Social Participation Ontology: community documentation, enhancements and use examples

Renato Fabbri[1], Henrique Parra Parra Filho[2], Rodrigo Bandeira de Luna[2], Ricardo Augusto Poppi Martins[3], Flor Karina Mamani Amanqui[1], Dilvan de Abreu Moreira[1] Osvaldo Novais de Oliveira Junior[4],

1 Institute of Mathematical and Computer Sciences, University of São Paulo, São Carlos, SP, Brazil
2 Cidade Democrática, Instituto Seva, São Paulo, SP, Brazil
3 National Secretariat of Social Participation, General Secretariat of the Republic, Brasília, Federal District, Brazil
4 São Carlos Institute of Physics, University of São Paulo, CP 369, 13560-970, São Carlos, SP, Brazil, renato.fabbri@gmail.com

Abstract

Participatory democracy advances in virtually all governments and especially in South America which exhibits a mixed culture and social predisposition. This article presents the "Social Participation Ontology" (OPS from the Brazilian name *Ontologia de Participação Social*), implemented in compliance with the Web Ontology Language (OWL) standard, for fostering social participation, specially in virtual platforms. The entities and links of OPS were defined based on an extensive collaboration of specialists and socially engaged agents, a characteristic not found, by the authors, in other social participation-related ontologies. OPS is linked to other OWL ontologies as an upper ontology and via FOAF and BFO as higher upper ontologies, which yields sound organization and access of knowledge and data. It is shown that OPS is instrumental for retrieving contents of web portals, both in terms of actors and of mechanisms and activities. In order to further illustrate the usefulness of OPS, we present results on ontological expansion and integration with other ontologies and data. Ongoing work involves further adoption of OPS by portals maintained by State agencies and NGOs, and further linkage to other ontologies for social participation.

1 Introduction

Easy access to social media is reshaping citizen participation in government affairs [1]. Information and communication technologies (ICTs) have exhibited such an impact on the way individuals interact that it is giving birth to new organizational methods in social movements. These changes can be observed, for example, in the 2010 Arab Spring, the 2013 Brazilian protests, and the 2018 USA March for Our Lives. These events gathered millions of people and have shown direct and strong impact in governments and new laws, and the forecast is an intensification of the process [2–4]. Concomitantly, electronic government initiatives are flourishing, favored mainly by the ubiquity of Internet technologies (e.g. HTML 5, Node.js, open source browsers) and by the need for renewal of representative democracy practices. These initiatives have taken

place in various platforms, including usual social networks (e.g. Facebook, Twitter) and specialized instances created by both government and civil society parties [1, 5–7]. A natural challenge arises: how to link information produced into an unified knowledge base. This is being addressed, at the technology level, by semantic web developments. Endorsed by the World Wide Web Consortium (W3C), current semantic web technologies include [8]:

- reasoning by means of ontological specifications;
- linking data from different sources (e.g. datasets);
- organization of domain knowledge for coherent consideration.

Key among these technologies, ontologies are considered one of the pillars of the semantic web. An ontology is usually defined as a formal specification of a shared conceptualization [9]. They give meaning to data and are useful for datasets available on the web to make them automatically retrievable and linkable with other datasets. The W3C lead the creation of the Web Ontology Language (OWL) as a standard to represent ontologies on the web [10].

In this context, to describe and attribute formalized meaning to social participation, the "Common Vocabulary of Social Participation" (VCPS from the Brazilian name *Vocabulário Comum de Participação Social*) was proposed through a collaboration of Latin America academic, civil and governmental groups [11]. Started in 2012, by 2014 it already yielded relevant material, including a public preliminary OWL ontology with a concise taxonomy. Also important are the reference documents reporting results from a first working phase, from July to December, 2012. As stated by the community, VCPS was propelled by three goals: 1) ease adoption of the vocabulary; 2) stimulate the creation of public tools to understand, visualize and summarize how social participation was being performed; 3) meet the needs of participatory initiatives to open and link their data. It is important to notice that VCPS, an ontology, was called a *vocabulary* both to ease understanding of the general public and because it started as a vocabulary. The present article presents the "Ontology of Social Participation" (OPS from the Brazilian name *Ontologia de Participação Social*), based on VCPS, in which the term *vocabulary* was substituted by the term *ontology* for the following reasons:

- the usage of the word "vocabulary" can lead to confusion is some situations as OPS is an OWL ontology (not, for example, a SKOS vocabulary).
- Documentation seems inconsistent when an ontology is repeatedly called a vocabulary.
- OPS is, in fact, an ontology, with a vocabulary, a taxonomic organization and properties further relating the terms.
- This coherent naming is a prerequisite for academic acceptance and further formal adoption by government instances, such as the Brazilian Federal Portal of Open Data [1] and the Brazilian Federal Portal of Social Participation [12].

