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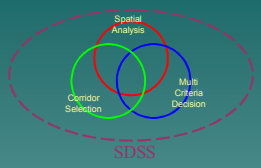
Spatial decision support system for the selection of an overhead electrical transmission line corridor.

Kershaw, Claude Ian.

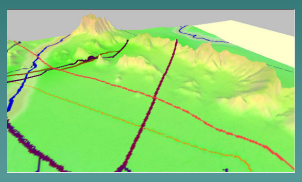
2011-10-06
http://hdl.handle.net/10539/10489

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Spatial Decision Support System





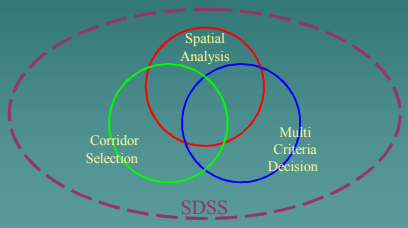


Claude Kershaw

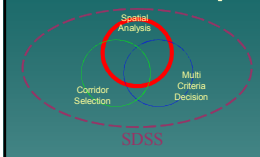
Contents

- Spatial Decision Support System
- 3D Visualization

Spatial Decision Support System



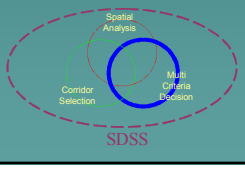
Spatial Analysis



- Measurement Operations
- Re/Classification Operations
- Scalar Operations
- Overlay Operations
- Neighborhood Operations
- Connectivity Operations

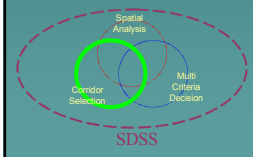
Multi Criteria Decision Making

- Cost-benefit Analysis
- Pros and Cons Analysis
- Outranking Methods
- Multi Attribute Utility Theory
  - Simple Multi-attribute ranking technique
  - Generalized means
  - The Analytic Hierarchy Process
    - Pair-wise comparisons on fixed scale
    - Support for group decision making
    - Consistency Ratio

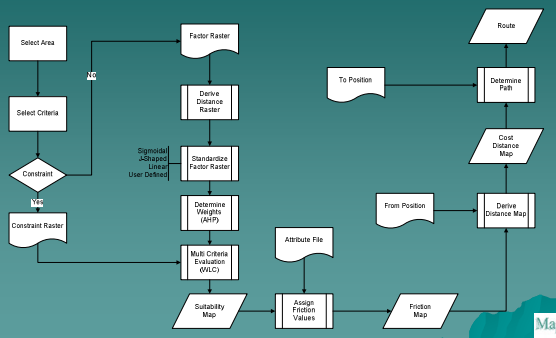


Corridor Selection

- Complex Problem
- Multiple Criteria to be considered:
  - Ecological
  - Electrical
  - Aesthetic
  - Socio-Economic
  - Environmental
  - Right of Way
  - Engineering

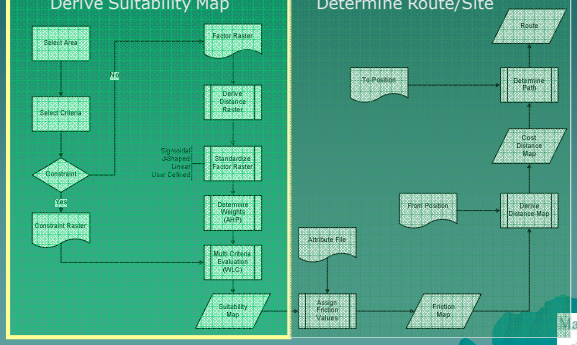


Model Overview



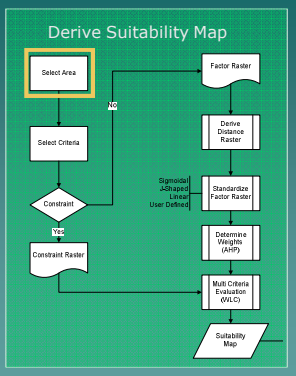
MapSmart

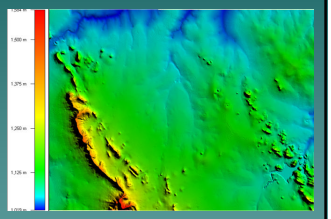
Model Overview



MapSmart

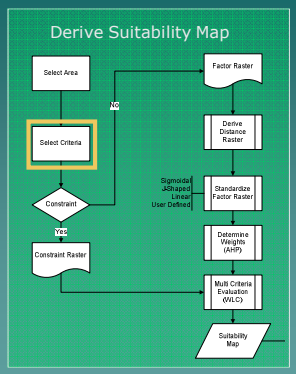
Select Area





MapSmart

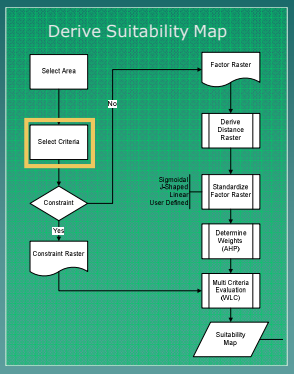
Criteria Definition



Criterion is some basis for a decision that can be measured and evaluated. Criterion can be either a constraint or a factor.
A **constraint** serves to limit the alternatives under consideration and is expressed in the form of a Boolean map.
A **factor** is a criterion that enhances or detracts from the suitability of a specific alternative and is measured on a continuous scale.

