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Changes and decision support

January 17th 2012

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DEPARTMENT OF URBAN AND REGIONAL PLANNING AND GEO-INFORMATION MANAGEMENT www.itc.nl

ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

CONTENT

- Group decision room
- Decision process & decision aiding
- Examples of planning and decision support systems
- Uncertainty

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THIS LAB IS ABOUT: DIVERGENCE & CONVERGENCE AROUND SPATIAL PROBLEMS AND SOLUTIONS

What is the practice of finding solutions?

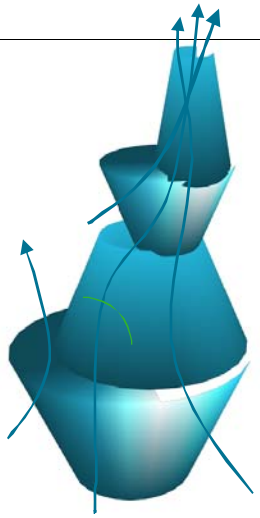
How to find solutions?

What are solutions for whom?

What is the practice of defining problems?

How to define problems?

What are problems to whom?



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Hendriks, P. and D. Vriens (2000). "From Geographical Information Systems to Spatial Group Decision Support Systems: AComplexItinerary." *Geographical & Environmental Modelling* ***4(1): 83-104.***

AVOIDING "GROUPTHINK"

A mode of thinking that people engage in when they are deeply involved in a cohesive in-group, when the members' strivings for unanimity override their motivation to realistically appraise alternative courses of action.

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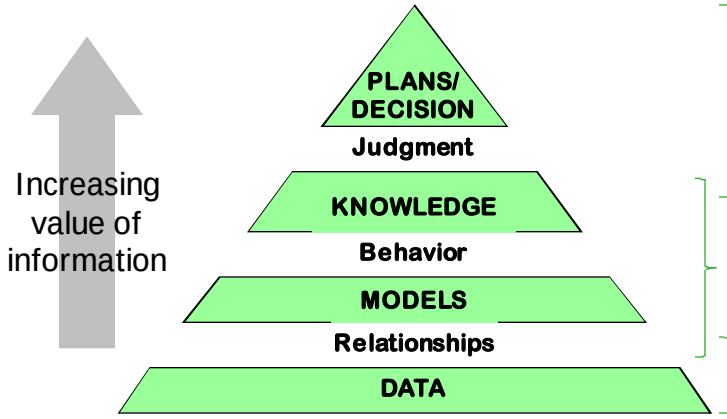
Janis, Irving L. Victims of Groupthink. Boston. Houghton Mifflin Company, 1972,

VALUE OF INFORMATION DEFINING PROBLEMS AND FINDING SOLUTIONS



Added value of ***Normative*** models PSS and DSS

Added value of ***descriptive*** models and simulations

Added value of databases and data infrastructure

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Adapted from (Ullman 2010)

THEORY ON SOCIAL AND TECHNICAL INTERACTION

10-15 YEARS AGO: ADAPTIVE STRUCTURATION THEORY

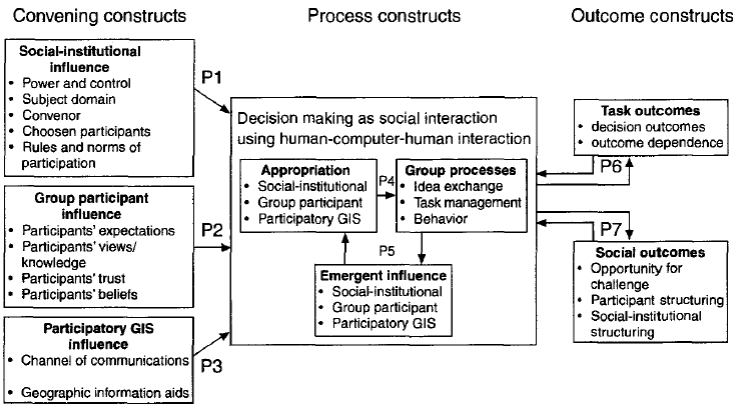
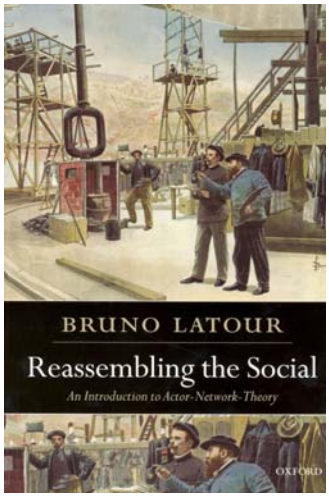


Figure 2.1 Enhanced Adaptive Structuration Theory 2 (EAST2) frames convening, process, and outcome constructs plus the respective premises to provide a conceptual map for understanding a group decision support situation

ACTOR NETWORK THEORY



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FROM BIG PICTURES TO CONSTITUTING PARTS AND DESIGNING PROCESSES

A ThinkLet

A thinkLet is a named, packaged facilitation technique, captured as a pattern that collaboration engineers can incorporate into process designs.

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De Vreede, G. J. (2006). "ThinkLets: a collaboration engineering pattern language." *Int. J. Computer Applications in Technology* ***25(2/3): 140-154.***

Briggs, R. O., G.-J. De Vreede, et al. (2003). "Collaboration Engineering with ThinkLets to Pursue Sustained Success with Group Support Systems." *Journal of Management Information Systems* ***19(4): 31-64***

BRIGGS' PATTERNS OF COLLABORATION

Generate	Move from having fewer to more concepts
Clarify	Move from less to more mutual understanding about a concept
Organize	Move from having less to more understanding of the relationships among concepts
Reduce	Move from having many concepts to a focus on a few deemed worthy of further attention
Evaluate	Move from less to more understanding of the benefit of concepts toward attaining a goal relative to one or more criteria.
Commit	Move from less to more commitment among stakeholders about an action toward the stated goal

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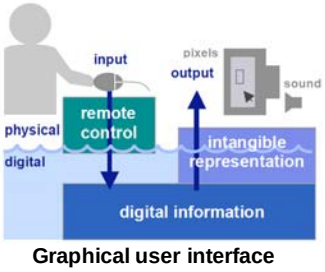
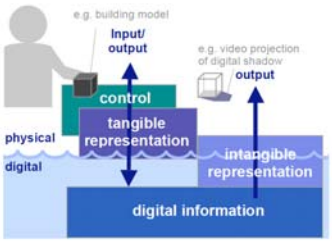
http://pm440.pbworks.com/w/page/25414197/Collaborative-Decision-Making-Tools-and-Techniques

From GUI to TUI

Advantages of Tangible User Interfaces (TUI)



Graphical user interface



Tangible user interface

from Ishii (2006) TUI

- improve fluidity and reduce cognitive load of user/content interactions
- positive influence for working styles and group dynamics
- enhanced interaction between stakeholder (horizontal environments)

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Working modes and associated components in the GDR

- A **computer network** that facilitates individual (anonymous) input (e.g. criteria) of participants (stakeholders) in a decision making process.
- A **multi touch table environment** (MTT) that facilitates small group (up to 6 participants) interaction and collaboration on spatial decision problems.
- A **large scale Interactive Whiteboard** (IWB) that is used for large group activities (e.g. structuring of criteria, commenting on a text or presentation) and plenary presentations and discussions.