Also, the term *common* was dropped when OPS was conceived, as the term is redundant for an OWL ontology. The VCPS presented other difficulties, such as missing classes, incorrect URI specifications (e.g. containing spaces), some logical flaws, and unnecessary out-of-standards restrictions. This were all solved within OPS.

Next subsection briefly presents most relevant related work. Section 2 presents OPS and modifications made from VCPS to OPS: class and property names and labels, class

[1] http://dados.gov.br/

restrictions and property axioms. Section 3 is dedicated to OPS usage: dereferencing, SPARQL queries, a toy OPS expansion, a discursive example of usage, and use cases from government, civil society and academic parties. Concluding remarks are stated with future work, in Section 4. The Appendixes hold directions for the scripts that are used to obtain OPS, notes on restrictions that were in VCPS but withdrawn from OPS and an inspection of the first-hand documentation about VCPS (reference textual documents, images, OWL code, blog posts, discussions and Etherpads).

1.1 Related work

There is a number of OWL ontologies for Social Network Systems (SNS, e.g. [13–15]), although only few are dedicated to e-Participation (e.g. [16–18]). Most importantly, the ontologies described in [19] (OPa, OCD, Ontologiaa, and OBS) were developed in compliance with OPS, a fact further exploited in Section 3. The authors only found ontologies related to e-Participation, i.e. to social participation performed in virtual platforms. Thus, beyond the already cited constributions, authors considered suitable to mention some ontologies which may be related to social participation as to enhance their utility. Electronic Government (e-Gov) and Electronic Democracy (e-Democracy) ontologies are abundant (e.g. [20–29]), encompassing the expression of different institutions, processes and roles as linked data, and provide specific mechanisms for supporting social participation in the proposal, development and creation of public policies. Other examples of ontologies promptly related to OPS are those related to human needs and smart cities (e.g. [30, 31]). In summary, OPS is potentially unique in presenting a conceptualization about social participation in general (i.e. not only as performed through online systems), and in being a simple upper ontology that is the product of a collective effort.

2 OPS: the Ontology of Social Participation

This section makes considerations about OPS label standardization and implemented classes, properties and restrictions. Features present in Figure 1, but not present in VCPS, are fully described in Section 2.1. Usage examples are addressed in Section 3.

2.1 Standardization and implemented features

Without explicit criteria, VCPS URI was `http://lumii.lv/ontologies/Corais.owl`. OPS URI was chosen to be `http://purl.org/socialparticipation/ops` for the following reasons:

- This URI is directly related to the ontology name (OPS).
- This URI, also an URL, is independent from government and other political associations. This is important to coalesce interested parties: the Brazilian Federal Social Participation Portal [12], the Brazilian government repository of vocabularies and ontologies [32], academic groups, NGOs, and non-organized civil society.
- Derived URIs, when reached via HTTP, can be redirected to where current documentation is held, as it is hosted by `http://purl.org`.

Labels in the languages of interest should be written in label fields. Even so, we advocate that OPS class names should be user-friendly, bearing the attention not to take the class name as the label or as a meaning restriction. For standardization, all classes are written in CamelCase [33] in plain English to ease internationalization, adoption

