TRB First International Roadside Safety Conference

*Safer Roads, Saving Lives, Saving Money*

June 12-15, 2017 - San Francisco, California

AFB20(2) Subcommittee on International Research Activities

“MAKING ROADSIDES SAFER FOR VULNERABLE ROAD USERS”

University of São Paulo
Polytechnic School
Department of Transportation Engineering
Road Safety Research Group
São Paulo - Brazil
Universidade de São Paulo - USP:

• One of the most prestigious higher education and research institutions in Brazil;
• Figures amongst the best universities in the world.
• Several campi distributed over 7 cities (Bauru, Lorena, Piracicaba, Pirassununga, Ribeirão Preto, São Carlos and São Paulo) within the state of São Paulo, Brazil;
• The schools of USP cover most of the disciplines and provide the students with a study and research fertile environment.

http://www5.usp.br/english/?lang=en
• Created in 1934, the University of São Paulo is one of the most important institutions of higher learning in Brazil.
• Its undergraduate program consists of 300 courses, dedicated to all fields of knowledge, distributed in 42 units of learning and research and offered to more than 90 thousand students.
• The graduate program is composed of 222 programs (with 353 Masters degree courses and 323 Ph.D courses).
Undergraduate:

- The University of São Paulo offers undergraduate courses in all areas of knowledge.
- All are free of charge and last from four to six years.
- Admission is made through exams, organized annually by Fuvest (Foundation for University Entrance Exams).
Graduate:

- USP has graduate programs in all fields of knowledge.

- These are “Stricto Sensu” courses offering Master’s and Ph.D degrees and their objective is to form highly qualified human resources for teaching, research and scientific and technological development.

- The graduate programs may be offered by a single teaching unit, in the fields of biological, exact or human sciences and/or by various units (called inter-unit courses) or even various different institutions of higher education (called inter-institutional courses).

- All are free of charge.

- The largest research hub of the country
# UNIVERSITY OF SÃO PAULO

**USP in Numbers 2015**

*Database 2014*

## General Data

- Founded in 1934.
- Advanced center for teaching, research and community extension services.
- Camps: São Paulo (4), Bauru, Piracicaba, Pirassununga, Lorena, Ribeirão Preto and São Carlos (2).

<table>
<thead>
<tr>
<th>Territory</th>
<th>Area in m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Territorial area</td>
<td>76,437,742m²</td>
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<tr>
<td>Built area</td>
<td>2,937,512m²</td>
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## Units

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>Teaching and research</td>
<td>87</td>
</tr>
<tr>
<td>Central organ of direction and services</td>
<td>42</td>
</tr>
<tr>
<td>Specialized institutes</td>
<td>31</td>
</tr>
<tr>
<td>Hospitals and appended services</td>
<td>6</td>
</tr>
<tr>
<td>Museums</td>
<td>4</td>
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## Enrolled Students

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<tr>
<th>Type</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>Undergraduate (1st semester)</td>
<td>59,081</td>
</tr>
<tr>
<td>Graduate</td>
<td>30,039</td>
</tr>
<tr>
<td>Master</td>
<td>14,130</td>
</tr>
<tr>
<td>Ph.D</td>
<td>15,000</td>
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<tr>
<td>Special</td>
<td>5,755</td>
</tr>
<tr>
<td>Men (51.71%)</td>
<td>49,056</td>
</tr>
<tr>
<td>Women (48.29%)</td>
<td>45,819</td>
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## Graduates and Titles Granted

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>Graduates of undergraduate program</td>
<td>8,007</td>
</tr>
<tr>
<td>Titles granted to graduate students</td>
<td>6,329</td>
</tr>
<tr>
<td>Master</td>
<td>3,022</td>
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<tr>
<td>Ph.D</td>
<td>2,704</td>
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## Undergraduate

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<thead>
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<th>Type</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>Courses offered</td>
<td>300</td>
</tr>
<tr>
<td>Signed up for Entrance Exam</td>
<td>172,005</td>
</tr>
<tr>
<td>Slots offered in classroom courses</td>
<td>11,057</td>
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<tr>
<td>Slots offered in blended learning courses</td>
<td>380</td>
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## Graduate

