Multimodal journey planners

Budapest University of Technology and Economics

Department of Transport Technology and Economics

Dr. Domokos Esztergár-Kiss
esztergar@mail.bme.hu
Table of contents

Introduction

Evaluation method

Evaluation of journey planners

Mobile journey planners

Journey planners in practice
Table of contents

Introduction

Evaluation method

Evaluation of journey planners

Mobile journey planners

Journey planners in practice
Motivation

- **Quality of travel:**
  - standard of information handling operations
  - time requirements of information handling operations
- **Trips:**
  - growth of information demand of travellers
  - extending technical opportunities
- **Problems:**
  - lack of local knowledge
  - changing traffic situation
Development
Journey planning trends

- Multimodality
- Real-time data
- Location based services
- Personal preferences
- Mobility as a service
Smart Mobility Challenge

- best multimodal journey planner
- EU competition in 2012
- more, than 100 journey planners

1. AnachB.at (ITS Vienna Region, Austria)
2. BayernInfo (Bavarian Road Administration, Germany)
3. Carpooling (carpooling.com GmbH, Germany)
4. DB (DB Vertrieb GmbH, Germany)
5. Door2Door (Amadeus IT Group SA, Spain)
6. E-podroznik.pl (INVENTORS.PL S.C., Poland)
7. Eco-comparateur (voyages-sncf.com, France)
8. EU Spirit (various providers, coordinated by VBB, Germany)
9. Fahr-Plan info (Nils Kahl, Germany)
10. Gira.autobus.it (PluService, Italy)
11. IDOS (CHAPS spol s r.o., Czech Republic)
12. In-Time (AustriaTech, Austria)
13. INTEGRA (partners in the START project, the United Kingdom)
14. Journey.fi (Finnish Transport Agency, Finland)
15. Citroën Multicity (Moviken for Citroën, France)
16. OPTI-TRANS (NCSR Demokritos, Greece)
17. OTP (developed by Ingartek Consulting SLL, Spain)
18. Rejseplanen (Rejseplanen A/S, Denmark)
19. RoundAbout (Duo nv, Belgium)
20. routeRANK (routeRANK Ltd, Switzerland)
21. Rozjazdy.pl (INNOVIS, Poland)
22. SBB (SBB/CFF, Switzerland)
23. SCOTTY (ÖBB PersonenverkehrAG, Austria)
24. SIPAX (Trenitalia SpA, Italy)
25. Transport Direct (Department for Transport, the United Kingdom)
26. Travel Planner Portal (UITP, Belgium)
27. Traveline south east (Traveline south east, the United Kingdom)
28. WISETRIP (FORTHNET S.A., Greece)
# Easyway project

- Information before and during the journey

## Political issues

**EasyWay: towards sustainable mobility**
- Increase safety
- Improve mobility
- Reduce pollution
- Deploy European harmonized services

## Solutions to study

**A5 – European harmonisation**
- European studies (Deployment guidelines)
- Cross fertilization and European harmonization
- Pilots

## Solutions to deploy

- **A1 – Europe-Wide Traveller Information Services**
- **A2 – Europe-Wide traffic management Services**
- **A3 – Freight and logistic services**

## Supporting infrastructure

**A4 – Connected ICT infrastructure**
(Monitoring, processing and data exchange infrastructure)

## A6 – Project Management, assessment and dissemination
EDITS project

- European Digital Traffic Infrastructure Network for Intelligent Transport Systems
- Cross border traveller information system
- Data exchange
- Graph Integration Platform to existing networks
- Door-to-door information
- Current travel times
- Seamless transition between regions
Linking Danube project

- Transnational, multimodal traveller information and journey planning for environmentally-friendly mobility in the Danube Region

Objectives:
- foster the usage of environmentally friendly mobility options
- by provision of transnational and multimodal journey planning
- demonstrate linking services within pilot actions
- connect less accessible areas by linking alternative transport services developed for rural areas to TEN-T
Linking Danube project
Linking Danube project
Linking Danube project

Request

START Country 1 to DESTINATION Country 3

SPLIT

REQUEST Country 1
REQUEST Country 2
REQUEST Country 3

ROUTING Country 1
ROUTING Country 2
ROUTING Country 3

Service 1

ASSEMBLY

Service 2

Service 3

Result

START Country 1 to DESTINATION Country 3

END USER
Central Node:

- main component
- logic to exchange enquiries with the Local Journey Planners and the International Routing Service
- web service that implements common API
- concatenates the received information to obtain the requested cross-border trip solutions
- implements a unified graphical user interface (GUI) for transnational journey planning
Linking Danube project

International Routing Service:
- information about relevant international hubs
- covers the routing between the relevant exchange points

Exchange Point:
- hub where the routing intelligence of one journey planner ends and the intelligence of another starts

Gazetteer:
- structured dictionary of geographical places, such as addresses, Points of Interests or public transport stops
- each Local Journey Planners has its own gazetteer from which the Central Node can request locations
Local Journey Planners:

• systems with limited spatial planning ability that serve for regional or country wide trip planning

• already implemented website that offers routing in the region

• supports the development of a web service using the common Open API interface

• using the central node web service the extended cross-border routing results via their own GUI can be displayed
Linking Danube project

Danube Region Journey Planner (DRJP)

- Central Node
- Exchange Points
- Routing Information
- International Routing Service

Open API Web Service

- System 1
  - Gazetteer
  - Routing Information

- System 2
  - Gazetteer
  - Routing Information

- System n
  - Gazetteer
  - Routing Information

Local Journey Planners (LJP)
Linking Danube project
LinkingDanube project

Open API:

- CEN/TC 278 technical specification
- responsible to ensure the connection and interoperability of the local journey planners
- communication protocol to exchange requests with two-way authentication (REST: Representational State Transfer)
- can be implemented by any local journey planning system

API services:

- location information: geographical context, address resolution
- exchange points: hubs, where trip calculation is handed over
- trip request: intermodal trip info from origin to destination
- distributed journey planning: multipoint trip request
LinkingDanube project

FIGURE 7: The linkingdanube use cases

TABLE 1

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Required systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIENNA (Address/POI)</td>
<td>BUDAPEST (Address/POI)</td>
<td>VAO, Utantlery</td>
</tr>
<tr>
<td>VIENNA (Address/POI)</td>
<td>BRNO (Address/POI)</td>
<td>VAO, Utantlery</td>
</tr>
<tr>
<td>RETZ (Address)</td>
<td>BRNO (Address/POI)</td>
<td>VAO, Utantlery</td>
</tr>
<tr>
<td>HEGYESHALOM (Address/POI)</td>
<td>VIENNA (Address/POI)</td>
<td>VAO, IRS, AUS, LJI</td>
</tr>
<tr>
<td>HEGYESHALOM (Address/POI)</td>
<td>TIMISOARA (Address/POI)</td>
<td>VAO, Utantlery</td>
</tr>
</tbody>
</table>

TABLE 2

<table>
<thead>
<tr>
<th>Type of traveller information service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multimodal - ALL transportation models (road, PT, walking, bicycle, train)</td>
</tr>
<tr>
<td>Railway service</td>
</tr>
<tr>
<td>Coach service</td>
</tr>
<tr>
<td>Car service</td>
</tr>
</tbody>
</table>

Coverage
- National
- Cross-border on selected main routes

IFOS

<table>
<thead>
<tr>
<th>Type of traveller information service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multimodal - at least two transport modes</td>
</tr>
<tr>
<td>Railway service</td>
</tr>
</tbody>
</table>

Coverage
- National
- Cross-border

UTVONALTERY

<table>
<thead>
<tr>
<th>Type of traveller information service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multimodal - at least two transport modes</td>
</tr>
<tr>
<td>Railway service</td>
</tr>
</tbody>
</table>

Coverage
- Regional

IXVC

<table>
<thead>
<tr>
<th>Type of traveller information service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Mode - only public transport OR road OR bicycle OR train OR bus OR car</td>
</tr>
<tr>
<td>Railway service</td>
</tr>
</tbody>
</table>

Coverage
- Regional
- Cross-border

ATOB LJUBLJANA (ATOB LJ)

<table>
<thead>
<tr>
<th>Type of traveller information service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multimodal - at least two transport modes</td>
</tr>
<tr>
<td>Railway service</td>
</tr>
</tbody>
</table>