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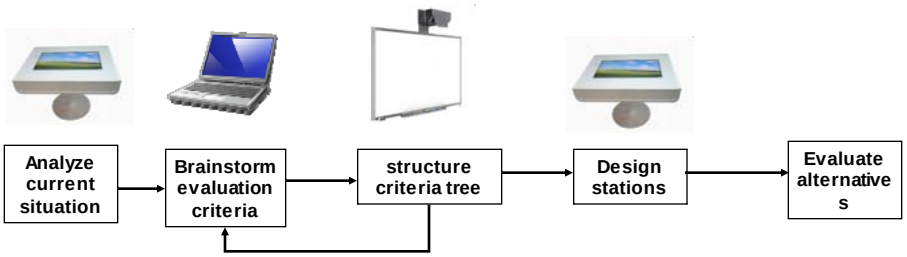
Use cases development: example joglosemar railway development



e.g. ArcGIS. ILWIS

e.g. Brainstorm plus, CMAP

e.g. ArcGIS

e.g. Community Viz,

e.g. Community Viz, ILWIS SMCE

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Details about hardware components the digital whiteboard

- a certain size of min. 70 inch
- a robust surface
- flexible input (fingers and electronic pens)
- multitouch input (more than 1 finger)
- use the board also as a normal whiteboard
- operate the whiteboard a (ultra) short throw beamer
- reflections of the board, quality of the representation (can it be used with daylight?).

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Details about hardware components the multi touch tables

- The main requirements for the MTT are:
- to be used with fingers and pens
- should allow for software development,
- should be mobile (inhouse, abroad)
- horizontal installation
- gesture development
- true multi touch (more than just duo touch)

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SOFTWARE

For brainstorming

Groupsystems ThinkTank mainly for brainstorming, we have done intensive testing already

BrainStormPlus also for brainstorming, I have downloaded a demo version, not yet installed and tested| something like a
(and many more)

For group decision making

Accord (Robust Decision.com)

For GIS applications

CommunityViz

Alias SketchBook Pro

Research questions LB2

- What are robust decisions?
- Which methods and tools effective for disciplinary decision problems?
- How the GDR and planning and decision processes shape each other mutually (looking at processes and tools/techniques)? (planning aspects)
- Social aspects of interactive group decision making (looking at behaviour)? (user aspects)
- Collaborative DM software development (Multi touch GIS functionality) (technical aspects, software development)

Slide 16

LB2 I recognize these. Good.
Luc Boerboom, 12/3/2010

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INFORMATION PARALYZES DECISION MAKING

- "[…] information consumes […] the attention of its recipient.
- Hence **a wealth of information creates a poverty** of attention,
- and a ***need to allocate that attention*** efficiently among the overabundance of information sources that might consume it."

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Herbert A. Simon, 1971. Designing Organizations for an Information-Rich World, in: *Computers, Communications and the Public Interest*, pages 40-41, Martin Greenberger, ed., The Johns Hopkins Press

WHAT IS A DECISION? ..... A PARADOX

- "Only those questions that are in principle undecidable, we can decide" (Foerster 1992).
- Everything else would be mere calculation.

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Foerster, H. v. (1992). "Ethics and Second-Order Cybernetics." Cybernetics and Human Knowing **1**: 9-19.

WHAT IS A "DECISION PROBLEM"?

IT IS NORMATIVE

Decision problem is defined as a situation where an individual or a group perceives a difference between a present state and a desired state and where:

- The individual or group has alternative courses of action available
- The choice of action can have a significant effect on this perceived difference
- The individual or group is uncertain *a priori* as to which alternative should be selected

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(Ackoff, 1981, The art and science of mess management, Interfaces 11(1) pp. 20-26)

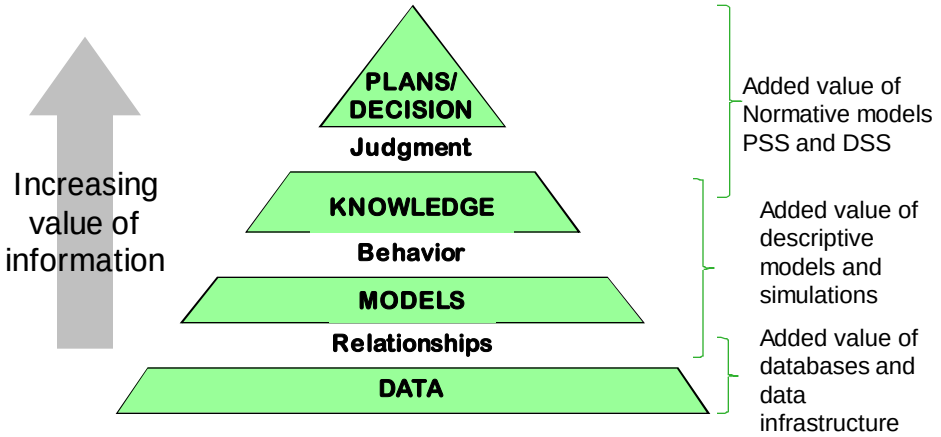
DECISION SUPPORT SYSTEMS (DSS): DEFINITION

Class of computer systems that help manager(s)/ decision maker(s) in the process of decision making, where:

- decision/choice problem exists
- human judgment (value judgment) is an important contributor to the Decision Making Process (DMP)
- human information processing capacity limits the DMP

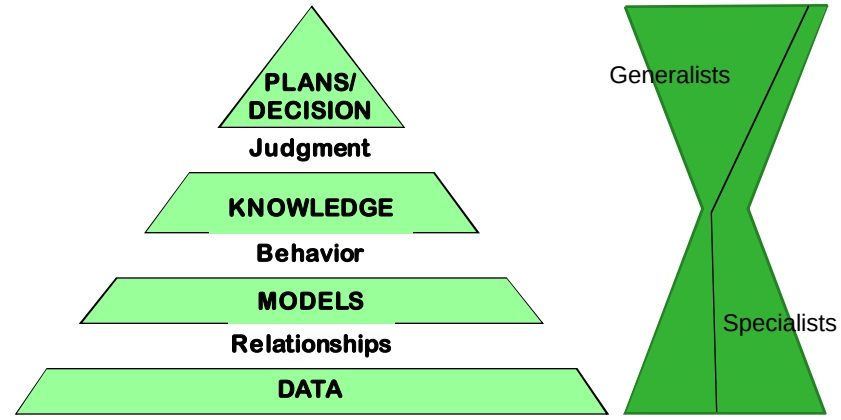
(adapted from Rauscher et al., 1995)

VALUE OF INFORMATION



Adapted from (Ullman 2010)

