CHeVIE: A Cultural Heritage Ontology for Tourism in Vietnam

For decades, the Travel and Tourism sector has significantly contributed to the global Gross Domestic Product of many countries. In Vietnam, this sector is now recognized as one of the three key economic areas targeted for investment. Cultural events and periodic festivities, such as commemorating historical events, traditional music or religious festivals, and visiting historic sites, are central to Vietnamese tourist activities. However, comprehensive sources of information about Vietnamese tourist destinations that include cultural heritage aspects are lacking, making trip planning time-consuming and often incomplete for travelers. To make the information accessible in a way that can be shared between applications, thus bringing it closer to the users, one can choose to store it in traditional database systems. Ontologies and knowledge graphs are, however, better alternatives that add semantics and reasoning power on top of the stored data. In this paper, we present our work on developing CHeVIE, an ontology to be used for travel planning that integrates cultural heritage information for Vietnam. Focusing on cultural and historic tourism, the ontology defines six main entities particular to the Vietnamese culture. We discuss the design decisions for the ontology, emphasizing the unique aspects of Vietnamese heritage and incorporating existing concepts from relevant cultural heritage ontologies. We evaluate our ontology for coverage, based on the competency questions used at the ontology design time, and for correctness, to identify potential errors in concept and relationship design. We also identify challenges in the ontology design phase, such as integrating historical information from various sources or handling historical periods. As tourism and culture are important factors in Vietnam's development strategy for 2030, we aim for CHeVIE to become the basis data set and data structure for the development of applications in this domain.

CCS Concepts: • **Information systems** → **Database design and models**; *Data provenance*; **Inconsistent data**.

Additional Key Words and Phrases: Ontology, Protege, OWL, DBPedia, Linked Open Data, History, Cultural Heritage, Tourism

1 INTRODUCTION

Travel and tourism are important economic activities in most countries around the world. This sector creates jobs, drives exports, and generates prosperity across the world. According to the annual analysis of the global economic impact of Travel & Tourism, in 2022, the sector is shown to account for 7.6% of the global GDP and 295 million jobs[1]. With a plethora of captivating tourist destinations, a rich and diverse cultural heritage, and a long history, Vietnam stands as an alluring travel destination. The country's tourism industry is experiencing remarkable growth; it is now playing a significant role in Vietnam's economic development. In 2022, Vietnam's tourism activities generated total revenue of $18.5 billion, attracting over 2 million international visitors and nearly 92 million domestic tourists[2]. Prior to the COVID-19 pandemic, the tourism and travel revenue peaked at almost $33 billion, constituting 9.2% of the country's GDP. Unique to Vietnam is its emphasis on *cultural tourism*, wherein travelers choose destinations to explore historical sites or participate in various religious or history-related festivals.

Whether for cultural exploration or leisure, tourism relies heavily on the availability of information and promotional activities. The evolution of information technology and the widespread use of the Internet and the World Wide Web have brought significant changes to this industry. Currently, travelers to Vietnam utilize various methods to obtain tourist information, including guidebooks, brochures, and tourism websites. Tourism departments, agencies, amusement parks, resorts, and luxury hotels in Vietnam have actively developed their websites and portals to enhance

[1]Economic Impact Report 2023 Global Trends World Travel & Tourism Council (WTTC), https://researchhub.wttc.org/product/economic-impact-report-2023-global-trends

[2]International visitors to Vietnam in December and 12 months of 2023, Statistics of the Vietnam National Authority of Tourism, https://vietnamtourism.gov.vn/en/statistic/international

Author's address:

visibility and promote their offerings. However, these platforms typically only provide information about their services and products. Consequently, travelers must invest time and effort in gathering and synthesizing information from multiple sources to create their preferred itinerary. Moreover, the search functionalities on websites and dedicated smartphone tourism apps primarily rely on keywords, often disregarding the user's context and preferences, resulting in the delivery of irrelevant information.

In 2020, Vietnam's government outlined the country's tourism development strategy until 2030, defining *tourism associated with history and culture* as a priority[3]. According to this strategy, combining tourism with history and culture will make tourism valuable, sustainable, and attractive. The high demand for this kind of travel, in turn, will urge the government and citizens to appreciate, preserve, protect, conserve, and promote the historical and cultural sites. The current tourism industry is merely interested in investing in service infrastructure such as hotels, resorts, and transportation without focusing on exploiting the historical assets' potential. There is a pressing need to develop more effective cultural and historical tourism information services in Vietnam. These services should deliver tailored information to travelers based on their interests and provide comprehensive details about tourist attractions across various dimensions such as *culture*, *festival*, and *history*.

While much of the current research literature on touristic information provision discusses the design and use of dedicated traditional database systems to store and retrieve tourism data, ontologies can be an alternative for data storage and representation with the additional availability of semantic search, knowledge inference, and context-aware computing to develop a smart tourism question-answering system for Vietnam. The use of ontologies and semantic web technologies has been introduced as the key to the success of e-tourism [4, 16, 24], offering a foundational framework for managing diverse representations of tourist locations and enhance data interoperability in the tourism industry [3].

Cultural tourism is a specific type of tourism concerned with a country or region's culture [10]. It focuses on concrete geographical areas of special interest or on communities that have diverse customs, unique forms of art, and distinct social practices. The geographical localization of this kind of tourism to the country of Vietnam leads to the need to develop a new Vietnamese historic and cultural tourism ontology for the following reasons:

a. **Heterogeneity**. In related literature on ontologies, some only focus on modeling tours, hotels, motels, means of transportation, resort forms, cuisine, and souvenir stalls [2, 9, 15, 23], while others focus on works of art, relics, and antiquities [7, 8, 12, 14]. This does not fit our goal of combining tourism with culture and history. As travels to cultural heritage sites are an important part of Vietnam's tourism, entities for historical figures, sites, events, festivals, and the links among these entities are necessary. Some of our desired concepts are scattered across different ontologies. They can be gathered to adapt and reuse in a new ontology. There is, however, no readily available ontology to represent Vietnam's historical and cultural tourism characteristics.
b. **Provenance**. Tourism-related ontologies present information without taking its provenance into account. This issue should be addressed, as populating an ontology with data involves collecting information from multiple sources to create entities and establish the links among them. Since recorded historical data are often inconsistent or even contradictory [25] depending on the historical information source, ensuring provenance is particularly important.
c. **Local Values**. Cultural and historical tourism ontology models typically depend on the specific history of each country and its legal documents pertaining to tourism. Vietnam's history is rich with unique features, and the Government of Vietnam has issued circulars and legal documents that regulate the ranking, protection, and

[3]Decision No. 147/QD-TTg of the Prime Minister: Approving the Vietnam Tourism Development Strategy until 2030, https://chinhphu.vn/?pageid=27160&docid=198927&tagid=6&type=1, in Vietnamese

development of tourism entities such as historic sites and festivals. An ontology for Vietnam's cultural and historical tourism needs to model these entities in accordance with the relevant legal documents, as detailed in Section 3.1.2.

In this paper, we address these issues by developing CHeVIE, A Cultural Heritage Ontology for Vietnam, to contain tourism and historical knowledge. The ontology builds on a number of ontologies from the tourism and cultural heritage domain. To this end, we follow the "Ontology Development 101" guideline [21] to develop the ontology by (i) collecting a set of requirements for the ontology, (ii) reusing existing ontologies, (iii) developing the ontology, (iv) populating the ontology with instances, and (v) evaluating the ontology.

Focusing on combining tourism with history and culture (cultural heritage), we surveyed Vietnamese tourism, historical, and cultural books [13, 17, 19, 20] and Vietnamese provincial tourism department websites to develop a set of competency questions for ontology construction. As a result, we built an ontology that centers around six main types of entities: historical figures, historical sites, historical events, cultural festivals, administrative divisions, and dynasties.

