Complaint Ontology Pattern - COP

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Abstract. In this paper we present an ontology design pattern to conceptualize complaints – an important domain still uncovered by ODPs. The proposed Complaint Ontology Pattern (COP) has been designed based on the analysis of free text complaints from available complaint datasets (banking, air transport, automobile) among other knowledge sources. We present a detailed use case from consumer disputes. We evaluate the pattern by annotating the complaints from our use case and by discussing how COP aligns to existing ontologies.

Keywords: ontology design pattern, complaint

1 Introduction

Complaints and complaint behaviour have been receiving a lot of attention in business, management, and dispute studies, as handling them properly might contribute to minimize users' dissatisfaction, increase users' loyalty, and generate trust both in business and public administration [20]. Our definition of complaint consists in an expression of dissatisfaction issued by a complainant against a complaint-recipient, describing facts, and motivations, where a request is explicitly or implicitly made through a medium. This term is broader, not necessarily linked to a legal suit, consensuated in ISO standard and in complaint research. In this paper we propose the Complaint Ontology Pattern (COP) to support knowledge engineers to create domain specific complaint ontologies. The resulting ODP is available in the ontology design patterns portal[2]. Complaints description is an important modelling challenge, since complaints occur in many different contexts and domains; for

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example, consumer, criminal, and health complaints received by diverse handling systems (from public administration, to companies or consumer centre handling bodies). However, these handling systems use to record complaints according to their own formats, reducing computer interpretation or systems interoperability.

With the increasing interest for transparency in this domain and with the wider adoption of Linked Open Data (LOD) to publish data, complaint datasets need to be more interoperable. This work contributes to improve semantic interoperability between complaint handling systems by proposing the COP. Several complaint datasets[3] are compounded of free text; this hampers its understanding by computers and complexity to implement data analysis. COP can bring complaint platforms into a new dimension where mediation or explanation can even be generated automatically, promoting personalized and rapid assistance to complainants.

Legal core ontologies, e.g., *LKIF*[4] and *Core Legal Ontology*[5] (CLO) do not encompass the conceptualization of complaints. Other related domains where ontologies exist are consumer protection and consumer dispute resolution, but the complaint concept is not included in their scope, as we could observe in the *Consumer Mediation Ontology*[6] (CMO) [7], the *Consumer Protection Ontology*[7] (CPO) [1][2][3], the *Legal Ontology Syllabus* [4], the *Mediation Core Ontology* [5], and the *Ontology of ODR Processes*[8]. The existing ontologies in which the complaint concept is included are customer-related ontologies [8], but they are not complete enough to be used. For instance, complaint main components like motivation, request, medium, etc., are still missing.

Professional mediators [15] highlight the importance to better address complaints and the necessity to have ICT solutions to support their tasks (as observed in other domains, like health, economy, etc.). They justify this need by emphasizing that complaints constitute the first stage of disputes, prone to *scale* to higher conflict levels, e.g. litigation. In our study, we observed that the requirements to describe a complaint can slightly change according to the application domain, but a subset of information is present in all studied domains. In practical cases, we observed that the omission of such information might entail a refusal or a misunderstanding of a complaint by the complaint recipient. This observation motivated us to define an ODP for complaints that can be used by knowledge engineers to model complaints for specific domains, satisfying different requirements via COP specializations [6].

The remainder of the paper is structured as follows. Section 2 describes the use case, the requirements, and the elements of COP. Section 3 evaluates the pattern, by applying to other ontologies or by annotating complaints. Finally, Section 4 concludes the paper and discusses future work.

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[3] The EU Complaint database, the dataset from the Consumer Financial Protection Bureau (CFPB), the Toyota complaint dataset, the complaint database from the UK Department for Work and Pension, amongst several other complaint datasets from disparate domains.

[4] LKIF-Core Ontology, A core ontology of basic legal concepts (http://www.estrellaproject.org/lkif-core/).