JUDGMENT FROM POLITICIANS, CITIZENS, EXPERTS, DIRECTLY ON DATA OR MODEL RESULTS



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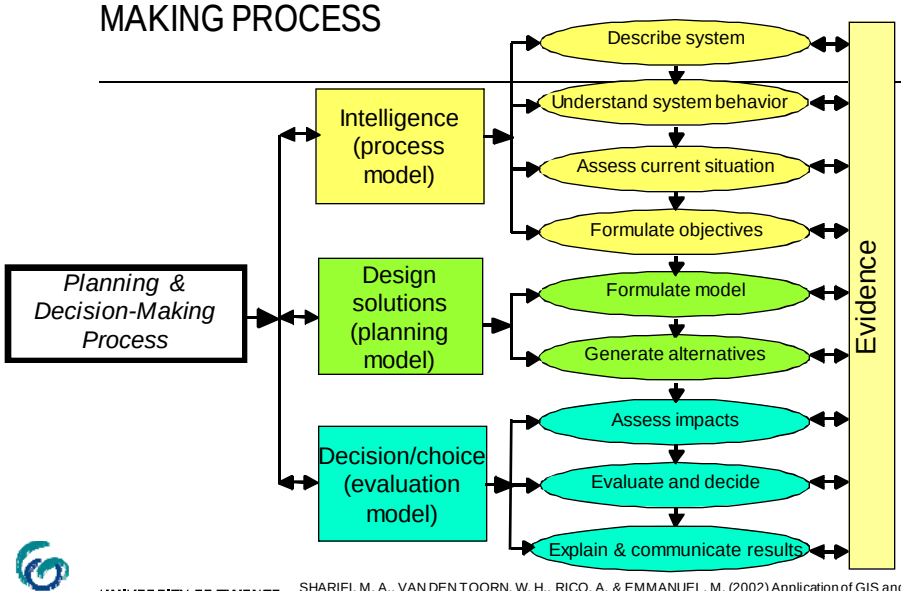
FRAMEWORK FOR THE PLANNING AND DECISION MAKING PROCESS



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SHARIFI, M. A., VAN DEN TOORN, W. H., RICO, A. & EMMANUEL, M. (2002) Application of GIS and multicriteria evaluation in locating sustainable boundary between the Tunari national park and Cochabamba city, Bolivia. In: Journal of Multi-criteria Decision Analysis, 11(2002)3. 151-164.

THE KEY WORD

Judgment

INTEGRATED ASSESSMENT

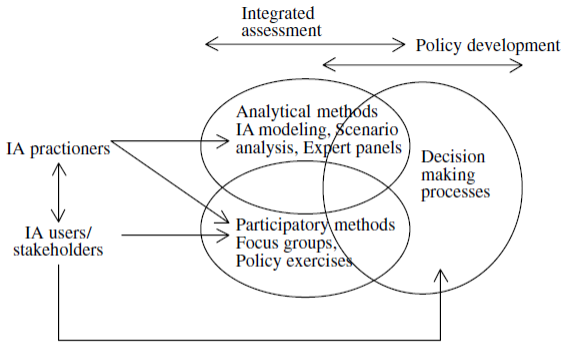


Figure 1 IA involves practitioners and users, uses technical analytical methods and participatory methods and overlaps with the policy development process

Sluijs, J. P. v. d. (2002). Integrated Assessment. *Responding to global environmental change. M. K. Tolba. Chichester, John Wiley & Sons, Ltd.* **4**: 250-253.

IT IS ALSO ABOUT THE PROCESS

- Not only **"Doing the right things"**

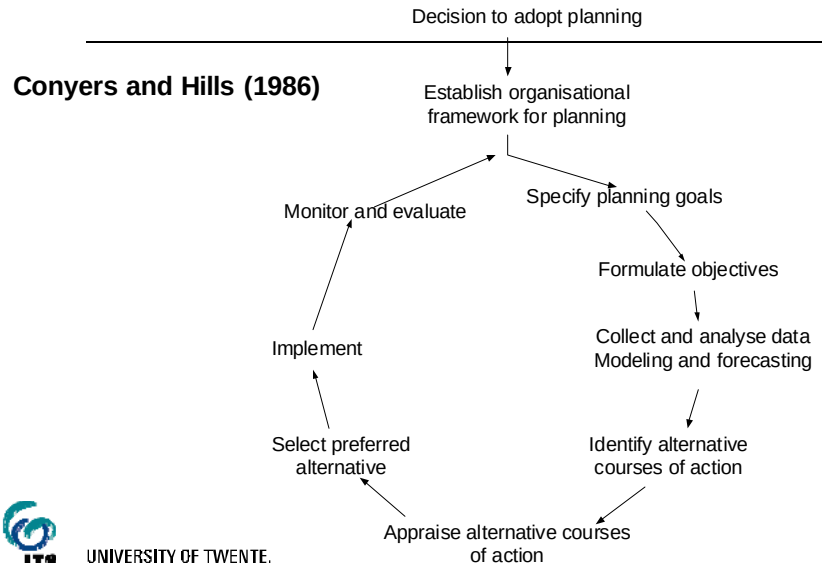
  Efficiency and effectiveness.

- Also **"Doing things right"**

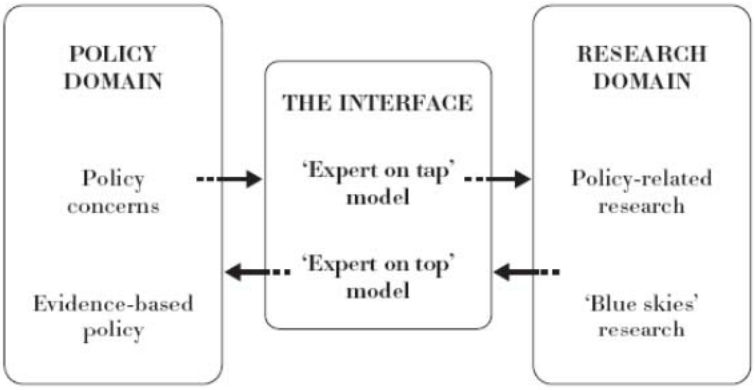
  Legitimacy: legality, participation and representation

Rational planning model

Conyers and Hills (1986)

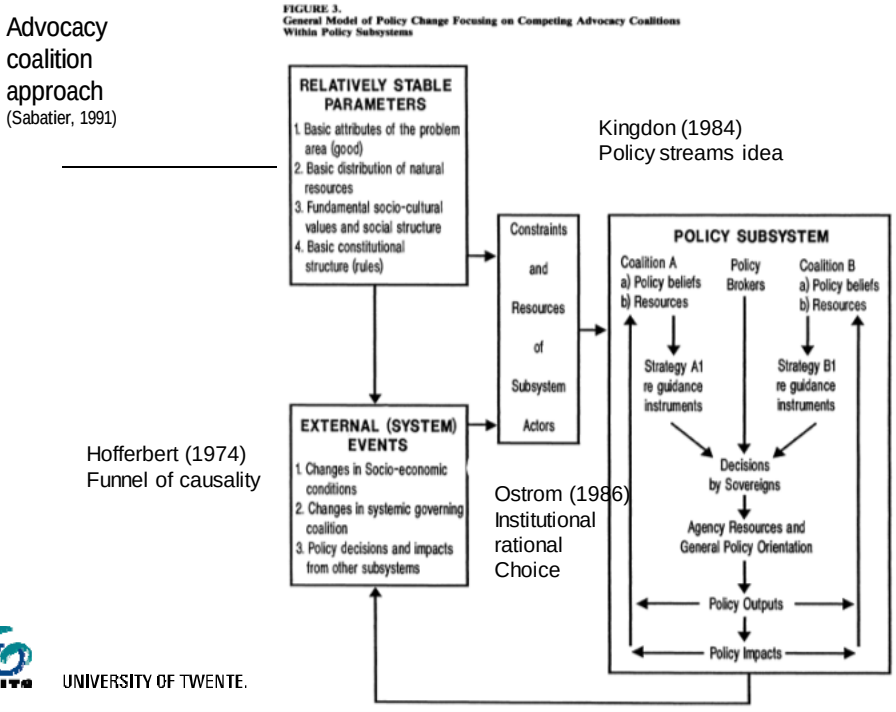


The policy-science interface



(Davoudi, 2006)

