Development of a Data Integration and Management Tool for the Strategic Environmental Assessment as a Contribution for Sustainable City Planning in Berlin

Michael Förster\textsuperscript{1}, Antje Köppen\textsuperscript{1}, Dietrich Bangert\textsuperscript{2}
Lutz Ross\textsuperscript{1}, Johann Köppel\textsuperscript{1}, Birgit Kleinschmit\textsuperscript{1}

\textsuperscript{1}Berlin University of Technology
\textsuperscript{2}Senate Department for Urban Development
1. Challenges of the SEA Directive

2. SEA Assessment Model in Berlin
   2.1 General Structure and Example
   2.2 Implementation (Prototype)

3. Planned Interoperable Assessment Model
   3.1 General Structure
   3.2 Example of derivation of semantic relations

4. Conclusions
The need to integrate heterogeneous data sources:
- Amount of application cases
- Amount of environmental data to be considered
- Interrelationships between subjects of protection to be investigated

Methodical concept for data integration and assessment
- Merge of “horizontal” data of different sources to make them comparable
- “Vertical” aggregation of data over different scales
- Methodical assessment framework (regulation system)
Motivation / Vision

Cadastral Data (ALK)

Environmental Atlas (Map 06.07 City Structure)

Occurrences of Herpetofauna

Scenario Tool
Assessment:

1. Technical or scientific relevance (quality potential)

2. Prevention of risks or hazards (risk potential)

Assessment Categories:

- Restriction area
  (legally binding restrictions, e.g., limits, thresholds, protected areas etc.)
- Precaution area I
  “Borderline area”
- Precaution area II
- Precaution area III
- Precaution area IV

Relevance for the decision-making process:

- No decision-making leeway
  Strict reglementation
- Increasing relevance for the decision-making process

Source: Dr. A. Herberg, Technical University Berlin, 2007
Assessment Model (Example Soil)

**Goal system**
- Secure / Recovery the capability of soil

**Assessment**
- Allocation of Value / Aggregation of values

**Thematic model**
- Soil functions
  - Living space function
  - Crop function
  - Buffer- and filter function
  - Water balance regulation function
  - Nature history archiv function
- Surface sealing
  - Sealing category

**Soil Sealing Categories**
- **Restriction area** (- no r. -)
- **Precaution area I** (0 – 20 %)
- **Precaution area II** (21 – 50 %)
- **Precaution area III** (51 – 70 %)
- **Precaution area IV** (71 – 100 %)

Source: D. Bangert, 2007
Impact Assessment of Land Use Changes 6th-9th April 2008, Berlin

Assessment Model (Example Berlin)

Assessment Map
Surface Sealing
Software Implementation (Prototype)
# Planned Interoperable Assessment Model

## Existing implementation scheme of the Assessment Model

<table>
<thead>
<tr>
<th>Data Set 1</th>
<th>Data Quality Assessment (integration, preparation)</th>
<th>Thematic Model</th>
<th>SEA-based Assessment Model</th>
<th>Evaluated Data Sets</th>
<th>Rule-based Aggregation (e.g. most sensitive factor is decisive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Set 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Planned Interoperable Assessment Model

<table>
<thead>
<tr>
<th>Data Set 1</th>
<th>Data Quality Assessment (integration, preparation)</th>
<th>geometric relations</th>
<th>semantic relations</th>
<th>SEA Assessment Model based on semantic instances</th>
<th>Related Semantic Groups (Instances)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Set 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Derivation of Semantic and Geometric Relations (Example)

- General approach for semantic and geographic interoperability is to establish semantic correspondences (by expert knowledge rules)
  - Problem 1: It is difficult to apply with a broad variety of data (as in Berlin).
  - Problem 2: To apply expert knowledge is not always possible (limited resources).
  - Problem 3: The derived semantic rules are difficult to evaluate (no validation measure).

