Defining urban mobility indicators

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3 points of note:

- EU Cities and regions are all facing exposure to high air pollution and emerging impacts from climate change,
- Mobility has important role in those issues
- All share the challenge to develop and implement reduction plans
- Wealth of knowledge and good practices already available

Each other experiences
CITEAIR II : Common Information to European Air

- funded under INTERREG IVc programmes
- 2nd part of a previous project CITEAIR (INTERREG IIIc)
- 3 years duration: oct 2008 - sept 2011
- 11 partners from 8 Member States
Every hour, an overall picture of air quality in European cities

- 2 different common air quality indices:
  - for background situation
  - for traffic situation.

- updated every hours

- more than 60 European cities and 3 languages
Technical organizations, local authorities and Networks

- **AIRPARIF** - air quality monitoring agency – Ile-de-France region and Paris area - *coordinator*
- **DCMR** - Environment Protection Agency Rijnmond (NL)
- **ATAC** - Mobility Agency of the City of Rome
- **INERIS** – French National Institute of Industrial environment and risks
- **CHMI** - Czech Hydrometeorological Institute
- **EGMASA** - environmental agency of Andalusia (Spain)
- **Municipality of Maribor** - Slovenia
- **URM** - City Development Authority of Prague
- **Polis** - network of EU cities and regions for innovative technologies and policies for local transport - Brussels
- **REC** - Regional Environmental Center for Central and Eastern Europe - Office of Slovenia
- **ARMAAG foundation** – air quality network in Gdansk and Tczew - Poland (*under approval*).
Method

- Identification of good practices:
literature, partners’ expertise, workshops and working groups …

- Tests and implementation by one or several partners
  and display on the common website

- Feedbacks from the users community

- Elaboration of a guidebook
  enabling the transferability of those good practices

Results expected
Tools to be developed

- Indicator of mobility or of « sustainable traffic »
- Integration of Greenhouse Gases in air pollutants emission inventories in order to identify suitable reduction measures and synergies for both issues (avoid antagonist measures!)
- A 3 level forecast of the common air quality indices developed in the previous CITEAIR
- Further development of www.airqualitynow.eu
  - new cities,
  - Integration of PM2.5 in the common air quality indices (CAFÉ dir.)
  - 5 languages
**Objective and logical steps...**

**Work in progress...**

**OBJECTIVE:** Benchmarking Traffic Situation and Impact

- Diffuse experience accumulated in Europe and Rome in managing mobility, planning models and measurement systems;
- Detailed analysis of the context to choose the right variable/measure that can fit with the original objective;
- Integration with analysis from universities and researchers (Literature overview);
- First Thematic Working Group (Rotterdam, May 2009);
- First Networking Workshop (Paris, June 2009);

**STARTING POINT:**

**OUTPUT...**

- List of 10 possible Indicators;
- More flexible evaluation structure - Modular structure;
- Step towards air quality issue;
Mobility Indicator: Preliminary considerations (1)

- Mobility indicator should be extremely synthetic representation of a phenomenon really complex.

- Main achievement: BENCHMARK TRAFFIC SITUATION IN URBAN AGGLOMERATE.

- The data to be used for the indicator shall be simple and reasonably available in the different cities.

- Main input to calculate the mobility indicator should come from traffic measurements.

- Need for homogenization of private transport data with public transport.

- For any people the time spent to get a destination has a deep importance: travel times need to be considered.
Mobility Indicator: Preliminary considerations (2)

- Speed and travel times shall be measured/evaluated in the different cities with **any type of technology/method**.

- The indicator shall allow the representation of the mobility situation in **specific zones or the whole city**;

- Different indicators for different **time period** could be developed (daily, weekly, monthly, annual).

- Its second main achievement should be to **DESCRIBE THE TRAFFIC IMPACTS IN URBAN AGGLOMERATE**

- Integrated structure to evaluate Traffic Indicator and Traffic Impact Indicator (in terms of Polluting Agents and Drivers Exposure)

- **Final Target**: the indicator should not be only a tools for experts, but also an immediate and simple measure to be shared and easily understood.
The proposed structure for the indicators

From the Paris Networking Workshop...

<table>
<thead>
<tr>
<th>Traffic</th>
<th>Air Pollution</th>
<th>Emissions: Air + GHG (PM, NOx, CO2, VOc...)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Speed + flow ➔ mobility</td>
<td>- Citeair traffic index</td>
<td></td>
</tr>
<tr>
<td>(average travel time)</td>
<td>- Citeair bckgd index</td>
<td></td>
</tr>
<tr>
<td>ATAC methodology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- number of passengers/ car</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- fleet composition</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Number of car drivers exposed to an air quality rather poor/medium… [traffic index]
  compare to the the general air quality of the city which was [back index]
- For a longer/same/ shorter time than usual (see average travel time)
- and have emitted X tons of CO2, NO2, Voc, Particles (emissions calculations)

Different options and level of complexity depending on the data available:

Timing:
- annual - passengers cars
- daily - public transports
- hourly - powered 2 wheels
- pedestrian, bicycle, …

Minimum requirement: annual data for passengers cars
- Possible comparisons with other transport mode, esp. public transport if data available
- Possible scenarios: effect + or - of fleet change or of the generalized use of other fuels (electric, biofuels, natural gaz…)
Towards the settlement of the Indicators

- questions and answers -
1. TARGET OF THE INDICATOR

WHO should mainly use this information?

