THE USE OF VALUATION DATA BASES AND ANALYSES AND GIS-TOOLS FOR THE ASSESSMENT OF URBAN INFRASTRUCTURE IMPACT ALONG LINE 4 OF THE SÃO PAULO SUBWAY COMPANY.

UPAV

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METRÔ

CTAGEO engenharia & geoprocessamento

PROJECT GOALS

IMPLEMENTATION OF A REAL ESTATE INFORMATION BANK (SPONSORED BY THE WORLD BANK) TO FOLLOW UP CHANGES AT:

- LAND USE AND OCCUPATIOM;
- REAL ESTATE MARKET;
- HOUSING PRODUCTION;
- INSTALLING OF NEW ECONOMIC ACTIVITIES.

AS AN EFFECT OF LINE 4 – YELLOW – OF THE SÃO PAULO CITY SUBWAY COMPANY, ALLOWING ITS ANALYSIS .

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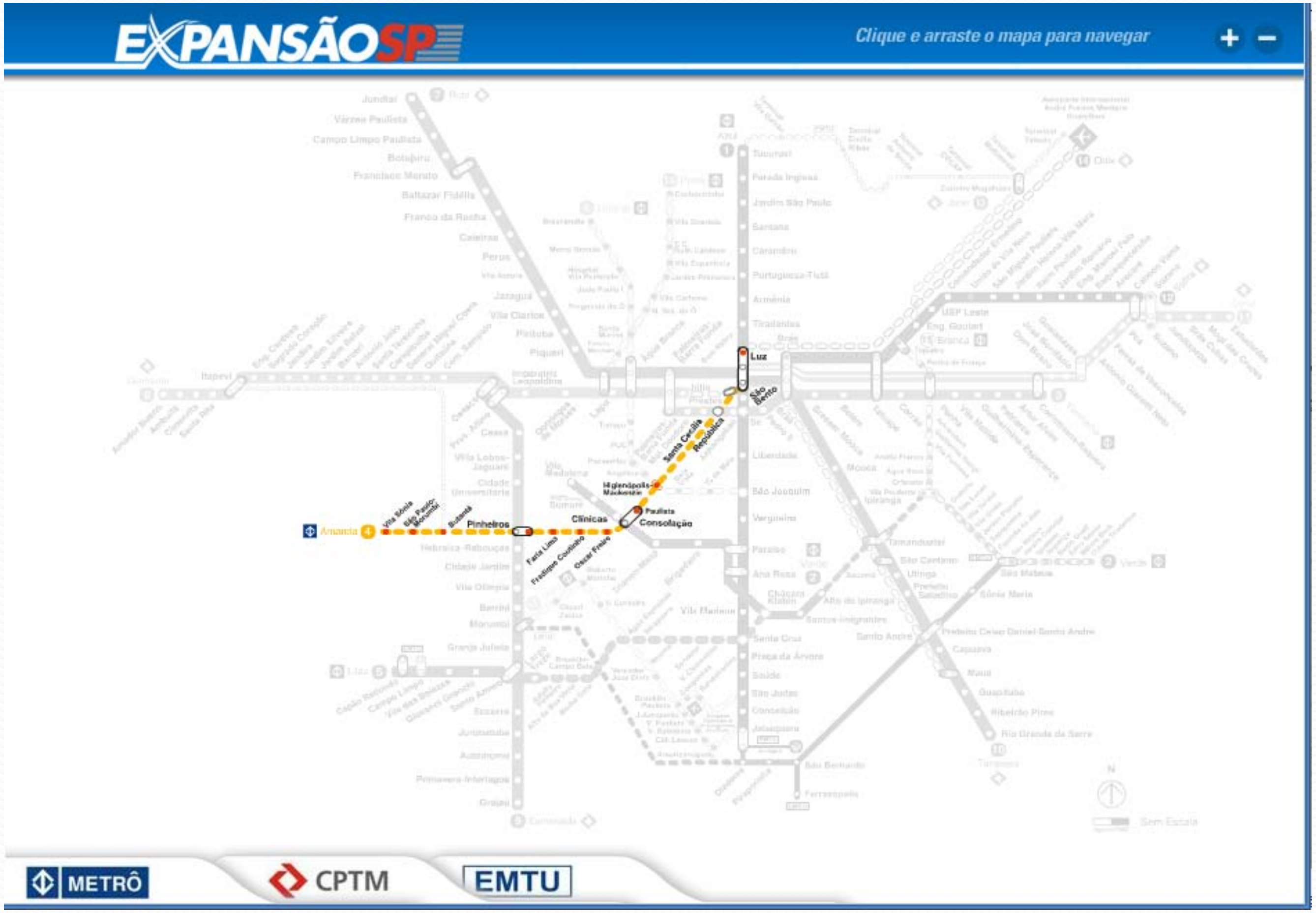
THE LINE 4 - YELLOW

