design &
decision
support
systems

# Generation of Downtown Planning-Ordinances using Self Organizing Maps

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# Outline

- 1.   Background

- 2.   Objectives

- 3.   The proposed method

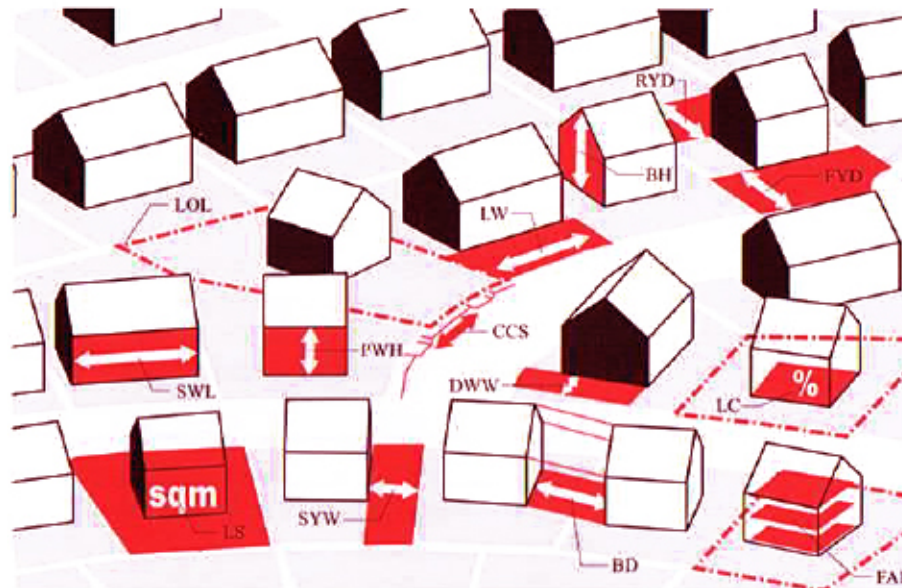- 4.   Illustration

- 5.   Conclusions and future research

# Ordinances?
# What is an ordinance?
# Ordinances = Urban Rules



Source: Lehnerer, A., 2009, Grand Urban Rules

# 1. Background.

- Ordinances usually are not capable of incorporating the **complexities** of the urban space.

- The Ordinance as **opportunity**.

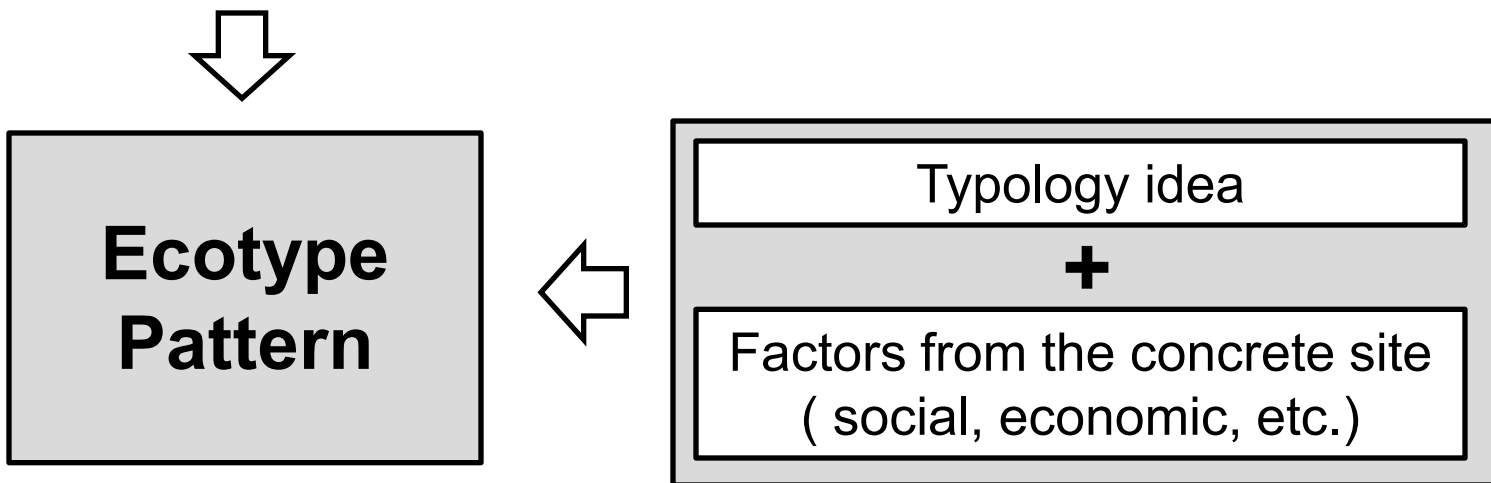- The Ordinance as **link** between urban projects and architecture.

# 2. Objectives.

- To be able to understand <u>urban complexity</u>:

  - 1st. Connect **traditional** and **new concepts**.

  - 2nd. This concepts as **urban fabric**.

  - 3rd. This urban fabric represent the urban reality as a **living entity:**

| The Ordinance is formed by parts of reality | ⇨ | If parts change | ⇨ | The Ordinance evolves |
|---|---|---|---|---|
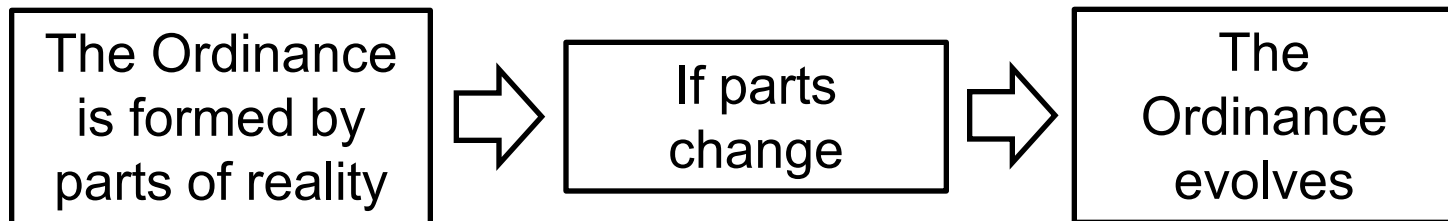
# 3. The Proposed Method (1)

- Reconstruct collected data into patterns:

  – Reconstruct data using a "recycling process" .

  – Using pattern (Alexander, 1968) (physical questions) + non physical questions (i.e. social or economic issues)



**Ecotype Pattern**

Typology idea

**+**

Factors from the concrete site ( social, economic, etc.)

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# 3. The Proposed Method (2)

- The Ecotype Patterns and their networks form a **Network Ordinance:**
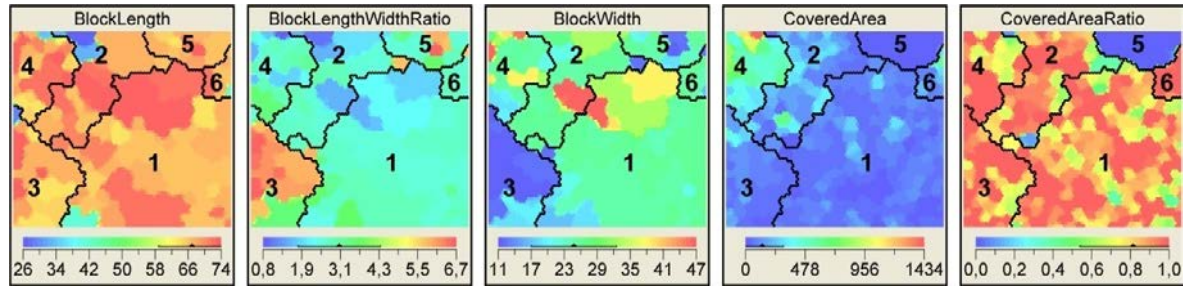


- – This is achieved by using a heuristic procedure.
- – A heuristic procedure that excludes strange or useles variables.
- – Self-Organizing Maps –SOM- (Kohonen,1989) as part of process:

By SOM each object is located near other simillar object.