- **Citizens**
  - They are the weakest component of the system;
  - They feel, mainly and immediately, the effects of system variations.

The same information could also provide the system’s manager with an useful and of fast reading tool;

- **Policy Maker**
  - analysis of historical series;
  - helping the manager to make him understand where the system is going (naturally or due to some interventions).
The original starting point

The Mobility Indicator

- Simple and immediate information regarding Mobility;
- Easy and understandable way of communication with citizens;
- Useful tools for policy maker

Idea of “Mobility Dashboard”
2. **WHEN** this indicator should provide users with information?

Temporal Aggregation Criteria

- Day
- Sub-period of a year
- Year
- Sub-period of a day

- **Day** -> data of the day before
- **Sub-periods of a day** -> homogeneous time periods in which divide the day hourly? ("real time")

**It will be possible to evaluate the indicators for any aggregation period chosen, according to the availability of data.**
3. **WHERE** this indicator should provide users with information

**Spatial Aggregation Criteria**

- How many zone?
- One zone for the whole city or more?
3. **WHERE** this indicator should provide users with information

**Spatial Aggregation Criteria**

- Each city could choose the most appropriate zoning;
- According to the availability of measurement data;
- Focusing the attention on the more central zone of the urban context.

- Case of Rome (some example of available zoning):
  - zoning for transportation planning = 1200 zones
  - borough = 19 zones
  - **Urban Traffic General Plan (UTGP) = 5 concentric zones**
A time-dependent indicator of traffic and mobility consistent (averaging process is correct) and comprehensive (enough measurement points) requires, in theory, the continuous monitoring of the entire transport network, which implies measuring every few minutes the flow state (speed and density) of at least each major link.

Relevant modelling effort to extend field data retrieved from just a limited number of road links to cover the entire transport network.
- estimation of traffic and speeds: a relevant **modelling effort** (road graph, o-d matrices) could be considered out of scale;
- not all the cities involved in the project could have such a modelling tools.

**Assumption**: measured links are a significant sample of the whole urban network, so that an average made on the sample, or on a part of it (if the indicator refers to specific portions of the network), well represents the reality.

The proposed indicators will be based simply on the links where an ITS probe (loops, AVM, UTT, ...) is actually present.
Example 1
- densely populated area but not so large
- relevant congestion and air pollution
- BUT...
- time spent for daily activities may be not so high (trip lengths are limited)
- FAIR MOBILITY PERFORMANCE (transit mode is available)
- BAD TRAFFIC PERFORMANCE

Example 2
- sparsely populated area
- no congestion
- BUT...
- trips are rather long and most of them requires a car
- BAD MOBILITY PERFORMANCE (only one expensive mode is available)
- GOOD TRAFFIC PERFORMANCE
Mobility indicator & data: from Traffic to Mobility....

- **Traffic** is a more general variable related to the condition of the infrastructural network - *quantitative variable*

  ![Traffic to Transport Supply](image1)

- **Mobility** is something more complex that accounts also the transportation system users displacement characteristics - *quantitative variable and qualitative variable*.

  ![Mobility to Transport Demand](image2)

Migrating from a traffic to a mobility indicator implies the understanding of the **average trip distances (ATD)** and **Standard Trip Time (STT)**.
The proposed structure for the indicators

**Input:** Set of Measurements (loops, AVM, UTT, …)

Standard travel time typical of each city = STT

**Measurement Points**

(Speed and Flow)

**Flows and Speed on the road network + ATT**

**MOBILITY INDEX**

**TRAFFIC INDEX**

**BACKGROUND INDEX**

**ATT-STT**

**ΔEmission**

COPERT: Emissions on the road network

**EXPOSURE INDEX**

**Exposure**

Direct calculation

Using CITEAIR I indices

**Average**

**ATT-STT**

**EXPOSURE**

Longer exposure to TRAFFIC INDEX

\[ \Delta \text{Exp} = (\text{TRAFFIC INDEX} - \text{BACKGRD INDEX}) \times (\text{ATT-STT}) \]

Shorter exposure to TRAFFIC INDEX

\[ \Delta \text{Exp} = (\text{TRAFFIC INDEX} - \text{BACKGRD INDEX}) \times (\text{ATT-STT}) \]
The evaluation structure

First step - Mobility Index

- Working just having only **dynamic data** gathered using traffic measurements systems and the **standard trip time** (STT - could be different mode by mode - every city should have acquired in their planning history).

