

Applying the LOT Methodology to Enhance the Cinematic Heritage Archives

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Abstract: The Locarno Film Festival (LFF) archives represent a valuable collection of cinematic history, providing essential resources for research, education, and the promotion of international film culture. To ensure these resources are easily accessible, it is crucial to develop advanced methods for managing and linking the information they contain. This work focuses on creating a shared way for organizing information, transforming the LFF archives into dynamic, interconnected resources. This transformation is essential for preserving cinematic heritage, improving discoverability, promoting digital transformation, and efficiently managing archives. Using an interdisciplinary approach, we developed the OntoFest following the Linked Open Terms (LOT) Methodology. Significant outcomes of this project include the successful reuse of existing ontologies to manage heterogeneous information, which has improved our ability to understand and retrieve relevant data. This work demonstrates the potential of digital archives in the cinematic field and provides a foundation for future initiatives in digitizing cinematic heritage archives. OntoFest not only contributes to preserving the cinematic cultural heritage of the LFF but also lays the groundwork for new research and creative applications in the digital transformation of film festival archives.

1 INTRODUCTION

In the era of Big Data, the overwhelming volume of information is becoming increasingly accessible and manageable. Therefore, archives should not be viewed as passive repositories of outdated data. Instead, they need to be redefined as dynamic and valuable sources of knowledge. The Locarno Film Festival (LFF), one of the most prestigious international film festivals, stands as a unique meeting point for cinema enthusiasts, industry professionals, and cultural scholars, with an extensive archive spanning various locations and including analog and digital formats. These archives, along with those of Radiotelevisione Svizzera (RSI) in Lugano and Cinémathèque Suisse in Lausanne, are crucial for preserving cinematic and cultural heritage, holding immense historical significance for researchers and historians. This work focuses on LFF archives as a case study of cinematographic archival collections, highlighting a largely dormant yet increasingly recognized legacy. Digitizing these archives is essential for preserving this invaluable cultural heritage for future generations

(Paschalidou et al., 2022). Moreover, digital archives improve accessibility, allowing easy access to historical information and democratizing knowledge for researchers, educators, and the public worldwide (Wagner and de Clippele, 2023). Additionally, digital formats also facilitate interoperability, enabling integration with other digital systems and databases while improving the efficiency of managing and retrieving archival information. To effectively manage and enhance these digital archives, ontologies provide a semantic structure that enables the organized, connected, and accessible preservation of cultural heritage information. They establish a framework that not only preserves historical information but also significantly improves its discoverability and usability for various applications in research and industry (Lodi et al., 2017). To address these challenges and opportunities, we introduce OntoFest, an ontology designed to transform the traditional Locarno Film Festival (LFF) archives into dynamic, interconnected resources. The primary goal of this project is to build an ontology that provides semantically rich descriptions of the cataloged material. To further support this

objective, OntoFest follows best practices by ensuring that the data will adhere to the Findable, Accessible, Interoperable, and Reusable (FAIR) principles (Wilkinson et al., 2016) and will be made available as Linked Open Data (LOD). OntoFest leverages the ArchOnto ontology (Koch et al., 2020), which integrates several complementary ontologies within the archival domain, providing a detailed representation that extends beyond the capabilities of CIDOC CRM. ArchOnto facilitates the description of specific aspects of the archival domain, ensuring comprehensive coverage of archival and cultural heritage materials. By incorporating ArchOnto, OntoFest enhances the discoverability and usability of the LFF archives, aligning with best practices in digital preservation and semantic web technologies. This work aims to transform the traditional LFF archives into a dynamic and interconnected resource, a transformation that is crucial for improving the discoverability and usability of cinematic heritage. While initially designed for the LFF, the framework is intended to be adaptable to other film festivals, enhancing access to these valuable cultural resources. This paper is organized as follows. Section 2 presents relevant projects and initiatives aimed at providing access to cinematographic research materials. Section 3 details the methodology used in the development of OntoFest, following the guidelines described in the LOT (Poveda-Villalón et al., 2022). Section 4 discusses the specific characteristics of OntoFest, including its framework, data model, and the structure of its ontology. Finally, Section 5 offers final remarks and expectations for future works.

