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Mapping Ghent's cultural heritage: a place-based approach with web GIS

Vincent Ducatteeuw[1,2,3] · **Fien Danniau**[1,2] · **Christophe Verbruggen**[1,2]

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Abstract
Space and place are fundamental to how people experience and interact with cultural heritage. Geographic Information Systems (GIS) provide heritage organisations with tools to manage spatial heritage data, and since the 2010s, efforts have been made to integrate GIS with the semantic web (web GIS). However, the adoption of web GIS by cultural heritage organisations remains limited due to challenges such as inconsistencies in spatial metadata documentation, a lack of granular gazetteers, and the need for sustainable spatial data infrastructure. This article examines these challenges through Ghent Mapped, a project in Flanders, Belgium, that aggregates urban heritage records from seven Ghentian heritage organisations into a unified web GIS. By reviewing Flemish metadata standards and the documentation practices of partnering organisations, we identify key barriers to spatial data interoperability and propose best practices for managing and sharing spatial heritage metadata.

Keywords Place-based web GIS · Digital cultural heritage · Spatial data infrastructure · Spatial heritage metadata · Digital historical gazetteers

1 Introduction

Article 2 of the Faro Convention defines cultural heritage as:

> 'a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. It includes all aspects of the environment resulting from the interaction between people and places through time.'

✉ Vincent Ducatteeuw
vincent.ducatteeuw@ugent.be

[1] Department of History, Ghent University, Ghent, Belgium

[2] Ghent Centre for Digital Humanities, Ghent University, Ghent, Belgium

[3] Antwerp Cultural Heritage Sciences, University of Antwerp, Antwerp, Belgium

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The concept of socially produced space (i.e. place) is crucial for cultural heritage practices, as identity and sense of place determine how heritage is perceived and engaged with (Graham et al., 2000; Schofield & Szymanski, 2011). While immovable heritage—such as historical monuments and archaeological sites—is physically embedded in the environment, the spatial nature of other heritage types is less evident. For example, artefacts and paintings have more implicit spatial connections through their place(s) of discovery, production, or depiction. When such movable heritage is separated from its original location, its spatiality should be documented by heritage organisations.

To achieve this, organisations are increasingly using digital repositories to document and manage digitised cultural heritage (Economou, 2015). Integrating heritage into GIS allows users to search through heritage data from a spatial perspective (Corns and Shaw, 2010). Cultural heritage objects can be mapped through the spatial metadata in their records, improving both their findability and accessibility.[1] This helps with user engagement as it allows people to discover meaningful connections to places they are familiar with (Rees et al., 2022).

Web GIS (i.e. web-based mapping) offers further advantages over traditional desktop GIS by allowing the consolidation of data from diverse online repositories into a centralised web mapping environment.[2] Projects such as Turin 1911 (Spreafico et al., 2023), which reconstructs the 1911 World Fair by integrating historical maps and archival documents, and Urban History 4D (Münster et al., 2017), which links historical photographs to 3D visualisations of Dresden (Germany), illustrate the potential of web GIS to digitally reunite cultural heritage records from multiple organisations. However, inconsistencies in spatial metadata and documentation standards still hinder interoperability (Nishanbaev et al., 2019). In particular, non-standardised coordinate data, ambiguous place names and changing historical addresses complicate spatial metadata integration. This issue is especially pronounced in urban heritage contexts, as current geographical thesauri (i.e. gazetteers) provide limited coverage of historical intra-urban places. As a result, urban heritage records either lack persistent spatial identifiers or even omit spatial information altogether.

This article addresses these challenges through the case study of Ghent Mapped, a public history project that spatially aggregates and maps cultural heritage records—predominantly movable heritage—from seven Ghentian heritage organisations using a custom web GIS. Designed for the spatial exploration of heritage collections, this web GIS also considers more place-based aspects of heritage representation. Specifically, it uses a digital historical gazetteer as its knowledge organisation system, linking records associated with the same place (Ducatteeuw, 2021). While our project primarily focuses on map-based representation of heritage records, it also

[1] This article defines 'spatial metadata' as the formalisation of spatial information (e.g. coordinate data, place names, addresses) in a cultural heritage record. A 'record' refers to the digital representation of a cultural heritage object, including both its metadata and media.

[2] For an overview of related projects, see Time Machine LTM Projects: https://www.timemachine.eu/ltm-projects

engages with place through the detailed, searchable content of the gazetteer (Agnew, 2011; Cresswell, 2015; Massey, 1994; Tuan, 2002).

The remainder of this article is structured as follows: Section 2 examines urban cultural heritage, its relation to place, and the role of web GIS and gazetteers in its spatial representation. Section 3 reviews Flemish spatial metadata standards and assesses their impact on interoperability through two case studies on spatial metadata of our partners. Section 4 presents the Ghent Mapped web GIS, outlining the design of the urban gazetteer, the process of linking cultural heritage records to places in the gazetteer, and their spatial visualisation using shared image standards (IIIF). The article concludes by emphasising the need for improved documentation and standardisation of spatial heritage metadata, as current inconsistencies hinder web mapping at scale.

2 Digital mapping of urban heritage

Local heritage extends beyond iconic monuments and national landmarks to include the everyday places and objects that hold cultural significance for local communities (Schofield & Szymanski, 2011). It is also inherently participatory, inviting heritage communities to engage directly in the curation and interpretation of their history (Zagato, 2015). In Flanders, initiatives like Collections of Ghent (2020–2023) are an example of this approach.[3] Through collaboration between cultural heritage organisations and residents, Collections of Ghent digitised everyday heritage and created a platform where people could contribute their own stories, photographs, and artefacts, fostering deeper engagement with communities. Similar initiatives demonstrate that geographical proximity amplifies community involvement, further underlining the interconnectedness between local heritage, communities, and place (Liew et al., 2020).