[5] Core Legal Ontology (CLO), http://www.ontologydesignpatterns.org/ont/clo/CoreLegal.owl

[6] ONTOMEDIA: Platform of Web Services for Online Mediation, 2008-2010).

[7] Drafting Legislation with Ontology-bases Support, http://www.dalosproject.eu.

[8] ODR stands for online dispute resolution; see https://www.evs.ee/products/cwa-16026-2009

2 The Complaint Ontology Pattern

In this section we present the materials and the methodology adopted to create the complaint ontology pattern and we introduce its components.

2.1 Methodology

We adapted the NeOn methodology to build COP. To develop COP, ontological resources and non-ontological resources (hereinafter NOR) were used and reengineered as explained in the processes below, considering the consumer law domain as a use case:

Non- Ontological Resource Reuse Process:
The following NOR were considered:

- *ISO Standard 10002:2014 on Guidelines for complaint handling in organizations* [19] provides guidance for the design and implementation of an effective and efficient complaints-handling process for all types of commercial or non-commercial activities, including those related to e-commerce;
- *Communication and Recommendation of the EU Commission on the use of a harmonized methodology for classifying and reporting consumer complaints and enquiries* for all European complaint handling bodies [17][18];
- *Customer Complaint Glossary*, stemming from the EU CCFORM project, with the aim of studying the foundation of a central European customer complaint form (CC-form), and to underpin a European online complaint platform;
- *Text Corpora* composed by a dataset of consumer complaints, totalizing 20,000 complaints in the domain of consumer disputes (air transport passenger field, telecommunications, etc.), which have been addressed by consumers to the Catalan Consumer Agency (CCA) from 2007 to 2010; a database of complaints in the banking and in the automobile field, accessible as open data, thus gaining insight into its topological and clustered structure;
- *Legal texts*: definitions and rationale provided by the consumer dispute resolution legislations in Europe, consisting in a primary source of law: EU's Directive on Consumer Alternative Dispute Resolution (Directive Nº 2013/11/EU) and Online Dispute Resolution Regulation (Regulation Nº 524/2013/EU).

Non-Ontological Resource Reengineering.
An annotation structure captured both the terminological and the narrative structure from the knowledge sources. We have proceeded manually through a: (*i*) direct extraction of terms; and (*ii*) abstraction of named entities. The refinement of the concepts and properties was manually done from our expertise in consumer law. Manual analysis of complaint datasets was done in order to extract relevant concepts and competency questions (CQs) from each analysed domain of application. This step provided a list of competency questions that we used as requirements for generating COP. These competency questions are presented in Table 1 (see general use case) and we assume that the ontology must provide ways to answer these questions. We also classified the complaint texts according to their propositions (e.g., describe a fact, indicate the existence of evidence, indicate a motivation, specify what they request,

and indicate when, how, and to who they first complaint). The adopted "classes" were intuitively selected when we searched for answers to the competency questions.

Ontological Resource Reuse and Reengineering Process:
It is defined as the process of using available ontological resources (ontologies, modules, statements, or ontology design patterns) for solving different problems. We implemented the following steps: (*i*) Literature review about legal core ontologies, consumer and complaint-related domain ontologies, and content ODPs in order to extract common (or close related) concepts relevant to describe complaints; (*ii*) Analysis of the obtained outcomes in order to determine the requirements for describing a complaint. We extracted from the selected ontologies a list of concepts that could potentially be reused to represent a complaint. Some slight differences in their definition allowed us to select the ones that better satisfy our requirements. In table 1, where the concepts are defined, we also indicate the ontology that inspired us (if the link is not indicated, then the concept was created based on the dataset analysis). We check if the classes from the analysed ontologies aligned to COP concepts, and if not, which adaptations/extensions are necessary. Finally, we defined the relations between the selected/adapted concepts and we evaluate if the resulting ontology still can answer the competency questions. The analysis step was an iterative process that required domain expertise and several iterations. The results of this analysis are summarized in Table 2, according to the catalogue entry fields proposed by [10].