2 BACKGROUND

The digitization of cultural heritage has emerged as a key area of interest in a wide range of research studies and projects. Despite this growing interest, there are still a limited number of initiatives specifically focused on digitizing film festival cultural heritage. Several notable projects have made significant progress in managing cinematic cultural heritage, adapting digitization methodologies to meet the specific needs of the seventh art domain. This review is limited to projects offering insights analogous to the goals of our study, with a particular emphasis on works that explicitly deal with cinematic archives. Further research in related areas might provide additional perspectives and insights beyond the scope of this study. Next, we present a summary of these key projects:

- **Cinema Context (CC) project** (van Wissen et al.,

2021) investigates the history of Dutch cinema from the late 19th century, focusing on the distribution and dissemination of films. While it provides valuable insights into the history and distribution of films, it does not extensively cover key figures integral to the film industry, indicating the potential for a more holistic approach that also addresses these aspects.

- **CINECOS project** (Biltreyst and de Potter, 2018) aims at developing an open-access platform for exploring the history of cinema in Belgium and Flanders, integrating information on production, distribution, and other fundamental aspects. Despite its achievements, the project does not emphasize the development of a comprehensive ontology, a gap noted by the authors of *Cinema Belgica* (Ducatteuw et al., 2023), a spin-off of the project.
- **European Cinema Audiences (ECA) project** (Porubčanská, 2022) examines the film culture of the 1950s in seven European cities, focusing on audience experience and film popularity. It collects and harmonizes a standardized archive of materials related to the cinematic experience, providing valuable data on demographics, preferences, and audience behavior. While it aims to understand the diverse cinematic experiences across Europe, it does not address all aspects of the film industry, indicating the need for more inclusive approaches.

There is a need for an approach that not only digitizes and archives film information but also creates a comprehensive framework for semantically rich descriptions. Such an approach should improve interoperability, accessibility, and usability, ensuring that archival information is preserved and easily accessible for future research and preservation initiatives.

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3 METHODOLOGY

OntoFest is developed based on the Linked Open Terms (LOT) Methodology, introduced by Poveda-Villalón in 2022 (Poveda-Villalón et al., 2022). This methodology focuses on reusing terms such as ontology classes, properties, and attributes from existing

vocabularies or ontologies and publishing the built ontology according to Linked Data principles. Furthermore, the LOT methodology is based on the ontological engineering activities defined in the NeOn methodology (Suárez-Figueroa et al., 2011). The LOT methodology involves iterations over a basic workflow consisting of the following activities: (1) identifying ontological requirements; (2) implementing the ontology; (3) publishing the ontology; and (4) maintaining the ontology.

This section outlines these activities, detailing their application in the development of OntoFest and highlighting key definitions and procedural guidelines.

3.1 Ontology Requirements Specification

The ontology requirements specification, the first activity, involves collecting the requirements that the ontology must fulfill (Suárez-Figueroa et al., 2015), which are associated with its goal, the domain it aims to model, and technical aspects such as the implementation language. This process typically involves collaboration among domain experts, ontology users, and the ontology development team. The goal is to collect information from diverse sources, including datasets, regulations, standards, data formats, API specifications, and database schemes. Subsequently, a set of ontological requirements is proposed, which can be formulated using the Competency Questions technique (Gruninger, 1995) or expressed as natural language sentences. Each ontological requirement is validated and completed in collaboration with domain experts and ontology users to create the Ontology Requirements Specification Document (ORSD), which is the primary outcome of this activity.

