LOW-COST GEOGRAPHIC INFORMATION SYSTEM FOR MUNICIPAL ROAD SIGNS MANAGEMENT IN DEPOPULATED AND LOW-DENSITY AREAS

Olga Gonçalves[1], Jorge Gonçalves [2,3], Jacek Chmielewski [4], Paulina Olenkowicz-Trempała[4]

[1] Belmonte Municipality, Portugal
[2] University of Beira Interior, Portugal
[3] CITTA, University of Porto, Portugal
[4] UTP University of Science and Technology in Bydgoszcz, Poland

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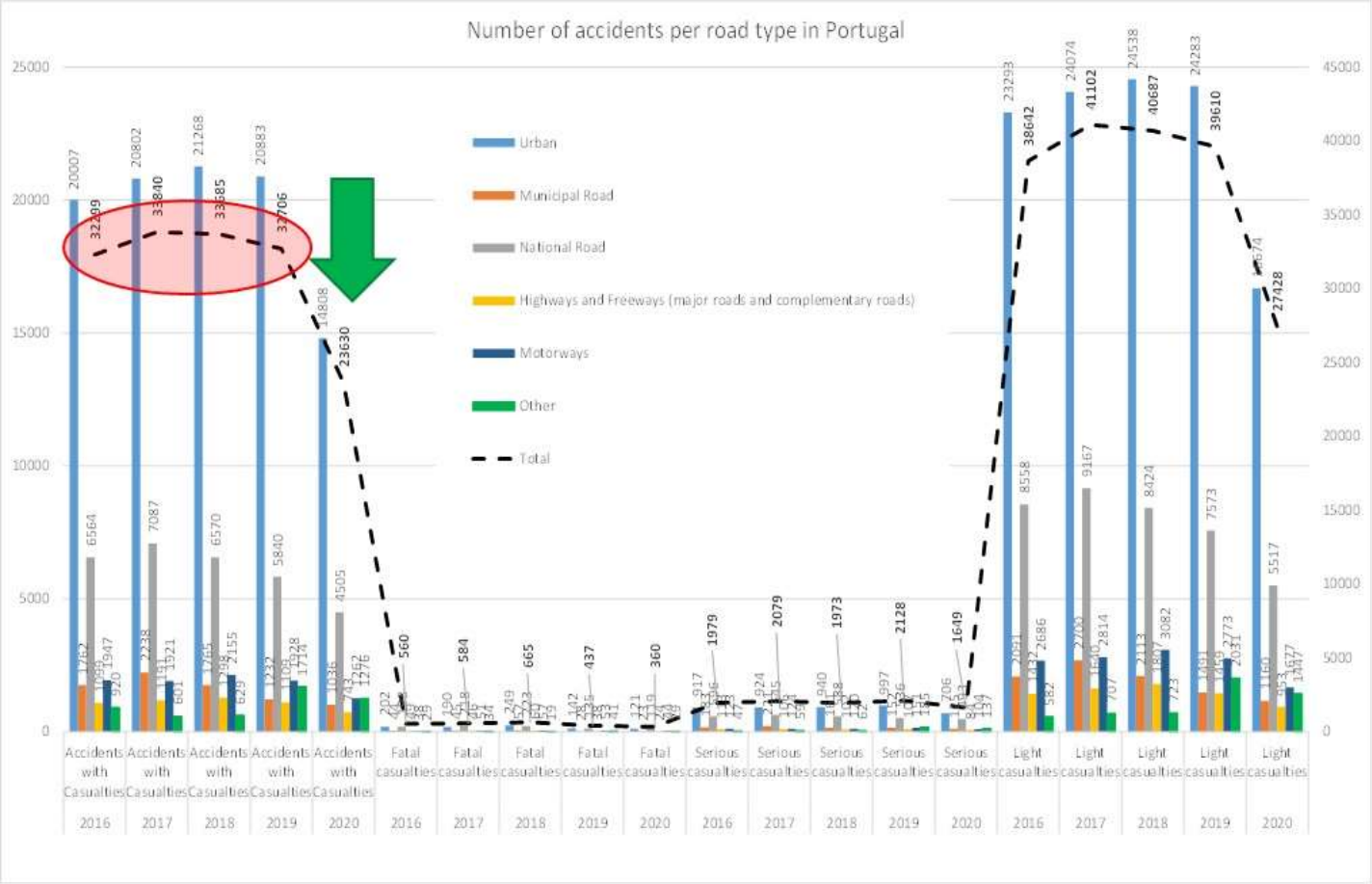
1. Introduction

- ✓ The current national and regional economical conjuncture in many countries, requires a sustainable management of different urban infrastructures, including road signs.
- ✓ A system to manage such an amount of information cannot be done by traditional means.
- ✓ Current commercial management systems, available in the market, generally have costs that small municipalities cannot afford.
- ✓ ***AIM OF THE STUDY***: Preliminary study for the definition of a low-cost methodology to quantify and qualify road signs in low density areas.