Table 1 Definition of the concepts reused in COP

Ontology Name and concept label	*Definitions*
CCO:Complaint	An expression of grievance or resentment issued by a complainant against a compliant-recipient, describing a problem(s) that needs to be resolved.
CCO:Problem	A source of difficulty or dissatisfaction in a consumer-provider relationship
CCO:Evidence	(WordNet) all the means by which any alleged matter of fact whose truth is investigated at judicial trial is established or disproved
CCO:Complaint Recipient	A legal person to whom a complaint is addressed.
CCO:Complainant	The legal person who issues a complaint.

Finally, the COP was cooperatively built as an OWL2 ontology. Details about the COP entities are presented in the next section.

Table 1: COP requirements

Slot	***Value***
Name and Identifier	Complaint Ontology Pattern (COP)
Intent	To represent core constituents found commonly in complaints across domains.
Consequence	Heterogeneous models for complaints can be aligned to this pattern, which then acts as a semantic facade to different complaint management applications (such as complaint handling process, customer complaint

	management systems, customer relationship management).
Scenario	A complaint refers to the narrated facts of an agent, grounded with a motive and a request, through a specific medium (used to generate the complaint document), where evidence may support the facts.
General Use Case (GUC)	GUCs are expressed using CQs [9] [11]. The following CQs are generated to reflect the needs COP is designed for and are formulated according to the specificities of the domain. 1. Who is the complaint recipient? 2. Who is involved in this complaint? 3. Which medium was used to express the complaint? 4. What motivates the complaint? 5. Which facts describe the complaint? 6. Which facts happened in "this" date or in "this" place? 7. What evidence is used to prove the narrated fact? 8. What is the claim?
Approaches	We declare all classes defined for the pattern to be disjointed. We also assert guarded domain and range restrictions for every property in the pattern (i.e., each object property P pointing from class A to class B has $\exists P.B \sqsubseteq A$ as the guarded domain restriction and $A \sqsubseteq \forall P.B$ as the guarded range restriction). Time is modelled in all the classes (with exception of Medium and Agent as time stamp).
Logic addressed	The classes and properties are formally encoded using OWL2. We make use of Description Logics (DL) notation. COP is documented in: and in https://w3id.org/vocabulary/cop and http://ontologydesignpatterns.org/wiki/Submissions:COP
Referenced to	*LKIF* and *CCO*

2.2 COP Components

Taken into account the requirements to build COP, we proposed the ODP depicted in Fig. 1. COP has 10 concepts (Complaint, Motivation, Fact, Evidence, Medium, Request, Agent, Complainant, Complaint_Recipient, and ThirdParty), nine object properties (adressedTo, basedOn, expressedIn, hasComplaintMotivation, partOf, hasThirdParty, justifiedBy, madeBy, supportedBy) and three datatype properties (hasSpace, hasStampTime, hasTimeOccurence).

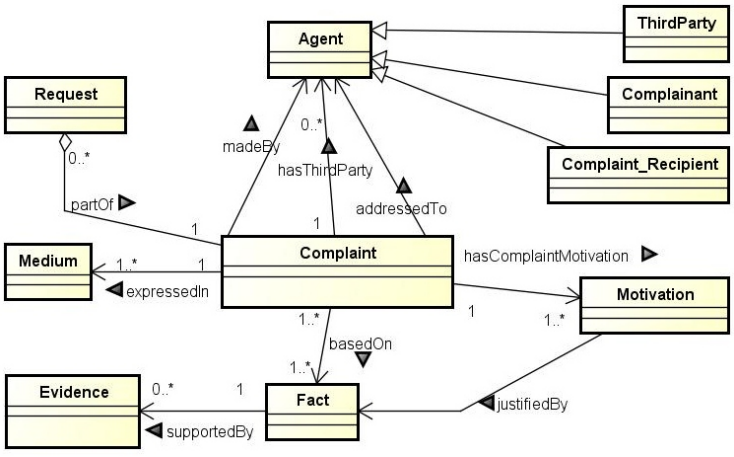

Fig. 1: UML class diagram representing COP. Some axioms and datatypes were deliberately hided to give better readability to the figure

