Interactive Network Assessment Tool

GIS-based Bicycle Safety Assessment

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Indicator-based Assessment Model

**Indicators**
- Bicycle infrastructure
- Road surface
- Maximum speed
- Traffic load (motorized)

**Weights**

**Calibration**

**GIS Model**

**Assessment result**

**Black box!**

gicycle.wordpress.com
Interactive Network Assessment Tool

1. Collect information (literature, experts, users) → Identify indicators for specified use case
2. Define indicators and value domains → Prepare and provide data as WFS → Hosted data on geodata server

Start

Initialize web application with default weights

Hosted web application on web server

Read data from WFS → CSV data import (data changes and adapted weights)

Assign weights to indicators

Calculate index and coloring features accordingly

Evaluate results (experts, users)

Manipulate indicator value

Adapt indicator weight

Store data changes temporarily

Store adapted weights temporarily

CSV data export (data changes and adapted weights)

Indicators and weights for specified use case

opt.
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- In an foregoing research 13 indicators were found to be relevant to the use case

Geometry, Attributes (bicycle infrastructure, road category, speed limits)

Reclassification from attributes to indicators

Height information

Attribute 1
Attribute 2
Attribute 3

Indicator 1
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- Reclassification from attributes to indicators
- Weighting accordingly to bicycle friendliness

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value domain</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle infrastructure</td>
<td>Bicycle way</td>
<td>Best = 0</td>
</tr>
<tr>
<td></td>
<td>Bicycle and footway</td>
<td>Better ≈ 0.25</td>
</tr>
<tr>
<td></td>
<td>Bicycle or bus lane</td>
<td>Good ≈ 0.5</td>
</tr>
<tr>
<td></td>
<td>No bicycle infrastructure</td>
<td>Worst = 1</td>
</tr>
<tr>
<td>Road category</td>
<td>Primary road</td>
<td>Worst = 1</td>
</tr>
<tr>
<td></td>
<td>Secondary road</td>
<td>Worse ≈ 0.75</td>
</tr>
<tr>
<td></td>
<td>Residential road</td>
<td>Good ≈ 0.75</td>
</tr>
<tr>
<td></td>
<td>Calmed road</td>
<td>Better ≈ 0.25</td>
</tr>
<tr>
<td></td>
<td>No road</td>
<td>Best = 0</td>
</tr>
</tbody>
</table>
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- Esri ArcGIS API for JavaScript
  + Bringing GIS functionality to a web browser
  + No ArcGIS installation needed
    - Runs client-side

- Esri ArcGIS Online
  + Easy data hosting and provision as web service

- Dojo JavaScript Framework
  + Provides widget library (buttons, sliders)
  + Making the application independent from browser quirks
Application Development

- Indicator Weighting
- Index Calculation
- Feature Rendering
- Data Manipulation
Application Development Indicator Weighting

- For every indicator one slider is initialized
- Each slider has a value between 0 and 100 %
- The sum of all weights must always be 1
- If one slider is moved, the others are adjusted accordingly
- On every slider move, the index is recalculated and the features colored accordingly
The index is calculated for every feature within the visible extent of the map with the following formula:

\[
\text{index} = \frac{\sum_{i=1}^{n} \text{indicator}_i \ast \text{weight}_i}{\sum_{i=1}^{n} \text{weight}_i}
\]

- Missing values are only excluded for affected road segments
Application Development
Feature Rendering
Application Development
Data Manipulation

- Overview of the available indicators and values → Popup window
- Coloring based on the color scheme of the road network → Positive or negative contribution to bicycle safety
- To change indicator values → Drop-down list
- Whenever a value is change, the index is recalculated and colored accordingly
Outlook

- Dynamic weighting of the indicator values
- Integration of live geoprocessing into the application
  - Routing
    - Optimized profiles or personalized preferences
    - Immediate visual feedback on every slider change
- Subsequent geoprocessing based on the assessment result
  - Location Analysis
  - Spatial Analysis
Routing

Common bicycle routing options:
- Avoid gradient
- Prefer bicycle infrastructure
Routing

Bicycle Infrastructure: **100 %**
Routing

Road Category: 100 %
Routing

Bicycle Infrastructure: 25%
Designated Route: 25%
Road Category: 25%
Gradient: 25%
Prototype: Indicator-based Routing
Quality of accessibility of an location from every raster cell (Loidl 2015)
Agent-based simulation of cyclists (Wallentin 2015)
Conclusion

- Static model → Dynamic process
- Black box → Transparent and comprehensible procedure
- Intuitive GUI → Increased usability also for non-GIS experts
- Responsive changes → Enhance the fields of application