Coverage
- Local
i-Tour project

- intelligent Transport system for Optimized URban trips
- Route planning with personal preferences
- Including road conditions, weather, public transport network condition

• How do individual make trade-offs?
  • What can route planner do?
MaaS4EU project

- Combines travel options from different transport providers into a single mobile service
Members of the information chain

- **Content providers:**
  - collecting data, recording without processing
  - local governments, commercial data providers, traffic management centers, transportation operators, operators of parking facilities, meteorological providers, map-constructing companies

- **Service operators:**
  - processing and arranging data

- **Network operators:**
  - provides the connection on a reliable communication network

- **System providers:**
  - getting through the information to the end users

- **End users:**
  - demands and expectations towards the system providers
Elements of the ICT infrastructure
Table of contents

Introduction

Evaluation method

Evaluation of journey planners

Mobile journey planners

Journey planners in practice
Evaluation process

1. Journey planners (j)
2. Aspects (i)
3. User groups (k)
4. Transportation share (r)

START

Scoring

Evaluation

matrix

General
evaluation
number (u_j)

Weighting

Weight matrix

Qualifier matrix

Average evaluation

STOP

Comparison

Average evaluation number (u_j*)
## Journey planners

### Classification

<table>
<thead>
<tr>
<th></th>
<th>BKK Futár</th>
<th>TfL</th>
<th>AnachB</th>
<th>9292</th>
<th>Bayerninfo</th>
<th>Útvonalterv</th>
<th>Google maps</th>
<th>Rome2Rio</th>
<th>TripGo</th>
<th>Eu-Spirit</th>
<th>RouteRank</th>
<th>DB</th>
<th>Scotty</th>
<th>Lufthansa</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>spatial coverage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>urban</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>regional</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>international</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>handled transport modes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>bike</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>car</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rail</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>air</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>multimodal</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>
Journey planners

- operator: Transport for London
- since 2002
- for all transport modes with real travel times
- London area
- based on NAVTEQ database
- completed with walking routes, bike routes and PT data
- traffic information connected to links and nodes
Journey planners

AnachB

- operator: ITS Vienna Region
- since 2006
- for all transport modes with real travel times
- Vienna, Lower- Austria, Burgenland
- lots of formats supplied
- stored in an SQL database
- developed for administration and e-government aims – traffic information and management
Journey planners

Útvonalterv

- operator: Topolisz Kft.
- since 2005
- for all transport modes
- main sources: Top-Map, TrafficNav (TMC data)
- other sources: camera pictures, FCD data
- Connections to BKV, Fővinform, FKF, Siemens
Journey planners

Bayerninfo

- operator: Verkehrs-informationagentur Bayern GmbH + PTV AG
- since 1990
- 193,000 km road network, 57,000 POI
- 41,500 stops, 30 transport operators
- open source
- NAVTEQ maps
- lots of formats
Evaluation process

1. Evaluation Matrix
2. Scoring
   - Journey planners (j)
   - Aspects (i)
3. Weighting
   - Weight matrix
   - Qualifier matrix
   - Average evaluation
   - Weight number (p_ij)
   - Weight number (u_ij)
4. Comparison
   - Average evaluation number (u_j^*)
5. STOP
<table>
<thead>
<tr>
<th>Route-planning services</th>
<th>Booking and payment</th>
<th>Handled data, operational features</th>
<th>Comfort service information</th>
<th>Supplementary information</th>
</tr>
</thead>
<tbody>
<tr>
<td>ways of data input</td>
<td>tariff information</td>
<td>static data</td>
<td>services at the stations/stops</td>
<td>environmental impacts</td>
</tr>
<tr>
<td>planning aspects</td>
<td>method of booking</td>
<td>semi-dynamic data</td>
<td>services on board</td>
<td>information in foreign languages</td>
</tr>
<tr>
<td></td>
<td>and payment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>displayed data</td>
<td>payment options</td>
<td>dynamic and estimated data</td>
<td>additional services</td>
<td>customer service</td>
</tr>
<tr>
<td>perspicuity of displayed data</td>
<td></td>
<td>personal data</td>
<td></td>
<td>equal opportunity Information</td>
</tr>
</tbody>
</table>
Aspects

