Towards a formal ontology for history of church administration

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Abstract. The paper presents preliminary results in the area of ontological engineering for historical research. Historical information systems are still in the initial stage of development. Our experience hitherto shows that the decisive stage in the development of such systems is a conceptual model and ontological engineering seems to be the right tool to build it. Our particular aim is to develop a database system for the history of the administrative structure of the Catholic Church in Central-Eastern Europe in the so-called pre-statical period, i.e. roughly from XII to XIX century. We use DOLCE as a foundational ontology, especially its part concerning social objects. We build an axiomatic system that formally defines the basic notions of those structures and may be interpreted as the conceptual scheme of this database.

Keywords. ontology of social objects, databases in historical sciences, administrative structure, church history

Introduction

History is not a favourite domain in ontological engineering. Perhaps one of the reasons is the fact that historical information systems are still in the initial stage of development and the issues of data integration and sharing are still some way ahead. That fact, however, may be interpreted as a motive for preparatory work in formal ontologies for history. So, instead of creating heterogenous systems that will need to be later re-integrated, we suggest that we should start with the ontologically-based sharable architectures. This paper presents some initial results in that area.

Our aim is to develop a database system to store information on history of the administrative structure of the Catholic Church in Central-Eastern Europe. Our initial experience with the subject shows that the decisive stage in the development of the system is a conceptual model of the objects and processes involved. It turns out that the domain in question is surprisingly complex, so we focused in this paper only on a selection of such entities. Namely, we present an axiomatic system that is supposed to formally define the following notions, which are considered in historical research as salient to the aforementioned domain:

1. beneficium ecclesiaticum together with its parts dos and officium

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2. parochia and beneficium parochialis
3. plebanus, patronus, and parochianus
4. territorium parochiae

We decided to stick to the Latin names because the English translations tend to change their semantic content and connotations. Table 1 provides the reader with the approximate translations.

Latin	English	German
institutiones ecclesiasticae	ecclesiastical institutions	Kirchliche Institutionen
parochia	parish	Pfarrei
beneficium ecclesiasticum	benefice	Kirchliche Benefizium
beneficium parochialis	parish benefice	Pfarrbenefizium
dos	endowment	Kirchenvermögen
officium	duty	Pflicht
ecclesia	church	Kirche
plebanus	parish priest	Pfarrer
parochianus	parishoner	Pfarrkind
territorium parochiae	parish territory	Pfarrkreis
ecclesia parochialis	parish church	Pfarrkirche
patronus	patron	Patron

Table 1. Bilingual translations of the Latin terms

Although the above selection is rather sparse, we needed 24 definitions and 21 axioms to characterise them with a medium degree of adequacy. The axiomatic system presented in this paper is envisaged as a small part of the more comprehensive formal ontology of sacral objects. We use the term "sacral object" without any prejudice to such ideological questions as the epistemic values of religious beliefs, social impact of religions, aesthetics of sacral art, and so on. A sacral object is understood here as an entity that is considered by some organised religious group as related to their beliefs in the supranatural being(s). In the case of more institutionalised religions some of these objects pertain to the administrative dimensions of these groups. This is our focus in this paper.

Obviously, the envisaged formal ontology of sacral objects (SacrOnt) will be a domain ontology. In order to avoid reinventing the wheel, we choose to "stitch" it up to a top-level ontology. After several unsuccessful attempts we found out that at the current stage of development the most suitable framework is provided by the DOLCE ontology - however, in section 5 we describe other possibilities.

The structure of the paper is as follows. First we briefly describe the current developments in historical databases. Section 2 summarises DOLCE's perspective on social entities and section 3 gives informal description of a place of sacral objects in that ontology. The next section is central to the paper as it presents in a formal manner our view on the sacral objects. Section 5 explains the reasons for choosing DOLCE as our top-level ontology and outlines other options. Finally section 6 presents the use of the SacrOnt formal ontology to construct a database schema to be populated with data from the ecclesiastical resources.

1. Databases in Historical Research

Applications of databases in the historical sciences have a tradition dating back to the 80s of the twentieth century. Major historical and geographical initiatives have shifted from the collection of data files to databases or networks of distributed databases (e.g., the U.S. National Historic Geographic Information System, Great Britain Historical GIS, The Belgium Historical GIS, China Historical GIS (CHGIS), The Electronic Cultural Atlas Initiative (ECAI), HGIS Germany – cf. [7]). However, most of the data collections concern the "statistical period" (XIX and XX century), where the quality of data is high, and does not go further into the past.

Such data collections are supported by systems known as HDBMS (*Historical Database Management System*) or TDBMS (*Temporal Database Management System*). Recent developments in geographical information systems have lead to the introduction of spatiotemporal databases (STDBMS). Their main advantage is the ability to record, store, analyze and share basic types of geometric attributes, including temporal descriptions. One of the most important research initiatives in Europe related to STDBMS was Chorochronos research project, which was funded by the European Commission in the late 1990s ([9]). One of the results of this project was a spatiotemporal extension of the Unified Modeling Language (UML) to support modelling of the historical phenomena. Also most of the modern database tools, both commercial and open source, enable the user to record spatiotemporal data (Oracle Spatial, PostgreSQL PostGIS, MySQL).