A profound topological relationship is revealed.



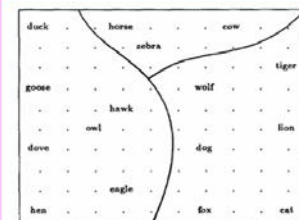Fig. 1. Animal names and their attributes

Fig. 2. After the network has been trained with inputs encoding animal names together with some attributes (see Fig. 1), presentation of the animal names alone elicits maximal responses at the cell locations shown. A grouping according to similarity has emerged.

Source: Kohonen, T., 1989, "Self Organizing Semantic Map"

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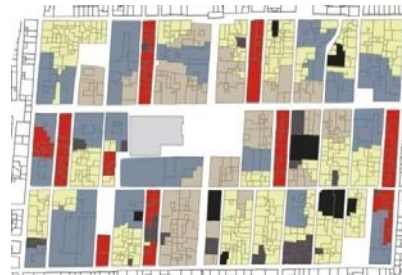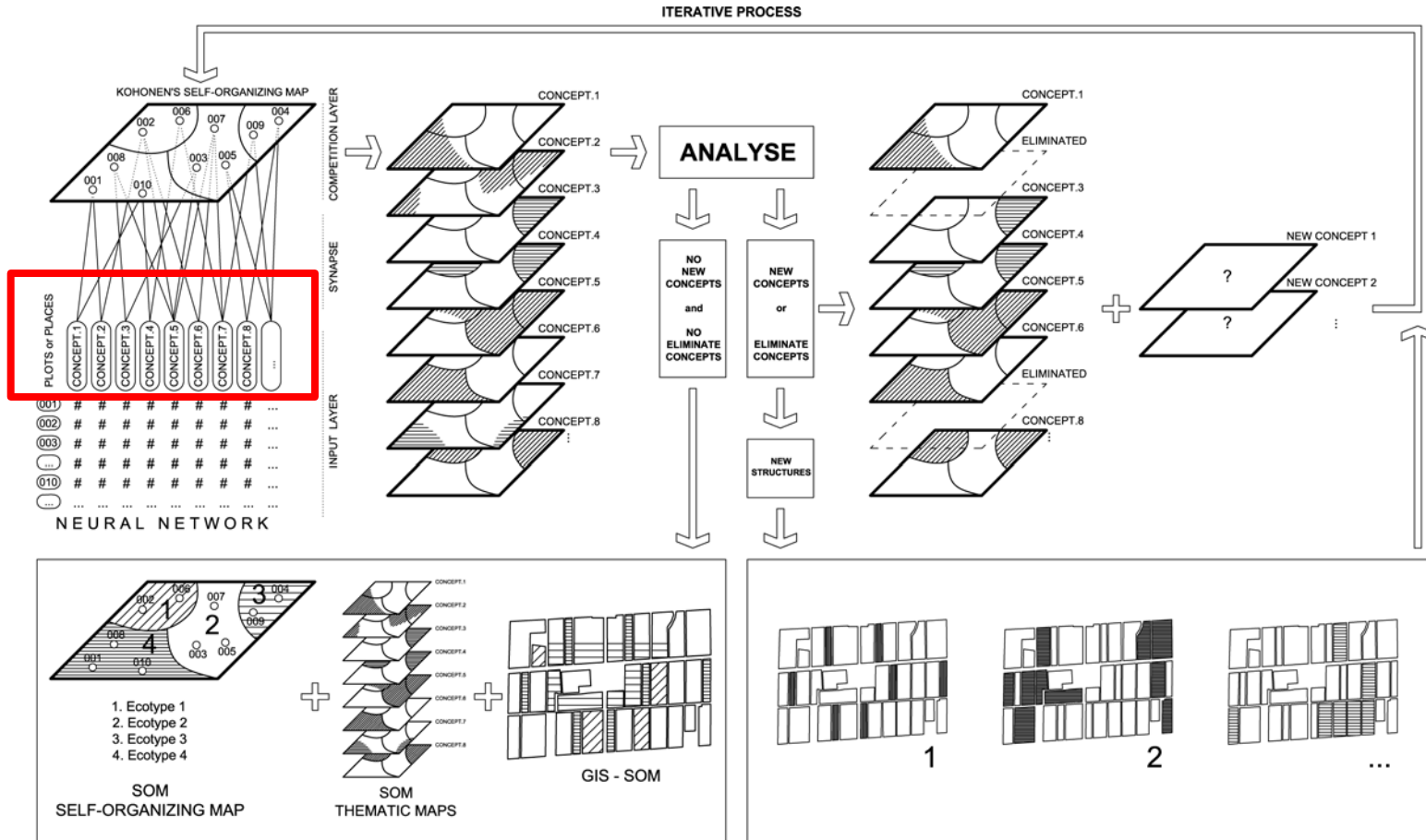
# 3. The Proposed Method (2)
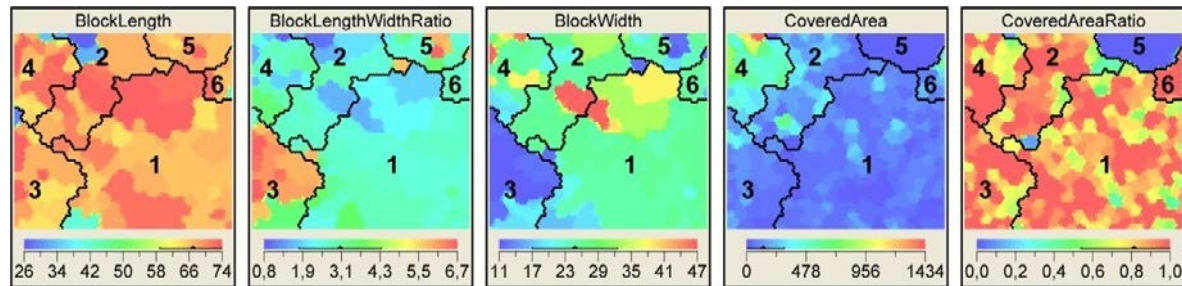


**NETWORK ORDINANCE**

Representation and Interpretation of SOM-WARD Cluster clasification on GIS-CAD.

+

=

# 3. The Proposed Method. The Process.

- Level 1. Selection of concepts which are deemed valuable.

# 3. The Proposed Method. The Process.

- Level 2. Generation of the Self-Organizing Map.

# 3. The Proposed Method. The Process.

- **Level 3.** Interpretation of the result obtained through the reading of maps of SOM-WARD Cluster and thematic maps obtained.