Advocacy coalition approach
(Sabatier, 1991)



Kingdon (1984)
Policy streams idea

Hofferbert (1974)
Funnel of causality

Ostrom (1986)
Institutional rational Choice

EXERCISE: WRITE YOUR DECISION PROBLEM

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(Ackoff, 1981, The art and science of mess management, Interfaces 11(1) pp. 20-26)

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Analytical tools

- Intelligence phase/problem analysis:
  - Data collection and analysis
  - Modeling current situation
  - Forecasting models
  - System analysis

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Analytical tools

- Intelligence phase/problem analysis
- Design phase/generation of alternatives:
  - Forecasting models
  - Optimizing models

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Analytical tools

- Intelligence phase/problem analysis
- Design phase/generation of alternatives
- Decision/Choice/Evaluation/appraisal:
  - economic techniques; CBA/SCBA, cost-effectiveness analysis, cost minimization,
  - physical planning approaches; planning balance sheet analysis, goals achievement matrix, threshold analysis
  - social impact assessment
  - environmental impact assessment
  - Multi Criteria Evaluation

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CommunityViz Planning Support System

CommunityViz® multi-dimensional GIS decision-making software.

Analyze choices about development, growth and change over the years to come.

Create realistic **3D visual models** of your world as it is, and as it could be.

Make and share decisions about your geography, your community and your land.

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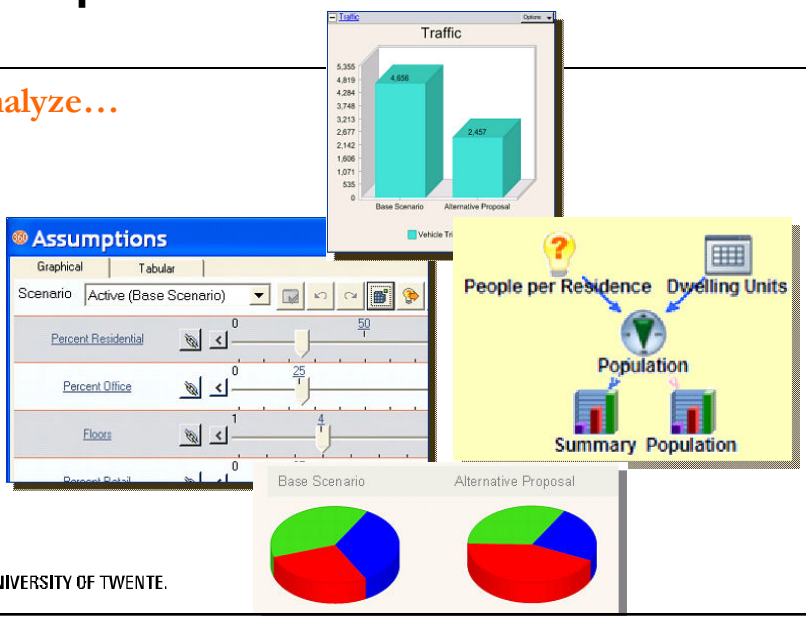
Spatial analysis and scenario development

analyze…



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3D visualization

visualize…

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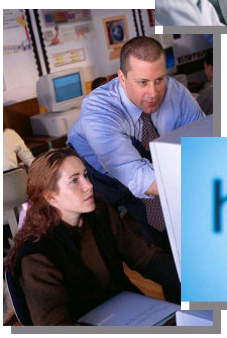
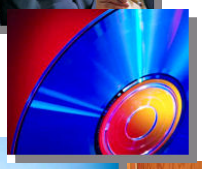
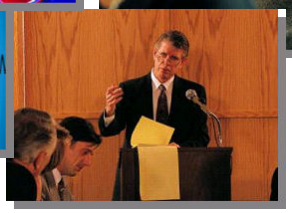
Communication

communicate…







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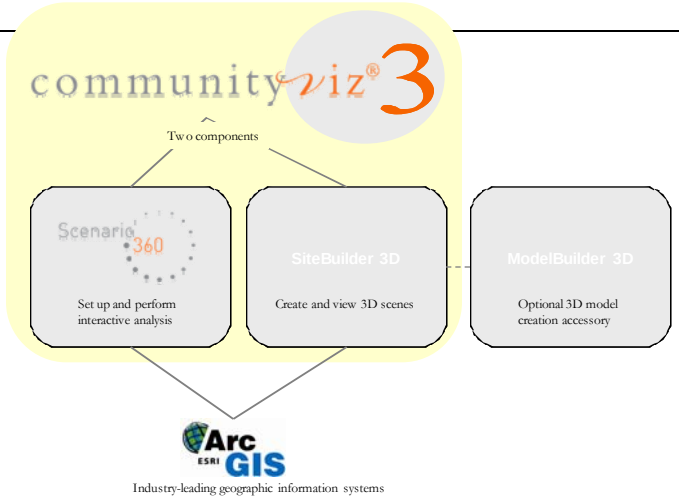
System Components



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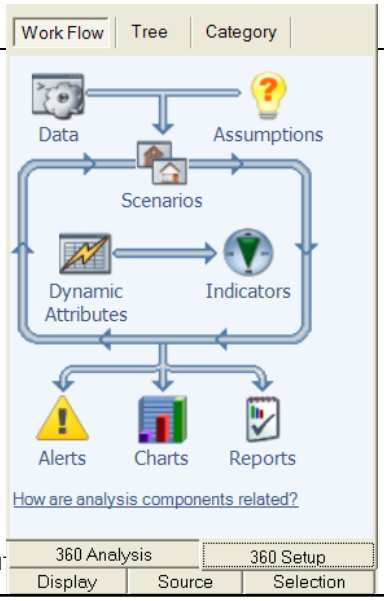
Structural Setup of CommunityViz



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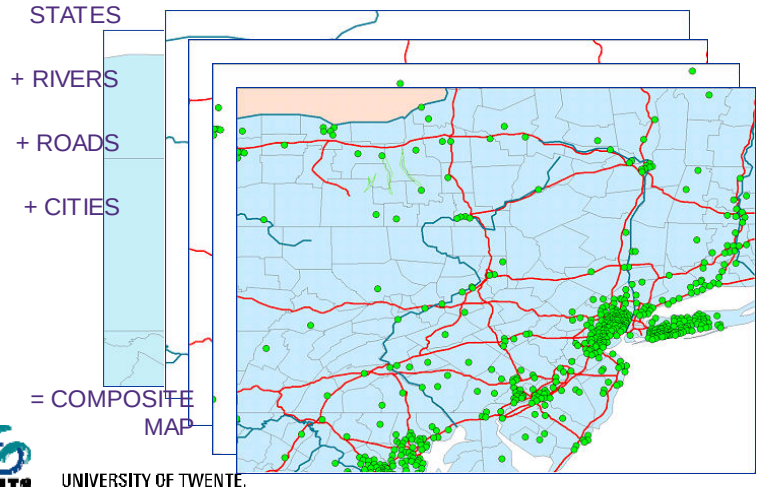
Contents

- What is CommunityViz PSS
- **Dynamic attributes: the core of CommunityViz**
- Components of CommunityViz: indicators, assumption, scenarios
- Decision support tools in CommunityViz

Standard GIS approach

In Geographic Information Systems (GIS), digital maps are made up of **layers**.