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<th>Type</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>Programs offered</td>
<td>222</td>
</tr>
<tr>
<td>Areas of concentration</td>
<td>876</td>
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<td>Master’s Areas</td>
<td>353</td>
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<tr>
<td>Ph.D Areas</td>
<td>323</td>
</tr>
<tr>
<td>CAPES evaluation - Grade 7</td>
<td>44</td>
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<tr>
<td>CAPES evaluation - Grade 6</td>
<td>44</td>
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<tr>
<td>CAPES evaluation - Grade 5</td>
<td>62</td>
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<tr>
<td>CAPES evaluation - Grade 4</td>
<td>57</td>
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<tr>
<td>CAPES evaluation - Grade 3</td>
<td>15</td>
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### UNIVERSITY OF SÃO PAULO
#### USP in Numbers 2015

- Professors: 6,090
  - Men (62.04%): 3,778
  - Women (37.96%): 2,312
- Full time dedication (87.49%): 5,328
  - PhD title or higher (99.30%): 6,001

#### Technicians/Administrative: 17,199
- Men (51.17%): 8,800
  - Women (48.83%): 8,300
- Level: Superior (23.97%): 4,123
- Level: Technical (46.52%): 8,001
- Level: Basic (29.38%): 5,053
  - Level: Out career (0.13%): 23

#### Scientific Production: 21,248
- In Brazil: 12,217
  - Abroad: 9,031
- Published and Indexed Works at ISI: 17,262

#### Awards and other distinctions received by Professors: 810
  - In Brazil and abroad

#### Libraries: 46
- Electronic Collection: 12,652,751
- Physical Collection: 7,012,313
- Circulation of Collection: 2,843,524
- Frequency of Library Users: 2,739,479

#### Informatics:
- Microcomputers: 56,600
- Printers: 13,292

#### Other publications:
- USP Publishing House (published works): 54
  - USP Newspaper (copies): 495,000
  - “Espaço Aberto” - Open Space (electronic editions): 6
    - USP Magazine (copies): 3,100

#### Cultural and Extension Activities:
- Extracurricular courses: 964
  - Participants: 26,942
  - Museums (visitors): 670,685
  - Paulista Museum (Ipiranga Museum) with the Republican Museum “Convenção de Itú” (MRCI): 217,801
  - Museum of Contemporary Art (MAC): 287,018
  - Museum of Archeology and Ethnology (MAE): 112,983
  - Zoology Museum (MZ): 58,833
  - Science Station (public): 1,325,030
## UNIVERSITY OF SÃO PAULO
### USP in Numbers 2015
#### Database 2014

### Cultural and Extension Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number</th>
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<tbody>
<tr>
<td>&quot;Maria Antonia&quot; University Center - CEUMA (public)</td>
<td>560724</td>
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<tr>
<td>USP Movies - CINUSP (public)</td>
<td>12152</td>
</tr>
<tr>
<td>USP Orchestra - OSUSP (public)</td>
<td>81872</td>
</tr>
<tr>
<td>Center of Scientific and Cultural Diffusion - CDCC (visitors)</td>
<td>69862</td>
</tr>
<tr>
<td>The University and Professions (participants)</td>
<td>120474</td>
</tr>
<tr>
<td>University for Seniors (students)</td>
<td>5959</td>
</tr>
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### Services - Treatments