2. Traffic safety in Portugal



- ✓ Most of the accidents in Portugal (around 82%) occur in urban and national roads.
- ✓ Accidents in urban roads represent around 62% of all accidents, but only 33% of fatal and 45% of sever casualties
- ✓ Considering only urban areas, the percentage of fatal casualties in urban roads increases to 65% and sever casualties to 74%

3. Relevance of traffic signage in Portugal

- ✓ A survey conducted by AFESP in 2020 [2] about the relevance on traffic signage in Portugal, revealed that ***vertical signs were the most relevant issue in normal visibility conditions*** and ***road surface marks in conditioned visibility***.
- ✓ 20% of the sample considered that the signage visibility should be improved.
- ✓Heavy vehicle drivers considered ***road marks as less visible*** (58% are "Poorly visible" and 15% "Nothing visible") and ***52% consider vertical signs "Poorly visible"***.
- ✓For Municipal Roads (including urban roads), ***surface road marks and vertical signs*** were the types of signage that presented a ***worse state of conservation***.

4. Traffic regulations and design norms

✓ Traffic signs' design is internationally accepted and relatively uniformized, but their placement and local specificities need regulation. These regulations include general and nationwide rules, and local ones, attending to each municipality's idiosyncrasies.

Portuguese regulation	Portuguese normative documents to technically guide and assist technicians
Road Traffic Code (RTC) Traffic Signal Regulation (TSR) Road Surface Marks Standard (RSMS) Vertical Signalling Standard (VSS) Orientation Vertical Signalling Standard (OVSS) Tourist Signalling Standard (TSS) Temporary Signalling Manual (TSM)	Highway Traffic Signals (HTS) Roundabout Signalling (RS) Crossroads and Junctions Signalling (CJS) Orientation Signalling - Information System (OS) Technical Instruction on the use of Variable Message Signs (TIVMS) Vertical Signalling – Features, (VS) Principles of Traffic Signalling and Circulation Regimes (PTSCR) Vertical Signalling - Usage Criteria (VSUC) Vertical Signalling - Placement Criteria (VSPC) Road Surface Marks - Dimensional Characteristics, Criteria and Placement (RSM)

4. Traffic regulations and design norms

✓ Despite all these regulatory elements, there are still a lot of problems in the implementation of traffic signage and in its correct maintenance.

5. Road signage in urban areas

- ✓ Since 2018, in urban, municipal and regional roads, the supervising competent authorities for road signage placement are the city council and assembly.
- ✓For road signage to be legally effective, it must be translated into an administrative act of external effectiveness. Thus, it is mandatory for the municipality to "elaborate and submit drafts of external municipal regulations for approval by the municipal assembly" [10].
- ✓The placement of traffic signs in urban areas by any other institution or individual, is not allowed without the municipality's authorization. To avoid situations of unauthorized signage change, either with replacement or disposal, the ***municipality must be able to check all the signs implemented,*** preferably with data of its exact location and pictures of it.
- ✓Unfortunately, ***there is no law stipulating that municipalities must draft municipal traffic regulations neither how they should be done***.

5. Road signage in urban areas

- ✓ These issues, with a strong spatial component, highlight the *need to implement municipal road signs management systems*, that allow the location and identification of all the relevant elements of road traffic facilities and equipment, validated through deliberations of municipal assemblies.
- ✓ A preliminary online survey in 2021 with 207 Portuguese municipalities (67% of the 308 Portuguese municipalities) revealed that ***only 39% had an approved municipal traffic regulation***, ***only 36% had the locations of traffic signs*** and ***18% the location of road surface marks*****.**
- ✓ Having a good sign management system with up-to-date inventory data is an important part of the municipal transport asset management effort.