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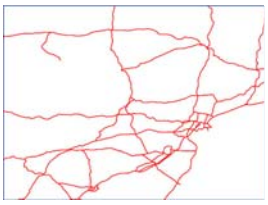
Standard GIS approach

Layers are collections of **features.**
Within a layer, all features are of the same type.
Typical features types include points, lines, and polygons.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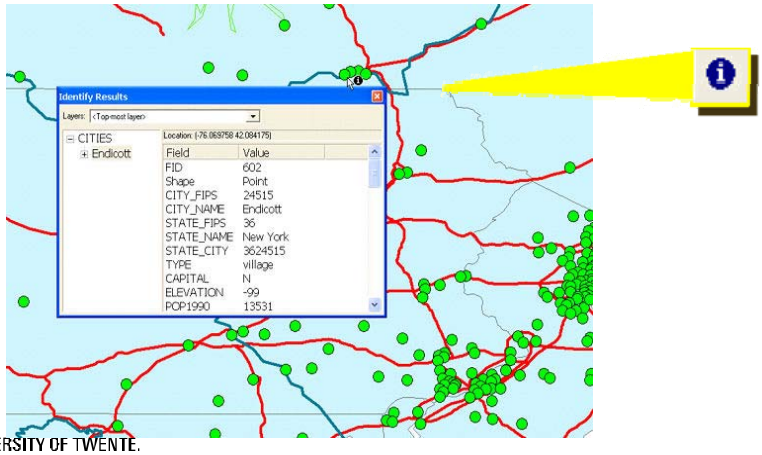
Standard GIS approach

GIS systems store additional information, or **attributes,** about each feature.



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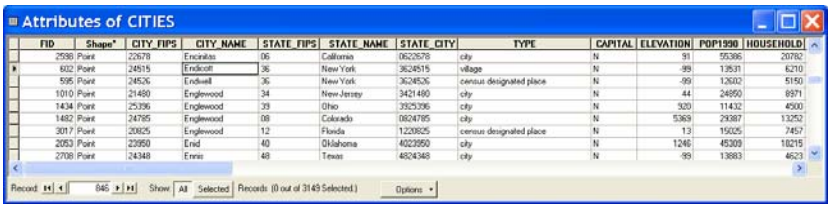
Standard GIS approach

information about each feature is stored in tables.

- Rows represent features (such as cities)
- Columns represent attributes (such as their names)

ATTRIBUTES

FEATURES



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Dynamic Attributes

- Attribute information can be specified by **formulas**
- Attributes can therefore change in response to changes in the map or changes in external assumptions
- Quantitative analysis of relationships within an existing map is also much easier than in traditional GIS systems
- Dynamic formulas are also used to calculate indicators as overall measurements for a specific map and attribute

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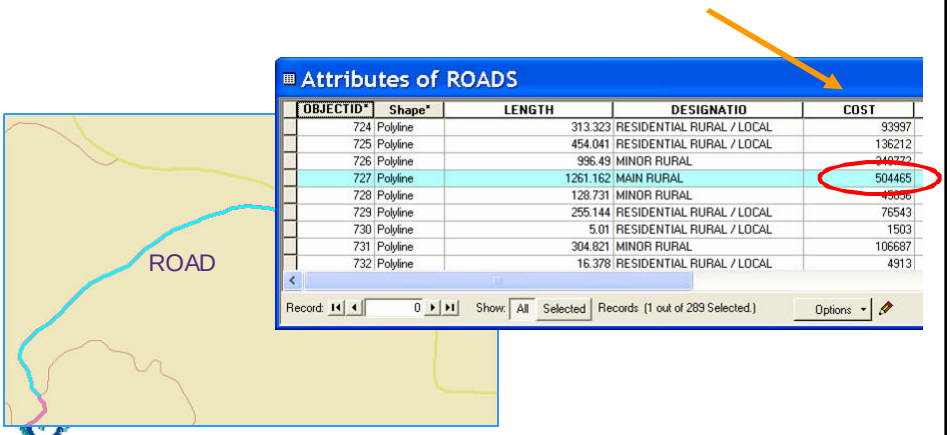
Dynamic Attributes

Example:

Formula-driven attribute for road construction costs.

LENGTH x COST PER KILOMETER = TOTAL COST



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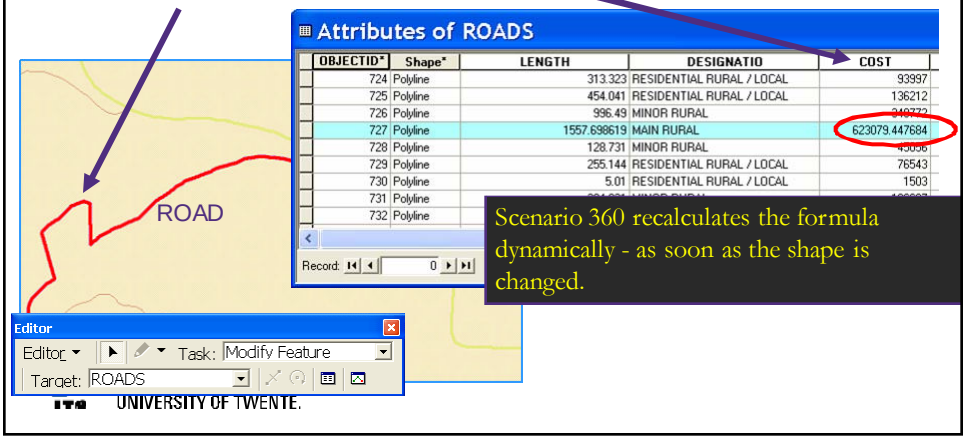
Dynamic Attributes

Example:

Formula-driven attribute for road construction costs.

LENGTH x COST PER KILOMETER = TOTAL COST

Changing the shape of the road changes its cost



Scenario 360 recalculates the formula dynamically - as soon as the shape is changed.