The existing solutions are optimised for collecting data at the time they appear (like live transactions or current statistical data) and for tracing their history. The approach to the past in historical research seems to be different. Past events are reconstructed from sources that are different from those available now. Consequently, the information collected is incomplete, uncertain and heterogenous, which makes it difficult to be stored in a database. Also, hardly any of the available systems have the capacity of representing intentional phenomena that prevail in human history. Our paper is one of the early contributions in this area.

2. Social Objects in DOLCE

DOLCE is a foundational ontology of particulars with a clear cognitive bias. In fact, its aim is to capture the ontological categories underlying natural language and human commonsense. For this reason the categories introduced in DOLCE are thought by its developers as "cognitive artifacts ultimately depending on human perception, cultural imprints and social conventions" [10, p. 13]. The categories are obtained by the analysis of the surface structure of language and cognition. In consequence, DOLCE's categories are at the so-called mesoscopic level, the level of the middle-sized objects we, as humans, perceive. This makes DOLCE particularly suitable as a basis for the domain ontology for history.

DOLCE provides a total of about 40 categories and 100 relations which are axiomatized by 80 axioms (see Figure 1). Each node in the graph is a category of the ontology. One category is a subcategory of another if there is a path in the graph from the former to the latter. The class of subcategories of a given category forms a partition except where dots are inserted.

The domain of discourse, i.e., of quantification, is restricted in here to particulars (see the top node of Figure 1), which means that universals themselves are not organized but only used for organizing and characterizing particulars.

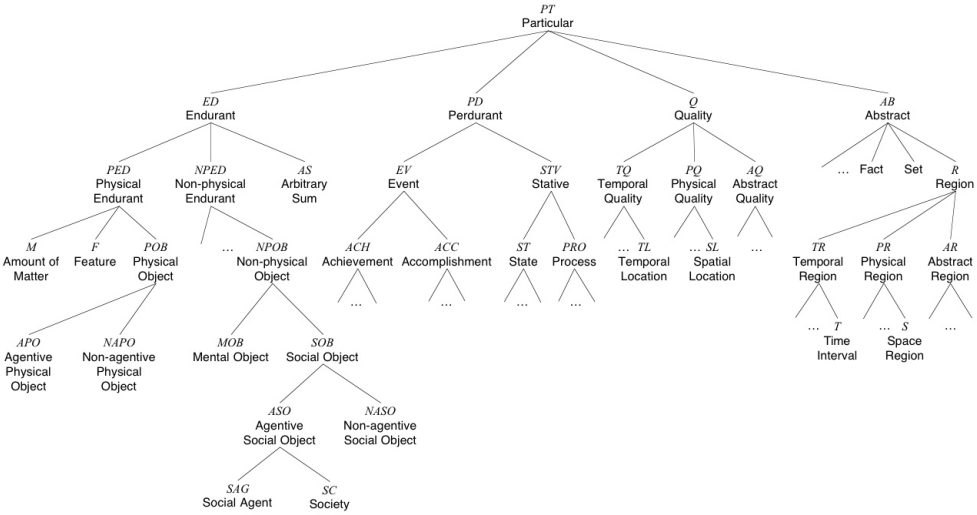

Figure 1. DOLCE taxonomy

Abstract entities are characterised as "existing neither in space nor in time", e.g., facts, sets, temporal and physical regions. On the other hand, concrete entities: endurants (e.g., a book), perdurants (e.g., my writing) and qualities (e.g., the weight of this object) "exist at least in time".

The categories of *endurants* (ED) and *perdurants* (PD) play here prominent roles. Endurants are entities that exist in time and all their parts are present at any time of their existence, whereas perdurants are entities that happen in time, and may be only partially present in the moment of time in which they exist. The main relationship between endurants and perdurants is *participation* (PC)—for any endurant there is always a perdurant in which it participates, and vice versa.

Applying DOLCE to history, we focused on non-physical endurants that depend in their existence on intentional phenomena or, strictly speaking, on social conventions. Object of that kind are dubbed the social objects (cf. [11,1]). DOLCE mentions three categories of social objects which we shall briefly describe below: *social concepts* (including the category of *role*) like theater, money, priest, *social descriptions* (i.e. the social conventions), and *social individuals* (including the category of *organization*) like NOKIA or The National Theatre in Warsaw.

Social concepts (CN) are those social objects that are defined (DF) by social descriptions (DS). Their main function is to classify (CF) other objects. If an entity is classified by a social concept (at some time) it means that (at this time) it satisfies all the constraints stated in the description of the classifying social concept (e.g. the piece of paper on my desk is classified as ten-zloty banknote because it satisfies all the constraints a ten-zloty banknote should satisfy in order to be considered as such). It is assumed that one entity

can be classified by different concepts in the same time. What is important to note is that social concepts do not change during their life, i.e. cannot change their definitions. It means that new descriptions define new concepts.

