

# Coordinated Views for Informed Spatial Decision Making

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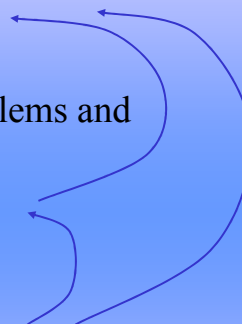
*Fraunhofer AIS: Institute for Autonomous Intelligent Systems*

<http://www.ais.fraunhofer.de/and>



## Decision-making Process

- Intelligence:
  - collect and integrate data;
  - explore the data, identify problems and opportunities
- Design
  - find possible solutions
- Choice
  - analyse and evaluate the options;
  - select the most suitable option or subset



H.A. Simon, *The New Science of Management Decision*



## Decision Support Tools

- Intelligence
  - Exploratory Data Analysis (EDA) techniques
- Design
  - Modelling tools
- Choice
  - Computational MCDM methods (multi-criteria decision making)

J. Malczewski, *GIS and  
Multicriteria Decision Analysis*



## Exploratory Data Analysis

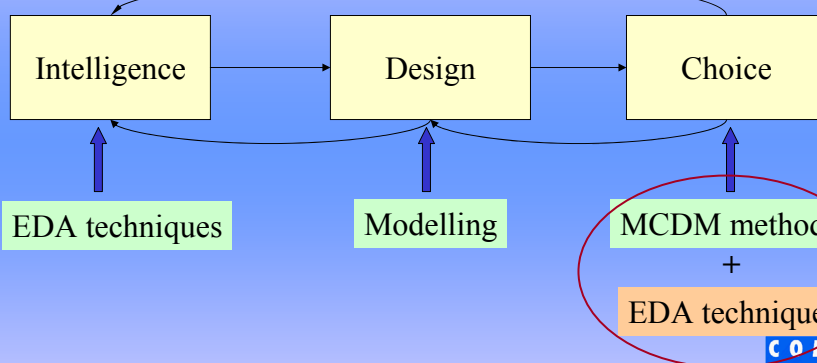
- Goal: detect relationships, patterns, and trends; generate plausible hypotheses
- Based on data visualisation
- Current standard: high user interactivity
- Multiple complementary displays represent various aspects of the data
  - Need to be linked to enable integration of information into a coherent picture of the data as a whole



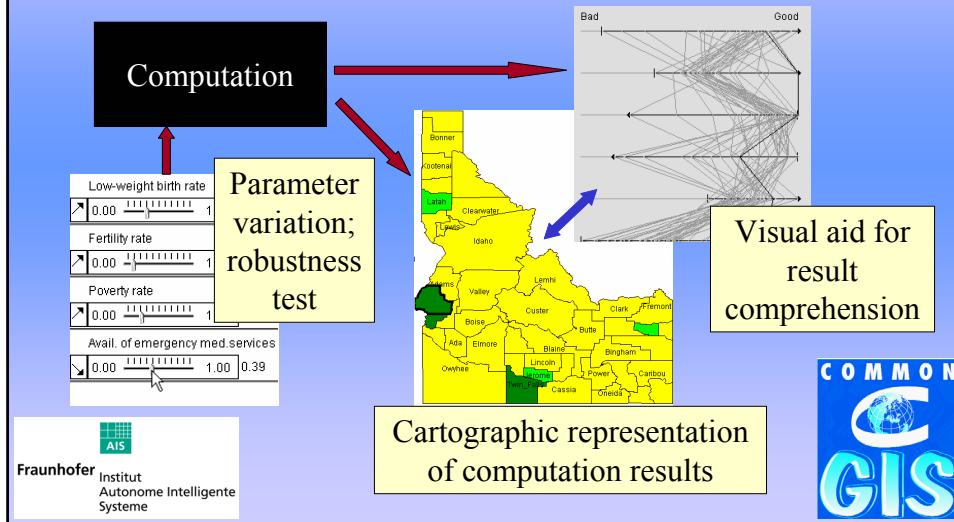
# Numerical MCDM Methods

- Criteria: numeric or ordinal attributes
- Types of criteria:
  - **benefit**: higher values are more suitable
  - **cost**: lower values are more suitable
- Different importance of criteria
  - direct specification: weights or ordering
  - indirect specification: aspiration levels, tolerance intervals, etc.
- Outcome variants
  - evaluation scores or ranking
  - subset of options close to the specified goal