<table>
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<tr>
<th>Service</th>
<th>Number</th>
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<tbody>
<tr>
<td>Students of the Experimental School of the College of Education</td>
<td>800</td>
</tr>
<tr>
<td>Drama School Students</td>
<td>304</td>
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<tr>
<td>Lorena Technical School Students</td>
<td>334</td>
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<tr>
<td>Hospitalization beds - HU</td>
<td>211</td>
</tr>
<tr>
<td>Hospitalizations - HU</td>
<td>10615</td>
</tr>
<tr>
<td>Emergency Treatments - HU</td>
<td>240792</td>
</tr>
<tr>
<td>Day-Care Treatments - HU</td>
<td>110720</td>
</tr>
<tr>
<td>Hospitalization beds - HRAC</td>
<td>91</td>
</tr>
<tr>
<td>Hospitalizations - HRAC</td>
<td>4039</td>
</tr>
<tr>
<td>Dental treatments - HRAC</td>
<td>1074</td>
</tr>
<tr>
<td>Medical treatments - HRAC</td>
<td>4655</td>
</tr>
<tr>
<td>Complementary treatments - HRAC</td>
<td>108569</td>
</tr>
<tr>
<td>Veterinary Hospital - HOVET (São Paulo and Pirassununga)</td>
<td>83900</td>
</tr>
</tbody>
</table>
The Polytechnic School of the University of São Paulo (Poli/USP) celebrates its 120th anniversary in 2013. Founded in 1893, the then denominated Escola Politécnica de São Paulo was integrated to USP in 1934. Turned into a national reference, it is considered the most complete engineering school in Latin America and dedicates its best efforts towards consolidating as a world class High Education Institution.

http://www.poli.usp.br/pt/international.html
Escola Politécnica is an Engineering School that has 15 teaching and research departments and encompasses 17 different courses divided into the following areas of concentration or emphases:

- Environmental
- Civil
- Materials
- Mining
- Petroleum
- Industrial
- Mechanical
- Mechatronics
- Metallurgy
- Naval Architecture and Ocean
- Chemistry
- Electrical emphases:
  - Computing
  - Automation and Control
  - Energy and Automation
  - Electronic Systems
  - Telecommunications
  - Computing Engineering – Cooperative Systems
The Civil Engineering course for undergraduate students is taught by four departments:

- Department of Construction Engineering – PCC - [http://www.pcc.usp.br/home](http://www.pcc.usp.br/home)


- Department of Structures and Geotechnics – PEF - [http://www.pef.usp.br/](http://www.pef.usp.br/)

- Department of Transportation Engineering – PTR - [http://www.ptr.poli.usp.br/](http://www.ptr.poli.usp.br/)
In recent years, considering international experience in teaching and research, the PTR has been structured around three sub-areas for both research and teaching purposes:

- Transport Infrastructure
- Transportation Planning and Operation
- Spatial Information

The PTR offers “Stricto Sensu” postgraduate courses at master's and doctoral level.
Research on Road Safety

The studies on road safety conducted by PTR – Poli/USP started in 2009, with the international project “SAFER BRAIN”

“SAFER BRAIN” - Innovative Guidelines and Tools for Vulnerable Road Users' Safety in India and Brazil

- Cooperation between European Commission, Brazil and India
- Funding: European (7th RTD Framework Programme)
- Duration: October/2009 – March/2012

http://cordis.europa.eu/project/rcn/92887_en.html
http://www.transport-research.info/sites/default/files/project/documents/20120405_180841_60755_SaferBrain_D5.2.pdf
The rapidly growing economies of Brazil and India are resulting in built environments where safety needs, especially for vulnerable road users, are not always considered.

The question thus was how to increase the safety of vulnerable road users, i.e. cyclists and pedestrians.

The SAFERBRAIN project focused on increasing the safety of the whole road transport system using knowledge gained through European Union road safety projects, including: SafetyNet, RISER and TRACE.

The theory and principles of infrastructure design and road safety management were used to create best practices that could be easily implemented.
MAKING ROADSIDES SAFER FOR VULNERABLE ROAD USERS

PTR – Poli/USP
Road Safety Research Group

Research subject of the team:

• Spatial approach and statistical analysis considering spatial and temporal aspects of:
  • Road accidents (in general)
  • Road accidents involving dangerous goods
  • Vulnerable road users – this presentation
According to the World Health Organization (WHO, 2013) vulnerable users of the transportation system are pedestrians, cyclists and motorcyclists.

More than half of all traffic accidents occur with vulnerable users.

In Brazil, in 2010, 4% of deaths due to traffic accidents were cyclists, 23% of pedestrians and 25% of motorcyclists.
Non-motorized transportation modes, especially cycling and walking, offer numerous benefits, including improvements in the liveability of cities, healthy physical activity, efficient urban transportation systems, less traffic congestion, less noise pollution, clean air, less impact on climate change and decreases in the incidence of diseases related to vehicular emissions (Machado et al. 2015).

