The ASTUTE project

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University of Catania (Italy)
BYPAD Final Conference
Tartu (Estonia), 18-19 September 2008
Advancing Sustainable Transport in Urban areas
To promote Energy efficiency

Acronym ASTUTE
Contract ref EIE-05-015 ASTUTE
Start & End 01-Feb-06 to 31-Jan-09
Total EC contribution 930.814,- €
Date of these slides Sept-08
ASTUTE: Partners

LONDON (UK)
- LB Bromley = Lead Partner
- Creative Environmental Networks

GRANADA (SPA) City council: International centre urban studies

DUBLIN (IRE) CODEMA Clean Urban Transport NGO

BUDAPEST (HUN) Studio Metropolitana Urban Research Centre

GRAZ (AUT)
- City of Graz Council
- FGM-AMOR Austrian Mobility Research

SIRACUSA (ITA)
- MEDORO Research Centre
- University of Catania
More quality for bicycle traffic

ASTUTE cities

DUBLINO
LONDRA
GRANADA
GRAZ
BUDAPEST
SIRACUSA

www.astute-eu.org
ASTUTE: Main Objectives

• Identify and overcome Barriers
• 10% increase in levels of cycling and walking
• Tried and tested Best Practice Toolkit for sustained application across Europe: Hosted on Website www.astute-eu.org Dec 2008
• Disseminate Best Practice further via ASTUTE Agents in 6 New Member States
• 100 businesses with a Travel Plan (Mobility Plan)
• Equivalent reduction in Co2
• Improved Health – fewer sick days, more alert staff fewer road accidents
ASTUTE Step 1
Defining the barriers
Benchmarking Report

- Stakeholder Consultation
  - 10 Launch events across the EU
  - New Member States Forum - 17 cities
- Best Practice Collation
- Barrier analysis and definition
10 Barriers to the uptake of Cycling & Walking

1- Safety and Security Concerns
2- Lack of Infrastructure and Support
3- Poor Public Perception and Lack of Awareness
4- Inadequate Urban Environment and Design
5- Accessibility and Health Issues
6- Congestion and Air Pollution
7- Lack of Public Sector Support
8- Lack of Education and Training
9- Lack of Private Sector Support
10- Inadequate Information
Breakdown into Sub barriers

Example - Inadequate Information

- Lack of information on how to reach destination safely
- Lack of information about walking/cycling routes
- Lack of convenient signage on walking/cycling routes
- Ineffectiveness of promotional campaigns
- Lack of information about walking and cycling facilities
- Lack of skills to promote walking and cycling amongst businesses and citizens
- Insufficient communication between city departments and citizens
ASTUTE Step 2

Draft toolkit of Best Practice
Draft toolkit of Best Practice

• Benchmarking exercise
• Link with PIMMS database
• Quality Control Workshops
  • London (Jan 2007) & Brussels (Feb 2007)
    POLIS EUROCITIES – Living Streets – VeloMondial – Travelwise – Sustainable
    Transport Solutions  London Councils – SWOV
• Investigating synergies: Spicycles, ELTIS, BYPAD
ASTUTE Step 3

Toolkit Testing & Overcoming Barriers

Bromley has signed up to the Local Authority Carbon Management Programme and intends to significantly reduce its overall carbon emissions by 2013.

- Do you want information on your public transport commuting options?
- Do you cycle or walk for part of your journey to work?
- Would you like to cycle or walk but you want the right facilities?

"Are you reducing your 20%?!"

We want to set the right example to the rest of the borough.