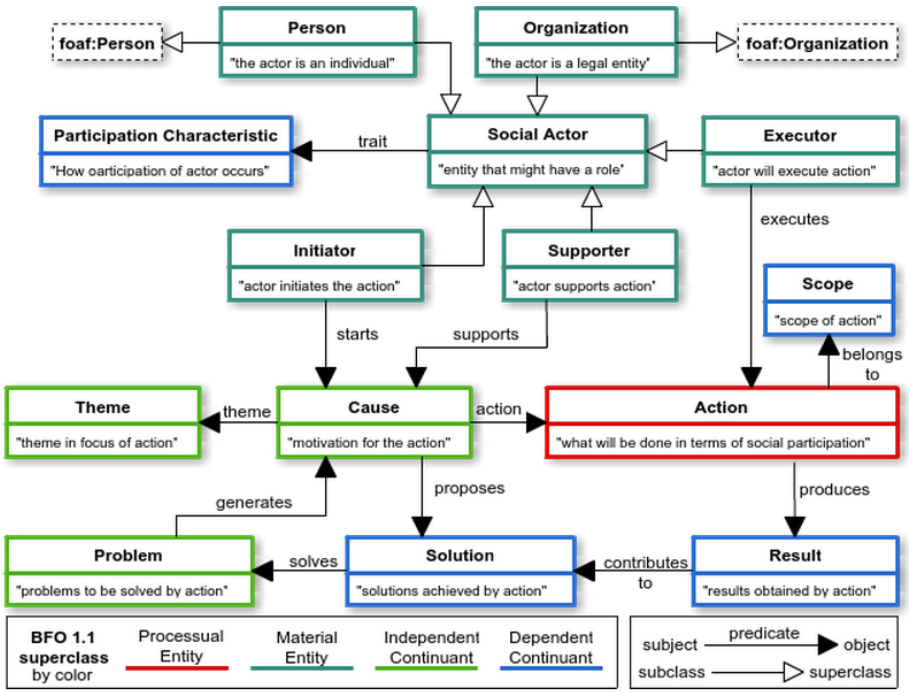

Figure 1. Diagram representation of the Ontology of Social Participation (OPS). Arrows with white heads indicate "is a" relations (subclass points to superclass). Arrows with black heads indicate property relations from subject to object . All property relations yield existential restrictions, with the exception of the "has characteristic" property, that does not yield restriction. Upper ontologies BFO and FOAF are asserted through color (BFO) and dashed boxes (FOAF).

and maturation. Labels are written in English, Portuguese and Spanish. Accordingly, class names changed from VCPS to OPS received labels (`rdfs:label`) in each language and a textual short explanation (`rdfs:comment`) in English. Table 1 presents all classes is OPS. OPS property names are written in the headlessCamelCase [33] format, are readable in English (to ease internationalization, adoption and maturation), and some of them have defined domains and ranges. Table 2 is dedicated to OPS properties, with labels in English, Portuguese and Spanish.

In the first versions of OPS, all properties yielded existential restrictions, except `ops:hasParticipationCharacteristic`. Although such efforts were aimed at providing a better defined OPS, further developments and discussions revealed that these restrictions made OPS rigid, a bit more complicated, and was not of much help, at least in this stage of OPS development and adoption. The result is that all restrictions were removed. Table 4 (at Appendix B) presents all dropped restrictions from VCPS to OPS.

An inspection of VCPS reveals the contradiction found in Figure S3-1: a role cannot execute, initiate or support a cause. These are performed by a social actor. Therefore, to maintain VCPS directions and obtain a sound ontology, `ops:Role` was removed from OPS. The result can be seen in Figures 1 and 2.

Table 1. Classes of the OPS (Ontology of Social Participation). These are core concepts in the ontology. Along with the taxonomic structure exposed in Figure 2, these classes are related by the properties in Table 2. In boldface is the VCPS class name "`vcps:Espaço de Ação`", which caused original VCPS OWL to be pointed as corrupted by Protègè (spaces are not allowed in URIs). Also, class `vcps:Role` was dropped as it yields logical problems in VCPS.

OPS class name	**VCPS class name**	**pt-br label**	**es label**	**en label**	**definition**	**upper ontology classes**
Person	Pessoa	Pessoa	Persona	Person	a person (social actor is a person)	`bfo:'Material Entity'`, `foaf:Person`
Organization	Organizacao	Organização	Organización	Organization	social actor is a group of individuals, organized formally or informally (e.g. movements, collectives)	`bfo:'Material Entity'`, `foaf:Organization`
Executor	Executor	Executor	Ejecutor	Executor	performs action directly and is responsible for results	`bfo:'Material Entity'`
Initiator	Iniciador	Iniciador	Iniciador	Initiator	originates cause, individually or collaboratively	`bfo:'Material Entity'`
Supporter	Apoiador	Apoiador	Apoyador	Supporter	supports cause with resources of any kind (e.g. cognitive, financial, equipments)	`bfo:'Material Entity'`
SocialActor	Ator	Ator Social	Actor Social	Social Actor	entity that might have a participatory role	`bfo:'Material Entity'`
Participation-Characteristic	NivelDe-Participacao	Característica de Participação	Característica de Participación	Participation Characteristic	the way the participation of the specific actor is happening	`bfo:'Dependent Continuant'`
Cause	Causa	Causa	Causa	Cause	the motivation for Action	`bfo:'Dependent Continuant'`
Scope	**Espaço de Ação**	Escopo	Ambito	Scope	the scope os Action	`bfo:'Dependent Continuant'`
Result	Resultados	Resultado	Resultado	Result	the result obtained with action	`bfo:'Dependent Continuant'`
Solution	Solucao	Solução	Solución	Solution	solution achieved with Action	`bfo:'Dependent Continuant'`
Problem	Problema	Problema	Problema	Problem	the problem that the Action aims to solve	`bfo:'Independent Continuant'`
Theme	Tema	Tema	Tema	Theme	the theme in focus by Action	`bfo:'Independent Continuant'`
Action	Acao	Ação	Acción	Action	what is done in terms os social participation	`bfo:'Processual Entity'`
dropped class	Papel	-//-	-//-	-//-	the role of the actor	-//-

Table 2. Properties of the OPS (Ontology of Social Participation) along original VCPS names. Only a few ranges were established, and no domain, as these were not regarded as useful at time and, without them, OPS can be used more freely.

