that behavior is better observable if at least the activities for the observed day are complete without leaving gaps of more than 15 minutes

Starting with the distribution of impulses reported two major peaks on Tuesdays and Wednesdays can be found, decreasing slowly during the week and resulting in a minimum at the weekend. This distribution is plausible because the survey started on Tuesday or Wednesday with the first day to report being Tuesday (sometimes just remembered) for comparability. The weekends have much less activities (see above) and they seem to be mostly planned during the week. The Monday as last day of the survey was basically not interesting for students and some did actually finish the survey beforehand.

Looking at the **time of day of impulse-input** one recognizes a pretty constant distribution between 9 o'clock and midnight with some doubling peak around shortly after Noon. This time could just be free to insert new data and not being the real impulse time. The **duration** of data entry which was recorded by the software is very different depending on the week-day. At three quarters of all days, the duration is less than 10 minutes, the time assumed to be acceptable for respondents.

Interpretation of the following numbers needs to consider that planning decisions were not mandatory to insert completely. It was said that it is more important to have people stay on the survey and supplying their planning changes and actually performed activity than to have them always to insert all details of their decision. Around 47% did not supply the impulse category (containing the cases of "no impulse" for routine activities and initial data entry).

One third of all planning activities were inserted immediately after the corresponding impulse. Another third of impulses was decided another time today or yesterday and one third at another time or not stated. Among the impulse categories stated 24% were routine and 20% were personal not related to routines. 64% of all activities were not coordinated with other persons. The means for coordination are 19% personal talk and fixed-line phones, and only 2% using "modern" media like cell phones. Only 8% of all decisions were actually dictated by other persons or conditions.

The single attribute of a planned activity was changed between the time of first insertion and final acting for a certain share of all activities and this share was changed a certain number of times listed below in Table 6. The number of changes was smallest for time and activity category and highest for the number or kind of people in company. The share of activities affected by changes varies from 21% to 45%. The highest share of changed attributes are mode category, the smallest is activity category.

changing attribute: change frequency	**Activity category**	**Location attribute**	**Start time**	**End time**	**Mode category**	**Trip duration**	**Company type or size**
no. activities/trips	304	329	364	569	635	634	539
Æ*	1.39	2.02	1.65	1.69	1.81	1.60	2.12
s	0.868	1.716	1.019	1.134	1.617	1.342	1.846
Share**	21.3%	23.1%	25.5%	39.9%	44.6%	44.5%	37.8%

Table 6: Summarizing number of changes to (a plan for) an activity/trip per attribute type

* The average describes only cases in which at least one change was made
** The "Share" states the portion of activities affected by at least one resc heduling operation.

The analysis of planning behavior needs to be extended further in the coming months, for example extracting patterns of planning sequence or detail. The high share of non-responding answers will be split into the ones not necessary (due to routine description not obeying to impulses) and certain corrections of data (belonging to the previous impulse thus having no extra impulse) and true non-responsiveness.

Weather conditions were very stable and almost no precipitation was measured during the survey period, so unfortunately little effects could be found on choices made by the students due to weather conditions.

OUTLINE - MODELING AND URBAN PLANNING

Doherty and Axhausen in [1] describe an integrated framework for the scheduling process. Adding to that structure we propose and intend to implement a model looking slightly different (see also Diagram 2):

- Split the land use submodel into: demand factors, offering factors, soft factors and mode infrastructure
- Join the household agenda simulator with the (individual) scheduler because they interact fairly closely
- Join mode choice with traffic flow, because ad-hoc decisions caused by (congested) flow change demand (this part does not need to be implemented, since it can be used through commercially available products)

Diagram 2 shows "institutions" where other models speak of attractions. In this model institutions are planned to expose the priorities of the activity involved and they do also offer time windows like opening hours for shops or parking lots, frames for school hours or beginnings of certain events. Contexts define conditions where certain

activities may be added to personal schedules. Skeleton activities will not necessarily be optimized by the model since they obey to long term considerations and household decisions.

