

# An applied ontology-Oriented Case Study to Distinguish Public and Private Institutions Through Their Documents<sup>†</sup>

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**Abstract:** The institutions we create shape many of the activities we engage insofar as they are pervasive entities in our society. In an era full of new technologies, including the semantic web, there is a movement toward sound conceptual modeling for socio-technical solutions applied to government institutions. To develop these complex solutions, one needs to deepen the ontological status of entities in the institutional domain, because literature is full of ambiguous and ad-hoc hypotheses about distinctions between public and private corporations. We believe we can find better explanations for such distinctions in the interdisciplinary field of library and information science. Within an ongoing semantic web project, we focus on a study case of official documents. First, we analyze theories about public and private corporations, seeking a reliable ontological distinction between them; then, by focusing on documents produced by each type of corporation, we hope to provide a well-founded analysis. Second, we adopt the aforementioned theories and the new analysis as recommendations for the improvement for the access and understanding of public documents, through appropriate classification of them within government information systems. This project, ultimately, aims to maximize the transparency of public government documents by favoring retrieval and comprehension by a society with plenty of automated information systems.

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## 1.0 Introduction

Institutions have made significant investments in information and knowledge management initiatives, mainly through the development of information systems with increased sophistication. In developing these complex systems, in addition to several technological resources, one needs to study the ontological status of the entities that populate the corporate domain.

In this work, the operational definition of a domain will be applied to the electronic government (eGov) as a concept (Smiraglia 2016). This definition is derived from several empirical works and included the following main points: i) an ontological base with an underlying teleology; ii) a set of common hypotheses; iii) an epistemological consensus; and, iv) a reasonable consensual semantics. Within an ongoing semantic web project, which aims to increase the transparency of public government documents, we take advantage of the interdisciplinary aspect of library and information science (LIS) to develop a theoretical perspective through a case study of government budget documents. Our ultimate goal is to improve the access, retrieval, and understanding of key government documents by the society as a whole.

To reach this goal, our starting points, then, are studies in the field of applied ontology (Smith 2008, 2014; Smith et al. 2007). First, we analyze interdisciplinary perspectives on public government institutions and private business corporations. One might say that there is no difference between public and private corporations, but some believe that they are fundamentally different because each has a distinct purpose.

Thus, we first seek this ontological distinction on which to build a hypothesis focusing our analysis on documents. Documents are a core subject of LIS, and we believe that the documents produced and used by institutions are one of their most distinctive and illuminating features. Second, we apply the framework thus acquired to a semantic web project for electronic government (eGov) systems.

Key terms used here are “institution,” “corporation,” and “ontology.” In this paper, we follow Berle and Means (1932) in using the term “corporation” to denote modern institutions originating in the US, public or private. The word “ontology” as used here is a combination of metaphysical principles and computational techniques used in applied ontology (Munn e Smith 2013). We also use the phrases “ontology as discipline” and “ontology as artifact” to distinguish the two meanings of the term (Almeida 2013). As a complementary view, “social ontology” is the

term adopted to name studies within the ontology of social entities (Tuomela 2013).

To reach our goals, the paper is organized as follows. In Section 2, we introduce speech acts theory and document acts theory; in Section 3, we present the historical nature of institutions from interdisciplinary literature and our analysis for comparing private and public institutions; in Section 4, we describe a case study that focuses on documents for creating a model for government institutions; and finally, in Section 5, we discuss our findings and offer final remarks and suggestions for further research as well.

## 2.0 Background of social ontology

Since the 1990s, the use of the term “ontology” within computer science and information science is used to name both models as well as the theoretical principles that underlie those models. While the “spatio-temporal ontology” corresponds to an attempt to classify natural categories (Munn e Smith 2013), the “social ontology” is a kind of theory for social entities, which addresses human artifacts and social devices (Searle 2010). Sections 2.1 and 2.2 address ontology as a social theory, while Section 2.3 presents it as an artifact.