6. Suggested low-cost methodology for registration and management of traffic signs

- **Possibility of several signs in each set**
- **Georeferenced point feature**
- **ETRS89 system**

Traffic Sign sets charateristics and location

Sign Information

Location (GNSS), type and subtype of sign, material, shape, color, symbols or alphanumeric characters, photo, physical state, sign placement date, replacements, type of road, position, sign orientation

INPUT DATA

Type, material, free height (tape measured) up to the first sign, projected distance to the roadside, conservation status, obstacles to visualization, perpendicularity, verticality, fixation to support, signs combination, number of signals, double signage

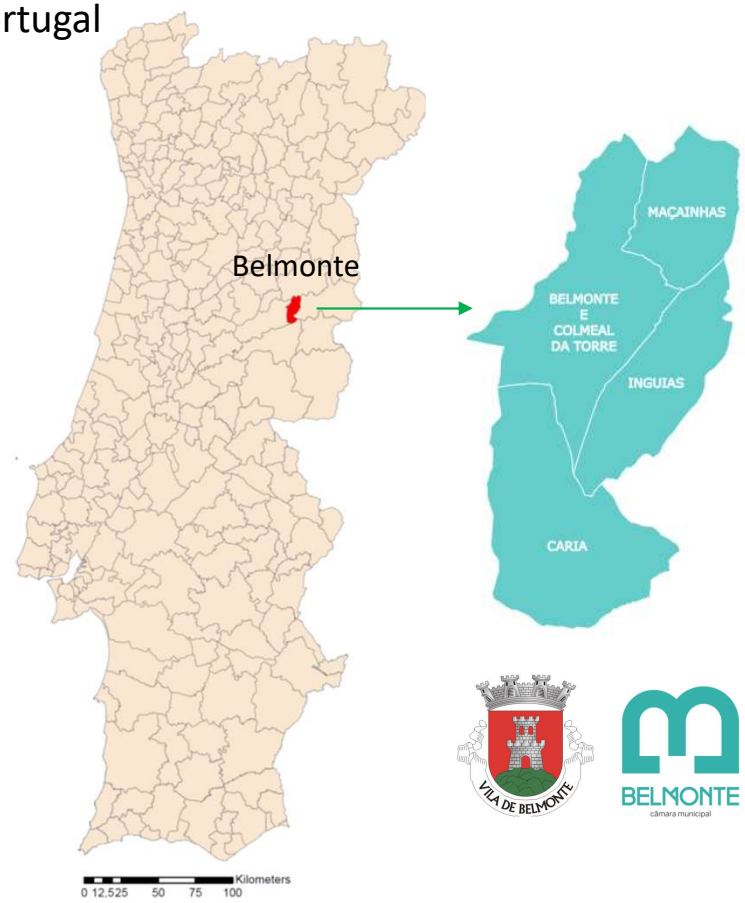
Support Information

Open-source Geographic Information System (QGIS)

- **Verify and validate all collected data**

7. Case study

Portugal



Municipality of Belmonte

- ✓ Central region of Portugal
- ✓ District of Castelo Branco
- ✓ Total area ≈ 119 km²
- ✓ Road network ≈ 383 km
- ✓ Population ≈ 6860 resident (2011)
- ✓ Population density ≈ 57.8 inhab/km²
- ✓ 4 civil parishes
- ✓ Urban area ≈ 1km²

7. Case study

- ✓ The data collection about signs set information took place on December 16, 2018, using a Trimble GNSS receiver equipment, model Geo 7x.
- ✓The survey team had 2 persons that collected the on-site information in 8h (344 sets) and processed it at office throughout 30h (4 days).
- ✓To obtain a quick features' location the coordinates were obtained in around 5 minutes with an average accuracy of 1m (considered enough for the survey purpose).
- ✓The cartographic base used was aerial orthophotos (raster data) at a 1:2000 scale, owned by the Municipality of Belmonte.