OSP property name	VCPS property name	pt-br label	es label	en label	domain	range
theme	possuiTemaAssociado	tema	tema	theme	-//-	Theme
belongsTo	pertenceAoEspaco	pertence ao	pertence al	belongs to	-//-	Scope
action	possuiAcao	ação	acción	action	-//-	Action
supports	apoiaCausa	apoia	apoya	supports	-//-	-//-
contributesTo	compoeSolucao	contribui para	contribuye para	contributes to	-//-	-//-
executes	executaAcao	executa	ejecuta	executes	-//-	-//-
generates	geraCausa	gera	genera	generates	-//-	-//-
starts	iniciaCausa	inicia	inicializa	starts	-//-	-//-
solves	soluciona	soluciona	resuelve	solves	-//-	-//-
produces	produzResultado	produz	produce	produces	-//-	-//-
proposes	propoeSolucao	propõe	propone	proposes	-//-	-//-
trait	temNivelDeParticipacao	traço	rasgo	trait	-//-	-//-
dropped	temPapel	-//-	-//-	-//-	-//-	-//-

A comparison of the VCPS OWL code [34] with the diagram in Figure S3-1, which reflects official VCPS documentation, revealed that a class, two properties and three restrictions were not implemented in VCPS. These were fully implemented in OPSẆhile restrictions missing in VCPS and implemented in preliminary OPS versions are presented in Appendix B, the missing classes and properties are:

- Class: `ops:ParticipationCharacteristic`.
- Property: `ops:hasRole`.
- Property: `ops:composesSolution`.

OPS is available online [35]. To ease navigation of the ontology by interested parties, it is also available in the Webprotege interface [36]. A diagram of OPS' taxonomic structure is provided in Figure 2.

Upper ontologies usage with OPS is under development and should receive a dedicated article. Pertinent and already used as upper ontologies for OPS are FOAF(for "linking and describing people and things they do" [37]) and BFO("designed for use in supporting information retrieval, analysis and integration in scientific and other domains" [38]). Upper ontologies classes related to each OPS class are also exposed in Table 1.

Figure 1 is a complete diagram of current OPS: classes, properties and relations to FOAF and BFO. Noteworthy, Figure 1 is more informative than the OPS OWL code, as restrictions were removed and not all properties have defined domain and range. Therefore, the diagram is an important source of relations envisioned by OPS creators.

Figure 2. A taxonomic tree of the Ontology of Social Participation (OPS). This image was rendered inside Protègè, with the OPS OWL code. Figure 1 is more informative, but this diagram is more standard and might be simpler for the newcomer. Note that the taxonomic tree does not present any information about properties further linking these classes. The prefixes `snap:` and `span:` are BFO specific for `snap`shot and `span`ning-time.

3 OPS usefulness

OPS is meant to be useful in at least two ways. First, as a systematization of what is social participation to Latin America groups, as conceived by VCPS. Second, as way to facilitate the representation of social participation-related data as linked data, and enable integration of various instances for social participation. An indicative of this pertinence is OPa, OCD, Ontologiaa, and OBS, ontologies that already use OPS as upper ontology [19].

OPS usage might not be obvious at first. How is data linked? How is field knowledge organized? Why and by whom? Core principles of OPS' utility can be understood by the following observations:

- different participation instances have social actors, actions being performed, organizations involved, problems being tackled, etc. These can yield one consistent dataset by means of OPS usage.
- One can understand and share the mutually exclusive nature of being a paid or a voluntary contributor by observing the expanded version of OPS (see Section 3.3). Also, noticing the fact that a mob can be very big or not, and that it can be convoked or not by a network, may make the field conceptualization more clear for a newcomer or ease discussions and problematization for senior researchers or politicians.
- Other fields of human knowledge and practice also have agents, problems and so forth. These can be linked to participatory data and ontologies by means of OPS.
- OPS holds a conceptualization that is the product of the contribution of many specialists. In other words, put aside the linked data aspects, it is useful as an organization of the knowledge related to the social participation field that is representative of current understandings.