- It links Luz (inner city) to Vila Sônia (south-west);
- 13,5 km, 11 stations;

- Connexion between derelict and very rich and active neighborhoods (“south-west vector”);

- Crosses two existent and one proposed Operações Urbanas (urban intervention projects).

Projected São Paulo Metropolitan network expansion.



PROJECT DEVELOPMENT

- Implementation of the Geographic Information System;
- Real estate values and occupancy surveys;
- Urban dynamics and real estate market (along Line 4) impact analyses;
- Real estate market prospective study.
- Software used was MapInfo 9.

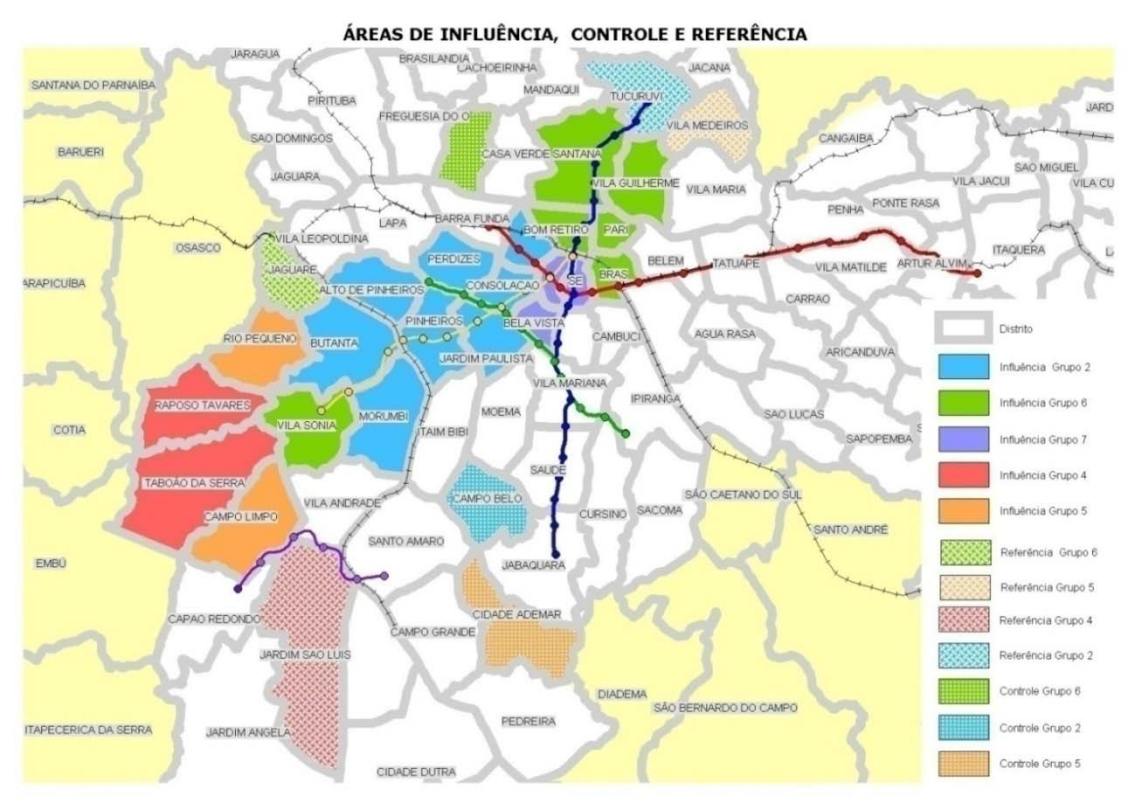
GEOGRAPHIC SEGMENTATION CRITERIA

- Over an Origin-Destiny planning transportation map, influence area was defined and subdivided into direct and indirect influence areas, as follows:
  - **Direct influence area** corresponds to the blocks contained in 600 m radius circles around the stations and up to 300 m of distance from the subway system axis;
  - **Indirect influence area** corresponds to the blocks contained in O/D Zones where would prevail travels using Line 4, isolated or together with other transportation ways and are located up to 10 minutes of automobile travel from its stations;
  - **Reference area** embeds influence area, and is composed by O/D Zones chosen by its similarity and proximity (up to 15 minutes of automobile travel) to the influence area; these zones are expected to suffer a mitigated impact of the new subway line;
  - **Control area** is also composed by O/D Zones selected by its similarity to the influence area, though also distant of future infrastructure transportation interventions.

Reference and control areas

- Selected by cluster analysis, using a number of urban and socio-economic indicators, such as:
  - Population number;
  - Number of job positions and employment profile;
  - Population age profile;
  - Accessibility level;
  - Land occupation patterns;
  - Median household income.
  - Defined through transportation time measures.