### 2.1 Speech acts: what can one do with words?

The theory of “speech acts” was proposed by John Langshaw Austin (1911-1960), a British philosopher of language, for whom one can “do things with words” (Austin 1962). For Austin, these forms of speech acts, which he considered the basic units of meaning, are constituted by three connected dimensions: locutionary acts, illocutionary acts, and perlocutionary acts. For example, in the proposition “I promise to pay you tomorrow,” there is an utterance (the verb promise) that constitutes the act of promising rather than the description of mental states. When a person utters the sentence, the promise is concretized; in other words, the force that characterizes the act is the promise (Almeida, Silva, and Brochhausen 2017).

The importance of speech acts in institutional contexts relies on their ability to bring about new social entities as obligations and claims to which promises and orders give rise. In Searle’s theory, institutions are created by a simple function: X counts as Y in C, where X is an entity and Y is the status of such entity in a context C (Searle 2010). For example, Trump (X) counts as president (Y) in the United States (C). Institutions are a particular case of this formula in which an issue emerges; there is no member X as a physical entity. This issue

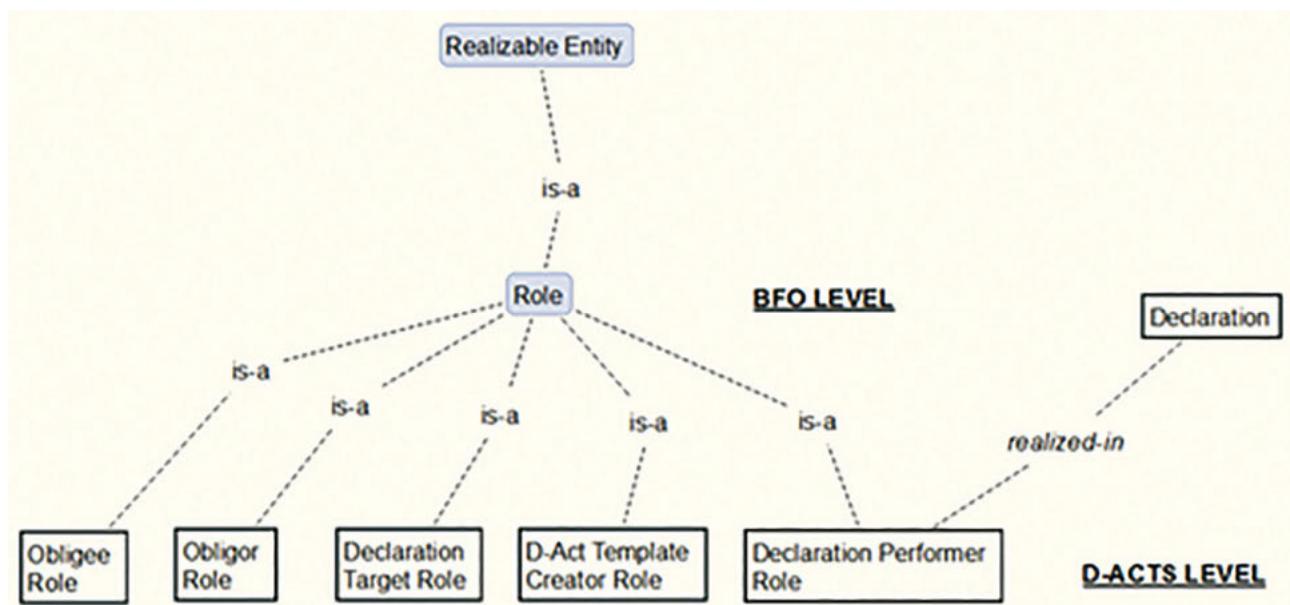


Figure 1. Roles in D-Acts Ontology.  
Source: Almeida, Ribeiro, and Barcelos (2020).

is solved by a divide called a “standing declaration;” they are of a certain kind that allows one to make something happen simply by promising that it will really happen. In the case of institutions, executing and fulfilling the statute of incorporation X counts as the creation and maintenance of a corporation Y within a specific legal code C (Searle 1976).