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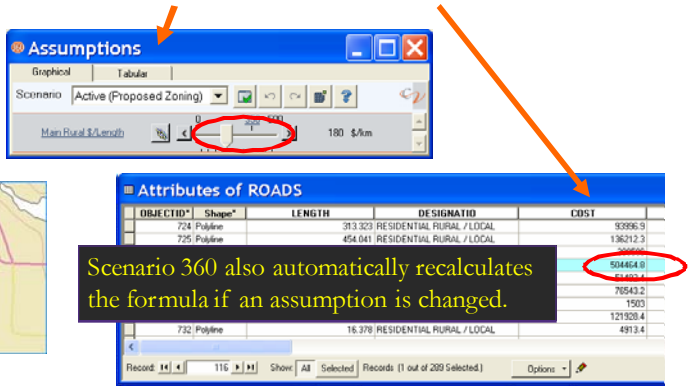
Dynamic Attributes

Formulas can also contain user-specified variables, called ~~assumptions.~~

LENGTH x COST PER KILOMETER = TOTAL COST



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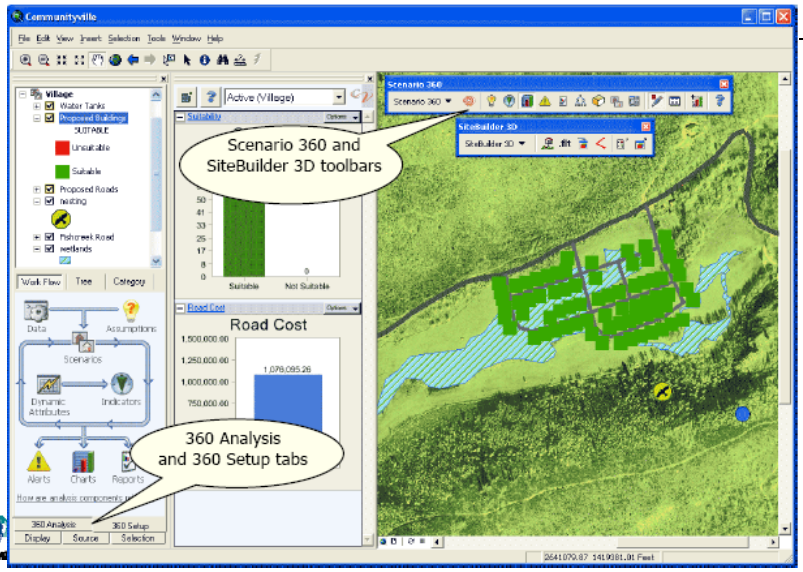
CommunityViz Scenario 360 interface



COLLABORATIVE DECISION MAKING: GROUP DECISION ROOMS

- ITC's new Group Decision Room
- Continuity in collaborative planning and decision processes in different place and time

- More common in Netherlands
- DHV: 50 sessions/year
- Several other companies

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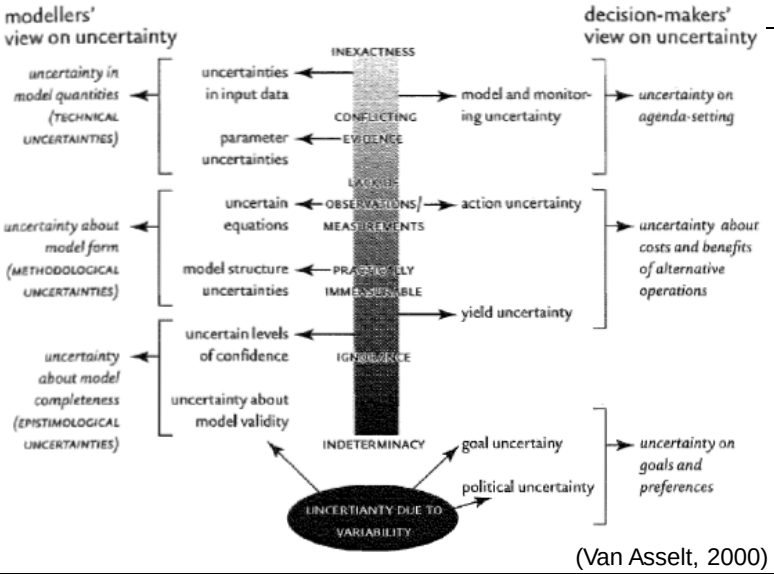
DECISION UNCERTAINTY



(Van Asselt, 2000)

Accord uses Bayesian methods

		Wt	Alternatives: Vendor 1	Vendor 3	Vendor 4
Criteria	Cost	.30	.8	.8	.8
	Response time	.17	.6	.6	1.0
	Training time	.17	.4	.8	1.0
	Ease of use	.17	.2	.8	.8
	Strong team	.10	.6	.8	.4
	Team experience	.10	.6	.8	.4
	Total	1.0			
	Weighted total		.56	.76	.78

Each cell is a probability that the alternative meets the criterion.

Methods for both qualitative and quantitative measures

Methods to fuse inconsistent evaluations

Generates:
- Alternative Satisfaction
- Probability of being best
- Consensus
- What to do next

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Measure criteria satisfaction and evaluation certainty

Criteria satisfaction is a measure of how well an alternative meets the criterion targets

Certainty is a measure of the accuracy of the information held by a decision-maker about a feature of an alternative (i.e. knowledge, confidence in assessment).

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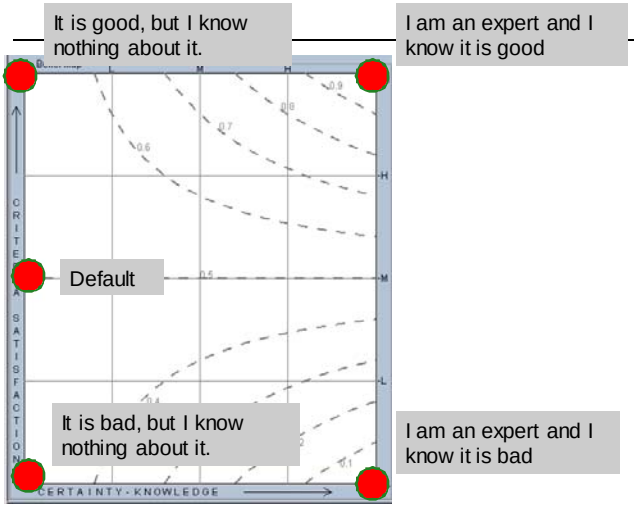
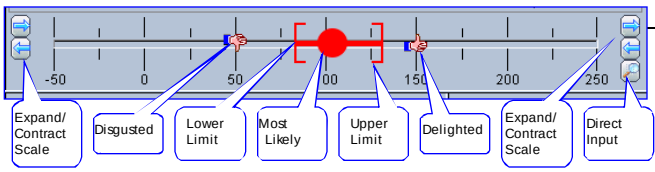
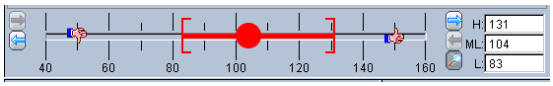
Qualitative evaluation



