Modeling Expert Knowledge in the Mediation Domain: A Mediation Core Ontology

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Abstract. In this paper we introduce the Mediation Core Ontology (MCO), and the steps taken in order to model the expert knowledge on the mediation domain. MCO is created from scratch by eliciting practical knowledge from mediation experts to identify the basic working concepts of the domain. MCO offers initial support towards knowledge acquisition and reasoning and, in later steps, will serve as a general basis for the development of different mediation domain and sub-domain ontologies to be used by the ONTOMEDIA mediation platform, currently also under development.

1 Introduction

Online Dispute Resolution (ODR) is an umbrella domain that covers a full range of processes (i.e. negotiation, early neutral evaluation, conciliation, mediation, and arbitration) to handle disputes online. While it was sometimes viewed as the online equivalent of ADR (Alternative Dispute Resolution) processes, there is a growing consensus in specialized literature that considers ODR more than just the delivery of alternative dispute resolution (ADR) services through the Internet, especially since Katsh first suggested to give technology the role of a "four party" [1]. In this line, the emergence of a panoply of both new terminologies and typologies to systematize current ODR practices proves that the domain is becoming a branch of dispute resolution in its own right [2, 3, 4, 5].

For fifteen years now, ODR processes have evolved with the development of the Internet. As an example, ENSs (e-negotiation systems) deployed in the Web use different Internet technologies to actively assist negotiators, facilitators, and mediators [6]. Yet, some experts have warned that ODR service providers may be lagging behind the curve of recent developments in both Web 2.0 and Semantic Web [7, 8, 9].

The ONTOMEDIA project aims at filling this gap by designing an interactive, web-based mediation platform to assist disputing parties and mediators in identifying different options for the management and resolution of disputes in different domains.[3] One of the objectives of ONTOMEDIA is to model expert knowledge on mediation

[3] ONTOMEDIA: Platform of Web Services for Online Mediation, Spanish Ministry of Industry, Tourism and Commerce (Plan AVANZA I+D, TSI-020501-2008, 2008-2010).

as a domain independent process that, in turn, may be able to encompass different mediation sub-domains (i.e. commerce, family, health, workplace, environment, etc.). The ONTOMEDIA platform will therefore assist users in considering different options of mediation and guiding them throughout the online mediation process.

In this paper we describe the methodological approach taken for modeling expert knowledge on mediation processes, and outline the design of the Mediation Core Ontology (MCO). MCO thus represents the common and reusable structure of mediation processes, which will provide the platform with conceptual machine-processable knowledge regarding mediation events. This is one of the first attempts to design an ontology that models mediation processes within the dispute resolution field.

1.1 Mediation as a domain of knowledge

A meta-analysis of the relational justice domain (the justice produced through cooperative behavior, agreement, negotiation, or dialogue among actors in conflict or post-conflict situations) reveals that there are at least thirty disciplinary areas contributing to the development of the domain [10]. It therefore comes as no surprise if the mediation domain is populated with a full range of concepts, operational definitions, and models [11, 12]. To quote a recent example, Alexander identifies up to six models of mediation practice: settlement mediation, facilitative mediation, transformative mediation, expert advisory mediation, wise counsel mediation, and tradition-based mediation [12]. In addition, as far as it provides a new procedural and communicational framework for interaction, decision-making, and emotion expression [13] online mediation may substantially transform any of those models.

Mediation as a process While bearing in mind the many possible ways in which mediation might be defined and modeled, therefore, we have opted for an approach that emphasizes the representation of the procedural aspects of mediation over the epistemological and theoretical ones. This is not meant to be an entirely agnostic approach, since the focus on procedures already implies epistemological and theoretical choices. Similarly, the emphasis on procedural knowledge does not entail neglecting conceptual knowledge on mediation. Rather, we intend MCO to be a shareable and reusable ontology so that we needed to restrain these ontological commitments to a minimum [14].

Coherently, we propose to define mediation as a voluntary, non-binding process in which a neutral third party, the mediator, assists the parties in reaching a settlement of the dispute. This definition is consistent with the one proposed by the recent Directive 2008/52/EC,[4] and flexible enough to allow any number of disputing parties, roles, and procedural stages of mediation.

[4] The Directive 2008/52/EC of the European Parliament and of the Council of 21 May 2008 on certain aspects of mediation in civil and commercial matters defines mediation in article 3(a) as "a structured process, however named or referred to, whereby two or more parties to a dispute attempt by themselves, on a voluntary basis, to reach an agreement on the settlement of their dispute with the assistance of a mediator. This process may be initiated by the parties or suggested or ordered by a court or prescribed by the law of a Member State".