7. Case study

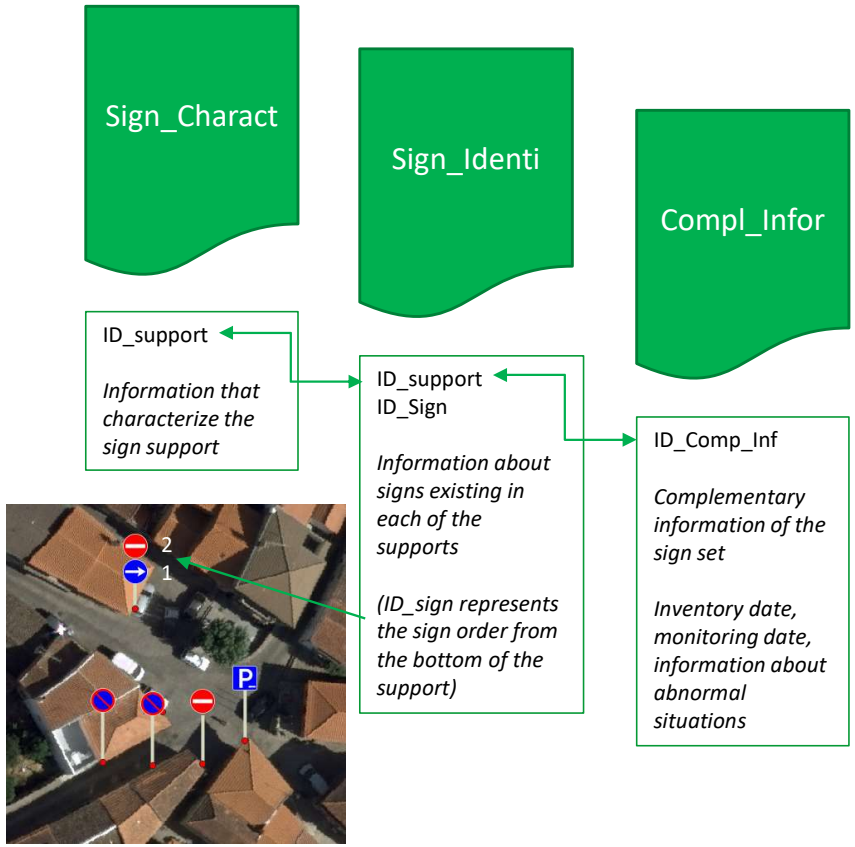
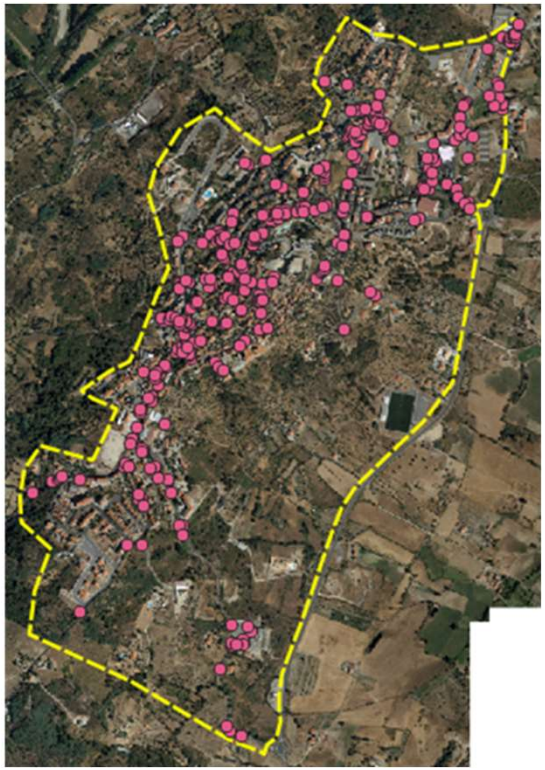


Table 2. Attributes of the alphanumeric "Sign_Identi" table.

Field Name	Description	Widget
ID_support	Support unique identifier code	Sequential number
ID_sign	Sign unique identifier code	Sequential number
Signalling_group	Identifies the signage group to which the signal belongs	An auxiliary alphanumeric table named "Sign_group" was created with a value relation widget (for example: A - Danger signs; B - Give way signs; C - Prohibition signs)
Sign_designation	Identifies the sign name	An axillary alphanumeric table was created named "Sign_Designa" with a value relation widget (example: A1a - Right Curve; A1b - Left Curve; ...; B1 - Give way; ...; C1 - Prohibited way; ...)
Photo	Sign image in SGV format	attachment
Sign_dimension	Identifies the sign's size: if it is less than 50cm, between 70 and 90cm, or not applicable	- <50 - 70 - 90 - na
Conservation_state	Describes the sign state of conservation (qualitative)	- Good - Reasonable - Bad - rusty - Bad - damaged
Double_sided	Identifies cases where the sign set is double-sided with the same sign, different signs or not applicable	- Yes, with the same sign - Yes, with different signs - na

8. Results

344 georeferenced sign sets surveyed



480 vertical signs surveyed

Table 1. Number and sign sets and equipment collected.