Route-planning services

ways of data input:
• address (2), name of stop (2), institutions and service facilities (2) (e.g. museums, restaurants, swimming pools, cinemas, offices, schools), GPS coordinates (2), pointing out on the map (2);

planning aspects:
• departure and arrival time (2), duration and costs (2), number of transfers and walking distance (2), other aspects (4) (e.g. preferred transportation mode, P+R, B+R, crowding);

displayed data:
• travel duration and distance (2), transfer information and location plans (2), waiting times (2), walking time and distance (2), alternative routes (2);

perspicuity of displayed data:
• compact design (2), easy understanding (2), visualization on the map (6) (e.g. details, zoom function, displaying transport lines)
Aspects

Booking and payment

tariff information:
• zones (2), prices (2), reduced fares separately (2) (e.g. tabular view), fee of the entire travel chain (2), calculation method (2);

method of booking and payment:
• way of data input (4), in how many steps (2), what kind of data is needed (2), possibility of choosing seats (2);

payment options:
• types of bank cards (2), payment per mobile phones (2), transaction fees (2), types of vouchers (4) (e.g. SMS, code per e-mail, paper ticket printed at home/at the station/sent by post)
Aspects

Handled data, operational features

**static data:**
- timetable for a given route and/or date (6), travel conditions and rules (2) (e.g. animals, luggage); export features (2) (e.g. PDF, printing);

**semi-dynamic data:**
- information about deviations (2), list of planned restrictions (4), visualization of planned restrictions (4);

**dynamic and estimated data:**
- information about current and extraordinary traffic situations (4) (e.g. weather conditions, accidents), usage of crowd sourcing data (2), deviation from the timetables (2), calculation of the probable impacts of the extraordinary traffic situations (2) (e.g. alternative routes);

**personal data:**
- creating a profile (2), setting personal preferences (4), saving searches and favourites (2), personalized offers (2)
Comfort service information

services at the stations/stops:
- Wi-Fi (2), luggage storage (2), other services (6) (e.g. newsagent’s, bakery, car sharing);

services on board:
- Wi-Fi (2), electrical supply (2), information about dining opportunities (2), other services (4);

additional services:
- weather forecast (2), booking a room (2), car rental (2), sightseeing (2), opening time of the shops (2)
environmental impacts:
• degree of air pollution (e.g. CO2), energy consumption, comparison of transport modes and travel chains;

information in foreign languages:
• how much of the homepage is translated, number of foreign languages, automatic language choice based on IP address;

customer service:
• requesting information via e-mail and/or telephone, feedback opportunities, opinion about travels or services, forum;

information of equal opportunity:
• routes for disabled passengers, information about vehicles, webpage for visually impaired people.
Evaluation process

START

Scoring

Journey planners (j)

Aspects (i)

General evaluation number (u_j)

Weighting

User groups (k)

Weight matrix

$w_{ki}$

Qualifier matrix

$u_{kj}$

Average evaluation

Comparison

Average evaluation number ($u_j^*$)

STOP
User groups

- Passengers
  - age
    - younger
    - older
  - features of locomotion
    - work-motivated
    - leisure time based
  - motion abilities
    - without any problem
    - handicapped

- Student
- Worker
- Tourist
- Businessman
- Pensioner
User groups

- **Student:**
  - interested in the comfort services and use dynamic data
  - but supplementary information is not that important

- **Worker:**
  - usually daily travel in the city
  - prefer the route planning options using actual data
  - comfort services have the lowest priority

- **Tourist:**
  - non-well-known routes, also handicapped passengers
  - route-planning services and payment are the most important
  - dynamic data and supplementary information the less

- **Businessman:**
  - interested in comfort services and supplementary information

- **Pensioner:**
  - can orientate and move mostly with difficulties
  - emphasis on the ease of use and supplementary information
Evaluation process

START

Scoring

Journey planners (j)

Aspects (i)

General evaluation number (u_j)

Evaluation matrix

Weighting

User groups (k)

Transportation share (r)

weight matrix

$w_{ki}$

$p_{ij}$

$u_{kj}$

Qualifier matrix

average evaluation

Comparison

Average evaluation number ($u_j^*$)