Thus, the institutional reality is created through speech acts by which duties and obligations are delivered throughout an institution, unfolding new forms of social interactions. However, the evanescence of speech acts, a consequence of their inherent orality, limits their possible impacts on institutional environments (Smith 2012).

## 2.2 Document acts: what can one do with documents?

While speech acts exist only in the moment of their performance, documents can also convey acts, allowing them to persist in time even while absorbing modifications through the document’s life cycle. This is the premise of the theory of “document acts” (Smith 2012); promises and obligations are established through speech acts.

The theory of document acts describes how people and institutions use documents to bring about new social entities. A document, as an input of a document-act, is the bearer of social and institutional powers (ethical and legal) that cause a variety of social effects. A document-act is a kind of process, for example, a contract (i.e., a document) brings about an obligation (e.g., to pay some amount of money) through a document-act (e.g., the process of signing the document); a statute of a corporation (i.e., a document)

brings about the existence of a corporation (e.g., with the obligation of delivering specific product or service) through a document-act (e.g., the process in which government stamps the statute of a corporation).

The modern institution requires a kind of document that endures over time, working as an input of acts that fulfill the obligations in different situations. We address here those additional functions of documents that, rather than only record information, create claims and obligations for people, as well as new social facts in society.

## 2.3 The Ontology of Document-Acts

The document acts theory was implemented for practical purposes through “document act ontology” (hereafter “D-Acts Ontology”) (Brochhausen, Almeida, and Slaughter 2013) using pre-existing resources of the Basic Formal Ontology (BFO) (Smith et al. 2007) and the Information Artifact Ontology (IAO) (Ceusters 2012). While IAO provides alternatives for representing information artifacts as documents that record information, D-Acts Ontology represents the kind of document used as an input of a document act to deliver obligations.

Figure 1 presents an essential branch of D-Acts Ontology that concentrates on the roles required to trigger document acts. Figure 2 presents another branch of D-Acts Ontology that gathers documents and the acts they contain. These two branches are linked by the class, “Declaration,” that appears in both Figures 1 and 2. Classes depicted by a shaded rectangle are not D-Acts Ontology classes, but BFO or IAO

