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1. Archivi, edizioni digitali, organizzazione della conoscenza

Harmonizing and modelling a bibliographic ontology of imperial diplomas within the OntoVE Knowledge Base

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ABSTRACT

In this paper, I discuss the modelling of an ontological module for imperial diplomas relating to Veneto territories with the goal of adding value to the resources, by formalizing the contents to make the relationship between the diplomas and Veneto searchable through a dedicated User Interface. The harmonization of different bibliographic ontological models lies at the centre of our practice, and will enable a better description of the entities, thereby enhancing the subsequent interrogations of the ontology. The modelling is guided by the Knowledge Base competency questions, the nature of the sources and the context of production. The modelling approach described here aims to harmonize already established ontological models within the LOD community, such as FRBRoo and Bibframe. I will argue that this approach has several advantages, since it allows to keep CIDOC-CRM event-centric model through FRBRoo classes, and to enrich the module with finer-grained classes and properties as described in Bibframe, which also constitutes a standardized vocabulary for bibliographic description. I will propose a modelling of the contents of the diplomas as a performative act, to which information about the actors involved and the places is attached. In order for the users to locate the relevant diplomas, also the places mentioned in the diplomas are modelled as subjects of it. I will argue that reusing already existing ontologies and harmonizing them, rather than creating *ad hoc* classes, constitutes a more economic practice, which enhances interoperability of the module with already established standards.

KEYWORDS
Imperial diplomas; bibliographic ontology; reusability; interoperability.

1. INTRODUCTION

With this paper, I discuss the modelling of an ontological module of written records represented by imperial diplomas starting from the Carolingian Empire and regarding Veneto territories. The ontological module is embedded within a wider project with the goal of creating a knowledge base of Germanic Cultural Heritage items in the Veneto region, the OntoVE Knowledge Base, to highlight the relationship between different Germanic populations and the Veneto territories. The KB will result from the close collaboration between academic scholars and a partner non-academic IT institution, Net7; the methodological choices, with their testing and implementation phases, result therefore from both scholarly assessment and technical expertise.

The modelling is guided by the nature of the sources, their context of production and the competency questions underlying the KB under construction. Starting from the latter, the competency questions underlying our KB should enable scholars to investigate, among other aspects, the complex relationship between Germanic populations and the Veneto territories. As an example, a user interrogating the Knowledge Base should be able to retrieve answers to the following questions: In which area are cultural heritage objects pertaining to the cultural scope x mostly found? Which written sources can be found for the chronologic period A-B? In which period or in which area is written production mostly found? Which kind of cultural heritage artifacts prevail for a certain time frame?

The relationship between Germanic populations and the Veneto territories is testified both by archaeological findings, which provide information about which areas of Veneto the first settlements were located, and help gather insights about their strategic importance [11], and by imperial diplomas, for instance. The dataset included in the OntoVE Knowledge Base is therefore both specific, since a specific portion of real-world knowledge is being described, and diverse, since the items included are of heterogeneous nature. Two ontological modules are devised to capture the items of the KB. The description of archaeological findings is carried out through the OntoVE_Archeo module, which will communicate with the module devised for written records. In this paper, I describe the methodological choices underlying the semantic description of imperial diplomas.

Imperial diplomas, starting from Charlemagne after the conquest of the Lombard Kingdom, offer insights into the relationship between rulers of Germanic origin and the Veneto territories subjected to them. With respect to a time when Charlemagne was reorganizing the Empire, diplomas have a special position in witnessing different administrative acts

that help scholars gain insights into the relationship between the new Carolingian empire and the overthrown Lombard rulers and their successors.