[11] restricts the domain of classified objects to endurants, however it also mentions the possibility of lifting this restriction. Indeed, [8] provides social concepts that classify perdurants and some abstract objects.

Social concepts that are anti-rigid (roughly, that are not necessary properties) and founded (roughly, that are definitionally dependent on other objects) are called *social roles* (RL). Everything that has been written above about concepts applies to roles as well.

Social descriptions are created by communities of intentional agents at the time of their first encoding in a language. They have a unique semantic content, however their internal structure can be complex: they can be decomposed into simpler descriptions. Descriptions must be encoded in some physical medium. They are usually accepted (adopted) by (communities of) intentional agents, but a description can exist even if no one accepts it, as long as it remains encoded. So, descriptions cease to exist when their last physical support ceases to exist. For the purposes of our formalisation, it is important to note that each social concept is defined by exactly one description[2]. A description must use at least one concept; obviously, one concept can be used by different descriptions. During their life, they always define and use the same concepts. Descriptions are usually created 'in the scope of' social individuals. As emphasised in [1], in order for a description to be *valid* for a social individual, a necessary condition is the occurrence of a social event in which both the social individual and the description participate.

Social individuals, similarly to concepts, are defined and can be used in descriptions, but they do not classify entities. The most interesting social individuals are agentive. They can create and accept descriptions, i.e. make them valid. It is often the case that one description defines both an agentive social individual (i.e., an organization) and a related social role. The agentive social individual acts "through" certain agents that are classified by this role.

3. SacrOnt as embedded in DOLCE

The ecclesiastic categories aforementioned in the introduction are embedded in the legal system and practice of the Catholic Church.[3] Obviously, their ontological content is not explicitly stated there and needs to be re-engineered, so to speak, from these sources. We started from the following definitions:

> Parochia stricte et proprie est certus territorii dictrictus per papam vel episcopum determinatus, habens unum rectorem stabilem, cum potestate populum ibidem existentem regendi et iudicandi, eique sacramenta aliqua divina administrandi. [2, p. 51][4]

[2] It is because in the extension of DOLCE on social objects [11] it is assumed that each description is defined by at least one description and that descriptions defining the same concepts are DF-extensional.

[3] We should rather say that they *were* embedded as the whole structure changed in the twentieth century, in particular after the Second Vatican Council.

[4] A parish is, in the strict and proper sense, a certain territory that is determined by a bishop or pope and has a constant governor who entertains the executive and judicatory powers and the power of administering divine sacraments to its inhabitants.

> Beneficium ecclesiasticum, de quo hic est sermo, est ius perpetuum percipiendi fructus ex bonis ecclesiasticis ratione spiritualis officii personae ecclesiasticae auctoritate Ecclesiae constitutum. [3, p. 1804][5]

> Unde iuspatronatus [...] sumptum definitur, quod sit ius seu potestas nominandi sive praesentandi clericum promovendum ad beneficium ecclesiasticum vacans. Est in re communis. Seu iuspatronatus est ius honorificum, onerosum et utile, alicui (1) competens in ecclesia, eo quod de Ordinarii consensu eam construxerit, fundaverit vel dotaverit; aut id a suis antecessoribus factum fuerit. [4, p. 1227] [6]

After several discussions with our SME (*subject domain expert*) in history on the actual content of these descriptions we established that the closest ontological category for the following notions are DOLCE's roles:[7]

1. beneficium ecclesiaticum (axiom 1) - in SacrOnt represented as BenEccl,
2. dos and officium (axiom 3) - in SacrOnt represented as, respectively, Dos and Officium,
3. parochia (axiom 2) - in SacrOnt represented as Parochia.

Moreover beneficium parochialis is also a role as a subcategory of beneficium ecclesiaticum.

The pivotal category here is beneficium ecclesiasticum. Definitions 8 and 9 imply that beneficium ecclesiasticum is construed as the mereological sum of two roles, i.e. Dos and Officium, that are defined by parts of the ecclesiastical description that erects institutiones ecclesiasticae.

Employing the notion role allows us to treat all aforementioned in the introduction categories of the administrative structure of the Church we selected as *sui generis* classifiers:

1. dos and officium classify plebani and patroni. To be more specific, we model beneficium ecclesiaticum as the composition of (exactly one) dos and (exactly one) officium (definition 8) and then within a single beneficium parochialis:
   (a) plebanus is classified *both* by dos and officium (definition 13):
      - SacrOnt categories Dos and Officium classify jointly through relation parochiaePlebanus certain non-physical agentive objects as plebani.
   (b) patronus is classified by dos but *not* by officium (definition 14):
      - SacrOnt category Dos classifies through relation parochiaePatronus certain non-physical agentive objects as patroni.

[5] A parish benefice, which is defined here, is the perpetual right to benefits from ecclesiastical properties because of the performed ecclesiastical duty, whose right has been constituted by the ecclesiastical authority.