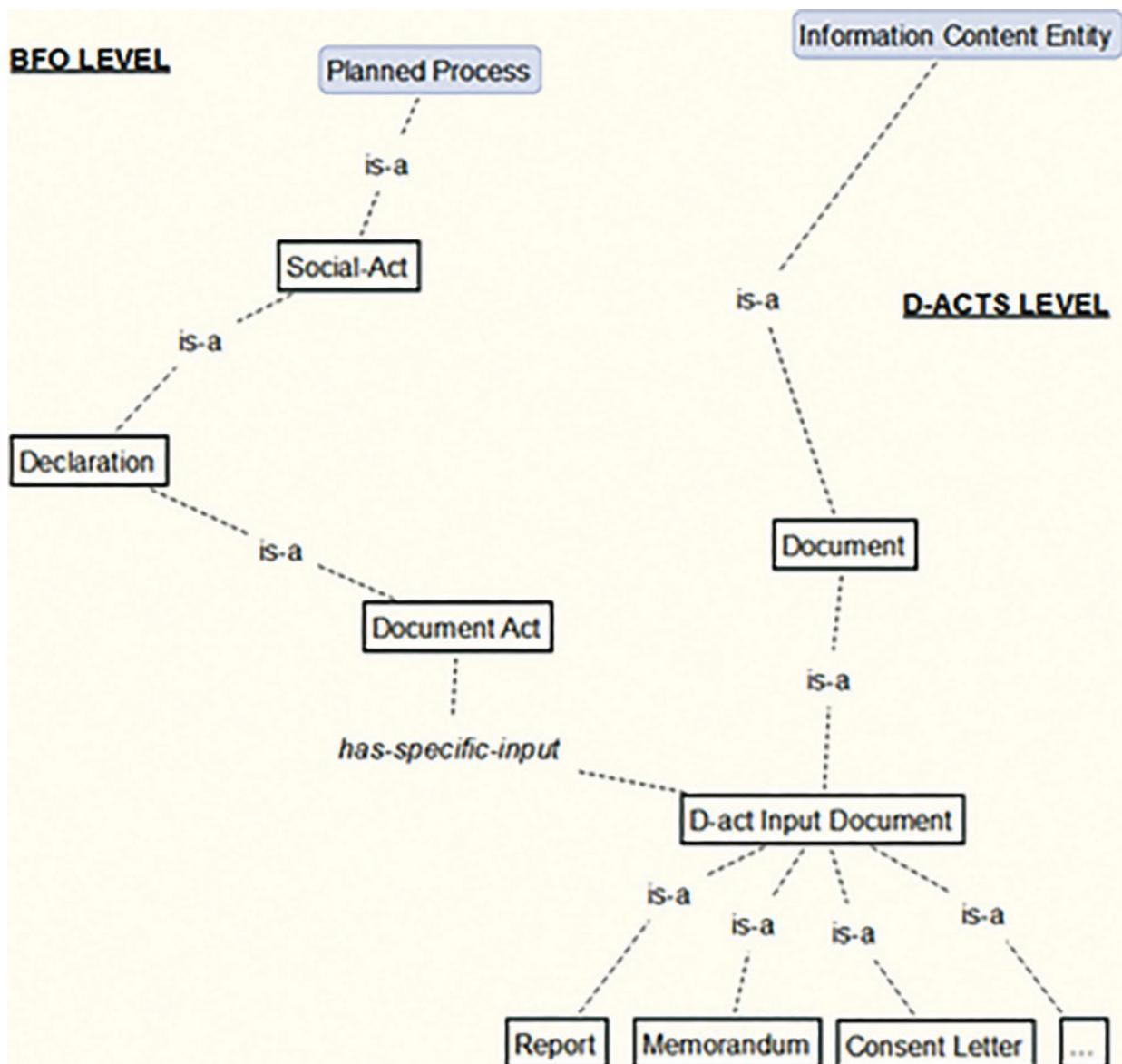


Figure 2. Document and document acts in D-Acts Ontology.

Source: Almeida, Ribeiro, and Barcelos (2020).

classes that illustrate the connection between the middle and the top-level ontologies.

D-Acts Ontology assumes that claims and obligations are subtypes of BFO's classes. Within this complex network of roles, acts, and realizations, one can explicate the basic operations of institutions. Using documents, people can trigger new processes while registering them for future assessments of responsibilities and performance.

### 3.0 Corporations: public or private?

In this section, we focus on finding the distinctions between two kinds of institutions, public and private corporations. The roots of institutions are briefly explained in Sec-

tion 3.1 and extended through excerpts of interdisciplinary literature in Section 3.2. In Section 3.3, we present our formulation for a distinction, using the speech and document acts theories.

#### 3.1. The nature of corporations—a brief overview

An understanding of institutions as legal entities had already existed when the English crown began to charter business organizations in the fifteenth century (Williston 1888). In this context, institutions have certain core attributes, which were adopted by jurists in America, where an institution began to possess additional legal attributes (Jones 1994). The classical formulation of institutional attributes

has come to be known as the “artificial person” doctrine, one of the several that arose to explain the notion of the corporate personality (Iwai 2007, 2010, 1999). US law maintains that a private or a public corporation must be treated as a person. Debates in countries like France, Germany, and Italy led to the emergence of different theories (Machen 1911): fiction theory, concession theory, group personality theory, bracket theory, purpose theory, Hohfeld’s theory, and Kelsen’s theory.

