GIS-BASED TIME MODEL OF GOTHENBURG

PROJECT INFO

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Älvstranden Utveckling AB

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GIS-based time model. Gothenburg, 1960 to present

GIS-BASED TIME MODEL OF GOTHENBURG

APPENDIX 2.
METHODOLOGY AND TECHNICAL DOCUMENTATION

The GIS-based time model of Gothenburg consists of:

- 12 GIS-layers of the street network, from 1960 to 2015, in 5-year intervals
- 12 GIS-layers of the buildings from 1960 to 2015, in 5-year intervals
- 12 GIS- layers of the plots from1960 to 2015, in 5-year intervals

The coordinate system used is SWEREF 99TM, EPSG:3006.

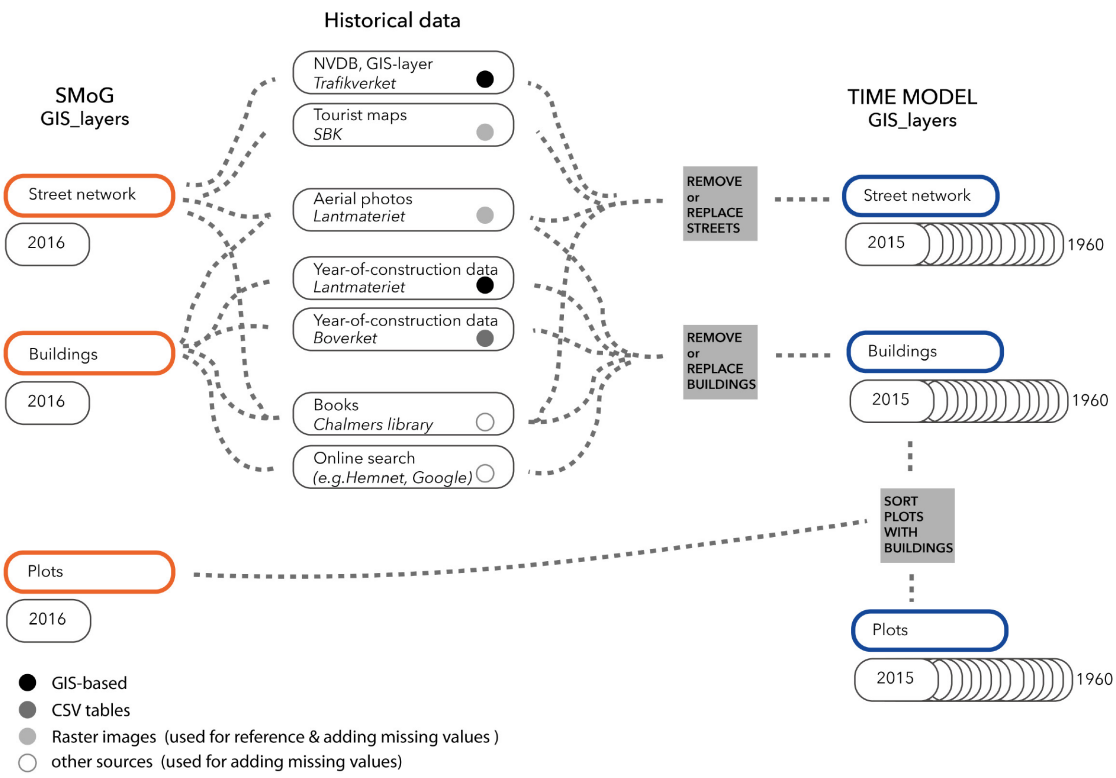

Figure 1. Overall workflow for the production of the GIS-time model of Gothenburg

A. Street network layers

a. Geometric features: Lines

b. Sources:

GIS-layers: Motorised network GIS-layer of 2016 (Spatial Morphology Group)

NVDB, 2016 (Trafikverket)

Analogue images: Tourist maps,1970-2005, 5-year intervals (SBK)

Aerial photos,1960&2001, 2005, 2009 (Lantmäteriet)

Literature references:

GAKO, 1971, *Göteborg bygger*, Göteborgs allmännyttiga och kooperativa bostadsföretag, Göteborg: GAKO

GAKO, 1966, *Göteborg bygger,* Göteborgs allmännyttiga och kooperativa bostadsföretag, Göteborg: GAKO

GAKO, 1960, *Göteborg bygger,* Göteborgs allmännyttiga och kooperativa bostadsföretag, Göteborg: GAKO

Moberg C., Schånberg, 1968, *Vägen till Göteborg*, Göteborg: Göteborgs gatunämnd

Hanson E., 2003, *Göteborg att bygga staden*, Göteborg: Göteborgs stadsbyggnadskontor, ISBN: 9189088115

Andersson, B., Jacobson, H., Jonsson, E., Heijl, M., Josefsson, T., 1977, *Göteborgs utbyggnad : några bidrag till Göteborgsstadsbyggnadshistoria,* Göteborg : Chalmers tekniska högskola, ISBN: 99-0460320-0

c. Method

The 2016 Motorised network provided by the Spatial Morphology Group was used as the starting point. The method followed in order to produce the network of the older timeframes was to go backwards and remove or replace streets that were not present in the immediate previous timeframe. So, to arrive to the network of 2010, streets

were removed or replaced from the network of 2015; to arrive to the network of 2005, streets were removed or replaced from the network of 2005 and so on.