The rest of the paper is structured as follows: Section 2 reviews the existing studies and applications that make use of ontology in the tourism and cultural heritage domains. We continue with a description of our ontology design following the "Ontology Development 101" guidelines [21] in Section 3. Section 4 presents the particular ontology concepts to the Vietnamese culture and history, further motivating and detailing the creation of the CHeVIE ontology. Section 5 describes our ontology evaluation and Section 6 discusses lessons learned that can be used to develop similar ontologies for other countries. Finally, Section 7 concludes our study.

2 RELATED WORK

In this section, we discuss cultural heritage ontologies and other ontologies that have overlapping classes with them. These include tourism ontologies, ontologies focusing on administrative divisions, and ontologies modeling historical events.

Cultural heritage aspects in tourism ontologies. Examining tourism ontologies from the literature, we observe that only a few consider cultural heritage-related information. The ontologies that intersect tourism and cultural heritage often reuse or extend the CIDOC-CRM ontology [7]. ArCo[4], the Knowledge Graph of the Italian Cultural Heritage, consists of seven vocabularies that describe the cultural heritage domain and data from the General Catalogue of the Italian Ministry of Cultural Heritage and Activities. One of these vocabularies is the Location Ontology, which defines cultural heritage-related concepts such as `Location`, `Site`, `Altitude`, `OldTown`, `Geometry`, `AdministrativeUnitComponent`, `GovernamentalAdministrativeArea`, and `Address`.

The CURIOCITY ontology [10] represents cultural heritage information in the context of urban tourism. It extends CIDOC-CRM in a way that its semantics and reasoning capabilities are enriched. For example, classes like `Event` and `Site` are extended with subclasses that themselves constitute a cultural heritage, such as festive events, rites, and natural sacred sites. On the user side, ontologies can capture the tourists' preferences for cultural attractions [18] and thereby promote the hidden values of heritage sites.

[4]The Knowledge Graph of the Italian Cultural Heritage, http://wit.istc.cnr.it/arco/?lang=en

Administrative division ontologies. To handle the complexity, diversity, and evolving nature of administrative divisions, the administrative division concepts have been developed in several ontologies, e.g., Juso[5], Geo[6], IGN[7], and ArCo[4]. The Juso Ontology[5] is a vocabulary for describing geographical addresses and features. An extension of the ontology with some country-specific terms for South Korea is also available. The ontology defines `AdministrativeDivision` as the superclass of `FirstLevelAdministrativeDivision`, `SecondLevelAdministrativeDivision`, and so on. Centering around the `Address` class, the ontology links these levels of division to the `Address` class rather than to each other.

IGN[7] is the ontology of The National Institute for Geographic and Forest Information that describes the administrative division of metropolitan France. This ontology has been defined to publish IGN data describing the administrative division of metropolitan France as Linked Open Data (GEOFLA database). It is aligned with the ontology defined by the French National Institute of Statistics and Economic Studies to describe the French administrative division. The ontology only develops terms for French administrative divisions such as `UniteAdministrative`, `Arrondissement`, `Canton`, and `Commune`.

The KnowWhereGraph Schema[8] is a knowledge graph that focuses on two domains: environmental and place identifier. The Schema first defines the `Region` class as a geographic entity created by the selection of characteristics that are relevant to an area of interest. It can have geometries including point, polyline, and polygon. The ontology then defines administrative regions from level 0 to level 6. `AdministrativeRegion_0` represents the earth; `AdministrativeRegion_1` represents the country level; `AdministrativeRegion_2` represents the state/province level and so on.

Abdelkaoui et al. [1] developed a spatio-temporal toponym ontology for the Algerian administrative division. The ontology includes geographic elements such as spatial relationships, concepts, terms, and historical names related to a place. WASOS [29] focuses on modeling the relationships between the classes *Person*, *Administrative Area*, and *Governance Unit Person*. Larger administrative areas are composed of smaller ones, whereas each area is governed by a governance unit which is made of members and is chaired by a head of administration.

Historical event ontologies. Several event ontologies have been developed, such as the Simple Event Model Ontology (SEM)[9], the Event ontology[10], and MON ontology[11]. Among these, SEM ontology [28] is the most comprehensive, designed to model events across various domains including history, cultural heritage, geography, and multimedia. Event-centered modeling captures the time and place aspects of a domain. Moreover, events provide a way to describe complex relations between people, places, actions, and objects. The Event ontology[12] deals with the notion of reified events. It defines a main concept, `Event`, that may have a location, a time, active agents, factors, and products. The ontology is used in several Linked Open Data datasets.

The MON (MARIO Ontology Network) comprises 12 ontologies, one of which is the MON event ontology. These ontologies are designed to equip MARIO robots with the capabilities to create, organize, query, and reason over a background knowledge base. This empowers the robots to address the significant challenges of loneliness and isolation faced by older individuals with dementia. The primary objective of the MON event ontology is to facilitate the robot

[5]The Juso Ontology for geographical addresses and features, https://rdfs.co/juso/latest/html
[6]https://www.w3.org/2003/01/geo/
[7]Ontology of IGN administrative units, http://data.ign.fr/def/geofla/20190212.en.htm
[8]The KnowWhereGraph Schema, https://stko-kwg.geog.ucsb.edu/lod/ontology
[9]The Simple Event Model Ontology, https://semanticweb.cs.vu.nl/2009/11/sem/
[10]Motools' Event ontology, http://purl.org/NET/c4dm/event.owl
[11]MON's Event Ontology, https://w3id.org/MON/event.owl
[12]https://motools.sourceforge.net/event/event.html

in tracking the relevant events in which it is engaged. The `Event` class within this ontology establishes connections between the number of agents and entities involved, the event's location, and the timing of its occurrence.

3 ONTOLOGY DEVELOPMENT METHODOLOGY

Earlier, in the Introduction section, we already established the need for an ontology that focused on cultural heritage concepts for tourism in Vietnam due to three main factors: (i) heterogeneity of concepts, (ii) lack of provenance, and (iii) integration of the local values. In this section, we describe the methodology that we adopted for developing our solution to address the aforementioned needs.

We follow the "Ontology Development 101" guidelines [21] which recommend a sequence of seven steps, from domain and scope definition up to instance creation. In this section, we will delineate the initial two steps: (i) Domain and Scope definition and (ii) Ontology reuse, as they establish the foundational context essential for understanding the subsequent design decisions of the ontology. The remaining steps are considered engineering processes and will not be further discussed within the confines of this paper. A detailed description of the resulting ontology will be provided in Section 4.

3.1 Domain and Scope Definition

Vietnam's strategy for sustainable tourism development, outlined in the Vision 2030 document[3], prioritizes tourism intertwined with history and culture, forming the focal point of our efforts. This approach serves a dual purpose: firstly, it contributes to the education of the younger generation and enhances public consciousness in preserving historical sites and traditional cultural treasures. Secondly, it acts as a catalyst for showcasing Vietnamese tourism on the global stage, facilitating international tourists in obtaining comprehensive information to comprehend the country, its people, and its rich history.

To enhance the overall tourism experience, interactive tourism portals need the capability to present information covering diverse aspects of a user's interest. Given the decentralized distribution of travel and cultural heritage information among different economic agents, there is a compelling need for these agents to establish a shared understanding of the structure of Vietnam's cultural and historical elements relevant to tourism.

Our ontology is specifically designed to encompass the cultural and historical dimensions essential to tourism, aiming to fill the gaps left by existing ontologies. To manage the expansive scope of culture and history, we have strategically narrowed our focus to several key areas. Preliminary efforts involved an exhaustive literature review, leading to the identification of six focal points within our ontological framework. These focal areas encompass (i) *administrative divisions*, (ii) *historical sites*, (iii) *historical dynasties*, (iv) *historical figures*, (v) *historical events*, and (vi) *cultural festivals*, all of which will be elaborated upon in the ensuing sub-sections. Additionally, a set of competency questions pertaining to these focus areas has been compiled and is detailed in Appendix A of this paper. We continue, here with details on the six CHeVIE focal areas.