1.2 Ontologies, mediation and ODR

To date, there is no working ontology dealing with the fundamental concepts of mediation as a process. Certainly, there is precedent work on ontology design within related domains, namely the e-commerce field [15], task collaboration [16], negotiation [17], and negotiation agents [18]. There are also some ontologies that model different conflict events [19, 20] but in these cases the emphasis is put on terrorism and security issues rather than in conflict management.

Finally, there are a number of ongoing research projects that are currently developing ODR-related ontologies. The BEST project (BATNA Establishment using Semantic Web Technology) aims to provide disputing parties with information about their position in the negotiations before they seek professional assistance, and to assist them in the dispute or get information about the legal possibilities to claim compensations [5]. The ALIS Project (Automated Legal Intelligent System) combines game theory, computational logic, and legal reasoning to analyze the compliance of parties' requests in intellectual property disputes [21]. The CEN Workshop on Standardization of Online Dispute Resolution Tools has elaborated a basic ontology of ODR processes [6]. While BEST and ALIS are producing in fact legal domain ontologies (covering damage disputes and intellectual property respectively), the CEN ontology is domain-independent and, thus, the closest precedent to our work [22].

2 Mediation Core Ontology development

The initial stages of the ONTOMEDIA project have run in parallel with the elaboration of the White Book on Mediation in Catalonia, a project coordinated by the UAB Institute of Law and Technology [7]. The main purpose of the White Book is to provide Catalan lawmakers with in-depth research on the state-of-the-art mediation theories and practices as the basis for future legislation and policies. The White Book project has provided a unique opportunity to gather national and international leading experts and practitioners in a number of work sessions and workshops on concepts, methods, techniques and protocols of mediation.

The expert knowledge and support offered by the participants and the outcomes of the White Book project have been integrated in the methodological development cycle of MCO. The methodological steps followed, already established and shared by several ontology development methodologies (such as METHONTOLOGY [23], On-To-Knowledge (OTK) [24], HCOME [25] or UPON [26], etc.), take into account both the analysis of relevant textual materials towards ontology learning and the participation of experts during all the development process. These methodological requirements influence the general steps taken: a preparatory step (establishment of requirements), a development step (knowledge acquisition, conceptualization and formalization), and an evaluation stage [27]. In the following sections, we will describe the preparatory and development steps.

[5] BEST Project, `http://www.best-project.nl/index.shtml`.

[6] CEN Workshop on Standardization of Online Dispute Resolution Tools: `http://www.cen.eu/cenorm/businessdomains/businessdomains/isss/activity/ws_odr.asp`.

[7] White Book on Mediation in Catalonia: `http://idt.uab.es/llibreblanc/index.php?lang=english`.

2.1 Ontology requirements

MCO will serve as a general basis for the development of the mediation domain ontologies and sub-ontologies that will be used by the ONTOMEDIA platform. Therefore, it is directed at knowledge reuse, although it may also offer initial support towards knowledge acquisition and reasoning.

The knowledge acquisition stage is mainly based on the elicitation of expert knowledge. Nevertheless, existing upper ontologies (and legal core ontologies) are taken into account for design purposes. This knowledge acquisition process is guided by a list of questions establishing which knowledge ought to be included in the ontology and what type of answers ought the ontology to be able to give.

Table 1. Mediation Core Ontology (MCO) Requirements Specification Document

Purpose	Explicit expert knowledge in the mediation domain for knowledge reuse and for providing support towards knowledge acquisition and reasoning.	
Methodological approach	An expert-based methodology based on the main steps provided and shared by several current ontology methodologies (METHONTOLOGY, OTK, HCOME or UPON): 1) preparatory step, 2) development step, and 3) evaluation step. The knowledge acquisition process is mainly based on knowledge elicitation from experts, although is supported by knowledge acquisition from texts and guidance from theoretical approaches to the analysis of the mediation domain.	
Sources of knowledge	— —**C. questions** — — —**Other** —**sources**	What types of mediation exist? What characterizes them? Are there separate acts or situations within a mediation process? Which documents or other information sources are produced or used during a mediation process or stage? Which participants can take part in a specific type of mediation process? Which restrictions on the mediation process are caused by the topic of the mediation? What are the limitations on agents regarding the roles they might take in a mediation process? Expert elicitation (White Book project). Relevant regulations and legislation (e.g. Directive 2008/52/EC, EC Recommendation 98/257 & 2001/310).
Tool support	Statistic text analysis tools (JRef, Yoshikoder, AntConc, etc.)	
Ontology editor	Protégé v. 3.4.	
Reuse	No direct reuse of existing upper ontologies (modeling solutions from PROTON [28], LKIF-Core [29], CLO (DOLCE) [30] have been taken into account).	

2.2 Knowledge acquisition

From the knowledge acquisition perspective, the White Book outputs (early drafts, workshop papers, literature reviews, etc.) are a first-hand input for ontology design in ONTOMEDIA. We have analyzed these materials in consensus building sessions to identify a common conceptual framework broader enough to support different models and sub-domains of mediation. As a result, we elicited an initial taxonomy of concepts and relations, guided by the established competency questions (ORSD).

