Conceptual model of an Information System for Studies of Sustainability of a Region

J. Bofill\(^1\)  J.J Felipe\(^1\)  C. Barrado\(^2\)

\(^1\)Càtedra UNESCO de Sostenibilitat, UPC
\(^2\)Departament d’Arquitectura de Computadors, UPC

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Outline

Motivation & Objectives

Information layers

Functionality
  System
  Models
  Variables
  Data

Application
  Prototype
  Development

Conclusion & future work

Snapshots
Motivation

- Data harvest
  - one of most time consuming and thankless jobs.
  - efforts are repeated on each annual report.
  - done by different people at different times (coordination, error-prone, ...)

- We use the software tool we all know: spreadsheet.
  - All-in-one: presentation, database, calculations, ....
  - But spreadsheets are not easy to maintain and share:
    - who has the latest? is yours the same as mine? can you incorporate the last changes I made in my local copy?
Objectives

- Information system to support studies on sustainability.
- Primary users: researchers on sustainable development.
- Generic enough as to be used in many contexts.
  - Different regional organizations.
  - Data, measures and observations obtained from disperse data sources.
  - Use different Conceptual models.
Three information layers

Conceptual Models
Data, measures, observations
Region
Data, measures and observations

- The researcher defines the variables, indicators and indexes: Name, description, data type & units.
- Data types can be numeric, text, logical, URL, ...
- Each value of a variable is referenced to:
  - Data source.
  - Date.
  - Territory.
- Time series from any variable.
Regional organization

- Generic territorial groups.
- Different subdivisions can be defined.

**Generic Organization Entities**

- Entity A
- Entity B
- Entity C

**Catalunya**

- Comarca
- Provincia
- Municipi

**Spain**

- Autonomy
- Province

**University**

- Campus
- Buildings
Conceptual Models

- Models conceptualize the main dimensions.
- Models select and group indicators differently.
- A Model is a logical structure that allows to organize indicators.

Figure: Models: Bossel, Gallopín, DPSIR
System

- Information System resident in an Internet server.
- Access through a web browser. No local installation.
- Access control via username.
- Anonymous access option.
As a researcher, you can:

- Use a previously defined conceptual model.
- Define your team conceptual model.
- Use your own model. Try a new model.
- Use them simultaneously.
You can define variables or indicators that are calculated from other variables at run time.

Must be able to write the formula in one line.

Example Gender Unemployment Index:

\[
GenderUnemployment = \frac{WomenUnemployed + 1}{MenUnemployed + 1}
\]

You can use the new variable as any other variable.
Variables: Repeated values

- A variable or indicator can have more than one value at the same time and place. Hows that? different equipment calibration, applied rules, calculation methodologies, etc.
- These “repeated” values are acceptable as long they come from different data sources.
- To manage the data:
  - Data sources are associated to a priority value.
  - User can select data sources to be used.
Variables: Repeated values

Measure: Population

year
- 1999: 170
- 2000: 185
- 2001: 225
- 2002: 312
- 2003: 345
- 2004: 330

Values with source priority of P>M>N
- 170
- 190
- 225
- 312
- 345
- 330
Variables: Repeated values

You can ..

▶ Create your own values for experimentation,
▶ Assign them as you own data source, ...

then

▶ Simulate different data scenarios
▶ Create future scenarios ...
Sustainability criteria
Reference values to inform or highlight some relevant feature

Each conceptual model can specify different criteria values: threshold values, rank semaphores, etc.
Working with data

▶ Daily work with data is done preferably with spreadsheets (excel, calc, ....)
▶ You can download data of any selection of indicators and regions.
▶ You can filter and select data by:
  ▶ Conceptual model
  ▶ Indicators of subsystem of a conceptual model
  ▶ Regional subdivisions
  ▶ Data sources
Data visualization

Select any combination of indicators, regions and data sources
Visualize time series and pies of the selected data.
Data management

Data management is done via spreadsheet.

1. Select your data
2. Download the spreadsheet
3. Modify, add or delete data on the spreadsheet
4. Upload the spreadsheet
5. System compares spreadsheet and database data, and changes the database accordingly
Select territory, variables and data source

Download spreadsheet

Add, modify and delete data

Upload spreadsheet. Accept changes
Experimental prototype: Girona comarques

- Conceptual model with 6 subsystems:
  - Territorial and ecological matrix, Infrastructure and mobility, Ecological footprint, Economy, Society and Governance.

- Data:
  - 216 variables and indicators
  - 142,000 values
  - 1980-2008 time extension

- Region:
  - 9 comarques
  - 221 municipalities
Software Development

- Only Free Software in the development and deployment.
- The end application will have a free software license.
Software Development

- Web framework: django
- Relation database: Sqlite, Postgres o Mysql.
- Development language: python
- Graphical library: matplotlib
- Disk used by the application, with prototype database: 16Mb.
Conclusions

▶ Adaptable Information System.
▶ Researcher oriented.
▶ Integrates Territory, Data, Data sources and Conceptual models.
▶ The use of spreadsheets facilitates the use and management of data.
▶ Free software.
Future work

- Integrate GIS data (geodjango)
- Integrated script/programs management (python)
- Integrated statistical and graphics tools and software (i.e., sagemath, R, ...)
- Semantic web integration (rdf, owl, ...)

Municipality data. Tab for each subsystem.

### Sostenibilitat Territorial Girona

| municipi de País, comarca de Baix Empordà, província de Girona |
| dades web semànàcia |

- latitud 41.97063282470703
-imatgedop
- wikipedia
- longitud 3.145833253860474
-vissir

--- informació cartogràfica (municat)

Marc conceptual: CST Centre per a la Sostenibilitat Territorial

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Data selection. Time series and pie views.
Links to external GIS applications
Indicator/Municipalities series
Men unemployment and Gender unemployment index, in 4 municipalities.
Municipality/Indicators series

Sostenibilitat Territorial Girona

Inici
Informe
Scripts

REPORTS
Gràfics per Municipis
Gràfics per Camps
pdf ddd

Usuari:
AnonymousUser
Base de dades
gitest0904.db ex233M

SELECCIÓ
Descarregar selecció

Marc: CST
municipis: Cadaqués, Capmany, Castelló d’Empúries, Llors.
Fonts: CST

Camps: PBL_ATU_H, PBL_ATU_D, IND_ATU_D.
If you need more information: jordi.bofill@upc.edu

Thank You