A description for each of these concepts and properties follows using the standard description logic notation to express the main axioms in the pattern:

- Complaint. This class is the cornerstone of the pattern. It is defined as an *expression of dissatisfaction issued by a Complainant against a Complaint-Recipient, describing the facts, motivations, where a response or resolution is explicitly or implicitly made*. The complaint entity differs from the act of complaining, which is out of the scope of this ODP[9]. A Complaint is based on, at least, one Fact, has at least, one Motivation, made by at least one Agent (Complainant), addressing at least to one Complaint_Recipient and expressed in, at least, one Medium:
  Complaint ⊑ ∃addressedTo.Agent ⊓ ∃basedOn.Fact ⊓ ∃expressedIn.Medium ⊓ ∃hasComplaintMotivation.Motivation ∃madeby.Agent
- Motivation. A motivation is a *subjective motive of dissatisfaction, justified by facts*. The motivation is generally rooted on some service disruption, behaviour, product. Each Motivations is justified by, at least, one fact:
  Motivation ⊑ ∃justifiedBy. Fact ⊓ ∃hasComplaintMotivation⁻.Complaint
- Fact. A fact is a *proposition about something described in a complaint*. *Facts are observed events by the Complainant Agent*. Because the appropriated definition of Fact varies widely depending on the particular application, such details are not restricted in the pattern to foster reuse and adaptability.
  Fact ⊑ ∃ justifiedBy⁻. Motivation ⊓ ∃ basedOn⁻. Complaint
- Agent. An Agent can act, i.e. *play the 'actor' role wrt. an action. It is a holder for propositional attitudes*. This class is related (skos:relatedMatch) to lkif-core:Agent. Three subclasses of Agent have been defined:
  - Complainant. *Person, organization, or its representative, making a complaint* (ISO 10002:2014). The Complainant can be assumed or implicit in some datasets. Complainant is a defined class, being any agent having made, at least, one complaint. Using the inverse property of madeBy, the axiom can be formulated as:
    Complainant ≡ Agent ⊓ ∃madeBy⁻.Complaint
  - Complaint Recipient: *Person, organization, or its representative, receiving a complaint* (ISO 10002:2014). Recipient is concretely the entity to whom the complaint is addressed to and is the object of the complaint. The recipient may be implicit in some datasets. This concept varies from the addressee, which may be the Recipient, or any other entity that receives the complaint. The

[9] Our concept relies in the middle term of both definitions from ISO and CCO [8], in a more abstract manner. In the ISO definition, complaint is an "[E]xpression of dissatisfaction made to an organization, related to its products, or the complaints-handling process itself, where a response or resolution is explicitly or implicitly expected". In CCO, it is "An expression of grievance or resentment issued by a complainant against a compliant-recipient, describing a problem(s) that needs to be resolved."

Complaint Recipient is a defined class, with the condition of an agent having receiving a complaint, namely:

ComplaintRecipient ≡ Agent ⊓ ∃addressedTo−.Complaint

- Third Party: *Any natural or any legal person who is acting, including through any person acting in his name or on his behalf, for purposes not related to the object of the complaint*. For example, a consumer complaining to a consumer protection entity about a dispute with an air transport company, the third party is the consumer entity, and the recipient is the company. A Third Party is a defined class, with the condition of an agent having acting to intermediate, accelerate, or judge a complaint, namely:

  ThirdParty ≡ Agent ⊓ ∃hasThirdParty−.Complaint

- **Medium.** *A Medium is a bearer of expressions, i.e. externalized propositions. Propositions become expressions once they are externalized through some medium*. In some complaint datasets, the medium is implicit. This concept is a close match (skos:closeMatch) to the lkif-core:Medium concept. Medium class is intentionally generic to accommodate possible different granularities in the use cases; verbal, writing, or face-to-face are known mediums of a complaint.