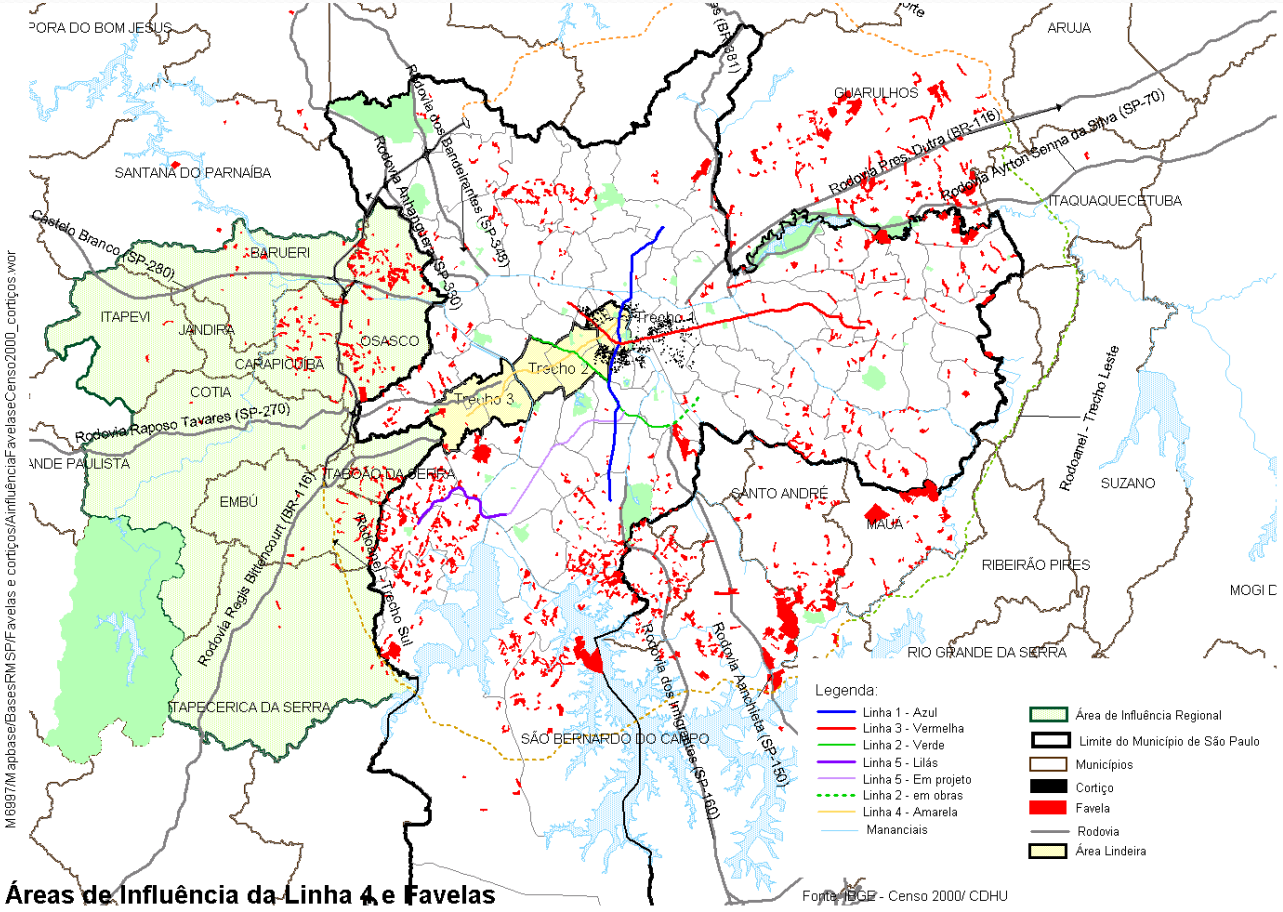
Reference and control areas



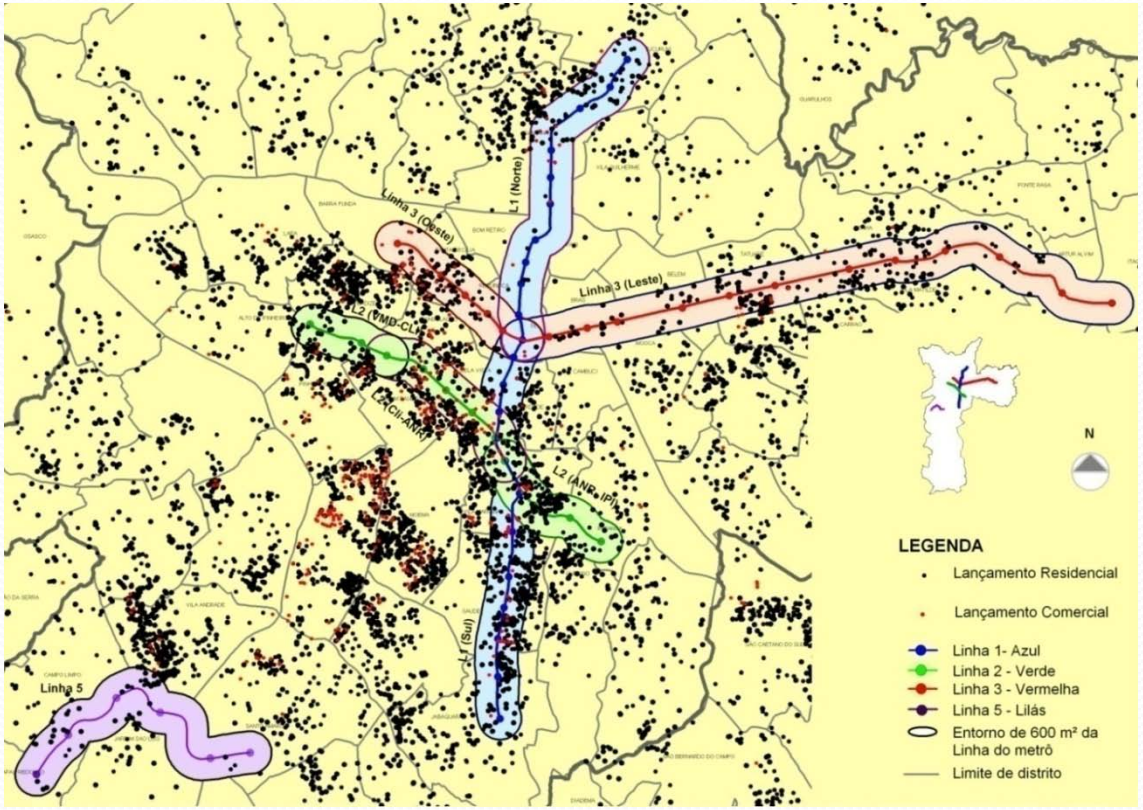
GIS implementation and secondary data collection

- The system implementation comprised the following steps:
  - Reorganization of data libraries already available at the Transportation Planning Department of Metrô-SP; this activity included compiling expropriation data surveyed in 1998 and 2000;
  - Inclusion of new data bases acquired, such as EMBRAESP's (on new housing start-ups), TPCL (Municipal building cadastre, following tax assessment criteria), ITBI (Municipal real estate sales' tax record), SEHAB (Municipal new building licensing records), RAIS (Federal government data on employment), O/D Zoning (updated in 2007 internally by Metrô-SP), etc.; besides these planning information, contractors' existing data on sales and rentals of properties for the 2002 basis-year(c.2,000 information) were also uploaded;
  - Acquisition and installation of GIS software;
  - Design and implementation of GIS maintenance routines;
  - Training of technical staff of Metrô-SP.