[6] Thus, the law of patronage may be defined as the right of power to nominate or present a priest for a vacating parish benefice. It follows from the common law that the law of patronage is a honorary, comendable, and useful right that belongs to a person in a church [building] because this person has built, funded or furnished it according to the bishop's permission or because its ancestors did that.

[7] Table 2 mentions all concepts SacrOnt borrows from DOLCE.

2. Moreover, dos classifies certain concrete objects as ecclesiastical endowments (definition 11) and officium classifies certain events as actions that are considered obligatory for certain agents (definition 12).
3. parochia classifies parochianus (definition 15) and territorium parochiae (definition 16):
   - SacrOnt category Parochia classifies through relation parochiaeGens certain non-physical agentive objects as parochiani,
   - SacrOnt category Parochia classifies through relation parochiaeTerr certain features as parochiae territorii.

However this schema constitutes the point of departure from DOLCE. Axiom A11 in [11] implies that all objects classified by social concepts are endurants. This constraint is too strong for our domain where dos may classify both endurants (e.g., a windmill) and perdurants (e.g., certain services). In order to emphasise this difference, we use the symbol $\mathtt{CF}^*$ (instead of CF) to represent this extended relation of classification. Although $\mathtt{CF}^*$ classifies now also perdurants, for the sake of uniformity, we keep its temporal parameter.

Axioms 13–18 express the various aspects of the uniqueness of the ecclesiastical classifications.

Since in DOLCE roles depend on descriptions, so we include the so called ecclesiastical descriptions (EcclDS) that contain

- descriptions that define dos (EndDS) via relation fundatio,
- descriptions that define officia (EcclNorm) via relation creatio,
- descriptions that define institutiones ecclesiasticae (ErecDS) via relation erectio.

In fact, we crafted our ontology so that these descriptions are the only primitive notions - all other terms are defined with the help of the DOLCE categories. The three aforementioned relations, i.e. fundatio, creatio, and erectio are subtypes of DOLCE's DF. Note that the domain of church administration requires that besides DOLCE constraint to the effect that each concept is defined by (DF) at most one description we should also have other constraints that concern our subtypes of DF - see axioms 8–10.

We should note that our formal-ontological analysis revealed the ontological ambiguity of the term "officium" as used in the church documents. It turned out that the term denotes both the *role* that classifies certain actions and the *description*, or more specifically a norm, that defines the aforementioned role. Other terms, e.g., "parochia", suffer from the similar problems.

The full formalism is presented in the next section. Table 3 lists all specific categories of SacrOnt. We should emphasise that the current formalism constitutes only a small fragment of the whole ontology. Consequently, we included certain notions that we will use in the more comprehensive subsequent version, e.g., institutiones ecclesasticae.

4. Formalism

In the formalism below all universal quantifications over whole formulas are left implicit. We make use of the standard priorities between connectives to avoid unnecessary bracketing. Terms with index "$_f$" are function symbols.

Expression	Meaning
$\mathtt{APO}(x)$	x is an agentive physical object
$\mathtt{CF}^*(x, y, t)$	x is classified by y at t where x can be *any* particular
$\mathtt{CP}(x, y)$	x is a permanent part of y
$\mathtt{DF}(x, y)$	x is defined by y
$\mathtt{DS}(x)$	x is a description
$\mathtt{ED}(x)$	x is an endurant
$\mathtt{Event}(x)$	x is an event
$\mathtt{F}(x)$	x is a feature
$\mathtt{lf}(x)$	life of x
$\mathtt{NAPO}(x)$	x is a non-agentive physical object
$\mathtt{P}(x, y)$	x is part of y
$\mathtt{PC}(x, y, t)$	x participates in y at t
$\mathtt{PP}(x, y, t)$	x is a proper part of y at t
$\mathtt{Pre}(x, t)$	x is present at t
$\mathtt{RL}(x)$	x is a role
$x + y$	the mereological sum of x and y

Table 2. DOLCE concepts used in SacrOnt

4.1. Salient definitions

Ecclesiastical subtypes of DF

(D1) $\mathsf{erectio}(x, y) \triangleq \mathtt{DF}(x, y) \wedge \mathsf{ErecDS}(y)$.

(D2) $\mathsf{fundatio}(x, y) \triangleq \mathtt{DF}(x, y) \wedge \mathsf{EndDS}(y)$.

(D3) $\mathsf{creatio}(x, y) \triangleq \mathtt{DF}(x, y) \wedge \mathsf{EcclNorm}(y)$.

Ecclesiastical subtypes of RL

(D4) $\mathsf{InstEccl}(x) \triangleq \exists y\ \mathsf{erectio}(x, y)$.

(D5) $\mathsf{Parochia}(x) \triangleq \exists y\ [\mathtt{DF}(x, y) \wedge \mathsf{ParDS}(y)]$.

(D6) $\mathsf{Dos}(x) \triangleq \exists y\ \mathsf{fundatio}(x, y)$.

