EPPOI: headless CMS for FAIR management of touristic contents

Melania Fattorini, Andrea Polini, Federico Valeri
Knoway Systems S.r.l. - UNICAM spin-off
School of Science and Technology
University of Camerino
Camerino (MC) – ITALY
{firstname.lastname}@unicam.it

***Abstract*—Tourism-related content managed by public administrations is often encapsulated within traditional content management systems (CMS), making it difficult for them to be recovered, integrated, or reused for distribution through multiple communication channels. Furthermore, the lack of structured metadata and semantic models limits both the findability and interoperability of the different platforms that should allow access to the content. In this paper, we present an ontology-driven approach to address these limitations, introducing EPPOI (Entry Platform for Point of Interest), a modular, FAIR-aligned platform designed to manage, enrich, and expose tourism data and contents. Using a graph-based architecture and domain ontologies, EPPOI enables semantic classification, dynamic search, and interoperability with external systems, offering a scalable solution for digital tourism and territorial information governance.**

***Index Terms*—Headless CMS, FAIR principles, Ontology management, Ontology based retrieval**

I. Introduction

In recent years, the public sector has accumulated a significant volume of digital content aimed at promoting cultural and tourism assets. However, much of this information remains embedded within monolithic content management systems, where it is difficult to retrieve, repurpose, or integrate with external platforms. The lack of structured metadata, semantic modeling, and standardized interfaces hampers both human access and machine-level interoperability. As a result, the potential value of such content for tourism development, citizen participation, and smart services remains largely untapped.

This challenge calls for a shift from traditional CMS-centric architectures toward data ecosystems designed for openness, interoperability, and semantic enrichment. In this context, the FAIR principles (Findable, Accessible, Interoperable, and Reusable) offer a conceptual and operational framework to guide the publication and management of public data. Originally conceived for scientific datasets, these principles are increasingly relevant for digital public services, where maximizing data discoverability and reusability is essential to enable collaboration, innovation, and accountability.

A critical enabler of FAIR-aligned systems is the use of ontologies: formal, machine-readable representations of knowledge domains that allow for structured classification, semantic search, and federated data integration. Ontologies enable content to be decoupled from specific platforms and usage contexts, supporting its redistribution and reuse across applications and institutions. This is particularly relevant for public administrations, which often require content to be interoperable across regions, sectors, and governance levels.

To address these needs, this paper introduces EPPOI, a modular, ontology-driven software platform designed to support the structured and interoperable management of territorial tourism information. Built upon semantic web technologies and a graph-based data model, EPPOI enables public authorities to manage, enrich, and expose tourism-related content in compliance with FAIR principles. The platform not only enhances data classification and retrieval capabilities but also allows third-party systems and users to contribute to and benefit from a shared, extensible information infrastructure.

II. FAIR principles

The FAIR principles — Findable, Accessible, Interoperable, and Reusable — were introduced to address the growing need for effective data management in increasingly complex, distributed, and automated environments. These principles aim to guide both human users and machine agents in the discovery, access, integration, and reuse of data with minimal friction. In the specific case of ontologies, FAIR compliance requires the use of globally unique and resolvable identifiers, rich metadata, adoption of shared standards and vocabularies (such as OWL and SKOS), and the provision of clear licensing and provenance information. An ontology cannot be considered truly FAIR simply by being published online: it must be semantically structured, persistently accessible, and accompanied by adequate documentation to enable reuse across heterogeneous computational environments []. Ontologies are not merely descriptive artifacts; they serve as foundational components in the engineering of software systems that aim to comply with FAIR principles. They provide the semantic infrastructure required to model structured data, enable semantic search, and support interoperability across domains and platforms. In this sense, ontology-based approaches are essential for building digital ecosystems where data can be effectively discovered, integrated, and reused in a sustainable manner.

III. Ontology based data model

Ontologies are increasingly valued for their ability to improve communication among stakeholders, reduce ambiguity during modeling phases, support the automation of repetitive tasks, and promote semantic consistency and component reuse.

The adoption of an ontology-based data model is a key enabler for achieving compliance with the FAIR principles in the design of information systems. This approach allows data to be structured semantically, thus enhancing its discoverability, accessibility, interoperability, and reusability.