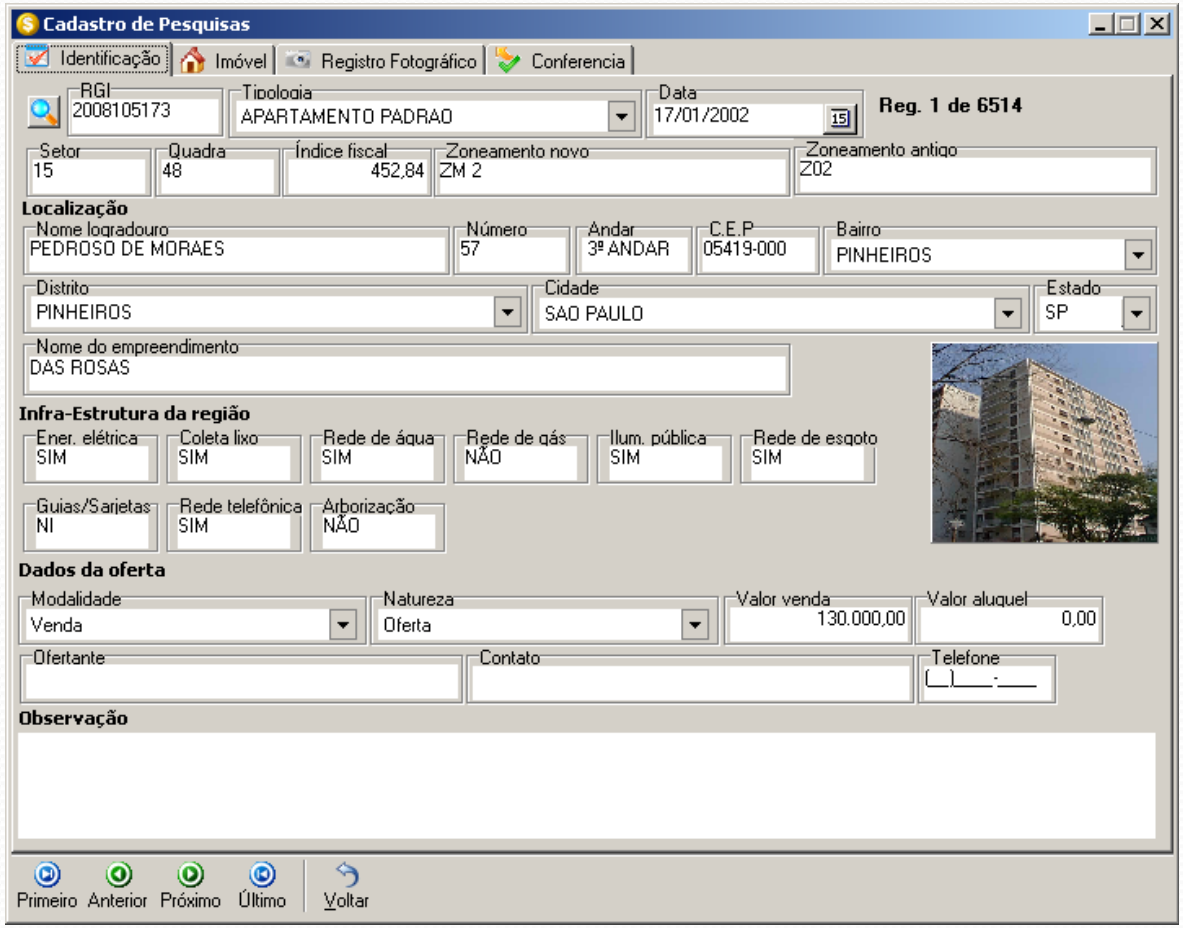
Sample of GIS output – Influence area and slums' localization



Sample of GIS output – subway network, direct influence area and new housing start-ups.