Please contact: Paul Curtis, Room 630, North Block, Civic Centre. Call 0800 807 7644 for more details.
Toolkit Testing & Overcoming Barriers

- Partners identify local barriers
- 15 month toolkit testing period to increase walking and cycling locally
- Toolkit tested for transferability
- Where no relevant case study available, partners research and insert additional ones
### ASTUTE Toolkit - Quick Search

#### Search for a mode
- Cycling

#### View schemes by Barrier
- Accessibility and Health
- Congestion and Air Pollution
- Inadequate Information
- Inadequate Urban Environment and Design
- Lack of Education and Training
- Lack of Infrastructure and support
- Lack of Private Sector Support
- Lack of Public Sector Support
- Poor Public Perception and Lack of Awareness
- Safety and Security Concerns

#### View a specific scheme
- Bike to work in Switzerland
Bike to work in Switzerland - Project Details

Scheme Background and Objectives

In 2005 the IG Velo Switzerland started a state-wide campaign to raise public awareness for active modes of transport (commuter cycling). Companies should take part in the event “bike to work” and motivate their employees to leave their car at home and instead use their bicycle as a means of transport.

Before the project about half of all employees working in the participating companies were insufficiently physically active and 30.7% of the participating employees did not use the bicycle before. This is way the project leader wanted to encourage people to start using their bicycles instead of taking the car, the bus or the train. Another goal of the campaign was more cycling promotion by the companies themselves. Furthermore the IG Velo Switzerland wanted to create a more positive image of cycling as a mode of transport for daily life activities.

Measures implemented

The companies participating in the campaign “bike to work” were asked to choose their own project manager whose task it was to present the campaign to his/her colleagues. They were supplied with detailed information about the event and with the registration form. It was then their responsibility to build groups of two three or four people. During the project duration of four weeks the participants had to use their bike as often as possible as a mean of transport to and from their work. In a “mobility diary” they had to mark how many kilometers they have driven. The participants who cycled to work on more than 50% during the project phase were included in a lottery where they could win interesting prizes.

Conclusions and Monitoring

All in all 21 Swiss companies participated in the campaign. Out of these 1332 employees actively took part in cycling to and from their work place. The project was highly accepted by all the people and eve 95% of the non-participating employees claimed that the event was very reasonable.

It is now planned to carry out the event every year from now on. Therefore it is tried make the project self-financed (by the sponsoring of private companies and a fee for participating companies).
### Stadium Best Practice Database - Advanced Search

Advanced Search - choose one or more options from the criteria below then click on search button at the bottom of the page:

#### Barriers and Sub Barriers

**Accessibility and Health**
- [ ] Exclusion of people reduced mobility/minority/elderly/residents living areas difficult to access
- [x] Lack of competence of citizens/organizations and lack of power to enforce their interests
- [x] Low fitness levels among citizens
- [ ] Low level of environmental and health awareness among citizens

**Congestion and Air Pollution**
- [ ] Level of car traffic and air pollution
- [ ] Reduced accessibility for businesses due to congestion
- [ ] Unbalanced level of utilization on public transport vehicles

**Inadequate Information**
- [ ] Ineffectiveness of promotional campaigns
- [ ] Insufficient communication between city departments and citizens
- [ ] Lack of convenient signage on walking/cycling routes
- [ ] Lack of information about walking and cycling facilities
- [ ] Lack of information about public transport vehicles
LB Bromley – Barriers

1) Poor public perception and lack of awareness
2) Accessibility and health issues
3) Safety and security concerns
4) Inadequate Information
5) Lack of Private Sector Support
Overcoming Barriers – LB Bromley

2) Poor Accessibility - Town Centre

- Attitudinal surveys of public – 63% improved walkability!
  - 61.5% “segregated bus stops more convenient”
  - 67% “improved access for wheelchair / push chair users”
  - 14% “walkability affects my decision to visit Bromley”
Overcoming Barriers – LB Bromley

4) Inadequate Information

• London cycle maps
• Bus and train frequencies
• Bromley Street Maps
• Innovative pocket street maps: “how long to walk”…
• Draft Toolkit available on the ASTUTE website (undergoing final development October and November 2008).
• Launch in December 2008
• See Toolkit on http://www.astute-eu.org
Overcoming Barriers – LB Bromley

5) Lack of Private Sector Support

- 2007 Shopping Centre Travel Plan: The Glades: 120 shops, 2000 staff, 120 shops, 6m visitors