### 3.2 Interdisciplinary perspectives on private vs. public corporations

From the perspective of economic and management sciences, fields inherently interested in institutions, one sees significant contrasts in stakeholders and sources of funding. By definition, public organizations are funded by the citizens, while private organizations are funded by owners and shareholders. Indeed, issues regarding funding have a considerable impact on governance practices. The management field addresses the public/private distinction but does not present any fundamental characteristic that differentiates the two. Corporations operating in the private sector have many differences relative to public sector government units and agencies. Financial management, on the other hand, identifies as the source of the most significant differences: funding sources and the character of stakeholders (Allison 1992; Ciepley 2013; Meier e O’toole 2011; Rainey e Chun 2009).

Within the literature from information systems, one can find a variety of initiatives on international cooperation and research addressing corporate information systems in the context of semantic web. Studies like this do not present any theoretical concerns with public/private distinctions, even though identified as “ontological” (European 2016). Indeed, the use of conceptual vocabularies such as “public” and “private” often generates much more confusion than understanding, because each suffers from theoretical premises with contextual, historical, and temporal assumptions and connotations (Weintraub 1997).

Much of the contemporary debate is still characterized by the ambiguity of post-modernism biases, which prevents the clear development of alternatives (Ackroyd and Fleetwood 2000). There are even lines of thought that reject a clear boundary between private and public institutions (Ciepley 2013, p.139).

In addition to fields related to management, social ontology offers alternative methods for explicating distinctions between public and private institutions. The analysis of private organizations include two main dimensions: i) the descriptive dimension, which describes how to divide corporations into units and subunits; and, ii) the prescriptive dimension, which explains duties, obligations, and responsibilities that corpora-

tions have to manage (Brochhausen, Almeida, e Slaughter 2013). Theories introduced so far (Sections 2.1 and 2.2) can be used to formulate new alternatives.

### 3.3 Private and public corporations: are they different?

Ad-hoc views, including some presented here in previous sections, are not suitable for ontological studies that take a more serious and precise approach to the nature of entities as a key criterion for constructing a classification system. To advance an ontological analysis, here we try to understand the identity of entities.

The criterion of identity is usually attributed to the German philosopher Friedrich Ludwig Gottlob Frege (1848–1925), who asked how one can know whether “a” is identical to “b,” when “a” and “b” are entities. To answer this question from an ontological perspective, one should refer to the properties that objects of the same category share, to the extent that they are identical. From this perspective, the distinctive property is described in terms of essences—an Aristotelian principle embedded in the computational artifacts we adopt here, namely BFO, IAO, and D-Acts Ontology. In seeking essential properties, we rely on documents and their function – in bringing institutions into existence. Before presenting a final analysis, we need to present four preliminary distinctions.

The first distinction held is between natural things and human artifacts; for example, an orange is a “natural thing” and a car is a “human artifact.” Human artifacts are not natural things, since they maintain a trace of human intentions that were applied to their design, like cars, hammers, and software (Preston 2013).

The second distinction involves the word “public,” which has here the sense of something that can be known to all individuals in society. Artifacts depend not only on one human being or his individual intentional state but on the intentionality that transcends their creator (Thomasson 2009). For example, if someone creates a spoon, that spoon is recognized as something used to eat food. One can create your own “spoon” by folding a piece of cardboard, but even though it can function as a spoon, it would not be recognized as a “real” spoon: an object created for a specific purpose, by adult people, in a particular context. Thus, an institution is a human artifact describable by two aforementioned dimensions (Section 3): 1) the descriptive dimension, which is a spatio-temporal perspective; and, 2) normative dimension, which is a social perspective. The normative dimension is relevant here, because documents are artifacts working as inputs for document-acts, which convey rules and norms, through which people create and maintain institutions.

The third distinction, between individual and collective intentionality, develops the need for public norms. Collective intentionality is more than a collection of individual inten-

tional states; this fact explains much of the cohesion of a society (Tuomela 2013). In short, the creation of an artifact is subject to certain norms, because artifacts are recognizable as something that has to be used (i.e., applied) in a certain way (rather than in other ways) by an intended community and in a collective context (Dipert 1993). Considering the scope of human artifacts created for collective purposes, we follow Thomasson (2009) in considering the existence of public artifacts as the result of public norms in a process highly dependent on cultural aspects, despite the intentionality involved.

