Leverage of Geospatial and other information sources in Mexico: an institutional perspective on urban resilience

Eduardo de la Torre
INEGI - MEXICO

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“Cities are where the battle for sustainable development will be won — or lost, if we fail.” Ban ki Moon – June, 2012

• Cities are where economic, social, cultural, political and environmental aspects of human activity come together in a dynamic way

• In 2050, around 70% of the world's population will live in urban areas

Urban population growth (% Mexico)
Contents

• INEGI as producer and coordinator of national information

• Information sources and tools

• Uses and applications
  ▪ National/ inter-institutional
  ▪ International uses and collaborations

3 Key Elements

- Geospatial and Statistical Information in a single Institution since 1983
- Autonomous since 2008
- Coordinates National System of Statistical and Geographic Information (SNIEG)
National System of Statistical and Geographic Information (SNIEG)

National Housing Inventory
Economic Census Atlas
National Directory of Economic Units (DENUE)

Total economic units by state

Data from economic units (commercial establishments)

Total economic units, by block (Mexico City)

Available Street Lighting
Available Wheelchair Ramp

Environmental Information
integration of statistics, administrative records, and geospatial information
ANNUAL OPERATION CERTIFICATE (COA Web)

• An online tool for the official reporting of emissions and pollutant transfers to air, water, soil, land and hazardous materials and waste, from industries and establishments from all productive sector:
  - Chemical, petroleum, automotive, pulp & paper, metal, glass, electric power generation, asbestos, cement, hazardous waste treatment, etc;
  - Waste management providers,
  - Those discharging wastewater into national water bodies, or
  - Those emitting 25,000 tonnes or more of CO2 or equivalent compounds
  - Greenhouse Gases (GHG) (transport, agricultural, trade & services, etc).

• Reporting is compulsory and free of charge;

• Information is validated and updated in real time

• Reporting fields include standardized physical address.

ANNUAL OPERATION CERTIFICATE (COA Web)

• All information about the location of the industries is geo-referenced, considering Technical Geographic Standards (Geographic Addresses)
Integration of statistical and geographic data sources

<table>
<thead>
<tr>
<th>GEO-STATISTICAL INTEGRATION to MONITOR NATIONAL PRIORITIES &amp; SDGs</th>
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</thead>
<tbody>
<tr>
<td><strong>Satellite Imagery</strong></td>
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<tr>
<td><strong>SPOT ERMEX</strong></td>
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<td><strong>GEOEYE EVISMAR</strong></td>
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<td><strong>RAPIDEYE LANDSAT</strong></td>
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<td><strong>Low resolution (250 m)</strong></td>
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<td><strong>MODIS</strong></td>
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<td><strong>Radar RADARSAT</strong></td>
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Single Cartographic Base – Urban localities

**AIM:**
To update Mexico’s urban cartography, through the use of institutional inputs*, administrative records, and other sources of geo-referenced data which, through a dynamic processing, allows for the maintenance of a single cartographic basis for the geo-statistic framework, topographic charts and all cartographic products required for census and surveys, thus consolidating the National System of Statistical and Geographic Information (SNIEG)

**Working universe:**
- **783 formats (scale 1:20,000)**
- **78% of total national population**
- **1,130 Municipalities**
- **2,411 Urban settlements**
- **11,918 Rural settlements**

*institutional inputs include data from various governmental and non-governmental organizations.
The Single Cartographic Base is integrated by 42 spatial objects, as follows...