# 3. The Proposed Method. The Process.

- **Level 4.** Variables without coherencies are singled out and eliminated. In this case return to level 2.
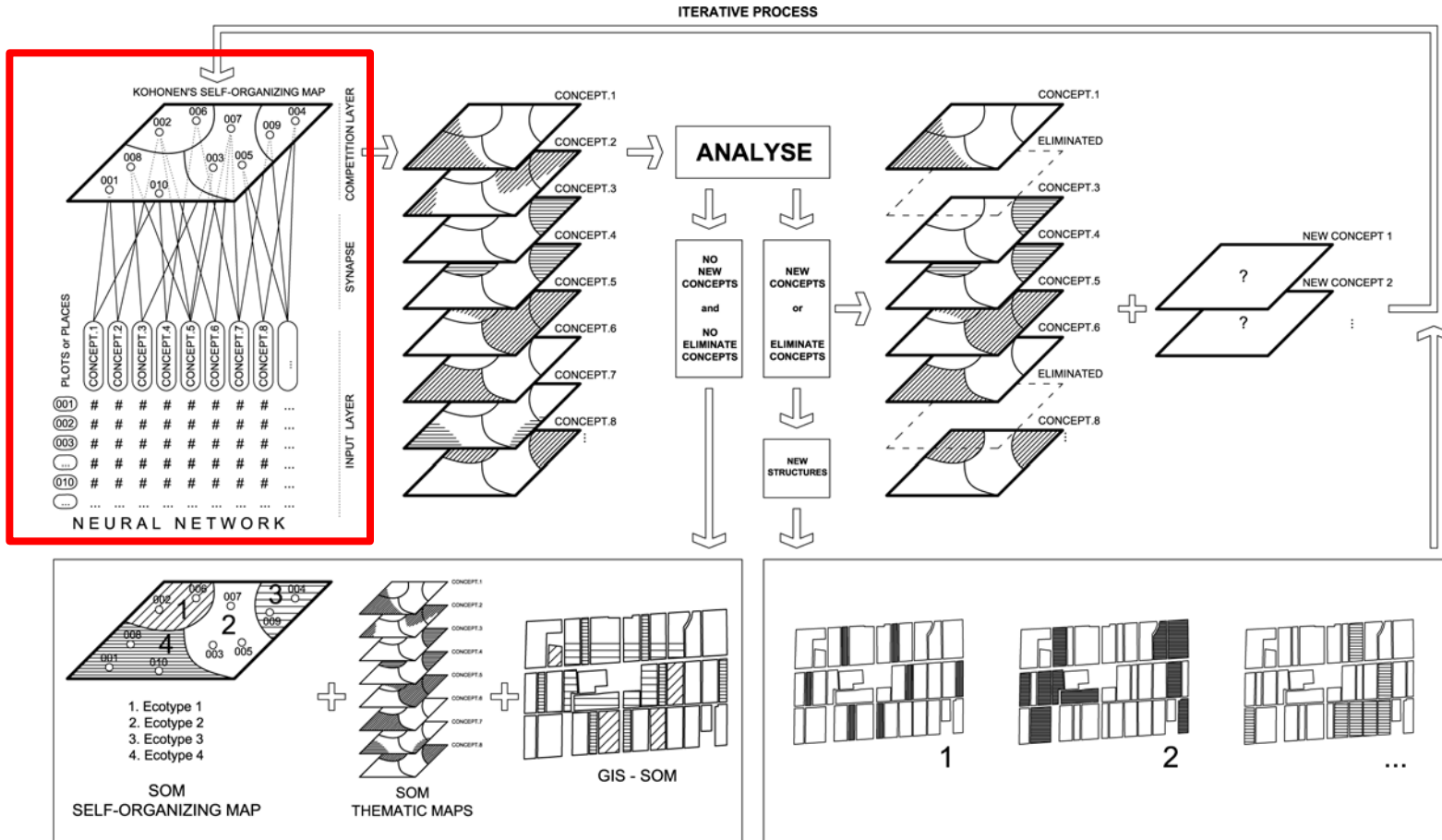


NETWORK-ORDINANCE

DISCOVERY OF THE URBAN STRUCTURES AS SEED FOR THE PROJECT AND INTERVENTION IN THE CITY.

# 3. The Proposed Method. The Process.

- Level 5. When concepts which provide coherencies are defined, the procedure concludes and definitive Self-Organizing Map is obtained.
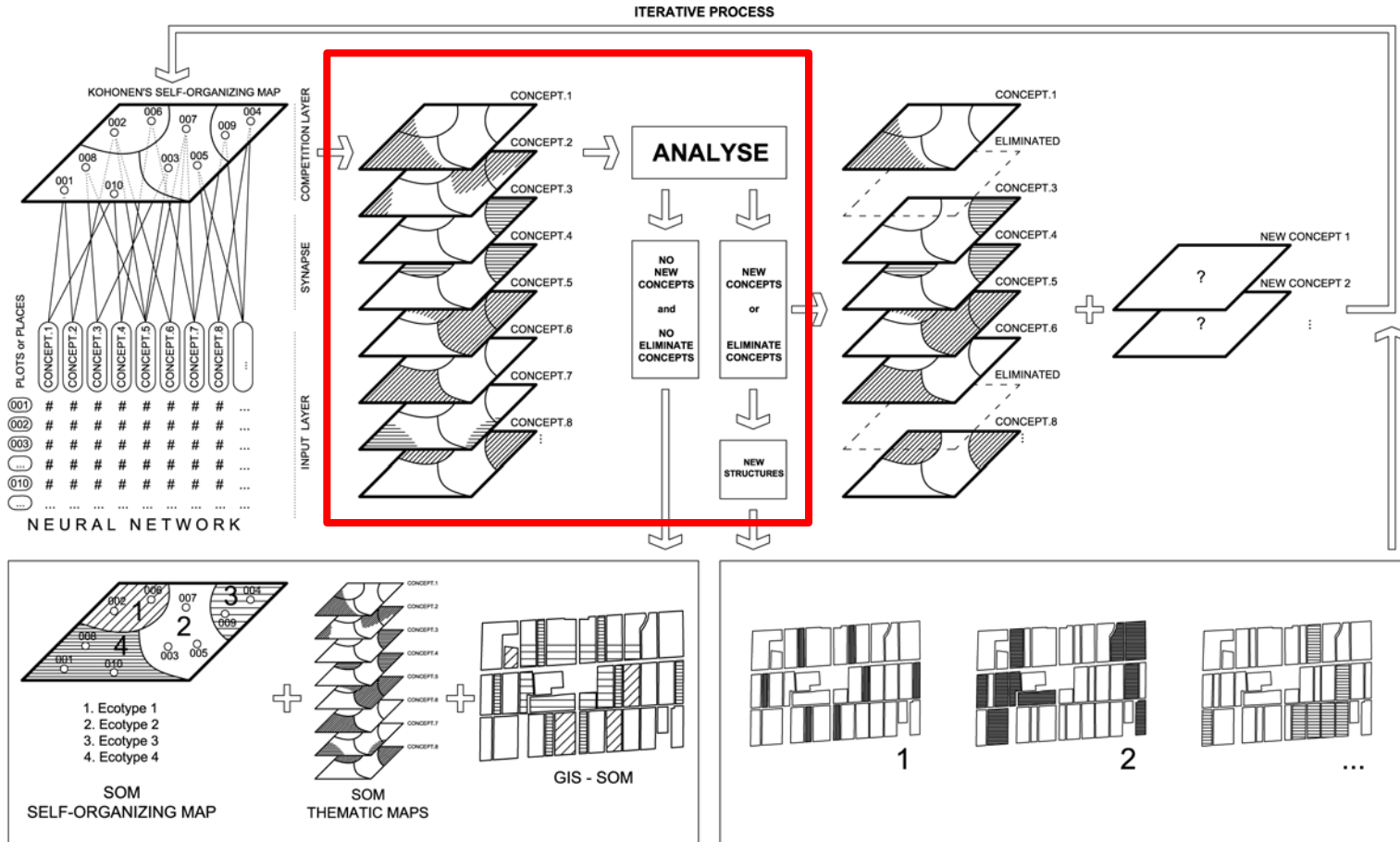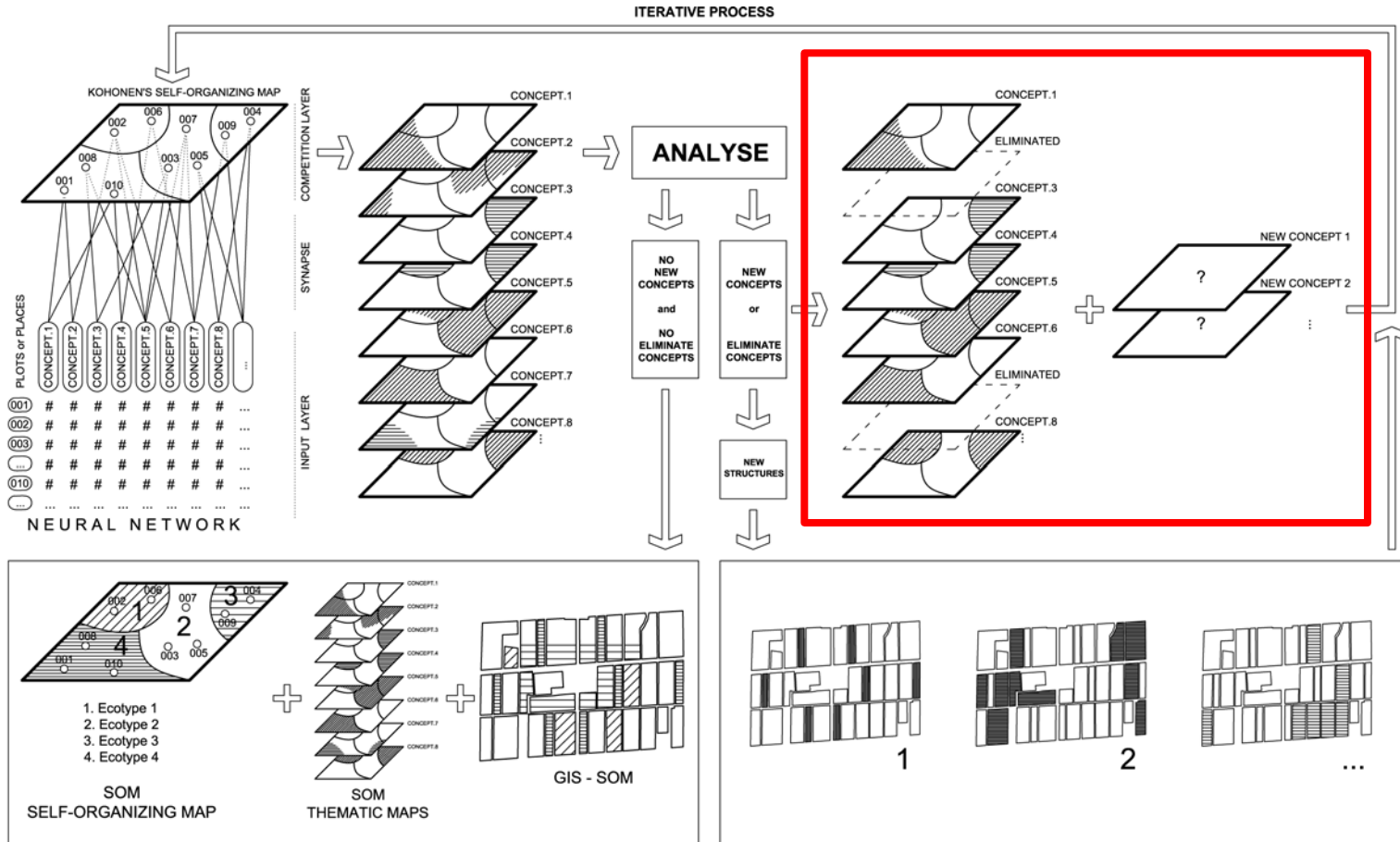