The fourth and last distinction addresses regulative versus constitutive rules (Searle 2010), which we employ to better explain the notion of a “public norm.” The former rule, which merely regulates, reflects acts performed independently of the rule. Constitutive rules not only regulate behaviors but also create the possibility of the existence of the same behavior they regulate. For example, “driving on the right side of the road” is a regulative rule that limits driving behaviors in which the act of driving is separated from the rule. On the other hand, there is no possibility of the game outside of chess rules; that is, the rules of chess create the possibility of chess.

Searle (2010) uses this distinction to explain how institutions are created by institutional facts that only exist through collective intentionality in the scope of a complex network of constitutive rules. For example, “John is a driver licensed to drive in the US” is an institutional fact that can exist only within a constitutive rule system collectively accepted within the US. One relevant last consideration of Searle’s framework is the kind of constitutive rule called a “standing declaration,” a declaration that has a doubled direction of realization. Searle (2010) explained the double direction within speech acts, and Smith (2012) extends it to documents explaining that a document, in one direction, is able to make a thing come to existence; a thing, on the contrary direction, can make changes in documents. For example, following the direction of realization human-mind to the world, a blueprint brings a building to existence; the building (follow the opposite direction, from human to mind) make changes in the original blueprint by replacing it with an “as-built” blueprint. This framework allows us to elaborate comparisons between public and private corporations, which constitutes the remainder of this section.

First, institutions, public or private, are human artifacts as they depend on human intentionality for their creation. As human artifacts, they must be public in the sense that they should be recognized as something associated with social use. To the same extent that a spoon could be made of cardboard (i.e., defined purely by function), one can also create a private corporation and maintain it for only personal use. In contrast, a public corporation cannot exist as a secret, and by definition, it cannot be a private tool.

Second, standing declarations make something happen by representing the possibility of the very same thing happening. For example, the existence of someone who satisfied the condition of being the oldest son of a dead king, in the context of medieval Europe, brought a new king to existence (Searle, 2010). By the same token, standing declarations also explain the creation of institutions: one declares that anyone who makes a declaration of a certain kind (in the context of a complex system of rules) will have constituted a corporation. Institutions, however, cannot be treated in the same way as the case of kings in old Europe, because they require explicit rules in the context of a complex legal structure and, thus, are dependent on written language. Documents have the power to accomplish these requirements. Such documents work as inputs for document acts that can create institutions.

Finally, the kind of document-act that creates a public corporation is different from the kind that creates a private corporation. While the former is a law, the latter is a statute of the corporation. Then, if we should point one distinctive and unique property of a document that makes evident the difference between public and private corporations, we choose the deontic powers embodied in the documents that create and maintain an institution. Besides, while a deontic power that creates public corporations emerges from society as a whole, the deontic power that creates private corporation emerges from a small group or only one individual.

#### 4.0 Case study: a government budget

In this section, we present an application of the theories described thus far to illustrate their practical utility. Section 4.1 describes how data was collected as part of our experiment; Section 4.2 explains the experiment itself.

##### 4.1. Collecting data: choosing a government document to test

To explore the characteristics of documents in corporations, we chose a budget. One can make budgets for several purposes, but “federal budgets” are public documents that work as a tool for planning by containing both revenues and expenditures within a given period. According to Brazilian law, the “Brazilian Federal Budget” (BFB) should be publicly available through an open linked data format for purposes of transparency. Thus, this public document made available is not the paper document; instead, a semantic model called the “Brazilian Federal Budget Ontology” (BFBO) (Araújo, Santos, and Silva 2015).