  Medium ⊑ ∃ expressedIn⁻.Complaint
- **Evidence:** *Proof supporting a fact described in the complaint*. Examples of proofs include receipt, contract, testimony, email correspondence, expenses, photo, etc. When an Agent holds the necessary proof, it mitigates the burden of proof of the counterpart. Evidence class is intentionally generic allowing one to freely introduce adornments to the class according to the needs of a particular use.
- **Request**: *A demand, claim or remedy set by the Complainant and expected to be pondered by the Complaint-Recipient*. The Request is part of a Complaint. Indeed, in other ontologies we observe that an Agent can issue a Request regardless of being related to a Complaint; however, this scenario is out of scope of COP. Examples of request consist in compensation, apology, response, resolution, settlement, or other action.

The main classes have been asserted to be disjoint with each other: Agent, Complaint, Request, Evidence, Medium, Fact, Motivation. Agent subclasses are not disjoint because an Agent can perform different roles (for instance, a Complainant can also be a Complaint Recipient) in different situations simultaneously.
Properties are described below:

- **addressedTo:** The property describing the Agent Recipient of the Complaint. Domain: Complaint Range: Agent
- **madeBy:** The property relating the Complaint to an Agent. A Complaint is made by an Agent. Domain: Complaint Range: Agent
- **justifiedBy:** Expresses the relation between the Motivation and the Fact(s). Domain: Motivation. Range: Fact
- **expressedIn**: The property that declares by which Medium the Complaint is expressed. Domain: Complaint. Range: Medium.

- supportedBy: The object property stating that a Fact can be supported by an Evidence. Domain: Fact. Range: Evidence.
- hasComplaintMotivation: The relation expressing the Motivation of a Complaint. Domain: Complaint. Range: Motivation.
- basedOn: The property declaring the Facts that contextualize a Complaint. Domain: Complaint. Range: Fact.
- partOf: The property stating that a Request can only exist if there is a Complaint.Domain: Request. Range: Complaint

Some datatype properties are domain specific and need to be adapted by the expert to satisfy the needs of the domain. For these cases, we did not set a type, instead we provide a link to another ODP that can support the expert in this specialization task. COP datatype properties are described below:

- hasSpace: Refers to a place. We did not define a type for this datatype, instead we suggest consulting the ODP Place[10] to detail this property. Domain: Complaint ⊓ Evidence ⊓ Fact ⊓ Motivation ⊓ Request
- hasStampTime: Use the type xsd:dateTimeStamp to describe specific time which a complaint, evidence, fact, motivation or request was declared or referenced: It can indicate the complaint date, or the date of presentation of evidences, or the date of description of the fact, or the date of a decision to make a complaint, or the request date. Domain: Complaint ⊓ Evidence ⊓ Fact ⊓ Motivation ⊓ Request
- hasTimeOccurrence: Refers to the description of a time period. We did not define a type for this datatype, instead we suggest consulting the ODP TimeIndexedClassification[11] to detail this property. Domain: Complaint ⊓ Evidence ⊓ Fact ⊓ Motivation ⊓ Request

3 Experimental Assessment and Evaluation

The evaluation method consists in: (i) expressing COP with complaints; (ii) the alignment of the pattern with other ontologies; and (iii) linking COP with the FrameNet's Complaining frame.

(*i*) Graphic notations are employed to visualize the application of COP with existing complaints from the Toyota dataset (Figure 2) and from the CCA dataset (Figure 3). As to the later, by direct extraction of terms, we identified the following key terms {flight delay, compensation, hours}. By an abstraction from the named entities in the modelling problem description, we can associate the terms (e.g., flight delay, compensation) with the concepts (e.g., motivation, request).