This growing recognition of local and participatory heritage reflects a broader shift in how urban heritage is understood. No longer confined to monumental architecture, the concept of urban heritage has evolved to encompass a much wider range of tangible and intangible elements (Ripp & Rodwell, 2015). This shift culminated in the 'historic urban landscape' paradigm (Sonkoly, 2023), which emphasises a holistic approach to urban heritage. Today, the protection and management of urban heritage extend beyond buildings to include socio-economic dynamics, environmental conditions, and community values, all of which contribute to identities of urban life. This new paradigm has also spurred investigations into the digital representation of urban heritage, as the detachment of records from their original historic environment challenges how place is understood, contextualized, and experienced in the digital realm.

Agnew (1987) identifies three fundamental aspects of place: location, locale, and sense of place. Location refers to the geographical position of a place, locale encompasses its tangible physical attributes, and sense of place captures the attachments

[3] https://www.collections.gent/

individuals form and maintain with spatial environments (Tuan, 2002). In a heritage context, understanding these attachments is crucial, particularly as the digitisation of heritage introduces new ways of experiencing and interpreting place-based identities. Dameria et al. (2020, p. 155) propose a conceptual framework for analysing sense of place, defining place-people bonding as a psychological attitude with three interrelated dimensions: cognitive (beliefs about a place's identity), emotional (affective connections to a place), and behavioural (functional dependence on a place). Place identity, a key component of sense of place, is reinforced by perceived authenticity and the distinctiveness of a place in comparison to other places (Scannell & Gifford, 2010). These frameworks provide valuable insights into how place can serve as an organising principle for structuring and interpreting heritage data.

Building on this understanding of place, GIS has become increasingly important in heritage practices by providing spatial frameworks for organising, visualising, and contextualising cultural heritage. It has been particularly integral to the inventorying and cataloguing of immovable heritage and archaeological sites. While recent efforts have sought to extend GIS applications to other forms of heritage, a literature review by Ferreira-Lopes (2018) revealed a strong imbalance: the vast majority (93%) of GIS heritage publications focused on immovable heritage, whereas movable heritage (6%) and intangible heritage (<1%) remained significantly underrepresented. This disparity highlights the need for greater attention to the spatial dimensions of all heritage types, ensuring that they are more effectively mapped, integrated, and made discoverable. In response to this gap, Ghent Mapped places particular emphasis on the spatial representation of movable cultural heritage records through GIS.

Historical maps are one of many examples of heritage records that have become more accessible through GIS. Although georeferencing maps is labour-intensive, advances in computational methods (Milleville et al., 2022) and crowdsourcing platforms (e.g. Allmaps, Georeferencer) are streamlining this task.[4] Many heritage organisations provide map-based search interfaces—Flemish examples include Cartesius and Kaart en Huis—though the availability and granularity of search functionalities vary.[5] Despite computational advancements (Hosseini et al., 2022; Kim et al., 2023; Vroey et al., 2024) and collaborative platforms (Simon et al., 2019) facilitating the process, the searchability of map features remains a challenge for many organisations. Beyond historical maps, GIS has been employed to visualise diverse heritage records. The Flanders Heritage Agency's Geoportaal allows users to look up inventoried and protected Flemish immovable heritage by location.[6] Similarly, the Onder de Radar project uses 810 digitised WWII aerial photographs of the Belgian province of Limburg to visualise the region's landscape transformations during and after the war.[7]

Beyond specific projects, collection registrars are increasingly working towards more systematic spatial representations of heritage collections. Archives Ghent, for

[4] https://allmaps.org/; https://www.davidrumsey.com/view/georeferencer
[5] http://www.cartesius.be/; https://erfgoedbrugge.be/collection-pagina/kaarten/
[6] https://geo.onroerenderfgoed.be/
[7] https://www.onderderadar.be/

instance, provides a map viewer that allows users to discover records based on their geographic location.[8] The Locating a National Collection project establishes best practices for the spatial discovery of heritage records based on user surveys (Rees et al., 2022), whereas Layers of London maps heritage records from multiple institutions using point-coordinate locations.[9] However, most initiatives focus primarily on 'putting heritage on a map' – emphasising the precise location of heritage objects – rather than exploring the relationships between objects, space, and place. Addressing these interconnections presents an opportunity to strengthen GIS for heritage, moving beyond mere coordinate data to a more integrative understanding of heritage.

Documenting spatial metadata (e.g. coordinate data, place identifiers) in heritage records facilitates the spatial discoverability of digital heritage collections beyond conventional text-based search interfaces. Digitisation efforts (Terras, 2011) have driven the development of repositories aimed at preserving, managing, and providing access to cultural heritage records (Addison et al., 2008; Ranjgar et al., 2024). However, inconsistencies in spatial metadata, along with limited interoperability between repositories due to varying documentation practices, continue to result in siloed data. Harvey et al. (2022) emphasise the need for more robust spatial heritage data management, advocating for improvements in both technical infrastructure (ontologies, APIs) and organisational expertise (human resources, sustainable practices). Similarly, Middle et al. (2022) argue that existing thesauri, ontologies, and interconnection formats fail to fully capture the complexity of place, thereby limiting the spatial findability and searchability of heritage records across digital repositories.

In practice, a number of challenges hinder the spatial searchability and visualisation of cultural heritage records. Typically, spatial mapping relies on coordinate data (i.e. points, lines, polygons). For instance, a photograph may be assigned point coordinates corresponding to the location where it was taken. However, coordinates alone are insufficient for formalising spatial meaning, as their interpretation requires a certain level of spatial proficiency. Moreover, coordinates do not unambiguously identify places. Even if all images in a repository were assigned coordinates, retrieving all photographs that depict a specific place would not be straightforward. While it is possible to query within a geographical area, this approach often necessitates additional filtering and manual verification. Thus, while documenting coordinate data in heritage records is valuable, it is insufficient on its own to ensure spatiality is adequately documented.