**Spatial Objects in the BCU**

- **Review of satellite imagery**
  - Quality
  - Temporality
  - Coverage

- **Digitalisation**
  - Polygons: city blocks
  - Points: punctual geographic objects
  - Lines: roadways

- **Review**
  - Completeness of the attention of the loads
  - Identification of the increments for updating in the field

- **Validation**
  - Congruence of the vectorial with the image
  - Information captured through the forms

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**General Process**

Use of satellite imagery, administrative records and field data and validation

**Review of satellite imagery**
- Quality
- Temporality
- Coverage

**Digitalisation**
- Polygons: city blocks
- Points: punctual geographic objects
- Lines: roadways

**Review**
- Completeness of the attention of the loads
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**Validation**
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**ADMINISTRATIVE RECORDS**
### Use of Administrative records in Urban Cartographic database

**Sources**
- Cadaster cartography
- Public property registry

**Processing**
- Production of a harmonized and geo-referenced data layer of land properties

<table>
<thead>
<tr>
<th>Tipo</th>
<th>Registros</th>
<th>Periodo de operación</th>
</tr>
</thead>
<tbody>
<tr>
<td>Núcleos Agrarios</td>
<td>30,250</td>
<td></td>
</tr>
<tr>
<td>Parcelas</td>
<td>6.2 Millones</td>
<td></td>
</tr>
<tr>
<td>Dominio pleno</td>
<td>180,937</td>
<td></td>
</tr>
<tr>
<td>Áreas de Uso Común</td>
<td>70,679</td>
<td></td>
</tr>
<tr>
<td>Salares</td>
<td>2.1 Millones</td>
<td></td>
</tr>
</tbody>
</table>

**Geo-statistical framework**
- Single Cartographic Database
- SNIEG

**Sectoral projects**
- Academia and civil society

**Use**
- Programa modernización estatal SEDESOL
- BANRAS
- CONAVI
- CFE
- PUV

*Source: Registro Agrario Nacional*
Updating of databases and cartography

**Data delivery**
- Production of photo-maps

**Data integration**
- Geo-statistical framework
- Topographic maps
- Base map for Digital Map

**Data exchange**
- State units
- SNIEG

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**Functional Regionalization of México (RFM)**

Territorial areas are organized under a scheme that starts from the dynamics in human settlements and the interrelations between them and their environment. The structure of the proposed functional regionalization is dynamic between the different levels that compose it.

*Source: SEDATU, Functional Regionalization of Mexico. Methodology (November 2015).*
Urban Rural Systems (SUR) are strategic centers in the urban areas with the largest population and in state capitals that make territorial cohesion, decision-making, among others.

Polygons with time travel distances:
- 0-30 minutes
- 30-60 minutes
- 60-90 minutes

Optimization of travel polygons considering:
- The National Road Network, and
- The Digital Elevation Model

Use of BiG DATA geo-referenced tweets to identify Urban-rural dependence patterns

55 urban/rural systems
94 million people = 84% total national population

Simbología:
- Linde estable
- Sistemas Urbanos Rurales
- 30 min.
- 60 min.
- 90 min.

Fuente: Elaboración DGDR, SEDATU 2015
Participatory Cartography

- An interactive, dynamic crowd-sourcing process to channel citizen input for territorial information used to permanently update and improve official cartography.

- Discrepancies or updates in addresses and roadways (numbering, nomenclature, senses, services and status updates during emergencies)

- Inputs: comments, pictures and other formats

- Input is validated by INEGI specialists and uploaded to the Digital Map of Mexico or the Collaborative Disaster Platform.
Damages after Hurricane Patricia (Oct 2015)

http://antares.inegi.org.mx/analisis/red_hidro/siatl/

Damages after tornado through Acuña City, Coahuila (April 2015)
Flooded cropfields. Chihuahua, september 2013

Damages after strong winds and hail, Chiapas
Partially destroyed town after a dam failure; Tropical Storm Manuel, September 2013

Destroyed bridge; Tropical Storm Manuel, September 2013
Partially flooded town (destroyed bridge); Tropical Storm *Manuel*, September 2013

Partially destroyed town (mudslide); Tropical Storm *Manuel*, September 2013
Uses and applications of diverse and integrated information systems

National System of Statistical and Geographical Information (SNIEG)
Thematic Information Subsystems