- When good traffic models are available, data collected on the basis of one more ITS technologies can serve for prediction of the speed and flows of the vehicles throughout the whole city or zones of it.
Some examples of Indicators: from Traffic to Mobility....

Traffic performances

1. NAS
2. NSI
3. VAS

Mobility performances

4. VSI
5. NTI
6. NDI
7. TAT
Average Trip Time - ATT

\[ ATT_{Zm}^J = D_{Zm}^J / VAS_{Zm}^J \]

From analysis of ATT changes in relation to STT the Mobility Indicator will be derived.
The evaluation structure

Second step - Exposure index

- number of passengers exposed for a fixed time period (ATT - Average Trip Time) to a certain air quality (value obtained using the traffic index developed in the CITEAIR I project);
- the direct calculation of the difference in emissions - \( \Delta \)Emission - using models (i.e. COPERT) between the current situation and the standard situation, where the value of the Average Trip Time is the Standard Trip Time.

The evaluation structure:

- Direct calculation
- COPERT: Emissions on the road network
- \( \Delta \)Emission

Flowchart:

1. **Average Exposure**
2. **ATT-STT**
3. **TRAFFIC INDEX**
4. **BACKGROUND INDEX**
5. **\( \Delta \)Emission**
6. **\( \Delta \)Exp = (TRAFFIC INDEX – BACKGRD INDEX) x (ATT-STT)**

- If ATT-STT > 0: Longer exposure to TRAFFIC INDEX.
- If ATT-STT < 0: Shorter exposure to TRAFFIC INDEX.
Examples of Exposure Indicators

Using CiteAir I Index:

10. Average Differential Exposure to Pollutant X - ADE

\[ ADE_{Zm}^J = (ATT_{Zm}^J - STT_{Zm}^J) \cdot (CTI_{Zm}^J - CBI_{Zm}^J) \]

**Using CiteAir I Index:**

- **ATT-STT**
  - From CITEAIR I
  - **Traffic Index**
  - **Background Index**

**EXPOSURE Using CiteAir I Indexes**

- **ATT-STT**
  - \( > 0 \)
    - Longer exposure to TRAFFIC INDEX
    - \( \Delta \text{Exp} = (\text{TRAFFIC INDEX} - \text{BACKGRD INDEX}) \times (\text{ATT-STT}) \)
  - \( < 0 \)
    - Shorter exposure to TRAFFIC INDEX
    - \( \Delta \text{Exp} = (\text{TRAFFIC INDEX} - \text{BACKGRD INDEX}) \times (\text{ATT-STT}) \)
Steps for the Indicator Evaluation

- Data Gathering
- Analysis of data
- Aggregations (spatial and temporal)
- Indicator evaluation
- Updating Tables and Maps

Next time period
First methodology application
The case of Rome
Which data do we need?

- Vehicles Flows;
- Speed (Travel Time);
- Average Trip Distance (ATD);
- Vehicle Fleet Composition.
Objectives:

- **2 separate mobility indicator for public and private**
- Not only one indicator per day (**4 homogenous day period** to evaluate the indicators)

Data gathering process

- accurate choice of measurements points

Historical analysis of data:

- Private: time and flows by loops, UTT (October 2008-October 2009)
- Public: time from AVM for the last year (January 2009-November 2009)
2. **WHEN** this indicator should provide users with information?

- Case of Rome (Sub-periods of a day):

- 5 time periods according to the private traffic trend during a typical working day
ATD & STT: The way to obtain it could be by model &/or by interview

**Users Characteristics (by model)**

11 Km - Average Trip Distance

(Private Mode - AM Peak Hour)

**Users Characteristics (by interview)**

?? Km - Average Trip Distance

40,000 telephonic interview

(Municipality of Rome)
Time along 12 road itineraries monitored (about 115 km of main roads)

Time and Flows from specific loops in strategic point for private mobility

Data from private network
Data from public network

Choice of suitable PT sub-network
Next steps and Preliminary Remarks

Next steps:

- Results for Rome case study to be discussed in Rome project workshop in January;
- Extension of case study to other project cities before March;
- Set-up of online testing procedure within June.
- Final data analysis and definitive indicators set-up on www.airqualitynow.eu within 2010.

Preliminary remarks:

- Differently from Air quality indices, few information on similar experiences in cities for such indicators;
- Participation to next steps from other cities is welcome, starting from Rome workshop;
- POLIS could support cities in contribution and in participating to indicators set-up, testing and use.
Thank you for your attention

- More information...

- on CITEAIR II - www.citeair.eu

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