To address these limitations, various initiatives have proposed more place-based approaches to mapping heritage records. Digital gazetteers are essential components of such initiatives, as they facilitate the management of spatial data by providing persistent identifiers for places (Goodchild & Hill, 2008). The adoption of the Linked Open Data paradigm in the heritage sector has further reinforced the role of gazetteers as key resources for linked open geodata (Janowicz, 2009; Harpring,

[8] https://beeldbank.stad.gent/index.php/places
[9] https://www.layersoflondon.org/

2010: 69; Shaw, 2016). However, international gazetteers (e.g. Getty Thesaurus of Geographic Names, Geonames, Wikidata) often lack the granularity necessary to document urban heritage collections effectively (Ducatteeuw, 2021).

The absence of urban gazetteers has contributed to a lack of standardised approaches to spatial metadata documentation among Flemish cultural heritage organisations. This lack of standardisation raises concerns about the interoperability of spatial metadata and its impact on web mapping. To address these challenges, the following section examines heritage documentation guidelines in Flanders, with a particular focus on spatial metadata standardisation. This discussion is further supported by two case studies using heritage records from our partners, analysing how differing organisational practices influence findability, interoperability, and visualisation in a web GIS environment.

3 Cultural heritage metadata in Flanders

This section examines how spatial heritage metadata is formalised in Flemish heritage organisations, addressing three key questions:

(1) What are the Flemish standards for cultural heritage metadata?
(2) How should spatial information be formalised according to these standards?
(3) How do organisational documentation practices impact spatial data aggregation, retrieval, and visualisation?

3.1 Flemish standards for cultural heritage metadata

Since 2018, heritage organisations subsidised under the Flemish Cultural Heritage Decree have been required to document cultural heritage objects according to a minimum registration standard.[10] This standard mandates nine metadata fields upon an object's acquisition, following the ICOM Code of Ethics (1991).[11] To assist collection registrars, the Flemish Institute for Archives maintains 'Kennisbank', a wiki providing practical guidance on implementing metadata standards. A key resource within Kennisbank is 'Invulboek Objecten', a documentation manual based on the SPECTRUM collection management standard, which structures heritage metadata into[12]:

- Groups—High-level categories (e.g. 'identification', 'acquisition').
- Elements—Subcategories within a group ('title' as part of 'identification').

[10] https://kennisbank.meemoo.be/invulboek-objecten/objecten-profielen-overzicht/minimale-registratie
[11] These fields are: 'name holding institution' (*naam bewaarinstelling*), 'object identifier' (*waarde objectnummer*), 'object type' (*term objectnaam*), 'short description' (*korte beschrijving*), 'title' (*titel*), 'acquisition method' (*term verwervingsmethode*), 'acquisition source' (*naam verwervingsbron*), 'acquisition date' (*waarde verwervingsdatum*), 'current location' (*identificatie huidige standplaats*).
[12] https://kennisbank.meemoo.be/invulboek-objecten

- Fields – Specific metadata fields within an element, which are mapped to various CMS and registration standards (e.g. 'title type', 'acquisition method term').

Despite these structured guidelines, spatial metadata remains underdeveloped in the minimum registration standard, which includes only a single spatial metadata field—'identification current location'—that records in which holding institution the heritage object is currently held.[13] The standard does not mandate the documentation of an object's broader spatial context, though organisations often embed such information in unstructured text fields such as 'title' or 'description'. However, to encourage structured spatial metadata documentation, the Flemish Institute for Archives recommends using authoritative gazetteers (e.g. GeoNames) and provides optional metadata elements within 'Invulboek Objecten', including[14]:

- 'Depicted location'—documents whether a place is visually depicted in an object (e.g. a painting of Ghent).[15]
- 'Associated location'—documents an association between a place and the object or group of objects.[16]
- 'Location event'—documents the location where an event takes place.[17]
- 'Place of creation'—documents all information about where the object was manufactured, designed or produced.[18]

While these optional elements allow for basic text-based querying based on place names or identifiers, the guidelines lack detailed instructions for recording geographical coordinates. 'Invulboek Objecten' provides only one metadata field for coordinate data, ('value coordinate place of discovery'), which is limited to the location where an object was found or excavated.[19] The absence of a mandatory structured approach to spatial metadata creates interoperability issues, particularly for GIS-based projects such as Ghent Mapped.

To improve metadata interoperability and facilitate cross-sector data exchange, the Flemish government developed the OSLO (Open Standards for Linking Organisations) cultural heritage standard (2020) in collaboration with the Flemish Institute for Archives. The OSLO Cultural Heritage Standard provides a framework for linking and exchanging cultural heritage data, consisting of:

1. A vocabulary—defines standardised terminology for cultural heritage objects.

[13] https://kennisbank.meemoo.be/invulboek-objecten/objecten-velden-overzicht/identificatie-huidige-standplaats
[14] https://kennisbank.meemoo.be/basisrichtlijnen/geografisch-ontsluiten
[15] https://kennisbank.meemoo.be/invulboek-objecten/objecten-elementen-overzicht/afgebeelde-locatie
[16] https://kennisbank.meemoo.be/invulboek-objecten/objecten-elementen-overzicht/associatie-locatie
[17] https://kennisbank.meemoo.be/invulboek-objecten/objecten-elementen-overzicht/locatie-gebeurtenis
[18] https://kennisbank.meemoo.be/invulboek-objecten/objecten-elementen-overzicht/plaats-vervaardiging
[19] https://kennisbank.meemoo.be/invulboek-objecten/objecten-velden-overzicht/waarde-co%C3%B6rdinaat-vindplaats

2. Two application profiles—(a) 'Cultural Heritage Object', details the use of vocabulary terms for documenting heritage objects, and (b) 'Cultural Heritage Event', to describe events related to these objects.[20]

As an example of its implementation, Collections of Ghent implemented the OSLO Cultural Heritage standard to publish heritage data from five organisations as linked open data (Van de Vyvere et al., 2022). Data from the organisations' CMS (Adlib) were extracted and modelled as OSLO-compliant JSON-LD, and made searchable through a SPARQL endpoint. In collaboration with Collections of Ghent, the Flemish Institute for Archives created a crosswalk that defines basic registration fields as a series of OSLO entities and properties.[21] For instance, the 'depicted location' element maps to the OSLO 'location' type, which serves as a generic descriptor for geographical locations. More specifically, coordinate data is documented using the data types 'Geographic Position' and 'Geometry'.[22] Despite the OSLO Cultural Heritage standard's potential to improve spatial metadata interoperability, its adoption has been limited. This may be due to factors such as institutional reluctance to transition from existing metadata frameworks, technical challenges in integrating OSLO with legacy systems, or insufficient funding for large-scale implementation. Addressing these challenges is crucial for broader uptake and effective standardisation of spatial heritage metadata.