A second source of acquisition of knowledge has been drawn from ethnographic fieldwork, since one member of the team has been participating in a multiparty mediation process involving five mediators (this is work in progress). Participant observation has produced informal interviews with mediators conducted either individually or in group to elicit procedural knowledge used by domain experts in their practice. The translation of ethnographic findings into manageable knowledge leading to the design of ontologies relies on experience from related research projects [31, 32]. In this case, ethnographic research also loosely follows the guidelines of the EthnoModel, which are

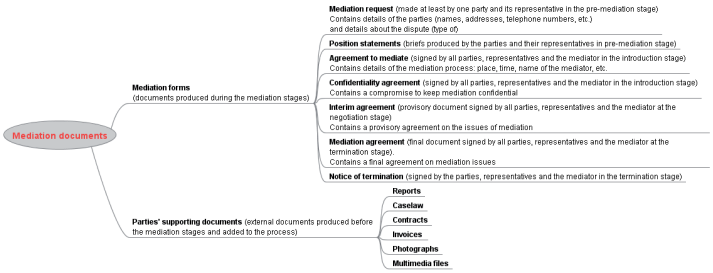

Fig. 1. Expert schema regarding mediation documents

defined as a set of generic heuristics that "may be used both by investigators to conduct ethnographic studies of work and by designers interested in system design" (i.e. plans, procedures, and coordination) [33]. We have complemented these previous inputs with an analysis of mediation procedures as deployed by major mediation services (both online and off line service providers). Again, we have benefitted here from synergies from the White Book project, where we have developed a template to analyze which mediation stages and related mediation forms are most usual among major service providers (up to 23 so far), regardless of the mediation sub-domain involved [34].

Finally, relevant existing regulations within the European Union (e.g. Directive 2008/52/EC of the European Parliament and of the Council of 21 May 2008 on certain aspects of mediation in civil and commercial matters) have been taken into account as regards concept definitions and linguistic use of terms. For example, extracted relevant terms in the mediation domain from European regulations are: *mediation, parties, dispute, agreement, process, mediator, information, resolution, provider*, etc.

3 Mediation Core Ontology (MCO)

The knowledge acquired in the previous phase (list of terms and conceptual schemas regarding knowledge required for the competency questions) from the experts has been further formalized in OWL-DL.[8] The current version of the Mediation Core Ontology has 62 classes. The main objective of the formalization stage was to model formally the main acquired concepts related to the mediation domain and to try to establish the most important relations between them.

Our approach has resulted in an initial taxonomic structure formed by the following concepts:

- `MediationAgent`: Includes all possible agents (actors) in the mediation domain.
- `MediationInformationSource`: All possible information sources, including forms that are created within the mediation process or `MediationForm` (e.g. `Agreement ToMediate`, or `NoticeOfTermination`), and other sources of information that can support the claims of the disputants.

[8] The ontology uses OWL DL constructs such as `owl:unionOf` and `owl:disjointWith`, together with cardinality values different from 0 or 1.

- `MediationTopic`: all topics that configure the different types of MediationProcess, for example, mediation regarding family issues, consumer related complaints, environmental issues, school or labour problems, etc. The mediation process, its agents and other related concepts may require different properties according to the topic or the particular problem underlying the process.
- `MediationProcess`: includes the different processes according to their topic. Thus, it includes as subclasses: `ConsumerMediation`, `SchoolMediation`, etc.
- `MediationProcessStage`: identifiable stages of a mediation process.
- `MediationSession`: identifiable situations taking part during the mediation process involving the different roles.
- `MediationRole`: all the possible roles that participants may assume in a mediation process (`Disputant`, `Mediator`, `ServiceProvider` are some of its subclasses).

Once this main hierarchy of concepts could be established, these concepts were specified and the main relations existing between them, elicited from experts, were also formalized. At the moment, 12 `owl:objectProperty` and 1 `owl:dataTypeProperties` have been included in the ontology.[9] More complex relations and concept definitions have also been specified to allow reasoning on the mediation domain, and facilitate its reuse and specification by the specific ontology for the OntoMedia platform. For example, the ontology includes the specification of the idea that a mediation process requires at least two disputants and one mediator, a termination stage is a mediation process stage that produces a notice of termination (document), an environmental mediation is a mediation process about an environmental topic, etc.

4 Conclusions and future work

In this paper we have introduced the Mediation Core Ontology (MCO), which represents a basic and flexible conceptual structure of mediation processes with minimal ontological commitments. We also offered an overview of the knowledge acquisition process and conceptualization stages leading to its design. Currently, the Mediation Core Ontology includes only the concepts related to the core mediation domain, and may be of use towards knowledge acquisition and reasoning tasks. Future work will include its modular extension to the different mediation subdomains (i.e. labour mediation, family mediation, etc.) and will be adapted for the use of the ONTOMEDIA platform.