For the OntoFest ontology, we conducted the requirements specification activity using data from the archives of the Radiotelevisione Svizzera di lingua Italiana (RSI) in Lugano and the Locarno Film Festival archives in Locarno. These archives provided crucial information about the films featured in the film festival and the television programming during the festival period. This information was enriched with additional data from external repositories, including IMDB (Internet Movie Database), TMDb (The Movie Database), and others. Multiple interviews were conducted with experts from the Locarno Film Festival and various international film festivals to validate the initial draft and integrate essential concepts. Additional concepts were sourced from the FIAF (International Federation of Film Archives), guiding metadata standards, archival practices, and

Table 1: Sample of OntoFest Requirements.

CQ	Answer
What films are featured in a specific edition of the LFF?	List of films screened at specific editions of LFF, including title, year, and other metadata.
Which films were screened in a specific section of the festival?	List of films featured in a particular section.
Which directors and cast members have participated in television programs during the festival?	Names of directors and cast members along with the titles of the TV programs and their broadcast dates

best practices in digital preservation.

Based on the initial inputs, we formulated an initial set of ontological requirements in the form of CQs (Competency Questions). These were defined and shared using an online spreadsheet that included the following fields: Identifier (unique for each requirement), Competency Question (specifies what the ontology aims to address), Answer (responds to the CQs), Clarification of Competency Questions (includes comments and additional context related to the CQs), and Reference (indicates the sources of the CQs). Once the initial proposal was drafted, we shared the spreadsheet¹ with the domain expert to validate the requirements. Table 1 presents a sample excerpt of some requirements for OntoFest. All files generated during the development process, including these requirements, are stored and managed in a GitHub repository that will be publicly available after the project ends in October 2024.

3.2 Ontology Implementation

The ontology implementation activity aims to develop an ontology using a formal implementation language based on the ontological requirements specified by domain experts. This process involves several stages, each dedicated to implementing a specific requirements set, resulting in a revised ontology version after each iteration. This phase typically comprises the following sub-activities: conceptualization, reuse, encoding, and evaluation. For OntoFest, the implementation phase was carried out using a structured and iterative approach that incorporated these sub-activities.

Ontology Conceptualization. In this phase, our goal was to create a comprehensive model that accurately represents the film festival domain. To achieve this, we collaborated with project stakeholders and

¹Google spreadsheet for requirements management: https://docs.google.com/spreadsheets/d/1iFgPIEGACIJJSmxp_ndQe8jN19C9JRrFRnZM3HhN8FE/edit?usp=sharing

technical experts from the archives of LFF and RSI. Utilizing tools such as draw.io and Miro, we created visual representations of the ontology. These diagrams facilitated a shared understanding of the concepts, relationships, and constraints within the ontology. This enabled us to define various elements of the ontology, including classes (representing entities with common characteristics within the domain), class hierarchies (establishing hierarchical relationships among classes for effective organization), properties (defining both relationships between classes and attributes), property hierarchies (structuring properties to reflect hierarchical relationships), and additional axioms (including necessary constraints such as cardinality, domain and range specifications, and other logical conditions).

Ontology Reuse. We integrated existing ontologies to ensure interoperability and leverage established standards. Significant reuse included the CIDOC CRM (ICOM / CIDOC CRM SIG, 2024) and ArchOnto (Koch et al., 2023). CIDOC CRM, a reference ontology in the cultural heritage domain, provides a framework for representing people, places, and time periods. It aims to exchange, mediate, and integrate heterogeneous sources of information related to cultural heritage. ArchOnto integrates several complementary ontologies within the archival domain (N-ary, DataObject, ISAD Ontology, and Link2DataObject.), offering detailed representations that extend beyond CIDOC CRM. This reuse enriched OntoFest with a robust framework for representing archival information. This choice is crucial for OntoFest, as it aims to model archival information generated from each edition of the LFF. By leveraging the principles of linked data and semantic web technologies, ArchOnto creates a richer, more connected representation of archival information, ensuring that OntoFest can comprehensively cover the diverse archival materials associated with the LFF.

Ontology Encoding. We translated the conceptual model into a formal ontology using the Web Ontology Language (OWL). Using Protégé, we encoded the classes, properties, and axioms defined during conceptualization phase, employing both manual and automated methods to ensure efficiency and accuracy.