3.2 Case studies on spatial heritage metadata

Beyond the minimum registration standard, Flemish heritage organisations operate autonomously in their documentation practices, with many choosing to enrich records by incorporating spatial metadata. This section examines spatial metadata documentation practices through two urban case studies: the 'Wintercircus' heritage site and the built heritage of labourers' houses. These cases illustrate how differing documentation practices can hinder the searchability and interoperability of records within and across data repositories.

Table 1 outlines how various heritage organisations formalise and publicly share spatial information on cultural heritage objects associated with the Wintercircus in their respective data repositories. The Wintercircus, built in 1894 by the Ghentian equestrian society, Cercle Equestre Gantois, has served multiple purposes over its lifetime, functioning as a circus venue, cinema, and garage, and currently operating as a mixed-use space for offices, catering, and music events. Its complex history, spanning more than a century, underscores the importance of spatial frameworks in heritage documentation. The building's multiple name changes and transformations,

[20] https://data.vlaanderen.be/doc/applicatieprofiel/cultureel-erfgoed-object/; https://data.vlaanderen.be/doc/applicatieprofiel/cultureel-erfgoed-event/

[21] https://kennisbank.meemoo.be/invulboek-objecten/objecten-profielen-overzicht/basisregistratie-als-oslo-json-ld

[22] https://data.vlaanderen.be/doc/applicatieprofiel/generiek-basis/#Geografische%20Positie; https://data.vlaanderen.be/doc/applicatieprofiel/generiek-basis/#Geometrie

including its reconstruction after a fire in 1920, make it a compelling case study for exploring spatial metadata standardisation.

Heritage organisations reference the Wintercircus across various metadata fields. While some records document the site's current name, others use its historical name, 'Nieuw Circus'. The lack of standardisation present challenges: for instance, a photograph depicting the 1920 fire that destroyed the building is tagged as 'Winter Circus Mahy'. This is misleading, as the Mahy family had no connection to the site at that time—Ghislain Mahy only acquired the building in 1939. Thus, the name 'Mahy' should not appear in the record metadata of a 1920 photograph. Further inconsistencies arise when records omit the site's name entirely, instead reference nearby places such as streets. For example, a record for a photograph of a clothing shop inside the Wintercircus mentions 'Lammerstraat' rather than 'Wintercircus'. This issue is compounded by the fact that the Wintercircus borders four different streets, further complicating spatial documentation.

The variability in place names and documentation practices (i.e. which metadata fields) complicates user queries. A comprehensive text-based search for records related to the Wintercircus would require multiple names (e.g. 'Nieuw Circus', 'Nieuw Cirkus', 'Wintercircus', 'Garage Mahy', 'Lammerstraat', 'Sint-Pietersnieuwstraat', 'Korianderstraat', 'Platteberg', 'Waalse Krook') to ensure full retrieval. Additionally, users would need to repeat this search across different metadata fields in various data repositories. Standardising metadata fields and adopting shared gazetteers could help mitigate these issues.

Another approach to documenting spatial information involves using addresses. While perhaps suitable for contemporary collections, this method is problematic for historical heritage collections due to street name changes and house renumbering over time. The case study on the built heritage of labourers' houses ('beluiken' in Dutch) highlights these complexities. Beluiken are a distinctive form of labourers' housing, consisting of terraced houses with small facades and narrow alley housing blocks. In 1971, the Working Group Industrial Archaeology Rijksuniversiteit Gent (WIARUG) began studying labourers' living conditions in beluiken. WIARUG's chairperson, Herman Balthazar, emphasised their historical and architectural significance as essential yet often overlooked elements of Ghent's urban development. Many beluiken remain inhabited today, evoking what Balthazar termed a sense of 'social livability'.

By the late nineteenth century, Ghent had become a centre for labourers' housing. Between 1865 and 1890, the city had over 650 beluiken, accommodating more than 31.000 residents (Savels, 2014). In 1977, WIARUG documented these housing sites, producing a substantial photo collection of Ghent. Following WIARUG's dissolution, its archive was preserved by Amsab-ISG, and the photo collection also became part of the Museum of Industry's holdings due to its relevance to the city's industrial heritage.

Both Amsab-ISG and the Museum of Industry created records for the photos, documenting their spatial context through place names and addresses. Historically, beluiken were named after their owners (e.g. 'Cité Muyncke') or a notable site feature (e.g. 'The Iron Gate'). WIARUG annotated these names and addresses on its photographs. However, documentation inconsistencies remain: Amsab-ISG recorded

Table 1 Variability in place name references to the Wintercircus in heritage records

Organisation	CMS	Metadata Field	Value
STAM—Ghent City Museum	Adlib	Title	Wintercircus[a]
Ghent University Library	Aleph	Subject	Lammerstraat[b]
Liberas	Atlantis	OCR search result	Nieuw Circus; Wintercircus; Garage Mahy[c]
Ghent Archives	Adlib	Category	Wintercircus Mahy na brand[d]
Amsab—ISG	Adlib	Title	Nieuw Circus[e]
Museum of Industry	Adlib	Title	Lammerstraat[f]
Museum of Daily Life	Adlib	Title	Nieuw Circus[g]

[a]https://stamgent.be/nl_be/collectie/kunstwerken/A2004_04_01

[b]https://lib.ugent.be/catalog/rug01:001482526

[c]https://hdl.handle.net/21.12117/63251301

[d]https://beeldbank.stad.gent/portal/media/search/98e42e07fd454d239330f737d28d534360c3e1e2e46341f29f941058b07957280f8c3044257c43889238350089005b55/details

[e]https://hdl.handle.net/10796/9D729D73-B02F-4F80-B6BF-BFE35C764417

[f]https://www.industriemuseum.be/nl/collectie-item/etalage-van-een-kledingwinkel-in-gent-8

[g]https://huisvanalijn.be/nl/collectie-item/kijk-hij-kijke-in-het-nieuw-circus-gent-1903–1904

these names in either the ‘street name’ or ‘remarks’ field, though in some cases, the ‘street name’ contains an address or a municipality. The Museum of Industry, in contrast, recorded name and address information in the ‘title’ or ‘description’ field. While it is commendable that this spatial information is documented, the inconsistent use of metadata fields complicates user queries.