2. MODELLING PRACTICE

Our modelling practice has as its centre the sources we are going to link in an Open Data environment; we decided to include collections that are already digitized and are openly accessible, in order to give scholars using our knowledge base and SPARQL endpoint the possibility of freely consulting the materials. The main source of data collection is the Digital *Monumenta Germaniae Historica* (dMGH, https://www.dmgh.de/), which consists in the digitization of the volumes edited in the course of the 19th and 20th centuries and curated by the *Monumenta Germaniae Historica* Institution. The digitized collection constitutes a step forward in the open circulation of documents and knowledge, but suffers from some limitations. By browsing the dMGH, for instance, one has the possibility of searching for text-strings within the whole collection, so one could look for the string *Venetia** and receive as results the portions of text in which is it found (https://www.dmgh.de/search?q=Venetia*). The results obtained from this kind of search, however, need further manual filtering out in order to locate the documents relevant to one's research questions. Such limits are well known in the research on Digital Humanities, cf. [2], and recent projects, such as MeMO [2] or STOLE [1] among others, show how Semantic Web technologies can overcome them by providing formalized descriptions of the dataset chosen, and by making the data searchable through dedicated SPARQL endpoints. Dedicated user interfaces can then provide the user with analytical tools for further inspection of the documents. I argue therefore that devising an ontology of such documents will add further value to the resources by providing formalized descriptions of their contents and context of production.

A first distinction in the model is made between the conceptual form of a written document and its different redactions. Such distinction is not new in the field of bibliographic ontologies, since different standards offer a version of this bipartition, in some cases articulated in subtler divisions, as shown in [12].

In particular, the diplomas are formalized in the redaction provided in the editions of the dMGH; the nature of the source constitutes a further factor in the modelling practice: in these editions, the contents of the diplomas are transcribed from various sources, listed in the introductory section preceding the diploma itself. The introductory section also contains claims about alleged falsification of the whole or parts of a given diploma. This kind of information is also relevant and modelled in our ontological module.

As is evident from the nature of the sources to be included in the ontology, therefore, the basic conceptual distinction between the *work* (i.e. the contents of a written document) and its *redaction* is relevant for our modelling. This distinction is further expanded through the models reused in the present ontology.

In the light of the best practices in Digital Humanities, the OntoVE module reuses established formal ontologies; in particular, we are reusing the model Functional Requirements for Bibliographic Records object oriented, FRBRoo, v. 2.4,[1] [4], since this merges CIDOC-CRM's [3] Event-Centric model with the formal division proposed in the FRBR ontology between *Work, Expression, Item* and *Manifestation* [4]. There are several advantages in reusing FRBRoo; as [7] writes, FRBRoo not only conceptualizes the characteristics of a work in its different forms, as the FRBR does, but also formalizes the events around the production of a certain document; moreover, it is more suitable for the resource description framework data storage since it is formalized according to the CIDOC-CRM model.

Furthermore, the adoption of this formal ontology within the OntoVE KB enables interoperability at the level of the knowledge base, since CIDOC-CRM is reused in the OntoVE_Archeo module mentioned in the Introduction; the FRBRoo model is in fact already aligned with CIDOC-CRM and reuses some of its properties and classes. As noted in the modelling of the OntoVE_Archeo module, the CIDOC-CRM and the FRBRoo models provide abstract and general classes and properties, which have the advantage of enabling the description of very diverse items, but are resistant to concrete implementation [2]. For this reason, classes and properties from finer-grained ontologies are added to the ontological modules of the KB. In the module under discussion, we are reusing the Bibframe ontology, which constitutes moreover a standardized vocabulary for bibliographic description and allows for finer-grained descriptions of the items and the events

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[1] A reviewer remarks that FRBRoo has been superseded by LRMoo in 2020; it must be noticed, however, that the LRMoo releases listed at https://cidoc-crm.org/frbroo/fm_releases (last accessed 01/05/2023) are all still in draft form, and do not therefore represent a stable version of the model, such as the November 2015 FRBRoo release, approved by IFLA, used in our project. As stated in the release page, a draft version "is subject to issues identified and discussed on the SIG mailing list. This release should be used only for the purpose of following ongoing modeling discussions, or ones of historical interest. This document is not meant to support implementations, referencing or other official activities." (https://cidoc-crm.org/frbroo/fm_releases, status). For this reason, the stable version of the model has been included in the present ontological design, since a stable version can be used for implementation and referencing. Once LRMoo provides a stable version of the model, the relevant changes will be carried out in our ontological design.

around the production of diplomas.[2] The two bibliographic models are then harmonized, i.e. their classes and properties are aligned within our ontological module, created with the editor Protégé Desktop, version 5.5.0 (http://protege.stanford.edu), [9]. More specifically, classes that are semantically overlapping are aligned by means of an assertion of equivalence, whereas finer-grained distinctions provided by the Bibframe model are assigned to classes or properties of the FRBRoo model.

