Towards a harmonised set of KPIs to assess and forecast the impacts of network management measures

The CONDUITS Initiative

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Cities needs when they have to chose an ITS

- Neutral assessment of ITS in urban environment
  - Ratio cost/benefit of an ITS investment
  - Assess the usefulness of an ITS as a whole
  - Identify the limits of an ITS

- Decision Support Tool (DST) for traffic managers and decision makers

- Allow comparison between different ITS solutions

- Control/assessment of an ITS implementation

- Possibility of sharing results between cities
Solution: KPIs with specific requirements

- Key Performance Indicators (KPIs) easy to use and communicate to decision makers and public
  - No or light extra work for the users
  - Clarity for the political decision makers and the public

- Adapted to cities individuality
  - Geographical scale:
    - sections, roads, zones, network, …
  - Adaptability:
    - Ability to use all kind of urban data that are relevant to quantify a performance
    - Weighting possibilities
Goal of the CONDUITS project

- To establish a coherent set of Key Performance Indicators (KPIs) for ITS used for urban traffic management

Main objectives

- To define a set of Key Performance Indicators for identifying best practices and best technologies
- To test these KPIs through real applications in
  - Paris,
  - Rome,
  - Tel-Aviv,
  - Munich
  - Ingolstadt

\[ I_{MOB} = w_{PV} \cdot \frac{1}{|R_{PV}|} \sum_{r \in R_{PV}} \frac{ATT_{PV}^r}{D_r} + w_{PT} \cdot \frac{1}{|R_{PT}|} \sum_{r \in R_{PT}} \frac{ATT_{PT}^r}{D_r} \]
The CONDUITS set of indicators
The Brussels case study

- Priority bus line 49
  - Many intersections with traffic lights

- 4 VISSIM simulations
  - Morning and evening peak hours
  - Situation before and after implementation
Expected results of the bus priority

- **Short-term**
  - Increase average speed of the buses
  - Increase average speed of the private vehicles displacement parallel to the line
  - Reduction average speed of vehicles crossing the line

- **Medium-term**
  - Change of route choices for private car drivers
  - Reduction of time losses in the implementation area

- **Long-term**
  - Demand shift towards public transport reduces private car rides
The first results reflect the expected short term effects:

- Improvement of the public transport quality:
  - increase average speed of the buses
  - reduction of the stops at intersections

### First results of the case study (1)

<table>
<thead>
<tr>
<th>Ave. Speed [km/h]</th>
<th>southbound</th>
<th>northbound</th>
<th>before</th>
<th>after</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16.8</td>
<td>17.3</td>
<td>17.4</td>
<td>18.5</td>
<td>+ 3%</td>
</tr>
<tr>
<td></td>
<td>17.3</td>
<td>17.4</td>
<td>18.5</td>
<td></td>
<td>+ 6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Stops [-]</th>
<th>southbound</th>
<th>northbound</th>
<th>before</th>
<th>after</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11</td>
<td>9</td>
<td>7</td>
<td>4</td>
<td>-18%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>43%</td>
<td>- 43%</td>
</tr>
</tbody>
</table>
but… increase in pollution

… what is (hopefully) normal!
First results of the case study (3)

- **Sensitivity analysis with a pragmatic methodology**
- The given demand levels of the relevant flows are progressively reduced in increments of 1%
- and the KPI values are recalculated for each scenario.

### Sensitivity analysis of the single pollutants

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Morning</th>
<th>Evening</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>- 1,5%</td>
<td>- 4,0%</td>
</tr>
<tr>
<td>NOₓ</td>
<td>- 3,5%</td>
<td>- 6,0%</td>
</tr>
<tr>
<td>PM10</td>
<td>- 0,5%</td>
<td>- 3,0%</td>
</tr>
<tr>
<td>KPI Pollution</td>
<td>- 1,8%</td>
<td>- 3,9%</td>
</tr>
</tbody>
</table>
Advantages of these Indicators

- Same methodology for all the indicators
- Calculation running with all kinds of data
- Easy weighting of the parameters
- Automatic calculation before, during and after the implementation of an ITS by using the VISSIM files as they are provided
- Allow sharing results got in other cities for similar ITS and the possibility to create a common DB with real measurements
Actual limits of these Indicators

- It will be necessary to wait a few years before having “before and after” data based on real measurements.
- Require a cost/benefit analysis to complete the set of KPIs needed to cover the overall sustainability assessment of an ITS.
- KPIs comparison between cities still needs an agreement on common weighting.
Future developments planned in Brussels

➢ Further steps: Road safety prediction module and Road safety prediction module

➢ Design of an integrated sustainability module using CONDUITS KPIs for VISSIM micro simulations

➢ Implementation of this integrated sustainability module for VISUM macro simulations and OPTIMA simulations
The Stuttgart case study

The Stuttgart Measures
The Stuttgart case study

Emission-based traffic control

Test site B14
- Main arterial road (3.5 km, 10 crossings, 2-3 lanes/direction)
- High traffic load, esp. in peak time
- High emissions
- Public transport, pedestrian and bicycle crossings

Modelling emission impact by

Microscopic Simulation
The Stuttgart case study

Measures to reduce stop-and-go traffic are going to be implemented and tested:

- Dynamic speed limit: 50 km/h and 40 km/h
  (30 km/h on a section as recommendation)
- Depending on immission situation or traffic situation
- Speed enforcement by cameras
- Start of operation middle of 2014
- Increase public awareness for the measure
Evaluation:

- Comparison before (July 2013), intermediate (May 2014) and after situation (October 2014)
- Test of different scenarios for control strategy
- Measuring of immissions by measurement stations (NO2, PM10)
- Noise level (national guidelines)
- Traffic counts, traffic observation, travel time measurement
- Compliance rates observation
- Effects on pedestrians, public transport, cyclists and traffic safety
The Stuttgart case study

Micro Simulation VISSIM -> CONDUITS/AIRE:

**VISSIM**
- single vehicle data every 0.5 s,
- travel time, average speed, congestion, stops

**CONDUITS/AIRE**
- emissions NO\(_x\), PM10, CO\(_2\) -> emissions KPI
- travel time aggregation

**Other impacts**
- waiting time for pedestrians/bicycles, accident records, costs, sensitivity tests,
- cost-benefit analysis
Advantages of the Conduits Tool for us so far:

- Good transferability and therefore an easy adaption into our system
- Fast assistance and support in case of technical problems
- Help to convince the city council with their decisions
- KPI`s for Traffic efficiency and pollution
Other developments outside Brussels and Stuttgart

- Tel Aviv
  - CIVITAS project 2MOVE2
    - Bus priority case study
    - To be completed by middle of 2014.
    - KPIs: Traffic efficiency and Pollution
- Haifa
  - Case study covers travel times in tunnel delivered through VMS. Aim of giving travel times is to encourage drivers to use tolled tunnel rather than alternative congested route.
  - KPI: Traffic efficiency (+ Pollution !)
Future developments: some thoughts!

- Integrated DST module including Traffic – Road safety – Pollution reduction in a first step
- Scientific approach for the choice of the KPIs weightings
- "Validation" of these weightings by political representatives
- Impacts of different vehicle fleet compositions on the pollution KPI
- Feasibility study of a predictive social inclusion KPI module for future inclusion in CONDUITS DST
- Discussion with PTV for a better integration of the CONDUITS DST in their products
Thank you for your attention!

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The CONDUITS Decision Support Tool is free of charge and a user manual is available, as well as a technical support.

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