The Ontology-Driven Software Engineering (ODSE) approach defines a set of practices and tools that leverage formal ontologies throughout the software development lifecycle from requirements elicitation and conceptual design to implementation, testing, and maintenance. By embedding ontologies into the engineering process, ODSE contributes to improving the quality, consistency, and traceability of information systems.

Through the use of foundational ontologies, it becomes possible to create conceptual models that accurately represent the realities of a given application domain. These models enable a precise definition of entities, relationships, and business rules, ultimately improving stakeholder understanding and collaboration.

ODSE therefore supports the development of intelligent and interoperable systems and drives the evolution toward a more semantic and sustainable software engineering paradigm.

The integration of ontologies into software development processes is not only promising but essential in contexts where findability, semantic formalization, and interoperability are critical requirements.

IV. Entry Platform for Point Of Interest (EPPOI)

The EPPOI platform is conceived as a back-office ecosystem for managing tourism-related information at the territorial level. It serves as a centralized environment for handling the full lifecycle of Points of Interest, thematic itineraries, promotional showcases of local businesses, and tourism-related content and experiences contributed by both professionals and citizens.

From an architectural perspective, EPPOI functions as an access proxy to various external infrastructures, marking a clear departure from the traditional CMS paradigm, where content is typically locked within the platform and scarcely accessible to external systems. Unlike conventional content management systems, EPPOI is designed to ensure seamless bidirectional interoperability with external services. Structured data is exposed through standard interfaces (e.g., REST APIs), enabling front-end applications to dynamically retrieve and present information to end users, while also allowing third-party back-end systems to enrich and extend the available content. This architectural openness not only improves the findability and reusability of information, but also enables distributed and continuous content management by a wide range of stakeholders, including municipal operators, local businesses, citizens, and regional data hubs. In this context, EPPOI acts as a semantic middleware layer, capable of integrating heterogeneous components within a content ecosystem tailored to territorial tourism management.

A key feature of EPPOI is its ontology-based data model, implemented using the Neo4j graph database. This semantic infrastructure offers high extensibility and expressive power for modeling complex relationships between domain-specific entities, significantly enhancing the system's ability to manage complex and heterogeneous datasets.

The data model is constructed based on two complementary ontologies:

- OntoPiA, the national ontology network promoted by AgID (Agency for Digital Italy), provides a robust semantic framework for modeling concepts relevant to the Italian Public Administration. Its hierarchical structure ensures compliance with public interoperability standards and promotes reuse in policy-driven information systems.
- OntoReMa, a domain-specific ontology tailored to the tourism sector in the Marche Region. In contrast to OntoPiA, OntoReMa is simpler and flatter: it includes a limited set of standalone classes without hierarchical or taxonomic relationships but captures localized tourism concepts not represented in OntoPiA. Despite the lack of annotations or hierarchical organization, its simplicity and focus make it highly effective for operational deployment.

The integration of these two ontologies equips EPPOI with a multilayered semantic infrastructure: OntoPiA ensures institutional and regulatory interoperability, while OntoReMa enables rapid customization of the data model for tourism-specific applications. This dual approach supports consistent data enrichment, semantic federation across platforms, and intelligent querying based on defined ontological paths. Furthermore, the semantic modularity of the model makes EPPOI inherently scalable: the system can be extended with additional domain ontologies, allowing adaptation to new application contexts without altering the underlying architecture. This open ontological strategy supports the progressive growth of a territorial knowledge graph, facilitating the evolution of EPPOI into a comprehensive, multi-domain territorial information infrastructure.

The use of a graph database allows for flexible and scalable data manipulation, particularly suited to the tourism domain, where entities and contexts are in constant flux. The geostationary point serves as the central node of the data structure, to which heterogeneous information—such as multimedia content, textual descriptions, temporal metadata, and virtual experiences—can be attached. Moreover, Neo4j natively supports advanced semantic querying, enabling functionalities such as dynamic itinerary generation and context-aware content personalization, key components of next-generation tourism services.

In conclusion, EPPOI represents a concrete example of an ontology-driven platform, designed to support FAIR-compliant information management, and oriented toward digital tourism innovation as well as integrated territorial governance and promotion.