Ontology Evaluation. Initial validation was conducted using reasoners to identify logical inconsistencies. Tools such as OOPS! (Ontology Pitfall Scanner!) (Poveda-Villalón et al., 2014), Pellet (Sirin et al., 2007), and Hermit (Glimm et al., 2014) were employed to detect modeling issues. Iterative testing

ensured that the ontology definitions aligned with the intended domain model and met the specified requirements and competency questions. Feedback from domain experts and ontology users was invaluable, allowing us to continuously refine and improve the ontology. However, since the project is at its intermediate stage, a comprehensive evaluation is planned for future developments, involving both system evaluation and user evaluation.

3.3 Ontology Publication

The ontology publication activity aims to make the ontology available online in human-readable and machine-readable formats. The human-readable version is typically presented as HTML documentation, which includes diagrams and examples to improve readability and usability. The machine-readable version is the formal ontology file, often in RDF/XML or Turtle format, which can be accessed using the ontology URI. For OntoFest, we defined persistent URIs for all the elements according to best practices described by W3C (Consortium et al., 2014). OntoFest will be published online and available under its URI ‘<http://OntoFest.LFF.com/def/OntoFest/#>’ in both human-readable documentation and a machine-readable file. The human-readable documentation will be provided in multiple languages, including English, Italian, German, and French, reflecting the national languages of Switzerland. Additionally, we will register ontology with prominent repositories such as LOV (Linked Open Vocabularies) to enhance its visibility and accessibility within the community. This will facilitate its reuse and integration with other datasets, promoting interoperability and broader adoption of OntoFest in various applications related to film festival archives and digital preservation of cultural heritage. OntoFest will be made publicly available after the project’s conclusion in October 2024, ensuring that the community can benefit from the advancements and contributions made through this work.

3.4 Ontology Maintenance

The ontology maintenance activity aims to update and improve the ontology after its latest release. This need may arise from various circumstances, such as identifying new requirements, detecting bugs, or feedback suggesting improvements. This activity can be initiated during the ontology development process, where new requirements or bug fixes are scheduled into one or more sprints. Furthermore, it can also be triggered after the development process, leading to the

generation of a new ontology version. To support the ongoing ontology maintenance, we have adopted effective strategies to facilitate updates and manage its evolution over time. These include utilizing robust issue-tracking systems to document and discuss proposed changes, enhancements, or new requirements, ensuring transparency and reliability in the evolution of the ontology. Gathering feedback from domain experts plays a crucial role in assessing the ontology and identifying areas for improvement. Engaging with users and stakeholders helps gather diverse perspectives and suggestions for improvement, ensuring the ontology is more accurately defined and better suited for its intended purpose. These strategies enable OntoFest to be recognized as a dynamic ontology, contributing to the preservation and accessibility of the cultural heritage associated with the LFF.

4 RESULTS AND DISCUSSION

The goal of OntoFest is to represent the domain of the Locarno Film Festival and to capture the media associated with films and TV programs, including their archival descriptions. OntoFest comprises six main classes: Person, Film, Film Festival Edition, Film Festival Section, Film Festival Award, and TV Show. Additionally, there are several subclasses that further specialize some of the main classes. Relationships between classes and subclasses were extracted from widely used common vocabularies, such as Wikidata and Schema.org to ensure semantic richness and broad interoperability. This approach aligns with linked data best practices and the FAIR principles, making data easily reusable and interoperable. Where certain relationships were not covered by a single vocabulary, we combined terms from different sources to achieve more comprehensive domain coverage.

Next, we will provide a brief overview of the OntoFest classes.

- **Film:** includes the creative works presented at the film festival, representing the entire collection featured at the LFF. It provides detailed information about the title, description, country of production, year of production, genre, duration, and more.
- **TV Show:** represents the television programs associated with the film festival, showcasing festival events, interviews, and highlighting various facets of the Locarno Film Festival.
- **Film Festival Edition:** contains detailed information on all editions of the LFF.