The website “Ontological Model for Expenditure Classification of the Brazilian Federal Budget” (available in Portuguese at <http://vocab.e.gov.br/2013/09/loa>) provides documentation as well as all BFBO datasets since 2000. We

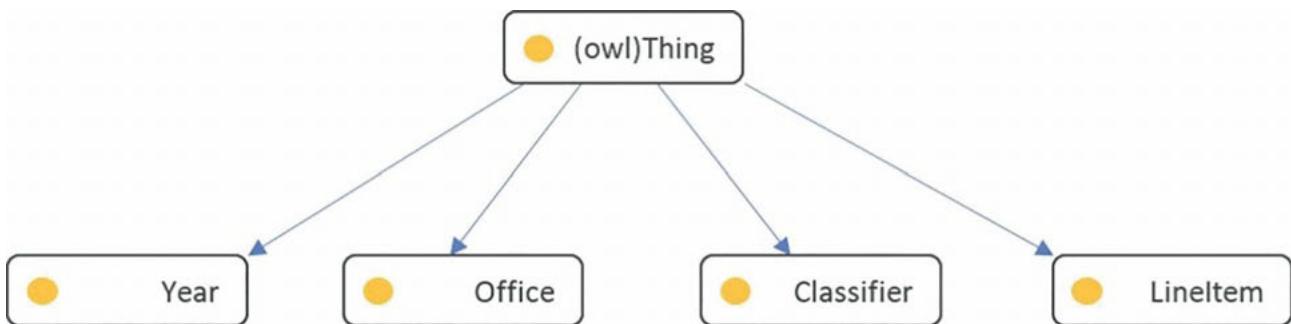


Figure 3. BFBO classes.

collected data about the predicted expenditures from this website.

#### 4.2 The experiment: building a new model

According to the ontological artifacts presented before (Section 2.3), we try to match of BFO's top-level classes to BFBO classes. BFBO reveals a poor classification structure. It is, in fact, just a list. It does not provide any organization in the form of generic classes but starts with the root concept "thing" and only uses representation languages typical from semantic web initiatives. Also, classes in BFBO are not adequately defined; for example, "year" is a property and not a class (Figure 3). In an even more simplified view, it can be said that the BFBO could have more semantic expressiveness if it were constructed as a thesaurus in which the relationships of the related term type (RT) were enriched. In the way that thesaurus are today, only the relations of the narrow term type (NT) and the broader term (BT) are supported. Studies show that the enrichment of RT relationships can help to understand and to retrieve information (Wu 2010).

To perform our experiment, we made BFBO classes fall under D-Acts and IAO models while maintaining BFO as the top-level. To follow the BFO framework and the kinds of concepts involved, some explanations of D-Acts and IAO models are necessary:

- An "information content entity" is an "object" that is about something, for example, as the content of a book can migrate from a paper book to a digital file.
- One level below this, a "directive information entity" is an "information content entity," for example, a consent letter provides a nurse the right to extract blood.
- One more level below, a "document" is an "information content entity," characterized as a collection of information content entities intended to be understood together.

On the other hand, IAO's "directive information entity" also encompasses devices that realize processes. Thus, a "directive information entity" is a kind of document that realizes acts, which is exactly the sense of documents within the D-Acts ontology. Under IAO's "directive information entity," we found a class "plan specification" that we have the sense of "planning," characteristic of a budget. In the context of D-Acts, a plan specification works as an input for a document act, which, in this context, represents all instances of Brazilian law involved in budget enforcement and approval.

From this, we created a class called "public budget," a subclass of plan specification as the starting point to better organize BFBO (Figure 4). With these and other amendments to the original BFBO, a new structure reflects a more suitable proposal of classification. By "suitable," we mean that the classes of the computational artifact received theoretical considerations to be classified and not defined in an ad-hoc way. Finally, it is worthwhile to say that we do not expect that formal frameworks do justice to the richness of the word "document" in the context of LIS.