3.1.1 Administrative Divisions. The demarcation of administrative areas and their boundaries underwent continual changes across the various dynasties in Vietnam's history. For example, Hanoi, Vietnam's capital, carried multiple names such as *Thang Long, Trang An, Dong Kinh, Ha Thanh, Long Thanh*, and more, reflecting its historical evolution. Moreover, Vietnam's territorial expanse experienced fluctuations over time. Before 1832, the territory did not encompass Champa, which comprised certain present-day southern provinces of Vietnam. These regions became integral to Vietnam only from the Minh Mang Dynasty onwards. The modeling of administrative divisions is crucial in capturing

Vietnam's historical narrative, serving as the birthplace of national heroes and the backdrop for significant historical events. Currently, almost all administrative divisions feature tourist attractions, hosting a variety of cultural festivals and historical sites.

3.1.2 Historical Sites. Sites and monuments represent remnants from the past, whether underground or above ground, holding cultural and historical significance. In accordance with the Law on Cultural Heritage of Vietnam 2001[13] and the Law on Amendment and Supplement 2009[14], Vietnamese sites are categorized into five classifications[15]: (1) Historical - Cultural Sites, (2) Architectural Art Sites, (3) Archaeological Sites, (4) Landscape Sites, and (5) Revolution Sites.

3.1.3 Historical Dynasties. A dynasty refers to a succession of rulers from the same family, typically within a monarchical system [27]. Historians commonly designate Vietnamese dynasties based on the family names of the reigning monarchs. For example, the Đinh dynasty derived its name from the family name Đinh of the ruling clan. Dynasties often exert influence on various aspects during their rule, particularly concerning historical sites and administrative divisions.

3.1.4 Historical Figures. Historical figures play a crucial role in Vietnam's cultural heritage, necessitating the representation of their diverse information, such as names, dates of birth, and degrees. Depicting historical figures poses three main challenges. (i) Firstly, Vietnamese history spans multiple eras, each with its distinct degree system. (ii) Secondly, due to incomplete documentation, the birth and death years of many historical figures are often represented as periods rather than exact dates. (iii) Lastly, the information is frequently documented in various sources, introducing potential biases into historical accounts.

We place a special emphasis on Vietnam's academic degree system used between 1075 and 1919, which contributed significantly to the recognition of historical figures. Various examinations were held under different dynasties, such as the *Hương*, *Hội*, and *Đình* exams, which were essential for becoming mandarins and were more than just educational assessments. They determined job positions and conferred social status. The *Hương* Exam was held every three years locally, it had four parts, each eliminating candidates progressively. Passing all parts granted the *Hương Cống* degree, later renamed *Tú Tài* and *Cử Nhân*. The *Hội* Exam was a national exam managed by the Ministry of Ceremonies, also in four parts, leading to the *Đình* exam. The *Đình* exam was the highest level of examination, overseen by the King. Candidates who had passed the *Hội* exam competed for doctoral degrees in this exam. Successful candidates were classified into three ranks (*Tam Giap*), with the top three titles being *Trạng Nguyên*, *Bảng Nhãn*, and *Thám Hoa*.

3.1.5 Historical Events. A historical event refers to an occurrence that happened during the development of society, encompassing both historical incidents and historical phenomena. Historical incidents are specific events that occurred at a certain point in time and place, involving identified historical figures; historical phenomena are events that reflect the characteristic features of a particular period or stage in history. These events collectively contribute to our understanding of the social processes and the laws governing them, and they help in identifying the distinctive traits of different historical periods. The classification of historical events can be based on their main characteristics, including content, structure, and significance [11].

[13] Law No. 28/2001/QH10 of the National Assembly: Cultural heritage, https://vanban.chinhphu.vn/default.aspx?pageid=27160&docid=80239, in Vietnamese
[14] Revised Law on Cultural Heritage, 2009, https://thuvienphapluat.vn/van-ban/Van-hoa-Xa-hoi/Luat-di-san-van-hoa-2009-sua-doi-32-2009-QH12-90620.aspx, in Vietnamese
[15] Vietnam Site types, https://vi.wikipedia.org/wiki/Di_t%C3%ADch_Vi%E1%BB%87t_Nam, in Vietnamese

3.1.6 Cultural Festivals. Cultural festivals in Vietnam are deeply ingrained in the country's cultural fabric, boasting thousands of traditional celebrations held throughout the year, each characterized by unique local and national cultural traits. These festivals hold significant value in Vietnamese society, being widely recognized and appreciated for their positive and vibrant elements. They play a vital role in preserving the richness of the national cultural identity. Festivals in Vietnam can be classified in various ways, with one simple classification comprising four main categories: (1) Festivals commemorating village pioneers or historical figures, (2) Festivals honoring ancestors of particular professions, (3) Belief and religious festivals, and (4) Seasonal festivals.

3.2 Ontology Reuse

We develop CHeVIE using the inheritance principle which allows us to integrate and connect with other data sources and ontologies. To this end, we identified a number of classes and properties that are reused from several ontologies, including: CIDOC CRM [7], the Time ontology, the FOAF ontology[16], the SKOS ontology[17], Art & and Architecture Thesaurus[18], the UNESCO Thesaurus[19], various geolocation ontologies (GEO[6], IGN[7], ArCo[4]), the event ontology [5, 28], and the festival ontology [6]. In the cultural heritage domain, CIDOC CRM is the most widely used ontology, and we incorporated as many of its concepts as possible into CHeVIE.

Given the prominence of past and historical events in CHeVIE, time representation is crucial. We reuse concepts of the Time ontology such as `time:Instant`, `time:Interval`, `time:DateTimeDescription`, and `time:TRS.` This facilitates the description and standardization of both specific dates and time periods. Since the dates of historical events are often uncertain, we encoded this uncertainty in our ontology as well.

Because historical information typically varies according to different information sources, we considered it important to incorporate concepts from the provenance ontology (PROV-O[20]) into CHeVIE. To handle persons, event locations, historical roles, and government functions of historical figures, we identify a number of relevant concepts from the FOAF, SKOS, and Event ontologies, expanded to describe historical figures, sites, administrative divisions, historical events, and festivals. Table 1 shows example concepts from existing ontologies relevant to our main focus areas.

4 CHEVIE ONTOLOGY

This section describes the CHeVIE ontology and the rationale behind design decisions pertinent to the choice of classes and properties. To this end, we will structure the section around the six main concepts of the ontology, which we previously described in Section 3.1. Figure 1 illustrates the six CHeVIE primary classes and their interrelationships.

4.1 Administrative Divisions

Based on Juso Ontology[5], the part of CHeVIE ontology that describes administrative areas is depicted in Figure 2. The hierarchical relationship between administrative units is represented by reusing the relation `juso:parent`. The CHeVIE `AdministrativeDivision` class is a subclass of the Juso `AdministrativeDivision` class and is connected to the CHeVIE `HistoricEvent`, `Festival`, `Site`, and `HistoricalFigure` classes.

[16] Friend of a Friend vocabulary, https://lov.linkeddata.es/dataset/lov/vocabs/foaf
[17] Simple Knowledge Organization System (SKOS), https://www.w3.org/TR/2008/WD-skos-reference-20080829/skos.html
[18] Art & Architecture Thesaurus, https://www.getty.edu/research/tools/vocabularies/aat/
[19] UNESCO Thesaurus, https://vocabularies.unesco.org/browser/thesaurus/en/
[20] PROV-O: The PROV Ontology, https://www.w3.org/TR/prov-o/