STOP
Compensational multi-criteria evaluation:
- evaluation of journey planners on a 0-10 valued scale
- according to certain aspects

\[ u_j = \sum_{i=1}^{I} p_{ij} \]

- \( i \) – aspects, \( i = 1, \ldots, I \)
- \( j \) – multimodal journey planners, \( j = 1, \ldots, J \)
- \( p_{ij} \) – elements of the evaluation matrix
- \( u_j \) – general evaluation number for the \( j \). multimodal journey planner
Method

Average evaluation

- **Normalization:**
  - evaluation matrix * weight matrix → qualifier matrix
    \[
    u_{kj} = \frac{\sum_{i=1}^{I} s_{ki} \cdot p_{ij}}{\sum_{i=1}^{I} s_{ki} \cdot p_{i \text{max}}} \]
  - \(k\) – user groups, \(k=1,..,K\),
  - \(s_{ki}\) – elements of the weight matrix (weight of the \(i\). aspect of the \(k\). user group)
  - \(p_{ij}\) – elements of the evaluation matrix
  - \(p_{i \text{max}}\) – the maximal given evaluation number according to the \(i\). aspect,
  - \(u_{kj}\) – elements of the qualifier matrix (qualifier value of the \(j\). journey planner considering the expectations of the \(k\). user group)
Method

Average evaluation

- **Qualification:**
  - transportation share * qualifier matrix $\rightarrow$ average evaluation

  $$u_j^* = \sum_{k=1}^{K} r_k \cdot u_{kj}$$

  - $k$ – user groups, $k=1,..,K$
  - $r_k$ – transportation share of the $k$. user group
  - $u_{kj}$ – elements of the qualifier matrix (qualifier value of the $j$. journey planner considering the expectations of the $k$. user group)
  - $u_j^*$ – average evaluation number for $j$. multimodal journey planner
## Top solutions

<table>
<thead>
<tr>
<th></th>
<th>BKK Futár</th>
<th>TfL</th>
<th>AnachB</th>
<th>9292</th>
<th>Eu-Spirit</th>
<th>Bayerninfo</th>
<th>Útvonaltér</th>
<th>Google maps</th>
<th>Rome2Rio</th>
<th>TripGo</th>
<th>RouteRank</th>
<th>DB</th>
<th>Scotty</th>
<th>Lufthansa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route-planning services</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>Booking and payment</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Handled data, operational features</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Comfort service information</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>Supplementary information</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Top solutions

- planned restrictions
- camera pictures and text information
Top solutions

Útvonalterv

- street view
Top solutions

SCOTTY

- rolling road (RoLa) planning module
Top solutions

AnachB

- permanently actualized searches
- P+R, citybike and car-sharing stations
- personalized route planning by bike
- information about the traffic situation
Top solutions

Bayerninfo

- route planning for bike
- height-profile
- sightseeing places
- B+R
- GPS track
Top solutions

DB and RouteRank

- calculation of estimated CO₂-emission
- comprehensive overview of multimodal travel opportunities and prices
Top solutions

Útvonalterv and 9292

- Pedroute: detailed adjustment opportunities (steps, pavement quality)
- Reading out and dictation function
- Accompany of the personnel for blind and disabled people
## Evaluation