Because of insufficient official data on the road year of construction, four steps were used in order to identify the streets to remove or replace in each timeframe.

1. The NVDB dataset Trafik was used to extract the year of construction, available only for a limited number of roads, mainly of the highways. The attribute used was Byggår.
2. For the inner-city part, visual inspection and tracing was used in GIS (i.e. ArcGIS) by overlapping the GIS layers with the digitalised historic tourist maps (SBK). Although the tourist maps provided great detail, they did not cover the whole urbanised area of Gothenburg and our study area.
3. For the outer-city part, visual inspection and tracing was used in GIS (i.e. ArcGIS) by overlapping the GIS layers with the georeferenced aerial photos (Lantmäteriet).
4. Cross-reference with historical photos in literature

Each network layer is complemented with a GIS-layer of 'Unlink' points, which are the locations of non-level intersections (e.g. bridges, tunnels, flyovers, overpasses, underpasses). These are point layers that were produced following the same method described above. The 'Unlink' point layer is necessary for the accurate network analysis.

B. Building layers

a. Geometric features: Polygons

b. Sources:

GIS-layers: Building layer 2016 (Spatial Morphology Group)

Building layer 2016 (Lantmäteriet)

Datasets: 5597859875 (Boverket)

Analogue images: Aerial photos,1960, 2001, 2005, 2009 (Lantmäteriet)

Literature references:

Caldenby C., Bjur G. L., Ohlsson, S., 2006, *Guide till Göteborgs arkitektur*, Stockholm: Arkitektur Förlag AB, Göteborgs stadsbyggnadskontor, Formas, ISBN: 9186050672

GAKO, 1971, *Göteborg bygger*, Göteborgs allmännyttiga och kooperativa bostadsföretag, Göteborg: GAKO

GAKO, 1966, *Göteborg bygger,* Göteborgs allmännyttiga och kooperativa bostadsföretag, Göteborg: GAKO

GAKO, 1960, *Göteborg bygger,* Göteborgs allmännyttiga och kooperativa bostadsföretag, Göteborg: GAKO

Frendberg, T., 1968, *Vi bygger i Göteborg: en berättelse om Göteborgs stads bostadsaktiebolag*, Göteborg: Göteborgs stads bostads AB

Hanson E., 2003, *Göteborg att bygga staden*, Göteborg: Göteborgs stadsbyggnadskontor, ISBN: 9189088115

Andersson, B., Jacobson, H., Jonsson, E., Heijl, M., Josefsson, T., 1977, *Göteborgs utbyggnad: några bidrag till Göteborgsstadsbyggnadshistoria,* Göteborg : Chalmers tekniska högskola, ISBN: 99-0460320-0

c. Method

The overall method was the same as for the Network layers. The 2016 Building layer provided by the Spatial Morphology Group was used as the starting point. The method followed in order to produce the network of the older timeframes was to go backwards and remove or replace building polygons that were not present in the immediate previous timeframe.

The Lantmäteriet dataset 'Belägenhetsadress, Byggnad och Samfällighetsregister', included an attribute with the buildings' year of construction (attribute Nybyggår). Although it covered the vast majority of buildings, it was still incomplete, with a lot of missing values. To complete the dataset and produce the historic building layers the steps followed were:

1. Cross-reference with the Boverket dataset (STD, Energideklaration, 2018)
2. Visual inspection and tracing in GIS (i.e. Mapinfo) by overlapping the GIS layers with the georeferenced aerial photos (Lantmäteriet), starting from the aerial photo of 1960.
3. Cross reference with historic aerial photos from Google maps Pro, from 2001 to 2018.
4. Literature sources were used especially for the suburbs of the Million Program (Miljonprogrammet) from 1965 to 1974.
5. In some cases, building year information was found in online sales ads for individual dwellings (e.g. Hemnet). Other online sources included cultural heritage documentation from the municipality, annual reports from companies or municipalities and private sources such as blogs about history.

After the aforementioned steps, the resulted dataset still included missing values.

From those, all polygons with area less that 40sqm were removed, as they were mostly complementary one-storey buildings (e.g. garages, small warehouses). The remaining polygons with missing values were either public buildings or industrial buildings, two categories that are not well-documented in the official available data sources. For the industrial buildings that clearly belonged to an industrial complex (e.g. Torslanda 5849) the assigned year of construction for the missing value was that of the complex. The final dataset still includes some missing values mainly of public buildings.

The final building layer includes attributes of GFA, Footprint, Height and No of floors for each building polygon. This information was extracted from the Building layer 2016 (Spatial Morphology Group). For the old buildings that were replaced, the respective values were estimated from their immediate surroundings, and were cross-referenced with sources (i.e. historic aerial photos, books, on-line search).

C. Plot layers

a. Geometric features: Polygons

b. Sources: GIS-layer: Plot layer 2016 (Spatial Morphology Group)

c. Method

The plot layers were produced using the respective building and network layers of each timeframe. The 2016 Plot layer provided by the Spatial Morphology Group was used as the starting point. Using GIS (i.e. ArchGIS) only the plots that included buildings were kept in each timeframe, using the already made historic building layers. To be noted is that the Plot layer documents the plots that were built upon and developed and not the remaining agricultural or natural land. It documents the process of urban development and the gradual addition of agricultural land to the urbanised build up areas.