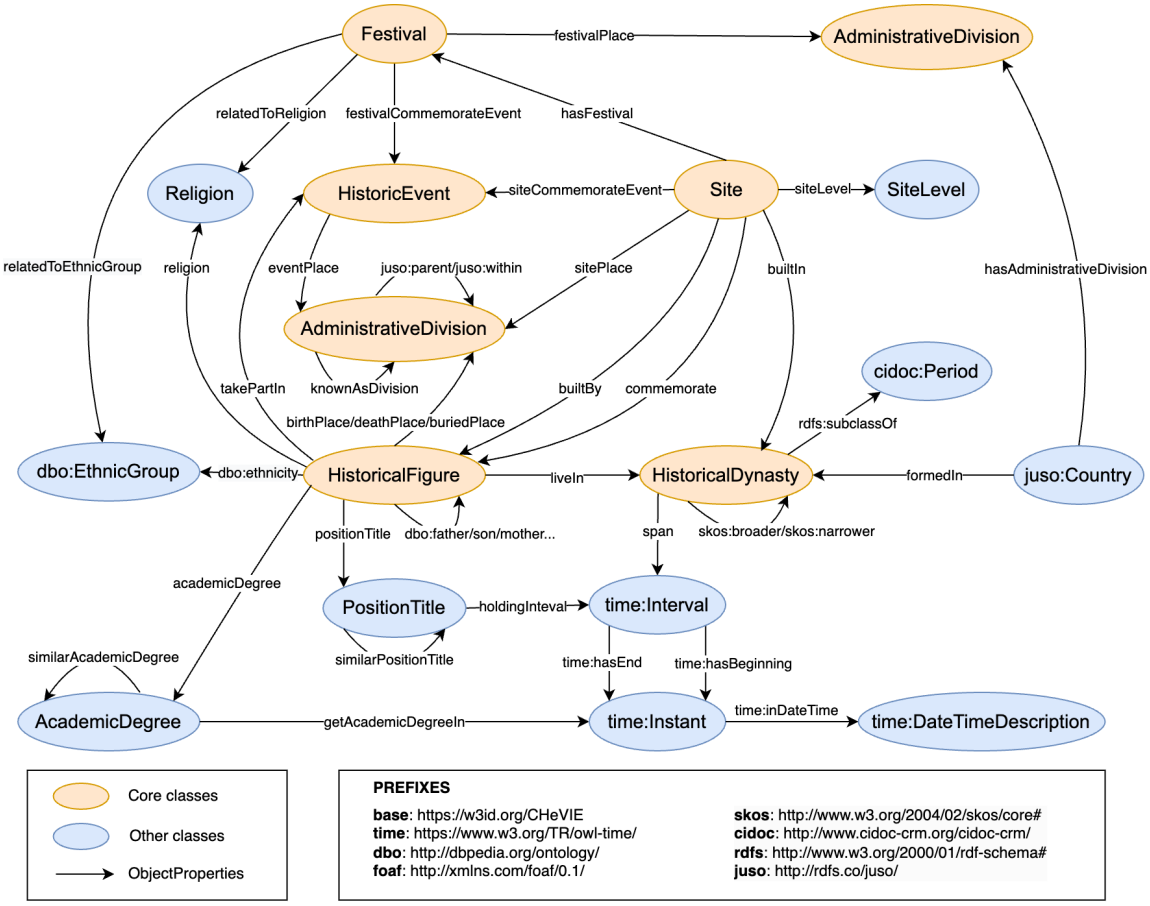

Fig. 1. Main classes and properties of the ontology.

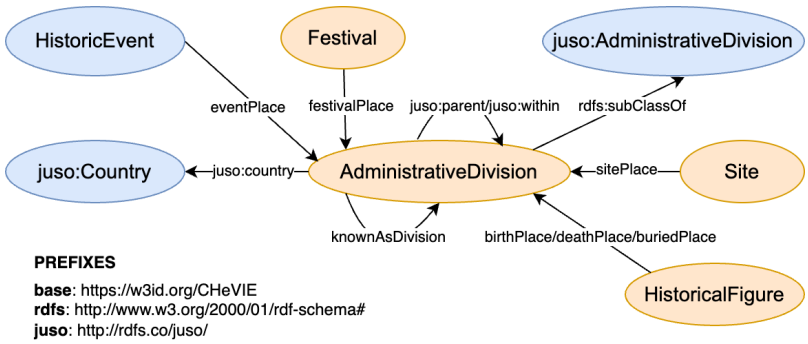

Fig. 2. Graph representation of the part of the ontology that describes administrative divisions. The connection to the JUSO ontology is done through the `AdministrativeDivision` concept.

Focus Areas	Related Concepts from Existing Ontologies	Ontology
Administrative Division	http://rdfs.co/juso/AdministrativeDivision	Juso
	http://data.ign.fr/def/geofla#UniteAdministrative	Ontologie des unités administratives de l'IGN
	http://stko-kwg.geog.ucsb.edu/lod/ontology/AdministrativeRegion	KnowWhereGraph Schema
Historical Site	http://dati.beniculturali.it/cis/Site	Cultural-ON
	https://www.cidoc-crm.org/Entity/e71-man-made-thing/version-6.2.1	CIDOC-CRM
	http://vocabularies.unesco.org/thesaurus/concept14272 (Temple)	UNESCO
Historical Dynasties	http://www.cidoc-crm.org/cidoc-crm/E4_Period	CIDOC-CRM
Historical Figure	http://xmlns.com/foaf/0.1/Person	FOAF
Historic Event	http://semanticweb.cs.vu.nl/2009/11/sem/Event	
	http://purl.org/NET/c4dm/event.owl#Event	The Event Ontology (motools)
	https://w3id.org/MON/event.owl#Event	MON
	https://www.cidoc-crm.org/Entity/e5-event/version-7.1.1	CIDOC-CRM
Cultural Festival	http://www.ontologydesignpatterns.org/cp/owl/recurrenteventseries.owl#RecurrentEventSeries	recurrent event series
	https://schema.org/Festival	schema.org
	http://dbpedia.org/resource/Festival	DBPedia

Table 1. Mapping of concept between the CHeVIE ontolgy and other relevant ontologies.

4.2 Historical Sites

We describe, now, in detail each of the site types introduced in Section 3.1.2:

- **Historical - Cultural sites** include construction works, places, relics, antiquities, and national treasures of historical, cultural, and scientific value. A Historical - Cultural Site must meet one of the following criteria: (1) Construction works and locations associated with typical national or local historical and cultural events; (2) Construction works and locations associated with the lives and careers of national heroes, celebrities, and historical figures who have positively influenced the development of the country or their locality in various periods.
- **Architectural Art Sites** encompass artistic architectural works, architectural complexes, urban architecture, and residence places that hold significant value for one or more stages of architectural and artistic development.
- **Archaeological sites** are archaeological locations of outstanding value that mark the development stages of archaeological cultures.
- **Landscape Sites** include natural landscapes or places that combine natural landscapes and architectural works of historical, aesthetic, or scientific value. A Scenic Landscape must satisfy one of the following criteria: (1) A natural landscape or a place that combines a natural landscape with an architectural work of significant

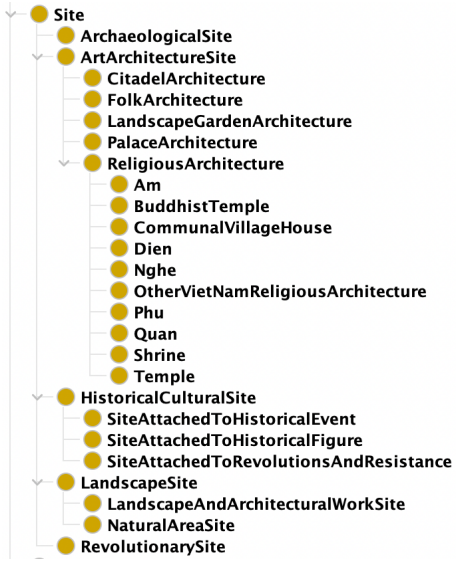

Fig. 3. Hierarchical representation of the part of the ontology that describes Sites/Monuments (using Protége).

aesthetic value; (2) A natural area with scientific value in terms of geology, geomorphology, geography, biodiversity, specific ecosystems, or natural areas containing material traces of the Earth's development stages.

- **Revolutionary Sites** are distinct from religious and belief sites such as communal houses, temples, pagodas, and shrines. Revolutionary Sites are specific locations and/or architectural works (e.g., houses, streets, tunnels) associated with significant events or historical figures that have become relics.

Figure 3 shows a subset of the CHeVIE ontology hierarchy for the `Site` classes and subclasses.