Moreover, both organisations continue to use the original 1977 spatial references, despite significant changes to street names and house numbers since then (Charles et al., 2001). Heritage organisations are aware of these challenges and document changes. For example, the Museum of Industry holds a record titled ’beluik located in Dobbelslot in Ghent,’ yet its description references the former street name ’Zaaimanstraat’. However, ultimately, addresses are not a reliable (i.e., sustainable) means of uniquely identifying a place, as they are subject to change.

The most effective approach to standardising spatial information is the adoption of gazetteers. These geographical thesauri provide persistent identifiers that uniquely reference a place, regardless of name changes. However, urban gazetteer remain scarce, including in Flanders. Notable exceptions include the Inventory of Immovable Heritage from the Flanders Heritage Agency, which serves as a tool for conservation and management but primarily focuses on recognised built heritage, excluding many unlisted historical sites.[23] Another example is the Building and Address Register maintained by the Flemish government, which contains identifiers for contemporary buildings and address data. However, these identifiers become obsolete when buildings are demolished or street names change, requiring heritage

[23] https://inventaris.onroerenderfgoed.be/

organisations to regularly update and validate them – an impractical task.[24] International thesauri such as Getty Thesaurus of Geographic Names, GeoNames and Wikidata incorporate historical places, but they provide limited intra-urban place data. Addressing these gaps through the development of detailed urban place data would further support the standardisation of spatial heritage metadata.

4 Mapping heritage records in the Ghent mapped web GIS

Ghent Mapped was a collaborative project (2020–2023) involving seven Flemish heritage organisations that sought to develop a standardised approach for spatially representing urban heritage records. The project addresses challenges in map-based representation of heritage records by developing a digital gazetteer to improve the coverage of intra-urban places – an aspect often lacking in existing gazetteers. Heritage records from the seven partner organisations were linked to places in the gazetteer:

- Ghent University Library (364 records)
- Archives Ghent (3121 records)
- STAM—city museum (155 records)
- Museum of Daily Life (1181 records)
- Museum of Industry (1899 records)
- Amsab-ISG (857 records)
- Liberas (761 records)

The public website of Ghent Mapped provides access to a custom web GIS that integrates eighteen georeferenced maps (spanning mid-sixteenth century to late-twentieth century) alongside urban places and their associated cultural heritage records.[25] Users can navigate through time and space, exploring Ghent's layered history. A core component of Ghent mapped—both in its digital infrastructure and project design—is the urban gazetteer.

4.1 Gazetteer design

The Ghent Mapped Gazetteer was developed to address inconsistencies spatial metadata documentation, enabling the representation of urban places and their associated heritage records through a web GIS. It builds upon the Zichten op Gent application (2010), an early example of narrative-driven digital place-making (Basaraba, 2023) by the STAM – city museum.[26] This earlier project explored connections between historical and contemporary places using four map views of Ghent. Although

[24] https://www.vlaanderen.be/digitaal-vlaanderen/onze-oplossingen/gebouwen-en-adressenregister#het-adressenregister
[25] https://kaart.gentgemapt.be/
[26] https://www.youtube.com/watch?v=jAa5t_JBpH0

further development was hindered by legacy code, its conceptual approach attracted interest from various heritage organisations seeking to make use of their digitised collections. Ghent Mapped expanded upon Zichten op Gent by incorporating additional place datasets from Flemish and city governments sources, including streets, bridges, parks, schools, churches. It also integrates historical knowledge about places from past heritage initiatives and exhibitions, covering places such as cinemas, beluiken, and factories. The Ghent Mapped Gazetteer currently contains 4018 place records, which are accessible via our web GIS.[27]

The gazetteer follows a simplified data model based on the Belgian Historical Gazetteer (Ducatteeuw, 2021) and aligns with best practices in place-based data management (Berman et al., 2016; Goodchild & Hill, 2008). Each place record includes key properties such as place name(s), type(s), location, date, description, and provenance (Fig. 1). To ensure broader interoperability, we maintain links to external thesauri, including Wikidata, the Flemish Address Register, and the Inventory of Immovable Heritage. To ensure long-term accessibility and reuse, each place in the gazetteer is assigned an Archival Resource Key (ARK), a persistent identifier designed to be both human- and machine-readable (Hilse & Kothe, 2006).

While we considered publishing our records in established gazetteers, such as the Getty Thesaurus of Geographic Names, GeoNames, World Historical Gazetteer, or Wikidata, we chose to develop and host our own gazetteer. This decision allows us to accommodate specific technical requirements for web GIS integration, retain authorship over the place data, and enable our partner organisations to contribute and maintain records through Omeka S (Fig. 1). Since its publication, the City Archives and the Ghent University library have been testing the gazetteer as a geographical thesaurus for registering places in their heritage collections. To ensure its long-term sustainability and usability, an editorial board was established, chaired by the Ghent University Library and including representatives from partner organisations as well as local historical societies.