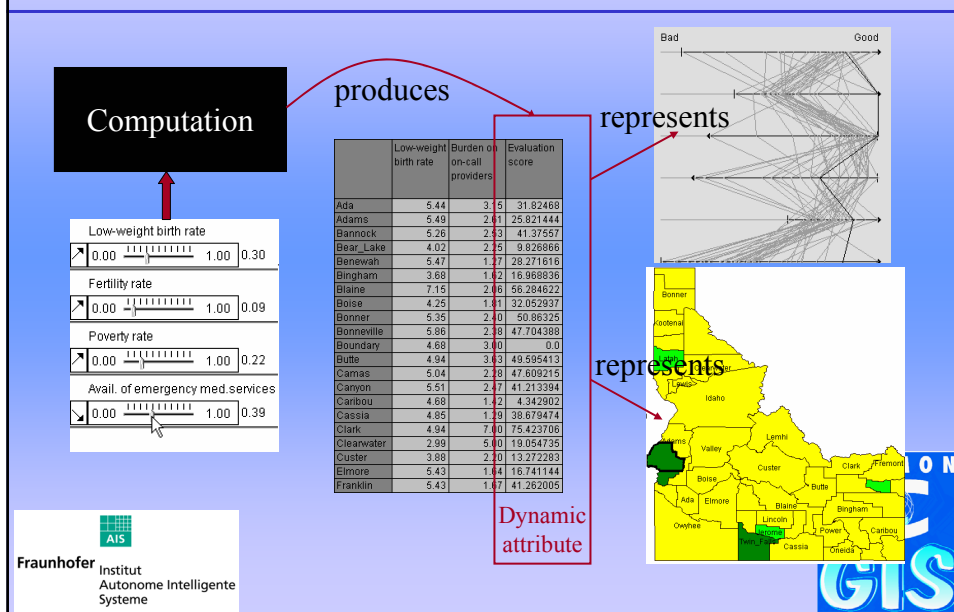
# Decision Support Tools (Our Proposal)



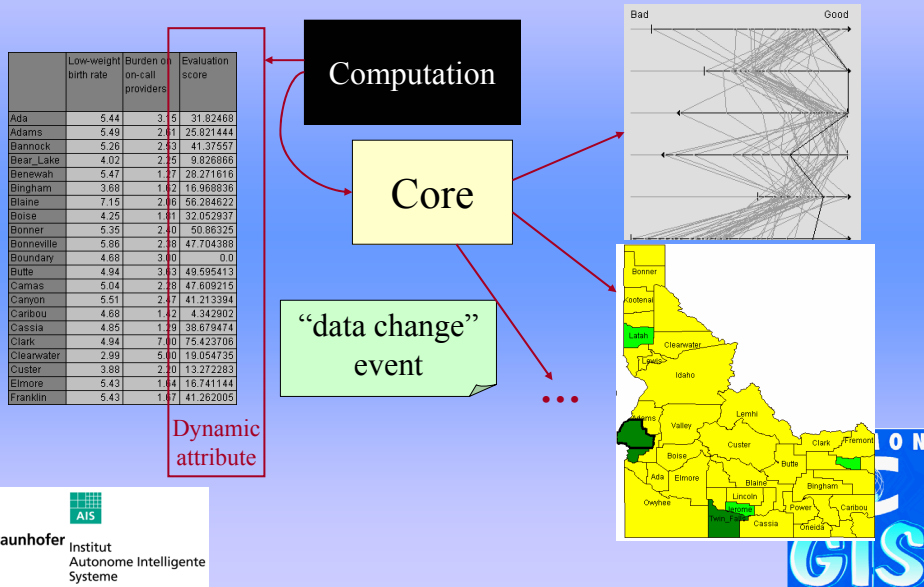
# Visualisation to Support Choice in Spatial Context