4.3 Historical Dynasties

In the CHeVIE ontology, the *Historical Dynasty* concept is defined as a subclass of CIDOC-CRM `Period` class. Specific historical dynasties, such as the Ly Dynasty or the Tran Dynasty, are represented as instances of this class rather than as classes themselves. This approach is taken because it eliminates the need to create additional instances of these dynasties. Moreover, by treating them as instances, we can annotate them with additional information, such as start and end times, descriptions of the dynasties, and more. This also allows for easy connections to other objects, such as historical figures or festivals associated with these dynasties.

4.4 Historical Figures and their Degrees

The CHeVIE ontology primarily focuses on depicting historical figures rather than ordinary people. Inheriting the `Person` class of CDOC-CRM, historical figures have basic attributes such as name, date of birth, birthplace, etc. Their most important attribute is the attached titles. Depicting historical figures involves three main challenges: (1) Vietnamese history spans many eras, each with its own title system; (2) Because the dates are not well documented, the birth and death years of many historical figures are often recorded as periods rather than exact dates; (3) Furthermore, the information is typically documented in a variety of sources, which may introduce bias.

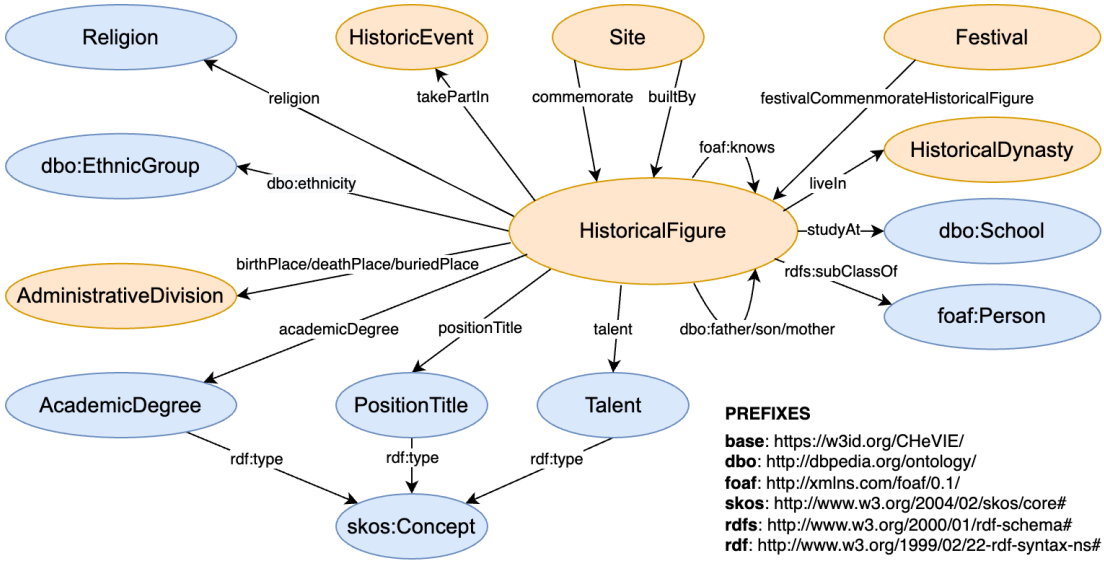

Fig. 4. Graph representation of the part of the ontology that describes historical figures

Historical figures are connected with other classes. We need to annotate the administrative unit they were born in, their educational level, ethnicity, and religion. The degrees of historical figures are represented through the `AcademicDegree` class. Rather than creating common instances of `AcademicDegree` and connecting them with historical figures, each historical figure will be associated with their own `AcademicDegree` instance. This allows us to annotate more information about the degree of each historical figure, such as the year the degree was obtained and the event associated with it.

The `HistoricalFigure` class is connected with their `Religion` via the `religious` property. The `Religion` class represents the types of beliefs or religions in Vietnamese history. Unlike the degrees, religion is composed of eight instances of the `Religion` class, including FolkReligion, Buddhism, Christianity, Catholicism, Protestantism, Hoahaoism, and Caodaism. `HistoricalFigure` is also connected to the `School` and `Talent` classes. We create subclasses of `Talent` class, including `Academics`, `Archery`, `Art`, `Financial`, etc. to annotate the detailed talents of each `HistoricalFigure`. Similar to the `Religion` class, these talents are generic so we do not create specific talent instances for each historical figure but rather general instances of talents connected to the historical figures.

The position of each historical figure within their dynasty is represented through the `PositionTitle` class, using the same approach as the `AcademicDegree` class. We create a class hierarchy with `PositionTitle` as the root. Each person has their title as instances of these classes, and the instances are annotated with detailed information, such as the time the person received the title or the period they held it.

The detailed classes and properties related to a `HistoricalFigure` are shown in Figure 4.

4.5 Historical Events

The classification of historical events is typically based on the event's content, structure, and significance [26]. We identify three ways to classify events as follows:

(1) Classification based on the content of historical events

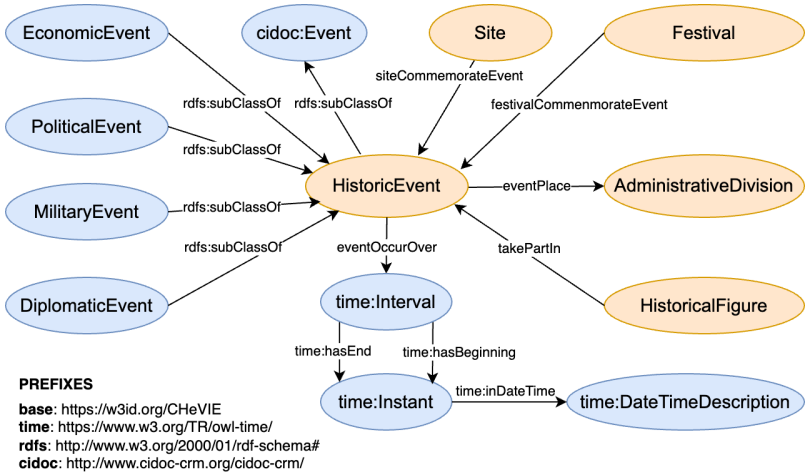

Fig. 5. Graph representation of the part of the ontology that describes historical events. Notice the links to other ontologies we re-use, here.

- Economic events: reflect the events, phenomena, and processes of the history of economic development
- Political events: reflect events and phenomena related to the historical process of political development, class struggle, war, revolution
- Military events: encompass military campaigns and battles
- Diplomatic events: refer to occurrences and activities related to diplomacy, involving the management of international relations between countries

(2) Classification based on the structure of events. Based on the location and time of historical events and phenomena, events are divided into two categories. (i) *Simple events* reflect a specific action or event identified at a certain point, within a short period of time. (ii) *Complex events* describe events that occur over a large time span and space, having a diverse and comprehensive nature.

(3) Classification based on the significance of historical events. Historical events are divided into two categories. (i) *Basic events* reflect occurrences, phenomena, and the laws governing a specific range of historical processes. These events have an impact on the development of subsequent periods; (ii) *Non-basic event* reflect occurrences and phenomena that, by historian agreement, lack significant importance, being minor in a historical process and leaving little profound impact on later development.

In the CHeVIE ontology, we use the first classification method to define four subclasses of the `HistoricalEvent` class: `EconomicEvent`, `PoliticalEvent`, `MilitaryEvent`, and `DiplomaticEvent`. Given that the history of Vietnam is closely associated with wars, historical events are mainly collected as `MilitaryEvent`. The superclass of `HistoricalEvent` is the `Event` class reused from the CIDOC-CRM ontology. The detailed classes and properties related to historical events are shown in Figure 5.