Place disambiguation remains a key challenge for digital gazetteers due to the evolution of place properties over time (Kauppinen et al., 2008; Garbacz et al., 2021). To differentiate places, we conducted cartographic and literature research, evaluating name, function, and location of places. In our gazetteer, a place is considered the same entity over time if at least two of these three properties remain constant between observations. For example, the 'Vooruit' building in the Sint-Pietersnieuwstraat retained its name and location but transitioned from a socialist cooperative to a cultural centre. Since two of the three key properties remained unchanged, it is treated as single entity in the gazetteer. Beyond structural data, we also aim to incorporate a 'sense of place' through detailed textual descriptions that capture the historical events shaping each place (Mostern & Johnson, 2008, p. 1092).

The WGS coordinate reference system (EPSG:4326) is used to assign geospatial attributes to each place. The choice of geometry type depends on data availability and place type. Contemporary places such as streets and bridges use line geometries,

[27] For example, https://kaart.gentgemapt.be/plaats/4224

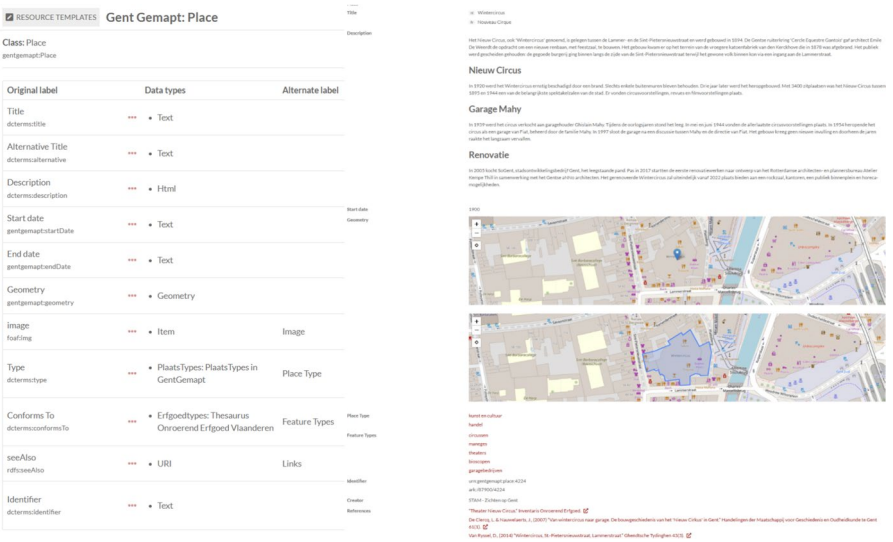

Fig. 1 Left – Omeka S admin interface for creating a new gazetteer place record using a custom Omeka S resource template. Right – gazetteer entry for Wintercircus in Omeka S

while schools and parks use polygon geometries, both are sourced from the Ghent Open Data Portal.[28] Historical places that no longer exist pose a greater challenge (Blaschke et al., 2018). For such places, we use approximate polygon geometries based on close reading of historical literature and maps by domain experts. These representations align with Casey's (2011) concept of place boundaries as having 'indeterminate leeway', shaped by interactions with their surroundings (70–73). For built heritage, we use the official polygon geometries of the Flemish Inventory of Immovable Heritage. As built heritage has more definable spatial footprints due to its administrative nature and physical presence, it closely resembles what Casey defines as a 'site' (70–73).

Place temporality is recorded through begin and end dates, allowing users to filter places in time. These dates are interpretive and shaped by our understanding of a place (Garbacz et al., 2021). The exact moment when a place comes into existence is often ambiguous, influenced by function and scholarly interpretation (Schneider et al., 2020). To balance usability and nuance, we use a simple minimum begin and maximum end date to filter, while also communicating ambiguities in textual descriptions—particularly in cases where historical sources and literature provide multiple foundation dates or where different aspects of a place (physical structures, function) emerged at different times.

The gazetteer is shaped by biases in data availability, organisational practices, and technical constraints. Digital gazetteers can both reinforce and challenge dominant historical narratives about places, contributing to the (de)construction of place

[28] https://data.stad.gent/explore/

identity (Halegoua & Polson, 2021; Basaraba, 2023). While the gazetteer serves as a tool to make heritage records more accessible, it can also reproduce their biases, such as the dominance of central areas over the urban periphery. Addressing these gaps requires continuous, critical engagement from historians and heritage practitioners. To this end, we integrate insights from exhibitions, publications, and participatory projects—such as De Vierkante Kilometer, which explores Ghentian neighbourhoods through community heritage engagement (De Ceulaerde, 2024). By incorporating these qualitative perspectives into place descriptions and ensuring they remain searchable, we aim to foster a richer, multidimensional understanding of Ghent's urban heritage.

4.2 Linking records to places

Partner organisations selected records based on metadata completeness, image quality, and licensing rights. Records available in IIIF (International Image Interoperability Framework) were prioritised due their interoperability, accessibility, and potential for reuse (Raemy, 2024). IIIF is an open standard that enables organisations to seamlessly share, view, and annotate high-resolution digital images across repositories. It provides robust APIs for access, making it an ideal solution for Ghent Mapped. While some partner organisations already had IIIF infrastructures, others implemented IIIF through Ghent Mapped or the parallel Collections of Ghent project (Van de Vyvere et al., 2022).

IIIF's architecture consists of two key components: IIIF manifests and IIIF collections. A IIIF manifest is a JSON file that integrates image data from IIIF servers with metadata exported from a Collection Management System (CMS), enabling a standardised viewing experience via IIIF-compatible viewers (e.g. Universal Viewer, Mirador, OpenSeaDragon). A IIIF collection is a JSON file that aggregates multiple manifests, allowing users to seamlessly explore related records across repositories. As shown in Fig. 2, we created a IIIF collection for each place in the gazetteer, aggregating relevant IIIF manifests from partner organisations.

The IIIF Presentation API, which defines the data structure of manifests, prioritises the viewing experience over enforcing a standardised, machine-readable schema for heritage object metadata.[29] As a result, record metadata representation in IIIF manifests varies across organisations, leading to inconsistencies in how information is presented to users. Figure 3 shows four IIIF manifests provided by different partner organisations. Due to variations in how CMS metadata fields are mapped to IIIF manifests, the same metadata labels can display different types of information. For example, the 'bron' label (source) refers to an object type in the first manifest, a title in the second and third (despite a separate 'title' field also being present), and the holding institution in the fourth.