NETWORK-ORDINANCE

DISCOVERY OF THE URBAN STRUCTURES AS SEED FOR
THE PROJECT AND INTERVENTION IN THE CITY.

# 3. The Proposed Method. The Process.

- Level 6. The SOM is represented on an usual GIS: showing clusters and their coherences between themselves in their spatial distribution.
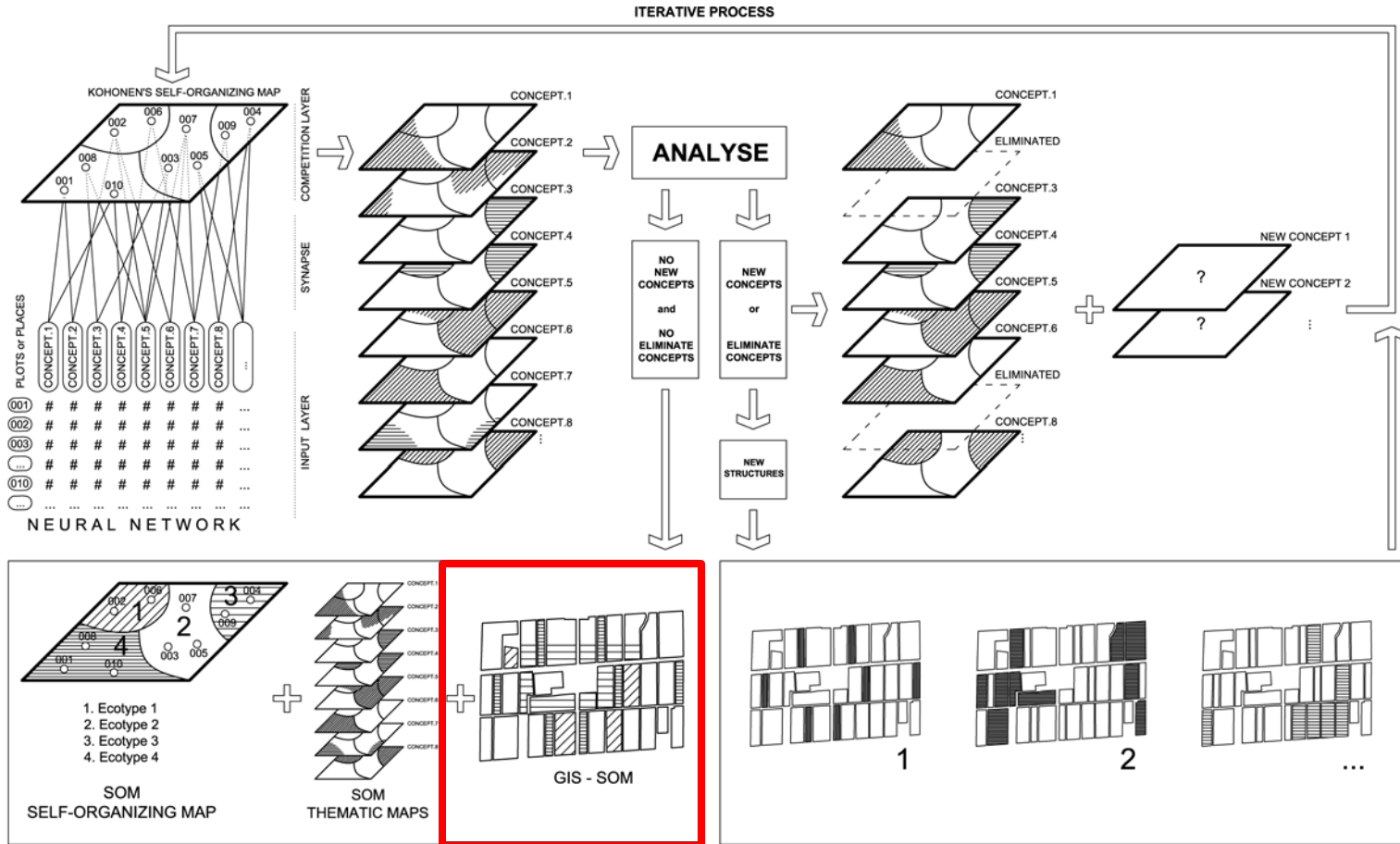
# 3. The Proposed Method. The Process.