4.6 Cultural Festivals

The *Department of Grassroots Culture of Vietnam*, under the *Ministry of Culture, Sports and Tourism*, is the agency responsible for managing festivals across the country. They categorize Vietnamese festivals as follows: (1) Folk festivals

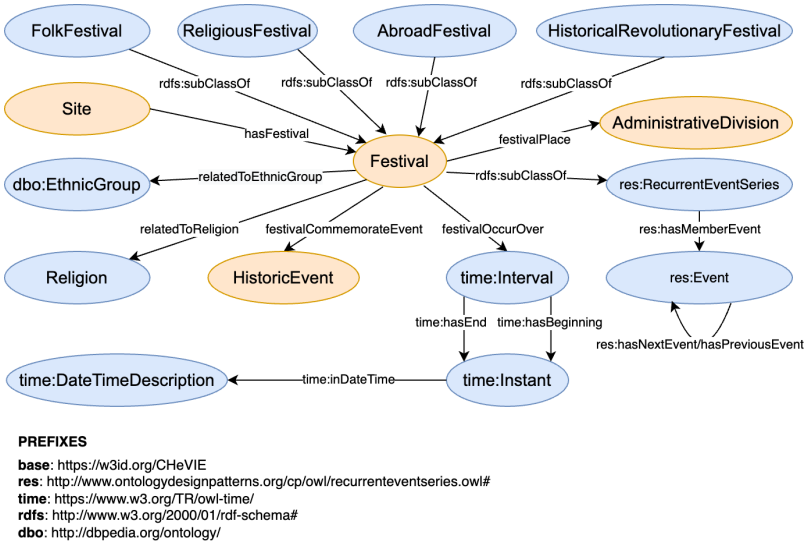

Fig. 6. Graph representation of the part of the ontology that describes historical figures. Note the links to ontologies we re-use in CHeVIE.

include 7,039 festivals, accounting for 88.36%; (2) Religious festivals include 5,449 festivals, accounting for 6.82%; (3) Historical revolutionary festivals include 332 festivals, accounting for 4.16%. (4) Festivals imported from abroad include 10 festivals, accounting for 0.12%; and (5) Others with 40 festivals, accounting for 0.50%. In total, there are 327 festivals managed by the provincial level in the whole country. The Ministry of Culture manages 8 festivals.

Following this classification, in our ontology, the `CHeVIE:Festival` class is defined as a superclass for all types of Festivals. Its subclasses are i.e., `TraditionalFestival`, `ReligiousFestivals`, `RevolutionHistoryFestival`, and `AbroadFestival`[21]. The detailed classes and properties related to a Festival are shown in Figure 6. Since festivals can be described as recurrent events, we reuse the `RecurrentEventSeries` class and its properties from [5]. Figure 6 represents the main classes and properties of the `Festival` class.

5 EVALUATION

In this section, we evaluate the CHeVIE ontology with respect to two factors: (i) ontology correctness and (ii) competency questions coverage. The evaluation process and results are detailed in the following subsections.

5.1 Ontology Correctness

We utilized OOPS! [22], an ontology-evaluation tool, to identify potential errors in defining concepts. The main functionality of OOPS! is to analyze ontologies and evaluate representation, domain, and annotation errors, among others. This tool categorizes errors into three severity levels, *Minor*, *Important*, and *Critical*. Addressing *Critical* errors is mandatory as they can affect the ontology's consistency. *Important* errors, while not critical, need to be corrected to ensure the ontology's meaning is well understood by users. Correcting *Minor* errors improves the organization and

[21] Vietnamese Festival Classification, http://vanhoanghethuat.vn/ve-phan-loai-le-hoi-hien-nay.htm, in Vietnamese

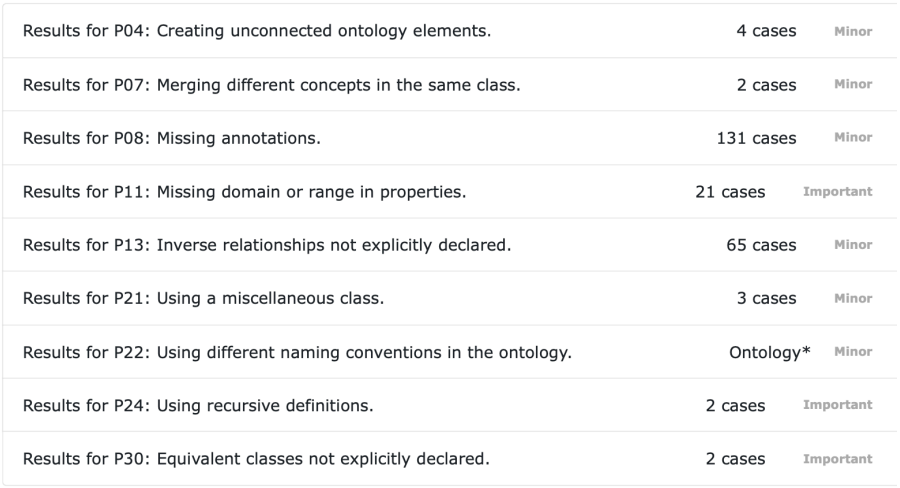

Fig. 7. A list of pitfalls detected by OOPS

user-friendliness of the ontology. We evaluated the initial version of the CHeVIE ontology with OOPS!, and it produced a total of three important errors and six minor errors:

(1) The first error (P11[22]) refers to missing attribute domains or ranges for some attributes. This error, however, is present in the imported ontologies such as SKOS[17], http://www.w3.org/2006/time#, http://www.w3.org/2003/01/geo/wgs84_pos#, and http://purl.org/dc/elements/1.1/. Therefore, it is not within our scope to correct these errors.
(2) The second error (P24) mentions the use of recursive definitions. Similar to the previous issue, this originates from the imported ontology (i.e., http://www.w3.org/2006/time#). Correcting this error is beyond our control.
(3) The last error, P30, involves detecting equivalences between two classes. For example, two classes, `King` and `Queen`, are declared as subclasses of `PositionTitle` without further characterization. Consequently, OOPS! considers these classes similar despite their different labels. To resolve this, we can add additional attributes to more clearly distinguish these classes. Similarly, `Point` and `Period` classes are detected as equivalents despite having different meanings. `Point` describes coordinates while `Period` refers to time periods. To clarify the differences, we add their types to the ontology.

OOPS! identified six minor issues in our ontology, which we detail below:

[22]We remark here that the OOPS! output identifies the errors with PXX, see Figure 7

(1) *P04 – creating connections between ontology elements.* The `Site` class lacks relationships to other classes in the ontology, despite having several related classes like `SiteAttachedToRevolutionsAndResistance` or `SiteAttachedToHistoricalFigure`. To address this, we can transform these related classes into properties of the Site class.
(2) *P07 – Merging different concepts in the same class.* Two classes, `LandscapeAndArchitecturalWorkSite` and `SiteAttachedToRevolutionsAndResistance`, attempt to represent multiple concepts within their URLs. We resolved this by changing the URL titles to represent a single concept.
(3) *P08 – Missing annotations.* This issue can be easily addressed by adding labels or comments to existing elements to provide more context and clarity.
(4) *P13 - Missing declaration of inverse relationships (*`owl:inverseOf`*).* This issue is inherited from the Time ontology and does not need to be addressed within our scope.
(5) *P21 - Creating a class to represent instances not in any sibling classes.* To resolve this, we can remove the detected classes and move related instances into the parent class, ensuring a cleaner hierarchy.
(6) *P22 - Inconsistency in naming elements.* This issue arises from inconsistent use of characters like "-" and "_". While it does not affect ontology performance, it can be resolved by standardizing the naming convention across the ontology

5.2 Competency Questions Coverage

To ensure our ontology can answer relevant questions, we developed a list of competency questions from users during the design phase (see Section 3.1 and Appendix A). We aimed to verify CHeVIEś ability to answer these questions by instantiating the ontology with relevant data and generating a set of sample queries based on our competency questions. The queries fall into six categories represented by instances of the classes, subclasses, and properties in our ontology: Administrative Divisions, Historical Sites, Historical Dynasties, Historical Figures, Historical Events, and Cultural Festivals. We collected 60 questions from experts across these six categories and created corresponding SPARQL queries. By running these queries, we assessed the answers and confirmed that the ontology provides correct responses to all the questions. A demo of the SPARQL queries is available online[23], and the list of questions is stored on GitHub[24].

6 DISCUSSION

This section discusses several challenges identified during the creation of the CHeVIE ontology and our approaches to addressing them. The challenges include: (i) integrating historical information from multiple sources (cf. Section 6.1), (ii) deciding between classes and instances (cf. Section 6.2), and (iii) addressing time uncertainty in historical data (cf. Section 6.3). All listings in this section will use the namespaces defined in Listing 1.