[10] http://ontologydesignpatterns.org/wiki/Submissions:Place
[11] http://ontologydesignpatterns.org/wiki/Submissions:TimeIndexedClassification

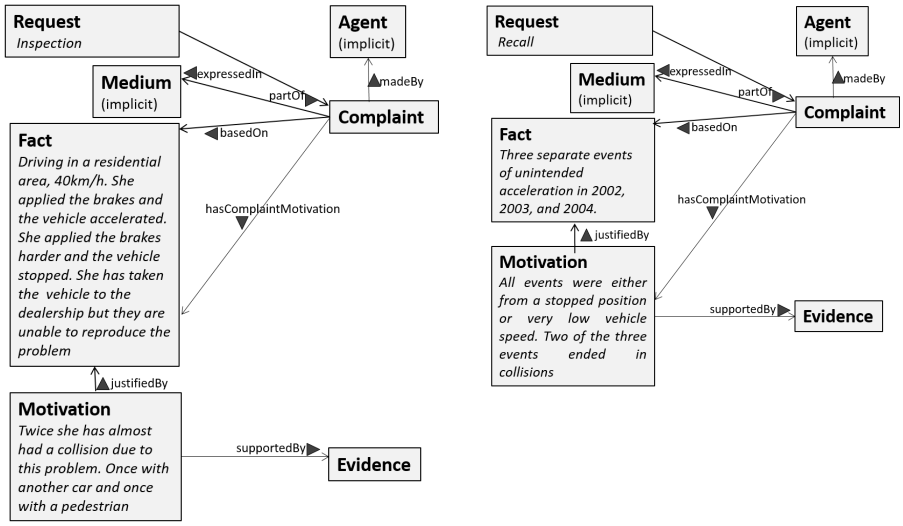

Fig. 2. COP annotated with 2 complaints from the Toyota Dataset

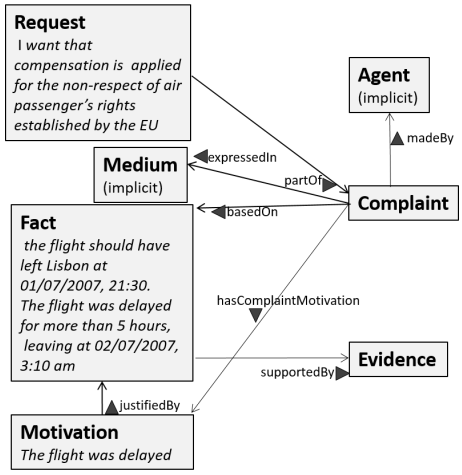

Fig. 3 Example of modelling COP with a complaint from the CCA dataset

(*ii*) We aligned COP with other ontologies, as depicted in Table 3. CCO represents the customer complaint as part as a global framework for complaint management and therefore our pattern is complementary to CCO. By analysing the definition of the concepts of CCO and COP, we could easily identify that the concepts of "complainant" and "complaint recipient" are equivalent. However, CCO failed to introduce the notion of "motivation" and "fact" that are important to describe and, later on, process the complaint. In consequence, COP complements CCO by relating "COP:Motivation" to the "CCO:Problem", enriching CCO and making it possible to

deal with the problem typology[12] at COP level. COP can be imported into other ontologies, such as: the Relevant Legal Information Ontology for Consumer Disputes ontology[13] (RIC): an incident (in the consumer dispute domain) is reported in a complaint. COP is also aligned to LKIF ontology.

Table 3 COP aligned to other ontologies

COP	*Object property used*	*Ontology concepts to be aligned*
COP:Agent	skos:relatedMatch	Lkif:Agent
COP:Medium	Skos:closeMatch	Lkif:Medium
COP:Complaint	reportedIn	RIC:Incident
COP:Motivation	equivalentTo	CCO:Problem
COP:Evidence	equivalentTo	CCO:Evidence
COP:ComplaintRecipient	equivalentTo	CCO:ComplaintRecipient
COP:Complainant	equivalentTo	CCO:Complainant

(*iii*) Frames are good resources for ODPs. By searching for "Complaining", it is visible that "frame elements" have a substantial overlap with the elements in COP (fig. 4). COP can be linked to the FrameNet's Complaining frame[14]. FrameNet is an important lexical knowledge base featuring cognitive plausibility, and grounded in a large corpus. Besides being actively used by the NLP community, frames are a great source of knowledge patterns once converted into a knowledge representation language [16]. The very reason for linking, besides the cognitive foundation of FrameNet, is that frames are linked to lexical and data resources, so that one can easily detect complaining signs from any text.