PRIMARY DATA COLLECTION – PROPERTIES' VALUES



$$Vacancy\ Rate = \frac{\#\ of\ vacant\ properties}{Total\ of\ properties}$$

PRIMARY DATA COLLECTION – OCCUPANCY ASSESSMENT

- Future absorption measure;
- Basic indicator is the vacancy rate, defined (for every property class) as:

$$Vacancy\ Rate = \frac{\#\ of\ vacant\ properties}{Total\ of\ properties}$$

- Sample of 285 blocks, distributed among the influence (subdivided in 3 stretches), reference and control areas.

Surveyed properties' profile (occupancy assessment).

	Study Area					
Usage	Influence, Stretch 1	Influence, Stretch 2	Influence, Stretch 3	Reference	Control	Total
Housing, horizontal	737	832	2,464	4,370	2,716	11,119
Housing, vertical	7,177	7,922	2,631	214	3,519	21,463
Parking	88	39	6	12	18	163
Business, horizontal	1,575	968	368	420	384	3,715
Business, vertical	7,699	2,323	218	45	288	10,573
Mixed, horizontal	214	153	143	291	538	1,339
Mixed, vertical	2,395	376	66	29	124	2,990
Vacant lots/ruined/others	25	17	105	22	32	201
Total	19,910	12,630	6,001	5,403	7,619	51,563

DATA TREATMENT THROUGH DESCRIPTIVE STATISTICS

Occupation assessment

- *Vacancy rates (adjusted mean) in study area – notably low figures:*

Usage	Global	Influence, Stretch 1	Influence, Stretch 2	Influence, Stretch 3	Control	Reference
Housing, horizontal	4.70%	10.60%	6.40%	6.20%	3.60%	3.20%
Housing, vertical	5.50%	6.00%	2.50%	10.00%	7.30%	2.80%
Parking	0.00%	0.00%	0.00%		0.00%	
Business, horizontal	7.30%	7.60%	8.70%	6.20%	8.70%	8.10%
Business, vertical	9.70%	10.10%	7.40%	43.00%	4.70%	3.80%
Mixed, horizontal	4.60%	7.30%	0.20%	4.20%	4.10%	6.00%
Mixed, vertical	5.50%	4.10%		9.60%	4.00%	6.30%
Vacant lots/ruined/others	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Total	6.30%	6.80%	5.00%	9.90%	5.50%	4.80%

Value Data treatment through hedonic modeling

- Circa 5,000 valid data – apartment market;
- 11 geographically referred variables were tested, of which 08 showed statistic significance:

  - **PD** = construction quality;
  - **AP** = private area (m^2);
  - **DORM** = number of bedrooms;
  - **DM** = distance to closest subway station (m)
  - **DATA** = date dummy variable:
    - If 2002 → DATA = 0;
    - If 2008 → DATA = 1;
  - **RM** = median household income (R$);
  - **DET** = service jobs density (total of service jobs per hectare);
  - **TC** = average travel time through public transportation;
  - **TI** = average travel time through automobile.

Resulting Model

$$[V.U.] = Exp(\ 6{,}176 + 0{,}214x[PD] - 8{,}6x10^{-4}x[AP] + 0{,}031x[DORM] + 2{,}34/[DM] + 0{,}10x[DATA] + 1{,}97x10^{-5}x[RM] + 0{,}373x[DET] + 0{,}011x[TC] - 0{,}0038x[TI])$$

- *Basic statistics:*
- Correlation Coefficient = 0,747
- Adjusted Determination Coefficient = 55,70%
- Model significance << 1%;

Relevance analysis of the model variables

Coeteris paribus condition, through Montecarlo simmulation:

Variable		**Variation Coefficient**
PD	Construction Quality	31,52%
TC	Average travel time through public transportation	15,83%
AP	Private area (m^2)	6,73%
DET	Service jobs density	5,41%
TI	Average travel time through automobile	4,92%
DORM	Number of bedrooms	2,98%
RM	Median household income (R$)	0,75%
DM	Distance to closest subway station (m)	0,27%