- Level 7. Discovery of unknown urban structures as seed for the project and intervention in the city.
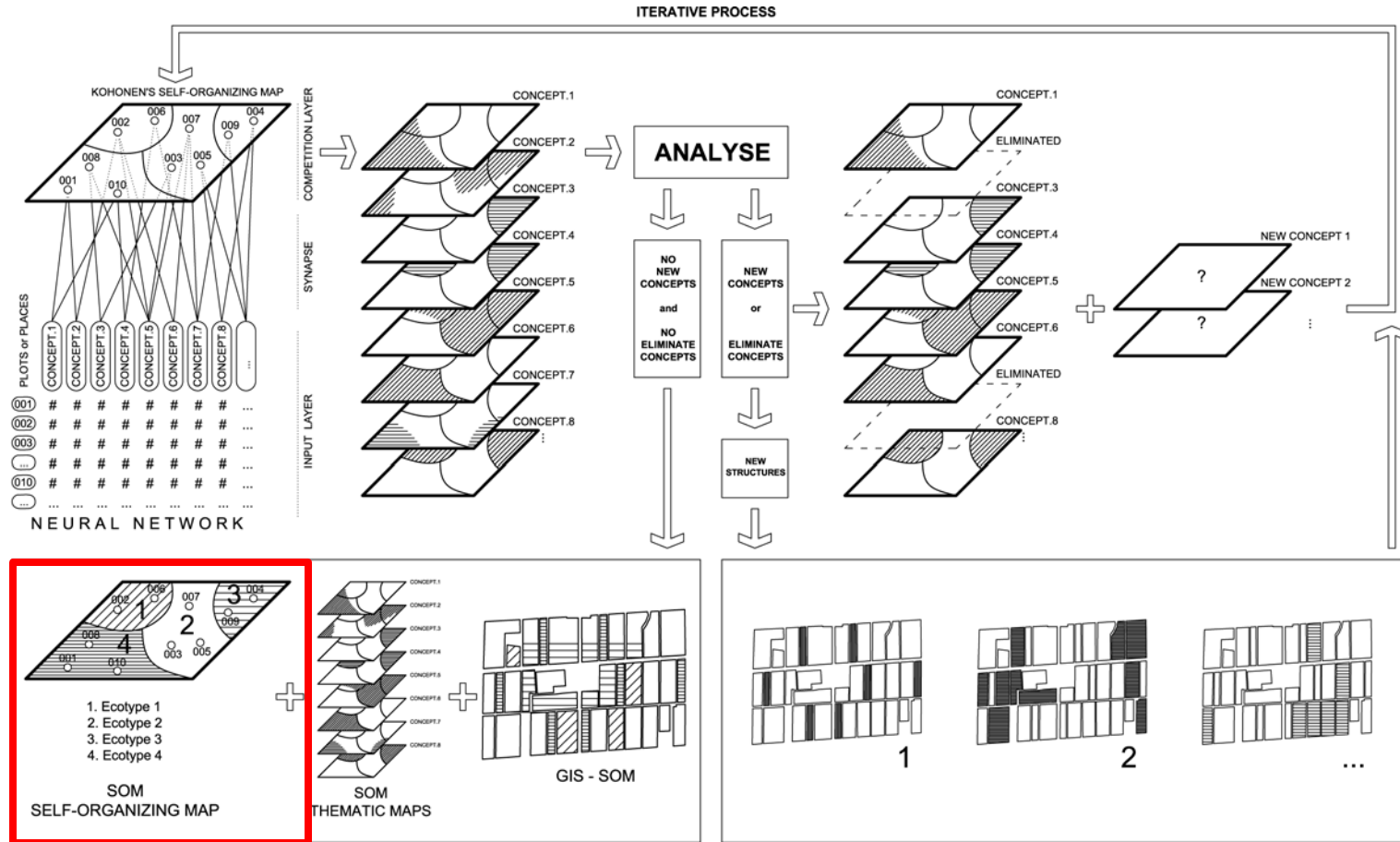


DISCOVERY OF THE URBAN STRUCTURES AS SEED FOR THE PROJECT AND INTERVENTION IN THE CITY.

# 3. The Proposed Method. The Process.

- The Network-Ordinance is achieved and new opportunities and projects are found on the way.
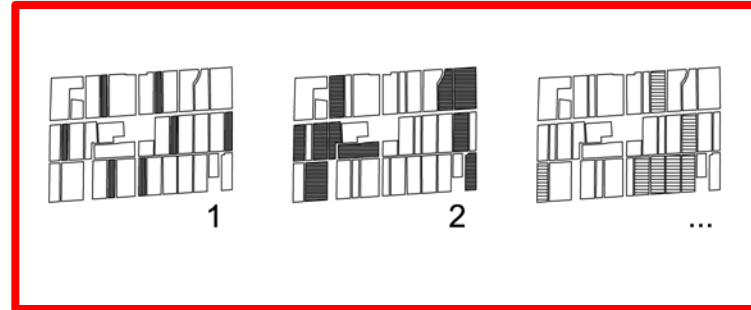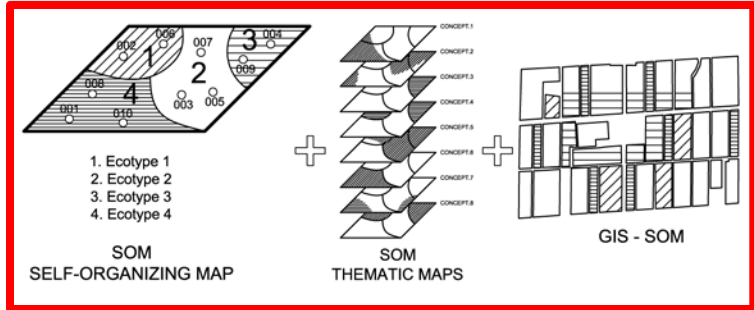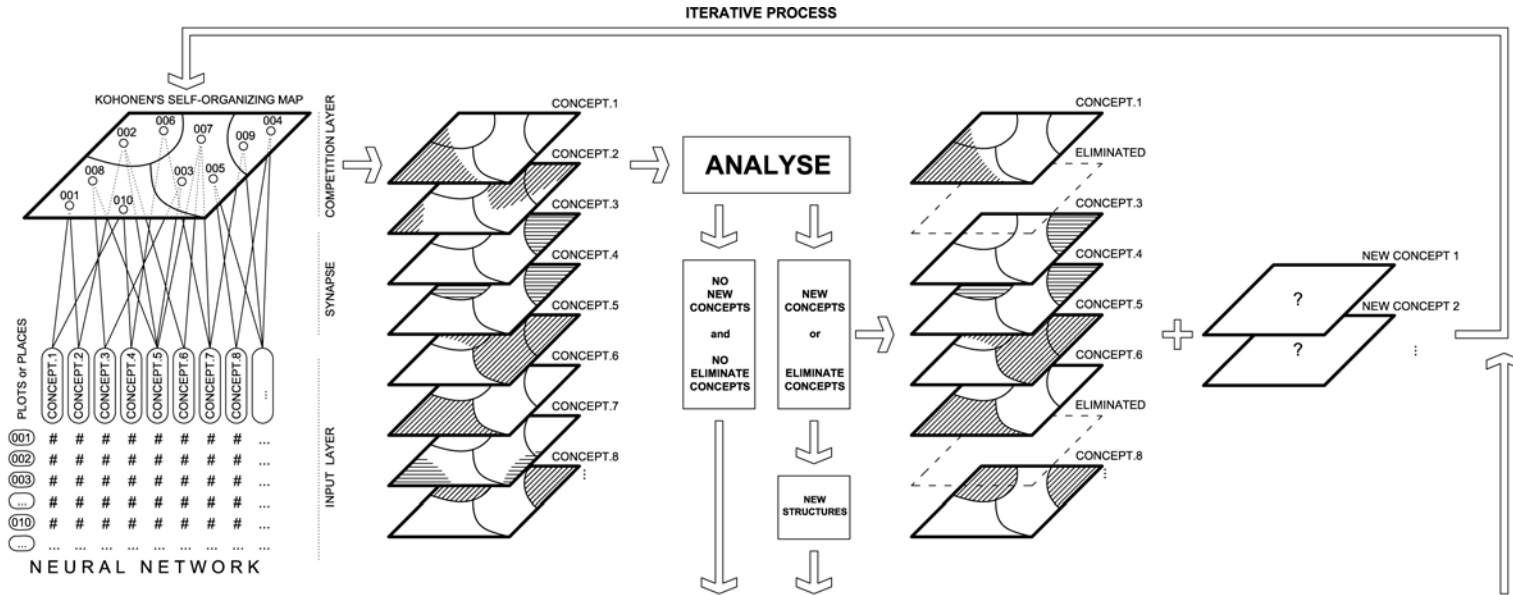


**NETWORK-ORDINANCE**

DISCOVERY OF THE URBAN STRUCTURES AS SEED FOR
THE PROJECT AND INTERVENTION IN THE CITY.