MapSmart

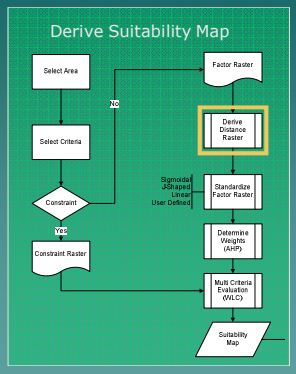
Select Criteria

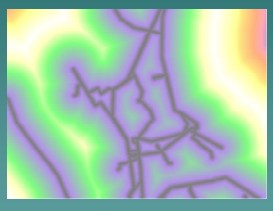


Criterion	Criterion Type
HV Network	Factor
Road	Factor
River	Factor
Dam	Constraint
Slope	Factor
Wetland	Factor
Farm Boundary	Factor
Preferred Route	Factor
Railway	Factor

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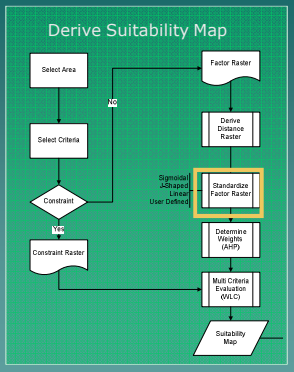
Distance Raster





MapSmart

Standardize Raster



- Fuzzy Set Theory

Sigmoidal



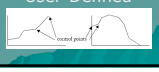
J-Shaped



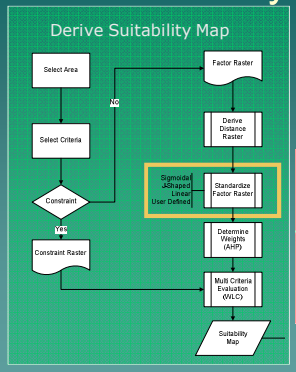
Linear

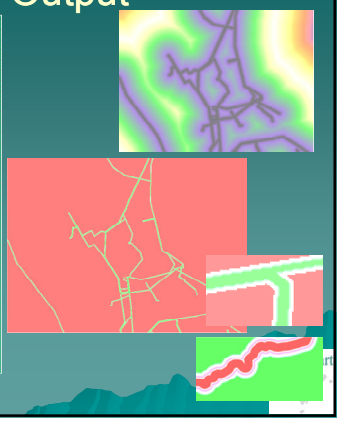


User-Defined

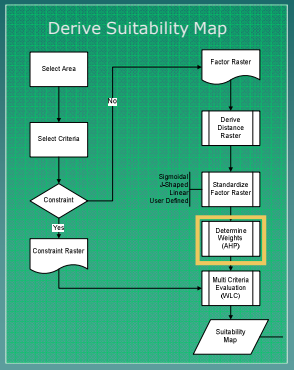


Fuzzy Output





Determine Weights



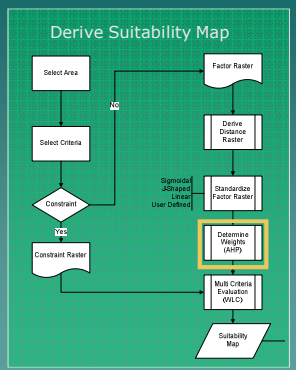
- Many Methods
- Analytic Hierarchy Process

Pairwise Comparison 9 Point Continuous Rating Scale								
1/9	1/7	1/5	1/3	1	3	5	7	9
extremely	very strongly	strongly	moderately	equally	moderately	strongly	very strongly	extremely
Less Important					More Important			

Pairwise Comparison

	Farm Boundary	HV Network	Preferred Route	Railway	River	Road	Slope
Farm Boundary	1						
HV Network	3	1					
Preferred Route	5	3	1				
Railway	3	1	1/5	1			
River	7	5	3	5	1		
Road	3	1	1/5	1	1/5	1	
Slope	3	5	3	5	1/3	5	1
Wetland	9	7	5	7	3	7	5

Weights

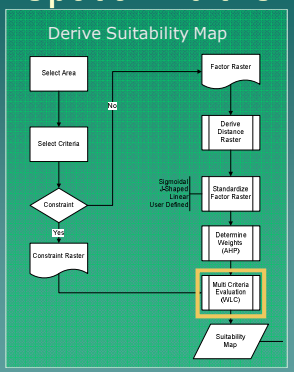


Farm Portion	: 0.0239
HV Network	: 0.0407
Preferred Route	: 0.1079
Railway	: 0.0391
River	: 0.2153
Road	: 0.0391
Slope	: 0.1479
Wetland	: 0.3860

Consistency ratio = 0.07

Consistency is acceptable.