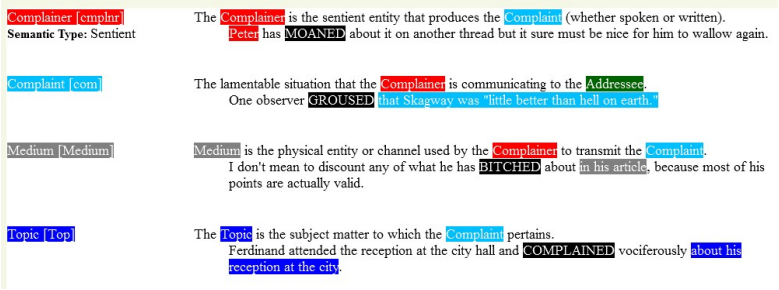

Fig. 4 FrameNet's Complaining frame

We kept this pattern as simple as possible, but other patterns could have been used. For example, it is the (frequent) case of delegating the complaint procedure into a third party (e.g. consumer agency), then the actingFor pattern[15] could have been invoked. Further aspects of the quality of the pattern have been evaluated. First, the

[12] http://www.jarrar.info/CContology/ComplaintProblems.htm
[13] https://github.com/Rel-incode/ric-ontology/blob/master/ric.owl
[14] https://framenet.icsi.berkeley.edu/fndrupal/index.php?q=frameIndex.
[15] http://ontologydesignpatterns.org/wiki/Submissions:ActingFor

ontology pitfall scanner OOPS[16] was used to verify inconsistencies and no major problem was found. Second, the validity of the pattern in multiple environments is demonstrated with the examples in the Toyota and ATP domain. Third, the representation of complaints using the COP model can give answer to the CQs initially proposed –the SPARQL queries being of a trivial nature: each of the 8 CQs refer to an entity that has been modelled with a class. In regard to the reusability of the ODP within the community, an OWL file and its documentation are provided and publically available (Github), which makes this resource easy to (re)use. It is published in the community portal for ODPs, benefiting from a persistent identifier. This ODP is distributed under a Creative Commons CC-BY 4.0 license.

4 Conclusion

This paper presented an ODP to represent complaints, stemming from mediators' experience, dispute resolution studies, and the work already done in online dispute resolution concepts and ontology building. It consists in a useful artefact [14] as (*i*) it models a phenomenon relevant to ontologists; (*ii*) it is constructed, published and documented in a manner which makes it accessible and easy to use. We intend to continuously validate and evaluate it in real cases in collaboration with companies which receive complaints in a daily basis*.

References

[1] Agnoloni, T., L. Bacci, E. (et al.): Building an ontological support for multilingual legislative drafting. In Legal knowledge and information systems. JURIX 2007, ed. A. R. Lodder (et. al) FAIA, Vol. 165, 9–18. Amsterdam:IOS Press (2007)

[2] Agnoloni, T., L. Bacci (et al.): A two-level knowledge approach to support multilingual legislative drafting. In Law, ontologies and the Semantic Web. Channelling the legal information flood, ed. J. Breuker (et al.). FAIA, V. 188, 177–198. Amsterdam: IOS Press (2009)

[3] Francesconi, E., Tiscornia D.: Building semantic resources for legislative drafting: The Dalos project. In Computable models of the law, ed. P. Casanovas (et al.), LNAI, Vol. 4884, 56–69. Berlin/Heidelberg: Springer (2008)