Quantitative information Input



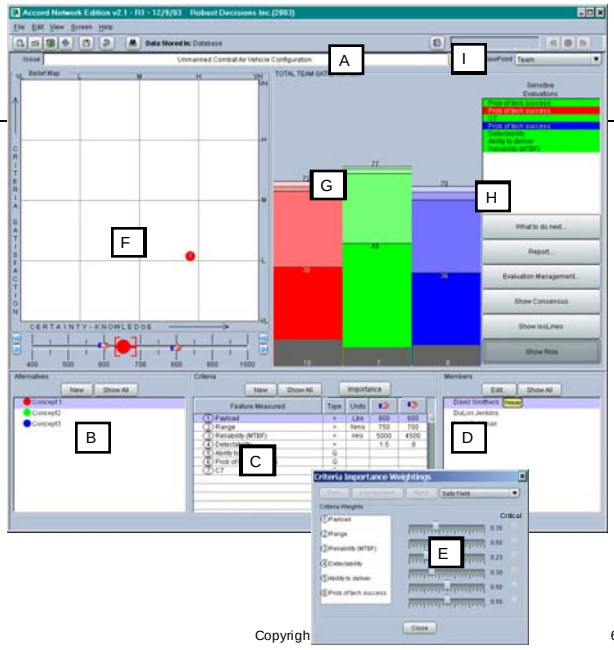
Direct Input



Accord screen

A = Issue
B = Alternatives
C = Criteria
D = Members
E = Weighting
F = Evaluation
- Belief Map
- Number Line

G = Results Display
H = Management/ Documentation Controls
I = Find History and View Issues



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Risk, definition

Risk is the expectation of an alternative not meeting the criteria as well as anticipated.

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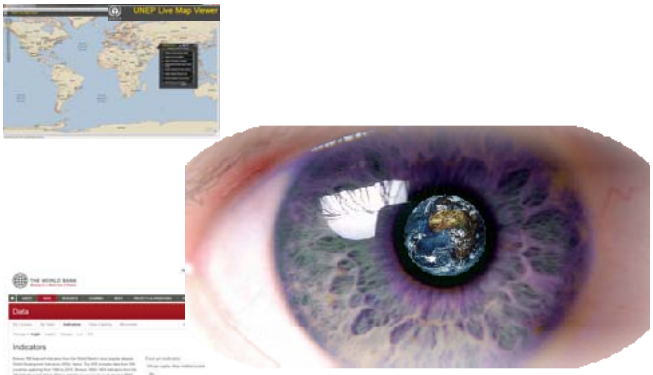
THERE ARE PLENTY OF INDICATORS …

…TO KEEP THE EYE ON EARTH

BUT HOW TO JUDGE & AGGREGATE WITHOUT THE NEED TO SHARE DATA ????



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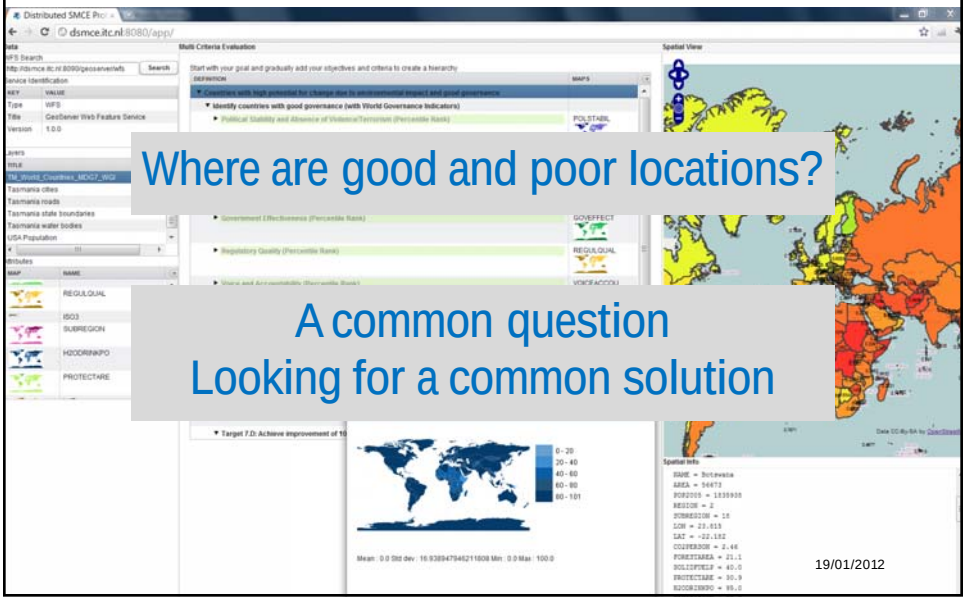
19/01/2012

WEB APPLICATION FOR SPATIAL MULTI-CRITERIA EVALUATION

NEW

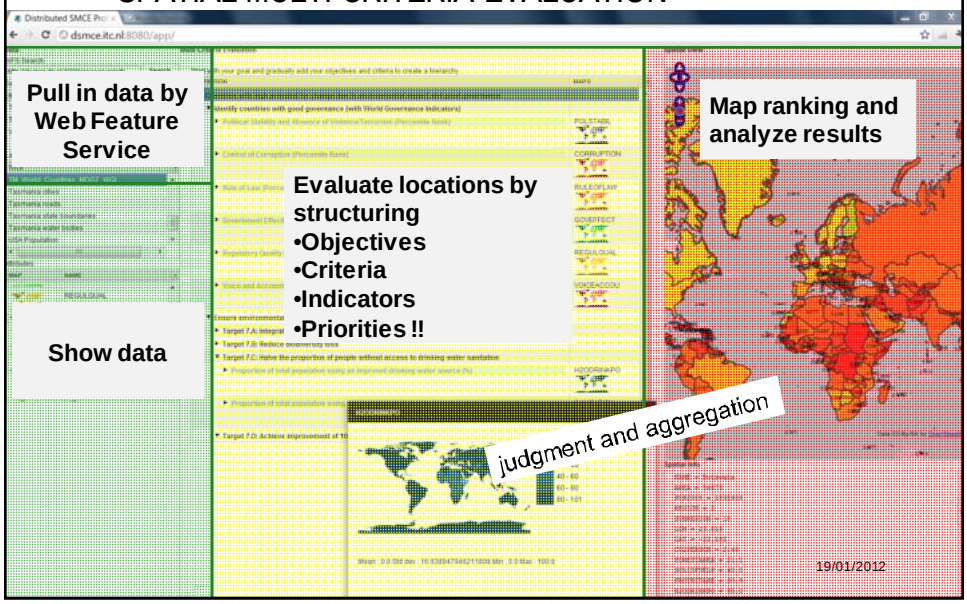


Where are good and poor locations?