(D7) $\mathsf{Officium}(x) \triangleq \exists y\ [\mathtt{DF}(x, y) \wedge \mathsf{EcclNorm}(y)]$.

(D8) $\mathsf{erectio}(x, y) \rightarrow \exists y_1, y_2, z_1, z_2\ \{[\mathtt{CPP}(y_1, y) \wedge \mathsf{fundatio}(z_1, y_1)] \wedge$
$[\mathtt{CPP}(y_2, y) \wedge \mathsf{creatio}(z_2, y_2)] \equiv \mathsf{benEccl_f}(x, z_1, z_2) \triangleq z_1 + z_2\}$.

8 is an implicit definition of $\mathsf{benEccl_f}$. That is to say, it specifies what it means that x is a beneficium ecclesiasticum that consists of dos z_1 and officium z_2, i.e., $\mathsf{benEccl_f}(x, z_1, z_2)$. Namely, z_1 and z_2 need to be defined by parts (respectively, y_1 and y_2) of the description (y) that defines x. The consistency of 8 is guaranteed by axioms 9–12.

(D9) $\mathsf{BenEccl}(x) \triangleq \exists y, z_1, z_2\ [x = \mathsf{benEccl_f}(y, z_1, z_2)]$.

(D10) $\mathsf{BenParoch}(x) \triangleq \exists y, z_1, z_2\ [x = \mathsf{benEccl_f}(y, z_1, z_2) \wedge \mathsf{Parochia}(y)]$.

Expression	Meaning	Status
$\mathsf{benDos}(x, y, t)$	x is classified as an (insititutionis) dos by y at t	defined
$\mathsf{BenEccl}(x)$	x is a beneficium ecclesiastice	defined
$\mathsf{benEccl_f}(x, y, z)$	beneficium ecclesiastice for (institutio ecclesiastice) x consisting of (dos) y and (officium) z	defined
$\mathsf{benEventum}(x, y)$	x is an event in the life of (beneficium ecclesiastice) x	defined
$\mathsf{benOfficium}(x, y, t)$	x is classified as an (beneficiorum) officium by y at t	defined
$\mathsf{BenParoch}(x)$	x is a beneficium parochialis	defined
$\mathsf{benVita}(x)$	life of (beneficium ecclesiastice) x	defined
$\mathsf{creatio}(x, y)$	(officium) x is established by y	defined
$\mathsf{Dos}(x)$	x is a dos	defined
$\mathsf{EcclesiaAedificium}(x)$	x is an ecclesia	primitive
$\mathsf{EcclDS}(x)$	x is an ecclesiastical description	primitive
$\mathsf{EcclNorm}(x)$	x is an ecclesiastical set of norms	primitive
$\mathsf{EndDS}(x)$	x is an ecclesiastical endowment description	primitive
$\mathsf{ErecDS}(x)$	x is a description erecting a church institution	primitive
$\mathsf{erectio}(x, y)$	(institutiones ecclesiasticae) x is established by y	defined
$\mathsf{InstEccl}(x)$	x is an institutiones ecclesiasticae	defined
$\mathsf{fundatio}(x, y)$	(dos) x is established by y	defined
$\mathsf{Parochia}(x)$	x is a parochia	defined
$\mathsf{Officium}(x)$	x is an officium	defined
$\mathsf{ParDS}(x)$	x is a description erecting a parochia	primitive
$\mathsf{parochiaeEcclesia}(x, y, t)$	x is classified as an ecclesia parochialis by y at t	defined
$\mathsf{parochiaeGens}(x, y, t)$	x is classified as a parochianus (ordinarius) by y at t	defined
$\mathsf{parochiaeMembrum}(x, y, t)$	x is classified as a parochiae membrum by y at t	defined
$\mathsf{parochiaePatronus}(x, y, t)$	x is classified as an (parochiae) patronus by y at t	defined
$\mathsf{parochiaePlebanus}(x, y, t)$	x is classified as a plebanus by y at t	defined
$\mathsf{parochiaeTerr}(x, y, t)$	x is classified as a territorium parochiae by y at t	defined
$\mathsf{parochEventum}(x, y)$	x is an event in the life of (parochia) x	defined
$\mathsf{parochVita}(x)$	life of (parochia) x	defined

Table 3. SacrOnt specific predicates and terms

Ecclesiastical subtypes of $\mathtt{CF}^*$

(D11) $\mathsf{benDos}(x, y, t) \triangleq [\mathtt{ED}(x) \vee \mathtt{PD}(x)] \wedge \mathtt{CF}^*(x, y, t) \wedge \mathsf{Dos}(y)$.

(D12) $\mathsf{benOfficium}(x, y, t) \triangleq \mathtt{Event}(x) \wedge \mathtt{CF}^*(x, y, t) \wedge \mathsf{Officium}(y)$.