The rest of this section explores different OPS uses: dereferencing, SPARQL queries, expansion, fictional use cases that reflect its potential, and real use cases.

3.1 Usage of OPS through dereferencing

All OPS classes and properties URIs are accessible via HTTP. A Pubby [39] instance provides information like name, labels and relations to other classes and properties. As an example, the URI http://purl.org/socialparticipation/ops/SocialActor returns information about this class, as shown in Figure 3.

3.2 Usage of OPS through a SPARQL endpoint

Linking multiple datasets is one of the core purposes of the OWL standard. The default way to retrieve data via OWL ontologies is by using a SPARQL endpoint. Such endpoint provides access to data from a triplestore (a collection of RDF triples) or, with more experimental technology, e.g. from relational database systems, such as a MySQL server (e.g. via OnTop/Quest [40]). Either way, the query is the same: the user or machine reaching the endpoint uses the SPARQL protocol in order to retrieve information through semantic criteria. Figure 4 is a schematic representation of OBDA (Ontology Based Database Access), which is a common term used for such multiple database access through ontologies.

Some examples of this usage can be given by SPARQL queries and concise explanations:

Figure 3. Dereferencing an OPS class: the URI is also an URL, which, reached by HTTP, returns information for the user as shown. Also, if the client is not an HTML browser, but a crawler or another type of linked data application, Pubby provides plain RDF, not a user-friendly HTML.

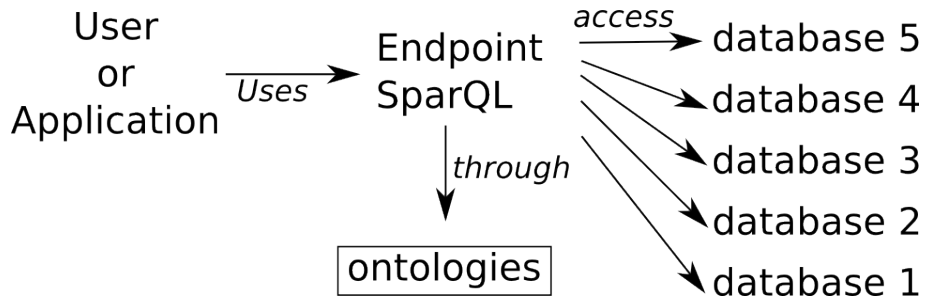

Figure 4. Scheme of the common use of ontologies for multiple databases integration. A user or application reaches a SPARQL endpoint. This endpoint, through ontologies, delivers data from one or more databases. Nowadays, the most usual is to find only one database available at an endpoint, and this database is usually duplicated and not synchronized, but available as a (converted) triplestore. Even so, it is possible to access multiple ontologies and it is desirable that the databases have synchronous access, i.e. without need to convert data to RDF triples beforehand.

- `"select ?s where { ?s a ops:SocialActor }"` or `"select ?s2 where { ?s2 a ops:Person }"` or `"select ?s3 where { ?s3 a ops:Organization}"`: the first query retrieves all social actors (returned in variable `?s`), be each a person, an organization, or something else; the second query retrieves all persons (variable `?s2`); the third query retrieves all organizations (`?s3`). In a similar manner, one may retrieve all roles played, all executers, all initiators and all supporters.
- `"select ?s ?o where {?s ops:starts ?o}"`: this query retrieves all causes

(`?o`) and their initiators (`?s`) or whatever use of the `ops:starts` property is taking place.

- `"select ?s ?s2 ?o ?o2 where {?s a ops:Action . ?s ops:belongsTo ?o . ?s2 ops:executes ?s . ?s ops:produces ?o2}"`: this query retrieves all Actions (`?s`) along their Action Fields (`?o`), their Executers (`?s2`) and their Results (`?o2`).

Noteworthy is that while `opa:Participant` can be used to retrieve all Participa.BR participants, `ocd:Participant` can be used to retrieve all Cidade Democrática participants, and `aa:User` can be used to retrieve all AA participants; their upper ontology class `ops:SocialActor` retrieves all of them and relates these entities directly to the class of generic actors of social participation processes [19].

3.3 OPS expansion

OPS matches VCPS online documentation [11] as strictly as possible while maintaining logic coherence. In this context, to exemplify the usefulness of the conceptualization and possible additional classes, an expanded OPS ontology is presented in this section and is uploaded to Webprotege [41]. Table 3 is dedicated to these additional classes while Figure 5 exposes the resulting taxonomic structure.