6.1 Historic information from multiple sources

History encompasses phenomena and events that occurred in the past, recorded in documents resulting from human cognitive activities. Historical records often come from various sources, and the information can be inconsistent or conflicting. Therefore, properly citing and sourcing all historical information is crucial, highlighting the essential role of the provenance ontology.

[23] CHeVIE SPARQL Query Editor, https://chevie.vn/sparql
[24] https://github.com/nguyenbahoang02/Semantic-web/blob/main/question.md

```
@prefix prov: <http://www.w3.org/ns/prov#>
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
@prefix time: <https://www.w3.org/TR/owl-time/>
@prefix : <https://CHeVIE.vn/ontology#>
```

Listing 1. Prefixes and namespaces used in the CHeVIE ontology

```
:S CHeVie:p :statement1 .
:statement1 a rdf:Statement, prov:Entity ;
    CHeVie:_p :object1 ;
    prov:wasDerivedFrom :<http://an.example.link> .
    prov:generatedAtTime "2022-09-05T00:00:00Z"^^xsd:dateTime .
```

Listing 2. Example of triple statements with provenance information.

```
:qtrung a :HistoricalFigures ;
    :deathDate :statement1 ;
    :deathDate :statement2 .
:statement1 a rdf:Statement, prov:Entity ;
    :_deathDate "1792-09-16"^^xsd:date ;
    prov:wasDerivedFrom :<http://example.org/resource1> ;
    prov:generatedAtTime "2022-09-05T00:00:00Z"^^xsd:dateTime .
:statement2 a rdf:Statement, prov:Entity ;
    :_deathDate "1792-09-15"^^xsd:date ;
    prov:wasDerivedFrom <http://example.org/resource2> ;
    prov:generatedAtTime "2022-09-05T00:00:00Z"^^xsd:dateTime .
```

Listing 3. Triple statements on "Quang Trung King"

Following the idea of Wikidata reification [30], the information is expressed indirectly rather than directly. Each CHeVIE:p property is accompanied by the CHeVIE:_p property. A triple (`:S CHeVIE:p :statement1`) collected from source `R` is represented as shown in Listing 2. For example, one data source might state that Quang Trung King was born on September 16, 1792, while another source might claim he was born on September 15, 1792. These conflicting pieces of information are annotated simultaneously as shown in Listing 3.

6.2 Class vs. instance

To construct the ontology, it is often necessary to decide whether to represent a resource as a class or an instance. We employ three criteria to guide this decision-making process: (1) Instances are preferred over classes because they facilitate connections with other instances. Connecting an instance with a class is compatible with RDF Schema and OWL Full but is outside the scope of OWL DL and OWL Lite. (2) We do not represent a concept as a class when there are no instances of that class or only one instance is created. (3) When the resource has descriptive information to annotate, we prefer to use instances rather than classes.

For example, there are two methods to annotate the academic degree of a person. (1) First, we can leave it as a class, and create its subclasses (e.g., `DoctorDegree`, `BachellorDegree`, `MasterDegree`). Assuming that Alice and Bob are

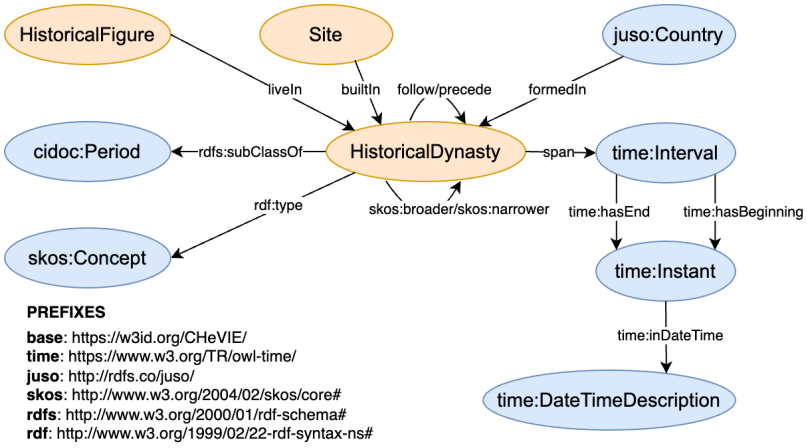

Fig. 8. Graph representation of the part of the ontology that describes Historical Dynasty. Note the links to other ontologies than CHeVIE.

two instances of `Person` class with the `DoctorDegree`, we would create two instances of `DoctorDegree`, i.e., `alice-DoctorDegree` and `bobDoctorDegree`. (2) Second, we can let `AcademicDegree` be one class, and `doctorTitle` and `professorTitle` be two instances of this class. Alice and Bob will be directly associated with the `doctorTitle` instance. Since we need to describe more information about Alice and Bob's degrees, such as the year they obtained their degrees, we will choose the first method.

`PositionTitle` is treated similarly to `AcademicDegree`. This approach allows us to represent and model that a person holds a position from 1900-1920 and another position from 1918-1950. The approach can represent the information of a person who holds multiple positions at overlapping time periods. We can query for information such as "*In the year 1900, what positions are held by whom?*".

Let us consider another example with the `Period` class. This class is based on the `E4 Period` class from CIDOC-CRM to express the name or definition of a period of time that has occurred in history. This class can accurately express the historical milestones of Vietnam. Vietnam's history can be considered in four main periods: `PrehistoricPeriod`, `AncientPeriod`, `ChineseDominationPeriod`, and `ModernPeriod`. The `PrehistoricPeriod` includes the `StoneAge`, `BronzeAge`, and `IronAge` periods. The`AncientPeriod` includes the `Van Lang` (Van Lang - first name of Vietnam) and `AuLac` (Au Lac - second name of Vietnam) eras.

To represent this information, we can let a period be a class or an instance. Periods such as `PrehistoricPeriod`, `AncientPeriod`, and `StoneAge` that include subperiods will be classes; periods that cannot be further divided are instances. This representation is inconsistent and will (1) make it difficult to query because we have to consider when a period is an instance or a class. (2) Moreover, it is impossible to consistently represent the `belongTo` relationship between historical periods, and which dynasties are in which period. (3) when there is a need to reorganize the time periods, such as adding or subdividing periods (e.g., dividing the Tran dynasty into 3 phases against the 1st, 2nd, and 3rd anti-Nguyen Mongols), it will affect the entire ontology. (4) It limits the ability to describe properties for instances, such as the start and end years of an era. (5) It is impossible to extend the general ontology to world history, as each country has a different historical periods/eras.

```
:advuong a :HistoricalFigures ;
    :deathDate :advuongDeathDateStatement .
:advuongDeathDateStatement rdf:type rdf:Statement, prov:Entity ;
    :_deathDate :advuongDeathDate ;
    prov:wasDerivedFrom <http://example.org/reference> ;
    prov:generatedAtTime "2022-09-05T00:00:00Z"^^xsd:dateTime .
:advuongDeathDate rdf:type time:Instant ;
    time:inDateTime :advuongDeathDateDescription .
:advuongDeathDateDescription rdf:type time:DateTimeDescription ;
    time:year "-206"^^xsd:gYear ;
    time:hasTRS <http://www.opengis.net/def/uom/ISO-8601/0/Gregorian> .
```

Listing 4. Example 1: According to one source, An Duong Vuong died in 207 BC. Note that there is no year zero; 1 BC is year 0, and 45 BC is the year −44

```
:advuong rdf:type :HistoricalFigures ;
    :birthDate :s1 .
:s1 rdf:type rdf:Statement, prov:Entity ;
    :_birthDate :advuongBirthDate ;
    prov:wasDerivedFrom :<http://example.org/referenceURL> ;
    prov:generatedAtTime "2022-09-05T00:00:00Z"^^xsd:dateTime ;
:advuongBirthDate rdf:type time:Interval ;
    time:begin :timeDescription1 ;
    time:end :timeDescription2 .
:timeDescription1 rdf:type time:DateTimeDescription ;
    time:year "-299"^^xsd:gYear ;
    time:hasTRS <http://www.opengis.net/def/uom/ISO-8601/0/Gregorian> .
:timeDescription2 rdf:type time:DateTimeDescription ;
    time:year "300"^^xsd:gYear ;
    time:hasTRS <http://www.opengis.net/def/uom/ISO-8601/0/Gregorian> .
```

Listing 5. Example 2: According to one source, An Duong Vuong was born between 310 BC and 300 BC

Thus, we let Vietnam's specific periods be instances of the CIDOC-CRM `Period` class rather than the subclasses of this `Period` class. The `include` (`belongsTo`) relationship between those periods is stated with `skos:broader` and `skos:narrower` properties (see Figure 8).