(D13) $\mathsf{parochiaePlebanus}(x, y, t) \triangleq \mathtt{APO}(x) \wedge \mathsf{BenParoch}(y) \wedge [\mathtt{CF}^*(x, \mathsf{dos_f}(y), t) \wedge \mathtt{CF}^*(x, \mathsf{officium_f}(y), t)]$.

(D14) $\mathsf{parochiaePatronus}(x, y, t) \triangleq \mathtt{APO}(x) \wedge \mathsf{BenParoch}(y) \wedge [\mathtt{CF}^*(x, \mathsf{dos_f}(y), t) \wedge \neg\mathtt{CF}^*(x, \mathsf{officium_f}(y), t)]$.

(D15) $\mathsf{parochiaeGens}(x, y, t) \triangleq \mathtt{APO}(x) \wedge \mathtt{CF}^*(x, y, t) \wedge \mathsf{Parochia}(y)$.

(D16) $\mathsf{parochiaeTerr}(x, y, t) \triangleq \mathtt{F}(x) \wedge \mathtt{CF}^*(x, y, t) \wedge \mathsf{Parochia}(y)$.

Ecclesiastical perdurants

(D17) $\mathsf{Parochia}(x) \rightarrow \mathsf{parochVita}(x) \triangleq \mathtt{lf}(x)$.

(D18) $\mathsf{parochEventum}(x, y) \triangleq \mathtt{P}(x, \mathsf{parochVita}(y))$.

(D19) $\mathsf{BenEccl}(x) \rightarrow \mathsf{benVita}(x) \triangleq \mathtt{lf}(x)$.
(D20) $\mathsf{benEventum}(x, y) \triangleq \mathtt{P}(x, \mathsf{benVita}(y))$.

4.2. Auxiliary definitions

(D21) $\mathtt{CPP}(x, y) \triangleq \mathtt{CP}(x, y) \wedge x \neq y$.
(D22) $\mathsf{dos_f}(x) = y \triangleq \exists z, v\ x = \mathsf{benEccl_f}(v, y, z)$.
(D23) $\mathsf{officium_f}(x) = y \triangleq \exists z, v\ x = \mathsf{benEccl_f}(v, z, y)$.
(D24) $\mathsf{parochiaeMembrum}(x, y, t) \triangleq \mathsf{parochiaePlebanus}(x, y, t) \vee \mathsf{parochiaeGens}(x, y, t)$.

The consistency of definitions 22 and 23 is guaranteed by axiom 19.

4.3. Bridging axioms

(A1) $\mathsf{BenEccl}(x) \rightarrow \mathtt{RL}(x)$.
(A2) $\mathsf{InstEccl}(x) \rightarrow \mathtt{RL}(x)$.
(A3) $\mathsf{Dos}(x) \vee \mathsf{Officium}(x) \rightarrow \mathtt{RL}(x)$.
(A4) $\mathsf{EcclDS}(x) \rightarrow \mathtt{DS}(x)$.
(A5) $\mathsf{EcclesiaAedificium}(x) \rightarrow \mathtt{NAPO}(x)$.

4.4. Proper axioms

Subsumption axioms

(A6) $\mathsf{BenParoch}(x) \rightarrow \mathsf{BenEccl}(x)$.
(A7) $\mathsf{ErecDS}(x) \vee \mathsf{EndDS}(x) \vee \mathsf{EcclNorm}(x) \rightarrow \mathsf{EcclDS}(x)$.

Ecclesiastical definition uniqueness constraints

(A8) $\mathsf{erectio}(x_1, y) \wedge \mathsf{erectio}(x_2, y) \rightarrow x_1 = x_2$.
(A9) $\mathsf{fundatio}(x_1, y) \wedge \mathsf{fundatio}(x_2, y) \rightarrow x_1 = x_2$.
(A10) $\mathsf{creatio}(x_1, y) \wedge \mathsf{creatio}(x_2, y) \rightarrow x_1 = x_2$.

Mereological axioms for beneficia ecclesiastice

(A11) $\mathsf{ErecDS}(x) \rightarrow$
$[\mathtt{CPP}(y_1, x) \wedge \mathsf{fundatio}(z_1, y_1) \wedge \mathtt{CPP}(y_2, x) \wedge \mathsf{fundatio}(z_2, y_2) \rightarrow y_1 = y_2]$.
(A12) $\mathsf{ErecDS}(x) \rightarrow$
$[\mathtt{CPP}(y_1, x) \wedge \mathsf{creatio}(z_1, y_1) \wedge \mathtt{CPP}(y_2, x) \wedge \mathsf{creatio}(z_2, y_2) \rightarrow y_1 = y_2]$.

