

FROM CULTURAL DATA TO POLICY NARRATIVE: A SEMANTIC FRAMEWORK FOR URBAN TRANSFORMATION

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Abstract

Data-driven approaches increasingly inform urban policy, yet the integration of intangible cultural heritage remains limited due to object-centric documentation and the separation of tangible and intangible domains. Existing frameworks conceptualize data as static records, inadequately supporting the semantic articulation of cultural meaning within urban contexts. This paper applies a semantic narrative approach based on a triadic model linking physical elements, procedural knowledge, and social practices. The framework structures heterogeneous cultural data into interpretable relational sequences. Through ecclesiastical heritage in Karachi, Pakistan, the study shows improved coherence between cultural data and policy-oriented interpretation and contributes to knowledge applicable to urban transformation.

Introduction

Approaches to cultural heritage digitization increasingly seek to transform collected information into accessible and meaningful resources by integrating both tangible and intangible heritage dimensions (Lupo, et al., 2023). In urban contexts, heritage is no longer perceived as a static collection of relics but as a dynamic system embedded in community identity and development processes (Ripp & Clifford, 2025). Cultural heritage reflects a synchronized relationship between society, norms, and values, where tangible elements act as expressions of underlying meanings. Within this relationship, intangible heritage provides the broader framework through which tangible heritage acquires significance (Bouchenaki, 2003).

Despite this recognition, urban heritage policies continue to privilege physically measurable assets due to their ease of regulation and conservation within planning systems (Sarihan, 2021). This imbalance is reflected in contemporary documentation practices, where intangible dimensions such as ritual practices, symbolic meanings, and social use of space remain underrepresented (Labrador, 2022).

This limitation is particularly evident in Karachi, Pakistan, where heritage governance has traditionally focused on architectural conservation and monument listing (Naeem, 2013). Existing measures prioritize material condition and stylistic value, offering limited scope to document living traditions and symbolic

meanings (Afridi, et al., 2025). Ecclesiastical architecture, as a minority typology, inherently embodies interdependencies between architectural form, ritual practice, and collective memory (Adeboye, 2015).

The paper proposes a semantic, data-driven storytelling approach that models these interdependencies, structuring cultural data into narrative layers aligned with UNESCO ICH domains and semantic heritage standards to support conservation and urban transformation processes (Schmitt, 2008).

Methodology

The study adopts a semantic methodology grounded in the principles of the CIDOC CRM and its architectural extension CRMba, which enable modelling cultural heritage as networks of entities and relationships across time and space (Bekiari, et al., 2021). Building on this foundation, a triadic model is introduced, linking physical elements, procedural knowledge, and social practices as the core analytical unit as shown in Figure 1.

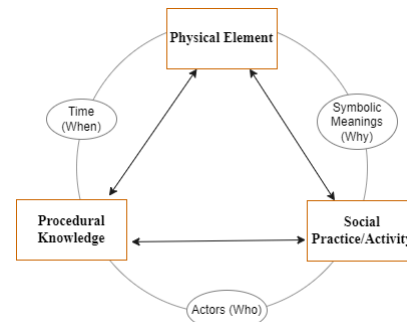


Figure 1: Triadic Semantic Model

The methodological process involves: (1) identifying tangible architectural elements, (2) documenting associated procedural knowledge such as craft techniques, and (3) identifying recurring social practices linked to these elements. These components are semantically connected using CIDOC CRM relationships, forming triadic units that represent tangible–intangible interdependencies. Cultural practices are further categorized according to UNESCO Intangible Cultural Heritage domains.

The structured data is implemented within a digital environment using Omeka-S, enabling navigation across elements, practices, actors, and spatial contexts. The methodology is applied to three colonial-era churches in

Table 1: Relational Matrix of Tangible-Intangible Interdependency

Tangible Element (E24 / CRMba)	Procedural Knowledge (E29)	Social Practice (E7)	Actors (E39)	Spatial Context	ICH Domain
Stained glass window	Glass-cutting and glazing technique	Interpretive viewing during worship	Clergy, visitors	Bay Window	Traditional Craftsmanship / Knowledge & Practices
Hymn boards	Display procedure	Congregational hymn recitation	Priest, congregation	Nave Columns	Oral Traditions

Karachi constructed between 1852 and 1900. Primary data collection included field surveys, photographic documentation, and observational analysis of spatial use, ritual practices, and symbolic interpretation. Among these, Holy Trinity Cathedral was selected as the pilot case due to its continuity of use and concentration of cultural practices.

Results and Discussions

During the investigation at the Holy Trinity Cathedral, tangible architectural features were examined in relation to the practices and procedures through which they acquire cultural significance. As outlined in Table 1, elements such as stained glass windows, hymn boards, the pipe organ, baptismal font, memorials, and carved stonework are consistently associated with recurring activities rather than existing as isolated objects.

Furthermore, the semantic structuring process revealed that tangible–intangible interdependencies may correspond to either a single UNESCO ICH domain or span multiple domains simultaneously, depending on how cultural meaning is enacted and interpreted. The stained glass window exemplifies this multi-domain structuring. It is modelled as an instance of E24 Physical Human-Made Thing, produced through specialized craft procedures (E29 Design or Procedure) aligned with the Traditional Craftsmanship domain. At the same time, its ongoing engagement through theological interpretation and commemorative reading is modelled as E7 Activity, situating the same element within the Knowledge & Practices domain.

In contrast, hymn boards demonstrate a more contained semantic alignment. While also represented as E24, their primary significance lies in facilitating congregational recitation, structured through a display procedure (E29) and enacted as a recurring oral practice (E7), corresponding predominantly to the Oral Traditions & Expressions domain.

The application of this framework demonstrates that semantically structured data can support relational knowledge systems beyond geometric modelling. The implementation in Omeka-S enables data traversal through relationships, supporting interoperability with digital environments and knowledge representation across systems.

Conclusions

A redefined understanding of cultural heritage is advanced by positioning architectural elements within interconnected systems of practice and knowledge

through which significance is constituted. The proposed semantic structuring enables cultural data to be interpreted beyond static representation, supporting governance and digitally mediated heritage management. While grounded in a single case and interpretive analysis, the framework establishes a basis for scalable integration within computational environments and broader urban contexts.

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