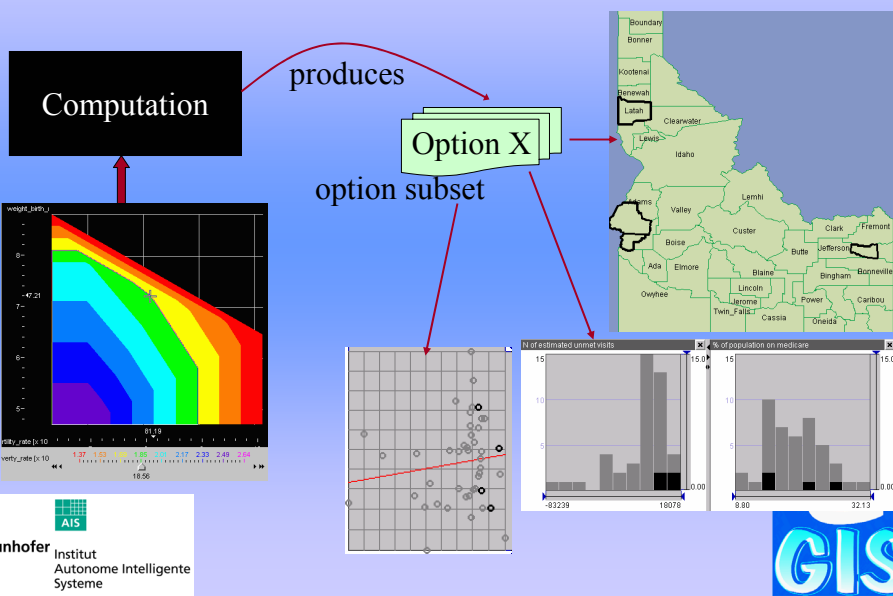
# Variant 1: Evaluation/Ranking



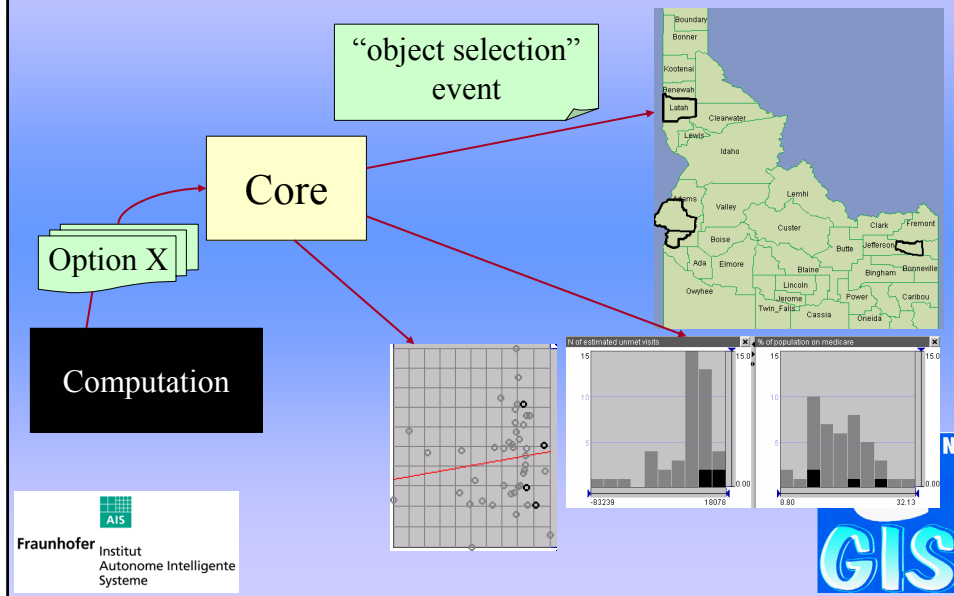
# Coordination Mechanism 1



# Variant 2: Goal Approximation



# Coordination Mechanism 2



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# Example Decision Problem

- Rural Clinics  
Total: 26 objects
- Nursing Homes  
Total: 57 objects
- Hospitals  
Total: 43 objects
- Ambulatories  
Total: 10 objects
- Cities  
Total: 10 objects
- Roads  
Total: 819 objects
- Counties  
Total: 44 objects
- Territory: Idaho
- Background

## Idaho, USA

	% of population on medicare	Low-weight birth rate	Poverty rate
Ada	16.00	5.44	7.09
Adams	19.93	5.49	12.06
Bannock	15.95	5.26	14.18
Bear Lake	26.36	4.02	14.46
Beneish	32.13	5.47	19.56
Bingham	17.67	3.68	13.60
Blaine	24.26	7.15	18.40
Boise	13.78	4.25	18.29
Bonner	12.67	5.35	12.74
Bonneville	14.20	5.86	10.35
Boundary	20.56	4.68	12.73
Butte	20.42	4.94	15.63
Carnas	19.58	5.04	13.96
Canyon	16.65	5.51	13.77
Caribou	20.56	4.68	12.73
Cassia	21.15	4.85	15.46
Clark	20.44	4.94	15.64
Clearwater	17.45	2.99	14.84
Custer	22.41	3.98	12.03
Elmore	14.40	5.43	8.83
Franklin	23.42	5.43	17.83
Fremont	24.32	5.29	16.89

**Task: distribute limited funds for attracting health care professionals**

N of estimated unmet visits  
 Burden on on-call providers  
 Avail. of obstetrical care  
 Avail. of emergency med. services  
 % of population on medicare  
 Low-weight birth rate  
 Poverty rate  
 Population in > 35 miles from hospital  
 Emergency room visits  
 Fertility rate

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See a demo...

## Conclusion

- Visualisation tools are useful on the choice stage of decision-making
  - in particular, for testing solution robustness
- 2 mechanisms for integrating computation and visualisation tools suggested
  - dynamic attributes
  - object selection events
- Can be used for other computational tools
  - fast computation required

## Future

- We seek projects in 6FP for applications and further development
- We seek tool users for getting feedback
- We seek support from industry for integrating our tools with widely used software

[www.ais.fraunhofer.de/and](http://www.ais.fraunhofer.de/and)

[www.CommonGIS.de](http://www.CommonGIS.de)