- Alternative approach: identify corresponding semantic groups by the analysis of the geometric characteristics (Kieler et al. 2007)

- First example with two data sets (Land use map [ISU 5] vs. Biotope Map)
Data Sets (Subset Berlin-north)

Land Use Map

Biotope Map

- Horticulture
- Fallow/Brownfield
- Residential
- Allotment
- Agriculture
- Forest
- Commercial
- Traffic
- Grassland

- Stream
- Lake
- Anthropogenic soil
- Grassland
- Shrubs
- Forest
- Agriculture
- Urban Green
- Specific Biotopes
- Urban Areas
1. Ratio between intersection and overlapping area is calculated
   $\Rightarrow 0$ means no semantic relation

2. The relation is meaningful if the overlapping of the objects
   results to more than 80 %

3. Different relations are possible:

   \begin{align*}
   A \text{ overlap to } B & > 80 \% \\
   \text{AND} \\
   B \text{ overlap to } A & > 80 \%
   \end{align*}

   \begin{align*}
   \text{near 1:1} & \\
   \text{near 1:n} & \\
   \text{near n:1} & (\text{Kieler et al. 2007})
   \end{align*}
4. Adding up all possible semantic relations for all overlaying polygons by this method

5. To validate the quality of the semantic relations the amount of semantic relations has to be corrected by the average size of the polygons of different classes → classes with larger polygons are weighted higher

6. The calculated semantic relations between two classes were divided by all possible semantic relations for the classes of the land-use map to achieve an estimation of the strength of the semantic relation (in percent)
Geometric Overlay - Results

- Fallow/Brownfield
- Allotment
- Forest
- Traffic
- Horticulture
- Residential
- Agriculture
- Commercial
- Grassland

Target categories:
- Stream
- Lake
- Anthropogenic pure soil
- Grassland
- Shrubs
- Forest
- Agriculture
- Urban Green
- Specific Biotopes
- Urban Areas

- Major Relation
- Relation > 10%
- Minor Relation < 10%
Geometric Overlay - Results

Fallow/Brownfield

Allotment

Forest

Traffic

Horticulture

Residential

Agriculture

Commercial

Grassland

Stream

Lake

Anthropogenic pure soil

Grassland

Shrubs

Forest

Agriculture

Urban Green

Specific Biotopes

Urban Areas

Major Relation

Relation > 10 %

Minor Relation < 10 %
Conclusions

- SEA has the every potential for being the starting point for the development of an efficient (geo-) data management.

- The added value of data collections is the combination of different data for new purposes that were not intended originally by the data producer.

- To realise added values data must be in a condition to be processible:
  - Semantic accessibility
  - Organisational and legal accessibility
  - Technical accessibility

- The presented assessment model is a good tool for an efficient evaluation of semantic homogeneity.

- A semantic approach can reduce double evaluations and inconsistencies in data sets as well as in the assessment of the SEA.

- The deriving of semantic relations by geometric overlay is a promising implementing method.
Thank you for your attention!

http://www.geoinformation.tu-berlin.de/

Michael.Foerster@tu-berlin.de
Koeppen@ile.tu-berlin.de
Dietrich.Bangert@SenStadt.Berlin.de
Geometric Overlay - Results

Fallow/Brownfield

Allotment

Forest

Traffic

Horticulture

Residential

Agriculture

Commercial

Grassland

Different class definition?

1:1

n:1

intersection by small green corridors

n:1

Urban class definition

Different class hierarchy?

Urban class definition

Biotope class definition

Major Relation

Relation > 10 %

Minor Relation < 10 %

Stream

Lake

Anthropogenic pure soil

Grassland

Shrubs

Forest

Agriculture

Urban Green

Specific Biotopes

Urban Areas

1:1

Different class hierarchy?

18 Impact Assessment of Land Use Changes 6th-9th April 2008, Berlin
Obligations of the Directive 2001/42/EG (SEA)

- Description of the **current state** of the environment
- **Prognosis** of the likely significant effects of the implementation of the plan or programme concerning
  - various **environmental issues** (biodiversity, flora, fauna, soil, landscape, human health, cultural heritage etc.) and
  - the **interrelation** between these factors
- Which **measures** have been taken to
  - avoid,
  - **mitigate / reduce** or
  - **balance** unfavourable effects?
- Which **alternatives** have been taken into account?
  - **Null**-option
  - **Self** examined options
  - **External** examined options
Data Integration and Assessment Schema SEAMS

Processes

Result

Goal system

Assessment process

Allocation of value / Aggregation of values

Thematic model

Entities A ...Z

Attribute 1 ...n

D 1 D 2 D 3 D ...n

Data processing

Data integration / (Data production)

Information models

Technical regulation level

Thematic regulation level

Methodical frame level

Goal for entity A ...Z

... ...

... ... ...

Results

... ...

Text Data Plans Maps Aerial views

Goal for entity A ...Z

... ...

... ... ...

Impact Assessment of Land Use Changes 6th-9th April 2008, Berlin