Specialized Technical Committees

Demographic and Social
12 Specialized Technical Committees

- Sustainable Development Goals
- Population Dynamics

Economic
11 Specialized Technical Committees

- National Accounts
- Tourism
- Industrial activity
- Transportation
- Infrastructure
- Science and Technology

Geographic and Environmental
8 Specialized Technical Committees

- Climate Change
- Energy
- Urban development
- Water
- Land degradation

Government, Public Security & Justice
6 Specialized Technical Committees

- Government
- Justice
Digital Map of Mexico

Open-source geomatic platform that allows the visualization and analysis of geographic and geo-referenced statistical information. It contains 208 vector data layers, with more than 71 million geographic objects and 4 raster layers covering the entire country.

Gender Atlas

46 Gender-related indicators (geo-referenced)

10 main areas:
- General population
- Education
- Health
- Labor
- Decision making
- Use of time
- Poverty
- Entrepreneurship
- Violence
- % Indigenous population

http://gaia.inegi.org.mx/atlas_genero/
Update of the national geostatistical framework
Provides support for censuses and surveys
Update of the National cartographic database
Updated every three years
2,234 localities - 80% of the country’s population.

Benefits
- Administrative records
- Information from INEGI
- Satellite images and pictures

Urban Cartographic database

Information sources

Collaborative platform for disaster preparedness

Multi-layer web platform
Accessible to all relevant government agencies
Combines layers on Population, economic, and environmental data
With real-time news and satellite/radar imagery
Data available prior, during and post-emergencies

data available prior, during and post-emergencies

geospatial information as a critical asset for disaster management

Web Geo-services
- Discovery
- Viewing and Consultation
- Downloading
- Direct Access

Employment of standards OGC:
- WMS
- WCS
- WFS

Permanent base layers and by phenomenon or event
The National Council for Sustainable Development and Agenda 2030

- A cross-sectoral committee (18 ministries), coordinated by the Office of the President
- It includes state and local governments, Congress, the private sector, academia and civil society;
- Technical advice from INEGI and other autonomous institutions;
- Launch of the National Platform for SDG monitoring (http://agenda2030.mx)

According to INEGI’s experience in geospatial information, a number of SDG indicators can be spatially referenced, as follows:
Measuring SDG indicators

**SDG 1 - No poverty**

**Target 4:** By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance.

**Indicator 1.4.1** Proportion of the population living in households with access to basic services

Use of the geo-referenced National Housing Inventory

Visualized within the Digital Map of Mexico

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**SDG 8 - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.**

**Target 8.3:** Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services

**Indicator 8.3.1** Share of informal employment in non-agriculture employment by gender

National Employment Survey visualized within the Digital Map of Mexico
SDGs related to Disasters

There are **25 targets** related to disaster risk reduction in **10 of the 17 SDGs**, firmly establishing the role of disaster risk reduction as a core development strategy.

Sustainable Urban Development (SDG 11)

**Target 11.5 Disaster Preparedness**

By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations

- **Indicator 11.5.1** - Number of deaths, missing and persons affected by disaster per 100,000 people
- **Indicator 11.5.2** - Direct disaster economic loss in relation to global GDP, including disaster damage to critical infrastructure and disruption of basic services
  - Collaborative platform for disaster preparedness
  - Technical Committee on Urban and territorial development
  - IAEG-SDG
  - Sendai implementation
Conclusions

• Diverse information sources (e.g. geospatial, Earth observations, *Big Data*, citizen data, and statistics) can and should be integrated in support of national priorities and global goals;

• Powerful synergies emerge in such integration; benefits are particularly evident in cities and during disasters, and can be instrumental in building *resilient, smart and sustainable* environments;

• Inter-institutional coordination (constant, expert & high-level) is key to generate, integrate, analyze and adequately use information for policy-making;

• This conversation benefits greatly from inputs by civil society, the private sector, and academia, as well as participation in international forums.