These inconsistencies arise because heritage organisations prioritise image interoperability in IIIF over metadata standardisation, which is unsurprising as the IIIF

[29] https://iiif.io/api/presentation/3.0/#11-objectives-and-scope

Presentation API does not enforce a standardised schema for record metadata. While it allows for references to additional descriptive metadata (e.g. JSON-LD files) through an optional property, none of our partners have implemented this feature. This maybe because internal CMS data models are designed primarily for institutional needs rather than external audiences. A potential solution to improve record metadata accessibility is the integration OSLO-mapped JSON-LD metadata files within IIIF manifests. However, as previously discussed, the adoption of OSLO is hindered by its recent introduction and the digital transformation challenges faced by many heritage organisations. Future efforts should explore how OSLO can facilitate cross-institutional metadata integration.

The recent introduction of IIIF's 'navPlace' extension to the Presentation API enables standardised geographic attribution using GeoJSON-LD features, supporting applications such as photo geotagging and web-based mapping (e.g. MapLibre, Leaflet, OpenLayers).[30] However, our partner organisations have yet to implement this extension, likely due to the fact that navPlace is still a very recent development.

Although navPlace standardises geometric object types (e.g. point, line, polygon), additional work is required to link coordinate data to places for web mapping. To aggregate manifests associated with the same place, we had to extract spatial metadata from partner CMS, as IIIF manifests did not consistently include this information. Place names were often found in unstructured metadata fields (e.g. 'title', 'description'), making automated linking difficult.

One potential solution, geoparsing, involves automated recognition of place names and linking them to geospatial representation (Gritta et al., 2020; Leidner, 2008). However, existing geoparsing implementations face challenges with intra-urban places (McDonough et al., 2019; Purves et al., 2019). While recent geoparsing applications in historical collections show promise (McDonough et al., 2019; Rees et al., 2022), accurate linking of historical place names to contemporary places remains difficult due to the limited availability of granular gazetteers and underdeveloped geoparsing tools for non-English historical texts.

Our attempts to link records containing historical addresses to modern street names using semi-automatic geoparsing were hindered by insufficient historical data on street name and house renumbering changes. Using OpenRefine's reconciliation service to match records with Wikidata street entries (e.g. wd:Q2605440) based on name similarity produced false-positives, as identical or similarly named streets existed in different time periods. Given these challenges, we ultimately adopted a manual linking approach, relying on historical interpretation and contextual analysis of heritage objects by domain experts. While labour-intensive, this method enabled more accurate record mapping by considering not only visual depictions of places but also indirect references and associated events, such as the place where an object was discovered or created.

[30] https://iiif.io/guides/guides/navplace/

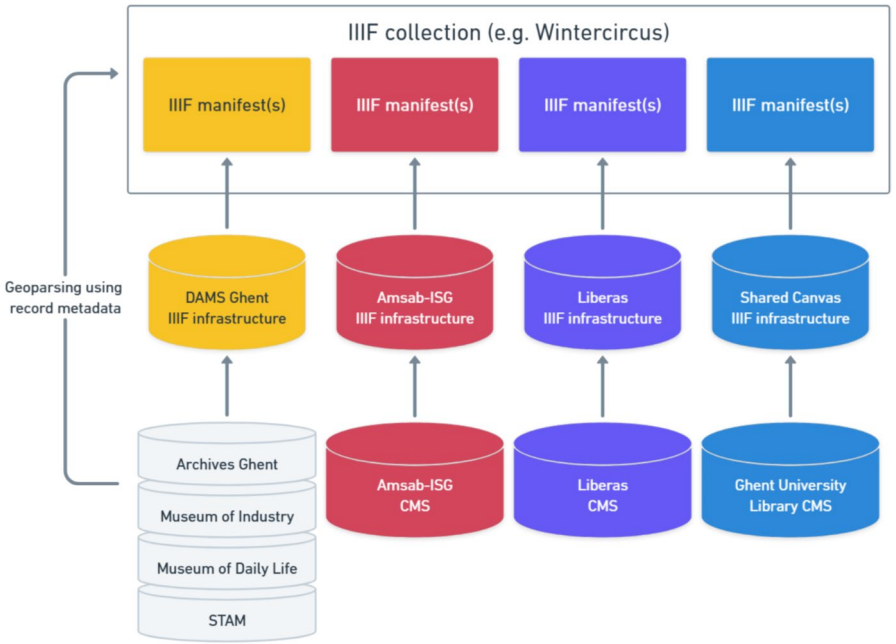

Fig. 2 Aggregating IIIF manifests from partner organisations into place-based IIIF collections, with additional CMS record metadata used for linking to places

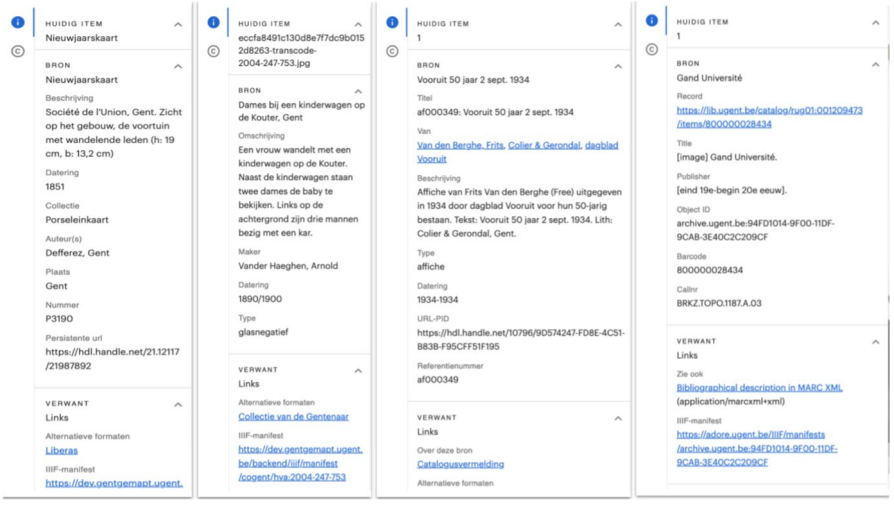

Fig. 3 Comparison of IIIF metadata from four partner organisations, highlighting variations in how CMS record metadata fields are mapped and displayed in IIIF manifests