# 4. Illustration. The site.

- **Sellection of the site:**

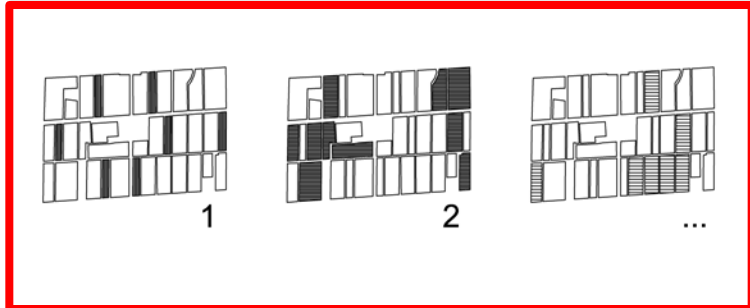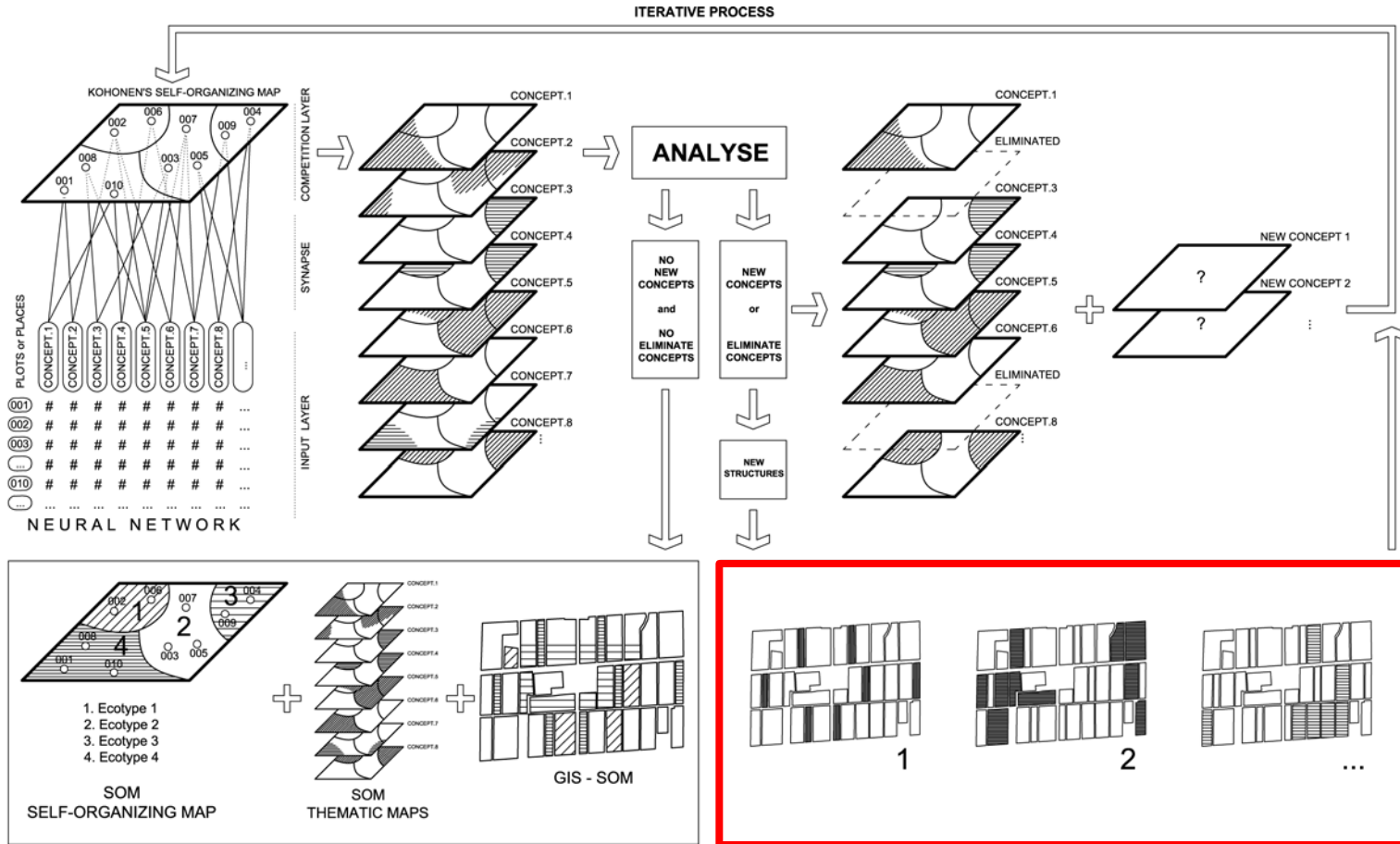  – Site with clear historic fabrics.

  – Site with recent profound transformations.
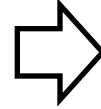
- **Santa Fe (Granada-Spain):**

  – Very well preserved urban fabrics. Founded as military encampment in 1483.

  – Since 1970 has recived profound typological transformation.
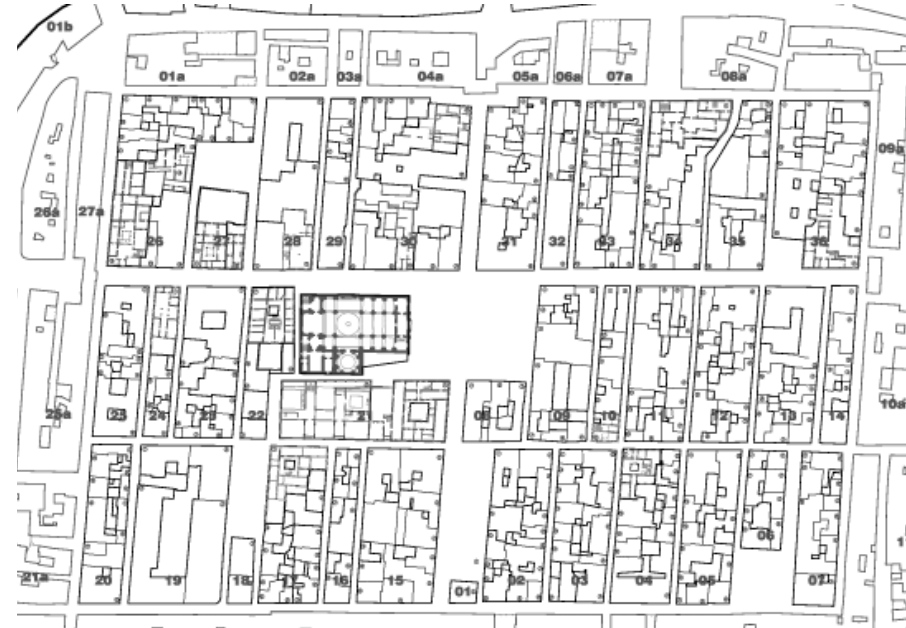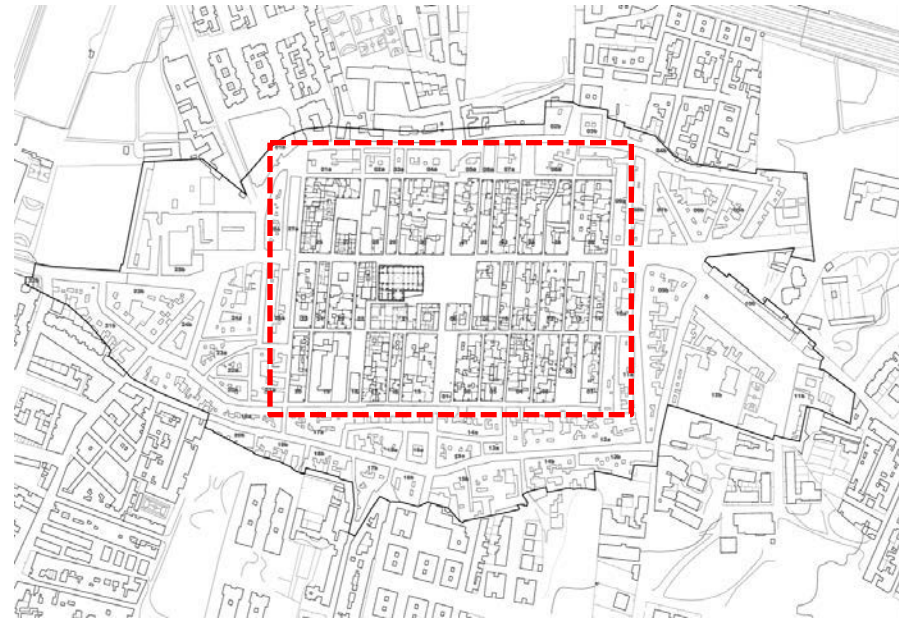