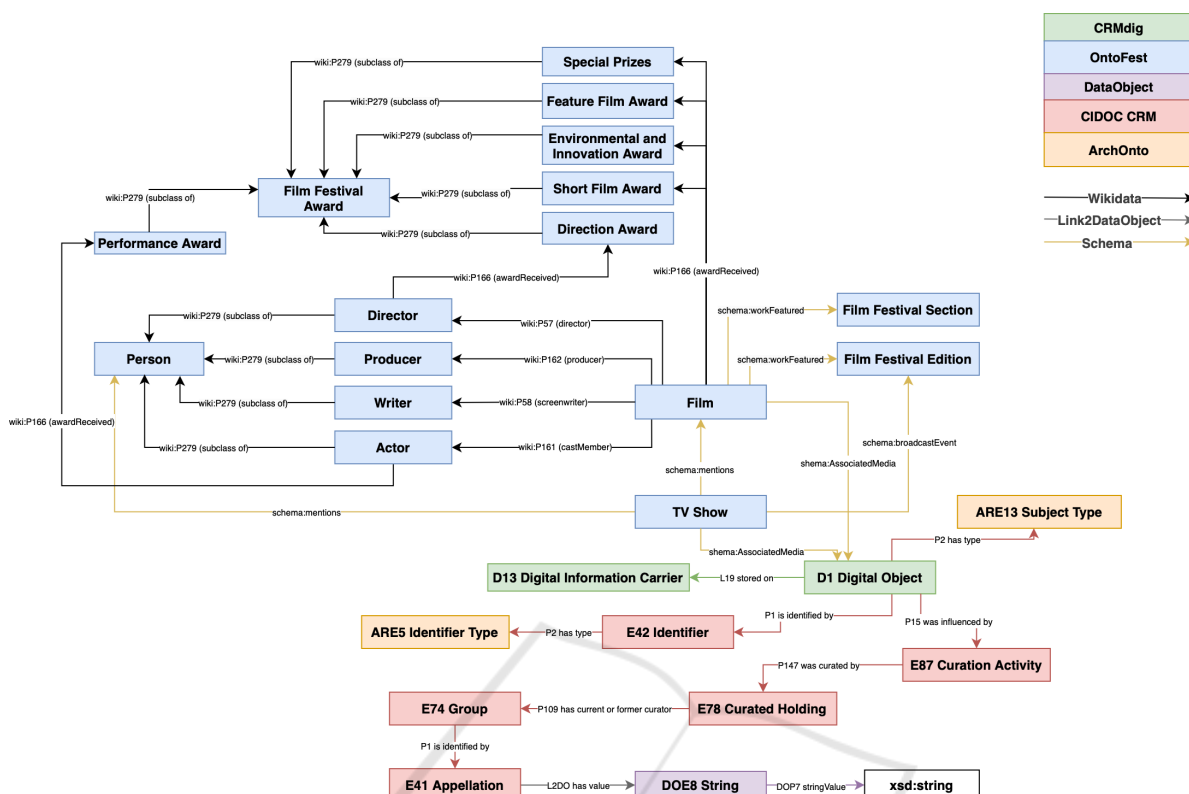
- **Film Festival Section:** represent the different categories in which films are screened during the festival, such as main competition, short films, and more.
- **Film Festival Award:** includes the awards given out at the film festival. It has six subclasses:
 - **Special Prize:** recognizes various exceptional merits.
 - **Feature Film Award:** recognizes excellence in feature-length films.
 - **Environmental and Innovation Award:** recognizes projects with environmental themes or notable innovations.
 - **Short Film Award:** recognizes outstanding documentaries and short films.
 - **Direction Award:** recognizes exemplary directing and production skills.
 - **Performance Award:** recognizes excellence in acting and performance.
- **Person:** represents all the individuals involved in the film festival. It has four subclasses:
 - **Director:** Individual(s) who have directed the films.
 - **Producer:** Individual(s) responsible for film production.
 - **Writer:** Individual(s) responsible for the screenplays.
 - **Actor:** Individual(s) who have performed in the films.