The property `ops:receivesFrom` was added and has an inverse: `ops:SocialActor ops:paysTo ops:Executor`. Also, the `ops:DownloadedMob` class is a defined class by the existential restriction: `ops:Mob ops:convoquedBy ops:Network`, with a newly defined property `ops:convoquedBy`.

This is one of the numerous ways by which OPS might cope with further classes, properties and restrictions. This particular expansion was chosen as an example by direct observance of VCPS documentation and recent social affairs, such as the Brazilian protests.

Figure 5. A taxonomic diagram of an example expanded instance of OPS. `ops:PaidExecutor` is defined as being the subject of a `ops:receivesFrom` relation with a `ops:SocialActor`; `ops:DownloadedMob` is defined by being the subject of a `ops:convoquedBy` relation with a `ops:SocialNetwork`. The OWL code is online for live editing [41]. New classes added to this expanded version of OPS are in Table 3

3.4 Fictional examples of usage

The following fictional examples have the purpose of facilitating the newcomer to grasp why and how OPS may be used:

- Suppose that a public SPARQL endpoint unifies several participation instances by means of OPS (we will see in Section 3.5 that this is not really fictional). Thus, the total number of participants is publicly available (`|ops:SocialActor|`). Also, depending on the platforms involved, one can observe how many of these participants are individuals (`ops:Person`), how many are organizations (`ops:Organization`), and understand to which extent the corporative influence is explicit. One can observe how many of the participants are the same in each platform, and what roles they take, and make assumptions about how much the society is really participating or if these processes are manipulated by few agents (`ops:SocialActor`). One can also gaze upon the problems being discussed and which solutions are being proposed, therefore hypothesize about the sense of what is being considered important and valid within public discussions. This list of possibilities is endless, specially when OPS variations and expansions are considered.

- Suppose a person has a new proposal for a participatory system that uses OPS. She can acquire a concise understanding of the conceptualization involved and make very objective observations and provide clear suggestions that relate directly to the systems used or envisioned. She can make an OPS variation or another ontology, as a way to confront paradigms.

- Suppose there is a specific system for exhibiting indicators about social participation (e.g. how effective it has been, how wide is the scope of interests). Instances that are integrated by OPS may be queried for information and, for example, this system registers any organization enroled as a social actor. Also, reflecting the expanded OPS described above, the system may register any mob involved, whose incidence was recorded in the database as a `DownloadedMob`, as related to some social network.

3.5 Real use cases

OPS has yield some real use cases can be pointed, most notably:

- The UNDP consultant contract 2013/00056, project BRA/12/018, was profoundly influenced by OPS [19]. Within written products are other participatory ontologies, such as OPa, OCD, Ontologiaa and OBS, which are directly akin to OPS. Also, some methods for analyzing OPS-related data and for resource recommendation were provided. These developments were accomplished by the first author of the present article, in collaboration with other parties, specially the Brazilian Presidency, the University of Brasília researchers, and free software parties. Data from three participatory instances were triplified (i.e. represented as RDF triples): Participa.BR, AA and Cidade Democrática; all related to OPS. These linked data resources are available in SPARQL endpoints and can be dereferenced, in a similar fashion as done for OPS. As these are all provided by research facilities, they might lack maintenance and should be kept by a dedicated team.

- Another UNDP contract was responsible for some advances in information technologies. A special case is a dedicated OPS expansion [42].

- The Brazilian Federal Data Processing Service (Serpro) is triplifying Participa.BR data (the Brazilian federal social participation portal). Is this process, they are making direct use of OPS [43].
- The linked data Brazilian community had some maturing related to OPS beyond the ontologies developed, UNDP development and documentation, Serpro data triplification, and VCPS. Interested government, civil society and academic parties dissaminated OPS documentation for conceptual and technological goals [2].

[2] Examples of such activity are https://www.facebook.com/rodrigobandeira01/posts/10152022880093236 and http://goo.gl/E52KlG, a Facebook post and an email thread, respectively.

Table 3. New classes considered for an example expansion of the OPS. The taxonomic organization of these classes within OPS can be observed in Figure 5. Further information is in Section 3.3.