Ecclesiastical classification uniqueness constraints

(A13) $\mathsf{parochiaeTerr}(x, y_1, t) \wedge \mathsf{parochiaeTerr}(x, y_2, t) \rightarrow y_1 = y_2$.
(A14) $\mathsf{parochiaeTerr}(x_1, y, t) \wedge \mathsf{parochiaeTerr}(x_2, y, t) \rightarrow x_1 = x_2$.
(A15) $\mathsf{parochiaeMembrum}(x, y_1, t) \wedge \mathsf{parochiaeGens}(x, y_2, t) \rightarrow y_1 = y_2$.
(A16) $\mathsf{parochiaeEcclesia}(x, y_1, t) \wedge \mathsf{parochiaeEcclesia}(x, y_2, t) \rightarrow y_1 = y_2$.
(A17) $\mathsf{parochiaeEcclesia}(x_1, y, t) \wedge \mathsf{parochiaeEcclesia}(x_2, y, t) \rightarrow x_1 = x_2$.
(A18) $\mathsf{benDos}(x, y_1, t) \wedge \mathsf{benDos}(x, y_2, t) \rightarrow y_1 = y_2$.

Other axioms

(A19) $\mathsf{benEccl_f}(x_1, y_1, z_1) = \mathsf{benEccl_f}(x_2, y_2, z_2) \rightarrow x_1 = x_2 \wedge y_1 = y_2 \wedge z_1 = z_2$.
(A20) $\mathsf{parochiaePlebanus}(x, y, t) \rightarrow \neg\mathsf{parochiaeGens}(x, y, t)$.
(A21) $x = \mathsf{benEccl_f}(y, z_1, z_2) \rightarrow \mathtt{CPP}(x, y)$.

5. SacrOnt outside DOLCE

SacrOnt	CIDOC CRM	SUMO	DOLCE
InstEccl	E73.Information_Object	Organization	RL
BenEccl			
Dos	E73.Information_Object	RegionalLaw / Contract	RL
Officium			
EcclesiaAedificium	E22.Man-Made_Object	Building	NAPO
EcclDS	E31.Document	RegionalLaw	DS
erectio	P67.refers_to	represents	DF
fundatio			
creatio			
parochiaeGens	shortcut/concatenation of P141.was_assigned by and P42.assigned	Classifying	CF*
parochiaeTerr			
parochiaeEcclesia			
parochiaePatronus			
benDos			
benOfficium			
parochiaePlebanus	shortcut/concatenation of P141.was_assigned by and P42.assigned	occupiesPosition	CF*
parochEventum	E5.Activity	IntentionalProcess	PD
benEventum			

Table 4. SacrOnt outside DOLCE

Our model of administrative structure of the Catholic Church is based on DOLCE. The main reason for this choice is its fragment that represents social objects. We found it useful that we could easily describe the following facts:

1. a document encodes a (social) description,
2. a description defines a (social) concept,
3. a concept classifies other objects.

In our opinion, this allowed us to simplify the structure of the resulting database mainly due to the use of the subtypes of DF we defined in SacrOnt.

Still, it is possible to locate SacrOnt's central categories also within other top-level ontologies. Table 4 shows this possibility for CIDOC CRM and SUMO. For most of SacrOnt concepts it has been rather difficult to find the adequate proper parent category in CIDOC CRM and SUMO, since in many places they are incompatible with DOLCE, which has determined our ontological choices. Although we tried to identify the

most suitable concepts, these mappings are rather imprecise. For some concepts (e.g., InstEccl, BenEccl) they are bound to change completely their meaning provided by the axioms and definitions of SacrOnt. On the other hand, some categories of CIDOC CRM might be seen as more suitable for our current formalism than DOLCE framework, e.g., E22.Man-Made_Object.

In sum, it turned out that in this case the efforts to keep the ontological neutrality of a given domain ontology from top-level ontologies are not as painless as in other cases (cf. [6]).

6. SacrOnt Database

SacrOnt **ontology**	**DB application**
APO	APO table
F	TERRITORIUM table
PC	table relationship
Parochia	PAROCHIA table
BenParoch	BENEFICIUM_PAROCHIALIS table
benEventum	BEN_PAROCHIALIS_EVENTUM table
parochEventum	PAROCHIAE_EVENTUM table
EcclesiaAedificium	ECCLESIAE_AEDIFICIUM table
parochiaePlebanus	(mediated) table relationship
parochiaeGens	(mediated) table relationship
parochiaeTerr	(mediated) table relationship
parochiaeEcclesia	(mediated) table relationship
parochiaePatronus	(mediated) table relationship
benDos	(mediated) table relationship

Table 5. SacrOnt database schema elements

We defined the above portion of SacrOnt with the aim to construct a database schema to be populated with data from the ecclesiastical resources. To this end, we selected a number of "leaf" nodes in the SacrOnt taxonomy together with the respective relationships - see table 5.

In order to deal with the temporal parameter of some of those relationships, we follow the method suggested in [5] and use perdurants as the so-called temporal pivots. Roughly speaking, in order to express the fact that, say, a certain agentive physical object is classified as plebanus at a certain time by a certain role, we find the relevant part of the life of this role, whose temporal boundaries coincide with this time, and use this role as our classifier. So it is not a role that classifies a certain object at a certain time, but a perdurant in which this role participates atemporally classifies this object.