- Board established

- Transport Management Association £150k, 3 years

ASTUTE Step 4
ASTUTE Agents - call for interest
ASTUTE Agents - call for interest

- 6 New Member States to appoint ASTUTE agents: BUL, HUN, LITH, ROM, POL, SLO
- Agents receive Training on Mobility Management & ASTUTE toolkit, London Dec 08
- Agents to set up local networks: 25 technicians and politicians
- Seminars in 6 capitals to disseminate, 2009
ASTUTE Final conference

Advance Notice

ASTUTE final conference
DRAFT PROGRAMME 5 December 2008, London


Drinks reception - 4 December 2008 - 17.30 London
Actions of the University of Catania in Siracusa

Barriers

- **Cultural barriers:** The city is dominated by cars and walking is often viewed as being slow and uncomfortable. In addition, many people feel they could not cope without the convenience of the car.

- **Road safety:** The volume and speed of traffic on many roads is a significant deterrent to walking, particularly for vulnerable groups such as children, the elderly and those with mobility impairments.

- **Footway and footpath conditions:** The condition of footways and footpaths is viewed as a factor can influence some people’s decisions on whether to walk for local journeys.
A mathematical model to increase walking in Ortigia

- All models are wrong
- However, some are useful

The use of mathematical models to promote pedestrian and cycling mobility
Travel Demand Modeling - Behaviour approach

- Travel is the result of choices made by individuals
- The objective of travel demand modeling is to predict the outcomes of these choices
- A correct planning and design of measures to promote non-motorized mobility requires the knowledge of the travel behaviour of the users.
Travel behaviour

• Travel behaviour depends on a set of decisions which define the travel choices:
  – If to make a trip
  – Where to go
  – Which mode of transport to use
  – Which path to follow

• Choice behaviour is affected both by functional characteristics of the alternatives (travel time, costs, comfort) and by socio-economic characteristics of the decision makers (income, car ownership, residence location, etc.)
Discrete choice models

• There are mathematical models able to describe individual behaviour choosing a best option among discrete alternatives.

• **Discrete choice models** belong to a well consolidated technique, widely used today for this scope.

• Are based on the Random Utility Theory.

• And enable the **calculation of the probability** of individuals choosing a given option, as a function of their socioeconomic, characteristics and of the relative attractiveness of the options.
Discrete choice models

• For a comprehensive scientific literature see:

Nobel Prize 2000 to D. Mc Fadden “for his development of theory and methods for analyzing discrete choice”
Hypotheses of discrete choice models

• Each decision-maker which has to make a trip, has a finite set of mutually exclusive alternatives available to him: the choice set;
  – for instance, he can choose among different modes of transport (walking, cycling, bus, car) or among different paths to follow, once the mode has been chosen
• Each decision-maker has a rationale behaviour, that is he chooses the set of alternatives with the aim to maximize his satisfaction
• His satisfaction is conventionally measured by a quantity called “utility” which can be calculated as a function of measurable variables (attributes) of the alternative and of the decision maker
• Discrete choice models give a mathematical formula that describes the dependence of choices on the relevant variables
Hypotheses of discrete choice models

• Random utility models attempt to capture the complexity of human behavior:
  – the decision rule is assumed rationale and deterministic (the decision-maker always chooses the alternative with the highest utility)
  – but utility is represented as a random variable (this is why users don’t have a precise information on options and relevant attributes and the model builder don’t have a precise information on which attributes are important for the users).

• In mathematical terms, this is obtained by separating the total utility $U_{ij}$ that the decision maker $i$ associates to the choice of the mode $j$, into
  – $V_{ij}$ deterministic component, called systematic utility,
  – $\varepsilon_j$ random component, called random disturbance.

$$U_{ij} = V_{ij} + \varepsilon_j$$
Utility function

\[ U_{ij} = V_{ij} + \varepsilon_j \]

Utility = systematic + error

Observable variables:
- Individual SE characteristics
- LOSs of alternatives

Unobservable variables:
- Individual idiosyncrasies, taste, attitude, habit, principle
- Measurement errors of observable variables
Building of the discrete choice model

• Building of the model requires three main steps:
  – Specification
  – Calibration
  – Validation
Specification

- Model specification concerns the mathematical form of the expression which calculates the probability of choosing an alternative and the mathematical expression of the utility function.