Source: Gómez-Ordoñez, J.L., Cabrera-Manzano, D., Rivas Navarro, J,L., 2008, Plan Especial de Protección y Ordenación del Centro Histórico de santa Fé, Granada.

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# 4. Illustration. The collected data.

- **Building and site form.**

  - **Definition:** Id., Transformed After 1970, Empty Lot, Under Construction, Basement, etc.

  - **Plot Shape:** Plot Area, Façade Length, Number Of Patios, Patios Area, Patios Perimeter, Covered Area, Covered Area Ratio, Stories, Gross Floor Area, FAR, etc.

  - **Block Shape:** Block Width, Block Length, Block Area, Block Covered Area, Block Covered Area Ratio, Block Gross Floor Area, Block FAR, Block Length/Width Ratio , etc.

  - **Relationship to Public Space:** Plot Public Space Area, Block Public Space Area, Block Public Space Area Ratio, Public Space / Gross Floor Area, etc.

  - **Construction Status:** Conservation Status, etc.

  - **Salubrity:** Façade Length, Façade Ratio, Patio Ratio, Façade Surface Area Ratio, Public Space to Façade, Street Section, etc.

  - **Accessibility / Visibility:** To City Center, Distance City Center, To Main Street, X Axis Length, Yaxis Length, To Main Block Façade, Façade Position in Block, Façade Position with Space Public, etc.

- **Social and economic issues.**

  - **Ownership Structure:** Property Rental, Inhabited, For Sale, etc.

  - **Density:** Number Inhabitans / Block, Residential Density, Gross Floor Area /Inhabitans Ratio, Block Number Dwelling, Gross Floor Area / Dwelling Ratio, etc.

  - **Social Issues (Labour / Schooling /Origin / Age):** Block Active Popolation, Block Porcentage Unemployed, Average Block Profession, Average Block Educational Level, Average Block Origin, Average Block Age, etc.

  - **Funtional:** Block Private Uses, Buffer Private Uses, Density Private Uses, Block Private Uses, Buffer Public Uses, Dessity Public Uses, etc.
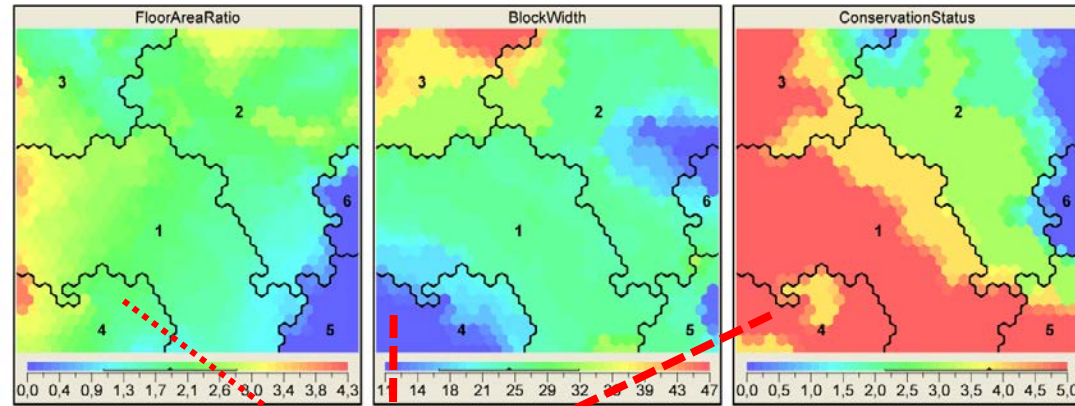
# 4. Illustration. The selected data.

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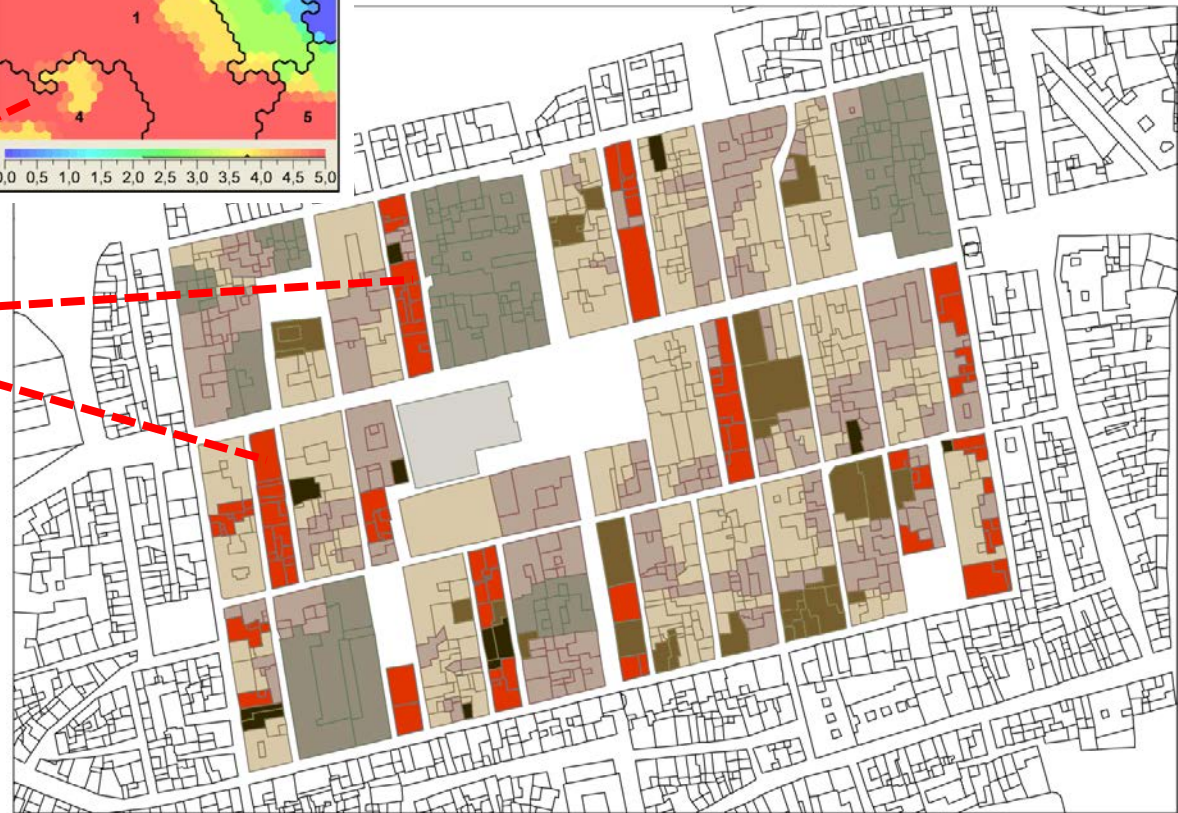


