APPLICATION OF CONCEPTUAL MODELS IN THEMATIC MAPPING



EUROCARTO 2015

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Outline

- The problem
- ER models in cartography
- Representation of relationships
- Error recognition: experiment

Complexity



Semantic (ER) model

- One of the first data modeling techniques to be developed (Peter Chen, 1976)
- Uses natural language concepts;
- Easily understandable by a human and can be interpreted by a machine;
- Enforces simplicity;
- Is conventionally presented in graphical form;
- Helps to structure information in a most natural way and to easily expand the structure in the future.
- Commonly implemented in spatial information systems.

Diagrams

Many notations and diagramming tools.

- Chen notation (United States)
- Crow's Foot notation (UK)
- UML (modified)



Application in cartography

- Formal description of syntactic and semantic rules of cartographic representation
- Presentation
- Database design
- Usability testing (e.g., in order to detect situations when the types of entities and relationships between them are not recognized rightly).
- Quality assessment

The idea



0..n

Label E

The algorithm

- 1. Data —> semantic model
- 2. Clean-up
- 3. Classification of attributes
- 4. Graphical entity model
- 5. Classification of attributes (g)
- 6. Attribute and domain mapping
- 7. Supplementary graphical entity
- 8. Design decisions
- 9. Map legend



Outcome





location -> position Ai -> A(g)i

EuroCarto

6 variables





Structures



National Atlas of Lithuania



1 langelis atitinka 4 procentus vaistinių augalų

Vaistinių augalų rūšys

meškauogės

pakalnutės

šaltekšniai kadagiai Vaistinių augalų plotas nuo viso miško ploto (procentais)



Pastaba. Kuršių nerijoje vaistažolės nerenkamos.





Maps: © Dovid Katz

Representation of relationships



Error identification steps

- Retrieve the ER model.
- Check the model for consistency.
- Analyze hierarchies and structures.
- Check type and domain matching.
- Check representations of relationships.



1. Missing superclass (castle)

- 2. Impossible combination of values (ruined wooden castle)
 - 3. Missing graphical variable (for existent/ruined)

Verification (error identification)

- Hypothesis: use of ER model facilitates error identification
- Samples: Cartography and IT students
 - Trained to use the algorithm (20)
 - Just familiar with cartography and ER (20, control group)
- Map fragment and the legend designed to contain 10 errors
- Task
 - To identify and describe all errors (unknown number)
- Measured variables
 - Identification score (0 to 10)
 - False identifications (0 to n)
 - Evaluation of difficulty (1 to 5)

Test map



Untrained

Outcomes

	-				
	Unt	rained		Trained	
	Diff	iculty	Score	Difficulty	Score
	1	5	1	5	4
	2	5	2	5	5
	3	4	3	3	5
	1	5	3	3	6
	5	4	4	4	6
	5	4	4	3	7
	7	5	4	5	7
	3	3	5	3	7
1	Э	3	5	4	7
1	D	4	5	2	8
1	1	4	5	5	8
1	2	3	6	2	8
1	3	4	6	3	8
1	1	5	6	4	9
1	5	2	7	2	9
1	5	3	7	4	9
1	7	4	7	3	9
1	3	3	8	2	10
1	Э	4	8	1	10
2	D	4	9	3	10
AVG		3,9	5,25	3,3	7,6
STDEV		0,85	2,10	1,17	1,76
Corr	-0,	,54418		-0,55032	



Outcomes: scores



Average: 7,6 vs 5,25

Conclusions

- Use of the conceptual model throughout all stages of a thematic map project results in a better control over:
 - database design
 - legend design
 - quality control of the final map
- Use of conceptual model and a systematic reverse engineering allows for better recognition of errors
 - Even though the process does not become much easier.

thank you