- The more experienced expression for the choice probability is called and is the following:

\[ P_i^i(j) = \frac{e^{\alpha V_j^i}}{\sum_{k \in I_i} e^{\alpha V_k^i}} \]

being

- \( P_{ij} \) the probability an individual choosing alternative \( j \),
- \( V_j \) the systematic utility of alternative \( j \),
- \( V_k \) the systematic utility of the generic alternative,
- \( \alpha \) the model parameter.
Specification (cont...)

• The more used expression for the systematic utility function is:

\[ V = \beta_1 X_1, \beta_2 X_2, \ldots, \beta_n X_n \]

being \( \beta_1, \beta_2, \ldots, \beta_n \), model parameters and \( X_1, X_2, \ldots, X_n \) which measure the alternative attributes (e.g. path length, travel time, transit fare, etc.)
Calibration

• Model calibration concerns how to find the values of the model parameters (α and β) in order the model has the required forecasting capability

• To make the calibration a sample of observations of the choice behaviour is needed

• The choice context may be:
  – The actual one and in this case the Revealed Preferences method is used
  – An hypothetic one and in this case the Stated Preferences is used
Calibration (cont...)

- The estimate of the parameters is usually made with the maximum likelihood method which is based on the principle of finding those values of the parameters that maximize the conjoint probability of simultaneously observing the choices made by each element of the sample, as they were independently made.

- There are several commercial or free software able to do the calibration.
Validation

- Model validation concerns the testing of the model, that is to verify its reliability by comparing its results with a new sample of observation other from the one used for calibration.
Examples of discrete choice models

• Transport mode choice model
• Pedestrian path choice model
• Parking choice model
Transport mode choice model

Mode Alternatives

- CAR
- BUS
- WALKING

Utility function

\[
V_{wl} = \beta_{time1} \text{TIME}_{wl}
\]

\[
V_{bus} = \beta_{time2} \text{TIME}_{bus} + \beta_{cost} \text{COST}_{bus} + \text{BUS}
\]

\[
V_{car} = \beta_{time2} \text{TIME}_{car} + \beta_{cost} \text{COST}_{car} + \text{CAR}
\]
### Transport mode choice model

<table>
<thead>
<tr>
<th>mode</th>
<th>( X_{ij} )</th>
<th>attributes</th>
<th>( \beta ) for home-work trips</th>
<th>( \beta ) for home-school trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>TIME(_{wl})</td>
<td>Time (h)</td>
<td>-11.94</td>
<td>-21.80</td>
</tr>
<tr>
<td>Car</td>
<td>TIME(_{car})</td>
<td>Time (h)</td>
<td>-5.45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>COST(_{car})</td>
<td>Monetary cost (in €)</td>
<td>-3.48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAR</td>
<td>Alternative specific attribute</td>
<td>-2.54</td>
<td></td>
</tr>
<tr>
<td>Bus</td>
<td>TIME(_{bus})</td>
<td>Time (h)</td>
<td>-5.45</td>
<td>-3.91</td>
</tr>
<tr>
<td></td>
<td>COST(_{bus})</td>
<td>Monetary costs (in €)</td>
<td>-3.48</td>
<td>-30.61</td>
</tr>
<tr>
<td></td>
<td>BUS</td>
<td>Alternative specific attribute</td>
<td>-2.29</td>
<td>-1.53</td>
</tr>
</tbody>
</table>
Transport mode choice model

\[
P(\text{walk}) = \frac{e^{\alpha V_{\text{walk}}}}{e^{\alpha V_{\text{walk}}} + e^{\alpha V_{\text{bus}}} + e^{\alpha V_{\text{car}}}}
\]