#### 4.3 Testing the new model

One of the most relevant developments in seeking a formal framework that can be applied in eGov systems is the attempt to solve problems of interoperability between systems. As this work is part of an ongoing research project, the evaluation of the proposed ontology will be performed at another stage of the project. The planned assessment is a data integration experiment using BFBO as an intermediate ontology in the context of ontology-based data access (OBDA) methodology. Another possibility of validation is the interoperation between KOS, using the already existing vocabulary and taxonomies of the Brazilian government. Several research paths have proven promising to facilitate the implementation of ontology (Lei Zeng e Mai Chan 2004). The remodeling experiment presented in the previous section is part of an on-going project in which we have constructed a complete practical interoperability case. In

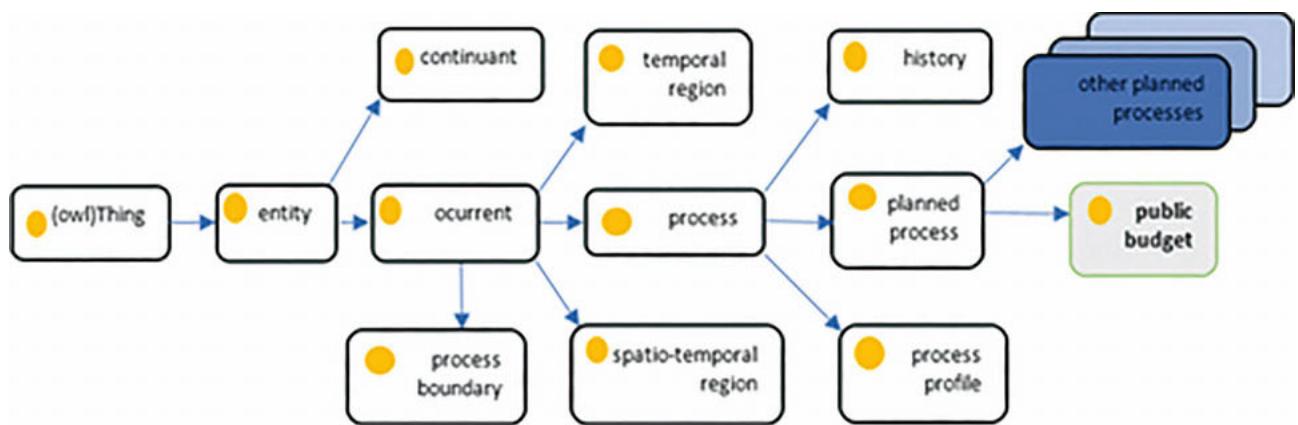


Figure 4. New BFBO classes and the “Public Budget.”

such an on-going project we: i) modify the public budget document using the ontological frameworks provided, adding new classes required to better represent official documents; and, ii) demonstrate the use of the new structure to retrieve data from BFB originally stored as a relational database.

## 5.0 Summary and conclusions

This paper introduces an ontological view that enables one to understand better, distinguish, and design eGov solutions. We began with an examination of the ontological status of institutions, emphasizing the weaknesses of ad-hoc hypotheses about the distinction of public-private. We focused our analysis on documents and used a formal framework to gather together theories of applied ontology and to present examples of applications.

We concluded that the kind of document-act that creates a public corporation is different from the type that creates a private corporation; while the former is a law, the latter is a statute of a corporation. Thus, this is evidence, a qualified one, of the differences between public and private corporations. We also highlighted that deontic powers embodied in the documents are responsible for creating and maintaining institutions.

The practical case verifies the possibility of using a public-domain ontology to build eGov solutions. We introduced D-Acts Ontology, which implements the theory of document acts and allows its practical use to describe how people and institutions use documents to bring about new social entities; we used a corresponding ontology to define classes within the socio-technical universe.

Finally, we hope to have provided a sort of template of tasks for designers and system developers for all their offices and public bodies, containing a solid theoretical foundation for the study of the eGov projects through ontological frameworks. By using this framework and its associated

tools, designers can take new perspectives and challenge heterogeneity issues within existing and new systems. In future research, we hope to provide an account of our experience with legacy systems in the context of the semantic web, in preserving such systems, and offering better services to citizens.

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