An example of the modelling of a diploma is provided in Figure 1 (cf. below): the prefixes *frbroo*, *bf* and *cidoc-crm* refer to the FRBRoo, Bibframe and CIDOC-CRM classes and properties respectively. Dotted arrows indicate the individuals, whereas full arrows represent properties. Notice that in Figure 1 we are focussing on the modelling and harmonization of the most relevant classes, therefore further properties related to classes not relevant for the present discussion are not represented.

In a nutshell, the model proposed in FRBRoo separates the abstract work from its expression (e.g. a translation in a different language), the items conveying the contents of a work (e.g. printed or electronic editions of the abstract work) and the manifestation (e.g. a unique copy of a document conveying the abstract work). Thanks to this first modelling, the redaction of a work as it is conveyed in the print edition and derived digitized dMGH form can be separated from the contents of the work itself. The different layers convey therefore different kinds of information: for instance, information about the actors involved, the original places and dates of conception of the work, and the subjects of the work are attached to the top layer conceptualizing the abstract work (cf. Figure 1 below).

A further methodological step involved in the modelling of this ontological module regards the alignment of the Bibframe and the FRBRoo models; Bibframe [8] provides a rich and standardized vocabulary for modelling different items according to MARC 21 standards. In its original conception, this model foresaw only two formal layers distinguishing between the *Creative Work* and its *Instance*, i.e. between the conceptual nature of a work and its physical embodiment on a carrier, cf [12]. However, the current version of the Bibframe model consists of three layers: *Work*, *Instance* and *Item*. The first two classes are mapped in our module to the FRBRoo classes *F1 Work* and *F3 Manifestation Product Type* respectively. The finer-grained conceptualization offered in Bibframe allows to explicitly assert the nature of the *fbrbroo:F3ManifestationProductType/bf:Instance* through the specific classes *bf:Electronic* or *bf:Print*.

An area which needs testing and implementation is the alignment of the FRBRoo *F1 Work and F2 Expression* classes, the latter of which refers to a different verbal form of the contents (e.g. a translation). The *F2 Expression* class constitutes a further layer, which cannot be directly mapped to a Bibframe class. One might argue that this layer can be discarded, but it is, however, relevant in our ontology. In fact, even though the diplomas in question are all conveyed in the same language, we find a distinction between *F1 Work* and *F2 Expression* relevant since redactions of the same diploma might present variant readings. We propose to use this layer to conceptualize the dMGH redaction of a given diploma.

Intuitively, the FRBRoo class *F5 Item* might be directly mapped to Bibframe's *Item* class, but on further reflection, we decided to assign the *F5 Item* and the *F4 Manifestation singleton* classes as subclasses of Bibframe's *Item* class. In fact, the *frbroo:F5Item* class does not overlap semantically with *bf:Item* class. The *frbroo:F5Item* class refers to a single item of a work which is produced in series (e.g. a given copy of a printed book), whereas the *bf:Item* class refers to any single copy of a work, including thereby also manuscripts, which are formalized in FRBRoo with the *F4 Manifestation Singleton* class.

Harmonizing these two models presents the advantage of keeping CIDOC-CRM's original event-centric formalization and enriching the list of classes with a standardly accepted vocabulary. Moreover, it has been shown by [13] that mapping between FRBR and Bibframe is possible and does not usually result in loss of semantic descriptive force, once properties are adequately assigned to the different classes (cf. also the FaBIO Ontology for an example of an integrated FRBR ontology, [10]). I will argue that harmonizing the FRBRoo and the Bibframe models, which has not been undertaken yet in my knowledge, could lay the foundations for a reusable model, which goes beyond the specific portion of real-world that is being described within the OntoVE project.