new class	subclass of	description	further notes
SocialNetwork	Organization	a social structure made up of social actors (such as individuals or organizations) and a set of dyadic ties between these actors	–//–
ScaleFreeNetwork	SocialNetwork	a network whose connectivity follows a power law distribution	disjoint with ErdosRenyiNetwork and GeographicNetwork. Usual social network structure
ErdosRenyiNetwork	SocialNetwork	also known as Binomial network, this network sets, with equal propability, an edge between each pair of nodes	disjoint with ScaleFreeNetwork and GeographicNetwork. Unusual social network structure
GeographicNetwork	SocialNetwork	a network whose connectivity is related to the distance of nodes in a metric space	disjoint with both ScaleFreeNetwork and ErdosRenyiNetwork. Unusual social network structure
SmallWorldNetwork	SocialNetwork	a network where most nodes can be reached from other nodes with few hops or steps	disjoint with GeographicNetwork. Usual social network structure
InformalOrganization	Organization	an organization that is not formalized	disjoint with Intitution
Mob	InformalOrganization	a crowd of individuals	–//–
GiantMob	Mob	a crowd with more than 10,000 individuals	–//–
DownloadedMob	Mob	a Mob convoqued by a network	this is a defined class, by being a network and being the subject of the relation convoquedBy with object Network
Institution	Organization	a mechanism of social order that governs a set of individuals	disjoint with InformalOrganization
PublicInstitution	Institution	an institution backed through public funds and controlled by the state	disjoint with PrivateInstitution
PrivateInstitution	Institution	an institution backed through private fundings and controlled by private parties	disjoint with PublicInstitution
AcademicInstitution	Institution	an institution dedicated to education and research, which grants academic degrees	–//–
NGO	Institution	a legally consituted corporation created by natural or legal people that operate independently from any form of government	–//–
SpuriousInstitution	Institution	an institution that holds prominent illegitimate or corrupt characteristcs	–//–
ExoticInstitution	Institution	an institution that does not fit previous classes or is characterized by very unique traces	–//–
VoluntaryExecutor	Executor	an executor that receives no formal reward for the tasks	disjoint with PaidExecutor
PaidExecutor	Executor	an Executor that receives formal reward for the tasks accomplished	a defined class, being an Executor and the subject of a receivesFrom predicate with SocialActor as object

4 Concluding remarks and further work

OPS, based in VCPS, yields initial steps in achieving an effective social participation ontology. Community has registered activities and delivered reference documents, including this present article which contains an organization of foundational conceptualizations, OPS diligent development, uses, upper ontologies and expansion of the ontological structures.

On the practical side, the use of this ontology or related developments for the Brazilian federal participation portal (Participa.BR [12]) is a desirable reality, as it implies usage and good maintenance. Moreover, an ontology was constructed for Participa.BR, based in the OPS: the OPa [19] (Ontology of Participa.BR). This is confluent with the presidential Decree 8.243 that establishes a policy and commitment for social participation [44]. In this context, presidential, ministerial and academic parties started formalizing current legal participatory mechanisms (e.g. conferences, councils, forums, public consultations, round tables) in ontological terms, which resulted in the Social Library Ontology (OBS from the Brazilian name Ontologia da Biblioteca Social) and the Social Library Vocabulary (VBS from the Brazilian name Vocabulário da Biblioteca Social). Hosting ontologies on Webprotege [45] have become handy and even pivotal, as a way to share specific ontologies in a friendly environment and to collect feedback.

Further work involves the consideration of community manifestations about OPS and this article, accomplishing usage by means of formal State and civil society instances, and studying upper ontologies for OPS. The use of OPS (or a variant) in different contexts is being tackled for the creation of social participation indicators and facilitating participatory processes. Academic texts dedicated to the new participatory ontologies (OCD, OBS, Ontologiaa, OPa) which uses OPS as an upper ontology should be written and submitted to peer review for enhancements and quality assurance [19]. Data related to these ontologies were found in relational databases and preliminary scripts were written to make them available as RDF [46]. A sound linkage of such data and the consequent incorporation to the Linked Open Data (LOD [47]) cloud is planed for a near future. This should make participatory structures and data more relevant to the Giant Global Graph [48].

Acknowledgments

This article is deeply influenced by Protègè and BFO documentation. Authors thank community and researchers related to these projects [38, 49]. Authors thank Corais platform maintainers for their efforts in delivering a collaborative platform which gave birth to VCPS documentation. Renato Fabbri is grateful to CNPq (process 140860/2013-4, project 870336/1997-5), UNDP (contract 2013/00056, project BRA/12/018), SNAS/SG-PR, and the postgraduate committee of the IFSC/USP.

A Script for obtaining current OPS

Preliminary OPS was done with Protègè software [49]. Current OPS is the output of a Python script [3]. Actually, this article, latex files, the OWL code, the Python script and auxiliary files are in a public git repository [4].

[3] Available at: https://github.com/ttm/ops/blob/master/scripts/ops.py.
[4] Available at: https://github.com/ttm/ops.