Due to space limitations, detailed tables on object properties (relationships) and data properties (attributes) can be found in the supplementary materials².

OntoFest reuses ten classes from two other ontologies: seven from CIDOC CRM (ICOM / CIDOC CRM SIG, 2024) and three from ArchOnto (Koch et al., 2023). This reuse ensures comprehensive coverage of archival and cultural heritage aspects.

1. **CIDOC CRM Classes:** we are reusing these classes as they can represent overarching concepts for digital media associated with films and TV programs and the provenance of their representation.
 - **D1 Digital Object:** represents identifiable intangible items represented as bit sequences,

²For detailed tables on object properties (relationships) and data properties (attributes), refer to the Google Spreadsheet: https://docs.google.com/spreadsheets/d/1GygsMIfaqypLpNj1_FfaG03biCqCYkPh/edit?usp=sharing&oid=14730170628215533786&rtfpof=true&sd=true



Note: The ontology includes inverse relationships and data properties in its representation that are not depicted in this figure.

Figure 1: Classes/subclasses and their interrelation in OntoFest.

- such as datasets, images, audio or video items, etc., and are documented as single units.
 - **D13 Digital Information Carrier:** Describes the physical or digital carriers of information.
 - **E41 Appellation:** Comprises all signs following a specific syntax, that are used or can be used to refer to and identify a specific instance of some class within a certain context.
 - **E42 Identifier:** Provides unique identifiers for digital objects.
 - **E74 Group:** Comprises any gatherings or organizations of human individuals or groups that act collectively or in a similar way due to any form of unifying relationship.
 - **E78 Curated Holding:** Represents curated collections of digital objects.
 - **E87 Curation Activity:** Represents the activities that contribute to the management and the preservation and evolution of instances of E78 Curated Holding.
2. **ArchOnto Classes:** We are using these classes since this model provides a more detailed representation of certain classes compared to CIDOC CRM representation in this aspect.

- **ARE5 Identifier Type:** Defines the types of identifiers used.
- **ARE13 Subject Type:** Describes the subjects covered by the digital objects.
- **DOE8 String:** Used for plain text validation.

The OntoFest conceptual model can be analyzed from the perspective of creative work and digital objects. OntoFest separates and interrelates these two perspectives, providing a comprehensive framework for understanding films and TV programs' creative and digital aspects. This dual approach is crucial for managing films as both works of art and digital entities. It ensures that films are recognized in their creative context while being efficiently stored, retrieved, and preserved in digital formats. By delineating and connecting these two facets, OntoFest supports archival practices and enhances the accessibility and usability of film festival archives.

Creative Work Perspective. This perspective emphasizes the artistic and production elements of a creative work, focusing on its conceptual and intellectual aspects rather than its specific encoding format. Key subclasses such as Director, Producer, and Actor exemplify the relationships and attributes that are pivotal to the creation and conceptualization of a film.

Table 2: A list of SPARQL queries and the respective results retrieved from the OntoFest ontology. Note: Partial Results only contain a subset of the total results due to space constraints.

