The open source GIS, an ideal framework for the development of an integrated modelling platform devoted to sustainable urban planning

First steps with OrbisGIS and CartoPolis

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Sustainable urban planning

An interdisciplinary and systemic approach

**Sustainability**
Environmental, sociological, economic and cultural dimensions

**Timescales**
Differences in time scales for planning and design, practice and management
From short to long term effects (trends, change, risks)

**Spatial scales**
Local, regional and global
Links between local action and global environmental change
Sustainable urban planning

Relationships
Between the environment, technical systems, social and economic practices, spatial planning,
Between different sectors and stakeholders.

Need of an integrated modelling platform for
Evaluation of urban projects (multicriteria, multi-actor),
Spatial analysis tools at ≠ spatial and time scales.

Open source
Spatial Data Infrastructure (CartoPOLIS)
+ Geographic Information System (OrbisGIS)

an ideal framework to fulfill this objective!
The need of an open source SDI

Huge amount of data

- coming from various origins:
  - Surveys
  - Measurements (*in situ* sensors, remote sensing)
  - Modeling and simulations (evaluation, indicators)

- of various nature (quantitative, qualitative)
- at different spatial and temporal scales
- to perform multi-criteria analysis
- for different actors (urban planners, decision makers, inhabitants, …)
Urban data representation and management

SDI - Spatial Data Infrastructure

Used of ISO and OGC standards for the acquisition, processing, capitalization, sharing and preservation of spatial data and metadata

Issues to face systemic and interdisciplinary applications

Description and storage of multi-source and multi-scale data/metadata

Querying of such data: what kind of language for users?

Utilization of data by models or tools: how to enable the integration?

Provision of data and tools:

- to manage the data flows?
- to manage the data processing flows, the storage of the spatial analysis tools?
- to visualize the spatial data according to specific mapping rules
The open source SDI CartoPOLIS
Modelling
For understanding complex systems and for urban planning

Decision making
Complexity → different planning scenarii
→ comparison of scenarii (evaluation)

→ Platform integrating a lot of urban models, producing, exploiting, sharing spatial data:
*Open source* SDI and GIS + standards
Exchange of data between urban models, applications, visualization tools

Interoperability and standard data like OGC standards (WMS, WFS, ...) and ISO standards (19115, ...)

Plugins and transfers of new models

Modular approach to development (model-view-controller software design pattern)

Nicolas Fortin « An open source tool to build urban noise maps in a GIS »
Friday 26th - 14:45 - Room E03

Data query and data processing

Language must be comprehensible to different users and easily completed when adding additional features like new evaluation tools or models
Integration of an extended spatial language
Management of vector and raster data
based on the Simple Feature SQL (SFS) standard

Vector + Raster
The open source GIS OrbisGIS

A unique way to describe spatial processing

Meta language

```
-- @script
-- @identifier Buffer
-- @title Geometry buffer
-- @abstract Computes a buffer around all given geometries
-- @/abstract
-- @input TABLE ( the_geom GEOMETRY )
-- @input LITERAL buffer_size DOUBLE
-- @output TABLE buffered
-- @/script

CREATE TABLE buffered AS
SELECT ST_BUFFER(the_geom, buffer_size)
FROM input;
```

Coupling with the Web Processing Service
to share in a common platform all geospatial processing available on-demand via internet
→ Enhancement of SDI uses by pooling all the processes built by IRSTV researchers (noise mapping, flooding modeling, atmospheric pollutant dispersion, etc.)

creating a geospatial knowledge repository to study cities
The visualization of spatial data must

Cope with static, dynamic and multi-scale data,
Be comprehensible by all stakeholders (good representation of the semantic and use of standards),
Be easily edited and disseminated on different supports.
Symbology encoding standards have to be consistent with the purposes of research and new applications.

Generic symbologies
Parameterizable, reusable

Thematic symbologies
At IRSTV, creation of a common platform

Where each member of IRSTV is an active contributor,

A common tool adopted by all the different users,

A single platform able to integrate and capitalize all the methods and tools necessary to describe, planify and manage the city.

→ **Needs of a specific collaborative methodology:**

to manage the understanding and the interaction between the various stakeholders (developers, users) and to preserve the quality of code.
Cooperative software engineering

Project management for the integration of new packages and the preservation of the quality of the delivered code (validation process) controlled by:

- the open source tool Jenkins to ensure a continuous integration without regression.
- the platform GitHub and the GIT tool for the sharing and the distributed control of codes.

Capitalization of basic functionalities

Triangulation algorithm
Alexis Guéganno
Collaborative development of the open source platform

Pedagogy and training

- MSc on Sciences and techniques for urban planning,
- Professional training providing full courses to learn how to use and develop these tools,
- Training project dedicated to the engineering of geographic information in cooperation with other existing communities like GvSIG and OpenStreetMap.

Contents: Theory and practice on open source software (GIS, SDI, relational database ...) and on open data.

... from software engineering to participating in coding
Collaborative development of the open source platform

A research platform for proof and benchmarking

A means to prove
  the quality of the concepts, their implementation and usage,
  their computation performances according to the amount of
data, and its ability to adapt to other datasets.

A tool to compare
  their performances to other approaches on the same datasets.

A way to demonstrate
  their relevance for the professional community.
To conclude ...

The open source paradigm
A response for an integrated modelling platform dedicated to sustainable urban planning.

The open data and open source SDI & GIS
A response for collaboration between all the stakeholders

Interoperability and common languages
A response to interdisciplinarity, cooperation (data exchange and crossing, new functionalities), communication (symbology encoding)
Research on sustainable urban planning is a great opportunity a source of innovation and progress for the open source community and vice versa
Thank you for your attention!

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I want to create a process to compute the watershed from a river outlet using a DEM

CREATE TABLE filled AS SELECT ST_FillSinks(raster, 0.1) AS raster FROM dem_chesine;
CREATE TABLE dir AS SELECT ST_DIRECTION(raster) AS raster FROM filled;
CREATE TABLE strahler AS SELECT ST_STRahlerStreamOrder(d.raster,a.raster, 1500) FROM dir d, acc a;
CREATE TABLE allrivers AS SELECT ST_VECTORIZE_LINE() FROM strahler ;
CREATE TABLE rivers_low_6 AS SELECT * FROM allrivers WHERE gid < 6;
CREATE TABLE watershed_chesine AS SELECT ST_DWatershed( acc.raster, ST_GeomFromText('POINT (303472.72 2254245.29)')) FROM acc;

-- Script
-- $Identifier DrainageNetwork
-- little drainage network and watershed
-- extraction
-- $Title
-- $Abstract Computes the drainage network
-- and the associated watershed from
-- a DEM raster
-- $Abstract
-- $Output TABLE dem_chesine ( raster RASTER )
-- $Output TABLE river_low_6
-- $Output TABLE watershed_chesine
-- $Output

CREATE TABLE filled AS SELECT ST_FillSinks( ...}