Understanding mechanism of individual travel behavior in urban space is essential for urban transportation planning and policy. Conventionally, travel is considered a derived demand from the desire to engage in activities at certain locations. Hence, understanding the relationships between travel behavior and daily activity engagement is effective in estimating individual and household responses to policy measures and to changes in environmental constraints. We have been developing the integrated system for data collection, analysis and evaluation of individual/household activity-travel patterns in urban space using Information Technologies (IT) and Geographic Information System (GIS).

**Constraints to Activity-Travel Pattern**

**Individual/Household**
- Individual/Household characteristics (household structure, residential location, travel mode availability, etc.)
- Activity demand

**Urban Environment**
- Land use (activity opportunities)
- Transportation network
- Institution

**Choice Set of Alternative Activity-Travel Patterns**

**Space-time Accessibility**
- Spatio-Temporal Constraints
- Interactions between Household Members
- Activity Scheduling

**Data collection**

**Analysis**

**Evaluation**

**Activity-Travel Pattern**

**Space-Time Path**
- Revealed Preference (RP)
- activity diary survey
- positioning technologies (GPS, PHS, etc.)
- Stated Preference (SP)
- computer-assisted self-interviewing (CASI)
The basic concept of our research is “activity-based approach” originated from TSU (Transport Studies Unit at Oxford University).
**GPS Mobile Phone-Based Activity Diary Survey System**

**Activity Diary Survey Application for Cellular Phones equipped GPS.**

This application has 2 major functions.

1. Automatic collection of GPS location data at regular intervals.
2. Showing activity record form and send respondents’ activity data to the data collecting server computer.

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**System Image**

The Internet-Based Travel Survey System with Web-GIS #1: Mode and Route Choice

Internet-based travel survey system

We developed this system to support multi-modal transportation planning with relocation of large-scale facilities. This system collects respondents' SP data. Web-GIS software was used to reflect geographical locations and transportation network data.

Sample below is a imaginary route choice of students of The Univ. of Tokyo after new campus (Kashiwa campus) building is completed.

The Internet-Based Travel Survey System with Web-GIS #2: Route and Parking Choice

It is very important to provide dynamic traffic information such as VICS, ATIS and Parking Guidance Information (PGI), and it is indispensable to understand the change of travel pattern by providing with dynamic information.

Paper-based survey cannot describe dynamic traffic services. Computer-based imaginary survey techniques have been developed to collect respondents’ SP data.

Imagine you are driving now to buy something at a department store.

In this system, origin and final destination are given. Some information are given while respondents are traveling in the imaginary space.

Imagine Parking Information Board is shown sometimes.

Velocity
25km/h

Select which direction you’ll turn to at the next crossing.

GIS-based Activity-Travel Simulator #1: Simulation Model for Activity Planning (SMAP)

SMAP was developed as an innovative integration of GIS and a feasible activity-travel pattern generation model. MapInfo GIS software was used as the system platform. MapBasic programming software was used for customizing MapInfo.

The activity-travel pattern generation model could enumerate feasible activity-travel patterns under spatio-temporal constraints of the individual’s scheduled activities and opening hours of activity opportunities.

With the introduction of two persons’ activity schedule constraints, not only private travel modes but also car-passenger mode availability was explicitly dealt with in the model.

The initial application of SMAP was aimed to understand constraints that affect travel behavior of the elderly households and their responses to the changes of the constraints in a local city.

- Travel demand side
  - Activity schedule (activity diary with space-time constraints)
  - Individual/household characteristics (e.g., mode availability, travel cost budget, the maximum walking time)
  - Travel tracking data collected by positioning technologies (e.g., GPS, PHS)
- Transportation supply side
  - Travel times between two locations (calculated from road and public transport network)
- Activity opportunity side
  - Locations and opening hours of opportunities

Generate alternative activity-travel patterns and/or test the feasibility of the patterns based on space-time prism constraints

Represent spatio-temporal component of activity-travel patterns on GIS

Basic Structure of GIS-based Activity-Travel Simulator

GIS-based Activity-Travel Simulator #2: SMAP for Education (SMAP-E)

SMAP-E was developed especially for the purpose of instructing students in understanding the theory of space-time prism/accessibility and travel behavior under spatio-temporal constraints. It was used in a graduate course as an educational tool.

The participants simulated the volume of prism and the feasibility of engaging in a discretionary activity in the prism, using their own one-week activity diary data, before and after changing important variables in activity schedule, transport system and activity opportunities affecting space-time accessibility.

From the analysis of students’ reports, it was found that a series of simulation using SMAP-E had contributed to help the students to better understand the theory of space-time prism and human activity-travel patterns under spatio-temporal constraints in the urban area, as demonstrated in HATS.

Operational Variables in the Simulation Exercise in SMAP-E


Representation of Activity-Travel Pattern and Available Opportunities within a Space-Time Prism

Urban Transportation Research Unit, The Univ. of Tokyo
GIS-based Activity-Travel Simulator #3: SMAP for Leisure (SMAP-L)

SMAP-L was developed as an decision-making support system for activity planning using interactive surveys to collect information on the activity scheduling process of tourists’ leisure tour.

Face-to-face interview surveys were conducted with SMAP-L to simulate pre-planned activity schedule of one-day leisure tour.

SMAP-L was very useful for supporting decision-making on activity scheduling, providing information on travel times, routes and opportunities, examining time and monetary budget constraints.

Data on scheduling process collected with SMAP-L were used to analyze respondents’ scheduling process in activity planning. The analysis revealed the inter-personal difference of scheduling patterns and responses when travelers found that the schedule was infeasible under time and monetary constraints.

Activity Scheduling in SMAP-L

Future Research

Future research concerns the following subjects:
- Self-diagnosing system for evaluating activity-travel patterns with a variety of indicators (travel time, travel distance, travel cost, fuel consumption, environmental damage, energy balance, etc.)
- Enhanced personal navigation system with a real-time scheduling function by getting real-time information on travel and activities
- Activity-travel scheduling/pattern including activities engaged in “cyberspace” by the use of telecommunications

Evaluation of Activity-Travel Patterns: Energy Balance

* The use of telecommunications affects some elements of the activity