Geospatial technologies provide a powerful analytical method for studying vulnerable road users - VRU safety frameworks using spatial analysis.
“MAKING ROADSIDES SAFER FOR VULNERABLE ROAD USERS”

This presentation is dedicated to VRUs as:

1. Integrate accident data occurred on urban environment relating pedestrians and cyclists with:
   - The near environment (engineering scale)
   - The "neighbouring" environment (land use)
“MAKING ROADSIDES SAFER FOR VULNERABLE ROAD USERS”

This presentation is dedicated to VRUs as:

2. Compare Brazilian experiences with international ones: prevention, data collection, use of information by the public authority

3. Evaluate Unite Nations 2020 targets

4. Main challenge: collecting (and maintaining) data
Characterization of the sites of traffic accidents involving vulnerable road users (VRU) in São Paulo City

Claudia A. Soares Machado, Mariana A. Giannotti, Eduardo Jun Shinohara, Henrique Nishisaki, José Alberto Quintanilha

Abstract

In this paper is discussed the spatial characteristics of the sites with the highest density in terms of number of accidents involving vulnerable road users (VRU - pedestrians, cyclists and motorcycle riders), and their relationship with socioeconomic aspects and the attributes of the transportation system. The database consists of the description of the road traffic accidents involving VRU during the time span 2001 - 2009 in São Paulo City, Brazil. Also, data from an Origin/Destination Home-interview Survey held in 2007 is used in order to analyse the transportation system, mainly in the areas where the amount of accidents is high. It is performed a density analysis (Kernel estimator) by using traffic accidents data, identifying the areas (traffic zones in São Paulo) where the number of traffic accidents involving VRU is higher, and to establish a relationship between VRU traffic accidents and the characteristics of the transportation system. Besides, the socioeconomic aspects of the traffic zones are taken into account in order to characterize the sites with the highest occurrences of accidents.

Keywords: Traffic accidents; vulnerable road users; spatial analysis.
Spatial analysis are used to:

Determine the locations of regions that are characterized by a concentration of traffic accidents (black zones) involving VRU (injuries and casualties) in São Paulo, Brazil (developing country), and Rome, Italy (developed country).

The black zones are investigated to obtain spatial patterns that can cause multiple accidents. A method based on Kernel density estimation (KDE) is used to compare the two cities and show economic, social, cultural, demographic and geographic differences and/or similarities and how these factors are linked to the locations of VRU traffic accidents (Machado et al., 2015).

Discuss the spatial characteristics of the sites with the highest density in terms of number of accidents involving vulnerable road users (VRU - pedestrians, cyclists and motorcycle riders), and their relationship with socioeconomic aspects and the attributes of the transportation (Machado et al., 2014).
“MAKING ROADSIDES SAFER FOR VULNERABLE ROAD USERS”

Comparison between Brazilian experience and European (Italy) experience

– SaferBraIn Project– EPUSP / CET-SP (São Paulo Municipal Transit Engineering Company|) / European Community

– University of Rome ("La Sapienza") coordination – Prof. Luca Persia and Prof. Antonino Tripodi
Spatial distribution of VRU traffic accidents in São Paulo – Brazil in 2009
“MAKING ROADSIDES SAFER FOR VULNERABLE ROAD USERS”

- GIS Analysis - Spatial density of VRU traffic accidents
- Kernel Density Estimator
- Black Spot Zones
Characterization of the sites of traffic accidents involving vulnerable road users (VRU) in São Paulo City, Brazil and Rome, Italy

Kernel Density Estimator Analysis

"MAKING ROADSIDES SAFER FOR VULNERABLE ROAD USERS"
“MAKING ROADSIDES SAFER FOR VULNERABLE ROAD USERS”

• Rome
  – Road traffic injuries in Rome are the principal cause of death among young people (14–30 years of age).
  – Managing traffic speed remains crucial for creating a safe road system and for achieving the European Union (EU)-imposed target of reducing road fatalities by 50% in 2011–2020.