[4] Ajani G., Boella G. (et al.): Legal Taxonomy Syllabus 2.0. In: 3rd Workshop on LOAIT, joint with 2nd Workshop on Semantic Processing of Legal Text (2009)

[5] Poblet, M., Casellas N. (et al.): Modelling expert knowledge in the mediation domain: A mediation core ontology. In 3rd Workshop on LOAIT joint with 2nd Workshop on Semantic Processing of Legal Texts. Ed. N. Casellas, et al., Barcelona, vol. 2, IDT Series (2009)

[6] Fernandez-Barrera M., Casanovas P.: Towards the intelligent processing of non-expert generated content: Mapping web 2.0 data with ontologies in the domain of consumer mediation. In Proceedings of ICAIL Workshop, Applying Human Language Technology to the Law, pp. 18–27 (2011)

[7] Poblet, M.; Casanovas, P. (et al.): Online Dispute Resolution for the Next Web Decade: The Ontomedia Approach, Journal of Universal Computer Science, Proceedings of the 10th International Conference on Knowledge Management and Knowledge Technologies, Austria, pp. 117-125 (2010)

[16] http://oops.linkeddata.es

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[8] Jarrar M.:Towards Effectiveness and Transparency in e-Business Transactions, An Ontology for Customer Complaint Management, in Semantic Web Methodologies for E-Business Applications, pp.127-149 (2007)
[9] Blomqvist, E., Gangemi, A. (et al.): Experiments on Pattern-based Ontology Design. In Proceedings of K-CAP 2009, pp. 41-48 (2009)
[10] Gangemi, A.: Introducing pattern-based design for legal ontologies, Proceedings of the 2009 conference on Law, Ontologies and the Semantic Web: Channelling the Legal Information Flood, IOS Press Amsterdam, The Netherlands, pp. 53-71 (2009)
[11] Gruninger, M., Fox, M.S.: The role of competency questions in enterprise engineering. In: Proceedings of the IFIP WG5. vol. 7, pp. 212-221 (1994)
[12] Presutti V, Gangemi A.: Content Ontology Design Patterns as Practical Building Blocks for Web Ontologies, Q. Li (et al.) (Eds.): ER 2008, LNCS 5231, pp. 128–141, Springer (2008)
[13] Blomqvist E. (et al.): Considerations regarding Ontology Design Patterns, Semantic Web – Interoperability, Usability, Applicability, IOS Press Journal (2015)
[14] Hammar, K.: Ontology Design Patterns: Improving Findability and Composition. Presutti V. (et al.) (Eds.), The Semantic Web: ESWC 2014, Greece, May 25-29, (pp. 3-13), LNCS Springer (2014)
[15] Casanovas, P. Díaz, L. (et al.): Materiales del Llibro Blanco de la Mediación en Cataluña. La mediación: conceptos, ámbitos, perfiles, indicadores. Generalitat de Catalunya, Departament de Justícia, Centre d'Estudis Jurídics i Formació Especialitzada Barcelona (2009)
[16] Nuzzolese, A., Gangemi, A. (et al.): Gathering lexical linked data and knowledge patterns from FrameNet, K-CAP '11 Proceedings of the 6th International Conference on Knowledge Capture, pp. 41-48, ACM, NY, USA (2011)
[17] Recommendation of the European Commission on the use of a harmonized methodology for classifying and reporting consumer complaints and enquiries (SEC (2010)572)
[18] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a harmonized methodology for classifying and reporting consumer complaints and enquiries (COM(2009) 346 final)
[19] ISO Standard 10002:2014 on Guidelines for complaint handling in organizations, partially available online in https://www.iso.org/obp/ui/#iso:std:iso:10002:ed-2:v1:en
[20] Faed, A. R., An Intelligent Customer Complaint Management System with Application to the Transport and Logistics Industry, Springer Theses, DOI: 10.1007/978-3-319-00324-5, Springer International Publishing Switzerland (2013)