6.3 Time uncertainty in history

Ancient history usually does not have precise dates. To model such information, like the *Đinh dynasty* starting from 924 to 979, we use the time ontology. This is the ontology of temporal concepts for describing the temporal properties of resources in the world. The ontology provides a vocabulary for expressing facts about topological (ordering) relations among instants and intervals, along with information about durations and temporal positions, including date-time information. Moreover, time positions and durations may be expressed using either the conventional (Gregorian) calendar or another temporal reference system such as the Julian calendar, Lunisolar (e.g., Hebrew), Lunar (e.g., Islamic)

```
:quTrung rdf:type vnt:HistoricalFigures ;
    :deathDate :s1 .
:s1 rdf:type rdf:Statement, prov:Entity ;
    vnt:_deathDate :quTrungDeathDate ;
    prov:wasDerivedFrom :<http://example.org/referenceURL> ;
    prov:generatedAtTime "2022-09-05T00:00:00Z"^^xsd:dateTime .
:quTrungDeathDate rdf:type time:Instant ;
    time:inDateTime :timeDescription1 .
:timeDescription1 rdf:type time:DateTimeDescription ;
    time:year "1792"^^xsd:gYear ;
    time:month  "--29"^^xsd:gMonth ;
    time:day  "---07"^^xsd:gMonth ;
    time:hasTRS <https://dbpedia.org/page/Lunar_calendar> .
```

Listing 6. Example 3: According to one source, Quang Trung died on the 29th of July, 1792, in the lunar calendar.

```
:trieuDynasty a :Period ;
    :start :s1 ;
    :end :s2 .
:s1 a rdf:Statement, prov:Entity ;
    :_start :trieuDynastyStartDate ;
    prov:wasDerivedFrom :<http://example.org/referenceURL> ;
    prov:generatedAtTime "2022-09-05T00:00:00Z"^^xsd:dateTime .
:s2 a rdf:Statement, prov:Entity ;
    prov:wasDerivedFrom :<http://example.org/referenceURL> ;
    :_end :trieuDynastyEndDate .
    prov:generatedAtTime "2022-09-05T00:00:00Z"^^xsd:dateTime .

:trieuDynastyStartDate a time:Instant ;
    time:inDateTime :timeDescription1 .
:timeDescription1 a time:DateTimeDescription ;
    time:year "-206"^^xsd:gYear ;
    time:hasTRS <http://www.opengis.net/def/uom/ISO-8601/0/Gregorian> .
:trieuDynastyEndDate a time:Instant ;
    time:inDateTime :timeDescription2 .
:timeDescription2 a time:DateTimeDescription ;
    time:year "-110"^^xsd:gYear ;
    time:hasTRS <http://www.opengis.net/def/uom/ISO-8601/0/Gregorian> .
```

Listing 7. Example 4: The Triệu Dynasty lasted from 207 to 111 BC, according to a source

calendars, or Ancient Chinese calendars. We provided several example instances of our modeling approach as shown in Listing 4, 5, 6, and 7. To facilitate the SPARQL query for this representation, we can use the Property Path syntax[25].

[25] https://www.w3.org/TR/sparql11-query/#pp-language

7 CONCLUSION AND FUTURE WORK

Tourism is a vital component of any country's economy, and in Vietnam, there is a strategic focus on cultural and historical tourism to drive sustainable development, aligned with the Vision 2030 national development strategy. Recognizing this, we developed CHeVIE - a cultural tourism ontology for Vietnam, with a focus on historical and cultural domains rather than infrastructure or culinary aspects. Leveraging unique historical insights from Vietnamese history and tourism documents, CHeVIE comprises six main entities and integrates concepts from various ontologies such as CIDOC-CRM for cultural heritage and time ontology for temporal representation.

Our approach involves incorporating provenance information and utilizing the time ontology to handle historical uncertainty, ensuring robust data integration and accurate representation of historical facts. While our methodology can serve as a reference for similar ontologies in other countries, it's essential to develop historical and cultural tourism ontologies tailored to each country's specific characteristics and legal regulations.

We assessed the ontology's syntax using OOPS and its representational semantics through competency questions, confirming its reliability and efficacy. The ontology holds promise as a foundational dataset for Vietnamese tourism applications, contributing to the advancement of the industry. Looking ahead, our goal is to integrate the ontology into a Question Answering system centered on historical and cultural tourism in Vietnam. Our strategy involves gathering data from various sources such as travel websites, DBpedia, Wikipedia, and Wikidata to populate the ontology. This populated ontology will serve as the foundation for generating training data to fuel the QA system.

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A COMPETENCY QUESTIONS FOR THE CHEVIE ONTOLOGY DOMAIN AND SCOPE.

1. Historical sites
   - What kinds of <historical_site> can be found in Vietnam? (note: can be, for example, a building, a mountain/hill, a scene of a fight, etc.)
   - Is a river, where a historical fight took place, a <historical_site>?
   - What kinds of religious architecture (specific type of <historical_site>) can we find in Vietnam?
   - Where is <historical_site> located?
   - When was <historical_site> constructed?
   - Who built <historical_site> and when?
   - What landscapes and architectural works are there near a <historical_site>?
   - Which site characteristics (e.g., construction year, to whom it is dedicated, related festival, etc.) can I consider when choosing a site to visit?
   - What is the best representative of <historical_site> for <historical_site> type?
   - When was this <historical_site> renovated?
2. Administrative areas
   - Where is <historical_site> located?
   - What historical events happened at the <administrative_area>?
   - What are the famous tourist attractions in <administrative_area>?
3. Dynasties
   - What kind of position tiles do we find in Vietnam <dynasty>?
   - Which historical sites were built during <dynasty>?
   - What is the period of <dynasty>?
   - Which dynasty did <historical figure> serve?
   - Who is the king of <dynasty»?
   - Which <historical_site> were built during <dynasty>?
4. Historical figures
   - Which king (i.e., a type of historical figure) won the battle of <historical_event>?
   - What political or administrative position did <general> (a type of position title that a historical figure holds) receive?
   - Who has ever passed the <historical_event> (e,g., Huong, Hoi, Dinh) exam?
   - Which son of Tran Thai Tong is a talented military man/diplomat/general?
   - Who are the historical figures of <dynasty>?
   - What is the historical site that commemorates <historical_figure>?
5. Festivals (Recurring Event)
   - What <ethnicity> is this <festival> related to?
   - What <religion> is this <festival> related to?
   - When does this <festival> take place every year?
   - Which <historical_figure> does this <festival> commemorate?
   - What are the <festivals> related to this <historical_site> or <administrative_area>?

- How long (i.e., days, hours) does a <festival> typically takes place?
- How often does a <festival> typically took place?

6. Historical Events

- How are <site>, <festival>, <event>, <administrative_division>, <historical_figure> connected to each other?
- Which types of historical-tourism-related entities are available on the tourism department website?
- What general information is available for a site/festival/event/administrative division/historical figure?
- What general information is displayed in a city's department of tourism
- Which historical figure participated in <historical_event>?
- When did <historical_event> happen?
- During which dynasty did <historical_event> happen?

7. General and Reasoning question

- Who are the descendants of <historical_figure> that were born in <administrative_area>
- Which <historical_figure> lived in <administrative_area> level 1.
- Which types of entities should be considered for historical tourism?

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