<table>
<thead>
<tr>
<th>Route-planning services</th>
<th>9292</th>
<th>Eu-Spirit</th>
<th>Bayreinfo</th>
<th>Linzautobus</th>
<th>Google maps</th>
<th>Rometr2kio</th>
<th>TripGo</th>
<th>RouteBank</th>
<th>DB</th>
<th>Scotty</th>
<th>Lufthansa</th>
</tr>
</thead>
<tbody>
<tr>
<td>ways of data input</td>
<td>18</td>
<td>24</td>
<td>24</td>
<td>33</td>
<td>36</td>
<td>24</td>
<td>30</td>
<td>10</td>
<td>24</td>
<td>26</td>
<td>9</td>
</tr>
<tr>
<td>planning aspects</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>displayed data</td>
<td>10</td>
<td>7</td>
<td>10</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>10</td>
<td>5</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>perspicuity of displayed data</td>
<td>10</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>7</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>4</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Booking and payment</td>
<td>8</td>
<td>11</td>
<td>6</td>
<td>10</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>tariff information</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>method of booking and payment</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>payment options</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Handled data, operational features</td>
<td>30</td>
<td>24</td>
<td>27</td>
<td>20</td>
<td>14</td>
<td>20</td>
<td>19</td>
<td>26</td>
<td>9</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>static data</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>semi-dynamic data</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>dynamic and estimated data</td>
<td>9</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>personal data</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Comfort service information</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>services at the stations/stops</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>services on board</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>additional services</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Supplementary information</td>
<td>21</td>
<td>14</td>
<td>17</td>
<td>24</td>
<td>16</td>
<td>13</td>
<td>21</td>
<td>16</td>
<td>7</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>environmental impacts</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>information in foreign languages</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>customer service</td>
<td>10</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>equal opportunity information</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>General evaluation number</td>
<td>96</td>
<td>77</td>
<td>85</td>
<td>72</td>
<td>66</td>
<td>57</td>
<td>73</td>
<td>81</td>
<td>56</td>
<td>52</td>
<td>40</td>
</tr>
<tr>
<td>%</td>
<td>53</td>
<td>43</td>
<td>47</td>
<td>40</td>
<td>37</td>
<td>32</td>
<td>41</td>
<td>45</td>
<td>31</td>
<td>29</td>
<td>22</td>
</tr>
</tbody>
</table>
Evaluation

Weighting

- estimated weight numbers \( (s_{ki}) \)
- transportation share \( (r_k) \) based on the results of the National Traffic Data Survey

<table>
<thead>
<tr>
<th></th>
<th>Route-planning services</th>
<th>Booking and payment</th>
<th>Handled data, operational features</th>
<th>Comfort service information</th>
<th>Supplementary information</th>
<th>Transportation share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>0.2</td>
<td>0.15</td>
<td>0.3</td>
<td>0.25</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Worker</td>
<td>0.3</td>
<td>0.2</td>
<td>0.25</td>
<td>0.1</td>
<td>0.15</td>
<td>0.3</td>
</tr>
<tr>
<td>Tourist</td>
<td>0.25</td>
<td>0.3</td>
<td>0.15</td>
<td>0.2</td>
<td>0.1</td>
<td>0.15</td>
</tr>
<tr>
<td>Businessman</td>
<td>0.25</td>
<td>0.1</td>
<td>0.15</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Pensioner</td>
<td>0.3</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.15</td>
</tr>
<tr>
<td>Average</td>
<td>0.26</td>
<td>0.17</td>
<td>0.19</td>
<td>0.21</td>
<td>0.17</td>
<td>-</td>
</tr>
</tbody>
</table>
### Evaluation

Normalization, qualification

- qualifier matrix \( (u_{kj}) \)
- average evaluation number \( (u_{j}^*) \) referred to all passengers

<table>
<thead>
<tr>
<th></th>
<th>BKK Futár</th>
<th>T1L</th>
<th>AnachB</th>
<th>9292</th>
<th>Eu-Spirit</th>
<th>Bayeminfo</th>
<th>Útvonalterv</th>
<th>Google maps</th>
<th>Rome2Río</th>
<th>TripGo</th>
<th>RouteRank</th>
<th>DB</th>
<th>Scotty</th>
<th>Lufthansa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>59</td>
<td>49</td>
<td>53</td>
<td>42</td>
<td>36</td>
<td>43</td>
<td>51</td>
<td>38</td>
<td>30</td>
<td>40</td>
<td>19</td>
<td>75</td>
<td>59</td>
<td>43</td>
</tr>
<tr>
<td>Worker</td>
<td>68</td>
<td>56</td>
<td>62</td>
<td>48</td>
<td>41</td>
<td>51</td>
<td>59</td>
<td>39</td>
<td>38</td>
<td>45</td>
<td>24</td>
<td>75</td>
<td>58</td>
<td>40</td>
</tr>
<tr>
<td>Tourist</td>
<td>56</td>
<td>49</td>
<td>50</td>
<td>41</td>
<td>31</td>
<td>39</td>
<td>47</td>
<td>39</td>
<td>31</td>
<td>41</td>
<td>24</td>
<td>78</td>
<td>59</td>
<td>45</td>
</tr>
<tr>
<td>Businessman</td>
<td>55</td>
<td>44</td>
<td>50</td>
<td>40</td>
<td>34</td>
<td>45</td>
<td>49</td>
<td>41</td>
<td>34</td>
<td>41</td>
<td>25</td>
<td>73</td>
<td>58</td>
<td>44</td>
</tr>
<tr>
<td>Pensioner</td>
<td>61</td>
<td>48</td>
<td>55</td>
<td>46</td>
<td>38</td>
<td>53</td>
<td>54</td>
<td>41</td>
<td>40</td>
<td>45</td>
<td>30</td>
<td>73</td>
<td>56</td>
<td>42</td>
</tr>
<tr>
<td>Average qualifier number</td>
<td>61</td>
<td>50</td>
<td>55</td>
<td>44</td>
<td>37</td>
<td>46</td>
<td>53</td>
<td>39</td>
<td>34</td>
<td>43</td>
<td>24</td>
<td>75</td>
<td>58</td>
<td>42</td>
</tr>
</tbody>
</table>
Evaluation