The harmonization of the models allows furthermore attaching different kinds of information to different layers, as exemplified in Figure 1. For instance, the Bibframe *originPlace* and *originDate* properties, relating to the context of

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[2] A reviewer wonders why I did not decide to reuse the FaBIO Ontology [10]. This ontology, which constitutes a further example of an FRBRoo-aligned ontology, is not appropriate for the description of the items in our KB, since it is specifically designed for items that are the result of scholarly publication. For instance, the FaBIO *manuscript* class does not describe historical documents, but rather the manuscript version of e.g. a research paper. In our ontological module, the main aim is to separate the information regarding the conception of historical charters and the information regarding the published form included in the KB. The latter pieces of information also includes claims about different redactions of the same work, and potential interventions by compilers or transcribers of the same diploma. The FRBRoo quadripartite conceptualization of a bibliographic record is relevant for the goals pursued by the KB described, and constitutes a standardly accepted ontological module. This ontology, which is abstract enough to capture the different conceptual phases around the production of a written document, is complemented with finer-grained classes and properties from Bibframe.

production and ideation of the work, are attached to the *frbroo:F1Work/bf:Work* layer in order to give place and time coordinates for the conception of the work. The FRBRoo model foresees an *F27WorkConception* class and different properties relating to the creation of a work; however, the *originDate* and *originPlace* properties devised in the Bibframe model allow to directly assign to the diploma the date and place of issuance reported in the diploma itself. In fact, few information might be retrievable regarding the original conception of the act being issued with a given diploma. The alignment of the two ontological models allow to define contextual information more precisely.

The dates of publication of the critical editions, or the handles of their digitized versions, are instead modelled within the *fbrbroo:F3ManifestationProductType/bf:Instance* layer. This layer is also relevant for modelling the information conveyed in the editions regarding other redactions of the same work, as shown in Figure 1, where the property *bf:references* explicitly states that an *frbroo:F4ManifestationSingleton* individual is cited in the dMGH edition. This layer is also relevant for the encoding of statements about falsifying of (parts of) a given diploma, or claims about interpolation from different sources. For reasons of space, the properties relating the abstract work described in Figure 1 and this particular instance of *F4ManifestationSingleton* are not represented in Figure 1.

Since the single diplomas are collected in a unique volume, in our modelling we assign the description of the whole digitized volume to the *fbrbroo:F3ManifestationProductType/bf:Instance* layer and we model the information regarding the single pages conveying the redaction of a given diploma as items, as can be seen in Figure 1.

Finally, not only is an event-centric model relevant for the description of the events concerning the production of a document, as argued for above, but is also relevant for the description of the contents of the diplomas object of the present paper. In fact, such diplomas not only report about the bestowing or withdrawal of certain benefits, but also consist in their actuation, since the contents written are then effectively undertaken (or meant to be) in the real world. Therefore, one can view such documents as performative acts, and consequently model the act, which constitutes the content of the diploma, as an event. Each event is then linked to the actors involved. At the same time, these events are also modelled as subjects of the diploma itself, through the Bibframe *subject* property, which is also used to link the work to the places it refers to. This approach exploits both FRBRoo and Bibframe classes and properties to model the contents of a given diploma as performative events and as topics of it at the same time, thereby allowing to link the contents of a work to the places they are related to (cf. [1] for a similar approach). In this way, the ontology can be later queried via a SPARQL endpoint and the nature of the acts involving specific places can be further analysed by scholars and a wider audience interested in the relationship between the Veneto territories and the Germanic populations ruling over it. Finally, I will argue that reusing already established ontologies and harmonizing them constitutes a more economic approach in the field of LOD, rather than using *ad hoc* classes and properties, because it boosts interoperability with ontologies based on wide-spread standards.