B Restrictions in VCPS and initial OPS which were removed from current OPS

These restrictions were part of VCPS documentation but were not implemented in VCPS OWL code:

- Restriction: `ops:Role ops:hasParticipationCharacteristic some ops:ParticipationCharacteristic`.
- Restriction: `ops:Results ops:composesSolution some ops:Solution`.
- Restriction: `ops:Problem ops:generatesCause some ops:Cause`.

Present in preliminary OPS implementation, all restrictions were removed from current OPS as explained in Section 2.1.

Table 4. Restrictions of the preliminary OPS: all restrictions are existential (`owl:someValuesFrom`).

subject	predicate	object
Initiator	starts	Cause
Supporter	supports	Cause
Executer	executes	Action
Solution	solves	Problem
SocialActor	hasRole	Role
Action	produces	Results
Result	contributesTo	Solution
Cause	action	Action
Action	belongsTo	Scope
Cause	theme	Theme
Cause	proposes	Solution
Problem	generates	Cause

Such OWL restrictions are valid, to the best of chances, for the final state of a participatory process (for example, in an arbitrary snapshot, a `SocialActor` may be not tied to a role). This might lead to NULL or "not yet defined" field supplies. Also, in VCPS, existential restrictions were written as "min 1". These were changed to the standard "some" existential restriction in preliminary OPS and were completely removed afterwards, as a way to avoid making OPS usage rigid and unnecessarily complicated.

C VCPS original documentation

From April to December, 2012, VCPS was first conceived. In the online process, as registered by Corais platform, 66 users interacted, 6 of them were the most active [50]. Various materials were produced both as activity traces and as reference media. This section is dedicated to these materials.

C.1 Reference textual documents

The main documents are:

- "Commented methodology" [50]: this document describes the public process of VCPS conception. It is composed by brief inspections of forum topics, pointing both pertinent characteristics of the online collective process and ontological

observations (about classes and properties). Considerations are made about tightening relations with the Open Government Partnership (OGP), an international initiative to foster transparency and open practices in governments worldwide [51], and the Brazilian formal action plan, as means to achieve ontology usage. There is also a proposal of a systematic study of electronic government initiatives, so that the VCPS might be better contextualized. This document ends by proposing an agenda of meetings with academics, entrepreneurs and government parties.

- "Conceptual modeling, version 0.1 (in natural language)" [52]: this document is a description, in English, of the VCPS. The introduction is mainly a collage of the document above [50]. Both the itemized description of the ontology, and the considerations for its usage, are of great value as references. Figure 1 is heavily influenced by a diagram related to this document and further described in Section C.2.

C.2 Images

There are various images associated with the ontology[5], most notably:

- Various proposals for the VCPS logo, some of which are in Figure 6.
- Figure 1 shows an English version of the original diagram of VCPS in the document [52].
- A diagram for general public consultations.

Figure 6. Some of the various logos for of the VCPS. (a) is a colored text logo proposal; (b) is a figurative logo; (c) is mixture of both ideas. It can be seen that these logos were conceived for the ontology when it was called a *vocabulary*. Community documents reflect this nomenclature, which changed with first versions of this article, in the final months of 2013, and subsequent work.

C.3 OWL code of VCPS

The OWL code of VCPS is online [53] and deprecated by OPS advent. The VCPS OWL code did not contain all relation from Figure 1. This is directly addressed in Section 2, which exposes the implementation of all relations in the OPS, including VCPS OWL corrections and adjustments to best practices. The complete and correct OPS is further contextualized in Section 3.

[5]Corais platform page with many images: http://corais.org/vocabulariodaparticipacao/node/1517.

C.4 Blog Posts

The VCPS blog aggregates both important discussions and documents in no more than twenty posts to date. All OWL code, final documents, public consultations, mental map and images are posted in the blog [6]. The first post is from July 24, 2012. Last post about VCPS is from May 7, 2013. Most blog posts are from the first day (almost half of them). They received more than twenty commentaries. Two "out-of-season" blog posts, one from August 9, 2012 and another from October 22, 2012, separate first day posts from last posts. Both have about ten commentaries. Last blog posts occurred as a few days burst and a final message, a month after.

There are three more recent blog posts, from November and December, 2013. But these already address OPS conception from VCPS.

C.5 Discussions and etherpads

Besides blog registries of collective elaborations, four Etherpads were written [7] (these are interfaces that allows writing online texts with multiple simultaneous contributors [54]):

- A pad for important words.
- A pad dedicated to a second phase of VCPS elaboration, which did not happen yet.
- A pad for process documentation. It became the first document described in Section C.1.
- A pad for both vocabulary specification and "questions not addressed to in the webinar".

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