Comparison of journey planners
Table of contents

- Introduction
- Evaluation method
- Evaluation of journey planners
- Mobile journey planners
- Journey planners in practice
Mobile applications

Budapest timetable

- offline timetable and route planner
- vehicles on the map
- favourite stops, vehicles, route plans
- Google maps based, traffic data
Mobile applications

Smartcity

- Hungarian developer team
- route planning based on address or map
- actual timetable based on GTFS data
- based on offline OSM map
Mobile applications

vonatDroid

- based on the Hungarian online timetable system
- list of nearby train stations based on GPS data
- map and information about the trains
- train news, information about traffic disturbances
Mobile applications

DB Navigator + DB Zugrader

- route planning based on the actual GPS position
- real-time location of the trains
- 200,000 stops, map of trains, train news
- booking option
Mobile applications

**Egérút**

- 230,000 km road network, actual map database
- community navigation – route planning in the center
- self learning algorithm – automatic refinement based on commonly collected traffic data
- information about traffic restrictions
Vision

- integrated transport database
- planning according to all transport modes
- adaptive operation
- real-time, dynamic data
- estimation of transport conditions
- centralized planning of alternative routes
- location-based services
- service of value-added information
- consideration of personal preferences
- wide range of comfort information services
Table of contents

Introduction

Evaluation method

Evaluation of journey planners

Mobile journey planners

Journey planners in practice
We are travelling in London today. We would like to reach Marble Arc from the Tower Bridge
- with the least walking distance,
- in a fast walking speed.

- How many minutes does it take?
- What kind of restrictions can be found at the metro line, you are using?

- http://www.tfl.gov.uk/
Searches

London

15:58
Marble Arch Underground Station
13 minutes
Central line towards Epping Underground Station, Newbury Park Underground Station, Hainault Underground Station or Loughton Underground Station
View all stops
View on a map
Crowding information

16:00
16:41

16:05
16:45

16:14
Liverpool Street Underground Station
3 minutes
Circle line towards Tower Hill and Embankment or Metropolitan line towards Aldgate Underground Station
View on a map
Crowding information

16:21
Aldgate Station - Boarding at Stop R
Searches

London

- We are travelling in London today. We would like to reach Marble Arc from the Tower Bridge
  - with the least walking distance,
  - in a fast walking speed.

- How many minutes does it take?
- What kind of restrictions can be found at the metro line, you are using?
- Without using the metro, how much more time would it require to reach our destination?
Searches

London

JOURNEY RESULTS

Marble Arch Underground Station  Leaving
Tower Bridge / City Hall  16:00

Public transport  Cycling  Walking

Travel by

- Bus
- DLR
- River Bus
- Coach
- Tube
- London Overground
- Tram
- National Rail
- Til Rail
- Emirates Air Line
### Least walking