Spatial Multi Criteria Evaluation

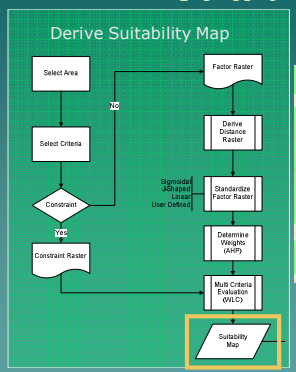


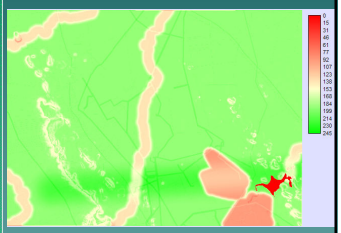
- Weighted Linear Combination

$$S = \sum w_i x_i * \prod c_j \quad \text{.....(xxx)}$$

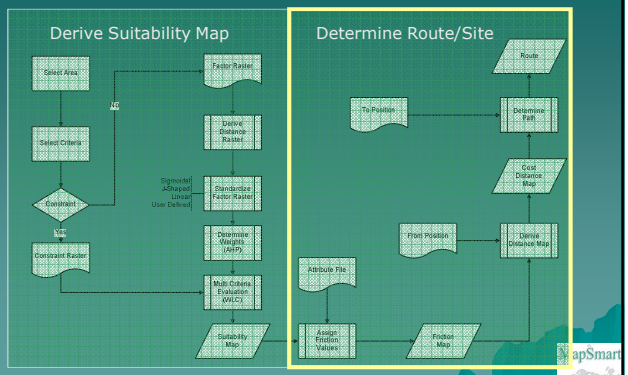
where S = suitability
w_i = weight of factor i
x_i = criterion score of factor i
$\prod$ = product
c_j = Criterion score of constraint j

Suitability Map



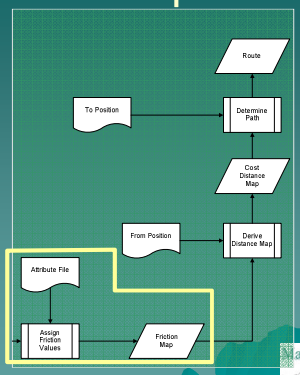


Model Overview

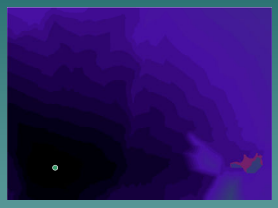


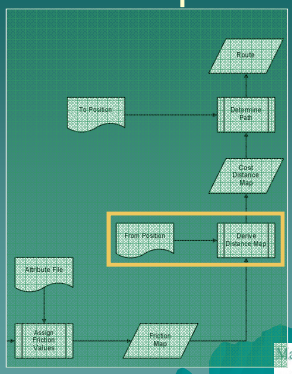
Derive Friction Map

- Reclassification of the Suitability Map
- Used to derive the Distance Map

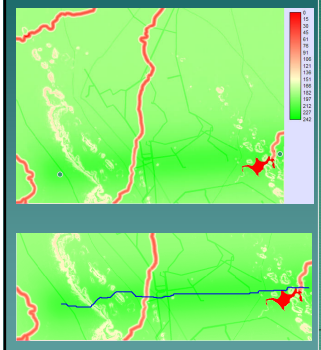


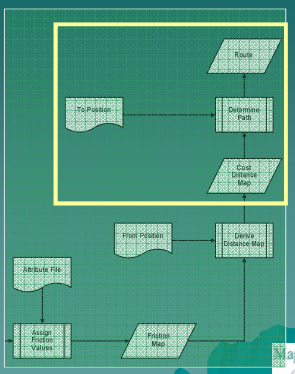
Derive Distance Map



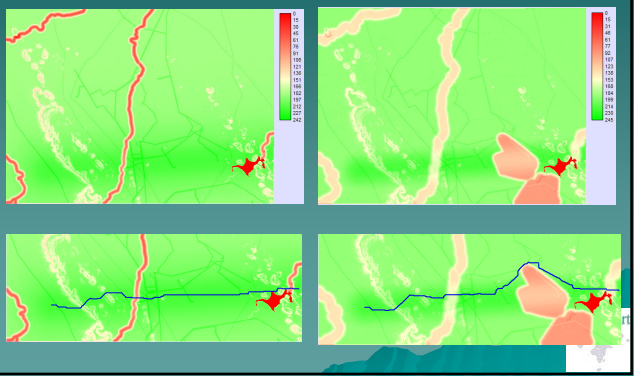


Determine Route





Considering Different Criteria



3D Visualization