Sign set type and traffic equipment	Quantities
Danger signs	9
Give-way signs	57
Prohibition signs	94
Combination of signals	6
Mandatory sign	35
Mirrors	12
Zone signs	5
Information signs	121
Pre-signalling sign	1
Directional signs	86
Additional panels	32
Complementary signs	14
Traffic lights	5
Tourist signs	3
Total	480

8. Results

Height	Signs found	Obs.
<2.2m	267 (55%)	Needs rectification
>=2.2m	213 (45%)	-

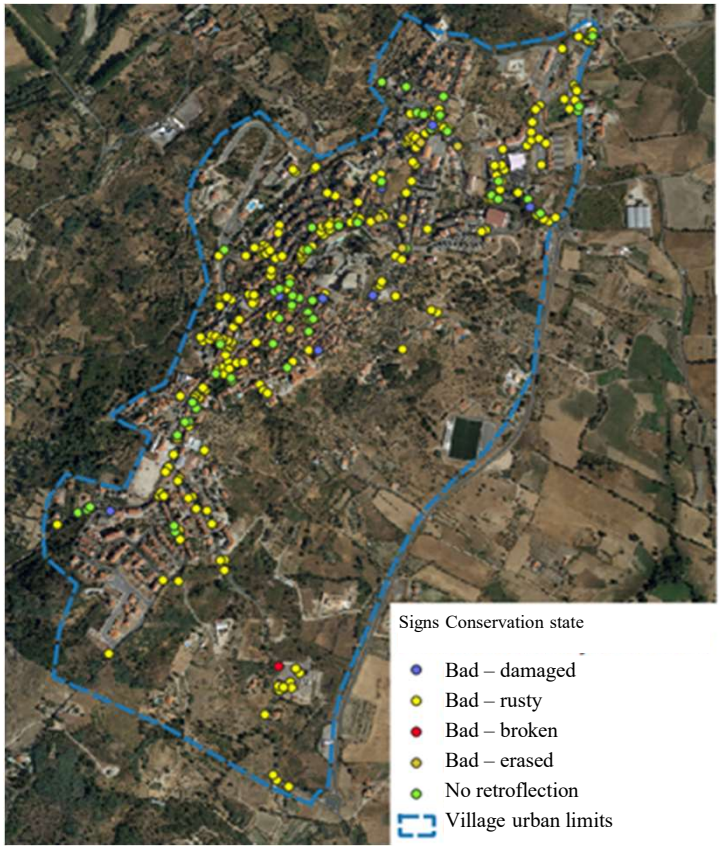
Dimension	Signs found	Obs.
90cm	0	-
70cm	293 (61%)	-
<=50cm	49 (10%)	Only with low speed
not applicable	138 (28%)	

Traffic Lights	Signs found	Obs.
Tricolor	2	-
Yellow blinking	3	-

Table 3. Number of signs identified per support.

Number of signs per support	Supports	
	N	%
1	270	78%
2	59	17%
3	5	1%
4	1	0%
5	3	1%
6	2	1%
8	4	1%
Total	344	100%

8. Results



Conservation (emprirical)	Signs found	Obs.
Bad	92 (19%)	-
Reasonable	341 (71%)	-
Good	47 (10%)	

9. Final comments

- ✓ Municipalities are responsible for the management of their urban territories.
- ✓GIS represent a powerful tool to support decision making by local authorities. They guarantee conditions for quality management, representing the existing situation and with the ability to help model future scenarios.
- ✓With the suggested low-cost methodology using the GIS, it was possible to evaluate the existing vertical traffic signs, namely specifying their numbers and location, as well as an empirical estimate of their conservation state.
- ✓The system also allows the signage monitoring and an easy updating of the database information, with few employees and in a short period of time.
- ✓The system is easy to implement and cost-effective and suitable for smaller municipalities.

THANK YOU FOR YOUR ATTENTION!

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This article/material has been supported by the Polish National Agency for Academic Exchange under Grant No. PPI/APM/2019/1/00003

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The project is financed by the Polish National Agency for Academic Exchange