• São Paulo
  – Traffic accidents are the main cause of injury and fatalities among children (above one years old).
  – The number of traffic accidents is related to fast and uncontrolled urban growth in São Paulo.
  – The proportion of fatal crashes involving VRU partly results from cultural and sociodemographic factors.
  – Many fatal traffic accidents or accidents with severe injuries are caused by poor traffic safety conditions, which are often accentuated by physical, political, technical and enforcement environments.
“MAKING ROADSIDES SAFER FOR VULNERABLE ROAD USERS”

• Findings:
  – Speed enforcement systems should be adopted to reduce urban road accidents, and the geometric characteristics of the road network should be re-evaluated and modified.
  
  – One method for reaching these goals is to introduce cost-effective practices, such as traffic calming strategies that benefit the mobility of VRU by reducing the speed of motorized traffic, re-designing transport infrastructure and introducing cycling and walking facilities.
  
  – Traffic calming refers to a combination of physical changes in road design and speed management that is aimed at improving road safety conditions, especially for users of non-motorized modes (VRU).
  
  – Traffic calming measures influence road safety by reducing vehicle speed and/or the volumes of traffic on urban road systems, reducing and/or eliminating conflicting movements, improving visibility, reducing exposure and sharpening drivers’ alertness.
  
  – Traffic calming measures include chicanes, central islands, traffic control devices (e.g., variable message signs or speed cameras), surface treatments (e.g., speed humps or transverse rumble strips) and roadside features (e.g., gateways or landscaping).
“MAKING ROADSIDES SAFER FOR VULNERABLE ROAD USERS”

• Findings:
  – The high socio-economic costs of traffic accidents clearly indicate the need for governments and policymakers to strengthen traffic accident preventive measures.
  
  – One of the most important intervention methods is educational action, which should be directed at the entire population and especially at adolescents and young adults, which are at higher risk for involvement in traffic accidents.
  
  – The behaviors of users (drivers and passengers of motorized and non-motorized vehicles and pedestrians) can interfere with the number and severity of traffic accidents, particularly speeding, poor driving skills and education, lack of familiarity with non-motorized transportation modes, lacking the use of safety equipment (seat belt, motorcycle helmet, etc.) and alcohol consumption.
3. Evaluate United Nations 2020 targets

The road safety targets have been included in the final text of the new Sustainable Development Goals adopted by UN member states in New York.

A specific stand-alone target in the Health Goal to reduce road traffic fatalities by 50% by 2020 and a target on sustainable urban transport in the Cities Goal has been approved, in a landmark achievement for the global road safety community.

“MAKING ROADSIDES SAFER FOR VULNERABLE ROAD USERS”
3. Evaluate United Nations 2020 targets

The final wording of the targets, which will be formally adopted, is:

“Goal 3: Ensure healthy lives and promote well-being for all at all ages: 3.6. By 2020, halve the number of global deaths and injuries from road traffic accidents.

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable. 11.2. By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.”
3. Evaluate United Nations 2020 targets

- Our research group is applying to contribute to the implementation guide for academia, scientific and research entities and networks.

- Small Scale Disasters: a proposal name used during the United Nations International Conference on Space-based Technologies for Disaster Management - “A consolidating role in the implementation of the Sendai Framework for Disaster Risk Reduction: 2015-2030”, in Beijing, China, on September 2015, considered as a technological disaster.
4. Main challenge: collecting (and maintaining) data

- Data collect normalization: in Brazil, usually, we don’t have traffic volume data and georeferences are not correctly collected (is used some like “accident occur at 550Km + 20 meters” but not the real coordinates), for example.
- “Clean” original data, obtained on state/local data.
- Improve the uses of spatial analysis and remotely sensed data (satellites and drones images, GPS, smartphones and the integration to existing navigation and traffic monitoring.
- Define a suitable threshold to consider a point as dangerous.
- Integrate the accident data using spatial data infrastructure, cloud computing, ...
# PTR – Poli/USP
## Road Safety Research Group

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>José Alberto Quintanilha</td>
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