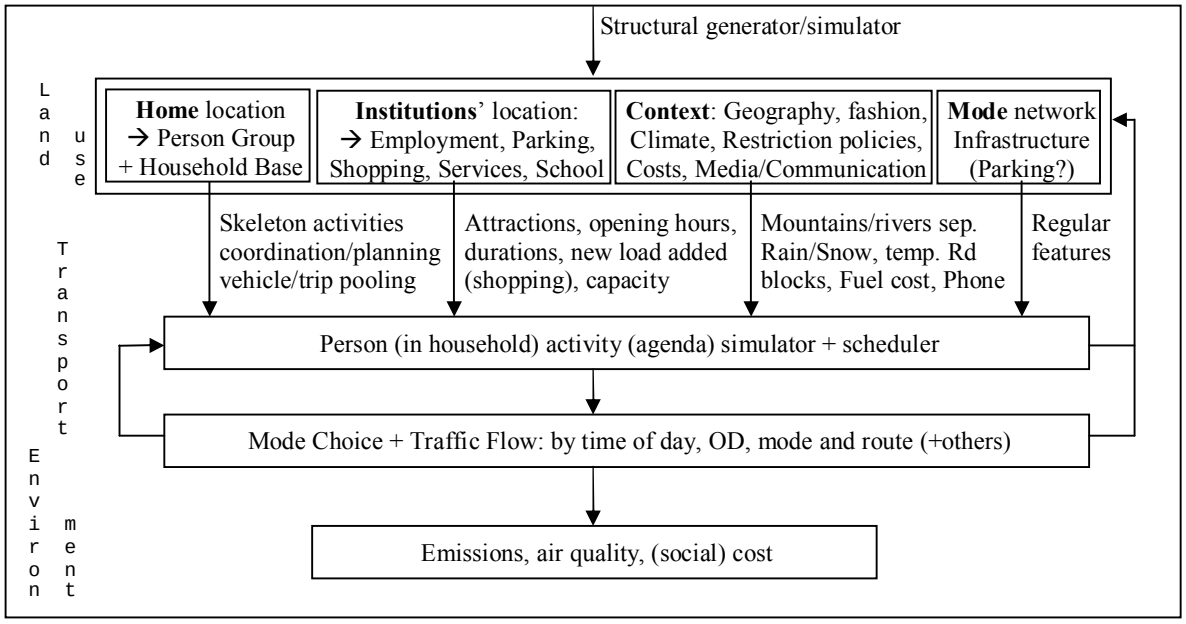

Diagram 2: Household activity scheduling within an integrated modeling framework (idealistic)

Especially the soft factors are sometimes difficult to assess but nevertheless with great influence: Traffic management including toll, lane reservation or temporal road blocks due to special events. The triggers should be propagated to the end user by different media which might eventually include PDAs holding schedules of the very person to be informed.

DISCUSSION

The survey implemented an approach to the scheduling process that is easier to handle compared to diary type surveys on other kinds of device or media. The time required to introduce the instrument and to actually use it during the one-week period is sufficiently short. The school environment was an ideal setting for the design of the software and an innovative institution with young persons to conduct the actual survey.

The survey instrument is using a rather familiar way to describe a day's schedule. The design and layout was on one hand successful because easy to use, nice to look at and similar to calendars and task planners on the device. On the other hand checks for plausibility resulted in a lot of messages to the user with choices of how to cope with an inconsistency. This needs to be simplified maybe by taking out some of the options to reconfigure the schedule exchanging activities for example. Trip attributes could be used for the reverse trip and walking at the beginning or end of a trip should be made easier or more obvious to enter. The instrument probably needs to be made more restrictive in terms of not accepting missing answer-details thus probably extending the share of persons breaking off the survey before regular ending time.

The students' motivation to participate depended much on the age: highly motivated younger students and much less motivated students in 12th grade. It was easier to conduct the survey in the school not being involved in the design process (only a few students being involved), probably due to rumors spread about initial problems or the time involved.

The project as a whole, the cooperation of different institution in developing this project, the ideas generated and the things to be built in the future were exceptionally motivating for all participants. Still a different sense for the timeframes involved in setting up a survey or building models was not predicted equally.

ACKNOWLEDGEMENTS

This project was sponsored by the private foundation "Alfried Krupp von Bohlen und Halbach Stiftung", ours being one of several "New Engineering Teams" formed by a mixed team of students, a university institute and a private engineering company. The project was also supported by the City of Karlsruhe supplying maps and structural data.

REFERENCES

1. Doherty, S.T. and Axhausen, K.W. (1999). The Development of a Unified Modeling Framework for the Household Activity-Travel Scheduling Process. In *Traffic and Mobility*: Simulation-Economics-Environment, eds. W. Brilon, et al. pp. 35-56. Berlin: Springer.
2. Doherty, S. T. and Miller, E. J. (2000). A computerized household activity scheduling survey. Transportation 27 (1): 75-97 (Kluwer Academic Publishers).
3. Axhausen, K. and Gärling, T. (1992). Activity-based approaches to travel analysis: conceptual frameworks, models, and research problems. Transport Reviews 12(4): 323-341.
4. Axhausen, K. (1995). Travel Diaries: An Annotated Catalogue (Working Paper, Draft, 2nd Edition)
5. Wermuth, M. et al. (2001, in German). TTS - TeleTravelSystem. A telematic system to automatically survey travel behavior. (Final report). www.teletravelsystem.de
6. Rindsfüser, G., H. Mühlhans, S.T. Doherty, K.J. Beckmann (2003). Tracing the planning and executing attributes of activities and travel - Design and application of a hand-held scheduling process survey. Paper presented at the 10th International Conference on Travel Behaviour Research, August 10-15 2003, Lucerne, Switzerland
7. Hunecke, M.; Tully, C.J.; Bäumer, D. (Eds.) (2002, in German). Mobility of young people - Mobilität von Jugendlichen. Opladen, Germany.