Moreover, the Mediation Core Ontology is currently under submission for evaluation to an expert panel from the White Book project, and will be further tested (and refined if necessary) with the instantiation of several currently available mediation services.

Once the ontology has undergone the evaluation and refinement processes it will be made publicly available.

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[9] For example, `isMajor` is formalized as a data type property with domain `NaturalPerson` and a boolean range.

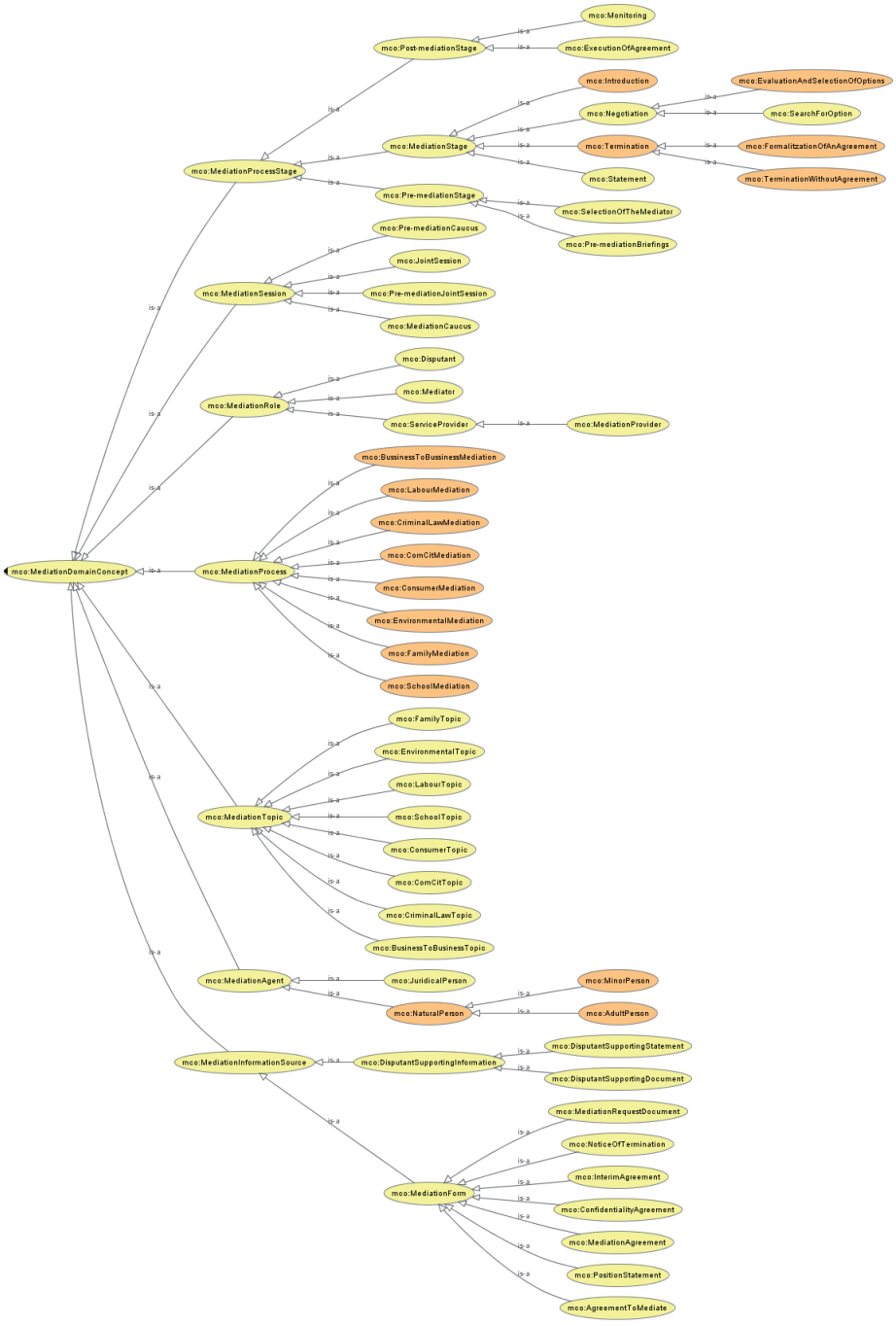

Fig. 2. An outline of the Mediation Core Ontology classes

I+D, TSI-020501-2008, 2008-2010); (ii) ONTOMEDIA: Semantic Web, Ontologies and ODR: Platform of Web Services for Online Mediation (2009-2011), Spanish Ministry of Science and Innovation (CSO-2008-05536-SOCI).

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