Decision Support Systems in Urban Planning

Dr Jan Kazak
Urban planning...

Who decide?

Smart decisions...

If we want smart urban design we have to know possible impact of our decisions!
Examples

Urban design that did not meet local needs
Examples

Urban design that did not meet local needs


Polish spatial planning system

Practice

- National Spatial Development Concept
  - Prepared by: Ministry of Regional Development (1)

- Provincial Spatial Development Plans
  - Prepared by: Marshal’s Office (16)

- Studies of Conditions and Directions of Spatial Development (obligatory)
  - Local Spatial Development Plans (optional but recommended)
  - Prepared by: Municipal Council (2479)

NO FEEDBACK

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Polish spatial planning system

Report prepared for the OECD review of National Urban Policies

About 1% of Poland is covered by housing area

Analysis of the current spatial planning situation in Poland

About 14% of Poland is designed in spatial planning documents for housing area purposes
Effect

Social needs
Economical possibilities
Environmental capacity

Decisions in spatial planning documents
Therefore, Decision Support Systems... (1)

A definition of Decision Support Systems (DSS) was first given in a research paper by Morton in the early 1970s, though these systems have been in common use since the mid-1960s. Morton conducted his research within a Department of Management and Information Processing, and he was one of the forerunners of supporting complex decision-making processes partially by the computerization of the analyses. The development of DSS was possible thanks to the popularization of minicomputers, timeshare operating systems and distributed computing.

Michael Scott Morton

http://mitsloan.mit.edu/faculty-and-research/faculty-directory/detail/?id=41412
Therefore, Decision Support Systems... (2)

DSS are computerized systems designed to help managers to choose one of several alternatives in the case of an analysed problem. They allow automating part of the decision-making processes that require the analyses of large amounts of data in a relatively short period of time. DSS provide the structure which arrange such elements as models, participants, procedures, software, databases, communication and equipment. Using DSS in unstructured or semistructured problems allows the results to become more readable for decision-makers.
Principles of DSS (1)

Key features of the decision-making models used for DSS:

- The ability to quantify the analysed elements.

  This is a particularly important step for multivariate analysis. The inability to express variables in numerical form gives rise to subjective judgments that cannot be supported by analysed systems.
Principles of DSS (2)

Key features of the decision-making models used for DSS:

- The finity or infinity of possible outcomes of analysis.

  The model, in each case, will be different. A finite list of possible solutions, will supply the user ranking that compares different scenarios among themselves, prejudging which solution is the most optimal according to the model. In the case of an open list of solutions one deals with an iterative procedure. The model can test new solutions all the time without providing a guarantee that it found the most optimal answer to the question. On the other hand, such models usually verify a much larger number of possible solutions, and make it possible to compare more elements.
Key features of the decision-making models used for DSS:

- **The uncertainty of the model.**

  It has to be determined which elements are based on so-called robust data. This means that the value of these data has been examined previously and it is well-understood at the beginning of the construction of the model. Complementary to the robust data is the knowledge about uncertainties. It should be clarified what values come from assumptions or plans and they might be changed in the decision making process (social acceptance of different factors, values which describe standards of quality of life, etc.).
Knowledge about the field of uncertainty is critical because it allows a user to specify the range of possible changes and the construction of different scenarios, for instance, pessimistic scenario, optimal scenario, most likely scenario or optimistic scenario.

More details:
Spatial Decision Support Systems... (1)

A special group of DSS is represented by Spatial Decision Support Systems (SDSS). SDSS combine the ability to store, search and retrieve data based on geographic information systems with models and algorithms to optimize decisions regarding spatial problems. These systems allow decision-makers to use multi-dimensional spatial criteria in order to make decisions about the location by testing different alternatives. Because of the methods used in the calculation process and the output of the whole analysis they are classified as part of spatial econometrics.
Spatial Decision Support Systems... (2)

The concept of SDSS evolved in the mid-1980s and by the end of this decade it was defined as the authoritative branch of GIS. The beginning of 1990s brought the development of research in that field. One of the outcomes of the studies, important from the management point of view, was that SDSS users were choosing more suitable solutions and made less errors in the decision making process.


SDSS are frequently used in the social sciences in order to explain the processes and mechanisms of decision-making among society.

Questions for DDS

Where something may happen?

What is the possible possible impact?
Metronamica workflow

Time Loop

Suitability

Zoning

Accessibility

Land use & Interaction weights

Potential for change

Source:

WROCŁAW UNIVERSITY OF ENVIRONMENTAL AND LIFE SCIENCES
Metronamica workflow

- **Suitability**
- **Zonin**
- **Land use at time T+1**

Source:
Metronamica workflow
Metronamica workflow

Neighbourhood (interaction weights)

Example
Metronamica workflow
Neighbourhood (interaction weights)

Example
Metronamica workflow

Suitability & Zoning

Example
Metronamica workflow

Suitability & Zoning

Example
Metronamica workflow

Accessibility

Example
Metronamica workflow

Total potential for land use change

More details:
Metronamica workflow

Total potential for land use change

More details:
Metronamica workflow
Metronamica workflow

Source:

WROCŁAW UNIVERSITY OF ENVIRONMENTAL AND LIFE SCIENCES
CommunityViz workflow

External forces
Choices & actions

Scenarios

Indicators

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CommunityViz workflow

Scenarios

Indicators

I  II  III  IV

A+  B  C  A

B  A+

C+  B+

A  B

D  C

Today  Future

Source: City Explained, Inc.
Scenario components

SAME FOR ALL SCENARIOS

• Map layers
• Symbology for each layer
• Whether a layer is dynamic
• Reference layers including all features and attribute values
• Dynamic attributes \textit{formulas}
• Indicators \textit{formulas}
• Charts \textit{created}
• Assumptions \textit{created}
• 

MAY BE DIFFERENT FOR ALL SCENARIOS

• \textit{Features} within map layers
• Dynamic attributes \textit{values}
• Indicators \textit{values}
• Charts \textit{values}
• Assumptions \textit{values}
• Alerts \textit{currently triggered}
Best practices for scenario analysis

• Use ~5 or fewer scenarios per project
  Clearly distinguishable themes

• Set up your analysis first, then start adding scenarios

• Make fair, „apples-to-apples“ comparisons
  Lock assumptions together unless there is a reason not to
  Avoid favourite until late in the process

Source: City Explained, Inc.
Case studies

- Wroclaw Larger Urban Zone (Poland) - a spatial policies assessment of the potential cumulative capacity. Calculations covered housing, population, employment and other economic estimates.

- San Sebastian (Spain) - indicator-based assessment of a masterplan with a special focus on public transport planning.

- Sepolnî (Poland) - selecting optimal real estate for different people according to their needs (suitability analysis).

- Mazury (Poland) - selecting optimal locations for a new development (suitability analysis).
Recent projects

Co-Creating in Wroclaw – a research paper by Karolina Peret & Geodesignhub

How do you engage people in urban planning? Everyone talks about the importance of Smart Cities and an engaged citizenry, but very few experiments have been conducted in regards to citizen engagement and co-creation with professional planners. In some ways, effective public engagement is one of the key links that is missing between the need for planners to connect with citizens. In our increasingly...
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Dr Jan Kazak
jan.kazak@upwr.edu.pl