**ecotype 4**

Heuristic Process

⇩

**Discovering**
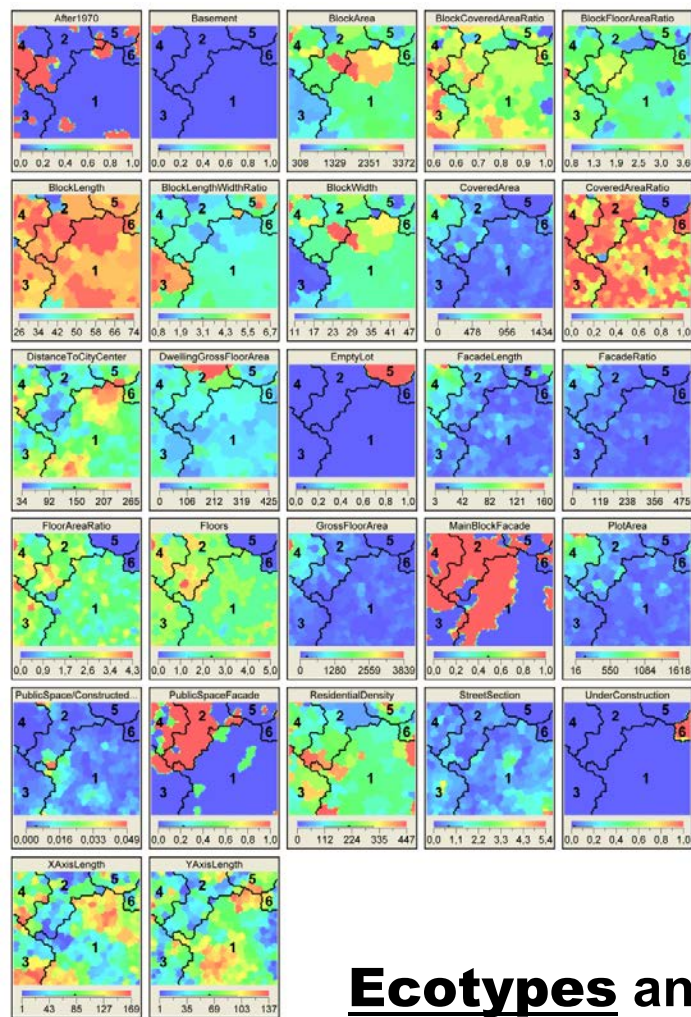Profound relation:
Block Width and Conservation Status

⇩

**Opportunity to discover**
<u>**new projects for the city**</u>

ecotype 1   ecotype 3   ecotype 5
ecotype 2   ecotype 4   ecotype 6

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# 4. Illustration. Results (2).



ecotype 1
ecotype 2
ecotype 3
ecotype 4
ecotype 5
ecotype 6

**Ecotypes** and **Network-Ordenance**

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# 5. Conclusion and Future Research.

- Conclusion:
  - Novel aproximation to urban complexity.
  - Novel concepts:  **Network-Ordinance + Ecotype**
  - Urban Ordinance as **alive entity**.
  - Urban Ordinance as **sum of realities**.
  - Discovering **unknown situations.**
  - Opportunity to **understand urban complexity.**
  - Opportunity to **discover new projects for the city**.

- Future research:
  - Characterize number and size of ecotypes.
  - Experiment with new reality generated by Network-Ordinance.
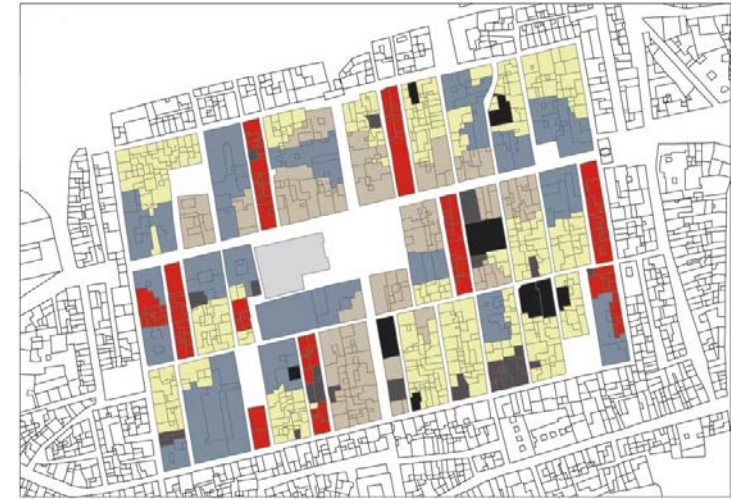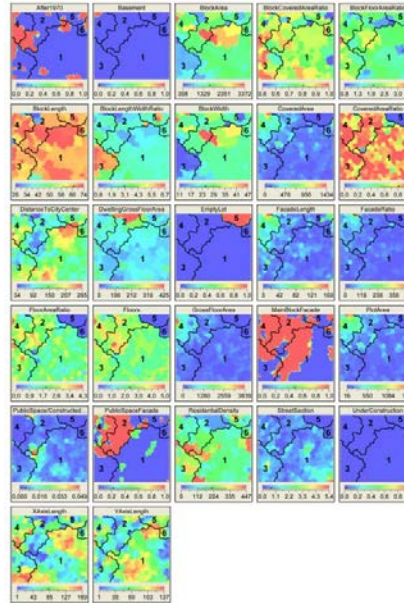  - Experiment in other sites and **other scales**.

# Thank you!



Building Distance [BD], Curb Cut Spacing [CCS], Driveway Width [DWW], Floor Area Ratio [FAR], Front Yard Depth [FYD], Lot Coverage [LC], Lot Width [LW], Perimeter Wall Height [PWH], Rear Yard Depth [RYD], Street Wall Length [SWL]
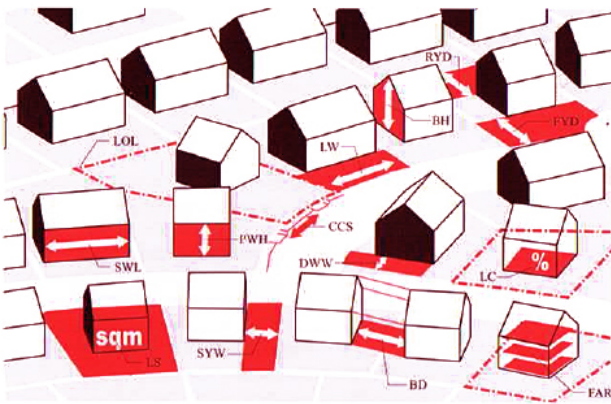
Typical Residential Stipulations: BD Building Distance (min), CCS Curb Cut Spacing (min), DWW Driveway Width (min), FAR Floor Area Ratio (max), FYD Front Yard Depth, LC Lot Coverage (max), LW Lot Width (min), PWH Perimeter Wall Height (max), RYD Rear Yard Depth, SYW Side Yard Width, SWL Street Wall Length (max).

Source: Lehnerer, A., 2009, Grand Urban Rules





ecotype 1   ecotype 3   ecotype 5
ecotype 2   ecotype 4   ecotype 6

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