A common question
Looking for a common solution

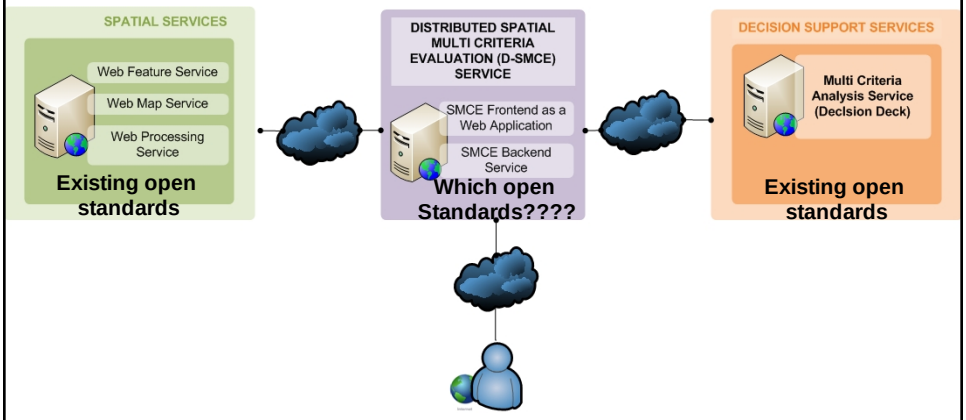
19/01/2012

WEB APPLICATION FOR SPATIAL MULTI-CRITERIA EVALUATION

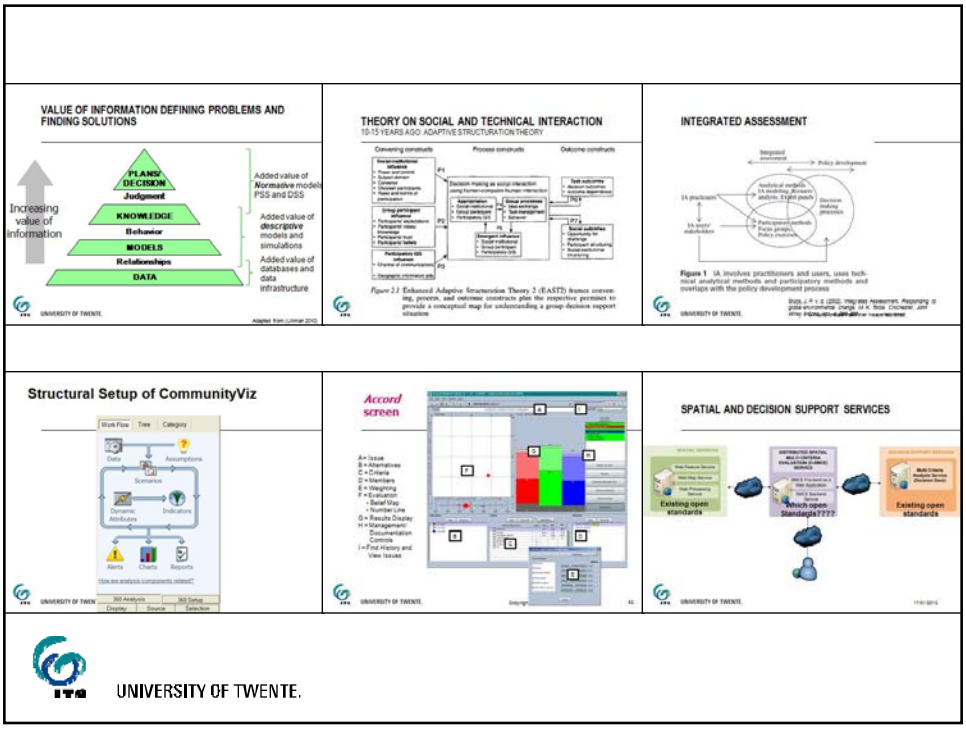


EVALUATING ENVIRONMENTAL SUSTAINABILITY AND POLITICAL STABILITY

SPATIAL AND DECISION SUPPORT SERVICES



DIFFERENT WEB SERVICE MAKE THE WEB APPLICATION, WHICH IS ITSELF CAN BE A SERVICE



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WHAT CAN WE DO?

- Formulate processes, methods and models to support collaborative planning and decision making
- Come to robust decisions
- Understand and structure decision problems and multitude of perspectives
- Understand the effect of methods, models and tools on planners and decision makers
- Test hypothetical solutions
- Develop software/web applications
- etc.

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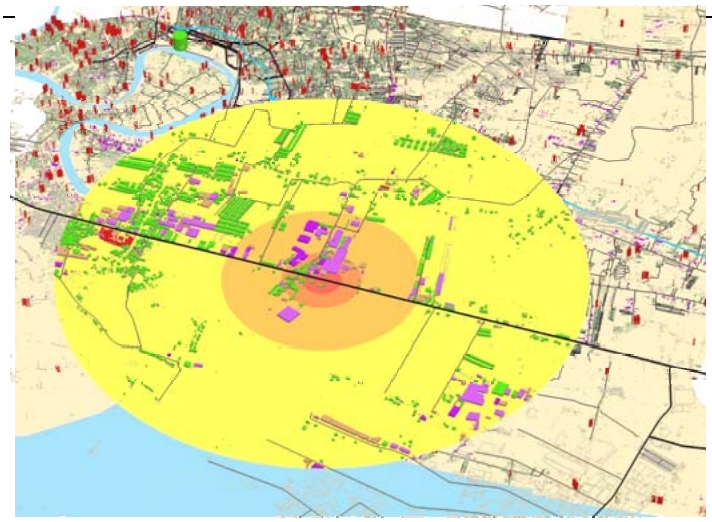
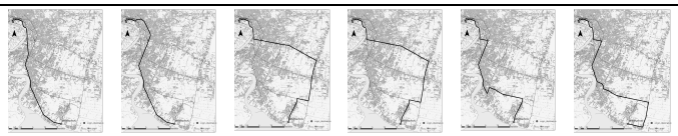
Impact of hazardous material accidents in Bangkok



Routing: multi-objective decision problem

The best route does not exist



But three options can be defined

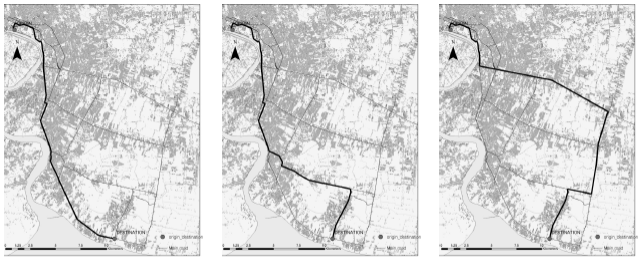
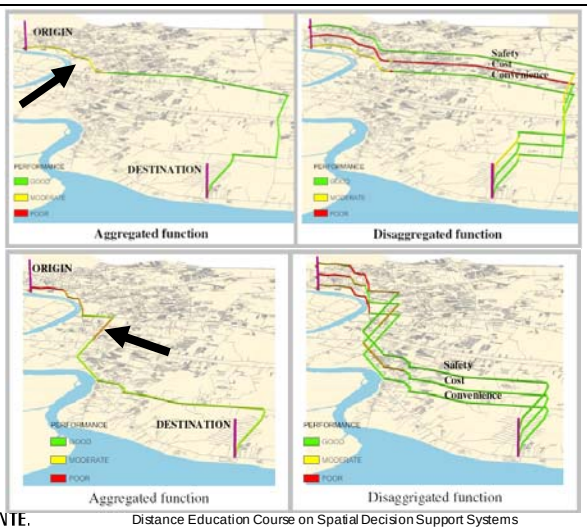


Figure 5.25 Multi objective optimization for nighttime without fly over(scenario 4)

Day time options: Multi-attribute decision problem & spatially distributed

With fly-over

Without fly-over



Night time options: Multi-attribute decision problem & spatially distributed

With fly-over

Without fly-over