<table>
<thead>
<tr>
<th>Depart</th>
<th>Arrive</th>
<th>Time</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:54</td>
<td>17:18</td>
<td>1 hr 24 mins</td>
<td>98 bus to Tottenham Court Road Station</td>
</tr>
<tr>
<td>4 mins</td>
<td></td>
<td></td>
<td>Walk to New Oxford Street</td>
</tr>
<tr>
<td>38 mins</td>
<td>25 bus to Aldgate Station</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Status alert for route 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 mins</td>
<td>42 bus to Tower Bridge / City Hall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depart</th>
<th>Arrive</th>
<th>Time</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>16:00</td>
<td>17:25</td>
<td>1 hr 25 mins</td>
<td>6 bus or 23 bus to Trafalgar Square / Charing Cross Stn</td>
</tr>
<tr>
<td></td>
<td>Status alert for route 23, 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 mins</td>
<td>15 bus to Tower Of London</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Status alert for route 15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 mins</td>
<td>42 bus or 78 bus or RV1 bus to Tower Bridge / City Hall</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Status alert for route RV1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depart</th>
<th>Arrive</th>
<th>Time</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>16:07</td>
<td>17:32</td>
<td>1 hr 25 mins</td>
<td>98 bus to Tottenham Court Road Station</td>
</tr>
<tr>
<td>4 mins</td>
<td></td>
<td></td>
<td>Walk to New Oxford Street</td>
</tr>
<tr>
<td>39 mins</td>
<td>25 bus to Aldgate Station</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Status alert for route 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 mins</td>
<td>42 bus or 78 bus to Tower Bridge / City Hall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
London

• We are travelling in London today. We would like to reach Marble Arc from the Tower Bridge
  – with the least walking distance,
  – in a fast walking speed.
• How many minutes does it take?
• What kind of restrictions can be found at the metro line, you are using?
• Without using the metro, how much more time would it require to reach our destination?
• Let’s check the camera picture at our destination!
Searches

London

STATUS UPDATES

Tube, Overground, TFL Rail, DLR & Tram | Buses | Traffic | River Bus | Emirates Air Line | National Rail

- Now 17:04
- This weekend
- Future date

Find a postcode, place or road
Westminster, London Eye, A406, SW

Add favourites

<table>
<thead>
<tr>
<th>Road</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Map options

- Map layers
  - Severe disruptions & closures
  - Serious disruptions & delays
  - Moderate road disruptions
  - Variable Message Signs
  - Speed cameras
  - Red light cameras

Traffic conditions
Road Corridors
GLA Boundary
Low emission zone
Congestion charge
# Searches

## London

<table>
<thead>
<tr>
<th>Road</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A4</td>
<td>Closures</td>
</tr>
<tr>
<td>Central London</td>
<td>Closures</td>
</tr>
<tr>
<td>Red Routes</td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>Serious delays</td>
</tr>
<tr>
<td>A2</td>
<td>Serious delays</td>
</tr>
<tr>
<td>A24</td>
<td>Serious delays</td>
</tr>
<tr>
<td>A3</td>
<td>Serious delays</td>
</tr>
<tr>
<td>A40</td>
<td>Serious delays</td>
</tr>
<tr>
<td>A12</td>
<td>No exceptional delays</td>
</tr>
<tr>
<td>A20</td>
<td>No exceptional delays</td>
</tr>
<tr>
<td>A21</td>
<td>No exceptional delays</td>
</tr>
<tr>
<td>A316</td>
<td>No exceptional delays</td>
</tr>
<tr>
<td>A41</td>
<td>No exceptional delays</td>
</tr>
</tbody>
</table>
• Visit Vienna! We would like to go Kahlenberg from the railway station using bike:
  – we arrive with the train to Wien Hauptbahnhof on Saturday at 11:10,
  – our speed by bike is fast, but we would like to avoid ascents.

• How much is the total elevation during the route?
• How many free bicycles are at the train station?

• http://anachb.at/
• Visit Vienna! We would like to go Kahlenberg from the railway station using bike:
  – we arrive with the train to Wien Hauptbahnhof at 11:10 from Budapest,
  – our speed by bike is fast, but we would like to avoid ascents.

• How much is the total elevation during the route?
• How many free bicycles are at the train station?
• Let’s go to the Stephansdom at 15:00! We prefer public transportation except from metro.
• Check tram proximity from Stephansdom!
Vienna

A service by Verkehrsverbund Ost-Region (VOR) and ITS Vienna Region.