CQ No.	Question	SPARQL Code	Partial Results
CQ1	Which films participated in the 61th LFF Edition and won the Direction Award? Retrieve characteristics of the associated media for these films.	<pre>SELECT ?film ?identifier WHERE { ?film schema:workFeatured of :61th_LFF; wiki:P166 ?directionAward; schema:associatedMedia ? digitalObject. ?digitalObject cidoc:p1 ? identifier. }</pre>	Film: Elle veut le chaos ; Identifiant: LFFArchive243728
CQ2	What is the archive ID of the TV Show that mentions the Film that won the Best Featured Film Award at the 60th LFF?	<pre>SELECT ?TVShow ?archiveId WHERE { ?TVShow schema:mentions ?film; schema:associatedMedia > ? digitalObject. ?digitalObject cidoc:p1 ?archiveId. ?film schema:workFeatured of:60th_LFF; wiki:P166 ?FeaturedFilmAward. }</pre>	Tv Show: Panorama Tagesschau ; archiveId: RSI_Archive_2116883
CQ3	Who are the producers of the films that participated in the Fuori Concorso Section of the 85th edition of LFF?	<pre>SELECT ?film ?producer WHERE { ?film schema:workFeatured of: Fuori_Concorso; schema:workFeatured of:85th_LFF ; wiki:P162 ?producer. }</pre>	Film: She Will ; Producers: Dario Argento, Philip Colbert, Sam Cryer, Natalie Denton, Jennifer Eriksson, Wendy Griffin, Sally Holder, etc.
CQ4	What is the subject type of the film directed by <i>Pedro Costa</i> and presented at the 72th edition of the LFF?	<pre>SELECT ?film ?subjectType WHERE { ?film wiki:P57 of:Pedro Costa; schema:workFeatured of:72th_LFF; schema:associatedMedia ?mediaObject. ?mediaObject cidoc:p2 ?subjectType. }</pre>	Film: Vitalina Varela ; subjectType: portuguese drama, grief, immigration

This view highlights the artistic value and production context, capturing the essential creative elements and their interconnections.

Digital Object Perspective. This perspective deals with the film or TV program as a digital object. It includes the technical specifications, digital format, and archival details. Classes such as E42 Identifier and ARE13 Subject Type are used to describe the digital files, their formats, and their unique identifiers. This view focuses on the storage, preservation, and accessibility of digital entities, ensuring that films and TV programs can be effectively managed in digital archives.

To validate the consistency of the ontology, we employed Hermit reasoner (Glimm et al., 2014). This check guarantees that OntoFest infers knowledge accurately and delivers correct information. Table 2 shows some queries executed within the ontology. The results obtained from these queries align with reality, confirming that the model faithfully represents its domain.

5 CONCLUSIONS

In this paper, we presented OntoFest, an ontology for representing the Locarno Film Festival (LFF) do-

main and its associated media, and explored its connections to other ontologies, such as CIDOC CRM and ArchOnto. The initial development and implementation phases have laid a solid foundation, and early results demonstrate the ontology's potential in organizing and facilitating the retrieval of relevant information within cinematic archives. OntoFest leverages the reuse of existing ontologies, such as CIDOC CRM and ArchOnto, to manage heterogeneous information, thereby improving the understanding and retrieval of relevant data. By employing the Linked Open Terms (LOT) methodology, we have ensured that the ontology adheres to best practices in ontology engineering and linked data principles, setting a standard for future initiatives in digitizing cinematic heritage archives. Despite these achievements, OntoFest is still in an intermediate stage of development, and several refinements are needed to further improve the ontology.

We plan to conduct two types of evaluations: a system evaluation and a user evaluation. The first one will involve technical assessments to measure the performance, scalability, and interoperability of the ontology, while the second one will gather feedback from domain experts, archivists, digital humanists, and ontology engineers to evaluate the usability, relevance, and completeness of the ontology. Based on the insights gained from these evaluations, we will itera-

tively refine the ontology to enhance its functionality, usability, and alignment with domain requirements. Additionally, we plan to develop a unified user interface that integrates two complementary data exploration functionalities. The first will be a visual browsing feature that allows users to navigate and explore data without requiring technical expertise. The second will be a direct query interface, accessible through a SPARQL endpoint via an API, enabling users to perform complex queries following Linked Open Data (LOD) standards and cross-reference with other LOD datasets. These functionalities are designed to work seamlessly together, allowing users to easily switch between them. For example, a user might start with a direct query to fetch specific data and then switch to browsing mode to explore related information, or vice versa. The work presented here lays the groundwork for future research and development in the digital preservation of cinematic heritage. As we move forward, we aim to expand the applicability of OntoFest to other film festivals and cultural heritage archives, demonstrating its adaptability to diverse cultural heritage settings.

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