\[
P(\text{car}) = \frac{e^{\alpha V_{\text{car}}}}{e^{\alpha V_{\text{walk}}} + e^{\alpha V_{\text{bus}}} + e^{\alpha V_{\text{car}}}}
\]

\[
P(\text{bus}) = \frac{e^{\alpha V_{\text{bus}}}}{e^{\alpha V_{\text{walk}}} + e^{\alpha V_{\text{bus}}} + e^{\alpha V_{\text{car}}}}
\]
traditional (not behavioural) approach
Pedestrian flow models of UCL (University College of London)

\[ \log(F) = A \log(X_1) + B(X_2) + C(X_3) + D(X_4) + \text{constant} \]

- X1 visibility along the road
- X2 transit station accessibility
- X3 sidewalk width
- X4 % of urban commercial spaces
example of mode choice modeling

- If 1000 persons have to go from A to B and have three available modes of transport (walking, bus and car), we can forecast how they will choose.
- It means that we know what to do if we want to change their travel behaviour.

\[
V_{\text{walk}} = \beta_{\text{time}} \times \text{TIME}_{\text{walk}}
\]
\[
V_{\text{bus}} = \beta_{\text{time}} \times \text{TIME}_{\text{bus}} + \beta_{\text{cost}} \times \text{COST}_{\text{bus}} + \text{BUS}
\]
\[
V_{\text{car}} = \beta_{\text{time}} \times \text{TIME}_{\text{car}} + \beta_{\text{cost}} \times \text{COST}_{\text{car}} + \text{CAR}
\]
example of mode choice modeling

\[ P(\text{walk}) = \frac{e^{\alpha V_{\text{walk}}}}{e^{\alpha V_{\text{walk}}} + e^{\alpha V_{\text{bus}}} + e^{\alpha V_{\text{car}}}} \]

\[ P(\text{car}) = \frac{e^{\alpha V_{\text{car}}}}{e^{\alpha V_{\text{walk}}} + e^{\alpha V_{\text{bus}}} + e^{\alpha V_{\text{car}}}} \]

\[ P(\text{bus}) = \frac{e^{\alpha V_{\text{bus}}}}{e^{\alpha V_{\text{walk}}} + e^{\alpha V_{\text{bus}}} + e^{\alpha V_{\text{car}}}} \]

- As we can change the probability of choosing a mode of transport by modifying the attributes that affect the perceived utility by users (path lengths, transit speed, parking fares, etc.)
- then, we can measure the effectiveness and efficiency of every single action.
What can you do with a discrete choice model

• we can easily simulate how the modal choice is affected by the change in one or more variables that you can manage:
  – Walk distance among O-D
  – Pedestrian facilities
  – Presence of barriers
  – Bus speed
  – Car costs
  – parking fares
  – Etc.

• Once you have fixed a budget to improve non motorized mobility, you can select the more effective action to do
A methodology for increasing walking in Ortigia, Siracusa
Ortigia – the bridges
main objective

• making (transit riding &) walking more than driving, thanks to special parking fares and appealing (and free!) transit services
**the methodology**

- based on a random utility model for discrete user choice applied to the choice of the parking area
- the model allows an allocation mechanism of car-park use to be established
- identification of a parking fare scheme for minimising the car access to the island
traffic zones
transport demand
(weekday morning)
transport demand
(Saturday evening)
parking zones

charged

free

residents'
road network

Pedestrian link
Main roads
Secondary roads
Only residents roads
Bus lane roads
users can choose whether parking in the centre or ‘at the edge’ the island

the choice of the parking area depends on:

- destination
- time of car trip
- park fare
- walking (and public transport) time
the choice model

model functional form:
- binomial Logit model
- linear Utility function
- maximum likelihood model calibration

\[
p_i(j) = \frac{e^{\alpha V_i(j)}}{\sum_{k \in I_i} e^{\alpha V_i(k)}}
\]

\[
V_j = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3
\]
results

assignment to parking areas: present fares

[Bar chart showing assignment to parking areas with labels for each area and corresponding capacities and assignments.]
results

assignment to parking areas: ideal fares
**results**

assignment to parking areas: **real fares**

<table>
<thead>
<tr>
<th>park</th>
<th>capacity</th>
<th>Alt 1</th>
<th>Alt 2</th>
<th>Alt 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>L01</td>
<td>112</td>
<td>0.00</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>L02</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>L03</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>L04</td>
<td>135</td>
<td>0.00</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>L05</td>
<td>59</td>
<td>0.00</td>
<td>0.50</td>
<td>0.00</td>
</tr>
<tr>
<td>L06</td>
<td>33</td>
<td>0.00</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>L07</td>
<td>22</td>
<td>0.00</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>L08</td>
<td>36</td>
<td>0.00</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>L09</td>
<td>36</td>
<td>0.00</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>L10</td>
<td>169</td>
<td>0.00</td>
<td>0.50</td>
<td>0.50</td>
</tr>
</tbody>
</table>
current traffic organization

- **a Restricted Parking Area** (ZSC, green on the map) in the north of the island which is accessible by car to everybody but parking is not allowed, except in Talete where parking is normally free of charge except from 9.00 pm to 5.00 a.m. when a flat fare of only 1 € is applied.

- **a Restricted Traffic Area** (ZTL, orange on the map) in the south of the island which is accessible by car only for residents and authorized users.

- some **pedestrian areas** (purple on the map).

- some road accessible by car only from Monday to Friday (only from 6.00 a.m to 8.00 p.m) white roads on the map.
some effects of the mathematical model

electric mini-buses

new sidewalks

‘Talete’ parking area outside the island full of cars
some effects of the mathematical model

more people walking
effects

• direct effects
  – parking fare policy definition
  – support to public transport route design

• indirect effects
  – new sidewalks and footpaths
  – intercity bus stops moved away from the island
  – new ideas about the upper floor of ‘Talete’ parking area
conclusions and lessons learned in Ortigia

• In spite of its approximation, the model allows an equilibrium point to be found among all the decision variables (fees, closures to traffic, public transport service lines, and trips and service costs), in such a way as to “automatically” drive users to follow the intentions of the planner without feeling that they are forced to do so.

• The use of “mathematical tools” helps the adoption of “unpopular” car restriction measures by administrator and politicians, because they can invoke the intervention of a “third part” support decision tool.

• This is, perhaps, the most important result for the administration, which obviously cares greatly about the “political” aspect of interventions on traffic and about their acceptability
conclusions and lessons learned in Ortigia

• The Ortigia experience proved to be very interesting, in particular from one certain point of view: the local administration’s sensitivity toward the numeric analysis was notable, if compared with the Southern Italian background.

• The administration suddenly understood the usefulness of the modelling tool we set up, and put most of the model’s findings into practice.

• Therefore, even if some results of the analysis could be roughly deduced by simply observing the real situation, the mathematical model provides a scientific objectivity and reliability, which enables the planner to make decisions with no qualms.
conclusions and lesson learned in general

• old paradigm
  – parking should be abundant and free at most destinations
  – focus on maximizing supply and minimizing price
  – parking facility costs should be incorporated into the costs of buildings or subsidized by governments
  – every destination should satisfy its own parking needs

• new paradigm
  – provide to users optimal parking supply and price
  – too much supply is harmful as too little
  – prices that are too low are as harmful as those that are too high
  – charge parking facility costs directly to users,
  – provide financial rewards to people who reduce their parking demand
conclusions and lesson learned in general

- An adequate parking pricing strategy
  - encourages more efficient transportation patterns, thus helping the reduction of traffic congestion, pollution emissions, energy consumption and traffic accidents.
  - helps create more accessible and efficient land use patterns
  - allows more clustered development and buildings, located closer to sidewalks and streets, thus helping to create more walkable communities
  - supports transit oriented development and transit use
Thanks for your kind attention…

Giuseppe Inturri
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