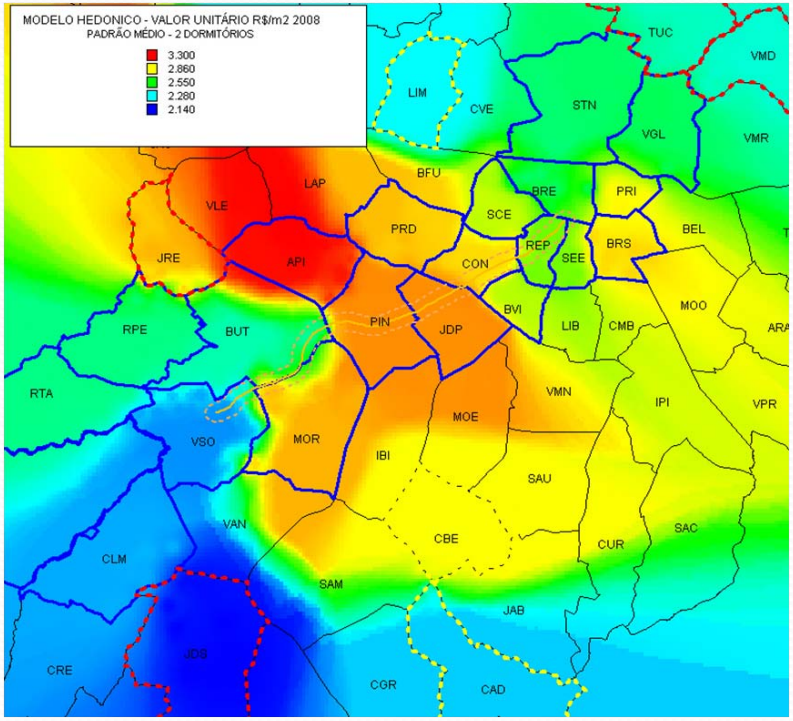
Results:

- General market appreciation between 2002 and 2008, on a constant 2008-basis:

$$GeneralAppreciation = \frac{e^{0,101}}{e^{0,100}} - 1 = 1,10 - 1,0 = 0,1 \text{ or } 10\%$$

Results:

- Spatial trends: 2008 cross cut of value variation of 02 bedroom apartments, private area of 68 m² (median of sample).



Results:

- *Local variations - Appreciation of apartments in study área – 2008 observations x 2002 inferred values*

AREA	ZONE	BDR	PRIVATE AREA	VU_INF_2002	VU 2008	APPRECIATION
CONTROL	CAMPO BELO	3	106,8	R$ 1.989,17	R$ 2.286,29	15%
REFERENCE	JARDIM SAO LUIS	2	49,23	R$ 1.981,75	R$ 1.908,63	-4%
REFERENCE	TUCURUVI	2	57,06	R$ 2.183,20	R$ 2.533,41	16%
INFLUENCE-STR.3	BUTANTA	3	72,06	R$ 1.941,58	R$ 2.432,42	25%
INFLUENCE-STR.1	CONSOLACAO	3	107	R$ 1.843,17	R$ 2.524,01	37%
INFLUENCE-STR.2	PINHEIROS	3	107	R$ 1.824,80	R$ 2.771,01	52%

Main Conclusions:

- Generally low vacancy rates, contrary to frequent common quotes;

- Hedonic modeling indicated as statistically significant a group of 8 variables, of which the most relevant were construction quality (PD), travel time in public transportation (TC) and private area (AP);

- Its analysis showed: i) general market appreciation of 10% above inflation (measures by inflation index IPC-Fipe) between 2002 and 2008; and ii) strong appreciation in stretch 2 of Influence Area (which correspond to the most dynamic region affected by construction works, from market point of view), though there were other active and well valued areas in the same period.

Main Conclusions (cont.):

- These valuation trends were confirmed by punctual analyses, in which observed values for 2008 were compared with inferred values for 2002. In these cases, appreciation was more intense in influence area (in special, in stretches 2 and 1), and less relevant, or even reverted in control and reference areas;

- The quantity of data and information available allow further analyses (both considering spatial aggregations and different typologies), which will be pursued before the next survey, expected to occur by 2011, when the line is fully inaugurated.

Thank you!

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