3. FUTURE PERSPECTIVES

As mentioned in Section 1, this ontological module is embedded within the wider OntoVE project aiming at describing Germanic cultural heritage artifacts in the Veneto region; the KB under construction within the OntoVE project has the goal of providing a uniform shared description of such items, to make the ontologies interoperable with both national and international standards.

The module described in Section 2 will be subject to further testing through a local SPARQL endpoint, with the goal of assessing the semantic solidity of the harmonization of the reused ontologies and the adequacy of the model with respect to the competency questions underlying the KB.

As mentioned in Section 1, the approach undertaken in the module described in this paper was also adopted for the formal description of archaeological findings: in the project, formal ontologies such as CIDOC-CRM are reused and complemented with finer grained ontologies, such as ArCo, Architecture of Knowledge [5] for the archaeological module. The methodology employed for both models aims at aligning CIDOC-CRM and FRBRoo, which are abstract enough to capture a diverse array of items, with ontologies designed for a specific portion of knowledge. In this way, interoperability with both national and international standards is ensured, while at the same time a controlled vocabulary is used to define the individuals included in the KB.

I will argue that our approach can be further applied to different domains of knowledge and can serve as the basis for interactive analytical user interfaces. In fact, we aim to provide the users not only with a SPARQL endpoint, but also with a user interface where data are displayed via different perspectives, such as place or time maps, or aggregations of diplomas according to the rulers they were issued by. The goal is to let the user have a glance on the different acts performed by a given ruler, in an approach inspired by the Sampo Model for Letters [6].

The ontological module described here is carefully planned in order for it to be consistent with future implementations that can offer the users dynamic analytic tools.
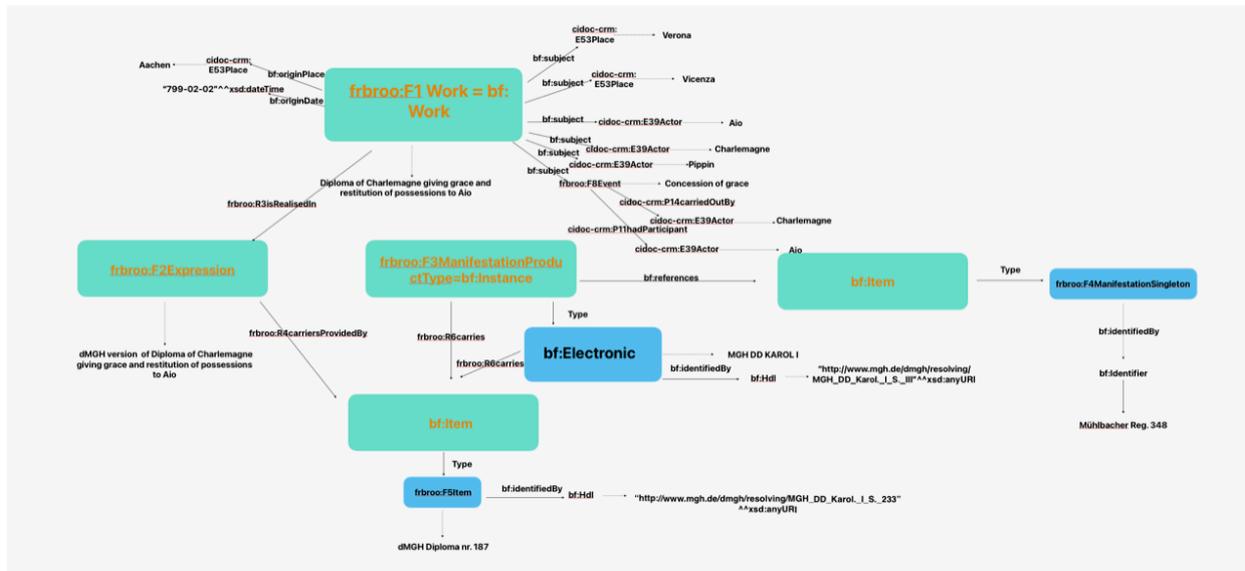
Figure 2. The OntoVE modelling exemplified through one diploma.

4. ACKNOWLEDGEMENTS

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