4.3 Web mapping records

We developed a custom web GIS platform for place-based discovery and interaction with records from our partners' IIIF repositories. The web GIS integrates open-source technologies, including Leaflet, Omeka S, IIIF and OpenStreetMap, aligning with recent GIS heritage initiatives (Simon et al., 2019). By prioritising place-based exploration, Ghent Mapped allows users to search and discover heritage records linked to familiar places—an approach inspired by modern user-centred heritage design (Mason & Vavoula, 2021). Our design was informed by audience research conducted by Rees et al. (2022), which found that people engage most with heritage related to places they know, drawn from memory, that are nearby, and community spaces.

These insights shaped both the gazetteer's content and the interactive search interface of the web GIS, which enables users to filter places by name, type, description, and date. Figure 4 illustrates this functionality: the web GIS displays place markers on a historical map (centre). Two search filters have been applied – showing only places categorised in the gazetteer as 'industry' and those still in existence in 1857 (upper right). The polygon of 'Vlasspinnerij Feyerick' (highlighted in blue-grey) has been selected, revealing detailed place information and associated heritage records (right).

An alternative mapping approach involves annotating the depiction of places on historical maps without georeferencing them—a method used in projects such as Sights of Ghent or the Map of Early Modern London (Jenstad, 2016). In the latter, references to places in historical sources are linked to their depiction on Ralph Agas's 1561 woodblock-printed map of London. This non-georeferencing approach

Fig. 4 Ghent Mapped web GIS interface with applied place filters: by name (upper left, magnifying glass icon), type (left panel), and date (upper right). The selected place 'Vlasspinnerij Feyerick', is highlighted by its polygon, displaying information about the place and associated heritage records (right panel)

is particularly useful for maps lacking Cartesian accuracy, as it avoids imposing an anachronistic georeferencing framework. However, Ghent Mapped opted for georeferencing for several reasons. First, historical maps often omit certain places that existed but were not depicted, depending on their resolution, level of detail, and purpose. Annotating only the features visible on a given map would limit users' ability to explore places that existed but were not depicted. Second, when maps have a reasonable degree of Cartesian accuracy, georeferencing is generally more efficient than manual feature annotation. Lastly, computational georeferencing methods facilitate the integration of new maps, improving the scalability and sustainability of the project.

Ghent Mapped renders eighteen georeferenced maps, spanning from the mid-sixteenth century to the late twentieth century, using Leaflet, an open-source JavaScript library.[31] As shown in Fig. 5, these maps are visualised as interactive layers, allowing users to adjust their selection, panning, zooming, and opacity. This interactivity facilitates the comparative exploration of cartographic content and helps contextualise both historical places and heritage records. The maps were selected based on their cartographic significance, scan quality, accessibility, and licensing rights. While some maps were already available as WMTS (Web Map Tile Service) from external providers and could be directly integrated, others required manual georeferencing. This was done in QGIS using thin plate spline (TPS) transformations to align them with real-world coordinates. The manually georeferenced maps were then converted into tile sets and hosted on the project's own servers, allowing them to be rendered within the web-based GIS platform.

5 Conclusion

This article explored challenges and solutions for improving the spatial accessibility of cultural heritage records through web-based GIS. We examined the current state of spatial metadata documentation standards and organisational practices in Flanders, identifying limitations and inconsistencies that hinder the effective spatial representation of heritage records across organisations. Case studies on the Wintercircus and labourer housing illustrated how varying documentation practices between heritage organisations create difficulties in aggregating and mapping records, underscoring the need for a more standardised approach to spatial data management in the Flemish cultural heritage sector.

We presented Ghent Mapped as a model for linking and visualising IIIF-based cultural heritage records through place-based representation. The creation of a digital historical gazetteer for Ghent addressed the lack of intra-urban coverage in existing gazetteers. By incorporating qualitative aspects of place (i.e. location, locale, and sense of place) through searchable free text, the gazetteer provides a richer contextualisation of heritage records. However, linking records to place identifiers

[31] For a detailed overview of all maps and their providers, see: https://gentgemapt.be/wat-staat-er-op-de-kaart

Fig. 5 Screenshot of the Ghent Mapped web GIS interface with Van Deventer's map (1545–1575) as a background layer. The left panel lists the available georeferenced maps, allowing users to toggle between map layers, adjust transparency, and compare maps to explore Ghent's urban evolution

proved labour-intensive. While manual linking has clear limitations, the expanded place data within the gazetteer lays the groundwork for future automated geoparsing efforts.

The open-source web GIS platform offers an intuitive, user-centred approach to exploring heritage records through space and place. While initial feedback has been positive, future work will include a more systematic evaluation with target users and stakeholders. The integration of IIIF for aggregating and presenting heritage records demonstrates its potential as a sustainable and scalable technology for image reuse. However, despite the benefits of the navPlace extension for improving spatial accessibility, adoption remains inconsistent. Additionally, the lack of standardised, machine-readable record metadata in IIIF manifests further limits seamless integration across heritage repositories. Addressing this issue – potentially through the OSLO Cultural Heritage standard – will be crucial for ensuring data interoperability across the cultural heritage sector.

Despite the organisational and technical challenges in standardising spatial metadata for cultural heritage records, projects such as Ghent Mapped demonstrate the potential of web-based mapping to improve the findability, accessibility, interoperability and reusability of heritage records within and across heritage repositories. By addressing these challenges, the cultural heritage sector can move towards more effective space- and place-based representation of collections, ultimately fostering deeper audience engagement with urban heritage.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Competing interests The authors declare no competing interests.

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