The logical model (entity relationship diagram) of the resulting database is presented in figure 2, the physical model (server model diagram) is shown in figure 3. Both models where created using Oracle Designer and finally implemented in a Postgres database.

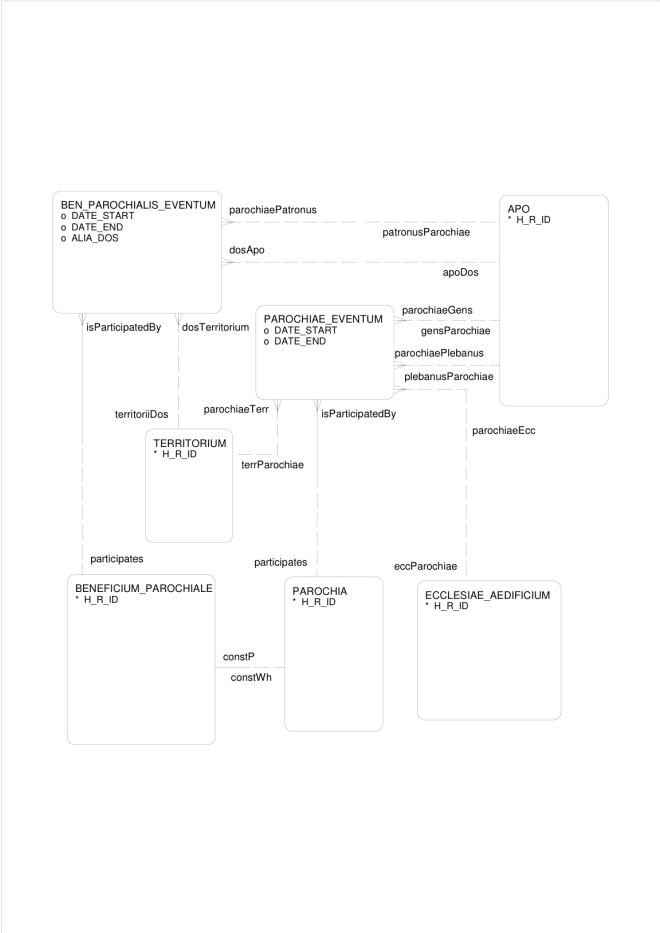

Figure 2.SacrOnt database logical model

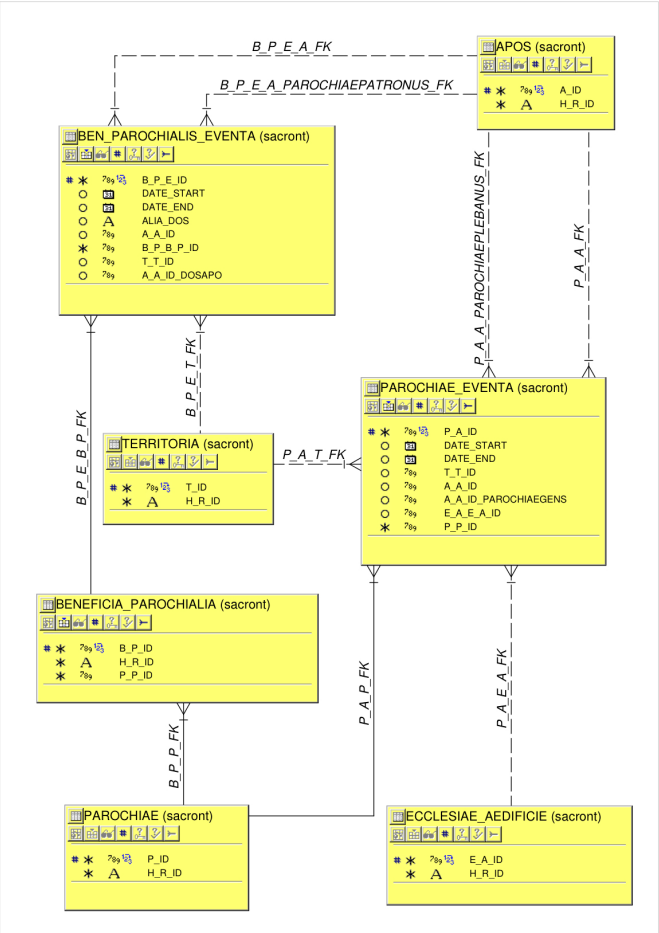

Figure 3.SacrOnt database physical model

7. Further work

The formal system presented in this paper is just a tiny part of the domain ontology that is needed to support the design of the database system for the history of the administrative structure of the Catholic Church in Central-Eastern Europe. The domain is broader and more complex than it appears at first. However, even our restricted study revealed the benefits of the formal-ontological approach. The conceptual framework we employed turned out to be subtle enough to disambiguate different meanings of such historical terms as "parochia" or "officium".

Besides adding new domain-specific concepts to the ontology (e.g., episcopus) we intend to extend it so that it would include concepts needed for spatio-temporal identifications. After all, we aim to provide a historian with a tool by means of which we would be able to locate such objects parochie in space and time.

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